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Ninth World Wilderness Congress Symposium

November 6-13, 2009
Meridá, Yucatán, Mexico



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Abstract

The Ninth World Wilderness Congress (WILD9) met in Meridá, Yucatán, Mexico in 2009. The symposium on science and stewardship to protect and sustain wilderness values was the largest of multiple symposia held in conjunction with the Congress. The papers contained in this proceedings were generated at this symposium or submitted by the author or authors for consideration for inclusion in this proceedings, and have been organized into six major topics: (1) empowering young people, (2) promoting involvement of local communities, (3) enhancing transboundary conservation goals, (4) exploring wilderness meanings, (5) monitoring and predicting change, and (6) new directions in wilderness stewardship. Included are papers that address wildland issues in Afghanistan, Antarctica, Canada, Czech Republic, El Salvador, the Gambia, Germany, Honduras, India, Lesotho, Mexico, Namibia, the Netherlands, New Zealand, Nigeria, Philippines, Puerto Rico, Russia, South Africa, Taiwan, Trinidad and Tobago, Uganda, and the United States.

Keywords: wilderness, biodiversity, conservation, protected areas, economics, subsistence, tourism, traditional knowledge, community involvement, policy, stewardship, education, spiritual values

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Front cover photos: Background photo: Pyramid of the Magician at Uxmal; jaguar and pyramids photo; Chinese photographer Xi Vhinong; Lacandon jungle of Monte Azul Biosphere Reserve, Chiapas, Mexico, courtesy of Leopold Institute. WILD photo, courtesy of The Wild Foundation. Waterfall in Monte Azul Biosphere Reserve, Chiapas, Mexico, courtesy of Steve Carver.

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**November 6-13, 2009
Meridá, Yucatán, Mexico**

Compilers: Alan Watson
Joaquin Murrieta-Saldivar
Brooke McBride

Preface

The 9th World Wilderness Congress convened in Meridá, Yucatán, Mexico in 2009 with a challenging agenda. Over the 8 days of WILD9, 1,800 delegates from over 50 nations gathered to FEEL, THINK, and ACT (Siente, Piensa, Actúa) on many important conservation issues requiring international cooperation. Among the many things people felt, thought about, and acted upon was the Message from Meridá, an international call to action with specific policy guidelines to integrate wilderness and biodiversity conservation into a global climate change strategy. Delegates from the governments of Mexico, Canada, and the United States also agreed to and signed the first international agreement on wilderness conservation. Also included were delegates committed to creating the first marine wilderness area in the United States and to significantly increasing protected area coverage in Yucatán. Additionally, WILD9 hosted the largest gathering ever assembled of conservation photographers and their work.

While this was the first time this Congress met in Mexico, it was not the first time in North America. The first meeting was in South Africa in 1977, followed by meetings in Australia (1980), Scotland (1983), the United States of America (Colorado) in 1987, Norway (1993), India (1998), again in South Africa in 2001 and again in the United States of America (Alaska) in 2005.



The papers included in these proceedings do not represent all of the oral and poster presentations of the Symposium on Science and Stewardship to Protect and Sustain Wilderness Values. It has been the tradition established by the World Wilderness Congress Executive Committee, however, to gather together many of those papers worthy of publication and compile them as an at least partial record of what transpired during these technical sessions. Other papers from the Symposium have been published in the International Journal of Wilderness and in other outlets, as well. Every paper in these proceedings received peer review and editing by at least two of the compilers.

The Aldo Leopold Wilderness Research Institute, the Sonoran Institute and the USDA Forest Service Rocky Mountain Research Station are proud to cooperate in compiling, publishing, and distributing these proceedings. The WILD Foundation exhibited leadership and patience in coordinating facilities, schedules, and supporting many Congress delegates to attend and present in this Symposium. We thank the Rocky Mountain Research Station Publishing Services Staff for yet another outstanding job of coordinating publication and distribution of these proceedings. Primary funding for printing and recording this publication came from the USDA Forest Service Office of International Programs.



The Compilers, September 2010

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1. EMPOWERING YOUNG PEOPLE



2. PROMOTING INVOLVEMENT OF LOCAL COMMUNITIES



3. ENHANCING TRANSBOUNDARY CONSERVATION GOALS



4. EXPLORING WILDERNESS MEANINGS



5. MONITORING AND PREDICTING CHANGE



6. NEW DIRECTIONS IN WILDERNESS STEWARDSHIP



7. TRIBUTE



1. EMPOWERING YOUNG PEOPLE



Photo courtesy of the WILD Foundation

The Promise of Youth Service as a Global Conservation Tool

Emily R. Sloane

Abstract—Youth conservation corps (YCCs) and related programs are established and valued in the United States, but little is known about similar programs overseas. This paper presents results from an exploratory survey of YCCs in 10 developing/emerging countries, with particular focus on their activities, challenges, and successes. The study countries exhibit several socio-economic characteristics and challenges, different from the United States, that shape the activities conducted by their respective YCCs. All YCCs in the study reported social and environmental accomplishments. Three renowned American youth service organizations professed interest in overseas involvement. Their support and leadership seems vital to helping international YCCs meet opportunities and needs for youth service as a global conservation tool.

Introduction

This paper begins with an overview of the youth conservation service movement in the United States, developing/emerging world, and finishes with some conclusions based on study data. Youth conservation corps (YCCs) hold real promise as a global conservation tool with the potential to simultaneously address multiple urgent social issues, while several U.S. youth service organizations are well suited to extend their roles to help lead a worldwide YCC movement. Today, there is greater need than ever to fulfill the promise of youth service as a global conservation tool.

Several authors have detailed the broad social, economic, and environmental achievements of the Depression-era Civilian Conservation Corps in the United States (Clancy 1997; Davidson 1997; Hendrickson 2003; Maher 2002), and Jastrzab and others (1997) document the benefits of U.S. YCCs to corpsmembers, host agencies, communities, and the public. Youth service and YCC programs are well established and valued in the United States.

Thorough analyses of youth conservation service programs in the developing/emerging world are scarce. However, a recent report by the United Nations Development Programme suggests that the substantial youth populations throughout

the developing world, along with the often concurrent poor states of education, employment, democracy, and health, make youth powerful sources of potential conflict, as well as of positive change (UNDP 2006). McDowell (2007) and Perold (2000) present numerous case studies of youth service projects throughout the developing world and outline trends and common positive outcomes from them. Evans and others (2006) describe overseas youth corps that focus on conservation activities, Kakonge and Sibanda (2008) provide an excellent in-depth study of Lesotho's National Environmental Youth Corps, and Stroud (2005) urges youth service directors in the United States to forge reciprocal relationships with national youth service programs abroad.

This study identifies and explores YCC programs outside the United States in developing and emerging nations, focusing on such questions as:

- What socio-economic and environmental factors influence the success, or, indeed, the feasibility, of youth-in-conservation programming?
- What have been the notable strengths, weaknesses, challenges, and opportunities of programs to date?
- How might sustainable development projects be integrated into traditional YCC conservation activities?
- Should such projects in fact be the main foci of YCC work in developing countries?
- How can programs be made more accessible to all sectors of the population?

Research Methods

Because information on international youth conservation service programs were either unavailable or nonexistent, I used several direct and indirect methods to gather information about them. YCC programs in developing/emerging countries were identified from: (1) the small body of published literature on the subject; (2) telephone contact with leaders in the American youth conservation movement; and (3) Google searches for "youth conservation corps," "environment youth corps," and similar phrases, so as to weed out the numerous general youth service programs that lacked a conservation focus. With these methods, I identified YCCs in 10 developing/emerging countries that had operated for at least some period of time during the last 10 years (table 1).

Direct communication with persons from these international YCCs was successful in four cases (Afghanistan, India, the Philippines and Trinidad/Tobago). No direct personal contacts were found for the three identified YCCs respectively in El Salvador, Honduras, and Mexico, but a representative from Partners of the Americas, a U.S. based NGO involved in establishing these corps, agreed to share what she knew about these programs. No response was received,

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Table 1—Selected YCCs identified in developing/emerging nations.

Country	Years of operation	Number of participants	Basic model
Afghanistan	2008-present	90/ year	Year-long program for unemployed 18-25 year-old males representing six villages in Nuristan Province; participants receive room and board and \$125/ month
El Salvador	1999-?	?	Short-term initiative in response to the devastation caused by Hurricane Mitch
The Gambia	2002-?	intended 10 year total of 100,000	Open to 13-30 year olds, either out-of-school or unemployed
India	1997-1999	25/ year; 50 total	Month-long program, open to 18-25 year olds with background in environmental and/ or community service work
Lesotho	1996-2004	2000+ total	Year-long program, open to 15-24 year olds, out-of-school or unemployed, with recruitment quotas for each locality/ village
Mexico	?	?	Focused on Yucatan region, with community-level work camps lasting 2 weeks each; originally modeled after CCC
Philippines	1999-present	185+ total (15-25/ year on average)	Six month residential and non-residential programs for out-of-school youth from Palawan; originally based on American YCC model, but has since adapted to needs of the country
Trinidad and Tobago	1993-present (discontinued from 1999-2002)	approximately 1200/ year	Six month non-residential program, under National Ministry of Defense direction, for unemployed youth aged 18-25; participants receive \$50/ day stipend

Sources: Anandakrishnan, Bruch, Baptiste, Magpayo, Markus and Selwitz, personal communication; Schmitt 2005; Sibanda 2008

nor were knowledgeable sources identified, for the African YCC programs identified in Gambia and Lesotho, and only limited on-line information could be found for the program in Namibia. Next, using an open-ended survey (table 2), I attempted to gather quantitative and qualitative information about each organization's background, scope and structure, activities undertaken, major challenges and successes, and future plans and goals. I also compiled demographic information about each country.

Finally, to assess the current and future role of American organizations in the international youth conservation service movement, I interviewed representatives of The Corps Network, EarthCorps, Innovations in Civic Participation, and the Student Conservation Association. These organizations were selected for their experience with international initiatives merging youth development and conservation. Questions focused on their current international involvement, future plans, knowledge gaps, and suggestions for future international roles of U.S. YCC programs.

Youth Conservation Service in the United States

An environmental calamity inspired the first U.S. Federal program to engage youth in conservation service work. Decades of forest clearing, poor farming practices, and extreme drought in the early 1930s triggered the Dust Bowl, the most catastrophic event in the history of U.S. agriculture. Against the backdrop of the Great Depression, the Dust Bowl displaced hundreds of thousands of farmers. Unemployment rates reached 30%, with disproportionately severe effects on the nation's youth (Davidson 1997).

In response to this economic and environmental disaster, President Roosevelt launched the Civilian Conservation Corps (CCC) in 1933 as part of his administration's "New Deal." Originally open to "at-risk" youth from low income backgrounds and later expanded to participants from all sectors of society, the CCC offered men aged 18 to 25 a rigorous, residential work experience building trails and roads and

Table 2—Open-ended surveys.

Group receiving interview	Questions asked during open-ended surveys
YCC programs in developing/emerging countries	<p>When was your YCC founded? Who founded it? How many participants has it had in total? How many during the most recent year?</p> <p>With what organizations, domestic or international, does your YCC collaborate?</p> <p>How is your program funded?</p> <p>What was used as a model for your YCC program? How has this model been adapted to meet the specific needs of your country?</p> <p>What projects do your corpsmembers work on?</p> <p>What are the biggest challenges/successes that your program has encountered?</p> <p>What are your program's short and mid-term plans for the future?</p>
U.S. Organizations with International Interest	<p>How has your organization been involved with youth service and conservation projects internationally to date? What is your strategic plan for international programming in the future?</p> <p>What is your knowledge of youth service and conservation programs in developing/emerging countries?</p> <p>What information about youth and conservation service projects worldwide would be useful for your organization?</p> <p>What are your organization's main priorities for the next decade?</p>

planting millions of trees. The CCC employed three million youth during its 1933-43 lifespan, declining as America's priorities shifted with the build-up to World War II, and federal funding for youth service programs ceased altogether in 1943 (Davidson 1997; Jastrzab and others 1997).

With the creation of the non-profit organization the Student Conservation Association (SCA) in 1957, American youth once again had the opportunity to serve the environment, this time through volunteer posts with federal land management agencies. The organization's rapid success, along with the dual challenge of under-funded public lands management agencies and high youth unemployment levels, prompted the U.S. government to establish the Youth Conservation Corps in 1970, followed some years later by the Young Adult Conservation Corps (The Corps Network 2009; Jastrzab and others 1997).

The National Association of Service and Conservation Corps, later renamed The Corps Network, emerged in 1985 to provide support and, primarily, DC-based advocacy for the youth service movement. Some government aid resulted under the Bush, Sr. Administration, and during the Clinton Administration, the National and Community Service Act was passed, making post-service stipends available to volunteers via the AmeriCorps program (Jastrzab and others 1997). Congress is currently deliberating a Public Lands Service Corps Bill that would bolster government support for and extend the reach of YCCs, and talks on creating a

designated funding stream for corps programs are underway (Prouty, personal communication).

The youth-in-conservation movement in the United States continues to grow and diversify, with programs in and around major cities joining the well-established rural efforts. The United States now boasts 143 separate youth corps, most focused on conservation activities and sponsored by federal, state, and local government or other institutions. Under the auspices of these organizations, 29,000 youth provide approximately 21.3 million hours of service each year (The Corps Network 2009). If one adds the contributions of SCA and EarthCorps programs (which share many attributes with American YCCs, despite some distinguishing characteristics) the youth service workforce is even more impressive in enhancing the amount of work that public agencies are able to accomplish, such as total number of trees planted, miles of trails rehabilitated, and acres restored each year. Given the trend of declining public land agency budgets, partnerships with youth service programs may become even more important for future management of public natural resources.

In addition to contributing work, U.S. youth conservation programs have positive impacts on participating youth and sponsoring organizations. Jastrzab and others (1999) reported that corpsmembers exhibited improved employment rates and wages and had fewer instances of arrest and unmarried pregnancies following their periods of service. Effects were most pronounced among African-American males.

Youth Conservation Service in the Developing World

For YCCs to succeed in developing/emerging nations, they must address local conditions, needs, and culture—just as they have done and continue to do in the United States. In some ways, many developing/emerging countries face conditions similar to those in America in the 1930s, with high unemployment rates and largely agrarian communities susceptible to drought and desertification. But developing/emerging countries today must contend with phenomena new to humankind, including disproportionately large populations of young people, a condition linked to increasing instances of civil unrest and violent conflict (UNDP 2006). Demographic data about the countries in this study (table 3) document that they all have a higher relative percentage of young people than the United States. In Afghanistan, Gambia, Honduras, and Lesotho, 40% or more of the population is under age 15 (UNDP 2008). As these youth mature, many tend to move to cities in hope of finding employment. The UNDP (2006) estimates that youth will make up 60% of urban populations worldwide by the year 2030, yet urban employment opportunities are unlikely to keep pace with the growth of cities. Unemployment rates among youth already tower over those for adults, and they are likely to increase as population growth strains the capacity of under-developed economies. Limited educational services, climate-change-induced natural disasters, and widespread epidemics (notably HIV/AIDS) only compound the potential disillusionment and discontentment among the world's underserved youth (UNDP 2006).

Because of the differences between the United States and developing/emerging countries, we should be wary of blindly exporting the American YCC model to them. Many are struggling with fundamental needs such as food, shelter and survival, which, as Maslow (1943) posits in his classic “hierarchy of needs,” must be met before people will be motivated by more complex social objectives. YCCs aimed

at “environmental conservation” and “positive youth development” (Evans and others 2006, p. 2) may be appealing in developed countries like the United States, but they must be adapted to local conditions, needs, and cultures in less developed countries, which may include rampant poverty, unmet basic human needs, illiteracy, limited infrastructure, and constraining local customs such as restrictions on the participation of women.

Characteristics of the Programs Studied

The data found on YCCs in developing/emerging countries was limited, with very little information for some countries. Nevertheless, some interesting findings emerge in this *preliminary* analysis of YCCs in the developing world (tables 1 and 4).

YCCs did not appear in the developing/emerging world until the 1990s; the first and oldest in the study group being Trinidad/Tobago's Civilian Conservation Corps (CCC), launched in 1993 (Baptiste, personal communication). The remaining corps programs were launched in the 1990s, except for those in Gambia and Afghanistan, which began in 2002 and 2008, respectively (Markus and Groninger, this proceedings; Sibanda 2008). Only four of the study's corps are known to be currently active (those in Afghanistan, Namibia, the Philippines and Trinidad/Tobago). El Salvador's YCC was a short-term initiative to provide emergency response to the devastation caused by Hurricane Mitch in 1998, and India's YCC program only lasted from 1997-1999. Partners of the Americas could not confirm whether the YCCs in Mexico and Honduras were still operating (Anandakrishnan, personal communication; Bruch, personal communication).

Enrollment varied considerably, from 15 to 25 per year in the Philippines to 1,200 annually in Trinidad/Tobago (Baptiste, personal communication; Magpayo, personal communication). Three of the YCCs followed the California Conservation Corps model, and all programs targeted youth, although the range in Gambia extended from 13 to 30, and

Table 3—Selected demographics for host countries of the YCCs studied.

	Human poverty index rank	Population, urban (% of total population)			Population under age 15 (% of total population)		Unemployment rate, total (% of labor force)	Employment in agriculture (% of total employment, 1996-2005)
		1975	2005	2015*	2005	2015*		
Afghanistan	“	13.3	22.9	27	47	45.5	“	“
El Salvador	35	41.5	59.8	63.2	34.1	29.7	6.8	19
Gambia	94	24.4	53.9	61.8	41.2	38.3	“	“
Honduras	41	32.1	46.5	51.4	40	34.3	4.1	39
India	62	21.3	28.7	32	33	28.7	4.3	67
Lesotho	71	10.8	18.7	22	40.4	37.4	39.3	57
Mexico	10	62.8	76	78.7	30.8	25.6	3.2	15
Namibia	58	23.7	35.1	41.1	39.1	33.2	33.8	31
Philippines	37	36	63	69.6	36.2	32.5	7.4	37
Trinidad and Tobago	12	11.4	12.2	15.8	22.2	20.8	8	7
United States	“	73.7	80.8	83.7	20.8	19.8	4.6	2

*Indicates a medium-variant projection.

“ Indicates that data are not available.

Source: United Nations Development Programme 2008

Table 4—Sample activities, challenges, and successes of selected YCCs in developing/emerging nations.

Country	Work project areas	Challenges	Successes
Afghanistan	Reforestation	Security; rangeland vs. restoration conflicts	Training and education; reforestation of depleted landscape
The Gambia	Fisheries, business, agriculture, tourism	High corpsmember turnover rate, difficulty recruiting and ensuring full participation of females	Beekeeping and rabbit husbandry projects, ecotourism and cashew/ orchard production
India	Watershed restoration, flora and fauna surveying, composting	Lack of funding, transition in leadership, shift in focus from hands-on to classroom training	Observed “multiplier effects”; some program alumni launched their own projects relating to urban environmental conservation
Lesotho	Environmental restoration, waste management, income generation, HIV/AIDS awareness, pollution control	Controversy over sustainability of corps members’ allowances, high corpsmember turnover rate, rangeland vs. restoration conflicts	Recruitment of females, support from national government, youth ownership of income-generating activities, capacity building of staff
Mexico	Trails, biological surveys, environmental education, agriculture/ agroforestry, stream restoration, soil conservation	Limited funding, lack of educational and employment opportunities for youth, transportation costs for participants, low participation of females	Diversity of participants (concerning age and rural/urban background), continued to operate without direct funding from international donors, perceived empowerment of participants
Philippines	Capacity building, sustainable agriculture, ecological restoration, income generation, ecotourism, technical skills, environmental education	Finding sustainable funding sources, difficulty tapping into tourist market (especially given security issues), government corruption	Post-secondary education pursuits of alumni, creation of Puerto Princesa Nature Park, restored 10 degraded sites around the city, produced environmental education materials for distribution in local schools
Trinidad and Tobago	Tourism/hospitality, computers/IT, agriculture/animal husbandry, technical trades	No mechanism in place for monitoring long-term activities of alumni	75% of alumni have gained employment post-program (most in government-run institutions like prisons or the coast guard)

Sources: Anandakrishnan, Bruch, Baptiste, Magpayo and Selwitz, personal communication; Kakonge and others 2008; Schmitt 2005; Sibanda 2008

Mexico reported one participant in his 70s (Bruch, personal communication; Sibanda 2008). Only Trinidad/Tobago, Afghanistan, and Lesotho claimed to offer daily stipends for corps participants, although perhaps the other corps at least covered living and training expenses (Anandakrishnan, personal communication; Baptiste, personal communication; Bruch, personal communication; Magpayo, personal communication; Markus and Groninger, this proceedings; Kakonge and others 2008; Sibanda 2008).

The foci of international YCCs varied. Many had an environmental component, but only Mexico’s CC closely resembled the U.S. corps in performing trail work, biological surveys, stream restoration, and environmental education campaigns (Bruch, personal communication). The Philippines’ CC worked cooperatively with Puerto Princesa Subterranean River National Park, a UNESCO-recognized World Heritage Site, to build a more accessible entrance and conduct other projects. It further created a nature park featuring a butterfly garden, a plant nursery, and an educational center in the city of Puerto Princesa, and provided corpsmembers

with trades education in plumbing, carpentry, bartending, and electrical wiring (Magpayo, personal communication; Selwitz, personal communication). The YCCs in Gambia and Trinidad/Tobago emphasized practical training for jobs in the hospitality and service sectors. Gambia’s CC proposes to collaborate with the national Tourism Authority to develop bird watching, tourist “camps,” and snack bars in a heavily visited region of the country (Baptiste, personal communication; Sibanda 2008).

In Lesotho, where desertification is a severe threat, corpsmembers constructed almost 6,000 check dams for erosion control, helped restore 4,000+ hectares, and planted nearly 90,000 trees, in addition to participating in trades training and HIV/AIDS outreach (Mapetla-Mokhesi 2002). Corpsmembers from Afghanistan’s CC reforested 100 hectares in the severely degraded Nurguram District (Markus and Groninger, this proceedings). India’s CC participants undertook stream and canal restoration projects, performed biological surveys, and organized a composting program for waste generated at the Chennai City marketplace

(Anandakrishnan, personal communication). All the YCCs except India's pursued some aspect of agricultural training, which generally focused on developing profitable and ecologically sustainable means of food production. In Gambia, for instance, plans called for the development of farms, orchards, and ranches in a deliberate attempt to encourage youth to settle in rural areas and thereby curb the country's rapid urbanization rate (Sibanda 2008).

Religion was incorporated into two of the YCCs. Based in a predominantly Roman Catholic province, the Philippines' CC offered daily prayers, Sunday masses, and periodic retreats to its corpsmembers. Afghanistan's CC provided two Islamic religion teachers on staff and five daily prayer breaks as well as basic academic classes (Magpayo, personal communication; Markus and Groninger, this proceedings).

All the YCCs reported important achievements, and some (in Lesotho and the Philippines) claimed to have increased awareness of environmental issues in communities where they had conducted outreach (Magpayo, personal communication; Mapetla-Mokhesi 2002). The Philippines and Trinidad/Tobago confirmed advancements in employment and educational prospects for some corpsmembers; at least two Philippines CC graduates pursued and completed undergraduate degrees in forestry following their service; and 75% of Trinidad/Tobago's CC alumni gained employment post-service (Baptiste, personal communication; Magpayo, personal communication). Several India CC graduates launched their own environmental projects, including urban clean-up, composting, tree planting, and environmental education (Anandakrishnan, personal communication).

Despite these accomplishments, all the international YCCs faced sobering challenges, many connected to the stark realities of their developing/emerging world environment, including sustainable funding, post corps employment for participants, the integration of females into corps programs, and enrolled females' reluctance to engage in traditionally "male" activities. In Gambia, some females displayed disinterest in activities requiring long-term investment, since Gambian women often leave their home communities when they marry. Gender restrictions in Afghanistan dictated that only males participate in the YCC (Bruch, personal communication; Markus and Groninger, this proceedings; Schmitt 2005).

Security issues were important in Afghanistan, where travel restrictions, fencing, and armed guards were used to ensure corpsmembers' safety (Markus and Groninger, this proceedings). In both Afghanistan and Lesotho, conflicts with herders arose during rehabilitation efforts on traditional grazing land, highlighting the importance of solid community involvement in projects (Kakonge and others, 2008; Markus, personal communication).

Conclusions and Recommendations

Charlotte McDowell (2007) writes that service programs offer youth the chance to become societal "assets rather than burdens to the collective wellbeing" (p. 38). Given the grim circumstances in so many developing nations, millions of today's youth face futures of enormous uncertainty. The YCCs described in this study represent a small phenomenon

to date, but one with enormous potential to help youth assume their rightful and crucial role as assets to a more equitable, environmentally sound planet.

The promise of youth service as a global conservation tool is immense, yet largely untapped. The international youth conservation corps surveyed in this study, though limited in scope and number, demonstrate that such programs can succeed in a variety of conditions and cultures and contribute to both youth development and conservation work.

Information on all aspects of international youth conservation service programs is limited, and pertinent information clearinghouses are needed to support further progress. The lack of readily accessible information on funding sources, best practices, program models, communication, appropriate program activities, and other topics poses a barrier to developing the potential of youth service programs for conservation and social benefits.

The high percentage of young people in developing/emerging nations, when compared to developed countries like the United States, highlights the need and potential for YCC as a global conservation tool. Indeed, without positive youth programming such as YCCs, there is great potential for these youth to contribute to civil unrest and to be recruited to military or illicit activities.

International youth service programs must adapt program content (education and technical training) and work projects to local conditions, needs, and culture. For example, Afghan culture currently prohibits female participation as corpsmembers and also requires the inclusion of religious education and daily prayers in corps programs. Projects that seek to rehabilitate "common lands" may conflict with livestock herders, as experienced in Afghanistan and Lesotho. And environmental priorities may be closer to basic human needs, such as sanitation, sewage disposal, and provision of clean water, in the poorest countries. Clearly, U.S. program models, while important, require adaptation for developing and emerging countries.

U.S. leadership of a global YCC movement is necessary and logical. Given the long U.S. history with youth service programs, and the current interest and involvement of several U.S. organizations in helping to expand the YCC idea (table 5), we are especially well positioned to help. The United States can provide information, training, leadership, technical assistance, and publicity to help energize a global YCC movement. This may be essential to meet the dual needs for positive engagement of burgeoning youth populations in developing/emerging nations and the escalating environmental concerns in those countries and the world.

The U.S. can support the global YCC movement, and recent activity demonstrates that it has already begun to do so. Throughout its 16-year history, EarthCorps has hosted seven Philippines CC staff, all of whom agreed to return home to corps work for at least a year after their U.S. EarthCorps experience. Exchanges work both ways; EarthCorps periodically sends U.S. alumni and staff overseas to learn from their international counterparts (Howard, personal communication).

All four U.S. organizations surveyed expressed great interest in learning about overseas YCCs, and most indicated that they hoped to expand their international work (table 5). Innovations in Civic Participation intends to research and

Table 5—Overview: international youth service programs and U.S. organizations.

Organization	International involvement to date	Specific vision for international youth conservation programming	Knowledge gaps
EarthCorps	Hosts 35 foreign participants a year as corpsmembers; also has collaborated with numerous international conservation initiatives in Russia, Latin America and the Philippines	Find other host agencies to offer more Earth Corps-style opportunities to motivated, qualified youth from other countries	Which other American organizations might be willing to host international youth as conservation programming trainees?
Innovations in Civic Participation	Provides technical assistance and information sharing, conducts research, facilitates funding	Create database of youth service programs focused on greenhouse gas emissions reduction; support new such programs through tech support and/ or financial assistance promote these programs to policymakers; encourage broad networking	Which youth service programs worldwide currently focus on climate change? What are their impacts on youth and communities? What criteria determine the strength of the program? How do different aspects of socio-economic factors affect programs?
Student Conservation Association	Periodic but not systematic collaborative projects (e.g., arranges internships in the U.S. for Brazilian and Japanese youth; set up exchanges in Russia and Mexico)	Expand SCA's model of conservation internships to the international setting, but with conservation NGOs, not government agencies, as hosts	Which conservation NGOs overseas might be willing to host American youth volunteers? What role could such volunteers play? What would be required of host country NGOs?

Sources: Coates, personal communication; Etra, personal communication; Howard, personal communication.

promote worldwide youth service initiatives focused on curbing climate change (Etra, personal communication). EarthCorps hopes to find additional partners to host more foreign youth to meet the high demand, as currently about 20 international youth apply for each available position (Howard, personal communication). The SCA, meanwhile, has considered extending its conservation internship program internationally (Coates, personal communication).

In conclusion, the “promise of youth service as a global conservation tool” is neither an illusion nor even a new idea. But with escalating youth populations and environmental issues worldwide, there is greater urgency than ever before to fulfill this promise. The window of opportunity is open.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

The Design and Implementation of a Conservation Corps Program in Nuristan, Afghanistan

Danny Markus and John W. Groninger

Abstract—Nuristan ranks among the least prosperous and educated provinces of Afghanistan. In 2008, the Nuristan Conservation Corps (NCC) was initiated to provide work, education, and training for 90 fighting-age males. Participants in this 1-year pilot program received basic education and natural resource management job skills training. Irrigation infrastructure was built on 26 ha (64 acres) and 62,500 tree saplings were planted. Successful planning and implementation of this project built trust among local leaders, resulting in the facilitation of further community-based natural resource management projects. The NCC serves as a model for similar conservation and development corps efforts being considered elsewhere in Afghanistan.

Introduction

In virtually all measures of environmental health, employment opportunities, and educational resources, rural Afghanistan ranks among the lowest on earth. Soviet invasion, followed by three decades of war, have degraded the Afghan landscape and deprived generations of young Afghans basic opportunities to maintain, let alone improve, their agricultural livelihoods. The collapse of both formal and informal education systems has hampered the transfer of basic skills and institutions needed to rebuild a productive society. In this environment, young males are vulnerable to the financial temptations of crime, including serving as fighters in anti-government elements. The Conservation & Development Corps model provides a framework to both stabilize Afghanistan and reverse the decline of its natural

resource and human capital. This paper describes a conservation corps program that serves as the model for similar efforts. The U.S. Civilian Conservation Corps (CCC) that operated from 1934 to 1943 was tremendously successful, providing work and training for millions of unemployed young men (Merrill 1981; Sloane, this proceedings). Tangible outcomes included road construction, implementation of soil and water conservation practices, and planting of literally billions of trees. Today, hundreds of conservation and development corps programs (federal, state and local) are carrying on the CCC tradition in the United States, employing tens of thousands of co-educational young people working on a wide variety of natural resource, infrastructure development, and other community service projects. Among the many programs inspired by the CCC is the U.S. Federal Job Corps, established in 1964 and now operating at 124 Centers nationwide, including 28 Job Corps Civilian Conservation Centers operated by the U.S. Forest Service (Dawson and Bennett, these proceedings). The vast majority of current conservation corps programs operate in the United States, but with some adaptation the concept has been applied with varying success in other countries (Sloane, these proceedings).

Since 2004, the United States Department of Agriculture (USDA) has been supporting the U.S. and Allied military action in Afghanistan (Operation Enduring Freedom) with agricultural advisors assigned to Provincial Reconstruction Teams (PRTs) throughout the country. PRTs have roughly 90 personnel and work in Afghanistan for approximately 1 year before being replaced by a new team. The USDA Agriculture Advisor is one of three civilian members of the team, the other two coming from the U.S. Department of State and U.S. Agency for International Development. By far, the largest component of the team is military personnel—Army, Navy, and Air Force. PRTs strive to bring enhanced security to an area while simultaneously delivering capacity building and reconstruction activities to bolster the Afghan government and improve living conditions of the Afghan people. The work is enormously complex and challenging, and progress is painfully slow.

The senior author, Danny Markus (hereafter referred to in the first person), served as an Agriculture Advisor from April 2008 to March 2009 in the province of Nuristan, a remote and rugged area in Northeastern Afghanistan. Among other activities, I helped design and implement the Nuristan Conservation Corps (NCC) program described in this paper.

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Developing the Nuristan Conservation Corps Idea

The initial idea for creating a conservation corps program in Nuristan, Afghanistan came from a military civil affairs officer on the Nuristan PRT, Major Rory Aylward, and it soon became my top priority. I worked closely with other PRT staff members, in particular two Afghan nationals I was authorized to hire, Ajmal Nuristani and Shakerullah Hashimi, to determine the feasibility of the project and how it could be implemented. A crucial first step was testing the level of interest and potential support for such a program at national, provincial, and district levels of the Afghan Government, and especially in the local community. The Nurguram District Governor helped organize a shura, an advisory council meeting of sorts, made up of respected community leaders, during which the idea received enthusiastic support. Over time, I and my Afghan co-workers, made additional presentations to the Provincial Governor and the National Government representatives in Kabul, including the Afghan Minister of Agriculture. The response from these audiences typically was “yes, this is a great idea that should move forward and you will receive our full cooperation.” The Greening Afghanistan Initiative (GAIN) provided support in the form of equipment (forestry tool kits) and other in-kind support (e.g., sacks of wheat and cooking oil provisions for NCC member families). However, repeated attempts to gain support and collaboration with an ongoing national program called the Afghan Conservation Corps (ACC) were not successful.

With interest and support growing, I began drafting a proposal for a 1-year Nuristan Conservation Corps (NCC) for 90 young men between the ages of 18 and 25 who would receive a paid job, training, education, living quarters, and food. Eligible participants would be recruited from the Nurguram District (a district in Afghanistan that is comparable to a county in the United States, just as a province is comparable to a state), allowing for easy coordination by the PRT located there.

To meet local needs, conditions, and culture, some adjustments in the traditional U.S.-CCC model were necessary. Much of our effort was focused on the key items of reforestation and erosion control, while providing high security, specific job training, basic education (including indigenous religious instruction and practice), and lodging arrangements to a male only population of corps enrollees. As the USDA Agriculture Advisor primarily responsible for the project, I drew on my experience studying conservation corps programs as a graduate student at the University of Idaho in the early 1990s. The internet, even in remote Nuristan, Afghanistan, allowed review of current literature and other pertinent materials to supplement telephone, email, and personal contacts in refining the NCC proposal. Personal and email contacts with the Corps Network, the professional association of conservation and development corps programs, based in Washington, DC, proved invaluable in making useful contacts with particularly successful organizations. These programs generously provided critical background information and tools needed to effectively implement a corps program.

Although clearly a great starting point, capitalizing on this information from U.S. programs would require considerable adjustment for Afghanistan. Especially important here was contact with a highly respected non-governmental organization, the International Foundation of Hope (IF Hope), in Jalalabad, who offered advice and personnel from its talented team of Afghan professionals to fill some of the key NCC staff positions. An overriding concern for both the PRT and IF Hope was the importance of visible support from the Afghan national, provincial, and district government in bringing this program to the people. In the end, for the conservation corps program to be viable and enduring, it had to be an Afghan initiative in perception and reality. Our PRT's role was to facilitate and provide support to help make success possible. This role also fit with mobility constraints on the civilian members of the PRT as security risks limited travel outside the walled PRT compound. This put great responsibility on Afghan members of the NCC team, who could come and go as they pleased, to effectively implement a corps program.

Securing NCC Start Up and Operating Funds

As interest in the NCC grew, we began to outline the necessary operational components and processes and the associated funding needs. By this time, the NCC concept had strong support as a potentially viable program of the Nuristan PRT and a \$670,000 proposal was submitted, in collaboration with other PRT members and IF Hope, to be funded by the U.S. Military “Commander’s Emergency Response Program” (CERP). The specific goal of the proposed project was to launch the NCC as a 1-year pilot program that would produce four main outcomes:

- Jobs to address the very high unemployment rate of fighting-age males;
- A trained work force to address the backlog of natural resource conservation work (particularly reforestation) and community infrastructure projects;
- Improved future job prospects for NCC graduates through delivery of a basic education program and job skill training; and
- Better community relations through shared living and work experiences of heretofore strangers, with a natural tendency to distrust persons from other villages.

The proposal moved through the military and civilian bureaucracies in the United States and Afghanistan in 3 months, a very short timeframe under the circumstances. During this time, there were many opportunities to explain the proposal up the U.S. military and Afghan hierarchy to persons whose support for the project was important and who influenced its ultimate approval. Once funding was secured, a contract with IF Hope was executed to help implement the NCC and the hard work began.

Implementing the Nuristan Conservation Corps

Several major tasks, logistical issues, and cultural concerns needed to be addressed in order to implement the NCC.

Staffing

The first step of implementation was recruitment and hiring 90 NCC participants (corps enrollees) plus 15 support staff (administrators, supervisors, cooks, guards, drivers, and teachers). Word-of-mouth and announcements on the local radio station stirred up a lot of interest in this project in the surrounding community and this helped recruitment of some participants and their immediate supervisors. To insure that a District-wide representation of young men would have a chance to participate, another shura was held and one elder from each of six valleys was asked to recommend roughly 15 young men from which the 90 corps members would be selected. Participants would be fighting-age males (18–25 years old) who were currently unemployed. The potential participants were subsequently interviewed to assess their suitability for the program. We were looking for eagerness and a willingness to commit to the program for a full year, so during the interviews, details about the NCC were explained and any questions answered. It turned out that nearly all those recommended by the village elders were selected to form the initial cohort of 90 NCC participants. Six supervisors, one from each valley, were also recommended by village elders and ultimately hired. These men would directly oversee the young men from their respective communities. In addition to the 90 NCC participants that needed to be recruited, approximately 15 support staff positions described in the proposal had to be filled. IF Hope filled some of the key support staff positions with current employees including three engineers/project managers, cooks, and drivers/security guards. All were Afghan men, not from the local area but from Jalalabad, 125 kilometers to the south. Problems arose when it came to finding qualified local teachers, so they were brought in from Jalalabad as well. To the extent practical and possible, the goal was to fill all positions from the local population, but we had anticipated and explained this difficulty and the compromise was not unduly disruptive to implementation of the program.

Establishing Camp

Camp setup typically entails locating and building a residential camp, and addressing logistical issues of food, water, sanitation, safety for the participants, and cultural concerns of the community. As luck would have it, a vacant construction camp from an abandoned infrastructure project was already available with lodging for all participants and support staff (105 in all). Water and sanitary facilities were also in place. Food logistics and the head cook were provided by IF Hope, an organization with some experience in food service. Camp participants assisted IF Hope staff in food service duties on a rotational basis. Local food was purchased when available or trucked from Jalalabad. NCC participants were responsible for maintaining their quarters and keeping the grounds in good order. This included making their beds, litter patrol, and landscaping activities. Free time activities included volleyball, soccer, cards, and trips to the local bazaar. Medical care was provided by an Afghan Government-run clinic in a village 2 km from the camp. The adjacent PRT's clinic was available for serious injuries or illnesses. Some measure of security was provided

by fencing already on the site and by guards provided by IF Hope. An added layer of security was provided by the PRT who maintained a manifest of NCC participants and could check it against issued identification cards; they would also provide timely evacuation and safe haven within the walls of Forward Operating Base Kalagush (FOB), home of the PRT, in case the camp came under attack.

Cultural concerns were addressed through the experience of IF Hope and good communications with the local community. For example, religious training was provided to assuage local fears that Americans are trying to convert NCC participants to Christianity. To prevent bullying, including sexual assault, sleeping arrangements included segregation of participants by home valley and having a strong village leader as a supervisor who slept in the same room.

Training and Education

Critical to the mission of the NCC was the design and delivery of appropriate academic, religious education, and job skill training programs. The formal academic education focused on the following subjects: reading, writing, mathematics, religious studies, and physical education. Participants also received instruction of a rudimentary Natural Resource Management training program. Instruction included the environmental benefits of trees as well as the economic impact of various reforestation designs including windbreaks, woodlots, riverbank stabilization, hillside erosion control, and plantations to produce construction poles and other wood products. Silviculture instruction included understanding the importance of site selection and factors to consider before establishing a plantation, planting layout and design, planting methods, fertility management, pest management, forest protection, irrigation management, tree training and pruning, and sustainable harvest management. Students also learned the basics of working with communities to solicit stakeholder involvement and about the concept of sustainability.

Project Planning and Execution

Continued support of the program required selection of appropriate community approved work projects followed by effective design and planning. A tremendous amount of time and effort went into selecting an initial project that would produce a tangible outcome and offer useful natural resource conservation training. Since there was an obvious need for land stabilizing erosion control and watershed improvement projects, a relatively ambitious reforestation project within Nurguram District was started. Engineers from IF Hope and the PRT designed and planned for 62,500 saplings to be planted in an unused parcel of land adjacent to the FOB and close to where the initial NCC camp would be located. A nearby river was tapped for irrigation water and three large water holding tanks were constructed. Saplings were shuttled from a nursery at IF Hope's main headquarters and were successfully transplanted and placed at the site. The species of trees were eucalyptus (*Eucalyptus camaldulensis*), shisham (*Dalbergia sissoo*), pistachio (*Pistacia vera*), and a few others. These were chosen after extensive research and

consultation with the Afghan Forestry Directorate within the Ministry of Agriculture. At the end of the first growing season, survival was 73 percent; a remnant of NCC graduates who were kept on as stewards replaced 17,000 dead saplings at the beginning of the following growing season.

The NCC in Action

The NCC operated somewhat similarly to a conservation corps program in the United States, but with adaptation to local needs, conditions, and culture. Enrollees followed a strict and regimented schedule that was prominently posted throughout the camp. After waking up at 6 a.m., living quarters were tidied up and a morning meal was served. Nearly all participants made the short 1.5 km walk to the initial work site, with the exception of a rotating handful who would stay back to attend to various camp maintenance duties. Activities at the work site would continue until 12:30 p.m. when the group returned to camp for lunch. The balance of the day was spent engaged in educational activities. A brief period before dinner was left open for free time. There was some additional time devoted to instruction and studies after the evening meal. By 9 p.m., it was time to bed down for the night. Prayer time was observed five times each day.

Feedback

The genius of the Conservation and Development Corps idea is the broad scope of beneficiaries. In Nuristan, this was certainly the case, but with a decidedly timely Afghan twist.

Benefits to participants—The basic education benefits of NCC training are perhaps best exemplified by improvements in literacy. At the outset of the program, the typical NCC participant went from writing a few characters to writing a simple letter. Work skills needed to develop a future labor force for Afghanistan included learning how to use a pick and shovel. This is especially significant in Nuristan because men had previously not used these tools in this society where animal husbandry was the male profession and crop production was the work of women. Initially, the participants were humiliated to be doing what they saw as women's work, but soon came to take pride in their new skills and their ability to shape their surroundings. Engaging young men in productive work is especially poignant for a country plagued by war and banditry. Six months after completion of the project, one graduate noted that if he had not found work in the NCC, he would have likely turned to illegal means of support.

Benefits to elders and communities—After this project was completed as planned, additional shuras were conducted in surrounding villages to identify other work the NCC participants could complete. These efforts focused on shoring up community water delivery systems by helping to rebuild canals. Elders were especially pleased with the employment aspects of the project and the fact that young men could find a job locally. Perhaps more importantly, a measure of trust was achieved between perhaps the most insular Afghan tribe and the outside world. Development in Afghanistan has been fraught with projects that have eroded relationships by fail-

ing to meet objectives and expectations. In this case, both westerners and Afghans delivered as promised in a short period of time, opening the door to future collaboration.

Benefits to the environment—A Nuristan hillside is now covered with thriving tree saplings that will help meet local fuel needs within the next 3 years and take pressure off the sparsely vegetated neighboring hillsides, already stressed with over grazing and excessive fuel wood collection (fig. 1). A handful of NCC alumni now tend the plantation. Although a small step, this effort represents progress toward stabilizing the upper watershed of one of the most critical crop production areas of Afghanistan. Perhaps more significant still, this project represents early implementation of community-based natural resource management that is a basis for the Forestry and Range Management policy of the Afghan government.

THE NCC TODAY

The future of the Nuristan Conservation Corps depends on the future direction of Afghanistan and the role of the United States and its allies in helping stabilize the country and funding reconstruction efforts. As of October 2009, the NCC had concluded its first year of operation and is in limbo until additional CERP funds are allocated for another year of operation. The Afghan government, while seemingly interested in expanding the program by using some of its budgeted funds, has not yet done so.

While the future of the NCC is uncertain, the trust between local Nuristanis and U.S. personnel is paying off in the implementation of a new participatory and community-based forest development project. In spring 2010, 5,000 fruit and nut tree saplings will be trucked from Jalalabad on a newly paved road to the NCC camp. From there, they will be distributed to each of the six home valleys of NCC participants. Thirty-six NCC alumni (supervised by six NCC supervisors) will use their newly developed skills to assist in the planting and care of trees that will help sustain their neighbors and families into the future. Fortuitously, the irrigation system used to establish the plantation will be used to serve the Afghan government's Nurguram District Agriculture Center scheduled to open in June 2010.

The Future of a CCC Model for Afghanistan

As with all ventures in Afghanistan, nothing is certain. However, the benefits associated with deploying the NCC approach throughout Afghanistan to address multiple problems are becoming widely recognized. As of spring 2010, several U.S. government development and military counter insurgency personnel have come to recognize the potential to use a CCC strategy to achieve stabilization and development objectives. Common themes include using fighting-age males to accomplish work projects desired by local communities. Technical curricula can be expected to vary somewhat but addressing illiteracy will be a universal goal. Some projects are likely to extend beyond the conservation corps mission of natural resources improvements, but the work plus life skills training will be a component of all these programs.



Figure 1—NCC graduates tending their plantation in March 2010 with denuded hills of Nuristan in the background.

First time visitors to Afghanistan are struck by the fact that this country needs all aspects of development, all at once, to alleviate some of the most widespread illiteracy, poverty, and accompanying environmental degradation in the world. Coupled with the particularly closed nature of Afghan society and lingering security issues, the success of the NCC should be regarded as nothing less than miraculous. This should be very heartening to supporters of conservation and

development corps programs everywhere in the developing world. We suggest that if it works in Nuristan, it can work anywhere.

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The U.S. Forest Service Job Corps 28 Civilian Conservation Centers

Larry J. Dawson and Alicia D. Bennett

Abstract—In 1964, President Lyndon B. Johnson laid out his plan for the Great Society. His vision for America was one in which all segments of society could participate equally. To this end, the Economic Opportunity Act, which created Job Corps, was passed. The Job Corps program provides economically disadvantaged youth, ages 16–24, with the academic, vocational, and social skills needed to pursue long-term, productive careers at 124 Job Corps Centers nationwide. Among these, 28 Job Corps Civilian Conservation Centers (JCCCCs) are operated on public lands under an interagency agreement between the U.S. Department of Labor (DOL) and the U.S. Department of Agriculture (USDA) Forest Service. Dating back to the Civilian Conservation Corps (CCC) of the 1930s, the Forest Service has a history of involvement with employment programs with a rich legacy of land stewardship. The Forest Service, which played a principle role in establishing and operating the depression era CCC, took a central role in designing the Job Corps program. JCCCCs are associated with national forests or grasslands and they span seven Forest Service regions, 22 national forests and grasslands and 18 states with a capacity to house, educate, and train over 6,200 enrollees. JCCCCs have a unique conservation mission and provide academic education and practical training in work-based learning to conserve, develop and manage, and enhance public natural resources and recreation areas, or to develop community projects in the public interest. The talents of JCCCC students are enlisted in a diverse array of Forest Service programs, although they are most widely known for their program contributions in urban forestry, hazardous fuels reduction, construction, and firefighting. Approximately 80% of all Job Corps students obtain jobs, enlist in the military, or go on to further education. JCCCCs conserve and develop human resources as well as the nation's abundant natural resources. Forest Service Job Corps is a flagship program in the agency's mission of "Caring for the Land and Serving People."

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Introduction

Since the founding of the Forest Service over a century ago, there has rarely been a time when the agency has not been involved with a jobs training program built on the idea of natural resource conservation. Job Corps, Civilian Conservation Corps (CCC), Accelerated Public Works Program (APW), Youth Conservation Corps (YCC) and Young Adult Conservation Corps (YACC) are just a few such Forest Service programs that serve people and natural resources alike.

The Job Corps program provides economically disadvantaged youth, ages 16–24, with the academic, vocational, and social skills needed to pursue long-term, productive careers. Today, there are 124 Job Corps Centers nationwide, the majority of which are operated by private contractors and non-profit organizations. Among these, 28 Job Corps Civilian Conservation Centers (JCCCCs) are operated on public lands under an interagency agreement between the U.S. Department of Labor (DOL) and the U.S. Department of Agriculture (USDA) Forest Service. The Forest Service operates 28 Job Corps Civilian Conservation Centers (JCCCCs) that are associated with national forests or grasslands and span seven Forest Service regions, 22 national forests and grasslands and 18 states (table 1) with a capacity to house, educate, and train over 6,200 enrollees. JCCCCs provide academic education and practical training in work-based learning to conserve, develop, and manage public natural resources and recreation areas, or to develop community projects in the public interest. The talents of JCCCC students are enlisted in a diverse array of Forest Service programs, although they are most widely known for their program contributions in urban forestry, hazardous fuels reduction, construction, and firefighting. Forest Service Job Corps students have fought forest fires, planted trees and grass, improved wildlife habitat, and built or maintained recreation facilities and miles of hiking trails. JCCCCs conserve and develop human resources as well as the nation's abundant natural resources. The Forest Service Job Corps program is a flagship program in the agency's mission of "Caring for the Land and Serving People."

Role of the Forest Service in Designing Job Corps

The year 2009 marked the 45th anniversary of President Lyndon Johnson's special message to Congress proposing

Table 1—Forest Service Job Corps associated Forest chart.

Civilian Conservation Center	National Forest/Grasslands	Forest Service Region	State
Anaconda	Beaverhead-Deerlodge	1	Montana
Angell	Siuslaw	6	Oregon
Blackwell	Nicolet	9	Wisconsin
Boxelder	Black Hills	2	South Dakota
Cass	Ozark and St. Francis	8	Arkansas
Centennial	Boise	4	Idaho
Collbran	Grand Mesa, Uncompaghre and Gunnison	2	Colorado
Columbia Basin	Okanogan-Wenatchee	6	Washington
Curlew	Colville	6	Washington
Flatwoods	G. Washington & Jefferson	8	Virginia
Frenchburg	Daniel Boone	8	Kentucky
Fort Simcoe	Wenatchee	6	Washington
Golconda	Shawnee	9	Illinois
Great Onyx	Daniel Boone	8	Kentucky
Harpers Ferry	Monongahela	9	West Virginia
Jacobs Creek	Cherokee	8	Tennessee
Lyndon B. Johnson	Nantahala	8	North Carolina
Mingo	Mark Twain	9	Missouri
Oconaluftee	Nantahala	8	North Carolina
Ouachita	Ouachita	8	Arkansas
Pine Knot	Daniel Boone	8	Kentucky
Pine Ridge	Nebraska	2	Nebraska
Schenck	Pisgah	8	North Carolina
Timber Lake	Mount Hood	6	Oregon
Trapper Creek	Bitterroot	1	Montana
Treasure Lake	Cibola NF/ Black Kettle and McClellan Creek National Grasslands	3	Oklahoma
Weber Basin	Uinta-Wasatch-Cache	4	Utah
Wolf Creek	Umpqua	6	Oregon
28 Centers	22 Forests & Grasslands	7 Regions	18 States

“A Nationwide War on the Sources of Poverty.” To this end, the Economic Opportunity Act, which created Job Corps, was passed. Dating back to the Civilian Conservation Corps (CCC) of the 1930s, the Forest Service has a history of involvement with employment programs with a rich legacy of land stewardship. The Forest Service, which played a principle role in establishing and operating the depression era CCC, took a central role in designing the Job Corps program.

JCCCCs were intended to help solve two of the country’s most serious problems: unemployment and resource degradation. In 1964, almost 30 percent of the two million young people entering the nation’s workforce were school dropouts. Without training for employment, many undoubtedly would have ended up on public assistance or in the crowded justice system. Job Corps is as relevant today as it was in 1964. Currently, an estimated 30 percent of America’s youth do not graduate from high school and 40 percent of high school graduates are unprepared for work or higher education. The Forest Service is responsible for managing and protecting the National Forest System, which includes 155 national

forests and 20 national grasslands, totaling 193 million acres of land. Forest Service Job Corps was a new opportunity to conserve and develop human resources as well as the nation’s abundant natural resources. Students and graduates of the Forest Service JCCCCs are integral to the success of the agency’s mission of “Caring for the Land and Serving People.”

At its inception, Job Corps was designed exclusively for young men who needed to complete basic education and develop skills and work habits necessary to find and hold jobs in the mainstream of society. Upon enrolling in a JCCCC, youth were assigned to camps on national forests and other public lands to perform natural resource conservation work, including planting trees, installing water systems, building recreation facilities and small erosion control dams, constructing roads, trails and firebreaks, fighting wildfires, and much more. The JCCCCs continue the positive tradition of the depression-era CCC and reflect the continuing American belief in the beneficial effects of healthy outdoor work in a natural environment on youth raised in poverty.

An early JCCCC orientation guide, addressing “The Outdoor Environment” reflects this belief:

Working and living in the outdoors, close to nature, often brings a beneficial effect to the individual—in his attitude, outlook, and philosophy, even in his mental and physical health. . .people of all ages seek out nature and natural surroundings for change, refreshment, recreation, and meditation (USDI n.d., p. 13).

For the majority of Job Corps students, JCCCCs are their first exposure to the “great outdoors” of our nation’s forests and grasslands. Forest Service JCCCCs still incorporate a nature-based curriculum that builds self esteem through connection with the natural world, along with discipline to overcome life’s obstacles, critical thinking, problem solving and team building skills (Russell and others 2000). For example, at the Schenck JCCCC on the Pisgah National Forest in North Carolina, Job Corps students have improved the national forests of the Southern Appalachians with road and trail building, construction of recreational facilities, soil erosion control structures and tree planting. Students built both the ranger station and the visitors center in what is known as the “Cradle of Forestry.” The Schenck JCCCC forestry program prepares its students for careers in natural resources, providing basic concepts of timber, fish and wildlife, soil and water, recreation management, and environmental restoration.

Job Corps helped me develop into being a leader. I look forward to completing the Advanced Forestry Program. I want to work for the Forest Service and at the same time honor my Navajo identity and be a positive, constructive role-model for my people.

—Schenck JCCCC student, Advanced Forestry Program

Forest Service Job Corps Today _____

The Forest Service has a strong commitment to making the Job Corps program an integral part of the core mission of the agency. Job Corps is a program of opportunity that incorporates environmental justice in its truest sense. JCCCC students are a diverse snapshot of our nation and reach across the spectrum of race, gender, and ethnicity. They are the citizens that are, all too often, missing from our national conversations about the environment.

Not only has Job Corps been an integral part of Forest Service history, it is an invaluable resource that has produced past and present Forest Service leaders, including district rangers, forest supervisors, and regional foresters. JCCCCs are an excellent opportunity for USDA employees to gain leadership skills, advance their careers and serve as mentors to help our nation’s young people. The Forest Service is facing critical shortages in workers. JCCCC students reflect our nation’s ethnic diversity, and recruitment of these students for permanent jobs strengthens the Forest Service in its mission to serve all Americans.

Forest Service Job Corps Education and Training _____

One of America’s greatest challenges is youth who have dropped out of school with no opportunities to move into the workplace, military service, or institutions of higher learning. Job Corps’ education, training and individualized attention, discipline, and support in a residential setting provides structure and security that are often lacking in students’ home environments.

Every year, an additional 2.2 million youth leave school insufficiently prepared for economic independence. Their inability to participate in America’s economy makes these young men and women more likely to live in poverty, receive public assistance, be incarcerated, unhealthy, divorced, and/or single parents to the next generation of high school drop-outs (Bridgeland 2006). The substantial economic investment in Job Corps is recouped in the form of the conservation of public natural resources, construction of public facilities, reduced dependence on social welfare programs, and long-term career growth for Job Corps students. Today, unlike the all-male centers of the past, all JCCCCs are co-educational and offer non-traditional vocational training to females. The majority of JCCCC students come from low-income communities, both urban and rural, who are seeking pathways to prosperity.

After finishing high school I wanted to go to college. However, I was unable to attend due to lack of financial funding. . . I stumbled across an application for Job Corps. . . My experience with Job Corps has profoundly changed the course of my future.

—Blackwell and Schenck JCCCC graduate, Welding and Advanced Fire Management Training Program

The typical Job Corps student has not completed high school, reads slightly below the eighth grade level, is from an economically disadvantaged family, has never had a full-time job, and is between 17 and 19 years old. Thirty-two percent of all Job Corps students come from families on public assistance. Approximately 76% of JCCCC students are male and 32% of JCCCC students are African-American, 55% White, 8% Hispanic, 3% American Indian and 3% Asian Pacific Islander.

JCCCCs are open 24 hours a day, 365 days a year, with two-week training breaks twice each year. Job Corps is a self-paced program and lengths of stay vary. Students who have not succeeded in traditional academic settings benefit from Job Corps’ small class sizes and hands-on, self-paced approach. Students who meet the economic criteria and enroll may obtain a high school diploma or a general equivalency diploma (GED) and receive vocational skills training. Education departments at Job Corps centers offer a broad-based program providing training to students at all levels who are preparing to take the GED test. Subjects include reading, mathematics, writing skills, critical thinking and problem solving skills, computer literacy, consumer education, work attitude, health, parenting, intergroup relations, English as a Second Language, and driver education.

The average length of stay is approximately 8 months for all students and approximately 12 months for graduates. Students may remain enrolled in Job Corps for up to 2 years, with an optional third year granted to students who qualify for advanced training. The length of time students are enrolled in Job Corps correlates with their post-program success. Students who remain enrolled longer are more likely to complete a vocational training program, attain a high school diploma or GED, and learn more employment skills. Those students who leave Job Corps prior to completion do so for a variety of reasons, including personal or family issues, an inability to adjust to Job Corps residential living, becoming homesick, or for medical or disciplinary reasons. Job Corps strictly enforces a zero tolerance policy for drugs, alcohol, and violence.

JCCCCs offer hands-on training in over 30 vocational trades, including cement masonry, welding, business technology, painting, carpentry, bricklaying, food service and culinary arts, wildland firefighting, and forestry (table 2).

Table 2—Current Vocational Training offered on Forest Service Civilian Conservation Centers.

✓ Business Technology	✧ Office Administration
✓ Construction	✧ Bricklaying
	✧ Carpentry
	✧ Cement Masonry
	✧ Construction Craft Laborer
	✧ Electrical
	✧ Facilities Maintenance
	✧ Floor Covering
	✧ Heating, Ventilation & Air Conditioning
	✧ Heavy Equipment Operations
	✧ Landscaping
	✧ Material Handler
	✧ Painting
	✧ Plastering
	✧ Plumbing
	✧ Welding
✓ Culinary Arts	
✓ Environmental	✧ Forestry Conservation & Firefighting
	✧ Advanced Forestry
	✧ Advanced Fire Management
	✧ Urban Forestry
✓ Health Occupations	✧ Nurse Assistant Home Health Aide
	✧ Pharmacy Technician
	✧ Medical Office Support
✓ Information Technology	✧ Computer Networking /CISCO
	✧ Computer Technology
✓ Mechanical	✧ Automotive Technology
	✧ Heavy Construction Equipment Mechanic
	✧ General Service Technology
	✧ Heavy Truck Driving
✓ Security & Protective Services	

Every Job Corps student participates in work-based learning as part of their vocational training. JCCCCs have rigorous performance measures and accountability standards and centers are evaluated on criteria such as the number of students who obtain employment, and graduates' average starting wages. Compared to their peers, young people who attend Job Corps are less likely to be on public assistance and less likely to be involved in criminal activities. (Schochet and others 2001). During a typical stay in the Job Corps program, students improve their math skills by 2.4 grade levels while their reading skills improve by 2.6 grade levels. Approximately 80% of Job Corps graduates obtain jobs, enlist in the military or enroll in higher education. After completing their education and training, Job Corps graduates return to their communities as productive workers, consumers, community leaders, and entrepreneurs.

Life at Job Corps Civilian Conservation Centers

During a Job Corps student's first few weeks, they learn about life on-center and focus on personal responsibility, social skills, and career exploration. Job counseling departments provide both individual and group counseling to aid students in setting realistic goals, evaluating their attitudes and interests, and developing social skills and character traits important to the working world. A Career Development Period represents the bulk of time enrollees are on-center, during which students learn vocational, academic, and employability skills.

During my stay at Harpers Ferry JCCCC, I received my GED and class 7 forklift certifications. I achieved a TABE score of 614 in reading and 585 in math. . .

—Harpers Ferry JCCCC graduate, Brick and Block Masonry Training Program

Following graduation, in the Career Transition Period, center personnel work with Job Corps graduates for up to 12 months providing transitional services and follow-up support in areas such as finding housing, healthcare, and/or transportation to and from work.

Learning leadership, personal accountability, and responsibility are integrated into all JCCCC activities. Job Corps teaches students to be a part of, and contribute to, the communities in which they live through public service. Job Corps students lend their time and talents to local service projects, often in partnership with community based organizations such as the American Red Cross and Habitat for Humanity. Service-learning projects integrate Job Corps students' vocational and educational curricula with activities that allow students to put their training into practice. The millions of dollars of construction and rehabilitation projects that JCCCC students conduct on their centers, in their surrounding communities, and on national forests and grasslands help students make the link between academics, their vocational trade, and the environment around them. Job Corps students volunteer thousands of hours to help maintain the health and diversity of our national forests and grasslands. Students conduct work that enhances wildlife habitat, revitalizes wildfire-damaged landscapes, restores

watersheds, and improves recreational resources for the benefit of all Americans. For example, students from the Timber Lake JCCCC recently spent a day restoring a denuded riverbank adjacent to the Clackamas River on the Mt. Hood National Forest (fig. 1), and students from the Anaconda and Pine Knot JCCCCs participated in “Operation Reclaim” on the Shasta-Trinity and Six Rivers National Forests to clean up abandoned Drug Trafficking Organization marijuana sites that pose a public safety risk and directly harm the environment.

As first responders during local, state, and national disasters, JCCCC students also assist during unexpected emergencies, including those caused by wildfires, floods, hurricanes, and tornados.

The Federal Bureau of Investigation (FBI) in Little Rock, Arkansas, asked the Cass JCCCC Heavy Equipment trade to help with search and recovery in the Ozark and St. Francis National Forest.

I would have never thought that I would be in a position to help in something so important.

—Cass JCCCC student, Heavy Equipment Training Program

JCCCC students often work during their enrollment and after graduation in Forest Service programs such as forestry, hazardous fuels reduction, firefighting, and conservation restoration. Students work as dispatchers, computer data

entry clerks, technical specialists, heavy equipment operators, mechanics, drivers, and carpenters, all of which are critical components of modern resource management and restoration.

Traveling from forest to forest, my supervisors and instructors helped me understand what life was like in wildfire and prescribed fire and the purpose behind them. My instructors taught me . . . to develop professionalism during both work and off-work hours.

—Schenck JCCCC student, Advanced Fire Management Training Program

Job Corps for the 21st Century

The Forest Service Job Corps program addresses two of the most important issues facing America: natural resources conservation and job skills training. A new “green” Job Corps curriculum will help train underserved youth for jobs in the emerging green economy and enhance the unique conservation mission of the JCCCCs. The JCCCCs are uniquely poised to become a foundation of America’s “Green Job Corps.” Their vocational trades are easily modified to integrate “green” skills. Most green jobs are traditional blue collar trade jobs—such as carpenters, welders, electricians, and plumbers—with a green adaptation to reduce consumption.

The new direction will promote public service, sustainable lifestyles, and vocational skills training that will enable Job



Figure 1—Timber Lake Job Corps JCCCC students help restore a denuded riverbank adjacent to the Clackamas River on the Mt. Hood National Forest (photo credit: Keith Riggs, USDA Forest Service Washington Office of Communications).

Corps students to compete for green jobs that will revitalize local economies in rural communities across America. The green curriculum will expand job opportunities through a new, energy-efficient focus in the traditional trades that will prepare Job Corps graduates to build green, energy efficient homes and renewable energy plants, enhance our natural resources and prepare students in numerous other ways to apply green skills to new and traditional vocations.

JCCCCs have the capacity and skills to operate as “mobile corps” and travel to remote locations and students experience work-based learning in real-time construction settings. JCCCCs have a proud history of erecting Forest Service structures. In northern Wisconsin, it is difficult to locate a ranger station or visitors center that was not built by the Blackwell JCCCC. Recent Job Corps projects include retrofitting the Challenge Visitor Center on the Plumas National Forest, refurbishing Adirondack shelters in the Cranberry Backcountry on the Monongahela National Forest, demolishing and rebuilding the Camino Real Ranger District office, and restoring Grey Towers, Gifford Pinchot’s ancestral home.

Within the last year, Job Corps students have worked with wildlife biologists in the Monongahela’s high-elevation red spruce forest to install hundreds of nest boxes to track the population of rare West Virginia northern flying squirrels, participated in a massive eradication of marijuana cultivation sites on the Shasta-Trinity and Six Rivers National Forests, and completed a streamside restoration project on the Clackamas River to enhance the spawning areas of native salmon on the Mt. Hood National Forest.

Future Forest Service projects range from forest and ecosystem activities to the rehabilitation and weatherization of 50-plus-year-old Forest Service facilities and developed recreation sites, hazardous fuels projects, and woody biomass conversion projects.

I take pleasure in talking about “green” living (sustainable operations), both because it interests me and because it is good for the environment. I helped Timber Lake JCCCC receive their “Green Team” award and the “Green Team Challenge” award from Mt. Hood National Forest in 2009.

—Timber Lake JCCCC student, Business Technology Training Program

Job Corps students are making our Forest Service facilities and operations sustainable, lowering its operating costs, reducing its carbon footprint, restoring terrestrial and aquatic ecosystems, and training students with the necessary skills for green jobs. The Job Corps program is developing workers with the leading-edge technical and conservation skills that are needed to build a green economy while building themselves a more prosperous future.

Conclusions

Forests and grasslands are a national treasure. JCCCCs are building a cadre of young people whose education and skills are being used in natural resource conservation projects that are restoring America’s national forests and grasslands. The Job Corps program helps ensure that none are left behind, and provides a solid foundation for economically disadvantaged youth to reach their potential and succeed both in their communities and careers. The work that occurs each and every day by Forest Service Job Corps students and staff showcases our nation’s wise and continuing investment in the conservation of America’s natural resources—not just our land, but our young people’s lives.

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2. PROMOTING INVOLVEMENT OF LOCAL COMMUNITIES



Photo courtesy of the WILD Foundation

Indigenous Ecotourism in Preserving and Empowering Mayan Natural and Cultural Values at Palenque, Mexico

Adrian Mendoza-Ramos and Heather Zeppel

Abstract—Indigenous ecotourism in the Mayan Area has gone virtually unmentioned in the literature. As a result of the course of tourism in the Mayan Area, this study assessed the level of empowerment in the Mayan communities surrounding a major archaeological site and tourism attraction of the Classic Maya: Palenque, in Mexico. The empowerment framework was used to assess whether or not tourism develops in terms that ultimately benefit the local communities economically, psychologically, politically, socially, and environmentally. A checklist of empowerment indicators identified from the literature were tested and contrasted with the interviews conducted with Mayan tourism stakeholders. Results indicate that local indigenous participation in tourism has not easily occurred due to a lack of knowledge of tourism and limited economic resources and negotiation skills, which has significantly disempowered Mayan communities. Non-governmental Organizations (NGOs) have not participated in local tourism development until recently and investment from the private tourism sector has not stood out with its presence. The Mexican government is tracing the course of indigenous ecotourism with several support programs. These results form the basis for more effective strategies to maximize involvement of Mayan communities in managing their cultural and natural resources and the tourism on which they depend.

Introduction

Over the last couple of decades, tourism has become one of the world's fastest growing industries and can be an important constituent of a country's economy. Currently, tourism provides 7.6% of global employment and 9.4% of the world's Gross National Product (WTTC 2009). In 2006, the World Travel and Tourism Council (WTTC) reported that US\$ 6.5 trillion was generated by all components of

tourism throughout the world, and forecasted an average of 4.2% annual increase for the next decade.

The United Nations Development Programme (UNDP) defines indigenous communities, people, and nations as those having “a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, are distinct from other settler groups and want to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity” (UNDP 2004). This historical continuity is based on occupation of ancestral lands, common ancestry, cultural practices, and language. Indigenous people are also economically and culturally marginalized and often live in extreme poverty. They mainly have a subsistence economy and rely on natural resources for food and cash. The United Nations Commission on Sustainable Development (UNCSD) stated that indigenous people comprise 5% of the world's population but embody 80% of the world's cultural diversity. They are estimated to occupy 20% of the world's land surface but nurture 80% of the world's biodiversity on ancestral lands and territories (UNCSD 2002). In Latin America, the World Food Programme (WFP) estimated the indigenous population at between 20 to 40 million in the last decade (WFP 1998). The exact number is unknown due to a lack of agreement on a definition and the steady impacts of globalization. For indigenous people, achieving sustainable ecotourism depends on asserting legal rights, indigenous control of land and resources, geographic location, funding or business support, and developing effective links with the wider tourism industry (Zeppel 2006).

Mexico is the seventh preferred country in the world for international tourists (WTO, 2006) and a mass tourism industry is based around beach resorts on the Pacific and Caribbean coasts. In fact, tourism is the third most important economic activity in the country. However, due to the global economic crisis in 2008 and the global influenza the year after, revenues from tourism industry dropped 15% in the country in 2009, adding up to US\$ 11.3 billion (SECTUR 2010).

The Mexican population's majority is *mestizo*, which is a combination of pre-Hispanic cultures and Spanish colonialists. However, more than 60 *etnias* (indigenous cultures) are spread throughout Mexico, and represent more than 10% of the country's population, and the biggest indigenous population for Latin American countries. Indigenous cultures in Mexico normally live in community-owned lands that they use in different ways for their livelihoods. This system of communal lands is known as *ejido* and is the most basic unit of village government in Mexico.

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Mexico has amazing biodiversity and is a center of biological endemism with large numbers of unique animal and plant species. It has about 10% of all amphibians, reptiles, birds, mammals, and plant species of the world. This positions Mexico as the world's fourth most biodiverse country (CONABIO 2009). The tropics in Mexico are located in the southeastern part of the country whereas subtropical, temperate, arid, and semiarid climates with different natural resources are located in central and northern Mexico. The *Selva Maya* constitutes one of the largest remaining zones of tropical forest in North and Central America and covers an area including the countries of Mexico (the Yucatan peninsula and the Lacandon forest in Chiapas), Belize, Guatemala, and Honduras.

Palenque

Palenque is a Mayan town of 37,301 inhabitants (INEGI 2005) and a major archaeological site in the Mexican State of Chiapas. It contains some of the finest architecture, sculpture, and relief carvings that the Maya produced. Its major archaeological remains date back to 400 A.D. The National Institute of Anthropology and History (INAH) controls research excavations and tourism activities on the archaeological heritage. In Palenque, INAH manages 330 ha in which archaeological mapping and exploration indicate that the city ruins seem to occupy about 150 ha, but the majority of the structures are covered by rain forest vegetation (Barnhart 1998).

As a result of its cultural value, the government declared the site as a cultural monument for humanity, resulting in the creation of Palenque National Park in 1981 and in the definitive preservation of its cultural and natural resources. The National Commission for Protected Natural Areas (CONANP) manages the natural resources of the park and develops programs with participation of two local indigenous communities located within the park's zone of incidence. The park encompasses 1,771 ha of which about 600 ha consist of primary rainforest vegetation. An additional 300 ha consists of second growth vegetation in different stages of regeneration. The rest consists of introduced pasturelands. Data from an earlier survey of the vegetation showed the existence of about 241 species of trees (Diaz Gallegos 1996). The terrain at the site is rugged, and elevation ranges from 150 to 500 m above sea level. The climate is tropical and it rains almost all year round. The average annual precipitation fluctuates around 2,200 mm, and the mean annual temperature fluctuates around 26 °C.

At the north, the park is surrounded by flat pasture lands owned by cattle ranchers while at the south the mountain range of North Chiapas starts to elevate. The Mayan communities of El Naranjo and Lopez Mateos adjoin the Park in the elevated southern part. El Naranjo is a *Maya tzeltal* spoken community whereas Lopez Mateos is a *Maya chol* spoken community. They are located 5 km up into the mountains from the Palenque archaeological site and some family members from both communities go to the park every day to offer guided tour services or sell handcrafts in the park to the visitors.

Like Cancun, Puerto Vallarta, and Los Cabos in the past, in 2008 Palenque was targeted by the Mexican government

to be the newest *Integral Planned Centre* in Mexico in order to boost the tourism activity and to attract three times the number of tourists and investments that come to the site today. This centre is planned to reinforce the connectivity of Palenque through the internationalization of the current local airport and the construction of a modern highway from Palenque to other tourism destinations within the State of Chiapas. According to the Ministry of Tourism (SECTUR) through its Tourism Foment National Fund agency (FONATUR), Palenque is the third most visited archaeological site in the country and attracts about 650,000 visitors each year. An investment of US\$120 million in the State is estimated for this project, which "will generate more and better jobs for the local families" (FONATUR 2008).

Methods

Qualitative and quantitative research methods were used to evaluate and compare sustainable tourism development and empowerment through tourism in Mayan indigenous communities around the archaeological site of Palenque in Mexico. A Mayan village was selected based on its proximity with this major Mayan tourism destination for archaeology, culture, and nature. The study relies on the indigenous ecotourism empowerment framework developed by Scheyvens (2002) because it is presented as a way of determining whether or not communities are engaging in tourism in ways that ultimately benefit them; this includes economic, social, psychological, and political empowerment. A fifth aspect of environmental empowerment was also tested in this study. Data collection and fieldwork research started in May 2009 and finished in November 2009.

Participant observation at Palenque was focused on tourist flows, community involvement with tourism, livelihood activities, and environmental conservation. Key stakeholders from the ministries involved with sustainable tourism development programs at a national level were interviewed in Mexico City. Semi-structured face-to-face interviews were also conducted with key stakeholders in Palenque. Overall, six semi-structured face-to-face interviews were conducted in Mexico City with directors of tourism departments, and five were conducted in Palenque including government authorities, one tour operator manager, one ecotourism NGO consultant, and the community sheriff from the Mayan community of El Naranjo. Additionally, two focus groups made up of 5 to 10 community members, including local tour guides and handcrafters, were held. Data were analyzed to determine stakeholders' views on community empowerment and tourism participation.

A checklist of economic, psychological, social, political, and environmental indicators on sustainable tourism development and community empowerment identified in the literature were completed for the community. Information collected from interviews and focus groups was subject to content analysis of themes on community empowerment and tourism participation. The checklist of empowerment indicators in El Naranjo was assessed quantitatively through a 5-point Likert scale (from very empowering = 5 to very disempowering = 1; fig. 1).

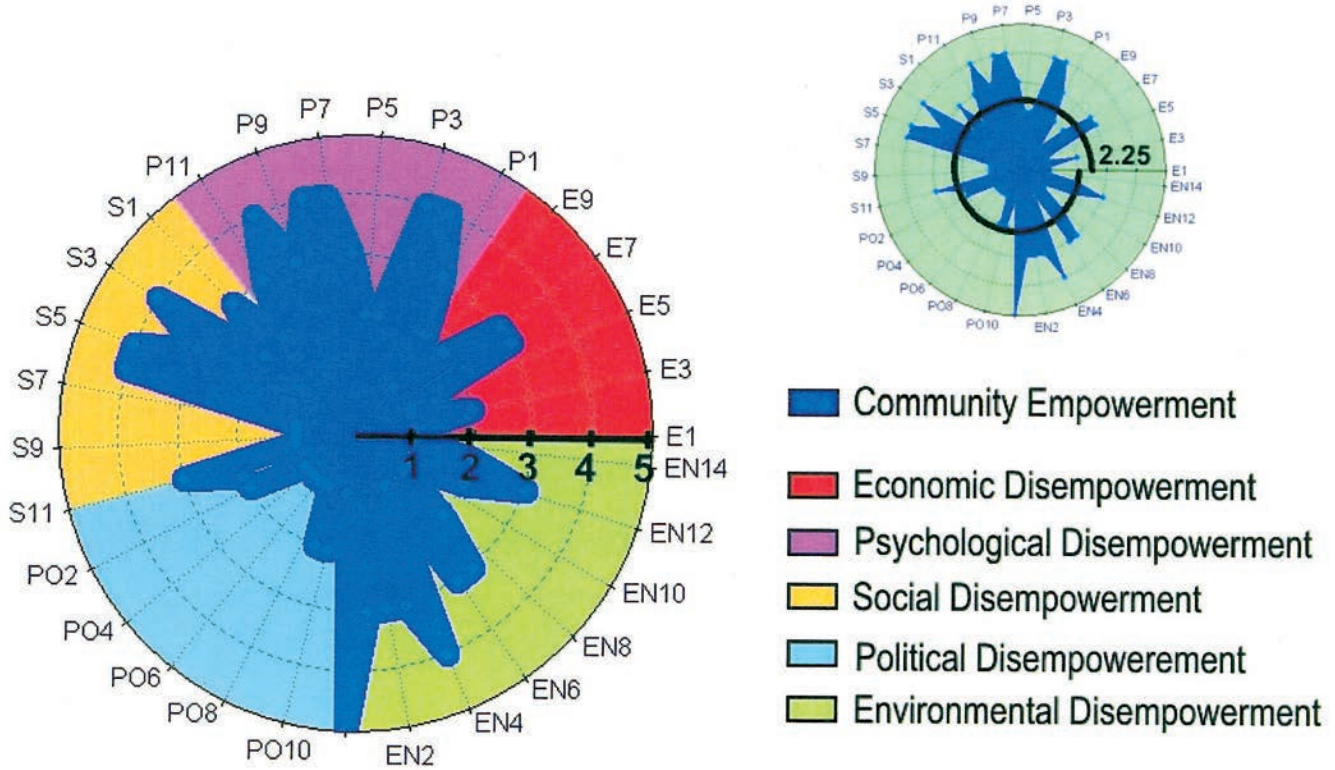


Figure 1—Levels of indigenous ecotourism empowerment in El Naranjo.

Results

El Naranjo and Lopez Mateos are two neighboring indigenous Mayan communities located 5 km apart, uphill from the pyramids of Palenque at an altitude of 232 m above sea level. El Naranjo’s population census accounted for 411 inhabitants (INEGI 2005). On average, families are made up of 6 members (range 4 to 12). The surface of the *ejido* extends for 1,500 ha. On average, each of the 72 *ejidatarios* or assembly members has 20 ha for his own use. El Naranjo village settled in the area in 1945 whereas Lopez Mateos settled in the early 1960s. Both have used their land for self-sustaining through agriculture, house farming, cattle grazing, and hunting. Over the past 20 years, many Mayans from the two villages have been converting their livelihoods toward tourism, and this activity has become the main and, almost only, money income generator for community households.

In the past, a few visitors used to arrive in El Naranjo and Lopez Mateos to experience contact with wild nature and indigenous Mayan communities. A path along a river course underneath the canopy of the rainforest in Palenque connected the archaeological Park with these two Mayan communities that inhabit the other side of the mountain. Without tourism services in El Naranjo in the early 1990s, members from both communities started to arrive at the park to offer handicrafts to the visitors, but were initially repelled by the guards from the archaeological Park.

The involvement in tourism became a need for families to improve their household economies within the community and boomed in 1994 along with the Zapatista movement.

The power of the Zapatista movement originated in Chiapas in the mid 1990s and spread into most of the Mayan indigenous communities in the State of Chiapas, including El Naranjo and Lopez Mateos. These communities took advantage of the situation to finally get a space for trade handicrafts inside the pyramids after 1994. However, this activity is neither promoted nor allowed by INAH inside archaeological sites of Mexico. Although members from both communities negotiated an agreement with authorities from INAH Palenque, this is still considered an informal activity today. This is how both communities started to get involved with tourism.

Today, the majority of people from El Naranjo and Lopez Mateos work in tourism-related activities at least part-time, either in their community producing crafts, or within the National Park in informal tourism activities such as handicraft sales and tour guiding inside the archaeological site. A small group of members from El Naranjo have become certified tour guides and offer tour guiding services at the pyramids in a formal way. A few others from both communities are hired by the park for guarding, ticket sales, maintenance, and support in the archaeological excavations or have permission to sell food and drinks to tourists outside the archaeological site.

The main results from the data collected through interviews and focus groups are presented in tables 1 and 2. A compilation of the opinions of eight government authorities interviewed is presented in the first column. These included two key government authorities in Palenque (SECTUR and CONANP) and six at a National Level, which involved ministries related to the economic, environmental, social, and tourism sectors that have programs for the development of indigenous ecotourism in their agendas. Advisers from an NGO (*Razonatura*) and from a tour operator company in Palenque are summarized in the second column. Opinions from the sheriff of the community in El Naranjo, and from two focus groups are synthesized in the third column.

Overall, 60 different indicators of economic (E), psychological (P), social (S), political (PO), and environmental (EN) empowerment were identified for the community of El Naranjo. Figure 1 shows the level of empowerment based on these indicators. Of the five aspects assessed in the chart, the highest scored was the psychological aspect with a mean of 3.2 points. This indicates neutral empowerment (neither empowered nor disempowered). The social and environmental aspect averaged 2.4 and 2.2 points respectively, meaning the community is somewhat socially and environmentally

disempowered by tourism. The economic and political aspects were the lowest scored, averaging 1.7 points in each case, indicating a disempowering situation resulting from tourism.

The upper-right smaller circle in figure 1 shows the linear fit of the chart, which resulted in a mean of 2.25 points and indicates that the overall effect of indigenous ecotourism is somewhat disempowering, based on the 5-point Likert scale used.

Discussion and Conclusions

Scholars from a wide range of disciplines have researched a large number of aspects of the Maya, including their traditional and contemporary environmental management practices (Toledo and others 2001). Interest in these practices arises from the fact that Mayas inhabit a fragile ecological zone and base their natural resources management strategies on centuries of accumulated experience (Faust 2001). By the same token, Mayan indigenous communities have collective land grants and control of more than 50% of forests in the *Area Maya*, which has politically empowered them in the way they manage the land they own, based on their uses and customs.

Table 1—Stakeholders' perspectives on Mayan indigenous ecotourism empowerment in Palenque, Mexico.

	Government Authorities	NGOs & Tour Advisers	Mayan Indigenous Leaders & Community Members
1	Few cases of indigenous communities that have benefited economically. Minimal benefits. However, "government intention is to benefit them." Funds for indigenous ecotourism development appear in more than 10 federal government departments.	Profits come from tour guidance and craft sales. Benefits are at a family level.	Almost the only economic revenues for the community come from tourism. There are more jobs in the crops paid for with money from tourism. There is more development in the community
2	Indigenous communities are interested in government subsidy for tourism, but not really optimistic for tourism. The real possibilities are short though. They are not trained for tourism and this is a disempowering condition.	Communities are more aware of tourism. They have better quality lifestyles than before	The community sheriff and most of the Assembly (elder leaders) are not keen about tourism involvement. Instead, youngsters and a few others are interested in tourism.
3	Tourism is not creating more problems than those existing without it, but might be causing social cohesion and organization willing to involve in tourism-related activities.	There are differences in opinion among community members from El Nanjo regarding tourism.	There are intra familiar problems since parents want their children to work on the crops rather than being involved in tourism. However it has activated a social cohesion process for those interested in it since they can't find tourism involvement opportunities in a different way.
4	Capacity-building is needed for communities to be involved in tourism. They normally have no knowledge of the tourism industry. They lack a development vision. The educational level has grown compared to a generation before, however.	They do not have administrative capacity for a major involvement in tourism.	Community is not organized at all. Young people involved in tour guiding and crafts sales are getting organized in order to aspire for more and better opportunities to be involved in tourism. Elders don't believe that their community has potential for indigenous ecotourism.
5	Communities need more environmental education and sustainable practices of tourism to develop a sense of awareness about the value of their natural landscapes	Some villagers still hunt at night; however, nowadays they are more aware of natural resources.	Community has a ban for hunting and logging. There are also clean policies for the community. "We persuade tourists to follow good practices of tourism in terms of environmental education while they visit the Park." The Assembly works together with government environmental projects.

1= Economic empowerment; 2 = Psychological empowerment; 3 = Social empowerment; 4 = Political empowerment; 5 = Environmental empowerment.

Table 2—Stakeholders’ perspectives on Mayan indigenous ecotourism participation in Palenque, Mexico.

	Government Authorities	NGOs & Tour Advisers	Mayan Indigenous Leaders & Community Members
Government	<ul style="list-style-type: none"> • Development of the offer; • Effective application of instruments for environmental management of tourism; • Development and knowledge of abilities for a sustainable development of tourism; • Support of impact assessment consultancies; • Development of tools for environmental foment and regulations for the tourism sector; • Financial assistance is given to the elaboration and performance of projects; • Training and ecotourism products promotion are facilitated; • Promotion of traditional indigenous celebration such as dance, music and gastronomy for tourism has been attended; • There are economic and training facilities to develop indigenous ecotourism ventures in Palenque provided by CONANP. 	<p>INAH doesn’t put order in the Archaeological site of Palenque, and allows illegal handcrafters and tour guides to offer their products and services, which is creating problems.</p>	<p>“FONATUR Integral Planned Tourism Centre in Palenque will affect the community.” Government doesn’t take the community into account. However, CONANP and local government are working on a couple of projects for development and conservation. INAH has caused clashes between community members and Park guards since they do not allow craft sales.</p>
Tour Operators	<ul style="list-style-type: none"> • Minimal collaboration or no negotiation between local communities and private enterprises. • Tour operators are not interested in many sites as products to market. • They do not care about environmental or cultural impacts of tourism. • Travel agencies that market the services are the link with the offer. • Results have been positive when the tour operators associate with indigenous communities. • Tour operators are normally narrow-minded just looking for the short-termed economic benefit. 	<p>Hire local tour guides in the visited sites. Tourists buy crafts. However, tour operators go regularly with the cheapest deal.</p>	<p>They are not participating directly in the communities, and they are not taking the community into account for ecotourism. Elders in the community do not like tourism.</p>
NGOs	<ul style="list-style-type: none"> • NGOs are hired by communities for technical assistance and take part in the process. • “They need to act coordinated amongst them as government does with other departments.” • They have originated confusion with their different ideas in some communities; however, they help to mitigate impacts of tourism. • Many times they participate as the performers of national and international financial assistance for development. • The challenge for NGOs is the transfer of knowledge and awareness about community resources for tourism. • NGOs integrate stakeholders and charge for that; some are oriented toward ecotourism. • NGOs have been the pioneers trying to benefit communities from ecotourism. 	<p>They have provided infrastructure and training (capacity-building). There are no NGOs in Palenque working on that, however.</p>	<p>No NGOs have visited the community before for development projects such as ecotourism. El Naranjo looks forward to receiving assistance from Fund Aids and support from NGOs.</p>

Many Latin American countries have policies for indigenous ecotourism that integrates nature and culture, but most village ecotourism projects rely on funding and support from conservation NGOs and other foreign aid (Dahles and Keune 2002). Governmental policies and funds for community-owned indigenous ecotourism ventures in Mexico have become more common in governmental ministries and local departments over the last decade. The participation of local and international NGOs has become necessary for the empowerment

of indigenous people to be involved with tourism. This has been achieved through the promotion of tourism committees within communities and transfer of knowledge and capacity-building in ecotourism. Mexican environmental NGOs have supported a few indigenous ecotourism projects in Mexico, such as *Pronatura* and *Amigos de Sian Kaan* that worked together with Mayan communities in the Yucatan (e.g., Punta Laguna, Punta Allen); however, they have been short-term and limited in effect (Zeppel 2006).

Very few private tourism companies have been involved in ecotourism in the past in Mexico. However, tourism towns such as Palenque and San Cristobal have been attracting migrants from rural areas to work in services in the hospitality sector. They have also attracted foreign business people, who have become residents after having been tourists, and who are now in the tourism industry. According to State authorities, tourism activity in Palenque increased 24% from 2006 to 2008, due to promotions by local, State, and Federal governments in Mexico. Coordination within government levels represents a challenge to the “transparency” promoted by the Federal government, because they often represent different government parties and, therefore, different plans and development strategies for tourism. The State governments have also given little rendering of accounts and arbitrarily pursue national economic resources, which has created an unfavorable panorama in the development of indigenous ecotourism. National government programs for indigenous ecotourism have acted together and in cooperation with ecotourism consultants and NGOs to reduce the gap in terms of local indigenous capacities to manage their natural and cultural resources. For indigenous ecotourism, government programs would ideally offer an economic alternative to logging, mining, hunting, and agriculture, provide funds for local schools and healthcare facilities, and strengthen indigenous cultures.

To avoid the promotion of paternalistic attitudes with indigenous communities nowadays, government funds invested in indigenous ecotourism are granted as a response to an action strategy drawing on the community. As seen by key Mexican government advisers, “ecotourism has not boomed in Mexico as it has done in other countries. The efforts must be focused on key communities to offer high quality services regarding the attractiveness and diversification of tourism products, and then be able to increase the visitor fees for conservation of natural and cultural areas.” The FONATUR investment for the development of an *Integral Planned Center* in Palenque would allow a better tourism development plan to be set up in Palenque. This will depend on the extent of local participation and expertise consultation for the strategy of ecotourism development and environmental management within the national park.

The involvement of the private sector for infrastructure and promotion is also necessary. In fact, the marketing sector has not received attention and tour operators are not promoting local destinations, many times due to a lack of accessibility, services, and indigenous negotiation skills, which has disempowered local communities. As reported in the literature, problems such as growing competition, low visitation rates, and security issues have limited these indigenous tourism enterprises in the past decade. Other limiting factors include a lack of basic tourism infrastructure, little name recognition for remote areas, and continued dependency on funding, staff training, and marketing support from environmental NGOs and industry partners (Dahles and Keune 2002).

There are no tourism services in El Naranjo today to receive tourists. Elderly people in the community think that if they do not use their land for crops, house farming, or domestic livestock, the government will take control of it for protection. Ecotourism is seen as a threat for this group of *ejidatarios* in El Naranjo since they believe tourism would dispossess

them from land control or become someone else’s business on their lands. As such, they are not keen to get involved with tourism. However, the amount of people from both communities participating in tourism services in Palenque is steadily growing to the point of involving, at least part-time, about one half of the population of El Naranjo and Lopez Mateos today. The differences in opinion about tourism in El Naranjo have not indicated an empowering or disempowering condition of the psychological aspect.

In Palenque, the National Institute of Anthropology and History (INAH) has been in charge of the management of the archaeological site for more than 50 years, but it has done little for better tourism planning in and around the archaeological site where more than half a million people visit each year. Conversely, although CONANP was not created until 2000, and administration of the natural park of Palenque started in 2004, their programs have involved participation of the communities of Lopez Mateos and El Naranjo. This might mean that the INAH’s attributions as a government agency for the conservation of historic and archaeological heritage have been taken over by other government agencies, and that there is an administrative gap in terms of tourism management that is not yet regulated inside the areas preserved by INAH.

The involvement of communities in tourism has become difficult since it requires time and internal organization. Villagers look for their daily benefit, which is based on the retail sales of crafts and other services such as tour guiding in the archaeological park. Although there is a disempowering condition caused by the limited economic revenue from tourism in El Naranjo, youngsters are improving their educational level and tourism skills for better involvement with ecotourism. It is worthwhile to conclude that the conservation of natural areas and preservation of indigenous cultural values associated with local profits from visitation activities is the essence of indigenous ecotourism. Indigenous ecotourism depends on community empowerment that is achieved once villagers are aware of the essence of ecotourism and have built capacities and negotiation skills to participate in it.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

From Dominance to Détente in the Face of Climate Change: Agreements Beyond Boundaries with Indigenous Nations

Linda Moon Stumpff

Abstract—This paper explores frameworks for expanding agreements between indigenous peoples, governments, and partner organizations to conserve and restore wild and protected areas impacted by climate change. From the Indigenous Peoples Treaty Project to the expansion of Federal nation to nation consultation with Tribes in the United States, new initiatives create models for reducing conflict in relationships formerly based on dominance. Impacts of climate change already “in the pipeline” call for shared participatory processes where traditional ecological knowledge and community participation form key components. Responses to climate change like natural or assisted migrations or reallocation of natural water flows illustrate the proclivity of climate change to break through borders. Impacts to indigenous communities, now an international issue, add to the need for careful examination of intergovernmental and international agreements. Water, above all else, suggests that cooperation and détente must replace domination to achieve trans-boundary goals protecting wildlands, biological corridors, waterways, and people. Détente is a balancing bar for traditional ecological knowledge, rights, and relationships that expand the reach of action to resolve problems. Innovation in bilateral and multilateral relationships harmonizes conflicts by building the foundations for agreements. Consultation between indigenous peoples, governments, and organizations protecting wildlands creates harmonizing mechanisms for inclusive multilateral relations and strategic planning. Rebalancing power relationships and combining authorities, vital to combat fragmented policy, ensures the survival of wildlands and indigenous peoples.

Introduction

As climate change progresses, consultation with indigenous peoples provides a critical tool for shaping agreements that protect natural and cultural heritage. For indigenous peoples, cultural survival is at stake. For wildland managers, the

ability to maintain a preservation and conservation mission is at risk. Climate change as a phenomenon is ridiculously complex, stretching across the arenas of scientific inquiry, policy-making, political boundaries, and economics. Stronger relationships between indigenous peoples and agencies can set forth a defense against a muddling, fragmented approach to a common threat. This is something that we can all accomplish.

Indigenous peoples need support. In the United States, Tribes govern between 4 and 5% of the landbase, but receive only about 1% of the monies for environmental protection and enhancement. While 85% of the Alaskan Native villages are now at risk due to flooding and erosion, and Northwest Tribes face a 50% loss in habitat for salmon, most can't access Federal funding due to prohibitive funding criteria (NCAI 2009). A fair and level playing field contributes to successful consultation and participatory decision-making. The National Congress of American Indians policy statement on global warming requests that specific attention should be directed to activities that protect traditional practices that are directly threatened by the consequences of a rapidly changing climate (NCAI 2009). They also evince concerns about programs like REDD that are moving ahead without specific protocols and processes to respect the rights and sovereignty of indigenous peoples. Actions to protect wild lands that include sacred areas and the sources of traditional ecological knowledge are critical to indigenous peoples to sustain traditional practices.

In his meeting with representatives of the 564 recognized Tribal Nations in the United States, President Obama promised that the Tribes would not be forgotten. As he prepared to sign, the President stated: “The memo I will sign directs every cabinet agency to give me a detailed plan of how to fully implement the Executive Order on Consultation and Collaboration and how we are going to improve tribal consultation” (President Obama 2009). He further stated that “we have a lot to learn from your nations to create the kind of sustainability we need” (President Obama 2009).

The model of consultation as an agreement-making process emerged after the period of self-determination and self-governance in the 1970s in the United States. Earlier, treaty-making as a consent system settled boundary issues, but it left a level of persistent conflict for implementing environmental policies. Assertions of Federal dominance prolonged tension and conflict in intergovernmental relations. Consultation developed as a framework for reducing conflict and enlarging the area of shared interests during a time when most government land management agencies

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moved to policies of ecosystem management. At the same time, Tribes moved to self-determination policies and consultation expanded into participatory decision-making. The potential impacts of climate change suggest that consultation policies and frameworks further strengthen to face unpredictable events and serious impacts on natural and cultural resources. Today, boundaries melt nearly as quickly as the Arctic ice. Animals and plants cross boundaries or reach barriers, land masses and coastlines change, and access to traditional resources becomes difficult. Getting it wrong by getting stuck in conflict is not an option. Increased understanding of the legal, social, cultural, and political context of consultation and agreements makes the case for a survival toolkit. “We are entering an era where we are looking out for each other” (Terry Williams, Puyallup Tribe). Détente, the recognition of the legitimate role of multiple authorities and partnerships, replaces dominance when the endgame is to mitigate the impacts of climate change.

Tribes hold water rights and lands, so they come to the table with resources of great importance to wildlands. They move beyond reactive positions and take the initiative to ask the questions, call meetings, and define strategies. Tribes have an equal stake in the process and the outcome, and so “should play an equal part in deciding the shape of the system” (DeLoria 1995 p.10). The rebalancing of the consultation system is nowhere more evident than in Obama’s change, echoed by Interior Secretary Salazar, from government-to-government language to that of nation-to-nation for consultation. Last week, Obama held meetings with tribal leaders on climate change, promising combined efforts from Federal agencies and ordering reports on progress from the agencies within 90 days. He has a clear and present understanding of the impacts of climate change on Tribes.

Steps in Consultation

Identification of Authority

The first step in an effective consultation process is for all parties to identify themselves and their authority, to be in a formal consultation process. This step can be taken through a memorandum of understanding or memorandum of agreement, as a means of establishing trust and credibility through protocols. These agreements may need flexible provisions to accommodate multilateral negotiations in addition to bilateral negotiations. Increasingly, tribes are coming together in multilateral entities like the Northwest Indian Fish Commission or the National Congress of American Indians (NCAI). The NCAI has suggested in its policy statement on global warming that in some places, in the absence of the rule of law, more must be done to assure title or meaningful rights to indigenous peoples for their traditional lands and resources (NCAI 2009).

Who Shall Treat?

Higher-level employees who are empowered with authority to make decisions need to be involved in key decisions around climate change. Delegation of authority to people with special expertise to make agreements in detailed matters remains important to success and speed of decisions. Often, getting

external brokers or stakeholders that stand between Tribes and agencies out of the way increases speed. At the same time, it is the people on the ground who start the process of making real decisions. They need to be fully educated in their country’s laws and policies and be provided with training and guided processes that involve them directly in participatory decision-making with indigenous peoples.

Strategy-Building

The third step is to identify strategies with specific tasks, time, and resource commitments. Through strategies, much important work can be accomplished, short of making laws or applying to the courts. The consultation process allows tribes and agencies to craft site-specific and issue-specific actions in tailoring strategies from the bottom up. Cooperative agreements or compacts and contracts are useful to identify roles, tasks, and responsible parties, along with budgets and funding sources. Multilateral strategies are not easy and all parties need expanded capacity and training to achieve success.

Working Transboundary

Tribal Transboundary Efforts

Examples of tribal initiation and management of transboundary consultation processes are significant for understanding the process. The Salish Gathering in the Northwest provides an example of tribal initiation of meetings to deal with the impact of climate change on both sides of the United States-Canadian border. States also play an important role in multilateral agreements for climate change that include Tribes. Many examples of state and tribal negotiations resulting in agreements can be found in enforcement and environmental regulations (NCSL 1995). In some States, like Oregon, conservation easements carry specific components enabling the holder to protect air and water values and provide for Tribes to obtain cultural conservation easements to protect cultural values (Olmstead 2009). Tribes have flexibility to use the tools of private property ownership themselves or cooperatively in combination with the land-into-trust process to achieve otherwise unattainable goals on private property. The Sinkyone Tribal Wilderness and the Arleco Creek project of the Lummi Tribe are examples of such interactions that extended the borders of influence from public to private holdings to protect a larger landscape. Cross-border Tribes like the Yaqui, Tohono Od’ham, Mohawk, and others at the Canadian and Mexican borders need to be involved in international consultation.

Jurigenesis, Traditional Ecological Knowledge, and Consultation

Cultural rights bleed into legal rights as Tribes enter into consultation with a set of important assumptions. From their position, indigenous rights are pre-existing and prior rights are bound in customary practice that forms its own body of common law and lands that they ceded in treaties or other agreements. It is asserted that all that was not specifically given up is retained as a pre-existing right. Prior

rights, such as water rights, demonstrate this position and many Tribes are concluding their water settlement agreements. Global warming impacts these rights along with the establishment of some parks, wild and protected areas, or programs like REDD that “inadequately values the concept of stewardship of the resource as practiced by indigenous peoples” (NCAI 2009). These protections and programs often change access to natural and cultural resources. Besides loss of ecosystem services, climate change has profound impacts on the cultural and religious practices of people around the world, and threatens traditional knowledge bases that contain innovative and cost-effective responses and practices. When adapted to functioning ecosystems on tribal or adjacent lands, traditional ecological knowledge defines special frameworks and practices that support the cultural, political, and economic life of the tribe (Stumpff 2006), so these impacts reverberate within and without boundaries. Climate change makes it all the more important “to recognize... the value of human endeavors such as the traditional practices of indigenous peoples that are sustainable, climate-resilient, time-tested, and in harmony with the natural environment” (NCAI 2009).

In the cultural context, stories and narratives act as analogues to precedent and provide the reasons and reinforcement for consensus about broad principles, while they justify or criticize certain deviations (Borrows 2002). They can be regarded as the authoritative basis for law and regulation by tribal members. They are guidance, more gyroscope than compass, and require specific internal interpretation to deal with dynamic environments and climate change. Borrows describes the process of applying cultural narratives to decisions and rule-making as jurigenesis (Borrows 2002).

Given a deepening cultural understanding, backed by consultation and meaningful environmental conflict resolution, agreements based on harmonizing interests between

distinctly different bodies of law and practice become possible. Table 1 suggests some mechanisms for harmonizing the process across different cultures and bodies of law.

The Rolling Carpet of Doom: Beyond Borders With Climate Change

Current scientific opinion points out that we are living in a time period within some sort of a tipping point range for climate change that leaves us teetering at the edge. Significant amounts of change already “in the pipeline” are likely to result in a 2 to 3 degree temperature increase (Hansen 2009). Reducing carbon emissions by 15-20% below levels of 2000 by 2020 is required (Union of Concerned Scientists 2008). Concurrently, we must work on solutions outside the usual range of Western science and indigenous knowledge, with ecological impacts that may be difficult to predict and others largely unknown. Because indigenous knowledge provides information about phenomena at the extremes and at the center, while offering alerts to problems in the ecosystem, it is key to agreement-making. The Quileute know something is wrong because there are no smelt eggs in time for Honoring Elders Day to make “stinky eggs,” so they know the smelt are out of balance often before scientists realize that this keystone species is faltering.

Tribes and indigenous peoples are asserting authorities and demanding voice. The impacts of climate change are already real and affecting their existence. New models are emerging like the agreement between the Confederated Salish and Kootenai Tribes and the U.S. Fish and Wildlife Service to co-manage the National Bison Range (fig. 1). Although it created controversy, the agreement was firmly established in law and regulatory agency processes as the Tribe asserted its essential right of self-determination. The

Table 1—Mechanisms for harmonizing multiple legal cultures.

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- Relationships over time establish trust.
 - Sui generis doctrine—Legal implications of cultural differences: uniqueness requires recognizing different categories, what is missing in common law requires that applied examples be drawn from appropriate legal, social and regulatory bodies in different cultures: open interpretations of wildlands protections and acceptance of cross-cultural concepts.
 - Negotiate
 - Expand each parties’ notion of the others foundations in law, history and culture
 - Recognize the dynamic nature of common law
 - Creative use of conservation easements, cultural easements and other mechanisms provided through state law for private property
 - Recognize the current status of Federal and tribal authority as a basis for action
 - Utilize tools from existing law: self-governance compacts, self-determination contracts, annual funding agreements with Indian tribes under the Indian Self-Determination and Education Assistance Act of 1975 (P.L. 93-638) as amended and additional new and innovative types of agreements created by sharing international models.
-



Figure 1—New models are emerging to assert rights of self-determination (photo: USFWS Online photo library).

Udall Institute’s Environmental Conflict Resolution unit provided an effective process for environmental organizations and Tribes that revealed their common concerns. Under conditions of climate change, bison herds like these will need help and research from multiple sources on genetics, migration, and social behavior that breaks through old political and internal governmental protocols to better support their continued existence.

Why Agree?

Agreements are needed now for some of the known and likely impacts, and our ideas about boundaries and access may need to change if we are to preserve ecosystems. Animals are moving. Tulalip Tribal Natural Resources Director Terry Williams asks, “Will the Tulalip become ‘People of the Mahi Mahi’ instead of people of the salmon?” In addition to exotic species that thrive and out-compete natives in the changing environment, southern native species are turning up in Northwest waters. Animals are moving north. Alpine and high-mountain species may be most at risk, since they cannot go higher. Tribes hold indigenous knowledge about the habits and migration routes of many species and they can act with considerable flexibility. Should assisted migrations become necessary due to climate change, tribal partnerships can be critical operational partners, especially when agency

authorities to carry out such activities are lacking and there may even be an appearance, but not of substance, of violating the agency mission.

Forests may receive serious long-term impacts, since trees cannot adapt quickly by moving and old-growth is not easily replaced. If, in fact, large forested areas are lost, as predicted for Alaska due to increased fire or other climate-related impacts, species relocation may also come into play. Reliance on tribal partners for knowledge and practice will be important as boundaries of wildland protection will need to be extended. Where there are trust responsibilities to American Indians and Alaska Natives, agreements ensure that these are met, especially when large changes in access to species and places occur. If permafrost becomes grasslands, then replacement species that can migrate, e.g., buffalo, may be the only means of continuing subsistence rights. For trees and plants, root systems are impacted by heat in the soil and insect infestations increase. Herbaceous plants used for cultural and medicinal purposes may not be available. Already, basket makers in the Northwest note that the beargrass is getting smaller and smaller. Exotic species and disease are likely to proliferate. If a Tribe or agency puts significant resources towards reducing pine bark beetles, it will be important that compatible and effective controls are used on adjacent jurisdictions. Many climate change scenarios suggest possible actions in response to climate change (table 2).

Table 2—Initiate and innovate administrative harmonizing mechanisms.

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- Develop a cross-departmental cross-governmental approach, including budget, to deal with significant climate change problems (possible model is the fire budget) to reduce delays and increase effectiveness in protecting lands and wildlife.
 - Initiate institutional practices like talking circles to reduce conflict pre- and post- agreement and to assist in harmonizing interests and finding out whether or not a conflict really exists.
 - Identify areas of common interest like riparian restoration to build relationships before climate change reaches crisis proportions in its impacts.
 - Establish standards for problems like water quality that are exacerbated by climate change.
 - Look for ways to create, share and exchange green energy programs, infrastructure and use with Tribes developing local and regional models.
 - Engage tribes in multi-departmental agreements for solutions such as carbon offsets, habitat and wildland protection, and energy conservation.
 - Implement wider use of traditional indigenous knowledge as covered in Secretarial Order 3206 as a model (ESA) and the Convention on Biological Diversity.
-

The Process of Consultation in the United States: Nuts and Bolts and DéTente

Consultation is not the same thing as consent, since consent implies absolute power to accept or refuse, though it often takes place in the long shadow of Treaties in the United States that were, at least legally, consensual in their nature. The plenary power of Congress affects Tribes while the trust doctrine applies to Federal agencies as they work with Tribes. In consultation, one party has the power to make the final decision; not as a right, but as a matter of law and power, and that is usually the Federal government (Deloria 1995). Yet, negotiation and compromise are required to achieve the support and general agreement that consultation implies and to find out what Tribes want. In some regions, as well as nationally, court cases set the tone for consultation. The Boldt decision on the implementation of tribal treaty rights colors all consultations in the Northwest and provides Tribes with protective parameters around rights to usual and accustomed sites for fishing, hunting, and gathering activities.

Today, Tribes hold significant resources, especially the rights to water resources, so they come to the table with resources of great importance to the ecosystem. The sea of change in relationships is underway as Tribes take the initiative to ask questions, call meetings, and create partnerships through Federal, state and private relations. Under conditions of climate change, the equity principle becomes self-evident; all have a stake when plants and animals move across boundaries, and water resources become unpredictable. Because of this, Tribes have an equal stake in process and outcome, and so “should play an equal part in deciding the shape of the system” (Deloria 1995 p.10).

The rebalancing of the consultation system is nowhere more evident than in Obama’s change, through Interior Secretary Salazar, from government-to-government language to that of nation-to-nation for consultation. It marks a time when

all nations should come together to mitigate global warming by protecting lands and resources.

- Take Action
- Build Trust
- Harmonize in the Face of Surprise
- The Power of Place Is in You

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Human-Wildlife Conflict and Its Implication for Conservation around Bwindi Impenetrable National Park

Margaret Aharikundira and Mnason Tweheyo

Abstract—This study analyzed the impact of wildlife on farmers who lived around the Bwindi Impenetrable National Park (BINP). The objectives were to assess the extent of damage exerted upon local farmers and to establish problem animal control strategies employed for park management and community members. Respondents identified crop loss as the major form of damage (40%), followed by social disruption (35%), damage to property (30%) and threats to human life (20%). The majority of the farmers (63%) reported that the park did not employ any measures to protect people's crops. Very small percentages recognized that the park management employed fencing, vermin guards, and HUGO, as preventive measures to guard against raiding of the peoples' crops. The study concludes that maize, sweet potatoes, and sorghum were the most frequently raided crops. This report recommends integrated management for conservation activities around the park, and integration of local communities into planning, management, and decision making of the Bwindi Impenetrable National Park.

Keywords: conflict, conservation, wildlife

Introduction

Human-wildlife conflict (HWC) is not a new phenomenon but dates back to the pre-colonial era where wildlife depredation caused food shortages and displaced settlements in Africa (Vansina 1990). For instance, forest dwellers in pre-colonial northern Gabon lived at the "brink of starvation" because their food supply was frequently devastated by elephants (Barnes 1990). In the early 20th century, high elephant populations in parts of western Uganda prevented agricultural activity altogether (GDA 1924). While some observers blame colonialism for ruining the traditionally harmonious

relations between wildlife and local people (Adams and McShane 1992), others believe HWC is as old as the beginning of agriculture in Africa (Naughton-Treves and others 1999). It is generally accepted that while conflicts between agriculturists and wildlife have always existed in Africa, the degree of conflict has escalated in the last 30 years or so with increasing amounts of land being put under cultivation (Hill 1997; Tweheyo and others 2005). Humans have lived in close relationship with wildlife and have shared resources like space, habitats, and food for a long time, which have stiffened to a nearly perfect competition (Knowledge Base Review Report 2003). Recently, HWC has intensified as a result of land use changes and the search for farmland, a situation that has been triggered by rapid population pressure. Human encroachment on wildlife habitat has thus resulted in an increase in conflicts between humans and wildlife (Madden 1999). Some progress has been made, however, to ensure that local communities benefit from wildlife through sharing of tourism revenues and establishing development programs (Knowledge Base Review Report 2003). This progress has not satisfied all the problems faced by humans due to wildlife, however. For example, threats to livelihoods from wildlife are still a constant reality, and people still face crop damage due to wild animals. The costs of destruction more often exceed the benefits to communities neighboring the park. Whatever the conflicts, livelihoods are impacted negatively. Bitter feelings among these communities has eroded local tolerance for wildlife, resulting in negative attitudes toward conservation efforts and aggression toward conservation managers and wildlife (Hill and others 2002). Consequently, the people living around protected areas in southwestern Uganda have become marginalized, and hence conservation can have a negative effect on their ability to provide for their needs. This study should help managers find solutions to these increasing occurrences.

Problem Statement

The expansion of human settlement and development towards Bwindi Impenetrable National Park (BINP) has resulted in isolation and creation of hard edges along the human and park interface. This has essentially turned the park into an island (Bell 1984). Local people have found themselves displaced and deprived of access to resources such as pastures, water, medicines, and wild foods that are vital for their survival. Furthermore, the negative interactions between people and wildlife (such as crop loss, damage to property, social disruptions, and threats to human life

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

by wildlife) have consistently intensified. Many of the local people around BINP consider wildlife to be a major threat to their livelihood. Most research done in BINP has not taken into account the communities' farmers' perspectives on wildlife, which is paramount to sustainable management and conservation of nature. The overall objective of this study was to assess the impact of crop-raiding animals on farmers' crops around Bwindi Impenetrable National Park. The specific objectives were:

- To assess the extent of damage exerted upon local farmers; and
- To assess the problem of animal control strategies employed by park management.

Methods

The research used the quadrant method developed by Sukumar (1990) to assess HWC around Bwindi Impenetrable National Park. This exercise was based on park user communities. The study was focused on measurements of human wildlife conflicts at the community level, leaving out factors external to the communities (such as implementing agency effectiveness and policy environment). This research used a participatory and descriptive survey design. This research design involved field walks, direct observation, interviews administered through questionnaires and secondary data extracted from desktop reviews, secondary data books, journals, and key informant interviews (KIs).

Sixty-four households that were randomly selected from two parishes made the sample. At least two villages from each parish were selected. The sample population consisted of local community members, local leaders, and park staff as key informants. A total of 64 structured questionnaires were administered to the sample. Three different questionnaires were administered: one to local community members, one to local leaders, and one to park staff. This gave them ample

time to provide relevant information. For respondents who could not write, face-to-face interviews were done to acquire the needed information.

Direct observation and field walks also provided good information. By this tool, one was able to note the wild animals in the park, housing standards of the local people, crops grown, terrain of the area, and other observable features. Twelve farms were selected at random, guided by the park rangers for each parish. Monthly visits were made to each farm, and people were asked to report any incidence of crop damage and raiding and whether they had observed the animals responsible at the time. Field visits were made to view and record incidents of crop raiding to make an independent assessment of bite size. To assess the degree of damage, five quadrants were sampled (each 2 by 10 m) from each affected crop stand. The quadrants were placed randomly within the crop stand, without further damaging the crop. The proportion of crop damage was calculated by counting the number of damaged or missing plants or parts or finding a fraction of the quadrant size when plants were not easily counted. The mean of the five quadrant values for each damaged field became a measure of the proportion of crop damage sustained. The mean percentage of crop losses for each farm was estimated taking into account the number of stands planted for each crop and the proportion of stands that sustained crop damage.

Results

The Extent of Damage Exerted on Local Farmers

Responses indicated that crop loss was the major form of damage, followed by social disruption, and damage to property, with threats to human life least commonly reported (fig. 1). Baboons and bush pigs were identified as the major

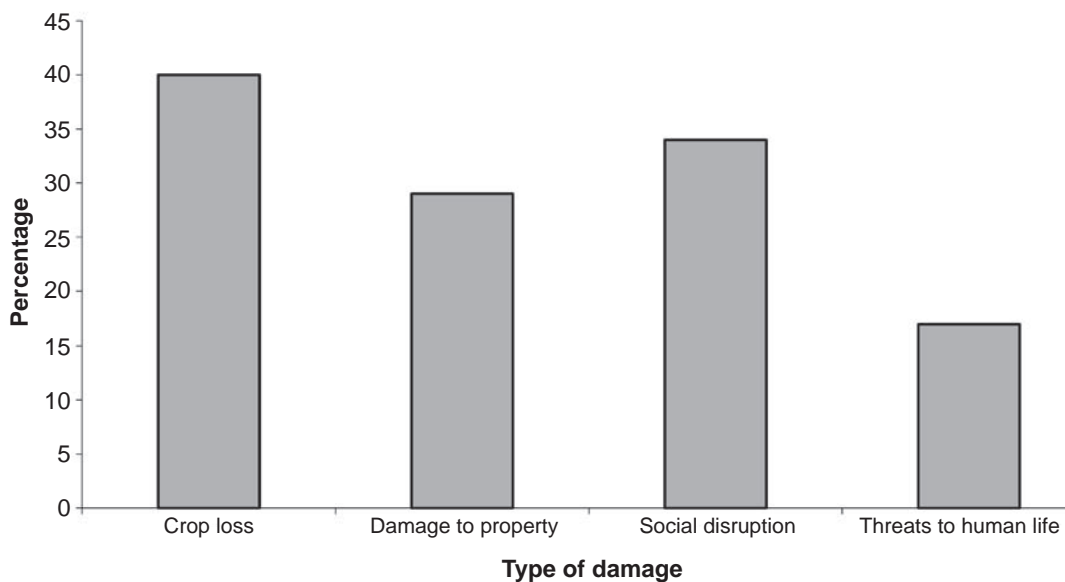


Figure 1—Sources of conflict between people and wildlife around the park.

crop raiding animals (fig. 2). The major crops raided included maize, sweet potatoes, and sorghum, as shown in figure 3. It must be noted that cost figures (table 1) were reported by farmers based on the estimated input to crop production. The farmers did not have exact records of input and output in crop production.

What Farmers Saw as Weaknesses by the Park Management

The community members and park management authorities did not have a good relationship. They had conflicting ideas about how they could live comfortably together. The community members looked at the park and its authorities as potential enemies to their well-being. Some of the errors by the park management as seen by the farmers are in table 2.

The majority of the people reported that the big mistake by park management was that they had failed to put vermin guards in place. The park management authorities did not bother to prevent the animals from raiding people's crops. Although local people sympathized with the conservation issues, park management failed to put control measures in place to ensure food security for the households. Even if the farmers reported raids to crops, there was no response from park management. The farmers expected response in terms of compensation for their losses (both in crops and life) but park managers did not inspect losses incurred by the farmers from wildlife. Park management was not willing to give compensation saying that it was difficult to quantify losses, since some losses were not significant. For example, young sorghum could always do well after an attack from the animals, whereas loss of human life would truly deserve compensation.

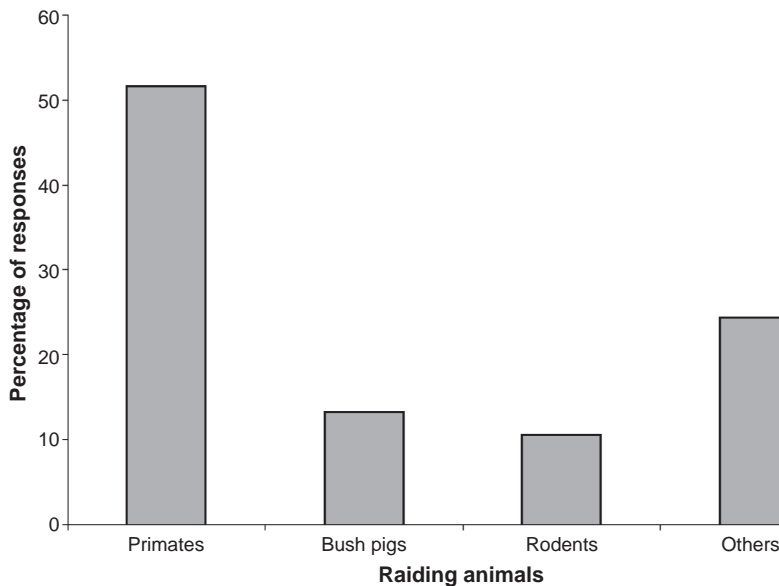


Figure 2—Major crop-raiding animals identified by farmers.

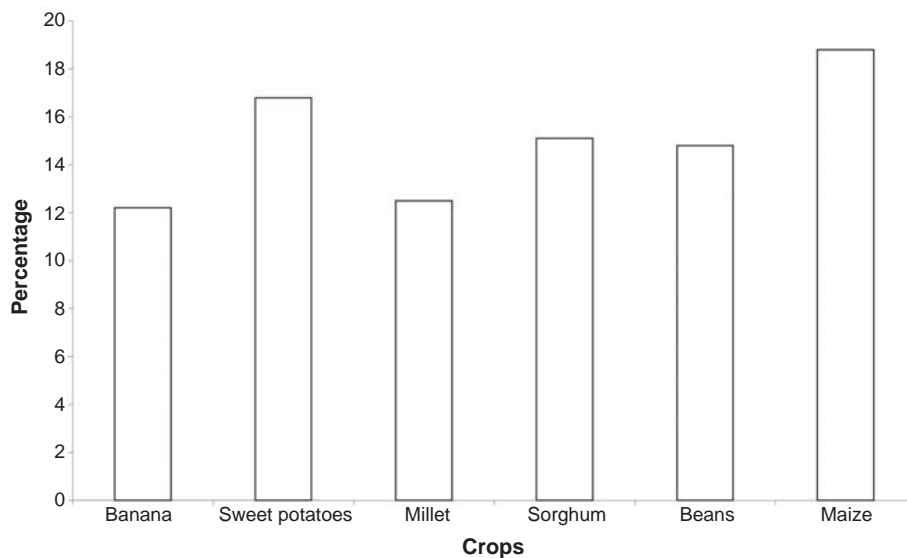


Figure 3—Percentage of crops raided as identified by farmers.

Table 1—Cost of damage in shillings as estimated by the farmers.

Cost (shillings)	Percentage
< or = 10000	33
10000–25000	42
25000–50000	20
50000 +	5

Table 2—Errors by park management.

Mistakes by park management	Frequency	Percentage
Do not chase raiding animals	15	18.98
No vermin guards	39	49.36
No response	24	30.37
None	1	1.26

Responses of Farmers When Animals Were Found in Their Fields

Local farmers stayed in the fields from morning to evening (6:00 a.m. to 6:00 p.m.) guarding against crop raiding. Farmers used several methods to stop animals from raiding their crops, including guarding, chasing, and scaring. On most occasions, when farmers found raiding animals in their farms, they would chase the animals back to the forest or report the incident to park management. Seventy-four percent of respondents chased raiding animals upon finding them in their fields, while 26.5% of respondents reported the cases of crop raiding to park management or to forest guides or rangers. Farmers built small huts in their gardens to shade themselves as they watched for animals approaching their fields.

Problem Animal Control Strategies Around BINP

In the past, women and children carried out most of the guarding activity, especially during the day, while men would guard at night. More recently, some families employed hired labor from Batwa communities to guard their crops. Chasing, shouting, and scarecrows were additional strategies used to enhance the effectiveness of guarding.

In parishes of Mukono and Nteko around BINP, management and the International Gorilla Conservation Programme (IGCP) introduced Gorilla Conflict Resolution (HUGO) groups to provide a remedy to crop raiding by mountain gorillas. The local communities were satisfied that this strategy was working. This program had brought about a significant reduction in crop loss and attacks on humans in the affected areas. Despite all the efforts to reduce damage by gorillas,

there was a general perception from the local community that the park authority did not care about crop loss to other animals such as baboons and bush pigs, which caused more crop loss.

Mauritius thorn fence was planted in several areas around BINP. Mauritius thorn is a thorny shrub that forms an impenetrable barrier that hinders bush pigs and baboons from entering fields. Fence maintenance was carried out by farmers with gardens close to the park boundaries and was organized on communal working days.

In the northern parts of BINP, cultivation of tea had proved to be an unintended strategy for reducing crop raiding by baboons, monkeys, and bush pigs. Tea production was encouraged near park boundaries because fields had been abandoned due to severe crop raiding by baboons and bush pigs. Planting tea close to the park boundary reduced crop raiding because tea was not palatable to either baboons or bush pigs. Hence, tea created a buffer zone that the animals had to cross in order to reach the food crops cultivated further from the park boundary. Measures employed by the park management to guard peoples' farms are shown in figure 4.

Summary

Crop loss was the major form of damage, and the animals causing the most damage were baboons. There were no substantive measures to mitigate the problem of crop raiding. Wild animals raided crops all year round. Bush pigs and baboons were the most destructive animals, mainly feeding on maize, sweet potatoes, and sorghum, which were the most frequently raided crops. Spatial distribution of crop fields also determined the frequency of the field raids. For example, fields nearest to the park boundary and those that did not have any crop fields separating them from the park were raided most. The raiding animals were unpredictable to farmers.

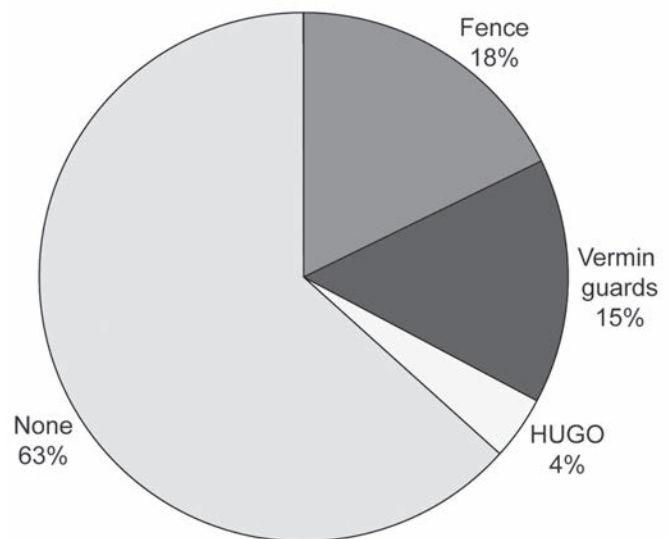


Figure 4—Measures employed by park management to guard peoples' farms.

Possible Solutions

Local communities around BINP could be involved in managing and benefiting from wildlife and natural resources in and around the park (collaborative conservation management). This could be done through a participatory approach where the community and other stakeholders are involved in the conception, planning, execution, and evaluation processes of park management. This could unlock the potential of communities solving their own problems, as opposed to waiting on park management to solve problems. Figure 5 shows a proposed community action framework. Conservation organizations could consider putting considerable effort

into community conservation programs so that farmers can be sensitized about wildlife conservation and allowed to give their views about wildlife; farmers could even earn some income to improve their way of living. There is a need to systematically document and compare approaches to wildlife conservation, so that there is harmony between local people and the conservation authorities. Critical issues to look at could include: traditional institutional structures, information flow networks, location, challenges that have been met, and adjustment mechanisms. Figure 6 shows the proposed Natural Resource Institutional Framework for BINP.

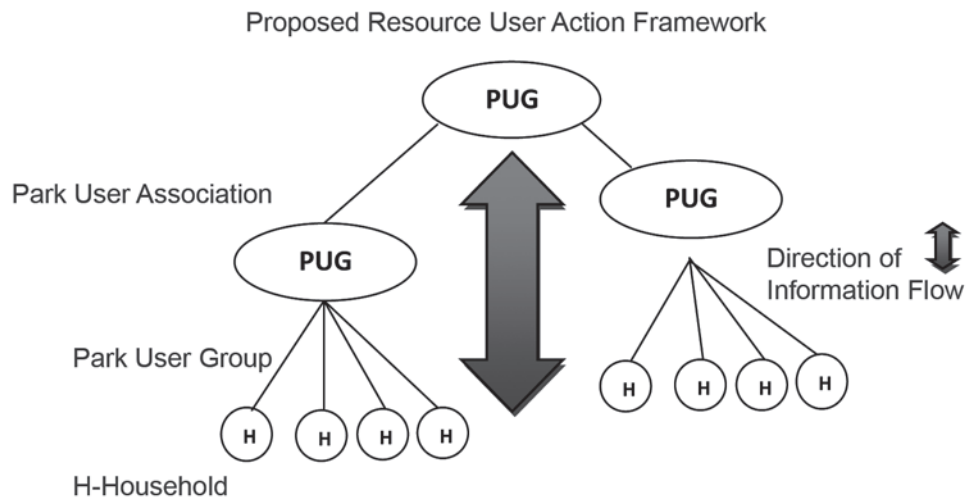


Figure 5—Proposed resource user action framework.

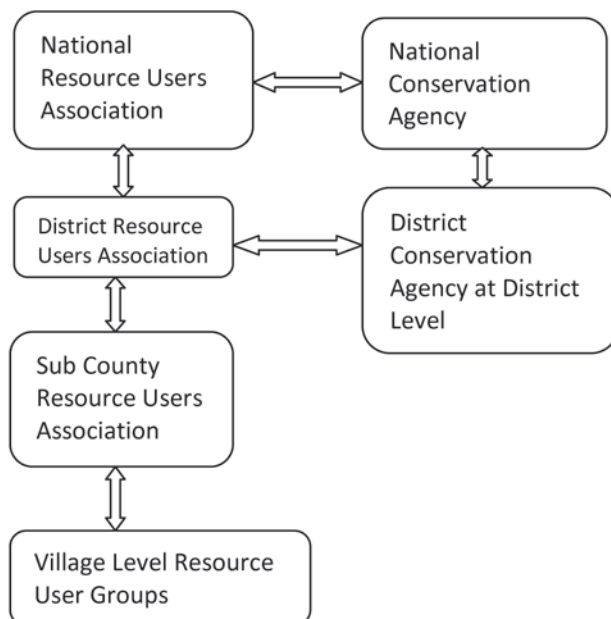


Figure 6—Schematic overview proposed for flow of information between national conservation Agencies and the Resource users.

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Understanding and Building Wilderness Management Partnerships with Indigenous Peoples and Communities

Gregory F. Hansen

Abstract—Learning about, understanding, and working with native cultures can be rewarding as well as enlightening. Such endeavors can also be time consuming, difficult, and even frustrating in certain instances. However, if coordinated carefully and managed properly, at the end of the day such efforts can ultimately result in innumerable benefits to native communities, land managers, and to the enduring resource of wilderness. Indigenous people have survived thousands of years of oppression, prejudice, and abuse. Yet today, some land management agencies and non-governmental organizations are beginning to realize that native people—the original keepers of the earth—have a great deal to offer, not only in terms of understanding and caring for the land in general, but more specifically, in caring for wild places. This paper will provide unique insights into how wilderness-benefiting, cross-cultural collaborations can be achieved and sustained by offering a simple-to-follow partnership development framework that has been ground-truthed and proven highly successful in many parts of the world. Furthermore, this indigenous partnership model will be supported by field-tested program examples in an attempt to provide wilderness managers with the basic tools and knowledge required in building and maintaining meaningful and productive wilderness management partnerships with indigenous people and communities.

Introduction

Terms Defined

Before delving into the particulars of building a fruitful partnership with native people, it is important to define a few integral terms that will be used throughout this paper. Although “Native American” is currently the politically correct terminology for referring to the original people of North America, excluding Alaska and Canada, it is not always the terminology that American Indian people prefer. Most

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

indigenous people around the world seem to appreciate being referred to by their respective tribal affiliations, and therefore, tribal names will be used throughout this piece whenever possible. General terms such as “indigenous” or “native” people, groups, and communities will also appear throughout this work, but in no way are intended to demean the individuality of any one group, band, nation, or native community.

It must be made clear that the author does not attempt to speak for indigenous people, as these proud Nations, tribes, bands and individuals speak for themselves—as they have always done. The information provided in this paper is, however, a direct result of the author’s experiences in growing up with, living, and participating in all aspects of traditional American Indian cultures for over 47 years. The basis of the information presented in this paper finds its roots in the author’s lifelong experiences with his traditional American Indian families, as well as over 6 years experience with various African tribal groups. However, the ideology, concepts, and techniques that are presented can most certainly be used as the basis for effectively bridging contemporary natural resource and wilderness management objectives with native cultures around the globe.

Many native people still have the ability to understand and communicate with the natural world. Throughout time, they have painstakingly managed to retain their deep-seeded relationship with the land and all that abounds on what many native groups refer to as “Earth Mother.” Numerous indigenous communities still carry the ancient knowledge of natural life cycles, medicinal plants, and the overall importance of respecting the land. Furthermore, these people have found ways to not only maintain the physical relationships with their environs, but their spiritual connectedness as well, both being central to how they view and engage the natural world around them. Ironically, these are fundamental and quintessential elements of the modern philosophy of “wilderness.” With imperative native issues such as the appropriate management of and access to indigenous religious sites located within public lands, it is long overdue for managers to seek out working relationships that move us closer toward the common goals of protecting and caring for wild places in a manner that benefits all people.

Better Understanding Indigenous Cultures

It is essential to understand how indigenous cultures “traditionally” or “historically” viewed the land; in many cases, native groups still adhere to these time-honored traditions

and cultural practices. Traditional or old-style beliefs and natural resource viewpoints may differ significantly from that of contemporary land managing agencies and organizations; such discrepancies must be clearly understood before approaching indigenous groups with the idea of building any type of wilderness management collaboration.

The six principles provided below are commonly recognized as being consistently present among American Indian Tribes, as well as many other native groups. As such, these are extremely helpful to managers in grasping how contemporary wilderness fits into some of the traditional systematic views of indigenous cultures worldwide. Thus, these six keys will serve to establish a basic foundation that managers may draw on when attempting to develop successful partnerships with native communities.

Values

If a manager wants to get to know more about a potential indigenous partner-group they should first make an effort to understand what is important to those people, or, what are their values? For example, many traditional (or old-style thinking) American Indian people—and many other native groups for that matter—have very different materialistic values than those of non-native cultures. To a traditional native person, it seems unimportant to own a big fancy house, an expensive car, or to have a television set and DVD player in every room of one's home, just for the purpose of status. What is important, however, is to have food and clothes for their family, to be free to live in a traditional manner upon the land, and to be allowed to practice their own religion without intrusion or fear of being persecuted for their spiritual beliefs and/or ceremonial practices. Such values can, to a large extent, influence decisions and/or actions pertaining to tribal natural resource management in general, and to tribal-related wilderness management more specifically.

Language

Language is at the center of any culture. The author's extensive experience with his American Indian relatives tells us that language plays an even more integral role with most native groups, as indigenous people seem to rely so heavily on oral traditions to pass cultural information down from generation to generation. For example, creation stories, tribal histories and important events, songs, and religious practices were, and to some extent still are today, passed down through word-of-mouth communication. Regrettably, many American Indian and other indigenous cultures around the world have lost their ancestral native tongues. Yet, a number of native groups have worked diligently to maintain their traditional languages, and some have made concerted efforts to revive them, because everything within the culture is so linguistically driven. It is not realistic for managers to be asked to learn a new language every time they deal with an indigenous group, but taking the time to recognize the basic principles of that language could be instrumental in perceiving how that group might deal with the natural world, or what their root-ideals relating to caring for wildlands might be.

Family

To indigenous people, family is the most important social, economic, and political structure within the tribal organization. In fact, many tribes are made up of groups of relatives, or clans, who traveled and lived together as bands in the past, and who still might live in family clusters of homes on tribal lands today. The significance of kinship in native cultures is essential in comprehending how native people interact with one another, with other outside ethnic groups, and with the natural environment; being a good relative has a strong influence over all aspects of every day tribal life. A prime example of this thinking is how, historically, large indigenous nations did not live all together in one consolidated group. They would be divided up into smaller family bands, or clans, because continually camping together would quickly deplete the very natural resources they depended on for survival. In many situations these same kinds of family influences can be recognized and translated into today's world and, therefore, should be acknowledged when attempting to partner with any native community or group.

Poverty

Please do not misinterpret and think that this text in any way insinuates that all native people are poor; we all know this not to be the case. Nonetheless, the reality is that some of the most impoverished places in the world are located on native lands. The reason this issue is necessary in understanding any culture plagued by poverty is that poverty can force people to do things they would not ordinarily do and, therefore, can change or modify typical cultural morals, beliefs, and or practices. An illustration of this would be a native rural community that is found poaching animals inside an adjacent park or game preserve. The primary rationale for the illegal behavior is simply that their families are hungry and they are doing whatever they must to feed them. Unfortunately, this all-too-often cultural dilemma must be recognized and sensitively adhered too when attempting to build any type of wilderness management relationship with native groups, bands, or tribes.

Humor

The role of humor in native cultures is meaningful when attempting to better understand American Indian people, as well as other native groups. They say "the more one is liked, the more that person gets teased." In other words, native people seem to fully comprehend the fact that life is hard and humor is a means of reducing stress and breaking up the solemn realities of the world around them. For this reason many tribes have individuals whose divine calling is to serve as ceremonial clowns who play instrumental roles in certain ceremonial, and sometimes, social gatherings. Although humor may not have any direct relevance when it comes to the physical management of wilderness, it certainly must be understood when attempting to develop any type of affiliation with either American Indian Tribes or other native groups.

Connection to the Land

Many of the books written about American Indian cultures convey the strong connection that all native people have with their environment. At one time, the people were totally dependent on the land for food, lodging, and clothing. Earth Mother was their church and the birds, the animals, and all things were their relations. Today, for traditional people especially, this same connection is still present. But, it is this very adoration for the land that can also create a difficult balancing act in regards to managing natural resources. An example of this would be when a tribal group is offered money to extract coal or timber from their land; many of the traditionalists are against the proposal, because they feel this would literally be like cutting the arm off their revered Mother. This is one reason why many tribes find managing natural resources like wilderness, in the way that land management agencies are accustomed to, to be very complex and confusing. However, many native groups not only completely comprehend how to manage their biological resources, as the examples below will point out, but also know how to maintain the Spiritual integrity of wild places as well. Thus, understanding the “all-encompassing connection” that native people have with the land is vital when trying to get a sense of how these communities look at the modern concept of wilderness. So, it is the author’s intention that these insights help managers better realize why, in many instances, tribal governments are challenged by not only having to look at the decisions they make from a resource utilization standpoint, but from their age-old Spiritual perspectives also.

The six keys outlined above should begin to help managers gain a better feel for indigenous people and their ways of doing things. Of course, these are just a few of the many exceptional traits that make our native cultures so exquisitely unique, beautiful, and complex. Now that the reader has a clearer understanding of how indigenous cultures still draw upon the ancient traditions and philosophies of their forefathers in relation to managing natural resources, and how these beliefs and practices may or may not influence contemporary wilderness management decisions and practices, let’s take a look at some field-proven strategies and techniques for developing a successful wilderness-related indigenous partnership.

Indigenous Partnership Development Tools

Building Trust and Rapport

Developing quality working relations with indigenous groups will obviously take patience and commitment. It will be crucial for managers to establish a solid trust with the native community they are communicating with before any type of cooperative work can be accomplished. However, “general” partnership goals should be shared right up front when first meeting with the group to make clear the managing agency’s intent for the relationship and to reduce the possibility of any unnecessary misunderstandings later on during the partnership. Meeting with tribal elders or leaders in their own home surroundings is helpful in building a positive rapport with the community as this will help tribal leaders feel more comfortable and open to speak freely. Having someone from the tribal community who knows and

trusts the agency/organization representative introduce the manager to community leaders can greatly assist in opening up communications more quickly. Then, if needed, this community contact can also serve as interpreter if any type of language barrier exists. Starting communications with a local community member will also serve to build that all-important trust factor with community leaders, a key that will be essential to the long-term success of the program.

Avoid “pushing too hard or trying to move ahead too fast” in terms of advancing your partnership and/or management objectives as this will often-times be strongly frowned upon and seen as a typical non-native self-serving tactic. But, do humbly accept invitations to visit the native community you work with, and take every opportunity to attend community activities that are open to the public, such as dances, feeds, and celebrations; this most certainly will help to send a positive message that your agency or organization is sincerely interested in learning more about their culture.

Look at offers from traditional elders and community leaders to share meals or to speak at meetings as a positive sign that the manager is beginning to be accepted by the community, thus helping to construct a positive and trustworthy reputation over time with the people.

Consider Tribal Politics

Take careful note that in some instances the “official governing body” of any one community may not always represent the philosophies, beliefs, or wishes of all community members. An example of this is a community that has a Tribal Council made up of primarily “progressive or contemporary-oriented leaders” as compared to traditional or old-style thinking tribal representatives. Be sure that the faction you are working with has the best interest of all community members in mind, as best can be denoted; undercutting any one tribal group for the benefit of another is a sure way to kill any chance for a lasting working relationship.

Be cognizant that certain community members might open up to the agency representative more quickly than others, and that some may never be completely comfortable with the affiliation. Try not to purposely avoid the people who seem resistant; everyone in the community must be involved at some level in the partnership. Embrace the openness of the leaders who are most receptive, and work closely with the more-approachable leaders. Once again, carefully and sensitively research if those receptive leaders do in fact legally and “traditionally” speak for the entire community, and NEVER get in between community divisions and/or tribal politics.

Program Development and Technological Capabilities

Generally speaking, indigenous groups do not share the same perception of time that other non-native cultures do. Practice patience and sensitivity when trying to communicate with native groups and realize that a manager’s sincerity and motives could be undermined by pushing ideas too quickly, or in an overbearing manner. Indigenous cultures will undoubtedly host a wide spectrum of technological capabilities, ranging from Internet access to nothing more than

word-of-mouth. Take the time to identify the best means of communication that works for both parties and then strive to build on that form of communication as the partnership evolves.

Once a positive rapport has been established and respectful communications are occurring, the manager can begin to share the more in-depth partnership program elements with community leaders. At this point, initial partnership goals and objectives can be developed. Note that “respective traditional values, beliefs, and practices must be carefully integrated into the entire goal-setting and overall planning process” if the partnership can be expected to grow and continue successfully. As stated earlier, it is vital to let the people know what the honest intentions of the partnership are early on in the relationship, and to be consistent with those intentions throughout, as any form of deception, real or perceived, is by far the fastest means of disposing the relationship.

Developing a Partnership Work Plan

Once the goals and objectives of the partnership have been agreed upon, it is possible to move ahead in co-developing a partnership work plan. The work plan should include partnership goals and objectives, individual work action items, timeframes for completing action items, parties who will be responsible for implementing the actual work, and an all-encompassing budget. Most work plans are designed to cover a 1- to 2-year timeframe. After that, the plan is re-visited, updated, and modified as program actions are achieved and/or management issues change. All work plan components will need to meld cohesively with the cultural elements of the group the manager is partnering with, and if this can be accomplished, an effective indigenous wilderness partnership can become a reality.

Indigenous Wilderness Partnership Examples

Salish and Kootenai Tribes / U.S. Forest Service Wilderness Partnership

Wildlands have always been very important to the people of the Confederated Salish and Kootenai Tribes, located in Western Montana, U.S.A., for the perpetuation of culture and traditional practices. However, after the U.S. Allotment Act, the once natural and primitive lands of the Flathead Reservation became congested by settlement and development. Many sacred, cultural sites were destroyed. The only wild and untamed areas that remained were away from so-called “civilization,” in the mountains where the bridge linking the past to present could still be found. When these mountain lands became threatened by such activities as logging and continued development, plans were made to preserve the remaining untouched areas in their natural state.

In 1979, the Confederated Salish and Kootenai Tribes of Central Montana set a national precedent by being the first American Indian Tribal group in the United States to establish what is recognized today as “designated wilderness” within lands surrendered to them, under governmentally

sanctioned Treaty decisions. The foresight of these tribal leaders to make such a controversial designation, and their abilities to accomplish this in a manner that meshes with their traditional ideology is nothing less than inspiring.

The Confederated Tribes worked closely with U.S. Forest Service wilderness managers to develop the designation language and also to develop a culturally sensitive wilderness management plan for the area. Although this precedent-setting designation of wilderness by the tribes describes their tribal wilderness land and its uses in similar fashion as the U.S. Wilderness Act of 1964, tribal authors looked to traditional leaders within their community for direction and to ensure that tribal beliefs, values, and practices were woven into both the designating language and management plan.

For the Confederated Salish and Kootenai Tribes, this wilderness designation provides hunting grounds and fishing waters, a sanctuary for cultural practices, recreation opportunities, scenic amenities, a place for educational and scientific study, and the economic benefits of various natural resources. The primary goals established by tribal wilderness managers were to preserve quiet and untamed areas for cultural and spiritual use; valuable goals for all wilderness managers around the globe to adhere to.

The Salish-Kootenais and U.S. Forest Service continue to communicate on a regular basis concerning their respective and joint wilderness management issues and activities. This is the first and longest running tribal/government agency wilderness partnership in existence, and shows exactly what can be accomplished if managers are open and willing to put in the time to develop a positive working relationship with native communities.

Imbewu Wilderness Education Partnership: South African National Parks Board / Rural Native Communities / Wilderness Leadership School

According to Andrew Muir, Executive Director of the Wilderness Foundation of South Africa, the word Imbewu is interpreted to mean “seed.” This African wilderness education partnership draws on the traditional knowledge of retired South African National Parks Board game guards, coming from various local tribal groups, who take indigenous youth into the wilderness bush to teach them both traditional and contemporary wilderness skills. Managed as a joint alliance between the Parks Board, the South African Wilderness Leadership School, and native rural communities, local tribal youth from underprivileged areas are encouraged to reclaim their birthright to a quality wilderness experience in their own world-renowned game reserves (Muir 1999).

Although many of the game guards cannot read or write, they teach the youth about the importance of the land and all that lives on it, using their native languages and traditional African-style storytelling. The key elements of cultural pride and preservation and the reasoning for wilderness being established for all Africans is conveyed. Muir goes on to point out “traditional knowledge links our wild lands, trees, animals, and birds to the hearts of our people. The insights of these black conservationists, born to South Africa, have for too long remained unshared.”

This is yet one more example of the positive consequence that native people can offer to wilderness managers and the general public: care for the land and eloquently and respectfully pass the values and ideals of wilderness on to the next generations.

Taos Pueblo / U.S. Forest Service Wilderness Partnership

In the United States, Federal re-classification and return of designated wilderness to tribal groups is rare, but has occurred. One example is the return of Blue Lake and the surrounding area to the Taos Pueblo, which was legislated through Bill - P.L. 91-550 on Dec. 15, 1970. The area, approximately 48,000 acres of U.S. Forest Service land located within the Wheeler Peak Wilderness, was returned to the Pueblo because it was one of their most important religious sites. However, legislation required the Pueblo to continue to manage the land as wilderness. The following excerpts from that legislation explain this unique wilderness management situation:

The lands held in trust pursuant to this section shall be a part of the Pueblo de Taos Reservation, and shall be administered under the laws and regulations applicable to other trust Indian lands, provided that the Pueblo de Taos Indians shall use the lands for traditional purposes only, such as religious ceremonials, hunting and fishing, a source of water, forage for their domestic livestock, and wood, timber, and other natural resources for their personal use, all subject to such regulations for conservation purposes as the Secretary of the Interior may prescribe.

Except for such uses, the lands shall remain forever wild and shall be maintained as a wilderness as defined in section 2 (c) of the Act of September 3, 1964 (78 Stat. 890). With the consent of the tribe, but not otherwise, non-members of the tribe may be permitted to enter the lands for purposes compatible with its preservation as a wilderness. The Secretary of the Interior shall be responsible for the establishment and maintenance of conservation measures for these lands, including, without limitation, protection of forests from fire, disease, insects or trespass; prevention or elimination of erosion, damaging land use, or stream pollution; and maintenance of streamflow and sanitary conditions; and the Secretary is authorized to contract with the Secretary of Agriculture for any services or materials deemed necessary to institute or carry out any of such measures. (Public Law 91-550, Section 4(b))

Note in the latter section of the legislation excerpt shown above, references to the Secretary of the Interior and the Secretary of Agriculture's Offices, with respect to conservation management of the area. Even though the government has ceded this area back to the Pueblo, both the Departments of the Interior and Agriculture remain involved in the overall management and administration of the Blue Lake Area.

This wilderness-based indigenous partnership is an extremely unique example of how a native community and a Federal land managing agency have melded together traditional and contemporary land management objectives into a realistic programmatic scenario that works for all parties. By simply sitting down and discussing, agreeing upon, and implementing a coordinated work plan, it is possible for these types of partnerships to flourish, thus producing a lasting

value of the land and a myriad of benefits for the people who need, love, and enjoy this special wilderness.

Conclusions

Executive Director of the Northern Arapahoe/Shoshone Wind River Indian Reservation's Environmental Quality Commission, Don Aragon (2007), says "The World Wilderness Congress has always operated on the principle that indigenous knowledge and perspectives must be included in any wilderness discussion to ensure a full understanding of the wilderness concept." The Wilderness Congress has therefore formally recognized that indigenous people instinctively know and understand our natural world and must be included in the overall stewardship of wilderness. As wilderness managers, we must begin to look for ways to combine our passion for the land and our modern knowledge of managing wild places with traditional people's devotion to and knowledge of Earth Mother.

By bringing the best of both worlds together through indigenous wilderness partnerships, it is possible to mend the Sacred Hoop of Life that for generations has been broken by deceit, prejudice, and unmitigated resource manipulation. This can indeed be achieved by

- Making a sincere effort to better understand native groups and their respective natural resource issues;
- Working toward building a trusting rapport with native groups or communities;
- Using the partnership building tools outlined above to develop, implement and evaluate constructive/lasting indigenous-group wilderness partnerships;
- Being aware of and avoiding tribal politics whenever possible;
- Being patient and never moving too fast or pushing too hard when communicating with tribal groups; and
- Being up front about partnership objectives, and when the relationship has been effectively established, co-developing a comprehensive partnership work plan that includes traditional tribal beliefs, values and practices.

Tribal elders from all walks of life are telling us that by restoring the symbolic Circle of Life the seven generations and beyond will be free to live in a world where people can accept and care for one another, and where all people can once again, live in harmony with their natural surroundings. The time is NOW to heed such powerful guidance—by reaching out to our native communities in a sincere and sacred manner—that will result in a resolved life balance that all of mankind can accept, understand, and value, to the end of time. Weebtheha!!

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

3. ENHANCING TRANSBOUNDARY CONSERVATION GOALS



Photo courtesy of Leopold Institute

Maloti Drakensberg Transfrontier Park Joint Management: Sehlabathebe National Park (Lesotho) and the uKhahlamba Drakensberg Park World Heritage Site (South Africa)

John M. Crowson

Abstract—On 8 April 2005, the first Joint Management Committee meeting was held at Qacha's Nek, Lesotho. This was to ensure co-operative management through joint management. The formation of a Joint Management Committee was part of the Bilateral Maloti Drakensberg Transfrontier Project agreement and consisted of officials from the Ministry of Tourism, Environment and Culture (Lesotho), Ezemvelo KwaZulu Natal Wildlife (South Africa) and assisted by the Maloti Drakensberg Transfrontier Project and the Peace Parks Foundation. The formation of a Transfrontier Park (TFP) could possibly pave the way for the establishment of a Transfrontier World Heritage Site (WHS), which would be invaluable when sourcing external sources of funding for projects. The principal challenge that faces the TFP is that, historically, insufficient financial and human resources have been allocated to the individual parks, thereby reducing the level of management effectiveness. The joint declaration of the TFP brings in an era of bilateral governance in support of this initiative. This initiative should progressively capacitate the TFP to a point where its globally significant natural and cultural heritage is effectively managed, its integrity secured, and a flow of benefits to surrounding communities optimized. There were many challenges that presented themselves to both Park Management authorities. Issues that are currently being addressed are the development of a Fire Management Plan for Sehlabathebe National Park (SNP), and the lack of staff, finances, and assets. On the South African side, all of the above are in place, and as such, we can help SNP to develop and become an extension of a Transfrontier WHS. Issues relating to wilderness both in South Africa and Lesotho needed to be addressed through Joint Management. The uKhahlamba Drakensberg Park (UDP) WHS has developed a Wilderness Management Plan that is an appendix to the UDP WHS Integrated Management Plan. Lesotho has only zoned potential wilderness and requires assistance to help management realize the importance of wilderness in SNP and manage it accordingly. The UDP WHS is busy developing a Buffer Zone Policy for its eastern boundary. At present, no Buffer

Zone Policy is being developed for the western boundary, which includes SNP. Because SNP is a small park (6,500 ha), activities outside SNP could heavily impact management initiatives and zoned wilderness areas, in particular.

Introduction

The Maloti Drakensberg Transfrontier Park (MDTP) (fig. 1) is the largest (249,313 ha) and most significant protected area within the Protected Area Network of the Maloti Transfrontier Conservation Area. It is an asset of international significance due to its unique natural and cultural values already recognized by the listing of the uKhahlamba Drakensberg Park (UDP) as a World Heritage Site and a Ramsar Site. The addition of Sehlabathebe National Park (SNP) broadens the spectrum of natural and cultural heritage protected by this Transfrontier Park and, therefore, it is envisaged that with time the entire Transfrontier Park will be listed as a World Heritage and Ramsar Site.

The Transfrontier Park is dominated by the Maloti Drakensberg, a mountain range of unique origins, and as such, has a diverse range of ecological niches with rich biodiversity and high numbers of endemic species (Derwent and others 2001; Ezemvelo KZN Wildlife 2005a). In addition, it is home to thousands of rock art paintings, a product of the San's long historical relationship with this mountainous environment as well as an interesting historical cultural heritage. Furthermore, the Transfrontier Park contributes significantly to the economy of the Southern African sub-region. Through the protection of a vast portion of this mountain range it secures the supply of high quality water from its dense network of wetlands (hence the Ramsar Site designation), the sustainable use of natural resources, and the development of appropriate forms of tourism (Ezemvelo KZN Wildlife 2005a). The UDP WHS has 109,530 ha of proclaimed wilderness. Overall, almost half (48.5%) of the total area of the UDP WHS has been designated as wilderness (Ezemvelo KZN Wildlife 2005b).

On 14 September 1997, there was a unanimous resolution by participants representing Lesotho, South Africa, the World Bank and interested non-governmental organizations to endorse the concept of a Transfrontier Conservation and Development Area encompassing the Lesotho Maloti Highlands and the KwaZulu Natal Drakensberg mountains in South Africa. Known as the Giants Castle Declaration, it also recognized that a joint declaration of a Transfrontier

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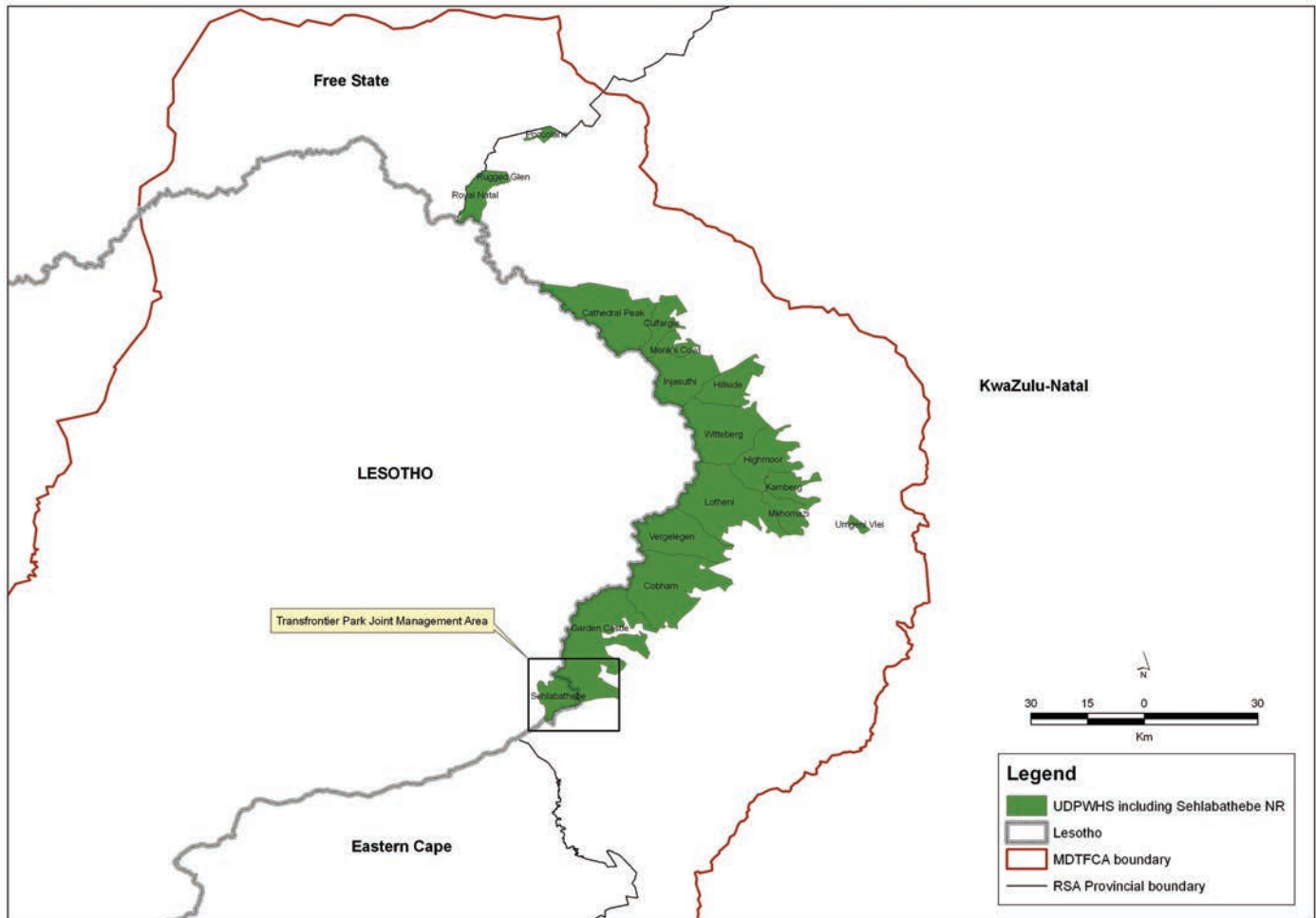


Figure 1—Location of the Transfrontier Park Joint Management Area.

Park between Sehlabathebe National Park and the then KwaZulu Natal Drakensberg Park would be an important achievement of that process.

Management Issues

As far back as the 1970s, staff from the former Department of Forestry and SNP worked together on law enforcement issues, especially stock theft, and the preparation of firebreaks on the international boundary. In the late 1990s, staff from Ezemvelo KwaZulu Natal Wildlife held a field visit to Sehlabathebe National Park. Informal training was given to park management staff on the use of Global Positioning Systems. The field visit highlighted the need to assist Sehlabathebe staff with firefighting equipment and advance planning with regard to the preparation of firebreaks between both parks. Radio communication at SNP did not exist due to the allocated radio being under repair. On 8 April 2005, the first Joint Management Committee meeting was held at Qacha's Nek, Lesotho, to ensure co-operative management through joint management. The first meeting set the Terms

of Reference for the Joint Management Committee and the way forward for the formation of a Transfrontier Park.

The lack of radio communication at SNP was an urgent issue to address. A proposal to donate radios programmed on the Ezemvelo KwaZulu Natal Wildlife's radio frequency was agreed to by senior management. This enabled both parks' staffs to communicate with one another on issues of security, fire management, and other management issues.

In-house training on path, fence, and road maintenance was put on hold until the time that SNP employed a full complement of staff. During 2008, five field rangers were employed by SNP and have undergone training at the South African Wildlife College in Hoedspruit. During October 2009, in-house training was given to the park manager and his staff on game monitoring and the completion of biological returns. Four pairs of binoculars were donated to the management staff so that effective game and vulture monitoring could be carried out. Further basic field ranger training has been offered by Ezemvelo KwaZulu Natal Wildlife Training Centre so that levels of competency could be on par with Ezemvelo KwaZulu Natal Wildlife field rangers. A draft translocation policy for game was submitted to the director

of Lesotho National Parks for consideration. The policy laid down guidelines for future introductions of game into SNP and other national parks in Lesotho.

Ezemvelo KwaZulu Natal Wildlife management and ecological staff met with senior park management staff and formulated a draft fire management plan for SNP, which is scheduled to be finalized early in 2010. With a finalized fire management plan, Lesotho will be in a position to secure adequate funds on an annual basis and institute a formal burning program for SNP. SNP staff and senior management from the Ministry of Tourism, Environment and Culture are invited to attend the uKhahlamba Drakensberg Park World Heritage Site annual fire workshop and are invited to participate by reporting on the previous year's burning season and planned burning for the following year.

Management Plans

Both parks have produced their own management plans that remain the guiding documents for the management of their protected areas. In accordance with the World Heritage Convention Act no. 49 of 1999, an integrated management plan had to be developed. In addition to this requirement, a concept development plan, business plan, and wilderness management plan have been developed for the UDP WHS. The integrated management plan for the UDP WHS was completed and published in 2006. This plan forms the framework within which the UDP WHS is to be developed toward the achievement of its management objectives. The Sehlabathebe National Park management plan was completed in June 2008 (National Environmental Secretariat 2008).

The joint management plan for the Maloti Drakensberg Transfrontier Park was based on the framework of the UDP WHS Integrated Management Plan. The main purpose of this plan is to provide the necessary policy statements and guidelines for the joint management committee to address common management issues. The joint management plan is reviewed annually for any minor corrections or alterations and the document is formally reviewed on a 5-year cycle. Joint management policies and guidelines listed in the plan are (Maloti Drakensberg Transfrontier Project 2008):

- Vision, mission and management objectives
- Zonation
- Management effectiveness
- Financial and human resources
- Security and safety
- Biodiversity conservation management
- Cultural heritage management
- Eco-cultural tourism, marketing and concessions
- Environmental interpretation and education
- Research
- Monitoring and evaluation
- Infrastructure

Both management plans went through an extensive public participation process. Relevant stakeholders and local community groups were consulted on the mission, management objectives, and content of both plans.

Challenges

One of the principal challenges that face park managers in Lesotho and South Africa is that insufficient funding and human resources allocated to individual parks have negatively impacted the level of management effectiveness. The development of a fire management plan, joint management plan, translocation policy, and the proposed formal and informal training of staff add credibility to the Maloti Drakensberg Transfrontier Park. This will help to secure long-term funding so that the park's goals and objectives can be achieved.

Within the uKhahlamba Drakensberg Park World Heritage Site, resources have been secured over the years through provincial government funding. Annual budgets are set and submitted to the provincial government for approval. Budgeting includes funding for staff, fixed and moveable assets, and operational requirements. Copies of all plans have been submitted to the Ministry of Tourism, Environment and Culture to encourage them to develop such plans for SNP. This will assist the Ministry in its nomination of the Transfrontier Park as a World Heritage Site.

In the development of the SNP management plan, discussions were held with regard to the zonation of wilderness. The proposed zonation did not align with those areas designated in the UDP WHS. The UDP WHS used the Recreational Opportunity Spectrum (ROS) while SNP used a slightly different zoning system, which was introduced in 1990. Several meetings were held and both countries agreed to adopt the same zoning system for SNP as that of the UDP WHS. The joint declaration of the Maloti Drakensberg Transfrontier Park will enforce bilateral government support for this Transfrontier Park.

Conclusions

The concept of establishing a Transfrontier Park has been in place for the past 40 years with informal transboundary co-operation between SNP and Garden Castle, which was managed by the Department of Forestry. Transfrontier Park Declaration is currently being planned for both countries in order that relevant Ministries officiate the declaration of the Maloti Drakensberg Transfrontier Park. The completion of the joint management plan and the SNP management plan will be a great step forward in the co-management of the Maloti Drakensberg Transfrontier Park.

The enthusiasm of the committee and park management staff has initiated seven of the 18 action plans listed in the joint management plan within the first year of its adoption. An annual review of the MD TFP Joint Management Plan will take place during December 2009. This meeting will evaluate progress and, where necessary, re-prioritize activities for the future. The MD TFP is viewed positively by all committee members, conservation managers, park managers, and will succeed with their positive input.

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The Climate Adaptation Programs and Activities of the Yellowstone to Yukon Conservation Initiative

Wendy L. Francis

Abstract—The Yellowstone to Yukon Conservation Initiative (Y2Y) is an innovative transboundary effort to protect biodiversity and facilitate climate adaptation by linking large protected core areas through compatible land uses on matrix lands. The Y2Y organization acts as the keeper of the Y2Y vision and implements two interconnected programs – Science and Action, and Vision and Awareness—to promote the landscape, political, public, and financial conditions necessary for wildlife connectivity. The Y2Y vision has inspired many others who are also undertaking programs, projects, and actions contributing to its realization. This paper provides examples of projects being undertaken by the Y2Y organization as well as those being implemented by others and includes a brief summary of successes to date.

Origins of the Yellowstone to Yukon Conservation Initiative

First conceived in 1993, the Yellowstone to Yukon Conservation Initiative (Y2Y) was inspired by the wide-ranging movements of animals like wolves and grizzly bears. A particular wolf, Pluie, was radio-collared in southern Alberta and tracked over a 100,000 square kilometer (40,000 square mile) area that encompassed portions of Montana, Idaho and British Columbia (Dean 2006). During the course of her travels, Pluie crossed through multiple local, regional, state and provincial jurisdictions and an international boundary. At times she was fully protected within national parks, while at others, she was a legal target for hunting, which was her eventual fate. The lesson of Pluie’s travels is that parks and protected areas, no matter how large, cannot be relied on to ensure a future for healthy populations of large mammals (Newmark 1995). Such species use the landscape at a much

larger scale than ever can be contained within a single park or even a network of parks. Rather, an integrated approach to management is needed that recognizes the large-scale movements of such animals and the need for coordinated responses from many levels of government and private land managers.

At the same time Pluie’s journey was taking place, historical studies of wildlife ranges demonstrated that populations that become isolated from each other “wink out,” or become locally extinct (Hummel and Ray 2008). A map of grizzly bear range contractions over the last two centuries graphically demonstrates this tendency (fig. 1).

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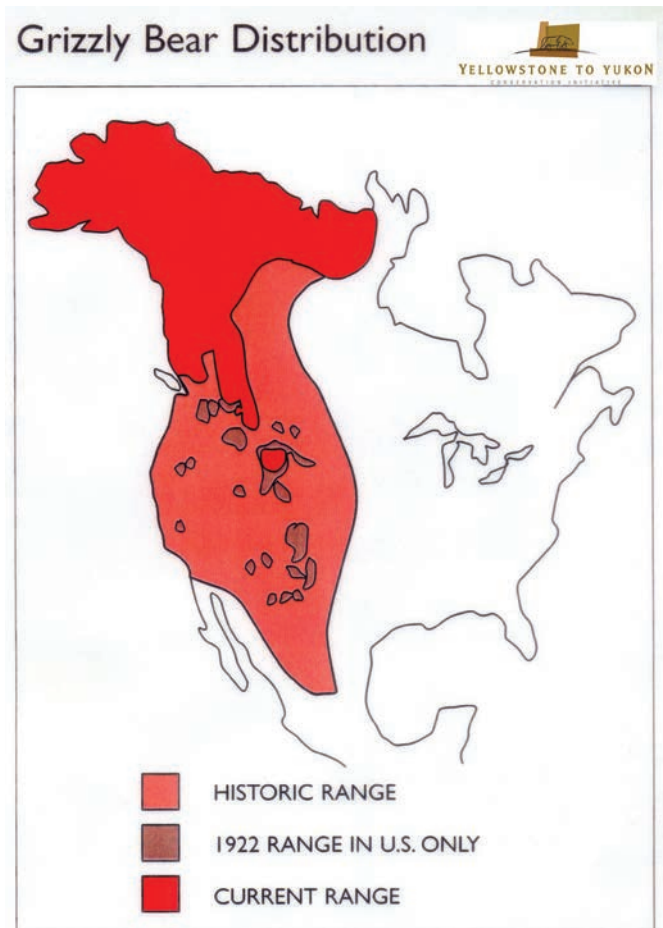


Figure 1—Map of historic grizzly bear distribution in North America.

At one time, grizzlies ranged as far south as Mexico and well out into the Great Plains. As European settlement came to dominate and fragment the landscape, the great bears were pushed out of much of their range in the United States and squeezed into many isolated pockets of habitat in remote areas. Over time, animals within these pockets were deliberately killed, hunted, or died from other fates such as disease or fire. With no ability for other bears to travel to those locations, the loss of bears there was permanent. The means to prevent such extinctions within current grizzly bear ranges is to ensure that populations remain interconnected with each other. This requires the ability of bears to travel throughout much of the landscape, regardless of its use by humans.

The Yellowstone to Yukon vision coalesced these ideas and applied them to the entire length of the North American continent's mountain chain, from Yellowstone National Park and its surrounding public lands to the Arctic Circle in northern Yukon Territory (fig. 2). A group of scientists and conservationists conceived an integrated approach to land management that would embed parks and protected areas within a matrix of public and private lands that were managed to support the ability of wild species to live in and move through them. Although the Yellowstone to Yukon regional boundary is somewhat flexible depending on the issue at hand, the landscape between Yellowstone and the Yukon shares many characteristics, including flora and fauna, topography, and climate and social characteristics, which make it a logical unit for such an ambitious endeavor.

Yellowstone to Yukon Mission, Vision, and Programs

As first constructed, the Yellowstone to Yukon Conservation Initiative was a network of dozens of scientists and environmental non-governmental organizations (ENGOS). A number of leaders from within those organizations formed a voluntary Coordinating Committee, whose role was to advance the vision, direct research projects, and produce communications materials. In the early years, a major activity of the Y2Y network was simply to keep transboundary participants connected to each other through the new medium of the Internet. After a few years, it became apparent that both a senior staff capacity and significant funding would be required to keep the momentum going. In 2000, the initiative formally shifted from being a collaborative network to a stand-alone organization with legal and charitable status in both Canada and the United States, a formal Board of Directors, and a complement of staff members having expertise in science, communications, collaborating, organizational development and fundraising.

Early in the evolution of the Y2Y Conservation Initiative, a broad strategic planning process resulted in the creation of Mission and Vision statements that have withstood the test of time and have been the inspiration for other large landscape-scale efforts.

Mission Statement

People working together to maintain and restore the unique natural heritage of the Yellowstone to Yukon region.

Combining science and stewardship, we seek to ensure that the world-renowned wilderness, wildlife, native plants and natural processes of the Yellowstone to Yukon region continue to function as an interconnected web of life, capable of supporting all of its natural and human communities, for now and for future generations.

Vision Statement

Ours is a vision for the future of the wild heart of North America. Aware that the Yellowstone to Yukon region constitutes the world's last best chance to retain a fully functioning mountain ecosystem, we envision a day:

- When a life-sustaining web of protected wildlife cores and connecting wildlife linkage areas has been defined and designated for the Yellowstone to Yukon region;
- When that life-sustaining web is embraced as a source of pride by those who live within it and visit it, and is acknowledged as a living testimony to a society wise enough to recognize the need for such a web, altruistic enough to create it, and prudent enough to maintain it;
- When all natural and human communities in the Yellowstone to Yukon region coexist in a healthy mountain ecosystem of clean air and water, abiding beauty, and abundant wildlife and wilderness;
- When land-use decisions in the region are based first and foremost on ecological principles;
- When natural resources in the region are managed with the goals of ecosystem integrity and long-term economic prosperity in mind;
- And when residents of the Yellowstone to Yukon region take it for granted that their long-term personal, spiritual and economic well-being is inextricably connected to the well-being of natural systems (Y2Y 2002).

Progress Toward the Vision

Translating the Yellowstone to Yukon vision into conditions that foster healthy and connected wildlife populations will require a myriad of actions, decisions, and policies by numerous actors (Federal, state and provincial agencies, industrial land managers, Native American Tribes, First Nations, private land owners, municipal decision-makers, and individuals) whose activities occur within the natural landscape. Progress toward the Y2Y vision is being accomplished in three ways:

- Through programs and activities undertaken by the staff, contractors, volunteers or partners of the Y2Y organization;
- Through programs and activities inspired or influenced but not led by the Y2Y organization; and
- Through programs and activities that are neither inspired nor influenced by the Y2Y vision but nonetheless are contributing to its achievement.



Figure 2—Map of protected areas in the Y2Y region.

Science and Action Programs and Activities of the Y2Y Organization—The activities of the Y2Y organization are delivered through two interconnected programs: (1) Science and Action and (2) Vision and Awareness. The Science and Action program seeks to create the landscape conditions that will maintain and restore the biodiversity of this vast, unique, and significant region. Vision and Awareness activities are designed to foster the public, political, and financial support necessary to achieve the Science and Action goals. The two programs operate synergistically to increase their effectiveness and efficiency.

Y2Y Priority Areas—At the heart of the Yellowstone to Yukon vision lies the string of large protected areas that form the core of the Yellowstone to Yukon region (fig. 2):

- Yellowstone National Park and surrounding Wildernesses,
- Waterton Lakes-Glacier-Bob Marshall-Scapegoat complex,
- Salmon-Selway-Bitterroot Wildernesses, Canadian Rocky Mountain Parks and adjacent provincial parks,
- Muskwa-Kechika Management Area in northern B.C., and
- Nahanni National Park Reserve in the Northwest Territories.

Ensuring that these core reserves are managed to the highest levels of protection for source populations of key wildlife species is a major strategy of Y2Y.

In addition, these reserves need to be buffered to provide an added layer of protection and ensure that development and fragmentation don't encroach right up to the parks' boundaries. Y2Y and its partners are advocating for new core protected areas in several key locations within the Yellowstone to Yukon region, including (1) new Wilderness areas in northern Idaho and western Montana; (2) adding B.C.'s Flathead Valley to Waterton Lakes National Park; (3) securing provincial park protection along the east flank of the boundary between Banff and Jasper National Parks, an area called the Bighorn Wildland; (4) protecting endangered caribou habitat in Alberta's Little Smoky River region; and (5) protecting a majority of the almost 70,000 square kilometer (17 million acre) Peel Watershed in northern Yukon.

However, it is what occurs on the lands that lie between protected areas that will determine the success, or failure, of the Yellowstone to Yukon initiative. These lands are owned or managed by governments at various levels, by Native American tribes or Canadian First Nations, by industries, or by private owners. Therefore, key strategies must include the promotion of Federal, state, provincial, aboriginal and municipal land management policies that reduce fragmentation and enhance connectivity. Industrial land managers must be convinced to implement best practices to coordinate access and reduce the impacts of roads and other fragmenting features. Private land stewardship is an increasingly important strategy, especially in the southern third of the Yellowstone to Yukon region.

In order to approach these issues in a systematic and manageable way, Y2Y divides the region into 12 priority areas (fig. 3). Eight of these priority areas were identified

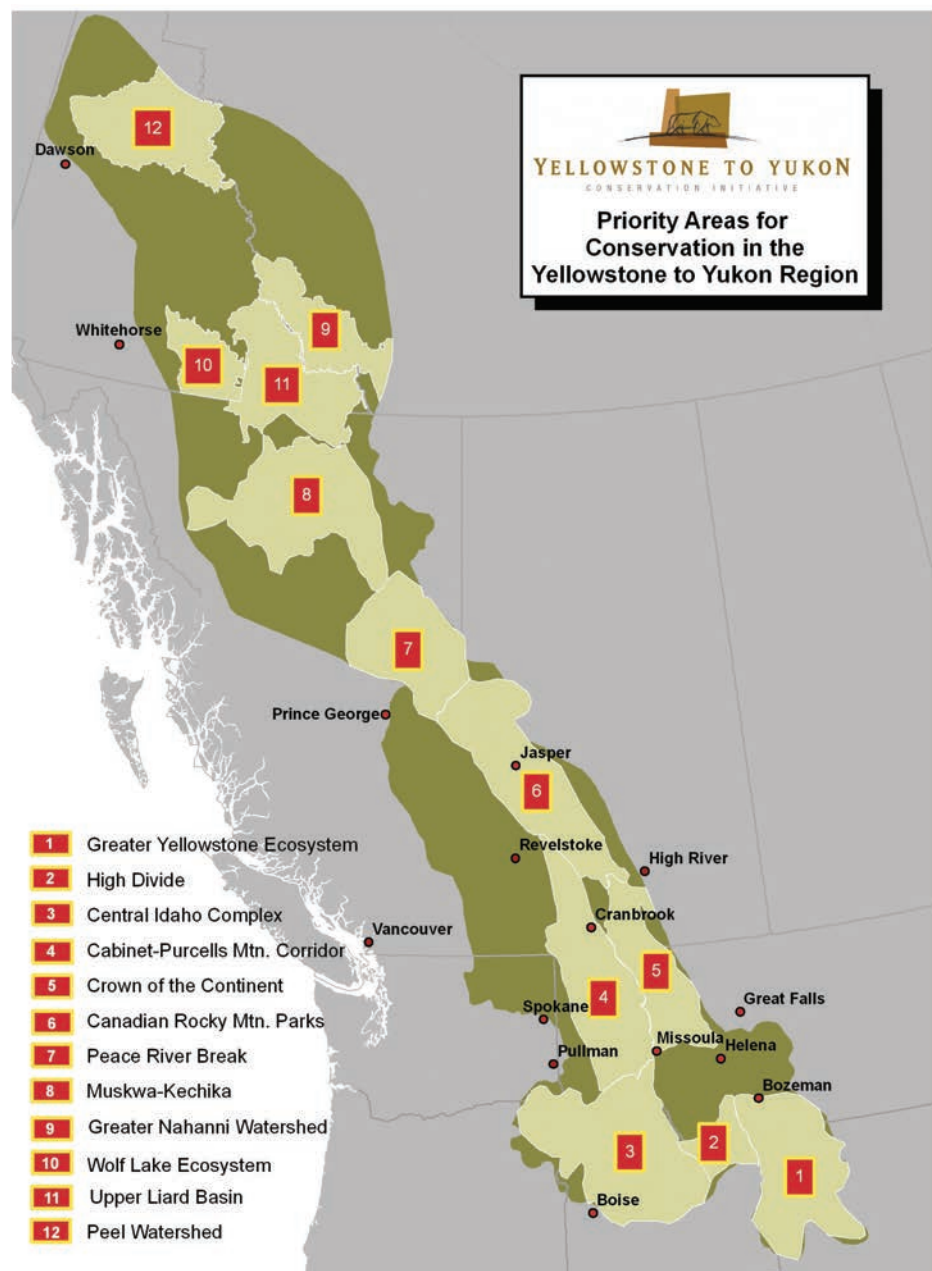


Figure 3—Map of Y2Y's priority areas.

through extensive research into the status of grizzly bear populations throughout the Yellowstone to Yukon region. Grizzly bears were chosen as a species around which to develop conservation programs because of their ability to act as an umbrella species, i.e., a surrogate for biodiversity. Grizzly bears have such large-scale habitat needs that if a landscape is managed for the survival of viable grizzly bear populations, many other species will also thrive under such management (Frankel and Soulé 1981). Y2Y’s conservation objectives and activities are intended to ensure the survival of populations of grizzly bears—and thus a vast majority of other species—over evolutionary time scales (i.e., centuries).

In addition to the eight priority areas identified by the grizzly bear strategy, the Y2Y organization also identifies four areas in the Yukon and Northwest Territories as priorities for conservation action. Identified as large, intact watersheds, these are the Upper Liard watershed, the Wolf Lake ecosystem, and the Nahanni and Peel River watersheds. These northern landscapes contain the largest, most intact, wildest lands remaining within the Yellowstone to Yukon region.

Y2Y’s Conservation Activities—Each of Y2Y’s eight grizzly bear priority areas and northern watersheds is unique.

One major lesson of Y2Y’s efforts to date is that there is no one recipe for achieving conservation outcomes. Having said that, Y2Y’s general approach in its priority areas is to build networks of diverse partners who are willing to agree on common objectives and work collaboratively on projects and activities to achieve them. Y2Y acts as a catalyst, a convener, and a resource for these partnerships.

The Cabinet-Purcell Mountain Corridor is the most advanced of Y2Y’s collaborations (fig. 4). Y2Y chose this landscape—which straddles the Canada-U.S. border and includes portions of British Columbia, Idaho, and Montana—because it is one of only two linkages remaining on the continent with the potential to keep grizzly populations connected to each other at the continental scale. A consensus of scientists convened by Y2Y over the years concludes that the best way to ensure the future health of Yellowstone’s grizzly bears is to encourage the movement of bears from Yellowstone northwest through the region known as the High Divide into the Wildernesses of central Idaho, and to facilitate a similar movement of bears from British Columbia south through northern Idaho and western Montana to the same Wilderness areas (Y2Y 2009). The Cabinet-Purcell Mountain Corridor is the name given by Y2Y to the region of southeast

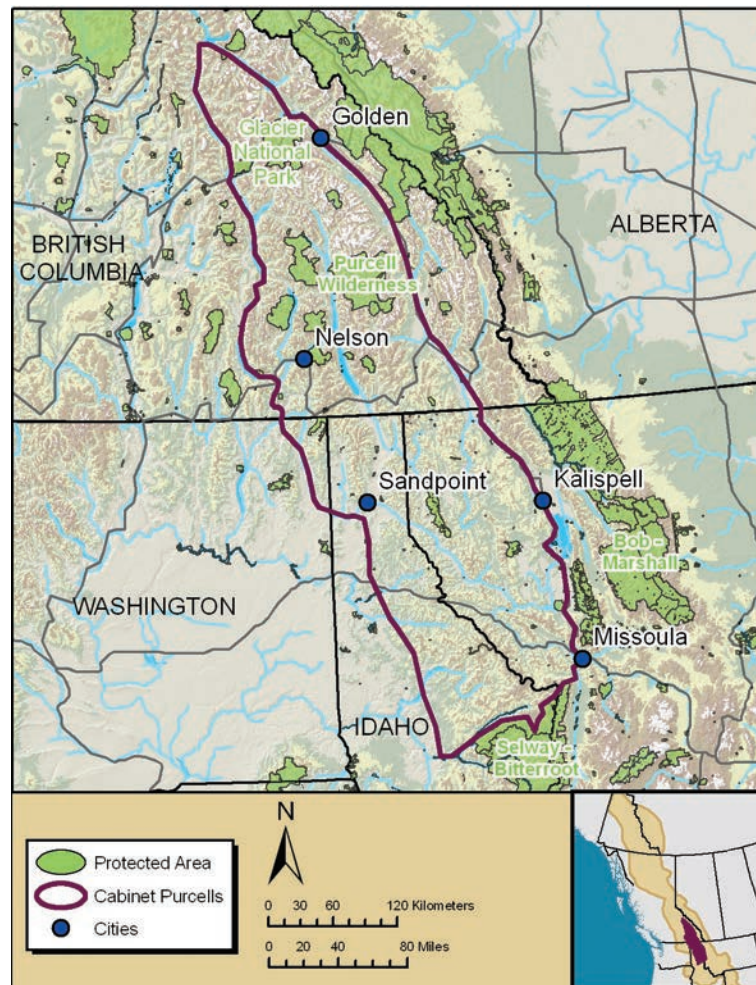


Figure 4—Map of the Cabinet Purcell Mountain Corridor.

B.C., the Idaho Panhandle, and western Montana within which public and private land management must favor the successful presence and movement of grizzly bears in order to facilitate their return to central Idaho.

Over a 5 year period, Y2Y has engaged dozens of groups, scientists, government agencies, Native American Tribes, First Nations, and progressive businesses in a series of meetings and workshops that have identified regional opportunities for, threats to, and strategies for increasing the likelihood of co-existence between people and bears in this important landscape. Participants organized themselves into the following working groups to prioritize and resource projects that address the primary threats to grizzly bear occupation of the landscape:

- Impacts of major transportation corridors;
- Managing garbage and other attractants to reduce conflicts between bears and people;
- DNA and radio-collared bear research to understand how bears are using the landscape and how populations are connected to each other;
- Reducing the impacts of roads and motorized access on remote public lands; and
- Identifying and acquiring through purchase or easement private lands within known wildlife movement areas.

These efforts, which have been 5 years in the making and will need to continue for many more in order to achieve lasting conservation outcomes, are starting to show promising results with respect to the ability of grizzly bears to move toward central Idaho.

In 2007 (Ridler 2007) and again in 2009 (Kramer 2009), grizzlies were found in parts of Idaho where they had not been seen for decades. These bears managed to move from northwestern Idaho or western Montana through cities and towns and across a busy interstate highway before meeting untimely ends—one was mistaken for a black bear and killed by a hunter, the other by a rancher defending his livestock. Despite these deaths, the movement and presence of grizzly bears in this part of Idaho is a validation of the approach being taken by Y2Y and its partners that their efforts are increasing the connectivity of the landscape for key wildlife species.

In addition to the Cabinet-Purcell Mountain Corridor, Y2Y is fostering collaborative approaches to wildlife connectivity and other relevant issues in the Canadian portion of the Crown of the Continent ecosystem, in the Canadian Rocky Mountain Parks and surrounding provincial and private lands and in the Peace River Break. Within the Muskwa-Kechika Management Area, Y2Y is leading a scientific assessment that will provide managers of this unique conservation model with new information upon which to assess development proposals and anticipate climate-related changes. Within the four northern Priority Areas, Y2Y supported partners' successful efforts to expand Nahanni National Park Reserve and is lending a hand to the campaign to protect the Peel River watershed.

Y2Y's Partner Grants and Contracts—Given the size of the landscape and the breadth and depth of activities necessary to promote policies, decisions, and actions that favor connectivity, Y2Y must inspire and support the actions of myriad partners. A primary tool that has become increasingly important over the years is the provision of

grants to partners or contractors who deliver projects that contribute to the Yellowstone to Yukon vision. In 2008, Y2Y flowed almost US\$500,000 to over 30 partners throughout the region. Some of this funding represents partner grants that are awarded through an open call for proposals. Other funding is targeted at specific partners as a result of joint fundraising efforts. It is estimated that since its inception, the Y2Y vision has attracted more than \$50M new dollars to support conservation activity in the region. Y2Y hopes to continue to expand its capacity to attract financial resources and share those with its growing network of partners.

Vision and Awareness Programs and Activities of the Y2Y Organization

Y2Y's Communications Activities—In order to create the political will to implement policies and decisions that favor connectivity for wildlife, Y2Y undertakes significant outreach and communication efforts to reach broad regional, national and international audiences. A new website, launched in 2008, is attracting hundreds of visitors per day. Several other regular communications tools keep the vast network of Y2Y participants connected to each other, including a thrice-weekly news digest, several list servers, organizational and project-based newsletters, fact sheets, and annual reports. Y2Y staff members and contractors regularly present at local, regional, national, and international conferences and gatherings.

Y2Y uses a variety of innovative tools to reach ever-widening audiences, including most recently being a sponsor of the international tour of the Banff Mountain Film Festival, and partnering with Seattle's Burke Museum and the Chicago Field Museum to exhibit photographs from Florian Schulz' stunning book, *Freedom to Roam*. Upcoming exhibits include a major new display on bears at Chicago's Brookfield Zoo, and an exhibit of the wildlife art of Dwayne Harty at the National Museum of Wildlife Art in Jackson, Wyoming, (in 2011) and at Banff's Whyte Museum (in 2012).

Programs and Activities of Others Inspired by or Contributing to the Realization of the Y2Y Vision

The number of actions and projects contributing to the Y2Y 100-year vision that are perhaps inspired by but beyond the sphere of Y2Y's influence are too numerous to list. A few examples will demonstrate how extensive and diverse they are.

Freedom to Roam—Freedom to Roam is both a campaign of the outdoor gear manufacturer, Patagonia, as well as a coalition of ENGOs. The goal of both is to create public awareness and support for the concept of wildlife corridors and landscape connectivity. Freedom to Roam is directed by a unique collaboration of conservationists and businesses. It is developing a suite of communications tools that will reach out to diverse audiences with resonant messages about the need to protect corridors and to promote Federal and state policies that will help implement corridors on the ground.

Heart of the Rockies Initiative—In 2002, Y2Y supporters convened a ground-breaking meeting of land trusts and

conservancies operating in the southern third of the Y2Y region. This meeting was the genesis of the Heart of the Rockies Initiative, a partnership of 24 independent local, regional, and national land trusts in three states and two Canadian provinces, working together to protect high priority lands. Collaborative efforts involve conservation planning, capacity building, and capital fundraising. This venture has resulted in a significant increase in the pace and amount of private land being stewarded for conservation objectives. From 2002 to 2007, Heart of the Rockies partners worked with landowners to conserve over 400,000 acres, 87% of which has been identified as having high conservation value. The Initiative also has supported or catalyzed several programs that have increased the funding available for private land conservation in the region.

Path of the Pronghorn—In south and central Wyoming remains one of the longest seasonal mammal migrations remaining on the continent—the annual 270 mile round-trip journey of a herd of 300-400 pronghorn antelope from their summer habitat in Grand Teton National Park south to their wintering grounds in the upper Green River valley. In 2005, conservation scientists began raising the alarm that a boom in energy development was constricting the antelope's movement opportunities to the point where a complete blockage was a possible outcome (Wilkinson 2005). A successful campaign by local scientists, communities, and conservation organizations led to the official establishment in 2008 of a nationally designated wildlife corridor, managed by the U.S. Forest Service (Environmental News Service 2008).

U.S. Federal Legislation—At the time of writing, there is almost a frenzy of activity in Washington, DC, as legislators in both the House and Senate promote several pieces of legislation that could advance the identification and establishment of a network of wildlife corridors for the purposes of adaptation to climate change. Generally speaking, these programs would generate the data necessary to identify the location of corridors used by specific species and require consideration of the impact on those corridors from new development proposals, particularly energy developments.

The creation of new Wilderness also advances the Y2Y agenda. In early 2009, Congress passed and the President signed an omnibus bill that, among other things, withdrew from oil and gas leasing over 1.2 million acres of breathtaking, wild landscapes in the Wyoming Range of western Wyoming's Bridger-Teton National Forest. The iconic Wyoming Range features world-class hunting, strongholds for cutthroat trout, and half of Wyoming's moose populations, all of which would be threatened by extensive oil and gas drilling.

At the time of writing, another piece of legislation, co-sponsored by Senators Testor and Baucus from Montana, would establish almost 700,000 acres of new Wilderness protection within the Y2Y boundary in western Montana.

Western Governors' Association—This cooperative venture between the governors of 19 western U.S. States has, since 1984, provided a forum for policy and program coordination. In 2008, the Association established the Western Governors' Wildlife Council to identify and conserve key wildlife corridors and crucial wildlife habitats in the West. To implement this objective, each state is now developing wildlife decision support systems that will help public land managers make decisions about the impacts on habitats

and corridors of various development options (WGA 2009). Several pilot projects have been proposed for funding, one of which would benefit wildlife movement across the Idaho/Montana border within Y2Y's Cabinet Purcell Mountain Corridor.

Hiking from Y to Y—In the mid 1990s, Karsten Heuer, a young biologist from Banff National Park, approached the Y2Y Board with an audacious plan—to hike from Yellowstone to Yukon, to see if the continental scale connections between core habitats still remain. By 1999, he and his partner, Leanne Allison, had accomplished that task, by foot, canoe, ski and horseback. Along the way, they observed grizzly bears or signs of bear on the vast majority of their days on the trail, and discovered that it is indeed still possible, theoretically, for the great bears to travel from Yellowstone to Yukon. During the trip, Karsten and Leanne also helped to raise awareness about the Y2Y effort and answer questions from dubious communities by holding public talks in many of the towns and villages that dot the landscape. Although they have moved on to other projects, Karsten and Leanne remain closely associated in people's imaginations with the Y2Y initiative.

Another marathon hiker, 'Walkin' Jim Stoltz, also has hiked from one "Y" to the other. Jim has spent his adult life hiking enormous distances across, up, and down the North American continent. In the late 1990s, he too walked from Yellowstone to Yukon. Today he sings and tells stories about this and other adventures as he travels the country visiting schools and other venues.

Successes to Date

Because the Yellowstone to Yukon landscape is so large and because the vision is being implemented through the myriad and sometimes uncoordinated actions of individuals, communities, groups, and aboriginal and non-aboriginal governments, it is impossible to know all that is contributing to its accomplishment. However, a few major outcomes deserve mention as examples of the diverse ways in which the Y2Y goal can be achieved.

Banff's Wildlife Overpasses

In the early 1990s, the Canadian Federal government proposed to "twin" the Trans-Canada Highway through Banff National Park, expanding it from a two-lane to four-lane highway. In order to minimize the inevitable collisions between vehicles and wildlife, the government intended to construct miles of parallel fencing to prevent animals from entering the roadway. Small culverts and underpasses would be constructed to facilitate wildlife movement between the two sides of the highway. Based on the emerging understanding that connectivity between large mammal populations must be maintained on the continental scale and research demonstrating that bears, in particular, were not using the existing underpasses, local conservationists called for a solution that would serve all animal species and prevent a "Berlin Wall of biodiversity" from dividing the national park in two. As a result, two 50 meter wide overpasses were constructed between Banff and Lake Louise. Over fifteen years later, monitoring has demonstrated that all of the park's

resident species are using the overpasses and underpasses and that connectivity has been restored. Banff's overpasses remain a world model of successful highway wildlife impacts mitigation.

This success has inspired efforts to reduce the impacts of highways and railways that transect other areas within Y2Y, including Interstate 90 through Bozeman Pass, Montana; Highway 93 south in Idaho; and Highway 3 through the Crownsnest Pass, Alberta and British Columbia.

Muskwa-Kechika Management Area

The science that inspired the Y2Y initiative also influenced a campaign to set aside an unbelievably large tract of unspoiled forest, river valleys, and mountains in northern British Columbia. The Muskwa-Kechika Management Area is the product of a collaborative land use planning process involving all those with an interest in the landscape's management, including First Nations, outfitters, hunters, resource industries and environmental organizations. Over several years of negotiations, they hammered out an agreement, subsequently ratified by an Act of the B.C. legislature, to manage almost 16 million acres of land (equivalent in size to the island of Ireland) as a unique experiment in wilderness conservation, within which 11 million are managed as protected areas and another 5 million as special management zones where sustainable resource development can occur.

Highway 3 Wildlife Linkages

One of the more successful collaborative efforts to emerge from Y2Y's leadership in the Cabinet Purcell Mountain Corridor is coordination between grizzly bear researchers and managers and private land conservancies located in both the U.S. and Canada. These agencies and organizations agreed on research priorities and also collaborated on the identification of the most critical private lands for the conservation of connectivity across three major highways that transect the region. Guided by this shared agenda, funds were raised to purchase the highest priority lands along Highway 3 in southern British Columbia, which are now owned and stewarded by the Nature Trust of B.C. Located along drainages where grizzly bears descend from the mountains to cross the highway, these linkages are now assured permanent protection for the bears' use.

Nahanni National Park Expansion

In 2009, the Y2Y vision received a major boost when the government of Canada, in partnership with the Deh Cho First Nations, announced that Nahanni National Park Reserve in the Northwest Territories was being expanded to six times its original size. The reserve now protects the headwaters of the Nahanni River, a tributary of the Mackenzie, as well as globally unique karst formations. At almost 30,000 square kilometers (more than seven million acres, or three times the size of Yellowstone National Park), Nahanni now serves as the majestic northern anchor of the Yellowstone to Yukon vision.

Conclusions

The Yellowstone to Yukon Conservation Initiative conceives and, with the help of hundreds of partners, implements a biodiversity conservation strategy at a scale unprecedented in the world. Yet, all the best science indicates that this is the scale at which conservation planning must occur if we are to counter the myriad threats that are creating the current extinction crisis, particularly the threat of climate change. As detailed in other sections of this report, maintaining connectivity at the continental scale, through the programs and activities of the Yellowstone to Yukon Conservation Initiative and many other actors, is the exact prescription for ensuring that biodiversity has the best chance of adapting to changing conditions.

When it was launched formally in 1997, Y2Y gave itself 100 years to accomplish its vision. Given that timeframe, a great deal has been accomplished. However, much more remains to be done. As the impacts of climate change are increasingly felt throughout the planet, the imperative for the Yellowstone to Yukon vision is even more urgent and timely.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

“Europe’s Wild Heart”—New Transboundary Wilderness in the Middle of the Old Continent

Hans Kiener and Zdenka Křenová

Abstract—The new born wilderness area “Europe’s Wild Heart” is located on the border of two Central European states and is shared by two national parks—Bavarian Forest National Park and Šumava National Park. The Bavarian Forest NP with an area of more than 24,000 ha and the Šumava NP with more than 68,000 ha create the largest island of protected nature in the cultural landscape of Central Europe. Mountain spruce forests, peat bogs, and mountain grasslands are the most important habitats of this area, which is also designated as an important location for the protection of the European lynx (*Lynx lynx*), European otter (*Lutra lutra*), Capercaillie (*Tetrao urogallus*), Black stork (*Ciconia nigra*), and many other important birds. Natural disturbances, mainly windstorms and bark beetle outbreaks, are very important players in the process of re-wilding this area. The common management guidelines for this transboundary wilderness area of the two National Parks have been prepared. The new wilderness area in the border zone of the Czech Republic and Germany with nearly 15,000 ha was established at the 20th anniversary of the end of the Cold War, which gives this wilderness designation a special connotation. Wilderness is not only important for rare species and habitats, but also an important matter for humans.

Introduction

The face of Central Europe has been shaped by civilization. Since the settling of our ancestors in the New Stone Age, their natural surroundings have continuously been changed into cultivated landscapes and expanding human settlements, sometimes leaving exploited and devastated areas and virtually no more space for wilderness. As Aldo Leopold, one of the well-known North American pioneers of wilderness protection, summarized in 1935 at the end of a study trip through Europe: “wilderness did not only vanish from the continent’s surface but also from humans’ minds and experiences,” and, we can add: for hundreds of years.

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However, if we are looking around today, we recognize that there are a few places left that remained less modified, or nearly unmodified, and have at least the potential for re-wilding. The Bavarian and Bohemian Forests are examples. Together, they form the largest contiguous woodlands in Central Europe, covering more than two million hectares. Until today, they have almost remained entirely uncut by roads and free of larger settlements. The State of Bavaria and the Czech Republic took the opportunity and set aside the most valuable parts of it as national parks: The Bavarian Forest National Park in 1970, and, after the Iron Curtain has come down, Šumava National Park in 1991 (fig.1).

The Idea, Process, and Result

Natural Conditions

Natural spruce forests on mountain crests, high-altitude plateaus, and active raised bogs and marshlands in flat depressions are characteristic features of the Šumava landscape. As relicts from the Ice Age, with a very specifically adapted flora (figs. 2,3) and fauna, they are closely related to the northern Taiga forests. At first sight, the autocratic spruce tree provides them with a monotonous and gloomy appearance. However, on closer inspection, they turn out to be an army of snow-broken and deformed, disabled trees that mutate into wood ghosts with their gnarled branches widely spread out in the fog. Encompassing a combined total area of roughly 22,500 hectares in Bavarian and Šumava National Parks, this natural growth of spruce trees—which were literally ennobled by famous authors Karel Klostermann and Adalbert Stifter—are the most significant relict forests in Central Europe outside the Alpine region. From antiquity, this large and deep forest on the border between the ancient Roma and Celtic Bohemia is called Silva Gabreta.

Both national parks are parts of the Natura 2000 network, the European network for the protection of the most endangered habitats and species. As a result of the common project (Husslein and Kiener 2007), more than 25 different Natura 2000 habitats have been mapped in this area. The following habitats are the most important:

- 9,410 mountain spruce forests (*Piceion excelsae*)
- 7,110 peat bogs (*Leiko-Scheuchzerion palustris*)
- 9,100 bog woodlands (*Dicrano-Pinion*)
- 6,230 mountain Nardus meadows (*Nardo-Agrostis tenuis*)

The area is also designated as an important location for the protection of the European lynx (*Lynx lynx*), European otter (*Lutra lutra*), Capercaillie (*Tetrao urogallus*), Black stork (*Ciconia nigra*), and many other important birds.

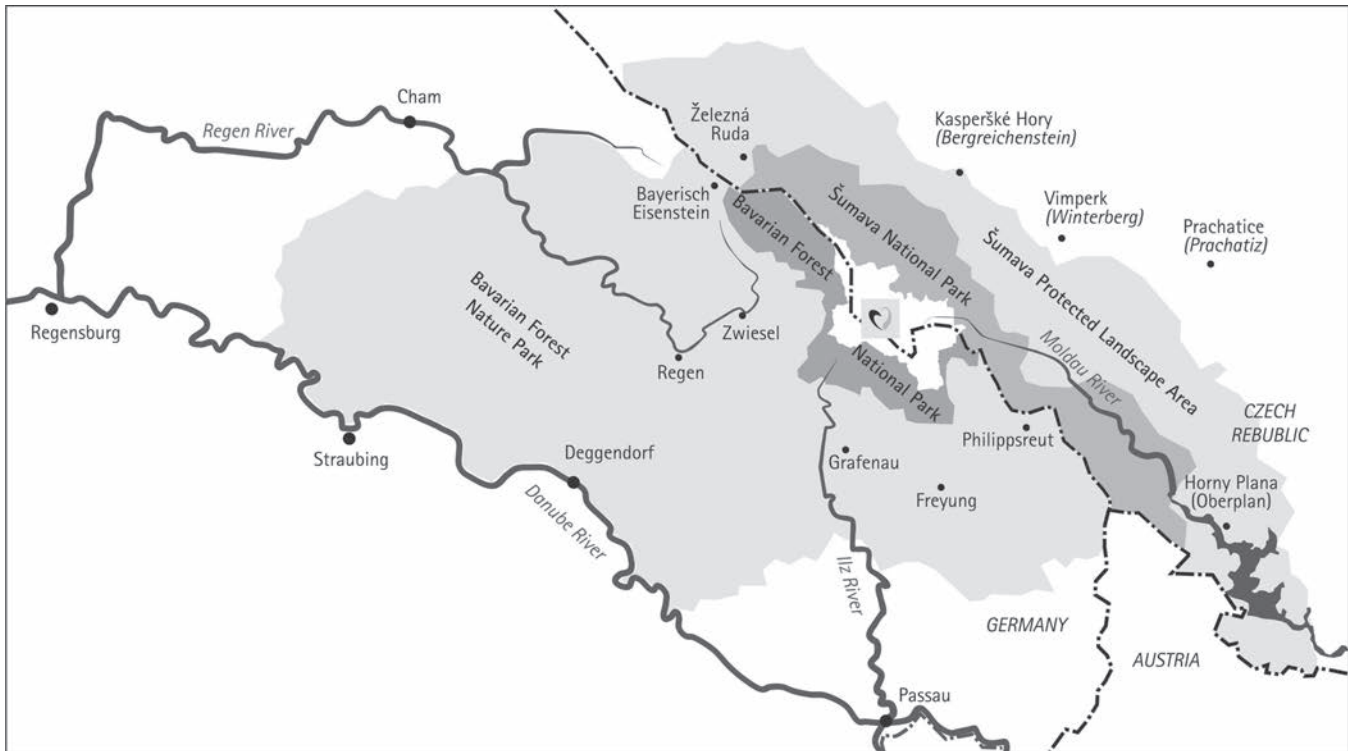


Figure 1—Map of the Bavarian Forest National Park in Germany and the Šumava National Park in Czech Republic (photo credit: Bavarian Forest National Park).



Figure 2—Lusen valley in Šumava National Park (photo by Hans Kiener).



Figure 3—Wintery aspect in "Europe's Wild Heart" (photo by Hans Kiener).

From National Parks to Wilderness Protection

How to get from National Parks to wilderness protection? In 1983, a thunderstorm uprooted and put down spruce trees on 175 hectares of the Bavarian Forest National Park. Against much protest, with the decision to leave these areas to their natural development rather than clearing them, a new concept of protection was established. Thanks to the courage of Hans Bibelriether, the first Director of the Bavarian Forest National Park, and the Bavarian State Minister Hans Eisenmann, who has given his backing with the legendary remark "a primeval forest for our children and grandchildren," the direction of the conservation policy had begun to change in Germany and Central Europe. In addition to the prevailing protection of species and habitats, the protection of dynamic processes emerged more and more. At that time, nobody could foresee the dimensions of the first great re-wilding experiment in Central Europe.

As a consequence, these dynamic processes are the focus of protection efforts, as a basic characteristic of vivid systems and essential to evolution. If we think this matter through consequently, the non-intervention concept directs us to wilderness protection (Křenová and others 2009). This also fulfills the international criteria of wilderness in the sense of the IUCN classification (IUCN, 2008) presented during the Prague Wilderness Conference (May 2009). Wilderness areas, in the sense of pristine areas untouched by humans, occupy around only 1% of this highly developed continent. Wilderness can also be land to be reverted to more wild conditions, where management measures were applied some time ago.

Restoration sites—Areas where humans have restored a damaged site (e.g., drained peat bogs) to allow for natural processes—can also meet the demands of wilderness classification (fig. 4). For 15 years now, the idea of wilderness



Figure 4—Abandoned mountain pastures accommodate a rich flora, e.g. *Gentiana pannonica* (photo by Hans Kiener).

has occurred in different places of our cultivated continent and currently there are many activities contributing to the wilderness movement in Europe. In this context, both Germany as well as the State of Bavaria have recently passed a "National Bavarian Strategy for Biodiversity" pointing out that "In Germany there will again be wilderness areas (e.g., in national parks) with natural and undisturbed processes of development." It is intended that "Nature can develop according to its own laws on at least 2% of Germany's territory by 2020." And the State Development Program for Bavaria is complimentary regarding the location of wilderness areas: "Areas which are close to the border are of special importance to the further development of the system of protected areas under consideration as areas worth being protected in the neighboring countries and states."

Bark Beetle as a Key Species of Wilderness

A piece of wild nature has also returned to the core of the old, civilized continent of Europe. Here in the neighboring national parks Šumava and Bavarian Forest, where the Iron Curtain used to separate the political power blocs as well as humans and nature for half a century, a clearly perceivable pulsation of reawakening wilderness beats again (Meyer et al. 2009).

Forests are allowed to grow on nearly 15,000 hectares as in ancient times, only complying with the laws of nature without any exploitation or management. Natural disturbances, particularly wind and insects, change the forest structure both in space and time and create gaps for new

generations of forests (fig. 5). The role of and the attitude toward the bark beetle, this successful and feared insect, has meanwhile fundamentally changed in both parks:

- The bark beetle is no longer a pest to be controlled or eradicated.
- The bark beetle is a key species (Müller et al. 2008) in natural cycles of coniferous ecosystems as are wildfires in the North.
- The Šumava mountains have harbored the bark beetle longer than man.

Thus, within a short time, a change occurred that was captured by the former President of the Federal Republic of Germany in his speech on the occasion of the 25th anniversary of the Bavarian Forest National Park: "I truly hope that it will be possible to experience a real primeval forest here and that the people, despite all their suspicions of the National Park, which I fully understand, will learn again that nature cannot only be used, but can also be left alone, even if this is against all traditional teachings of German forestry."

In the meantime, these forests are well-known throughout Europe. A distinctive feature is that these forests have been able to develop and regenerate in a region spanning nearly 15,000 hectares since the mid-nineties without any human interference. By allowing natural bark beetle cycles to occur, which are as typical for these forests as are wildfires in the North, both national parks have challenged the values of local people and have broken with the tradition of forest management. Yet, by doing so, they



Figure 5—Rich natural forest regeneration below dead trunks 15 years after bark beetle outbreak (photo by Hans Kiener).

have initiated the development back to conditions that are similar to primeval forests. The rich forest regeneration that grows up below old trees that were killed by the bark beetles (Heurich 2009) disproves the critics who said that no forest could ever grow here again. In Europe's Wild Heart, myriads of spruce seedlings use the large natural stock of rotting wood as a germination bed and grow into impressive trees (fig. 5). A number of species, extinct in former times, have returned to the newly developing wilderness. The beautiful lynx has returned to roam through the spacious open woodlands and boglands; on ancient tree skeletons, broken by the wind, the impressive Ural owl breeds again. In the not too distant future, the wolf's howling might be heard (Bufka et al. 2005) and the impressive silhouette of the moose might be seen again.

This new born wilderness area, located on the border of two Central European states, is shared by two national parks—Bavarian Forest NP and Šumava NP. The same ecosystems, habitats, and species have occurred on both sides of the border for centuries. We believe that fences, which separated this beautiful nature and people for decades, will never be returned in the history of this region. We hope that "Europe's Wild Heart" will be a common core zone of both national parks forever, where nature can develop without human intervention and people can come and marvel at nature and think about their role. Different forest management strategies were applied along the borders over the

last several decades. Fighting of bark beetles and cutting of infected trees were standard management practices on the Czech sites in a time when a non-intervention strategy has already been adopted in the Bavarian Forest NP.

Lecture After the Kyrill Windstorm

A long lasting discussion about the appropriate management of forests in Šumava NP emerged after the Kyrill windstorm in January 2007, when gusts of wind with a maximum speed of 135 km/h affected more than 1.5 million cubic meters of wood (fig. 6). Windstorms of these intensities occur in the region periodically, about once every 20 years, but damages after the Kyrill windstorm were significantly higher. Mountain spruce forests were strongly affected and thousands of spruce trees were uprooted. Open stands were especially affected where the cutting of beetle-infested trees was applied in previous years; these were highly damaged. We received a lecture. The situation in the upper part of the mountains along the Czech-Bavarian border was crucial and cooperation and coordination of the management became necessary. The first birds of a common management strategy for both NPs appeared in this post-Kyrill period. Cooperation improved over the ensuing months, and currently, common management guidelines for "Europe's Wild Heart" are being prepared (Křenová and Kiener 2009).



Figure 6—Large uprooted areas in mountain spruce forests after the Kyrill windstorm in January 2007 (photo by Hans Kiener).

Common Management for a Common Core Zone

With common guidelines, both National Park administrations have decided to preserve and manage this unique common core area as a common wilderness heritage for future generations according to the principle "leave it as natural and wild as possible." We are sharing the common core zone of both NPs with the same management regime, and the following basic principles are applied:

- No intervention and utilization of resources are allowed in forests of this wilderness area.
- No intervention and harvesting of grasslands are applied in the wilderness area; only the regulation of natural succession on a few special sites with high species diversity (e.g., Schachten, which are former mountain pastures) is allowed.
- No game (deer) management is applied (fig. 7); protection of habitat for reproduction of endangered species is asked for.
- Temporarily restricted restoration measures of a natural water regime in disturbed bogs and temporarily restricted restoration measures of formerly changed mountain brooks are possible; construction of new dams or restoration of old ones is not allowed.
- For public access, guided tours are preferred; new trails must avoid sensitive biotopes; passages across boggy ground have to be crossed by wooden runways to avoid stepping-damages.

Research and Education

Both national parks are important LTER (long-term ecological research) sites (Heurich et al. 2009), which are now in a process of emerging to a common LTSER (long-term socio-ecological research) platform. Many scientists are interested in research on mountain ecosystems under different histories, different kinds of land use, and different management practices applied in this area for decades. Others welcome the unique opportunity to set up permanent plots for the monitoring of global and ecosystem changes in an area without direct human intervention.

"Europe's Wild Heart" is not only a very important area for research but also for the education of the public. Numerous field trips, school excursions, and interpretive talks are organized in this area to offer people the opportunity to learn more about nature. Various publications, audios, and movies are published to support our motto "better knowledge for better understanding." Understanding nature helps us understand our life on this planet.

Both researchers and visitors are following nature and cross the borders (both in the field and in our minds) more and more, year by year. Our cooperation is still improving. The new Research and Training Centre, *Silva Gabreta*, will be established on a former military base in Kvilda, a village in the centre of Šumava NP. Scientists and students, not only from Czech and German Universities, are going to stay in places where soldiers maintained iron curtain fences 20 years ago. Young interest and enthusiasm replaces militancy and war-anxiety. Common visitors, local people, and school kids will be highly welcome in this Research and Training



Figure 7—Red deer is the largest mammal in the Šumava mountains, which does not care about the national border (photo by Hans Kiener).

Centre to meet researchers and have new experiences with wild nature, wilderness, and research through the projects conducted here.

Conclusions

"Europe's Wild Heart" is a new born transboundary wilderness area in the cultural landscape of Central Europe. However, this new wilderness is not only an El Dorado for rare species and habitats; wilderness is an important matter for humans. Coming from a manipulated, mostly disenchanting natural environment, they once again will be able to be astonished by a nature that returns to its original state. In addition, wilderness allows us a very special quality of nature experience, mental inspiration, and spiritual renewal. The brilliant composition "Vltava," by the Czech composer Bedřich Smetana, contains passages on the mighty powers and dynamics of a stream that has its source in the Šumava mountains and that had partly been a wild river until the end of the 19th century. Let's try to imagine what would have become of this masterpiece if the well-tended commercial forests and regulated rivers of our present cultivated landscapes would have been Smetana's models.

"Europe's Wild Heart" is not only inspiration for our recent composers, writers, and many other artists, but it is also a great opportunity to demonstrate our common interest and responsibility for appropriate management of our common European natural heritage. We have a possibility to let nature be nature, wild nature—maybe even wilderness—at least in this small piece of land. Nature is likely more ready for this than we are. There are many challenges in front of us. Yet, there are also many opportunities both for humans and nature.

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Shared Wilderness, Shared Responsibility, Shared Vision: Protecting Migratory Wildlife

Will Meeks, Jimmy Fox, and Nancy Roeper

Abstract—Wilderness plays a vital role in global and landscape-level conservation of wildlife. Millions of migratory birds and mammals rely on wilderness lands and waters during critical parts of their life. As large, ecologically intact landscapes, wilderness areas also play a vital role in addressing global climate change by increasing carbon sequestration, reducing fragmentation, and providing dispersal corridors. However, potential biome shifts, fragmentation, and the effects of urbanization threaten even remote wilderness areas. The National Wildlife Refuge System (U.S. Fish and Wildlife Service) protects over 18 million acres of designated wilderness in Alaska. Wildlife protected within this wilderness spend significant parts of their lives in Canada, Latin American, and other countries, which are also suffering the effects of global climate change. We briefly discuss three species that spend significant portions of their lives in the Arctic National Wildlife Refuge, but rely on habitat in other countries during other phases of their lives. Examples of successful international efforts are provided. We suggest that by enhancing hemispheric partnerships to preserve critical habitat as permanently protected wildlands, we can increase resiliency, redundancy, and representation of habitats for these shared species.

Introduction

Large, relatively pristine areas allow wildlife to naturally flourish. In the absence of habitat fragmentation, urbanization, and other human induced disturbances, evolutionary forces can persist without interference. These areas, often termed wilderness, can also function as natural laboratories for furthering the understanding of wildlife conservation and of the effects of climate change. Wilderness areas reduce habitat fragmentation, provide important dispersal corridors that connect landscapes, and play a vital role in addressing climate change by increasing carbon sequestration.

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While the preservation of wilderness is globally recognized as important for the conservation of biological diversity and integrity, climate change compels us to protect more of these valuable areas. Many hemispheric-migrating species, while benefitting from large conservation units, rely on intermediate stopover sites that may be half a world away, in many cases. Despite their perceived importance, research on the links between these temporary habitats for the conservation of migratory wildlife on a global scale is fairly limited. Large iconic species such as grizzly and polar bears that migrate only seasonally have received significant attention in the development of conservation plans. Less charismatic species receive less research attention, even though their migratory patterns and habitat requirements may be more complex and extensive. Through the development of hemispheric partnerships we may be able to protect the essential habitat that migratory species need to survive.

Wilderness Management in the Refuge System: A Look at Arctic National Wildlife Refuge

In Alaska, sixteen national wildlife refuges protect statutorily designated and de facto wildernesses, the largest being the 19.2 million acre Arctic National Wildlife Refuge (fig. 1). The United States established this area nearly 50 years ago to preserve unique wilderness, wildlife, and recreation values. The supporters were especially interested in protecting an area large enough to protect wilderness-dependent wildlife, like grizzly bears and wolves, that had mostly disappeared from the conterminous United States. Extending across more than 200 miles from north to south, the refuge spans five ecological zones from arctic coastal lagoons and barrier islands to subarctic boreal forest. The Arctic Refuge also includes over 150 miles of coastline and encompasses 97,000 acres of coastal lagoons and barrier islands. The Arctic Refuge may well exhibit the greatest ecological diversity of any protected area in the circumpolar arctic.

Eight million acres of the Arctic Refuge are designated wilderness under the Wilderness Act of 1964 and three rivers (Sheenjek, Wind, and Ivishak) are designated Wild Rivers under the Wild and Scenic Rivers Act of 1968. The Arctic Refuge's wilderness is free of non-climate stressors such as habitat fragmentation, barriers to migration, roads, and industrial development. All wildlife-dependent recreation including hunting and fishing is well regulated, as is subsistence use. Today, the Arctic Refuge is home to many wildlife species that benefit from its intact, wild ecosystems. The importance of protecting terrestrial and marine wilderness in the Arctic is intensifying. As temperatures increase and

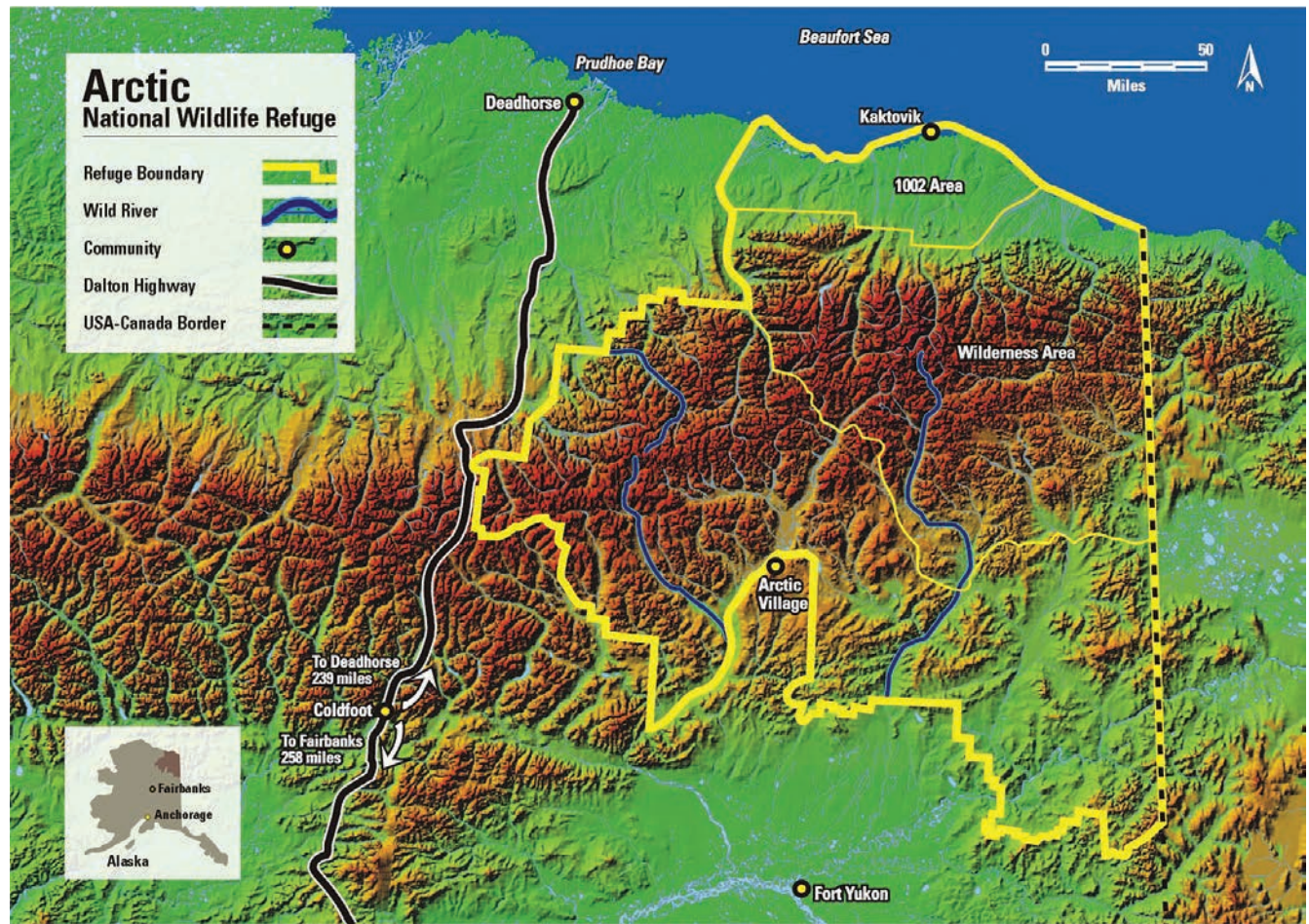


Figure 1—Location of Arctic National Wildlife Refuge.

sea ice recedes, the arctic will experience increasing potential for oil spills, shipwrecks, invasive species introductions, habitat fragmentation caused by development, and negative human-animal interactions. Within the boundaries of the refuge, habitats are expected to change as well. Scientists expect increasing coastal erosion; changing vegetation succession; shifts in plant phenology, animal migrations, life stages of invertebrates and shrub distribution; an increase in wildland fires; and significant changes to the surface hydrology. We highlight three species that exemplify the importance of arctic wilderness and discuss multinational opportunities to conserve these species.

Caribou

Caribou are a nomadic species of deer that naturally occur in the Arctic. More than 30 years of research on Alaska's North Slope around Prudhoe Bay indicate caribou are sensitive to habitat alteration and human disturbance, especially during calving. Nevertheless, there is much debate about the potential effects on caribou if the Arctic Refuge is opened to oil and gas development. The wilderness of the Arctic Refuge provides habitat for two distinct herds of barren ground

caribou: the Central Arctic Herd and the Porcupine Herd (fig. 2). The location of the birthing areas distinguishes the two herds. In recent years, female caribou of the Central Arctic Herd have calved across a broad swath of the arctic coastal plain from the Canning River drainage of the Arctic Refuge west to the Colville River. Most calves are born in areas on either side of the Prudhoe Bay oil complex. Soon after calving season, the herd moves outward both east and west to their summer range, which extends from the western portion of the Arctic Refuge coastal plain well west beyond Prudhoe Bay. In the fall, many of these caribou migrate south through the Brooks Range Mountains to spend the winter along south slope river drainages deep within the Arctic Refuge. Some members of the herd, however, remain on their summer range north of the mountains throughout the year, seeking out wind-blown valleys and tundra benches to find the lichens they need in order to survive the long, cold winters.

The Central Arctic Herd is growing in number, and recently its core calving area shifted southward away from the developed areas of Prudhoe Bay. Recently, scientists discovered the size of caribou born near the developed areas of Prudhoe Bay were smaller than caribou born to the east

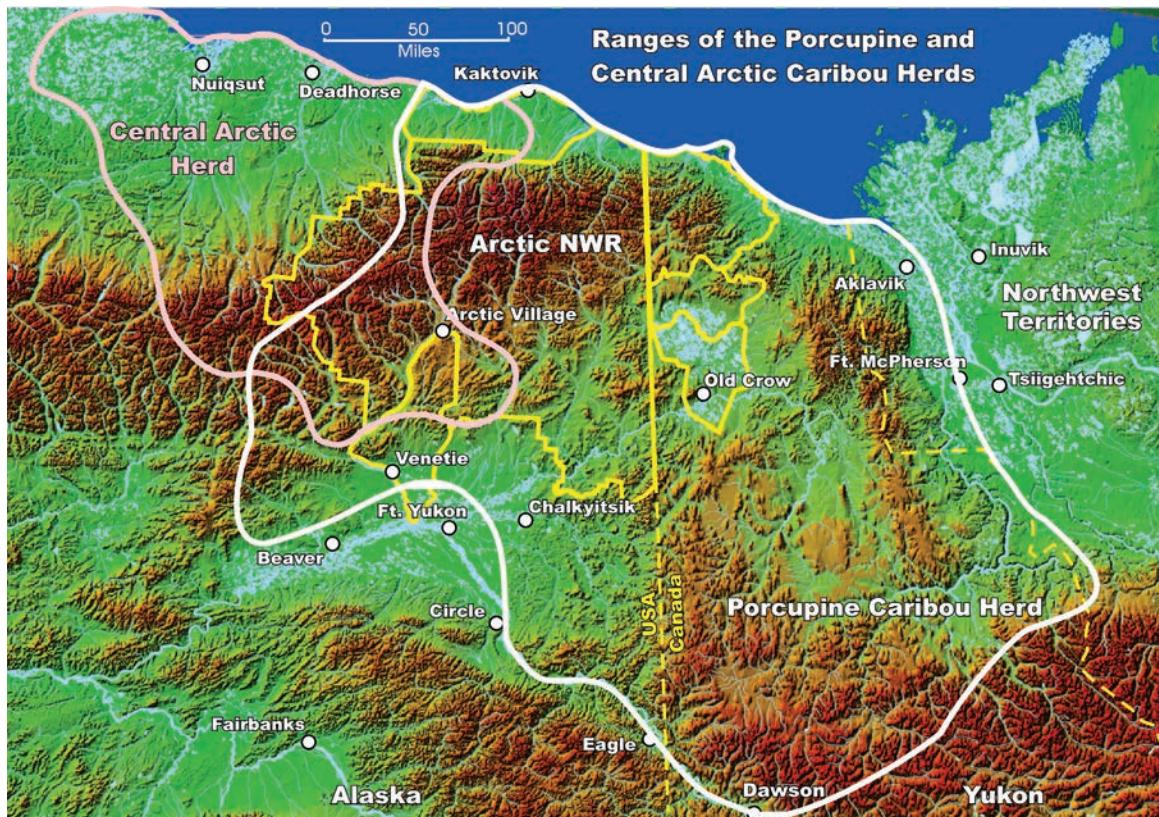


Figure 2—Ranges of the Porcupine and Central Arctic caribou herds. Both herds use portions of the Arctic National Wildlife Refuge; the Porcupine herd ranges extensively into Canada as well.

in an undeveloped area. These data suggest that when cow caribou are not using their preferred calving areas, their calves are smaller at birth and survival and growth are impeded (Arthur and Del Vecchio 2007). However, both groups moved eastward onto the Arctic Refuge coastal plain during periods of high insect activity.

The Porcupine Caribou Herd population status is unknown at this time, but many suspect it has declined since 2001 for unknown reasons. This herd normally calves on the coastal plain of the refuge, and ranges across the entire refuge and in the wilderness of Canada. At 250,000 km², this herd has a vast home range, and individuals have been observed to travel over 3,000 miles in a year. The herd uses the Arctic Refuge throughout the year. The fidelity of this herd to a fairly small specific area is unique.

Canada has also taken important steps to protect this shared caribou herd. In 1984, Canada created the Ivvavik National Park, Canada, which permanently protected a large portion of the herd's habitat as wilderness. The Vuntut National Park south of Ivvavik protects additional areas of the caribou's habitat from development. Most of the rest of the herd's Canadian range is located in areas that have either been withdrawn from development or are subject to Aboriginal land claim agreements that place stringent restrictions on development. Habitat changes caused by industrial development and climate change within its calving area threaten the Porcupine Caribou Herd.

Dunlins

Dunlins are diminutive shorebirds that nest in the high latitudes of North America and Eurasia and overwinter in coastal areas in the northern hemisphere. Thousands of dunlins use the Arctic Refuge coastal plain during the summer breeding and nesting season and as a fall staging area before migrating to Siberia and then moving southward along the coast of Japan and China (fig. 3). They breed in wet coastal tundra and prefer mudflats, estuaries, marshes, flooded fields, sandy beaches, and shores of lakes and ponds during the non-breeding season. The International Union for the Conservation of Nature lists the dunlin as abundant but populations may be declining. Loss of non-breeding habitat in eastern Asia is believed to be the greatest threat to this important migratory bird. For example, in South Korea, a large overwintering area has just recently been converted from coastal floodplain to a dry area for economic development.

Additional threats in the wintering areas include loss of water, pollution, unsustainable harvest of marine resources like shellfish, and human disturbance in critical feeding and roosting areas. This species is especially vulnerable because its wintering area is facing unsustainable environmental practices. Potential threats to this species at the Arctic Refuge include loss of feeding and roosting habitat due to coastal erosion and rising sea level, and potential for increased oil

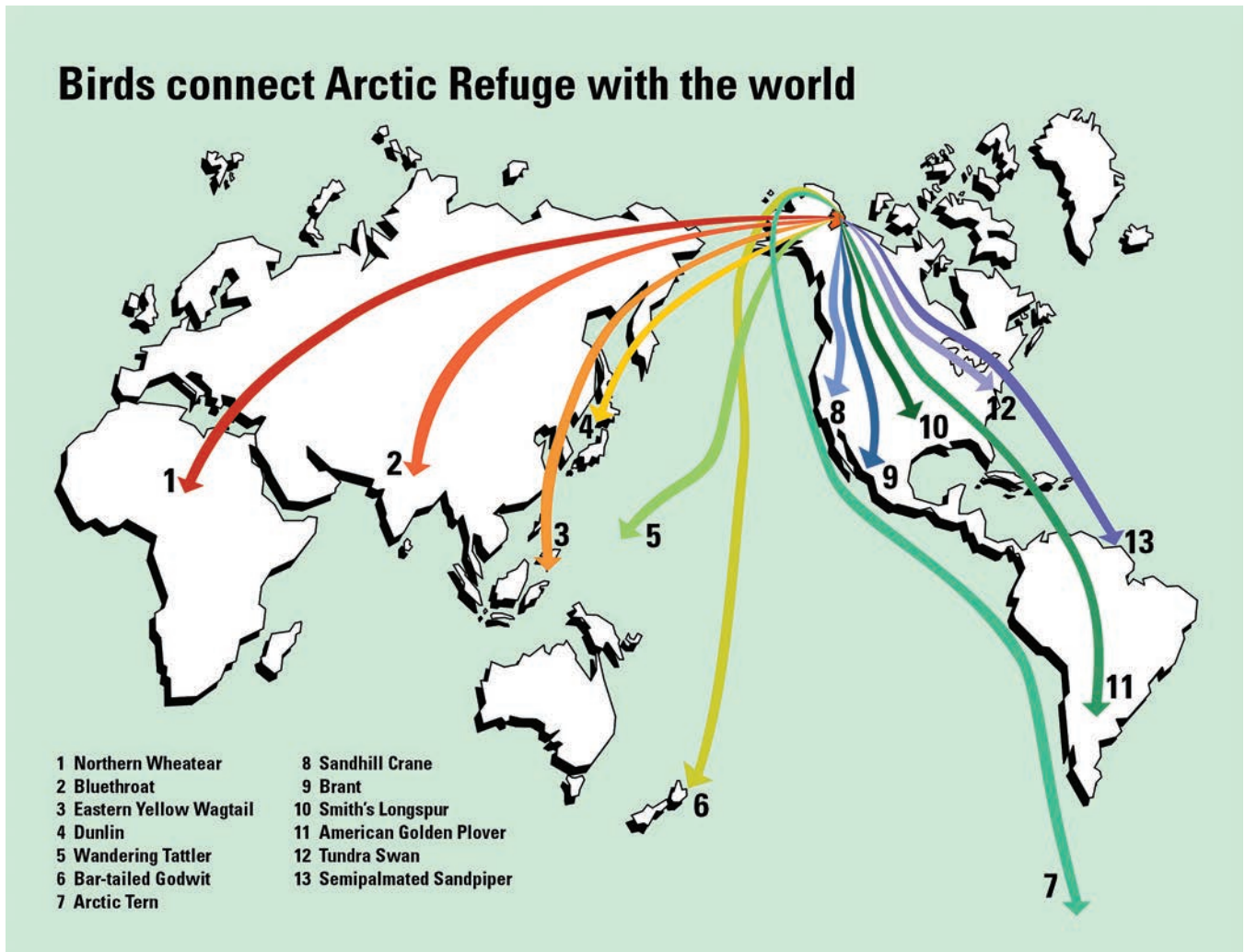


Figure 3—Schematic of 13 bird species, including dunlin, that migrate from the Arctic National Wildlife Refuge to other countries during the course of one year.

spills and shipwrecks. The wilderness areas of the refuge and the relatively unaltered habitat of the North Slope of Alaska provide habitat essential for this species' life cycle. The importance of these wilderness areas may become ever more critical to the survival of this species.

Polar Bears

The Arctic Refuge is home to members of the Southern Beaufort Sea population of polar bears. Polar bears that den on the refuge range over a large area in Alaska and Canada (fig. 4). Every year during the winter, several of these impressive animals come to the refuge to den and give birth on the adjacent uplands of the Arctic Refuge coastal plain. Up to 50 others congregate along the coast of the refuge in October and November. The bears spend most of their time on the drifting pack ice, feeding, resting, and denning. Each year, however, many of the pregnant females come to shore to dig maternity dens in snowdrifts.

Along Alaska's coast, the highest density of polar bear land dens occurs within the Arctic Refuge. Many more dens have been found here than would be expected if bears denned uniformly along the coast. One reason may be that the refuge coastal plain and northern foothills have more uneven terrain than areas to the west, allowing snowdrifts to form more readily. The Arctic Refuge is the only U.S. conservation area where polar bears regularly den and is the most consistently used polar bear land denning area in Alaska.

Polar bears den, breed, and forage on sea ice throughout the year. The Southern Beaufort Sea polar bear population is facing rapid change in their preferred habitat. Sea ice extent in the Arctic is receding at an unexpected rate. On May 14, 2008, the United States listed the polar bear as a threatened species under the Endangered Species Act because of the predicted continued loss of sea ice in the arctic. As sea ice disappears, the importance of the Arctic Refuge wilderness to polar bears as a place of refuge increases.

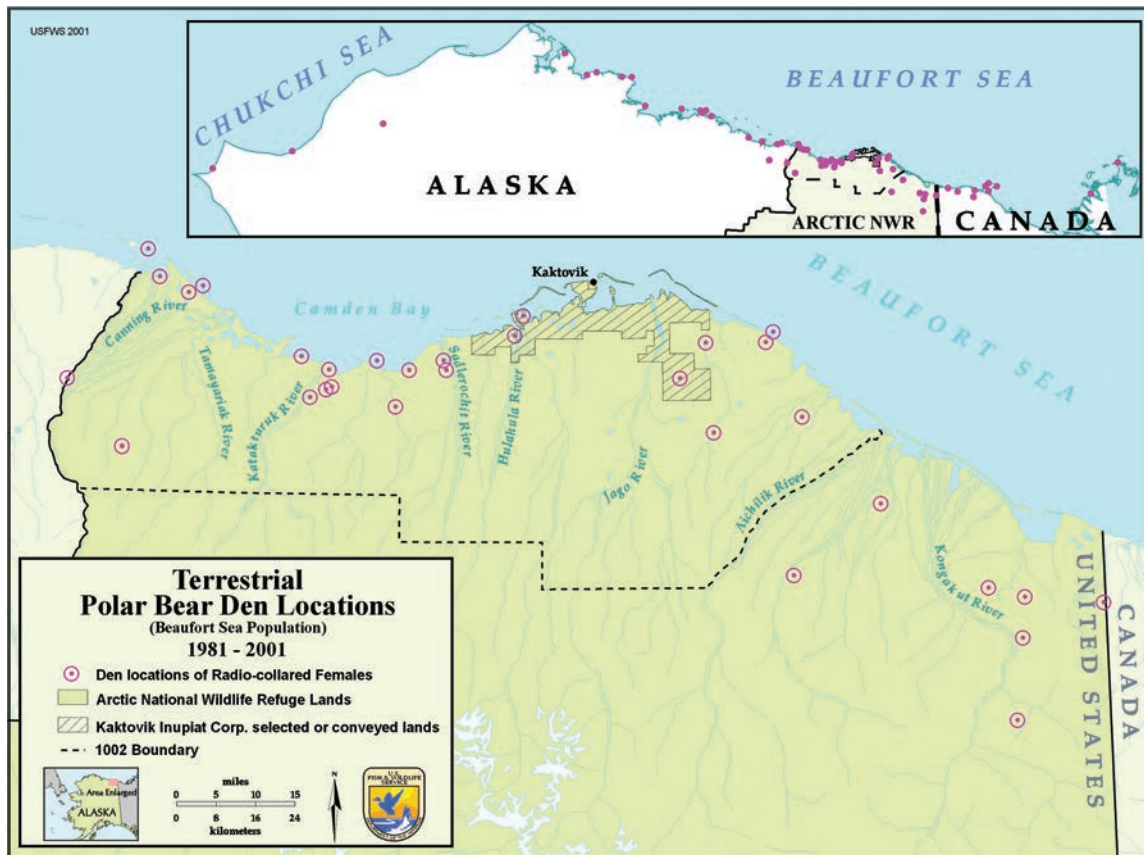


Figure 4—Terrestrial den locations of the Beaufort Sea population of polar bears.

Discussion

The three species discussed, caribou, dunlin, and polar bears, are just a fraction of the species that depend on the Arctic Refuge wilderness during part of their life cycle, and the wildlands and waters of other countries for other parts of their lives. In addition, there are many other North American migratory species that rely on habitat in two or more countries. We, therefore, have numerous opportunities for international cooperation to protect important wildlife habitat.

The U.S. Fish and Wildlife Service has a long-standing commitment to assist other nations in the conservation of wildlife species that share or cross United States' borders or whose range is on foreign soil. These obligations are contained in numerous treaties, laws, agreements, and cooperative programs with other nations. The Division of International Conservation cooperates with domestic and foreign governmental agencies, national and international non-governmental conservation organizations, universities, and other interested parties to conserve wildlife and their habitats. This is accomplished by strengthening the capabilities of local institutions to cultivate and train local nationals to effectively manage natural resources by focusing on enforcement of protected areas, buffer zones, and

corridors; catalyzing conservation partnerships at local and international levels to raise public awareness; and promoting communication and information exchange among communities, institutions, and countries.

An excellent example of a mechanism that promotes international cooperation on wildlife conservation is the Canada/Mexico/U.S. Trilateral Committee for Wildlife and Ecosystem Conservation and Management. The Trilateral Committee, which has been active since 1996, facilitates and enhances cooperation and coordination among the wildlife agencies of the three nations in projects and programs for the conservation and management of wildlife, plants, biological diversity, and ecosystems of mutual interest. The Trilateral also facilitates the development of partnerships with other associated and interested entities.

Species-specific agreements play an important role as well. There is already extensive international cooperation on studying and understanding the lives of polar bears. For example, there is an *International Union for Conservation of Nature* Polar Bear Specialist Group, and an International Agreement on the Conservation of Polar Bears signed in 1973 by the United States, Canada, Denmark, Norway, and the Union of Soviet Socialist Republics. Under this Agreement, the countries coordinate research programs related to the conservation and management of polar bears and exchange

information on management programs. Canada and the United States also work together to protect caribou through an Agreement on the Conservation of the Porcupine Caribou Herd and the International Porcupine Caribou Management Board.

Including wilderness as a component of wildlife conservation efforts could greatly enhance these international wildlife conservation treaties, agreements, and cooperative programs that have resulted in active partnerships accomplishing effective conservation on the ground. Unfortunately, the role wilderness plays in the conservation of wildlife has typically been undervalued. However, a new international agreement—the Memorandum of Understanding (MOU) on Cooperation for Wilderness Conservation—was signed by representatives from the United States, Mexico, and Canada at the 9th World Wilderness Congress in November of 2009. This timely agreement recognizes the growing evidence of the importance of wilderness conservation in climate change adaptation and mitigation and monitoring for climate change effects; the outstanding opportunities wilderness provides for increasing our understanding of global climate change, ecosystem adaptation, and resiliency; and as some of the least manipulated environments left, wilderness provides connectivity and wildlife migration corridors.

Formally protected wildlands and wild waters will help us meet the challenges of climate change and conserve wildlife. Recent studies suggest that to enable many species to endure climate change, we must establish relatively large, diversified, intact habitat areas to protect primary ecosystem functions (Locke and Mackey 2009). Providing connectivity among these areas is one of the best strategies

to allow species to adapt to a changing environment and for ecosystems to persist (Heller and Zaveleta 2009).

It is critical that we expand our pre-existing treaties, agreements, and MOUs on international wildlife conservation. We must develop programs that recognize the value of wilderness to wildlife conservation and our response to climate change, and incorporate wilderness conservation into their objectives. Wilderness areas can serve as protected corridors of intact ecosystems and limited human activity that can help increase resiliency, redundancy, and representation of habitats for native species. These efforts must also include international partners, to ensure that all the ecosystem components required by shared species are evaluated and protected. By enhancing hemispheric partnerships to preserve critical habitat as permanently protected wildlands, we may have a real chance at realizing our shared vision of protecting migratory wildlife. Only by working intensively with countries with which we share many of “our” species, will we truly have a chance to preserve sufficient habitat to permit their continued existence.

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String of Turquoise: The Future of Sacred Mountain Peaks in the Southwest United States and Mexico

Linda Moon Stumpff

Abstract—The Southwest is the birthplace of wilderness policy in the United States, yet the unique ecological environments of its peaks, cordilleras, and ranges that dot the high desert remain only partially protected. Some areas are relatively secure, yet mid-century Federal policy responded to multiple development pressures, from ski basins to roads, that sliced these peaks and their associated high-country environments into zones for different kinds of development. This string of jewels that crosses from the United States into Mexico was once protected by isolation and a variety of limited protected zones. Today, the mountains' precious resources of water, wildlife, forests, and traditional ecological knowledge are being sliced by new uses and impacts that are amplified by global warming. International cooperation and extension of protection to include sacred cultural resources can provide solutions that must be pursued without hesitation.

Introduction

The Southwest is the birthplace of wilderness policy in the United States, yet the unique ecological environments of isolated peaks, cordilleras, and ranges that dot the high desert remain only partially protected. Some areas are relatively secure, yet mid-century federal policy responded to multiple development pressures, from ski basins to roads that sliced these peaks and cordilleras into zones for different kinds of development. Today, threats from heavy motorized recreation, mining, development, and other pressures are heightened by global warming.

These mountains are the key to adaptation and mitigation of the effects of drought and floods—the likely effects of climate change. They are long known by the indigenous cultures as sources of retreat, traditional ecological knowledge, and spiritual well-being.

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

Climate change amplifies the effects of a number of threats to these areas. A lack of understanding of the natural connectivity between these areas, now cut in half by a border fence, threatens both cultural knowledge transmission and biodiversity.

To think about mountains is to think about what they are to us at the borderlands, at the centers of being, not at the edges or as boundaries. Then, one realizes that they are the first line of defense against cultural disintegration, and the tipping point of climate change. From an indigenous perspective, think about them not as isolated peaks, but as radiating centers of connectivity to the surrounding lands, wildlife, and people, as the fountains that feed rivers and underground water resources, and as the craggy nests of indigenous knowledge. If we explore what sacred mountains mean in these borderlands, we can get a snapshot of what is elsewhere much the same.

Maps, Mountains and Minding the Sacred

Envisioning a string of turquoise peaks did not emerge from looking at maps, but from consideration of the peaks as resources for traditional ecological knowledge. Maps are prepared for a variety of reasons, but they are usually based on political boundaries, elevation or physiographic regions, lines of administrative authority or the physical characteristics of mountains like high point, accessibility, location, and context or dimensions, wilderness zones, or geological features (Jolyan 2006). Existing maps were too large or too small to focus on the meaning of the peaks and tended to make the peaks look like islands. Mountains themselves are hard to define, and agreement about measuring the key attributes of elevation is not always in place. Attributes are highly variable and attempts to define their dimensions are difficult because ranges are often disarticulate; multiple peaks meld into each other in cordilleras, while rolling foothills and mesas lift the mountain proper to its final height. The relative term of conspicuity attempts to tie these various attributes together:

A mountain, strictly speaking, is a conspicuous elevation of small summit area... An essential and yet indefinite element in the definition of a mountain is the conspicuity... Conspicuity, like height, is a relative matter, and depends upon the personal evaluation or the standard by which it is measured. Mountains should be impressive: they should enter the imaginations of the people who live within their shadows (Prattie 1936).

Attempted definitions tended to isolate peaks, and this led to slicing up the mountains and taking their key role as refugios (refuges)—holding the essence of wildness and traditional ecological knowledge all the way down their slopes—out of context. Under conditions of global warming, their slopes become all the more important for plants and animals readjusting to new conditions. Horizontal administrative classifications protected peaks at higher elevations at a higher standard, but destroyed their connectedness and function in the ecosystem. The very carving up of mountains defies their vertical nature and multiple life zones with crosscutting horizontal regimes of use.

With the help of Paul Olson, I was able to create a metaphoric map that shows this necklace of sacred peaks and cordilleras that swing down into Mexico and hold the great pendant of the Sierra Madre (fig. 1). Google Earth provided the technology and the sacred peaks did the rest. From this type of mapping emerges a visible string of turquoise encircling the border and connecting the Southwest highlands to the Sierra Madre. This emergent string of peaks is no less than the supporting structure for biodiversity for the southwestern United States and northern Mexico. The metaphoric map reveals a system based on connectivity of the movements and activities of water, animals, and people, especially the Tribes whose relationships and resources are split by political borders and mapping categories—Seri, Yaqui, Apache, Tohono O’odham, Raramuri, Huichole, and others. Seen as a connected group, these sacred mountains act as religious portals for indigenous people and connect the paths of people, animals, forests, and water as they flow south to the Sierra Madre Occidentale.

An Indigenous View of Sacred Peaks

From the viewpoint of many indigenous people, mountains take on key functions and peaks mark the territorial axis around which cultures engage with the natural ecosystem. In ancient times, sacred mountains were intimately associated with water. Archeologists associate these sacred mountains, often those above 4,000 feet in elevation, with the cult of water (Garcia and Arturo 1999). Snow packs on the mountains of the Southwest are critical to multiple overlapping ecosystems, biodiversity, and the human water supply. In addition to this critical function, the peaks often mark the cardinal directions that place indigenous people in the center of their cultural and natural cosmos, in the space where human ecology became integrated within the ecosystem over the years. They link people back to creation and migration narratives that carry forward the knowledge from the past, forming prominent points in the visual and cultural landscape. Unlike political boundaries, they connect ecology with responsibility within indigenous religion. As geographical points, they are flexible open points that allow for passage and overlapping ecotones. Knowledge can be organized within a geographical domain (Blake 1999) and the cardinal points situate that ecological knowledge. The peaks highlight points indicating zones of influence and are primary for understanding the natural systems. In the first page of the Popul Vuh, this kind of centering is described:

Great was the description and the account of the time when all in the sky and on the earth was formed, the squaring

of its signs, the measure of its angles, its alignment and the establishment of parallels in the sky and on the earth, the four extremities, the four cardinal points (Castledine, 2009, p. 23).

More recently, Governor John Antonio, Sr. of Laguna Pueblo discussed the broader meaning of peaks as identifying zones of influence that ultimately move an agency-proposed boundary:

Many Laguna elders speak of guardian peaks that surround the mountain. While these guardian peaks do not constitute a boundary per se, their distribution is significant in assessing the boundary of the traditional cultural property delineated by the Cibola National Forest (Antonio 2009).

Another important aspect of the indigenous view is the representation of mountains as spiritual homes and the belief that the mountain itself holds knowledge and life. For that knowledge to be preserved, the mountain must be treated with respect. Mountains as homes of the mountain spirits are sources of knowledge, ceremony, and cultural identity. Traditionally, most groups used mountains for sacred ceremony and restricted uses that impacted their character and functioning as supports for multiple life zones. Ecologically and culturally, they represent spiritual homes through multiple sacred sites and features. Functionally, they are home to the mountain spirits and to a multiplicity of plants and animals, without division of their cultural and natural aspects.

Turquoise by Turquoise Mountain: Mt. Taylor-Tsoodzil

Each mountain range or cordillera in the string of turquoise has a special cultural, historical, and ecological significance. Mt. Taylor, or Tsoodzil in the Dine (Navajo) language is the sacred turquoise mountain and the cardinal point of the south, fastened between sky and earth by a great flint knife decorated with turquoises. To the Acoma, it is the home of The Rainmaker; to the Zuni, it is the “lightning hole.” It sits near the turquoise trail that reached across the borderlands, connecting ecosystems and people. The mountain holds extraordinary significance for a number of tribes with its surrounding group of six guardian peaks and mesas.

At over 12,000 feet, Mt. Taylor holds the snowpack, making it a major source of water for the region. Its cordillera hosts abundant game, deer, mountain lions, and eagles that are important culturally and for preserving healthy gene pools. Its natural resources are matched by the enormity of its cultural resources, with key religious sites for numerous tribes. At the same time, various uses like recreation predominate and no logging has occurred since 1946. “But now and certainly in the future, recreation is the dominant use” (Jolyan 2006, p.110). The question remains: what kind of recreation and what will be the impacts?

In Dine narratives, the mountain is the place where the monster was slain by the hero twins, where his blood became the great lava flows. Today, it is regarded by energy developers only as a source of uranium. Dine thought holds direct relevance to nuclear culture through applying the term “nayee”—that which gets in the way of a successful life (Yazzie-Lewis and Zion 2007). In her chapter, Esther Yazzie-Lewis sees this story replayed today with the initiative to



Figure 1—Focus map for String of Turquoise peaks.

reopen the uranium mines surrounding Mt. Taylor. These mines have bad history, creating a boomtown environment where violence and radiation disease spread through the families of the workers, Dine people who were uninformed of the dangers and worked without protective equipment. She names the monster Leetso, or yellow earth, because tradition says that to name an evil is to confront it. Further, she sees a monster that feeds on power and creates other monsters: the energy development industries and the war industries. To counter such a monster of disrespect and greed for power, she recommends the balance of respect and group action (Yazzie-Lewis 2007).

This year, six tribes proposed listing the mountain under the Historic Preservation Act. Their successful efforts took the first step in the battle. At 4 p.m. on June 5, 2009, the announcement went out of the unanimous vote for listing Mt. Taylor as a traditional property under state listing. Tsoodzil got a reprieve. In the paperwork, 316,456 contributing resources including pilgrimage trails, plants, animals, mineral gathering sites, and viewsheds were listed. However, it is to be noted that private property holdings between the patchwork management authorities of the USDA Forest Service, BLM, and the Laguna Tribe were not included in the listing. The tribes gained the right to consult with the state, but a multiplicity of management regimes with decision-making powers subject to development pressures still crosscut the mountain. The listing will not prevent mining or other development, but it will halt expedited mining permits.

The Great Sitting Mountain of the Pinalenos: Mt. Graham (Dzil Nchaa si'an)

Mt. Graham was originally part of the Apache Indian trust lands through treaty. It was removed from the Apache Reservation by an executive order in 1873. Wilderness designation and remoteness left much of the summit undeveloped until the observatory initiative led by the University of Arizona began. Ultimately, they gained congressional support to remove all Federal environmental laws in order to construct a system of observatories and facilities for the study of astronomy. Earlier partners included the Smithsonian, Harvard, and the Max Planck Institute in Germany—all of these institutions backed out when air quality and indigenous religious rights became central concerns. Today, the University and the Vatican continue on in their pursuit.

Building the astronomy structures entailed logging and construction of a road system that would never have passed environmental laws. Because of the installations, the natural fire regime must be disrupted and intensive fire-fighting operations conducted to protect the buildings. Only a special act of Congress permitted the construction projects that threaten the red squirrel, an endangered species, remove old-growth, and violate the religious rights of Tribes, particularly the Apache. The Forest Service administers the area, but is barred from applying environmental laws. At one point, the University of Arizona threatened tribal members with arrest for praying on the mountain without a permit. The project has been identified by the United Nations as an egregious violation of the religious rights of indigenous people. The University continues its work, dogged by delays, protests, and a growing body of evidence that the site is less than top-notch due to visibility concerns.

This sacred mountain is a spiritual home to Apache people. Several nonprofit organizations were created to protest the current use, which violates the sacredness of the mountain as home to the mountain spirits and as a site for religious activities. By ecological parallel, it is the home to diverse species, arguably containing all eight life zones found in North America—if monsoon season is considered—that are violated by the roads and construction.

A Million Lights: The Huachucas, The Chiricauhuas, and The Dragons

These ranges run along the borderlands and contain numerous endemic species including rare reptiles and birds. Cut by a mix of administrations—National Park Service, USDA Forest Service, BLM, state, military, and private holdings—no consistent policy protects their fragile ecology while their connected ecosystems are attenuated by the border.

Dotted with important sacred sites and formations now battered by intensive recreational demands from surrounding urban areas, they remain in grave danger from heavy off-highway vehicle use. Intensive recreational use and proximity to housing developments and urban areas means high fire danger, cell towers, mining, motorized recreation, and disruption of the cultural meaning and use of the mountains. These areas are included in the Apache Highlands Eco-Region described by the Nature Conservancy.

The Sierra Madres: The Greatest Jewel

From the string of turquoise hangs the great pendant of the Sierra Madre Occidentale, a mosaic inlaid with a thousand colors of life. The diverse forest environments range from the subtropical coniferous forest to mixed pine-oak-madrone forest, to the grasslands and desert grasslands of the Chihuahuan Desert foothills, the canyon slopes, the cypress riparian habitat, to the blooming, fruit-laden canyon floors, from sierra dry pines to the dry tropical deciduous forests to the thorn forests and the tropical riparian habitat of the Fuerte River; the total estimate from botanical studies suggests that there are more than 3,500 plant species here. The Sonoran Desert, just to the north, harbors more unique diversity, reflecting the high level of endemism of the Mexican dry forests—the highest of all Neotropical dry forests. A conservation group from the United Kingdom has mapped out 218 endemic bird areas of which 22 are in Mexico (www.canyontravel.com).

Biodiversity is mirrored by cultural diversity. The Raramuri (Tarahumara is a Spanish corruption) maintain a rich spiritual ideology and strong cultural identity connected with the Sierra Madre in some of its roughest regions around the Copper Canyon. Despite its ruggedness, the region supports a fragile ecosystem. The Huichole people remain closely linked to the land through their religious beliefs:

For the Huicholes, the land is the fundamental point of reference for everything from the religious to the productive and the political. In recent times, the land has become the axis around which a territorial organization has been created, which has made it possible to confront eternal forces that stand in the way of their continued existence as a distinct culture (Angeles and Arcos, 1999).

Key to the cultural identity and cosmogony are pilgrimage routes across the Sierra Madre that join the Pacific coast with the Gulf of Mexico. The Huichole Route through the sacred sites to Huiricuta, referred to as “an itinerant Meso-American University, the main axis of a knowledge system based on nature” was submitted to the World Heritage Office as a nomination for the World Heritage List (whc.unesco.org/en/tentativelists/1959) and was promoted again for the World Heritage Convention list in 2004. On the route, deer, clouds, and other elements are identified as “older brothers” or “teachers,” a clear indication of gathering and continuing traditional ecological knowledge. Since 1994, a small non-profit organization in Mexico called Conservacion Humana has been helping the Huichole people conserve some of their sacred sites with assistance from the Hopi Tribe in the United States. Work continues to provide some form of protection for the entire route. Indigenous Tribes, Yaqui, Pima, Apache, and others hold ancient relationships to these mountains.

The Baboquivaris: Tiny Bit of Wilderness and the Water of Life

These mountains wind along the borderlands with mixed administration from the Bureau of Land Management and the Tohono’O’odham Tribe. The tip of the unique Baboquivari summit is designated as a wilderness area, the smallest in the system in Arizona with around 2,065 acres. The rest of the mountainous system and its surrounding context as the traditional home of the Tribe is impacted by illegal immigration. The Border Patrol crisscrosses the area in pursuit, the border fence cuts through it, and the Tribe pours millions into law enforcement in an effort to protect its sovereignty, people, cultural sites and natural resources. Tribal members have organized into groups to protest the wall. Their Tribal Chairman Ned Norris, Jr. testified against the wall:

We are older than the boundary with Mexico and had no role in creating the border. But our lands are now cut in half, our sacred sites, salt routes and our families are divided (Norris 2008).

The sacred nature of the peak as the protector of water is echoed by its ecological function as a major source of underground water. It is home to distinctive wildlife and flora. A floristic survey in 2005 identified 16 new species in the Sonora (Van Devender and Reina 2005) in this little-studied area, many of which have traditional uses. Gentry’s Indigo Bush, an endangered species listing, is among them. Many species, including tribal members and jaguars, become entangled in the border fence. The peak was divided in half by Executive Order in 1917, leaving the Tohono O’odham with only the western half, despite their continued religious and cultural use of an area central to their cosmology, the center of the earth, and the dwelling place of the creative force I’itoi.

Better cooperation and support for the Tribe is needed. Consultation for a tribally managed wilderness area and co-management at a higher standard is a realistic alternative that provides for biodiversity and environmental justice. Respecting the religious and cultural sites of the Tohono O’odham will only bring more respect and protection to the mountain.

Sierra Blanca

This peak in southern New Mexico is sacred to the Apache. Access to the summit is limited by the Mescalero Apache Indian Tribe, except by permission. Parts of the mountain fall under the Forest Service’s administration. The Forest Service opened a ski-basin resort permit and the Tribe decided to manage the permit themselves, rather than let a private business do so. In this way, it can be managed with respect to Apache values and beliefs.

This mountain represents the southernmost location of the Arctic Life Zone, and the southernmost point in the United States to have a glacier in the last Ice Age, 12,000 years ago. Its climate and beautiful forested surroundings attract significant tourism. The Tribe removed areas on the mountain from logging and works to reduce fire hazard, the primary threat to these southern, dry forests, with prescribed burning and thinning. The Tribe has pursued a unique co-management type of agreement with the U.S. Forest Service lands through a Stewardship Contract. Nevertheless, global warming presents increased fire hazards, while only limited funds are available to reduce fire hazards.

The San Francisco Peaks

The San Francisco Peaks are sacred for Dine (Navajo), Apache, Hualapai, Yavapai, Hopi, and other Native Nations. These Tribes conduct a number of ceremonies there for healing, balance, passages, and for the worlds’ water and life cycles. The Peaks mark the western cardinal direction for the Dine and are important religious sites for at least 13 Tribes. The privately run Arizona Snowbowl concession and the USDA Forest Service proposed a plan to expand the Snowbowl ski resort and to use recycled sewage to make artificial snow. In recent years, the Snowbowl has reduced its open days due to lack of snow, a condition likely to continue due to global warming and the southern location of the ski area.

Native nations and environmental organizations lost a final round of their legal battle opposing the expansion and the sewage-to-snow scheme in 2009 when the Supreme Court refused to hear their petition for review of a previous pro-development decision that reversed an earlier decision in their favor in the 9th Circuit Court. Since the treated sewage water has endocrine levels that are not determined by testing or regulation, the mounting evidence of impacts to human health and to fish and water quality in streams affecting biodiversity creates a clear and present danger. Environmental groups and university scientists opposed the expansion and a nonprofit organization called “Save the Peaks” was formed, leading to a “Save the Peaks Coalition” with a broad array of partners. In 2009, the Navajo Nation Council passed this resolution:

The Navajo Nation hereby finds that the proposed desecration of Dook’o’osliid (San Francisco Peaks) and the en banc opinion in *Navajo Nation, et al. v. United States Forest Service, et al.*, 535 F.3d 1058 (9th Cir. 2008) constitutes an emergency matter which directly threatens the sovereignty of the Navajo Nation (Navajo Nation Council 2009).

Summary Proposal

The summary of this article is a proposal to counter the current threats and inadequate protection for the cultural, religious uses and sacred nature of this string of turquoise peaks that span the southwest border into Mexico. The current system of extremely limited protections, most of them only for the highest elevations, is wholly inadequate under conditions of modern development and access, and of global warming. It is proposed to establish a string of protected mountains threaded together by non-motorized trail systems, migratory paths, and conservation easements. This is essential to the protection of four major migration routes in the borderlands, because these peaks and their mountainous mesa systems and grasslands are where species on the move from global warming go. They hold the water and the multiple life zones that species need. This wilderness-connected design must be flexible and nonlinear, with clear conservation standards that protect indigenous rights and ecological systems. It is suggested that in many cases, only wilderness policy has the strength, clarity, and flexibility to stretch over such sensitive regions with respect to their sacred and sensitive natures, and to provide an alternative to the border wall. In many cases, tribal management and co-management of extended areas protecting wild values is needed, and interagency and international cooperation required.

The overall conceptual design is no less than a large and significant collaborative international initiative on both sides of the border. It returns the region to an indigenous system by referencing sacred peaks as the key indicators and protectors of the multiple ecosystems, ecotones, and ecological zones of stewardship backed by collaboration. It restores the potential for resource adaptation under conditions of global warming, including migration routes and movements up and down ecological zones. It is essential that areas between and around the sacred peaks be treated with respect, that conservation standards be adopted and that incentives and support be put in place to help those who conduct agriculture in these areas to reduce impacts.

By accepting the important role of supporting indigenous religious and cultural rights, it becomes possible to use the whole suite of cultural and historic preservation laws in tandem with environmental laws and wilderness designation to protect the future of the String of Turquoise. This new direction ends the path of conservation evictions and

conservation refugees. Groups like Defenders of Wildlife and the recent coalition of groups at the 9th World Wilderness Conference (November 2009) understand this. Taking the high road of inclusiveness and intercultural respect means avoiding the loss of native foods, culture, and religious sites. Through the protection of sacred peaks, traditional ecological knowledge and sustainable ways of living on the land are preserved. We can all be inspired by the words of the Governor of the Zuni Tribe:

These mountains are living beings. They were created during the time when the earth was formed, and since then they have provided and maintained life to all living beings (Cooyate 2009, p.2).

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

4. EXPLORING WILDERNESS MEANINGS



Photo courtesy of Steve Carver

The Socio-Cultural Value of New Zealand Wilderness

Kerry Wray

Abstract—New Zealand’s wilderness resource has become iconic on both a national and international scale, and provides an important source of cultural identity for many Kiwis (a colloquial term for a New Zealander). Now, in the early 21st Century, however, social changes such as urbanization, globalization, increasing consumerism, and growing international tourism may be eroding the traditional values and practices that underpin New Zealand’s wilderness heritage. This paper explores the complex phenomenon of wilderness in contemporary New Zealand society. It addresses questions such as:

- What does wilderness mean?
- Why is it important to those who venture within it? and
- How is it being affected by social and environmental changes?

It is argued that the protection of wilderness is critical to New Zealand society for social and cultural (as well as ecological) reasons. Wilderness in New Zealand represents a historical affinity with the land and the natural environment and is viewed by many as a cultural icon. Wilderness provides important connections to a proud pioneering heritage. It represents a legacy and is interpreted as a gift to future generations. Protected area managers require a deeper understanding of the ideas and philosophies behind wilderness in order to maximise the personal, social, and environmental benefits wilderness can provide for society.

Keywords: wilderness protection, social values, cultural identity

Introduction

New Zealand’s wilderness is of great importance to the nation for a variety of social, cultural, political, ecological, and economic reasons. The wilderness landscape is recognized—nationally and internationally—as one of the country’s defining characteristics (Bell 1996; Bell and

Lyall 2002; Clark 2004). It provides a setting in which New Zealanders can practice a variety of ‘traditional’ outdoor recreation activities such as tramping, hunting, fishing, and kayaking. (Tramping is a New Zealand term, used to describe the activity of extended walks or ‘hikes,’ generally with a back pack and on conservation land. The term also has cultural connotations, involving connections with the landscape. Tramping is known elsewhere as ‘hiking,’ ‘trekking,’ ‘walking,’ or ‘rambling.’) Wilderness is also habitat for a large number of rare and endemic species of flora and fauna, and has significant economic value because of the way it is used to promote New Zealand as an international tourist destination. Various studies have highlighted the economic and ecological value of New Zealand wilderness (e.g., Cessford and Thompson 2002; DOC 2005, 2006b; Molloy and Reedy 2000; Shultis 1997), but the social values have been neglected in academic research until now.

Recent international studies have emphasised the need for socio-cultural wilderness research (e.g., Patterson and others 1998; Watson and others 2004; Williams 2000, 2002a), and developments such as increasing international tourism and proposals to allow extractive activities in the wilderness resource have brought to light growing tensions over the meaning and use of wilderness in contemporary New Zealand society. As yet, however, no one has explored these issues in New Zealand through academic research. Little is known about the people who visit New Zealand wilderness, the values they hold for these places, and the potential effects of broader social changes on the country’s wilderness heritage. The current paper aims to address this research gap through a discussion of the socio-cultural meanings and values of New Zealand wilderness. It is based on data from a doctoral research project that explored the phenomenon of wilderness in New Zealand through the eyes of wilderness recreationists.

Existing Research

Over the past few decades, there have been some major changes in the theoretical and methodological approach to wilderness research. In broad terms, there has been a shift from behavioural approaches to wilderness toward more socio-cultural and human geographic research programs, adopting a variety of qualitative methods. Rather than assessing wilderness motives or visitor satisfaction levels (as was the focus of earlier wilderness studies), the socio-cultural approach emphasizes the multiple meanings and interpretations of wilderness. It focuses on the nature of the experience, and seeks to understand the meanings and values that different groups in society ascribe to wilderness. Examples of socio-cultural wilderness studies include, among

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others, Alessa and Watson (2002); Cronon (1995); Grant (1998); Low (2002); Schrepfer (2005); Watson and others (2004) and Williams (2000, 2002a, 2002b).

Findings from these studies have given strong support to the idea that what we understand and denote as wilderness is socially constructed. For example, Williams (2000, p. 78) noted: "it is impossible to talk about the meaning and value of wilderness without acknowledging to some degree the role of culture in giving meaning to things." Strong links have also been identified between wilderness and national identity in many countries. Schuster and others (2005, p. 116) found that "Wilderness seems to be one path to the creation and continuation of American heritage, history, and national identity," and Williams (2002a, p. 123) claimed that "Recreational use of wilderness and nature became a ritual for reproducing the frontier experience and what was taken to be American character." Grant (1998, p. 39) concluded that the contemporary Southern Canadian understanding of wilderness is an "identity myth" that has developed because of a desire to protect and maintain their idealistic view of the arctic as a pristine wilderness. Schrepfer (2005, p. 8) wrote that protecting the American wilderness "preserves centuries of a multi-layered, cultural history of meanings imposed upon meanings, realities laid upon fantasies, and fantasies set against the force of very special places." (See also Borrie and Roggenbuck 1995; Eriksen 1993; Low 2002).

The key message underlying these studies is that wilderness meanings are inextricably interlinked with the social and historical context in which they occur. They are "anchored in history, and culture, and not simply the inherent, enduring, tangible, and visible properties of nature" (Williams 2000, p. 78). An understanding of the way these meanings are created, negotiated, and contested is, therefore, seen as "necessary for the effective allocation and management of wilderness" (Williams 2000, p. 77). Without this knowledge, managers are likely to be "ill prepared to provide recreation opportunities to suit the diversity of cultural values, norms or lifestyles of the recreation clientele" (Williams and Carr 1993, p. 210) (see also Borrie and others 2002; Patterson and others 1998; Watson 2004; Watson and Williams 1995; Williams 2002a). The social and cultural meanings of New Zealand wilderness are the focus of this paper.

Background: New Zealand Wilderness

This research was conducted in an area of New Zealand wilderness. Over one third of New Zealand's land mass is protected in parks and reserves, including six officially designated wilderness areas. Wilderness areas are a particular classification of public conservation land, which is afforded significantly high protection from human use and development. In addition to its significant ecological value, wilderness in New Zealand also has strong cultural connotations. The wilderness movement was central to the development of a new national identity that distinguished New Zealand from England, following independence in 1947 (England formally granted New Zealand the right to independence in 1931, but the New Zealand Parliament did not officially accept the offer until 1947) (Bell and Lyall 2002; Clark 2004; Lochhead 1994; Shultis 1997; Sinclair 1986). Wilderness formed the basis

of this new identity in several ways. First, it distinguished New Zealand from England by providing a unique natural habitat for species that were found nowhere else in the world. Second, the wilderness landscapes enabled New Zealanders to showcase their outstanding natural heritage (in contrast to the cultural/built heritage of England). Third, wilderness embodied the pioneering ethic of adventure and exploration, which helped to define New Zealand settler society and to distinguish it from Europe. And finally, wilderness symbolised two of the fundamental values of early New Zealand society that were believed to be lacking in England: freedom and egalitarianism (see Barr 2001; Bell 1996; Devlin 1995; Molloy and Potton 2007; Shultis 1991).

Specific legislation that defined wilderness areas and recognized the value of wilderness was developed in New Zealand in the 1952 National Parks Act. This was based on the philosophies and ideas embodied in the United States wilderness movement. It lasted until the mid 1980s, when outdoor recreationists and conservationists began to lobby the government for a change in the legal definition of wilderness to better reflect the country's unique social, political, geographical, and ecological situation. They desired a more 'indigenous' version of wilderness (Shultis 1997), which would "give future generations the same opportunities to pioneer" and to explore in wild nature (Barr 2001, p. 18). The lobbying was successful, and the legal definition of wilderness was refined and modified to create a much more exclusive and 'purist' concept than in other countries such as the United States or countries in Europe. (The Wilderness Policy 1985 provides the most comprehensive description of the legislative concept of wilderness in New Zealand. It was developed by a government appointed group, following the 1981 New Zealand Wilderness Conference).

While permitted in wilderness areas in many similar Western countries, developments such as tracks, huts, bridges, sign, and motorised access are now strictly forbidden in New Zealand wilderness. (For cultural and historic reasons, aircraft access is allowed in particular sites in some Wilderness Areas in New Zealand during the popular hunting season). Because of this, many remote areas of New Zealand conservation land are managed as wilderness, but cannot be legally designated as wilderness because they do not meet all of the strict legal criteria. The current study uses the terms 'wilderness,' 'wilderness setting,' and 'wilderness resource' to describe New Zealand wilderness areas and adjacent lands offering qualities of a wilderness experience.

Threats to New Zealand's wilderness heritage— Despite the cultural and heritage value of New Zealand wilderness, there are fears that social changes such as urbanization, globalization, increasing consumerism, and growing international tourism may be eroding many of the traditional values that underpin it. These values include freedom, egalitarianism, solitude, escape, self-sufficiency, and personal challenge. They were fundamental to the early New Zealand pioneering society, and remain highly regarded aspects of the traditional New Zealand wilderness experience. However, these values are not necessarily needed, or may no longer be compatible with, modern Western lifestyles.

New Zealand society is changing, and this is causing tensions to develop over the meaning, value, and importance of

wilderness. Over 85 percent of the New Zealand population now lives in urban areas (compared to less than 40 percent in the late 1800s), and fears have been expressed that Kiwis are gradually becoming disconnected from the country's wild areas as they are "softened by the experience of urban living" (Statistics New Zealand 2009, p. 2). Increasing international tourism is also causing tensions in the wilderness arena. The number of international visitors to New Zealand doubled between 1993 and 2006, to reach almost 2.5 million in 2007 (Tourism New Zealand 2008). The majority of these visitors come to experience the country's natural environment, but also bring their own values and ideas about how such places should be used. There are fears that this may eventually alter the way New Zealand wilderness is conceptualized and used (see Cessford and Dingwall 1997; Cloke and Perkins 1998; Coughlan 1997; Coughlan and Kearsley 1996; Kearsley and Higham 1997).

Another major concern is the recent Government plans to review existing legislation to facilitate mining for mineral deposits on conservation land. Although the proposals have generated significant controversy among the general public, the possibility that economic interests may outweigh any desire to protect New Zealand's wilderness from development still remains. A recent quotation from the current Conservation Minister, Tim Groser, highlights this fact. He was reported in the popular press as saying "If you can extract wealth from that [conservation land], that's what we should do" (Hotton 2009).

Methods

The methods employed in this research were designed to explore the experiences of New Zealand wilderness users. In order to combat some of the logistical difficulties associated with contacting this user group, clear geographic and temporal parameters were created. The fieldwork was undertaken in a specific area of New Zealand's wilderness resource: Fiordland National Park in South West New Zealand (fig. 1), and research participants were limited to those accessing a defined 'remote' or 'wilderness' area of the Park during the summer of 2004/2005 (fig. 2). Fiordland National Park is considered New Zealand's largest remaining expanse of 'wilderness,' and provides significant opportunities for wilderness recreation (DOC 1996). It covers an area of 1,260,200 hectares and forms part of the Te Wahi Pounamu World Heritage Area (DOC 2006a). The area is famous for its combination of rugged glaciated landforms, remote coastline, unique flora and fauna, abundant wildlife and extreme weather conditions (ibid.). The Park is also one of the country's most popular international tourist destinations (Ministry of Tourism 2009).

The study used two different qualitative research methods, research diaries and semi-structured interviews, to gather data on respondents' interpretations of the wilderness experience in the Park. Diaries were distributed to eligible participants before the start of their wilderness visits. They were asked to complete the diary on each day of their trip, recording details about where they went, what they saw, what they heard, how they felt, and anything that was important to them during that stage of their visit. A total of 67 completed diaries were returned. The sample included

a variety of activity types, ages, and nationalities (63 per cent New Zealanders versus 37 per cent overseas visitors), although it was heavily dominated by males (85 per cent males compared to 15 per cent females). This is indicative of the particular sub-section of the New Zealand outdoor recreation population (see DOC 1996). Nineteen interviews were then conducted with those recreationists who had completed a diary and were still available for further engagement. Questions focused on major themes that arose as a result of the diary analysis. Due to the time lag between the diary completion and the interviews taking place, most of the international respondents were no longer in the country, and consequently all but one interview participant was from New Zealand. Both the diary and interview data sets were qualitatively analysed with the aid of NVivo software. Because the focus of this paper is the socio-cultural value of New Zealand wilderness, findings presented here are entirely from New Zealand respondents. Direct quotations (from the diaries and interviews) are in italics.

Research Findings

I think that wilderness is a big part of Kiwi identity, and we should protect it at all costs. It's a huge part of Kiwi culture – the whole exploring, going on adventures, getting into the bush, fishing, boating, hunting and having to fend for yourself (F 134).

The above quotation encapsulates the feelings of New Zealand respondents about their country's wilderness heritage. The theme of culture and identity permeated almost every discussion about wilderness, thus highlighting its socio-cultural value. The three major ways in which wilderness contributes to New Zealand culture and identity are discussed next.

A means of national distinction—New Zealand nature helps New Zealand people define who we are, what makes us similar to each other and distinct from other people (Clark 2004, p. 6).

Wilderness was commonly described as something that distinguished New Zealand from other countries. Respondents believed that the mere existence of such large expanses of wild land rendered the country unique on an international scale:

We need to make the most of our wilderness because, in a global sense, we are one of few countries that still have some areas that are relatively untouched, and we still have reasonably easy access to these areas... That's what makes us quite different to many similar places overseas (D 007).

The unique natural environment that exists in New Zealand wilderness was also seen as a feature of national distinction. Supporting the concept of wilderness is a way for New Zealanders to protect the native biodiversity and thus part of their heritage.

I think that conserving these environments is important to New Zealanders for their identity. Because a large part of our identity is about the land and the amazing landscape that we live in – so preserving that is really important (N 202).

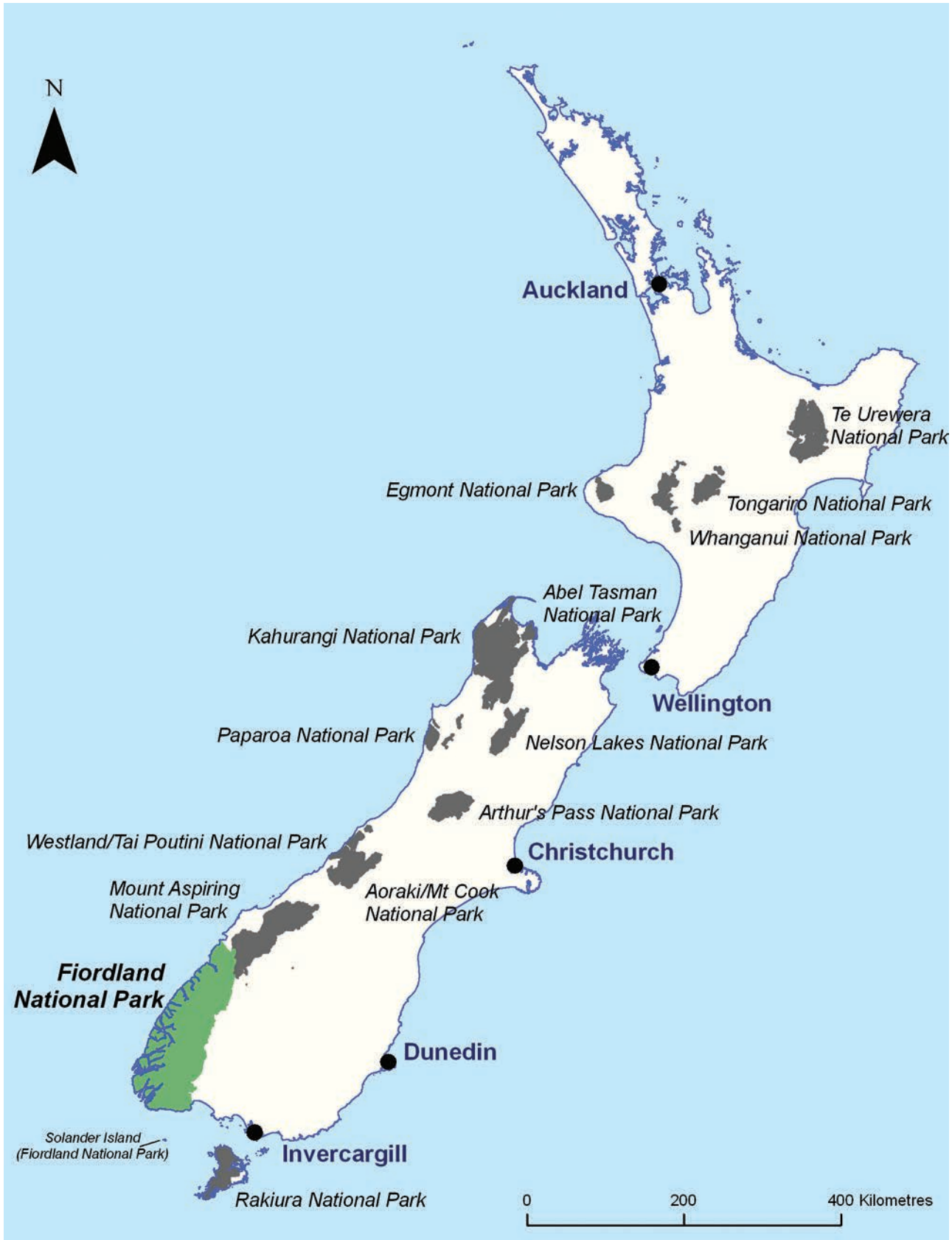


Figure 1—Fiordland National Park location.

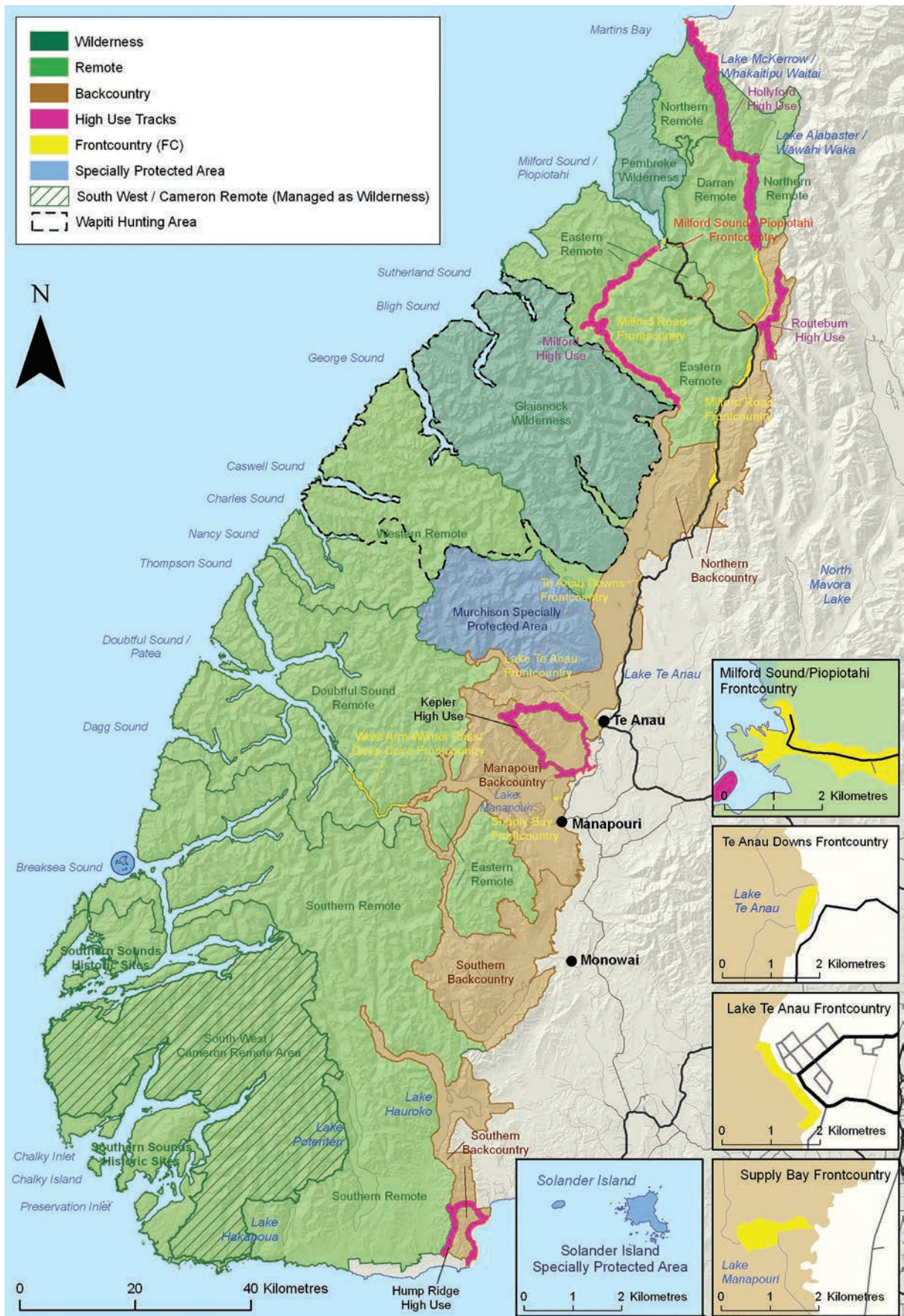


Figure 2—Remote and wilderness areas in Fjordland National Park.

In addition, respondents placed huge value on the opportunities that they currently have to explore the country's wilderness resource—to get away from urban society and everything associated with it (work, family ties, noise, man-made constructions); to feel what it was like to live as a pioneer, and to experience a wholly natural environment that is uniquely 'Kiwi,' in relative freedom and for very little cost.

Wilderness is really important to New Zealand society, because one of the points of difference about what it means to be a New Zealander is that we have this wild outdoors. It is something that is uniquely ours—uniquely New Zealand. I really value the opportunity to be in those wild lands, and I feel really proud that we still have places like that where we can have a wilderness experience (B 067).

Connecting with the past—Wilderness was described as a way for New Zealanders to connect with their past, and to explore the country's natural and historic heritage: "Wilderness shows us where we came from" (F 134). Respondents saw this as an important way of developing a sense of cultural identity—a way of 're-living' and 'taking part in' a long history of association with the land and exploring. As explained by 'J':

When we visit these areas, we're maintaining, or taking part in something that has been going on in this country for over a hundred years, and that's very important to a lot of us, because in some small way, we're part of that history (J 995).

They often enjoyed visiting areas of wilderness that contained a significant amount of human history—be it exploration, indigenous or early occupation or wildlife management. For example:

Fascinating to come across the odd scotch thistle—a reminder of the old days when people lived here. Hope these 'relics of the past' are not exterminated as they are of cultural value (Diary 62).

Several commented on the strong connections between wilderness and the country's Maori (indigenous Polynesian people of New Zealand) and European history, and expressed great interest in exploring the tracks of early New Zealanders. It is likely that these connections with the past have helped them to develop such strong attachments to wilderness: "It's part of who we are"; "I think it's just that sense of history and everything that's been before you" (J 194):

I think that we visit these places because of an affinity with the land—we just feel part of the place. The history of what's gone on in that area is just phenomenal. And to feel a part of that; to go right back beyond that day when Europeans arrived in New Zealand, and to ask "why did we come to New Zealand?" is a really important part of wilderness in this country (J 995).

Interestingly, these historical associations with human use of wilderness appear to conflict with the more 'traditional' or 'purist' views of wilderness embodied in New Zealand wilderness legislation. This serves to highlight the complexity of the wilderness concept, and indicates that it may be

important to preserve cultural links to the past where they already exist.

*And I think that to **really** be able to appreciate and understand New Zealand and New Zealanders, you have to be able to appreciate the outdoors and this amazing wilderness that we've been blessed with (B 067).*

A cultural identity—An important aspect of New Zealand wilderness was that it enabled respondents to practice cultural traditions, to connect with the New Zealand landscape and to reinforce particular aspects of their identity. It was regarded as a cultural icon and a cultural practice, and one that represented an historical affinity with the land and the natural environment:

I think that wilderness trips are a cultural experience for New Zealanders... there's definitely some sort of bonding with the land, and with each other. It's great to get out there and to feel that you're actually part of the place, because this is where you're from (N 202).

Most New Zealand research participants had grown up in an environment where they were surrounded by the 'Kiwi outdoors culture,' and so they had been instilled with key wilderness values from a very young age. As far back as many of them could remember, they had been learning about New Zealand's wilderness heritage, why it was important, and how they should behave within a wilderness setting:

My father used to look at the pioneering spirit of our forefathers and encourage that to come through in our education and our upbringing. We'd always be out in the middle of nowhere, fishing or whatever, just learning those values that I still hold today (S 152).

The values and practices learned on these family trips have been passed down through generations, and visiting wilderness has become a significant part of their lives. A number of respondents indicated that they were continuing this practice by passing on the same ideas and values to their children, and their children's children. For them, wilderness is a way of taking part in a long-held, and highly valued tradition of escaping to and exploring and connecting with wild New Zealand nature and the New Zealand landscape. It is also a tradition that they feel very strongly about protecting:

I would really like it if these wilderness experiences were available to future generations. I think that it's part of our heritage, and so it needs to be available for people in the future (D 007).

An important cultural dimension of New Zealand wilderness that became clear through this research was that it embodies many of the defining characteristics of New Zealand society and what it means to be a New Zealander: freedom, independence, egalitarianism, adventure, exploration, self sufficiency, an affinity with nature and the ability to withstand hardship—particularly with regard to surviving in the outdoors. Respondents felt that their desire to experience wilderness was part of the Kiwi 'pioneering mentality': "It's kind of a pioneering feeling—where you're out there in the elements and you've got to fend for yourself, and I really enjoy that about it" (A 258).

I think part of this wilderness thing is yearning that pioneering spirit to go and see something different, to take on a new challenge, and to discover something new (S 152).

Wilderness was also described as a symbol of the Kiwi socio-democratic ideology of equity and egalitarianism in terms of access to outdoor recreation opportunities.

And one of the things I like most about wilderness is that it attracts people from all walks of life. You can be so different, but you still have this one passion; this one thing in common, and that's the wilderness. I just love the fact that it encompasses all spheres of society (B 196).

Another of the key attributes of the 'new world' is that the first settlers to New Zealand strove to embed in the national psyche. It reflects a commonly held belief in New Zealand that conservation areas were created for the "common man" to enjoy, so they could "be free of the old world class and tenure barriers which might prevent them from enjoying ready access to the wildest and most beautiful places in their new land" (Molloy and Potton 2007, p. 23). As explained by 'R':

The wilderness thing, it's part of the Kiwi egalitarian lifestyle, and it was established by the English immigrants who came here back in the 1800s; they were often peasants who'd been down-trodden by the British class system, and the private ownership of natural resources. Whereas here it's public ownership; everybody is allowed to go in, to get off their backsides and make the effort to develop the skills and fitness to do it. If you really do want to, then your average Kiwi, whatever their social status, should be able to go to these areas as long as they're willing to put in the effort (R 230).

Wilderness can thus be regarded as a way for New Zealanders to maintain a sense of national identity and solidarity. It can provide a reaffirmation of "who we are," and is a way to put into practice many of the attributes that Kiwis are traditionally believed to possess. Without such opportunities to practice cultural activities, this sense of collective national identity may gradually disappear.

Discussion and Conclusions

Our wild lands are fundamental to who we are. For many of us they are a major part of our identity, and their practical and spiritual significance influences our lives, our values, our interests and our culture.

(Spearpoint 2007, p. 33)

This paper has explored the socio-cultural value of New Zealand wilderness. It has shown that wilderness has much more than recreational or ecological value for many of the New Zealanders who visit it. For the respondents in this study, wilderness embodies many of the values that define what it means to be a New Zealander. Wilderness is about where they came from, how they came to be here, and the traditional Kiwi values instilled by the first European settlers. New Zealand wilderness participants are proud of their pioneering heritage, and one way in which they can demonstrate, protect, and maintain this heritage is through spending time in wilderness. An understanding of

the cultural value of wilderness helps to explain why many of the New Zealanders in this study have developed such an attachment to wilderness, and why they feel so strongly about protecting it.

The findings presented here, however, only represent the views of a small sub-section of the New Zealand population. Current wilderness policy and legislation in New Zealand was developed to reflect the needs and desires of this group (wilderness users), and aims to protect and maintain the values they associate with it. The extent to which their views will continue to be the driving force for New Zealand wilderness policy will, however, depend on the economic and political pressure placed on wilderness managers by powerful lobby groups seeking improved access and alternative uses of conservation land. As the nation becomes increasingly urbanized and more culturally diverse, the number of people who support the protection of 'traditional' wilderness in favour of economic development may also decline. Social changes such as urbanization, globalization, increasing consumerism, and growing international tourism have the potential to alter the way in which wilderness is conceptualized, valued, and used, and the traditional practices and activities that underpin the country's wilderness heritage may eventually be lost forever. Traditional users of wilderness (albeit, few in number) are unlikely to accept that policies should be altered to reflect the changing needs of society, and will expect the 'purist' wilderness ethic they believe in to be protected and maintained. This places managers in a particularly difficult position, and one in which they will undoubtedly require a deeper understanding of the complex meanings, values, ideas, and philosophies behind wilderness. Their challenge will be to continue to protect and maintain New Zealand's unique wilderness heritage, while also serving the economic, environmental, and social needs of wider society.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

El Toro Wilderness, Luquillo Experimental Forest, Puerto Rico

Peter L. Weaver

Abstract—The El Toro Wilderness, designated by Congress in 2005, occupies about 36 percent of the 11,300 ha Luquillo Experimental Forest (LEF) in northeastern Puerto Rico. It is the only tropical forest in the wilderness system managed by the U.S. Department of Agriculture. El Toro extends from 370 to 1,074 m in elevation, and is occupied by four forest types found in the mountainous Caribbean: lower montane rain forest, montane rain forest, palm brake, and dwarf forest. The LEF, a Biosphere Reserve since 1976, contains 225 tree species, 45 of them endemic to Puerto Rico, and 23 to the LEF alone; 150 species of ferns; 79 species of orchids; 11 native bats; 101 birds, 12 of them endemic to the island; 19 native reptiles, 8 endemic; 14 native amphibians, 8 endemic; and 6 native fish species. Most of these species occupy the wilderness. The LEF's century of research has provided a wealth of useful information on local climate, geology, soils, water resources, flora, fauna, and ecology. Temporary and permanent plots established within the wilderness have provided information on forest structure and species composition along elevation and topographic gradients. El Toro, surrounded by a dense human population, is under multipurpose management. Future research should demarcate wilderness boundaries and wildlife habitat requirements, and monitor for environmental changes. El Toro must be managed for solitude, an uncommon resource on an island where stakeholder support for wilderness is lacking.

Keywords: Puerto Rico, El Toro Wilderness Area, research, fauna, flora, designated areas

Introduction

The Wilderness Act begins with “It is hereby declared to be the policy of Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness,” and later puts humans in their place with “A wilderness, in contrast with those areas where

man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain” (U.S. Department of Agriculture, Forest Service 1983, pages 177-178). Wilderness areas provide numerous advantages to society—ecological services such as clean air and water, natural habitat for flora and fauna, scenic beauty, and solitude—and direct economic benefits to surrounding communities through recreation and tourism (Dombeck 1999).

In 1999, a new wilderness agenda was proposed that specified six goals for the U.S. Forest Service (Dombeck 1999):

- Identify new wilderness areas that fill critical habitat gaps within the system.
- Coordinate activities with other entities that manage wilderness areas.
- Provide advice regarding wilderness needs in all regions.
- Monitor wilderness as a baseline to determine the nation's environmental health.
- Orient people to enjoy wilderness areas while protecting their intrinsic values.
- Demonstrate expertise regarding the wilderness areas.

The purposes of this report are to first briefly review the variety of ecological information available regarding the Luquillo Experimental Forest (LEF), including the El Toro Wilderness Area. Although the wilderness is only 3 years old, ecological research has been carried out within the LEF for about a century. The second purpose is to review permanent plot information and data collected along gradients within the wilderness area. The third purpose is to briefly relate the LEF's current management program to four program topics of importance to this wilderness conference, namely:

- Hydrologic and human connections with aquatic systems—conserving aquatic biodiversity and the ecological services of water and wilderness.
- Nature protection—humans and tourism.
- Global change and wilderness, especially with regard to monitoring and stewardship.
- The role of education in the stewardship of wilderness resources.

Luquillo Mountains: Setting

The Luquillo Mountains of northeastern Puerto Rico, which include 11,300 ha of the LEF and 4,050 ha of the El Toro Wilderness, are steep and wet. They rise abruptly from 150 m at the forest border (370 m at the lower wilderness border) to 1,074 m in elevation at El Toro Peak, the highest summit in both the wilderness and the LEF (fig. 1). Annual

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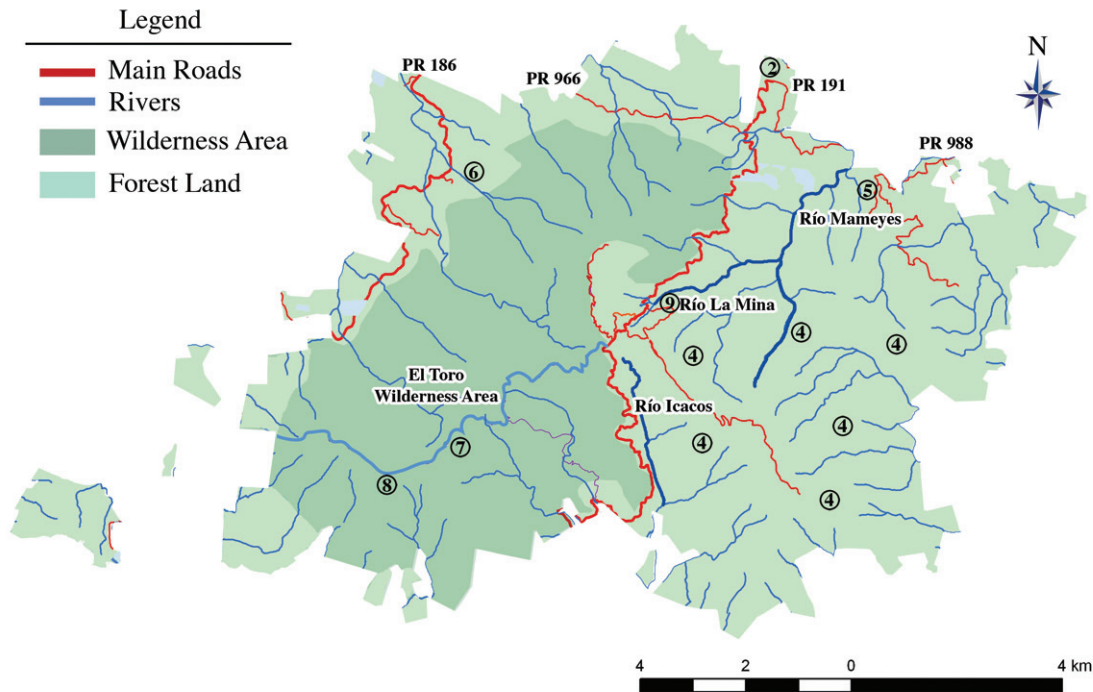


Figure 1—Map of the Luquillo Experimental Forest (LEF), showing the El Toro Wilderness and other areas mentioned in text: (1) Highways, including PR route 191; (2) El Portal Visitor Information Center; (3) Wild and Scenic Rivers: Río Icacos, Río de la Mina, and Río Mameyes; (4) Baño de Oro Research Natural Area; (5) Bisley Long-term Ecological Research Site; (6) Luquillo Forest Dynamics Plots at El Verde; (7) El Toro Trail; (8) El Toro Peak; and (9) recreation centers and picnic areas (Palo Colorado and Sierra Palm).

rainfall increases from 2,500 mm near the forest border to >4,500 mm at the summits (Briscoe 1966; Wadsworth 1948). Five ecological life zones are encountered along this gradient: subtropical moist forest, subtropical wet forest, subtropical rain forest, lower montane wet forest, and lower montane rain forest (Ewel and Whitmore 1973). Four major forest types are also recognized within the LEF and the El Toro Wilderness: lower montane rain forest between 150 and 600 m; montane rain forest between 600 and 900 m; and dwarf forest above 900 m (fig. 2). Palm brake occurs on steep slopes and in drainages above 450 m (Beard 1949; Wadsworth 1951).

Historical Perspective and El Toro Uniqueness

The following observations provide a brief orientation of the LEF's history, diversity, and challenges for management. The El Toro wilderness is unique, and its establishment has helped the agency to achieve its 1999 agenda of developing a more diverse wilderness system. First, the LEF is the only tropical forest within the National Forest system. It was set aside as a forest reserve in 1876 by the Spanish King Alfonso XII, whose declaration antedated the 1891 Land Revision Act that created the U.S. National Forest system (Domínguez Cristóbal 1997). Second, the number of distinct forest types, tree species, ferns, and orchids is impressive for such a small area (table 1). Tree species in the LEF exceed those in all other U.S. National



Figure 2—Dwarf forest, a short, dense, gnarled, and epiphyte-laden vegetation type occupies the summits of mountainous islands in the Caribbean, including the El Toro wilderness (photo by Peter L. Weaver).

Table 1—The El Toro Wilderness Area, Luquillo Experimental Forest (LEF), Puerto Rico. Summary of details regarding the wilderness and adjacent designated areas.

Factor	Explanation
El Toro Wilderness Area^a	
Size	4,050 ha, established by the Caribbean National Forest Act of 2005.
Elevation (m)	Between 370 m at Quebrada Grande (north) to 1,074 m at El Toro Peak.
Forest types ^b	Lower montane rain forest (Tabonuco forest), montane rain forest (Colorado forest), palm brake, dwarf forest.
Permanent plots	Lower montane rain forest (TS-3); palm brake (PS-2), montane rain forest plots (CV-1, CV-3, CV-4, CS-3, CS-4) all established in 1946.
Gradient (temporary) plot study	18 groups of 3 (ridge, slope, and ravine) between 450 and 970 m elevation.
Major streams (clockwise)	North (Quebrada Grande, and Jiménez); east (Quebrada Linguete, Quebrada Coca, and Quebrada Juan Diego); south (Río Sabana, Río Cubuy, and Río Gurabo); southwest (Río Cubuy); northwest (Quebrada Grande, Río Espiritu Santo, and Quebrada Sonadora).
Plant species in LEF^c	
Trees	225 species in 144 genera and 59 plant families; 45 endemic to Puerto Rico, and 23 to the LEF alone.
Ferns	150 species in the Luquillo Mountains.
Orchids	79 species in the Luquillo Mountains.
Classified plants	38 species, including 24 trees, 2 shrubs, and 12 herbs (1 liana, 1 grass, 1 fern, 2 Lycopodia, and 7 others). U.S. Forest Service lists 8 plant species as endangered and 30 as sensitive.
Wildlife vertebrates^d	
Mammals	11 species of native bats.
Birds	101 species, including 12 island endemics.
Reptiles	19 species of native reptiles, including 8 island endemics.
Amphibians	14 natives, including 8 island endemics.
Fish	6 native species of fish.
Classified animals	13 species, including 1 bat, 1 snake, 5 frogs, and 6 birds. The U.S. Forest Service lists 5 animal species as endangered, 7 as sensitive, and 1 as threatened.
Trail	El Toro/Tradewinds Trail, situated between 650 and 1074 m elevation, and 11.4 km in length; points of interest—montane rain forest, dwarf forest, tree and bird species, El Toro peak and panorama; suggested as a challenging hiking experience.
Luquillo Experimental Forest (other designations)^e	
Baño de Oro Research Natural Area in 1949	745 ha and contains lower montane rain forest, montane rain forest, palm brake, and dwarf forest.
Luquillo Forest Biosphere Reserve in 1976	11,300 ha, or the entire LEF.
Long Term Ecological Research Site (LTER) in 1985	About 363 ha of the Bisley watersheds.
Luquillo Forest Dynamics Plot (LFDP) in 1990	16 ha near the El Verde Field Station.
Wild and Scenic Rivers in 2002	2,812 ha, Río Icos (329 ha), Río Mameyes (1,783 ha), Río de la Mina (700 ha).

^aSource: United States 2005.

^bSource: Wadsworth 1951.

^cSources: trees (Little 1970; Little and Wadsworth 1964; Little et al. 1974; Little and Woodbury 1976, 1980); ferns (Kepler 1975); orchids (Ackerman 1992, 1995; Kasomenakis 1988); classified plants (U.S. Department of Agriculture, Forest Service 1997a, 1997b).

^dSources: reptiles and amphibians (Joglar 1998, 2005); mammals, fish and classified species (U.S. Department of Agriculture, Forest Service 1997a, 1997b); birds (Wiley and Bauer 1985); for recent numbers of bird species (Wayne Arendt, see endnotes).

^eSources: Research Natural Area (Weaver 1994); Biosphere Reserve (Lugo 1987); LTER (Scatena 1989); LFDP (Thompson et al. 2004); wild and scenic rivers (U.S. Department of Agriculture, Forest Service 1997a, 1997b).

Forests combined (U.S. Department of Agriculture, Forest Service 1997b). In contrast, there are fewer bird species in the LEF's rain forests than in Puerto Rico's dry southwest (Kepler and Kepler 1970). This apparent anomaly may be due in part to the abundance of competing frogs and lizards within the forest. Also, during the Pleistocene, West Indian fauna was adapted to an island land mass that was larger and drier than today (Faaborg and Arendt 1990). Third, the Puerto Rican parrot (*Amazona vittata*) was probably among the first birds seen by Spanish explorers (fig. 3). At that time, the noisy parrot was widespread and flew in large flocks. By 1972, the parrot was rare and endangered—only 12 parrots remained—and they were confined to the LEF, including the wilderness area (Snyder and others 1987). Finally, in 1970, long after the island's native bird species had been identified, studied, and written about, the elfin woods warbler (*Dendroica angelae*) was discovered in the LEF (Kepler and Parks 1972; Raffaele 1983). The warbler lives at high elevations, including the wilderness area.

The 690 wilderness areas in the United States occupy a total of about 432,700 km² and range in size from 2.4 ha (Pelican Island, Florida) to 3,675,577 ha (Wrangell-Saint Elias, Alaska) (Wilderness.net 2007). The 4,050 ha El Toro Wilderness Area, with its high diversity of flora and fauna (table 1), is the only declared wilderness under U.S. Forest Service management. Moreover, the El Toro wilderness:

- Covers 36 percent of the LEF, making it proportionally large in comparison to the total area of the forest;

- Contains cloud covered peaks—El Cacique, La Mina, and El Toro—and lies near the renowned El Yunque peak;
- Encompasses the largest block of undisturbed vegetation on mainland Puerto Rico, is largely buffered by the LEF, and is traversed by one trail but no roads;
- Contains a great number of rare plants and animals, including several endemics;
- Lies within an area of tropical moist and wet forests, and contains the headwaters of 12 streams that provide pristine water supplies to surrounding communities; and
- Lies 40 km east of San Juan and is surrounded by a dense human population, providing one of the steepest gradients between a major metropolitan area and relative solitude within the wilderness system.

Research: LEF and Wilderness _____

A century of research within the LEF has provided a wealth of information on its flora, fauna, and ecology, much of it applicable to management of the El Toro Wilderness Area. Research methods for these studies varied considerably depending on research objectives. The earliest surveys at the beginning of the 20th century dealt with species identification, taxonomy, forest structure and composition, and were followed after 1960 by a variety of ecological studies.



Figure 3—*Amazona vittata*, Puerto Rico's only parrot, occupied most of the island at the time of discovery. Currently it is classified as rare and endangered (photo by Gerald P. Bauer).

Past Research Within the LEF

It would call for an effort well beyond the scope of this report to review all of the research carried out in the LEF, which is one of the best studied tropical forests in the world. However, several noteworthy publications provide an example of the type of information available for management of the wilderness area:

- The scientific survey of Porto Rico and the Virgin Islands (Britton and Wilson 1923-30; Gleason and Cook 1927), part of the New York Botanical Garden's expeditions to Puerto Rico, provides some of the earliest information on the LEF's flora and fauna.
- The Caribbean Forest atlas (Upson 1949) contains a chronology of legislation and events relating to the creation, enlargement, improvement, and management of the LEF from December 1898 to June 1949.
- Trees of Puerto Rico and the Virgin Islands, Volumes I and II (Little and Wadsworth 1964; Little and others 1974), consider all 547 native tree species and numerous introduced timber species.
- A tropical rain forest: a study of irradiation and ecology at El Verde (Odum and Pigeon 1970) is a 1600 page compendium of 9 chapters on the flora, fauna, and ecology of the LEF.
- The descriptive flora of Puerto Rico, Volumes I-V (Liogier 1985-97), contain a relatively recent taxonomic update of Puerto Rico's flora.
- History and conservation of the Puerto Rican Parrot (Snyder and others 1987) covers the history, ecology, and current efforts to save the rare and endangered Puerto Rican Parrot, a model for parrot conservation worldwide.
- Special hurricane issues of *Biotropica*: (1) Ecosystem, plant, and animal responses to hurricanes in the Caribbean; and (2) Long term responses of Caribbean ecosystems to disturbance (Walker and others 1991, 1996), contain post-hurricane observations on the LEF's flora and fauna.
- Tropical forests: management and ecology (Lugo and Lowe 1995), contains several chapters on the forests and ecology of the LEF.
- The food web of a tropical rain forest (Reagan and Waide 1996), with 14 chapters, summarizes studies of rain forest animals, including their abundance, food habits, and ecological roles in the ecosystem.
- The revised Land Management Plan for the Luquillo Forest (U.S. Department of Agriculture, Forest Service 1997a, 1997b) are two documents that contain an environmental impact statement and management plan for the entire LEF, including the 1997 proposal for wilderness.
- Forest biodiversity in North, Central and South America, and the Caribbean: research and monitoring (Dallmeier and Comiskey 1998) deals with the neo-tropics and includes five chapters on the LEF.
- Producción Forestal para América Tropical (Wadsworth 2000) describes forest management practices throughout the tropics, including some experiences from the LEF.
- Geology, geochemistry, geophysics, mineral occurrences and mineral resource assessment for the Commonwealth of Puerto Rico (Bawiec 2001) is a compendium that describes nine geologic formations found within the LEF.
- The soil survey of the Luquillo Experimental Forest (U.S. Department of Agriculture, Natural Resources Conservation Service 2002) summarizes five general and 20 detailed soil map units within the LEF, along with their classification, potential use, and management.
- The bio-ecology of native and exotic tree species in Puerto Rico (Francis and Lowe 2002) summarizes life history information for 88 tree species, including many native trees of the LEF.
- Innumerable journal articles and reports on the flora, fauna, geology, soils, water resources, and ecology of the LEF after the mid-1960s. Three of these papers consider forest structure, species composition, and post-hurricane changes within the Montane rain forest, and include plots sampled within the wilderness area (Weaver 1989b, 1991, 2000).

Studies Within the El Toro Wilderness Area

The wilderness is one of six designated areas within the LEF (table 1; fig. 1). Despite the abundance of research available within the LEF, only a few studies have actually been carried out within the wilderness boundaries.

Gradient study—The gradient study used 48 temporary plots to determine species composition and forest structure by elevation and topography between 460 and 970 m elevation. On each plot, all trees ≥ 4 cm in d.b.h. (diameter at 1.4 m above the ground) were identified and d.b.h. and height measured. Plot size varied by forest type: 42 plots of 0.05 ha were used within lower montane and montane rain forests, 6 plots of 0.025 ha in dwarf forest. Aboveground total woody biomass was determined by equations that were developed for different forest types within the LEF (Weaver and Gillespie 1992). The temporary plots showed (table 2; fig. 4):

- A total of 5,107 trees and 89 species on 2.25 ha;
- *Prestoea montana* (Sierra palm) and *Henriettea squamulosa* accounted for nearly one-third of the total stems, and the 10 most common species for nearly two-thirds; nine species were tallied only once and 29 species ≤ 5 times;
- Several tree species per plot, which decreased from low to high elevation;
- Relatively high stem density, which increased from low to high elevation;
- Moderate canopy height, which decreased from low to high elevation; and
- Estimates of biomass, which showed no trends with regard to elevation.

The temporary plots showed correlations of species richness and structural features with changes in elevation. The lack of correlation with biomass may be due to several factors, including the variety of habitats sampled, small plot size, and the sporadic occurrence of exceptionally large trees, which tend to inflate plot biomass estimates.

Table 2—Recorded tree species (126) within the El Toro Wilderness from the gradient study and permanent plots.^a

Species name	Occurrences		Stems ^b			Percent of total
	Plots	Stems	R	S	V	
Species recorded (89) in gradient study						
<i>Alchornea latifolia</i> Sw.	14	40	14	12	14	0.78
<i>Alchorneopsis floribunda</i> (Benth.) Muell. Arg.	1	2	0	0	2	0.04
<i>Antirhea obtusifolia</i> Urban ^c	7	7	1	4	2	0.14
<i>Ardisia luquillensis</i> (Britton) Alain ^c	1	1	1	0	0	0.02
<i>Buchenavia tetraphylla</i> (Aublet) R. Howard	11	14	6	5	3	0.27
<i>Byrsonima spicata</i> (Cav.) HBK	2	2	1	1	0	0.04
<i>Byrsonima wadsworthii</i> Little ^d	15	35	24	7	4	0.68
<i>Calyptanthes krugii</i> Kiaersk. ^d	9	26	20	4	2	0.51
<i>Casearia arborea</i> (L.C. Rich) Urban	3	7	6	1	0	0.14
<i>Casearia decandra</i> Jacq.	3	3	0	1	2	0.06
<i>Casearia sylvestris</i> Sw.	2	2	0	0	2	0.04
<i>Cassipourea guianensis</i> Aubl.	4	9	7	2	0	0.18
<i>Cecropia schreberiana</i> Mig.	20	83	15	30	38	1.62
<i>Cestrum macrophyllum</i> Vent.	1	3	3	0	0	0.06
<i>Citharexylum caudatum</i> L.	7	18	2	0	16	0.35
<i>Cleyera albo-punctata</i> (Griseb.) Krug & Urban ^e	1	1	1	0	0	0.02
<i>Clibadium erosum</i> (Sw.) DC.	3	9	5	2	2	0.18
<i>Clusia clusoides</i> (Griseb.) D'Arcy	13	97	52	42	3	1.90
<i>Cordia borinquensis</i> Urban ^d	34	251	89	78	84	4.91
<i>Cordia sulcata</i> DC.	1	2	0	0	2	0.04
<i>Croton poecilanthus</i> Urban ^c	25	173	6	33	134	3.39
<i>Cyathea arborea</i> (L.) J.E. Smith	7	34	3	27	4	0.66
<i>Cyathea bryophila</i> (R. Tryon) Proctor ^d	3	12	3	1	8	0.23
<i>Cyathea portoricensis</i> Spreng ex Kuhn ^d	1	1	0	0	1	0.02
<i>Cyrilla racemiflora</i> L.	19	117	75	36	6	2.29
<i>Dacryodes excelsa</i> Vahl	15	94	42	47	5	1.84
<i>Daphnopsis philippiana</i> Krug & Urban ^d	16	55	16	33	6	1.08
<i>Dendropanax arboreus</i> (L.) Decne & Planch.	1	2	0	0	2	0.04
<i>Dendropanax laurifolius</i> (E. March.) Decne & Planch. ^d	1	1	1	0	0	0.02
<i>Ditta myricoides</i> Griseb. ^e	13	30	2	9	19	0.59
<i>Drypetes glauca</i> Vahl	13	94	20	52	22	1.84
<i>Eugenia borinquensis</i> Britton ^c	18	151	55	64	32	2.96
<i>Eugenia eggersii</i> Kiaersk. ^d	1	3	0	0	3	0.06
<i>Eugenia stahlia</i> (Kiaersk.) Krug & Urban ^d	14	30	10	16	4	0.59
<i>Ficus citrifolia</i> P. Miller	3	3	0	2	1	0.06
<i>Ficus crassinervia</i> Desf.	3	3	1	2	0	0.06
<i>Ficus sintenisii</i> Warb.	2	2	1	1	0	0.04
<i>Guarea glabra</i> Vahl	6	10	0	6	4	0.19
<i>Guarea guidonia</i> (L.) Sleumer	4	6	1	2	3	0.12
<i>Guatteria caribaea</i> Urban	1	5	5	0	0	0.10
<i>Guettarda valenzuelana</i> A. Rich.	9	28	6	5	17	0.55
<i>Haenianthus salicifolius</i> Griseb.	21	109	57	30	22	2.13
<i>Hedyosmum arborescens</i> Sw.	4	7	5	1	1	0.13
<i>Henriettea squamulosa</i> (Cogn.) Judd. ^d	40	629	196	253	180	12.32
<i>Hirtella rugosa</i> Pers. ^d	18	119	78	40	1	2.33
<i>Homalium racemosum</i> Jacq.	4	11	5	6	0	0.22
<i>Ilex nitida</i> (Vahl) Maxim.	7	11	6	5	0	0.22
<i>Ilex sideroxyloides</i> (Sw.) Griseb.	1	1	1	0	0	0.02
<i>Inga laurina</i> (Sw.) Willd.	1	1	0	1	0	0.02
<i>Inga vera</i> Willd. Ex L.	5	6	1	2	3	0.12
<i>Ixora ferrea</i> (Jacq.) Benth.	8	23	15	8	0	0.45
<i>Linociera domingensis</i> Lam.	2	3	1	2	0	0.06
<i>Magnolia splendens</i> Urban ^c	15	29	7	17	5	0.57
<i>Manilkara bidentata</i> (A.DC.) Chev.	7	27	14	11	2	0.53
<i>Matayba domingensis</i> (DC.) Radlk.	21	112	59	47	6	2.19
<i>Mecranium latifolium</i> (Cogn.) Skeeon	4	4	0	1	3	0.08
<i>Meliosma herbertii</i> Rolfe	5	27	18	9	0	0.53
<i>Menendezia urbanii</i> Cogn.	3	8	7	1	0	0.16
<i>Miconia laevigata</i> (L.) DC.	10	32	10	21	1	0.63
<i>Miconia pachyphylla</i> Cogn. ^d	3	7	3	2	2	0.14
<i>Miconia tetrandra</i> D. Don	17	73	40	22	11	1.43

(continued)

Table 2 (Continued)

Species name	Occurrences		Stems ^b			Percent of total
	Plots	Stems	R	S	V	
Species recorded (89) in gradient study						
<i>Micropholis garciniifolia</i> Pierre ^c	30	389	160	212	17	7.61
<i>Micropholis guyanensis</i> (A. DC.) Pierre	27	289	147	109	33	5.65
<i>Myrcia deflexa</i> (Poir.) DC.	2	4	4	0	0	0.08
<i>Myrcia fallax</i> (A. Rich) DC.	18	54	38	14	2	1.06
<i>Myrcia leptoclada</i> DC.	4	18	7	10	1	0.35
<i>Myrcia splendens</i> (Sw.) DC.	1	1	0	0	1	0.02
<i>Myrsine coriacea</i> (Sw.) R. Br. Ex Roem. & Schult.	1	1	0	0	1	0.02
<i>Ocotea leucoxydon</i> (Sw.) Mez	14	27	17	7	3	0.53
<i>Ocotea moschata</i> (Meisn.) Mez ^d	4	7	1	5	1	0.14
<i>Ocotea portoricensis</i> Mez ^d	4	5	4	0	1	0.10
<i>Ocotea spathulata</i> Mez	25	139	95	31	13	2.72
<i>Ormosia krugii</i> Urban	7	26	21	5	0	0.51
<i>Palicourea croceoides</i> W. Hamilton	2	4	3	0	1	0.08
<i>Prestoea montana</i> (R. Grah.) Nichols	38	1013	202	256	555	19.83
<i>Psychotria berteriana</i> DC.	12	33	12	7	14	0.64
<i>Rheedia portoricensis</i> (Urban) Alain ^d	4	31	23	8	0	0.61
<i>Rondeletia portoricensis</i> Krug & Urban ^d	3	8	2	0	6	0.16
<i>Sapium laurocerasus</i> Desf. ^d	13	31	4	5	22	0.61
<i>Schefflera morototoni</i> (Aubl.) Mcguire	9	23	11	11	1	0.45
<i>Sloanea berteriana</i> Choisy	17	43	20	10	13	0.84
<i>Syzygium jambos</i> (L.) Alston ^f	1	4	0	4	0	0.08
<i>Tabebuia heterophylla</i> (DC.) Britton	4	5	2	1	2	0.10
<i>Tabebuia rigida</i> Urban ^c	17	183	75	84	24	3.58
<i>Tetragastris balsamifera</i> (Sw.) Kuntze	6	37	27	8	2	0.72
<i>Torrabasia cuneifolia</i> (C. Wright) Krug & Urban	5	17	15	2	0	0.33
<i>Trichilia pallida</i> Sw.	1	3	0	0	3	0.06
<i>Vitex divaricata</i> Sw.	1	1	0	1	0	0.02
<i>Xylosma schwaneckeanum</i> Krug & Urban ^c	3	6	5	1	0	0.11
Totals	48	5107	1912	1795	1400	100.00

Species recorded (37) on permanent plots and not listed above

<i>Andira inermis</i> (W. Wr.) DC.	<i>Ilex sintenisii</i> (Urban) Britton
<i>Ardisia glauciflora</i> Urban ^d	<i>Marliera sintenisii</i> Kiaersk. ^c
<i>Ardisia obovata</i> Desv. ex Hamilton	<i>Maytenus elongata</i> (Urban) Britton ^c
<i>Beilschmiedia pendula</i> (Sw.) Hemsl.	<i>Mecranium latifolium</i> (Cogn.) Skean
<i>Casearia guianensis</i> (Aublet) Urban	<i>Miconia mirabilis</i> (Aublet) L.O. Williams
<i>Citharxylum caudatum</i> L.	<i>Miconia prasina</i> (Swartz) DC.
<i>Clidemia cymosa</i> (Wendl.) Alain	<i>Myrcia citrifolia</i> (Aublet) Urban
<i>Clusia rosea</i> Jacq.	<i>Ocotea coriacea</i> (Sw.) Britton
<i>Coccoloba swartzii</i> Meisn. in DC.	<i>Ocotea coriacea</i> (Sw.) Britton
<i>Cupania americana</i> L.	<i>Ocotea globosa</i> (Aubl.) Schlecht & Cham.
<i>Daphnopsis americana</i> (Mill.) J.R. Johnston	<i>Ocotea membranacea</i> (Sw.) Howard
<i>Faramea occidentalis</i> (L.) A. Rich.	<i>Ocotea sintenisii</i> (Mez) Alain ^c
<i>Ficus trigonata</i> L.	<i>Ourata striata</i> (v. Tiegh) Urban ^e
<i>Guettarda valenzuelana</i> A. Rich.	<i>Piper aduncum</i> L.
<i>Guettarda scabra</i> (L.) Vent.	<i>Quararibea turbinata</i> (Sw.) Poirlet in Lamarck
<i>Haenianthus salifolius</i> Griseb.	<i>Symplocos micrantha</i> Krug & Urban ^d
<i>Hedyosmum arborescens</i> Sw.	<i>Ternstroemia heptasepala</i> Krug & Urban ^c
<i>Hirtella triandra</i> Sw.	<i>Ternstroemia luquillensis</i> Krug & Urban ^c
<i>Ilex nitida</i> (Vahl) Maxim	

^aTotal area of gradient plots = 2.25 ha; total area of permanent plots = 2.8 ha.

Sources: USDA Forest Service 1997b; Little and Woodbury 1976, 1980; Woodbury et al. 1974.

^bStems: R = ridge, S = slope, and V = ravine topography.

^cEndemic to Luquillo Mountains.

^dEndemic to Puerto Rico.

^eRare in Puerto Rico but native elsewhere.

^fExotic (introduced).

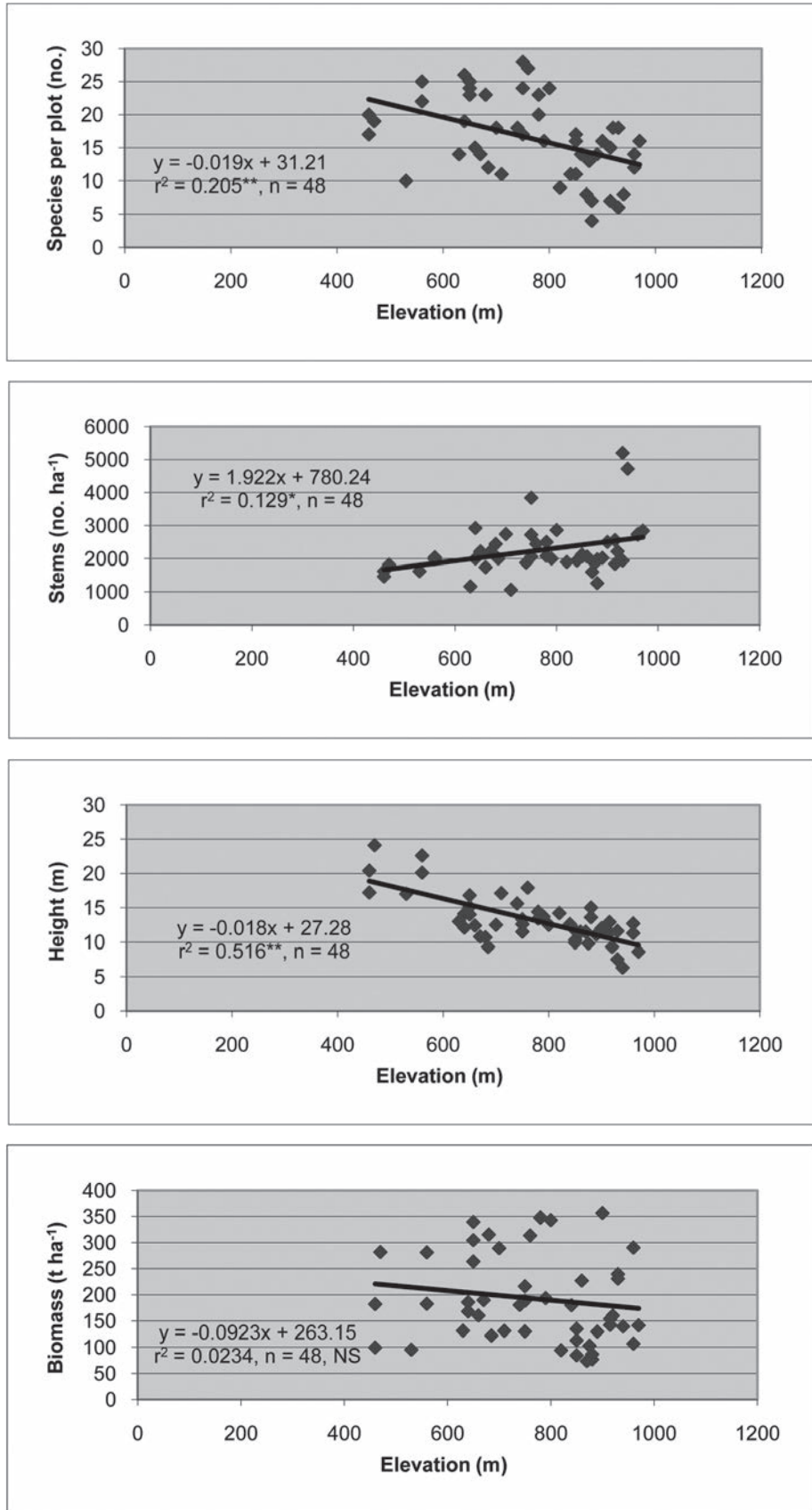


Figure 4—The gradient study showed increases in the number of stems with elevation, and decreases in mean canopy height and number of species per plot. Biomass showed no correlations

Permanent plot network—In 1946, seven permanent 0.40 ha plots were established: one in lower montane rain forest (TS-3), one in palm brake (PS-2), and five in montane rain forest, including valleys (CV-1, CV-3, CV-4) and slopes (CS-3, CS-4) (table 3). A total of 13,121 trees were originally sampled. The plots were re-measured in 1976 or 1981 to determine changes in species composition, basal area, and increment. Although palms were measured for determination of basal area, they were omitted from d.b.h. growth calculations. The permanent plots showed the following trends (table 3):

- Stem changes (per plot) ranged between a 17 percent loss and a 13 percent gain.
- Basal area changes (per plot) ranged between an 8 percent loss and a 19 percent gain.
- Long-term mean d.b.h. growth (per plot) for all tree species combined ranged between 0.09 and 0.21 cm yr⁻¹.
- The logarithm of the d.b.h. distribution within the undisturbed, uneven-aged TS-3 plot was linear (Wadsworth 1977).

The measurement period on the permanent plots was characterized by forest recovery after hurricanes San Felipe and San Cipriano (1928 and 1932). The major negative changes in basal area during the measurement period were due to the loss of large *Cyrilla racemiflora* (Palo Colorado) trees; in contrast, major increases were caused by an influx of palms, mainly on valley plots. Both of these species are comparatively large in d.b.h. and influence basal area disproportionately within forest types dominated by small dimension trees. Broadleaf trees grew relatively rapid in palm brake where the abundance of narrow-crowned palms allows more light to filter through the canopy (table 3). D.b.h. growth rates were intermediate in lower montane rain forest, and declined from valley to slope plots within montane rain forest. Slow d.b.h. growth is typical for trees throughout the wilderness area where forest stands are characterized by many small tree species, high stem density, closed canopies, and competition for light.

A total of 126 tree species were tallied in the gradient and permanent plot studies on 5.05 ha, or only 0.125 percent of the El Toro Wilderness Area (table 2). The list includes 19 Puerto Rican endemics, 13 Luquillo Mountain endemics, and 3 species that are rare in Puerto Rico but native elsewhere. Based on this small sample, it would appear likely that all of the LEF's tree species are represented within the wilderness.

Riparian palm brake research—In 1980, research was initiated on a 0.25-ha palm plot located at 750 m in montane forest near permanent plot CV-1 (Frangi and Lugo 1985, 1991, 1998). The studies revealed:

- About 765 stems >1 cm in d.b.h. representing 27 tree species;
- Abundant *Prestoea montana* accounting for 40 percent of the tallied stems; and
- Details regarding the carbon, phosphorus, and water cycles.

Periodic flooding, poor soil aeration, heavy annual rainfall, and low atmospheric saturation pressure deficits were suggested as the controlling factors in the abundant regeneration and growth of the palm. After Hurricane Hugo in 1989, the palm plot, protected by topography, showed only 1 percent tree mortality. About 30 percent of the trees, however, had suffered some damage, mainly in the canopy.

Conference Program Topics

The Wilderness Act serves to guide planning, implementation, and monitoring of the wilderness system. The El Toro Wilderness is relatively small and is surrounded by a dense human population. Under these conditions, wilderness protection calls for the management of the entire LEF to minimize further development, to set standards for forest use, to regularly monitor and patrol the entire forest, and to cooperate with local government officials to enforce buffer zone legislation, particularly near the wilderness boundary.

Table 3—Summary of stand data from permanent plots located within the El Toro Wilderness Area^a.

Forest type ^b	1946		1976/1981 ^c		Ingrowth		Mortality	Increment		d.b.h. range	Species ^e	
	Stems	BA	Stems	BA	Stems	BA	Stems	MAI ^d	Stems	in 1946	first	last
	no.	m ²	no.	m ²	no.	m ²	no.	cm yr ⁻¹	no.	cm	no./plot	
Lower montane rain	2359	41.6	2032	43.5	642	4.3	969	0.14	1099	4-106	51—45	
Palm brake	1772	31.9	1470	31.8	338	3.3	640	0.21	383	4-49	37—33	
Montane rain												
Colorado: CS-3	1677	45.2	1531	43.7	704	3.8	850	0.11	758	4-98	40—40	
Colorado: CS-4	1810	51.7	1793	43.9	637	3.3	654	0.09	852	4-111	32—40	
Colorado: CV-1	1650	36.0	1873	42.9	812	5.8	589	0.10	901	4-94	37—37	
Colorado: CV-3	1949	42.5	2114	44.8	901	5.8	736	0.13	990	4-103	58—49	
Colorado: CV-4	1904	33.7	2030	34.3	904	5.7	778	0.16	820	4-82	49—45	

^aSources: Weaver 1983 and this paper. All data are in metric units and on a per hectare basis, as follows: stems (number ha⁻¹); basal area (m² ha⁻¹); MAI (mean annual d.b.h. increment) (cm yr⁻¹); and d.b.h. range (cm).

^bElevations: Lower montane rain forest (TS-3 at 570 m); Palm brake (PS-2 at 570 m); and Montane rain forest (Colorado slope, CS-3 and CS-4 at 690 m; and Colorado valley, CV-1 at 750 m, and CV-3 and CV-4 at 640 m).

^cMeasurement dates for Lower montane rain and palm brake forests, 1946 to 1976; and for Montane rain forest, 1946 to 1981.

^dSurviving broadleaf stems per hectare used for d.b.h. calculations. On the palm brake plot, the palm was excluded from the MAI calculations.

^eNumber of species recorded at first (1946) and last (1976 or 1981) measurement.

Much of the proposed wilderness management program benefits from past research carried out in the LEF.

Hydrologic and Human Connections with Aquatic Systems

The Luquillo Mountains are in essence an island within an island. If sea level were to rise about 50 m, the valleys of the Río Grande de Loíza, Río Gurabo, and Río Antón would flood and the mountains would become an island comparable in size to many of the Lesser Antilles (Weaver 2002). Within that imaginary island, the water budget of the LEF may be summarized as follows: Rainfall averages 3,580 mm yr⁻¹, 64 percent of which is runoff and the remainder evapotranspiration (Crook and others 2007; García-Martinó and others 1996). The average volume of water extracted before leaving LEF boundaries is estimated at 250 mm yr⁻¹, which equals 7 percent of the annual rainfall and 11 percent of the annual runoff. Although little groundwater exists at high elevations, it may become important at lower levels (Larsen 1997). In summary, the LEF and its wilderness area are steep and wet; moreover, they provide streamflow to the surrounding lowlands throughout the year.

One of the major objectives of wilderness management is the maintenance of free flowing aquatic systems to provide ecological services and to conserve biodiversity. By 1990, more than 30 dams had been constructed for water supplies at some point on all the streams draining the LEF (i.e., within and below forest boundaries) except the Río Mameyes (Benstead and others 1999). By 1993, however, the Puerto Rico Water and Sewer Authority had plans to install a dam on that waterway as well (Nieves 1998). In addition, many LEF streams near bridges are used by visitors to the forest (Kartchner 2003). Surveys carried out at the Puente Roto bridge on the Río Mameyes and the Río Espíritu Santo bridge on PR route 186 showed that visitors enjoyed picnicking near the rivers, which were also used for bathing. In 1995, household and recreation surveys were carried out to estimate the willingness of islanders to pay for preserving in-stream flows on two forest rivers—the Río Mameyes and Río Fajardo (González-Caban and Loomis 1999). Protecting the environment for future generations was a common response for caring about the rivers. The annual “willingness-to-pay” to avoid placing dams on the rivers was \$21.00 per household, which when extrapolated would yield \$110 million yr⁻¹. Moreover, visitors to the Río Mameyes indicated that they would reduce their visits by >90 percent if heavy withdrawals were made from the river. Public opposition to the proposal for a dam resulted in a compromise involving the installation of an in-channel withdrawal system (March and others 2003). The new intake has minimal impact on the LEF’s aquatic migratory fish and shrimp.

The Forest Service has a permit system for special uses to control and monitor all extractions from the LEF’s streams. On a typical day, 70 percent of the water originating within the LEF is diverted before reaching the ocean (Crook 2005; Crook and others 2007). Unfortunately, water losses in the delivery system between island reservoirs and local users

average 43 percent. Obviously, the water authority must take corrective measures to reduce water losses. The ecological integrity of LEF streams cannot be sacrificed because of inappropriate management and maintenance (Naumann 1994).

Nature Protection—Humans and Tourism

Naturalness, wildness, and protection from human influence are the wilderness values that society treasures. Management, therefore, is needed to keep human impacts on the environment to a minimum and to assure a wilderness experience for all visitors.

Some of the human influences within the LEF include: administration buildings and the El Portal Tropical Forest Center (a visitor information center); automobiles, roads, and trails; radar and communication towers; recreation, picnic, and bathing sites; independent hikers and guided tours; researchers and their project sites; and small dams for water supplies. Human presence, notably during vacation periods and local holidays, sometimes causes serious congestion along the roads and at favorite bathing areas like La Mina Falls and Puente Roto. The bathing sites are undoubtedly contaminated.

An estimated 650,000 recreation users visit El Yunque each year; moreover, during the past 17 years, rapid suburban development has occurred in areas adjacent to the LEF, including the wilderness area (Ramos Gonzalez 2001; U.S. Department of Agriculture, Forest Service 1997b). In the past 8 years alone, counties surrounding the forest have increased in population from 268,900 to 288,600, or by 7.2 percent (U.S. Department of Agriculture, Forest Service 2009). In 1983, the area around the forest was zoned mainly for agriculture (amended in 1991) to promote its conservation, but recent suburban developments have been in violation of the suggested norms (Lugo and others 2000, 2004).

Current access to streams along the LEF’s lower forest boundary and to recreation areas at higher elevation is unrestricted. In the future, however, vehicular traffic to the forest interior must be controlled to reduce noise and congestion, and to help protect wildlife, water supplies, and other forest resources. Safety precautions for visitors include first aid at the recreation centers and arrangements with emergency units surrounding the forest. Many of the current incidents involve hikers ill-prepared for a rigorous day in the field. Fortunately, the LEF has no dangerous animals or poisonous snakes.

The major LEF species calling for protection are sensitive, threatened, or endangered plants and wildlife (table 1). Efforts should be made to map their critical habitats and to protect them. Demands for new recreation opportunities by tour groups could present serious challenges regarding the nature of wilderness (untrammled) and its use. Since Puerto Rico has no other wilderness areas at the moment, human use must be defined, controlled, and monitored.

A final consideration involves aircraft flying low over the LEF, including the wilderness area. Long considered a problem, the topic once again came to the attention of forest managers and the public on December 3, 2008, when

a Rockwell International 690B turbo commander crashed in the wilderness (Hernández Pérez 2008). Although such flights are prohibited to aid the recovery of the Puerto Rican Parrot, they apparently occur occasionally. In the case of wilderness, low flying aircraft may also be viewed from the standpoint of air quality issue and noise pollution.

Global Change and Wilderness—Monitoring and Stewardship

Monitoring is the basis for determining change. The now famous monitoring for global warming began in 1957 at the isolated Mauna Loa Observatory in Hawaii. In 1900, Christmas bird counts were initiated in the United States to protect bird species from traditional holiday hunts. That tradition was introduced to southwestern Puerto Rico in 1921 (McCandless 1962). Since 1994, bird counts have been underway in northeastern Puerto Rico, including sites within the LEF near the wilderness.

With continued urbanization around the LEF border and projections of increased global changes, the LEF may become warmer and consequently drier in the future (Scatena 1998). The LEF's hydrologic cycle could be altered affecting water availability for ecological processes and human activities. Some global models project that hurricanes may become more intense and frequent. Such changes could have an impact on the LEF's forests. Long-term changes in species' abundances and distributions might include more secondary species—those that complete their life cycles in shorter time spans—at the expense of primary species (Gomez-Pompa and Vazquez-Yanes 1974; Scatena 1998). Changes could also increase the rate of erosion, the number of landslides, the amount of debris accumulated in waterways, and alter wildlife populations.

During the mid-1940s, Forest Service researchers established several permanent forest plots within the LEF (Crow 1980; Weaver 1983), some of which are re-measured today. Monitoring revealed the impacts of past hurricanes, showing immediate damage and gradual recovery in forest structure, tree species composition, and species diversity (Crow 1980, Weaver 1989b). Some managers suggest that permanent plot monitoring could provide information on forest change caused by global warming and should continue. Hurricanes cause so many changes, however, that parts of the forest are always recovering from past events (Crow 1980; Weaver 1983, 2009). In summary, monitoring is expensive and should be statistically tailored to provide critical information for good management. Otherwise the cost of the program will collapse in future budgets.

Regular monitoring of classified plant and animal species, or those cited as sensitive, threatened, or endangered (table 1), is called for in the management plan. Recurrent surveys by knowledgeable taxonomists might also provide information on plant and animal migrations within the LEF, or from the LEF to sites outside, or vice-versa. Recurrent surveys could provide information on the accidental introduction of exotic weeds by wilderness users, evidence of excessive human use such as trail erosion at particular locations, or

possible violations like poaching of wildlife. Finally, surveys for cultural artifacts have been carried out within the LEF, including areas bordering the wilderness. Because of the tenuous nature of this information, reports have not been elaborated. All future research on the flora, fauna, insects, disease, and cultural sites should be formulated within management plan guidelines.

Role of Education in Stewardship of Wilderness Resources

In 1996, more than 50 years after the first recreation areas were constructed within the LEF, the El Portal opened to the public (fig. 5). Located along PR route 191 (National Forest, Route 191, Intersection 988, Km 4.4, Barrio Barceloneta, Río Grande, PR 00721) at the entrance to the LEF, El Portal has about 930 m² of exhibit space with four pavilions, a theater, a nature trail, and a gift shop (fig. 1). The pavilions orient visitors to the beauty, diversity, and complexity of tropical forests, and current activities aimed at their management. The information center's central theme is that tropical forests and people are linked together in a global community, and that people working together can help to conserve tropical forests. Interpretation is carried out in six areas: orientation; introduction to tropical forests; displays promoting an understanding of the forest; connections, or benefits and relationships that connect humans with forests; responsible forest management; and the future hope for forest conservation. The El Portal also has related interpretative facilities such as theater, a nature trail, and a nursery.

In addition, 15 hiking trails totaling >40 km offer visitors a close-up view the LEF's major plant and animal species (U.S. Department of Agriculture, Forest Service 1997b). The trails include Angelito and El Portal at low elevation, and 11 separate trails at intermediate to high elevations in the El Yunque and the La Mina groups. The longest is the El Toro/ Tradewinds trail located in the wilderness area. It traverses Montane and Dwarf forests en route to El Toro Peak, the highest point in the LEF. Field tours are available within the LEF and guides provide details with regard to the flora and fauna. Free brochures are available for hikers. Signs for orientation and interpretation are strategically placed on well-marked trails.

The public has also been involved in planning the management of the LEF (U.S. Department of Agriculture, Forest Service 1997a, 1997b). The LEF's 1997 multi-purpose management plan, under current revision, considers primary forest, wildlife, water resources, wild and scenic rivers, wilderness, recreation, forest access (roads and trails), and research. Planning involves the presentation of management alternatives, the environmental impacts of proposed actions, and public input. A previous proposal for a demonstration of sustainable timber harvest was eliminated from the plan because of public concern about protection of the LEF. Current interest in expanding public use of the forest, especially tours and camping, must be carefully weighed against the obligation to protect forest resources, notably water and wildlife.



Figure 5—The El Portal Tropical Forest Center is the gateway to the Luquillo Experimental Forest. The center has numerous displays based on themes, a theater, a souvenir store, a snack bar, and ample parking (photo by Peter L. Weaver).

Conclusions and Recommendations

The El Toro Wilderness Area is new, small, diverse, and surrounded by a dense human population. Fortunately, the LEF's century of past research provides abundant information for multi-purpose forest management, public education, and interpretation. The updated multi-purpose management plan will consider forest resources and human impacts within the entire LEF. Recurrent surveys should determine habitat needs to protect the area's flora and fauna, and to monitor environmental change. The wilderness boundary must be determined; moreover, the area must be managed for solitude—an uncommon resource elsewhere on the island. Current stakeholder appreciation and support for wilderness is generally lacking, and the issue of protective rather than invasive public interest in the area may be a major challenge for LEF managers. Management uses a planning process to make decisions. Researchers should help managers to the extent possible with needed information. Managers, in turn, should make an effort to understand and correctly use the information. If not, "never the twain shall meet" (Kipling 1889).

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Public Perception of the Antarctic Wilderness: Surveys from an Educated, Environmentally Knowledgeable European Community

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Abstract—In 2007 and 2008, students from Tilburg University (the Netherlands) collected 269 responses on a questionnaire about Antarctica and its management. Respondents in the Netherlands clearly supported protecting Antarctica as a wilderness, and acknowledged Antarctica's importance as part of the global climate system and as a science laboratory for the benefit of mankind. Since the Consultative Parties to the Antarctic Treaty frequently state that they manage Antarctica "for the benefit of mankind," research on the general public's opinion on management issues should be considered relevant information for the decision making process within the Antarctic Treaty System. The strongest opinions of those surveyed suggest that they would like to see that management of Antarctica would allow for scientific research and educational visits on a small scale, while several other categories of activities—many commercial, for-profit or extractive—would be discouraged or prohibited. Large scale tourism, land-based tourism, construction of roads and airstrips, mineral resource activities and whaling all received little support from the respondents. According to respondents, "protecting Antarctica's wilderness values," as mandated under the Environmental Protocol to the Antarctic Treaty, means ensuring that Antarctica remains as close as possible to its original condition.

Background

The Antarctic Treaty System

Since the Antarctic Treaty in 1961, the Antarctic area (south of 60 degrees south latitude, comprising the Antarctic

continent and the surrounding oceans) has been managed collectively by countries that have a substantial scientific interest in Antarctica. The number of these so-called 'Consultative Parties to the Antarctic Treaty' has grown from 12 to 28 in the past four decades. They meet annually at the Antarctic Treaty Consultative Meeting (ATCM) to discuss the implementation of the agreements that are in force and to consider the need to take additional management measures in view of new developments. Various other international agreements (separate conventions, a protocol to the Treaty and a large number of measures) have been adopted after the Antarctic Treaty to manage human activities in the Antarctic.

The main aims of this international management system—known as the Antarctic Treaty System (ATS) ([http:// www.ats.aq](http://www.ats.aq))—are to (1) safeguard peace, (2) ensure the freedom of scientific research, and (3) ensure the comprehensive protection of the Antarctic environment. A major step to pursue this third objective was made through the adoption of the 1991 Protocol on Environmental Protection to the Antarctic Treaty (commonly referred to as the Madrid Protocol or the Protocol) that entered into force in 1998. Article 2 of this Protocol designates Antarctica as "a natural reserve, devoted to peace and science" and Article 3, paragraph 1, stipulates that:

The protection of the Antarctic environment and dependent and associated ecosystems and the intrinsic value of Antarctica, including its wilderness and aesthetic values and its value as an area for the conduct of scientific research, in particular research essential to understanding the global environment, should be fundamental considerations in the planning and conduct of all activities in the Antarctic Treaty area (http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1991.php).

Managing Antarctica "In the Interest of All Mankind"

According to the preamble of the Antarctic Treaty, the Parties to this treaty recognize "that it is in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord" ([http:// www.ats.aq/documents/ats/treaty_original.pdf](http://www.ats.aq/documents/ats/treaty_original.pdf)). Later, the Consultative Parties related the concept of "the interest of mankind" also to the issue of environmental protection within the ATS. Examples include Recommendation

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

ATCM VIII-13¹ on the “[p]rotection and monitoring of the Antarctic Environment” (Oslo 1975), Recommendation ATCMXII-3, “Environmental impact of scientific research,” (Canberra 1983) and the preamble of the Protocol. According to this preamble, the Contracting Parties are “[c]onvinced that the development of a comprehensive regime for the protection of the Antarctic environment and dependent and associated ecosystems is in the interest of mankind as a whole.” Similar statements can be found in other recommendations, as well as declarations that have been adopted by the ATCM. For example, the declaration adopted at the occasion of the 30th anniversary of the entry into force of the Antarctic Treaty (Declaration 30th anniversary 1991) states:

The Antarctic Treaty provides an example to the world of how nations can successfully work together to preserve a major part of this planet, for the benefit of all mankind, as a zone of peace, where the environment is protected and science is pre-eminent

This statement as well as the other relevant recommendations and measures adopted by the ATCM (for a recent example, see Resolution 9 in Secretariat of the Antarctic Treaty 2009: 288-289), indicate that the Consultative Parties consider their management efforts in the interest of all mankind, particularly those efforts that support or strengthen one or more of the three pillars of the ATS: to safeguard peace, ensure the freedom of scientific research, and ensure the comprehensive protection of the Antarctic environment.

In the literature, the efforts of the Consultative Parties to manage Antarctica “in the interest of all mankind” have been related to the issue of international acceptance of the ATS. This is reflected in Francioni’s explanation for the decrease of tensions between the ATS and the United Nations (UN): “Now, few States, if any, are ready to deny that Consultative Parties have acted responsibly with regard to the protection and conservation of Antarctica for the benefit of humankind” (Francioni 1996, p.2; for the relationship between the ATS and the UN, see Beck 1994 and 2006). However, the Consultative Parties’ ambition to manage the Antarctic in the interest of all mankind has also been criticized by several authors. For example, Klaus Dodds (2006) makes the power imbalances among various Antarctic states explicit, tracing how less-developed states such as India and Malaysia have critiqued the Antarctic Treaty System in the United Nations. The Consultative Parties’ claim that they manage Antarctica in the interest of all mankind constitutes the starting point of the present study, while a discussion of the legitimacy of this claim is beyond the study’s scope.

Research Objectives

In 2007, a team of researchers from Europe and North America set up a research project entitled “Managing Antarctica for the Benefit of Mankind: A Research Project on the Public Perception of Antarctica and the Way it Should be

Managed.” The objective of this ongoing research project is to get a better understanding of the perspectives of the global public with respect to Antarctica and the way Antarctica should be managed now and in the future. This objective is directly related to the above discussed claim of management of Antarctica in the interest of all mankind. This claim obliges the Consultative Parties to take note of the interests and views of stakeholders outside the ATS. These stakeholders include states that are not a Party to the ATS-instruments as well as members of the general public.

As the public’s opinion has received little and/or sporadic attention from Antarctica’s decision makers, the research team plans to collect the opinions of people from a wide variety of backgrounds, cultures and professions across the world.² Few systematic studies exist on this subject, and we hope that the present project can provide information that could bridge the gap. The current paper presents the findings of the first phase of our project in which a cross-section of the Dutch population—predominantly young, highly educated, and localized in the southern part of the Netherlands—responded to our questionnaire. The research team is well aware of the fact that the outcome of the survey is highly dependent on the cultural background of the respondents. We plan to continue the project in countries in other parts of the world.

Methodology

Between March 2007 and June 2008, students in Tilburg University’s Master of Environmental Law program were asked to collect answers for a questionnaire as part of their term-time assignment. A total of 12 students participated, collecting 269 useable responses.

The questionnaire was divided into four parts, containing a total of 15 main questions, which required answers in the form of multiple choice, short answers, or longer elaborations. A short introduction at the beginning of the document provided the respondent with some factual background information on the Antarctic Treaty and the goal of the research. Every care was taken so as not to influence the respondents prior to providing their responses on their perceptions of wilderness or of Antarctica.

In part I of the questionnaire, the respondent was asked to provide some information about him/herself, including age, gender, educational level, and level of knowledge about Antarctica. In part II, the respondent was asked to elaborate on his/her general perception of Antarctica, including his/her impressions of Antarctica and whether the respondent considers Antarctica interesting or important. In part III, the respondent was asked more specific questions on his/her perception of Antarctica, including what he/she considers as the importance and role of Antarctica, human activities that he/she supports and believes are taking place in Antarctica, and whether/how he/she thinks these activities should change in the future. In part IV, the respondent was asked to elaborate on his/her general perception of wilderness and of wilderness in Antarctica, specifically.

¹ All recommendations and measures adopted by the ATCM can be accessed through http://www.ats.aq/devAS/ats_meetings.aspx?lang=e.

² Anyone who is interested in participating in the study and helping to expand its geographical and social coverage is welcome to contact any one of the co-authors, who are all member of the research team.

Results

General Information on Respondents (Part I)

The questionnaire was completed by a total of 269 respondents, between 15 and 91 years old, mostly Dutch (table 1). There were nearly equal numbers of male and female respondents. Approximately 40% of the respondents were between 20 and 29 years old. A large proportion of the respondents had secondary or higher levels of education, and medium or high levels of environmental knowledge. None of the respondents had traveled to Antarctica and the general level of knowledge of Antarctica among respondents was low.

Table 1—Characteristics of respondents.

Characteristics of respondents	Percentage of all respondents
Male	57
Female	43
With secondary or higher education	98
With medium or higher level of knowledge of environmental issues	78
With medium or higher level of knowledge of Antarctica	25
Below age of 20	8
Between 20 and 29 years old	41
Between 30 and 39 years old	10
Between 40 and 49 years old	15
Between 50 and 59 years old	13
Above age of 59	13

Perception of Antarctica (Parts II and III)

The large majority of the respondents (95%) considered Antarctica as interesting and/or important. Respondents were asked to indicate which of the following represents the importance of Antarctica:

- A science laboratory for the benefit of mankind
- A tourist destination
- One of the world's last great wildernesses
- A reserve of mineral resources that might support society in the future
- The 'refrigerator' of the world, an important component of the Earth's climate system
- Antarctica does not have any value for mankind
- Other, namely ...

They could choose multiple answers and were encouraged to explain how multiple activities could co-exist. Two-thirds of the respondents thought that the importance of Antarctica lies in its being "c. one of the world's last great wildernesses," and "e. an important component of the Earth's climate system." Perhaps because they are from a low-lying country, many respondents were aware of the consequences of the melting of Antarctic ice sheets on sea levels. Half of the respondents also considered Antarctica as an important "a. science laboratory for the benefit of mankind" (fig. 1).

The respondents were then asked if they supported the undertaking of any of these activities in Antarctica:

- Small to medium-scale ship-based tourism (up to 300 tourists per ship; make short excursions ashore)
- Large-scale ship-based tourism (between 300 and 3,000 tourists per ship; no excursions ashore; luxury entertainment, dining and sports facilities onboard)
- Development of land-based tourism, e.g., building of hotels, tourist accommodation in research stations, snow mobile excursions, etc.
- Educational trips, e.g., students
- Production of art projects, e.g., films, books, music, paintings
- Building of over-snow road networks
- Building of airstrips
- New stations for conducting scientific research
- Mining / oil exploration
- Fishing
- Hunting for whales
- Exploitation of biological or genetic material for commercial purposes
- Exploitation of icebergs for fresh water supply
- Designating Antarctica as a wilderness reserve where development of infrastructure is limited

Again, multiple answers were permitted. The respondents were not told which of these activities are currently taking place in Antarctica. These activities are marked with an asterisk in figure 2. Seventy-nine per cent of the respondents

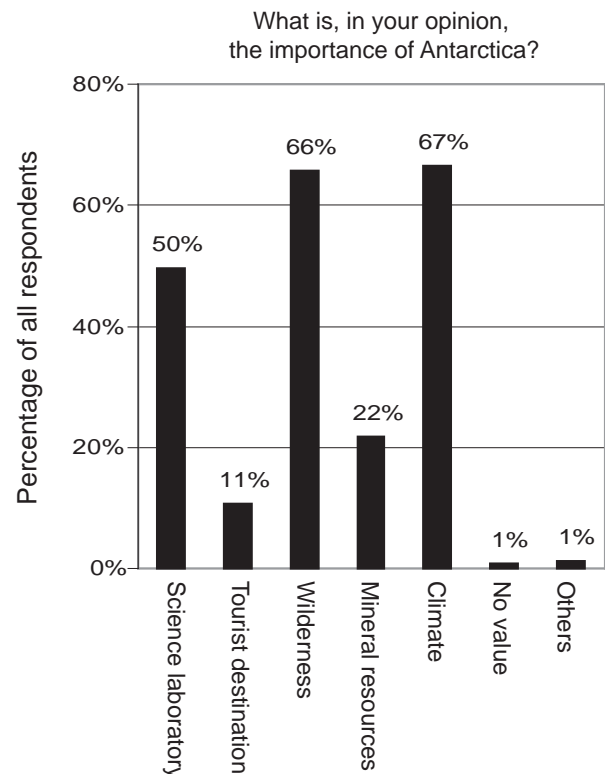


Figure 1—Respondents' perceptions of the importance of Antarctica.

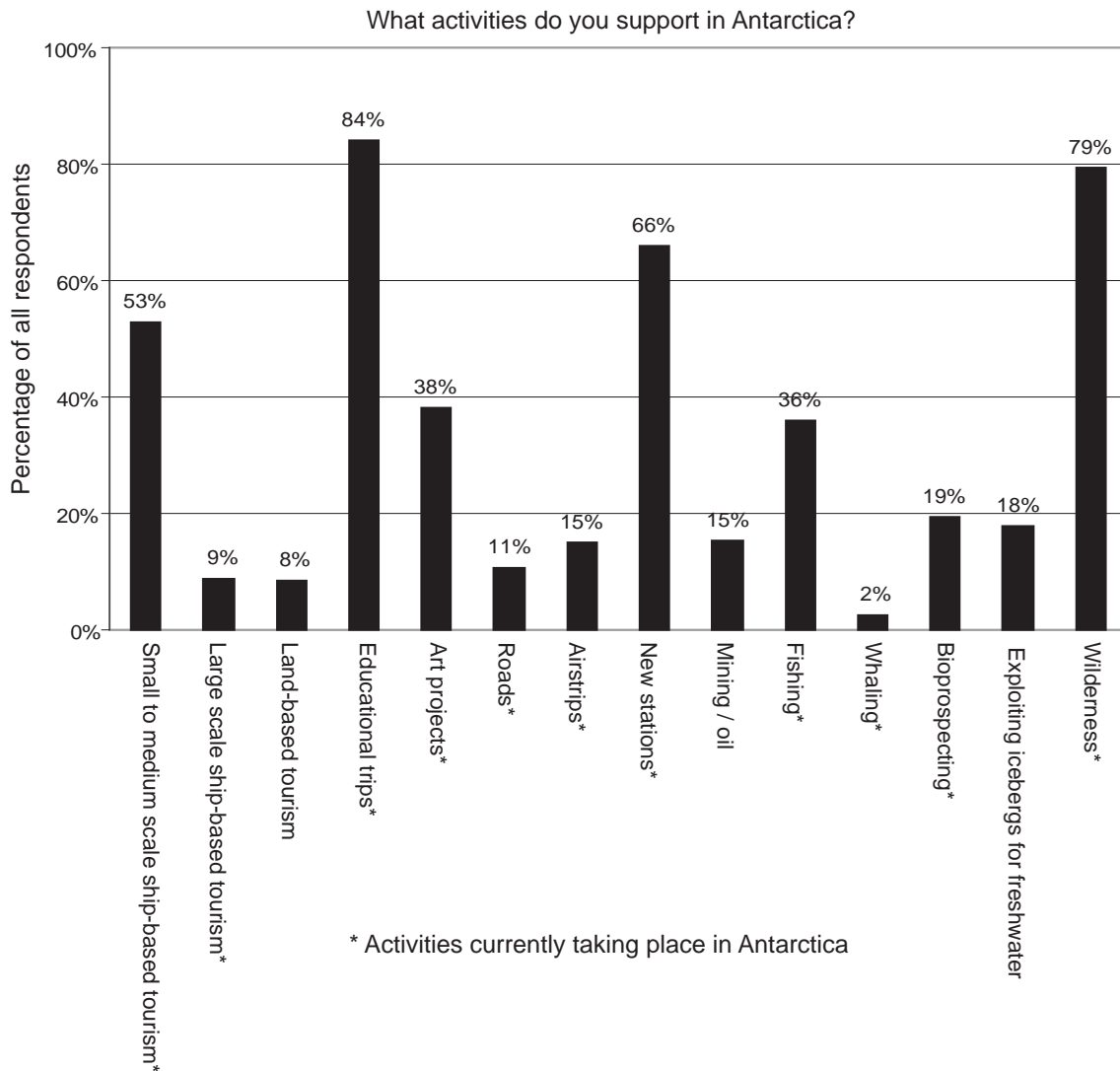


Figure 2—Respondents' support of activities in Antarctica.

supported “n. protecting Antarctica as a wilderness,” while there was little support for the activities of “k. whaling” (2%), “b. large-scale ship-based tourism” (9%) or “c. land-based tourism” (8%) and “i. mining” (15%) (fig. 2). There was, however, significant support for “d. educational trips” (84%), “h. new stations for conducting scientific research” (66%), and “a. small to medium scale ship-based tourism” (53%).

Respondents were asked what they thought was the current level of human activity in Antarctica. Half of the respondents believed that thousands of people go to Antarctica each year (table 2). Another 45% believed that tens of thousands of people go to Antarctica each year. Approximately 74% of respondents correctly answered that the area visited and area covered by infrastructure is less than 10% of Antarctica’s surface.

According to the Council of Managers of National Antarctic Programs, all the 75 active research stations in Antarctica combined can simultaneously accommodate a maximum of 4,500 people (COMNAP 2009). While this

number can be used as an indicator, the exact number of people that cycle through the various research stations and field camps each year is not readily available and could be several times such a value. Tourism is the other activity that brings people to Antarctica and in the 2007-2008 austral summer season, a total of 74,000 passengers, staff, and crew went to Antarctica with the tourism industry (IAATO 2008a). Most tourists travel to Antarctica on expedition cruise ships (that carry from several to 500 passengers, in addition to staff and crew) and make occasional landings at specific sites on the continent or surrounding islands. Tourists also arrive by air and may spend significant amounts of time on land for the purposes of long distance expeditions or climbing. Increasing numbers arrive onboard large ships (carrying between 1,000 and 3,000 passengers, in addition to staff and crew) but no landings are made. In the 2007-2008 season, out of the 46,000 boat passengers, at least 32,600 passengers made landings at a total of 202 sites on the Antarctic continent, while 12,400 passengers traveled

Table 2—Respondents' perception of the level of human activity that is currently taking place in Antarctica.

In your opinion:	Percentage of all respondents answering		
	1,000's of people	10,000's of people	100,000's of people
How many people go to Antarctica each year?^a	49	45	6
	<10	10-50	50-100
Humans currently regularly visit how much of Antarctica's area?^b	67	31	2
	<10	10-50	50-100
Long-term infrastructure, e.g., research stations, cover how much of Antarctica's area?^c	74	26	1

^a As a rough estimate, the number of people going to Antarctica every year is getting closer and closer to the 100,000 mark (see text for details).

^{b,c} Human activity and infrastructure currently cover roughly less than 10% of Antarctica's surface area on a regular basis.

on large cruise ships and did not set foot anywhere within the Antarctic Treaty area³ (IAATO 2008b, c). Therefore, as a rough estimate, the number of people going to Antarctica every year is getting closer and closer to the 100,000 mark. The results with respect to the Antarctic visitor numbers indicate that our respondents' perception of the level of human visitation to Antarctica is, overall, lower than what is in reality.

When asked how they would like to see the level of human activity in Antarctica change, more than 90% of our respondents supported no change or decrease in the area occupied by human activities (table 3). In the case of the number of people visiting Antarctica, of the 6% of the respondents who believed more than 100,000 people are going to Antarctica each year, most supported a reduction in the number of people going to Antarctica. None of these respondents supported an increase in the number of people going to Antarctica. For the respondents who believed that tens of thousands of people go to Antarctica each year, about half supported no change in numbers and the other half supported a reduction in numbers. Again, there was very little support for the increase in the numbers. Respondents who believed that thousands of people go to Antarctica each year also displayed a similar opinion. Thus, these results imply that over 90% of our respondents find the current number of people going to Antarctica unacceptable.

We found that there was no significant difference in the responses from respondents of different genders. Respondents who characterized themselves as having a high level of knowledge of environmental issues tended to have a perception of the level of human activity in Antarctica that was closer to reality. Apart from this aspect, we found that

Table 3—Respondents' support for change in the level of human visitation to Antarctica.

Respondents who believe:	Percentage of respondents in each category who support:		
	No change	Decrease	Increase
Thousands of people go to Antarctica every year	59	32	7
Tens of thousands of people go to Antarctica every year	47	43	10
Hundreds of thousands of people go to Antarctica every year	20	80	0

levels of knowledge of respondents about environmental issues or Antarctica explained little of the difference between responses.

Respondents between the ages of 30 and 49 and above the age of 59 tended to place particular importance on Antarctica as one of the world's last great wildernesses (fig. 3a). Respondents over 20 years old considered Antarctica as a scientific laboratory being of special importance, with more respondents in the higher age group having this opinion (fig. 3b). Curiously, compared to other age groups, fewer respondents within the age group of 30-39 years old considered the importance of Antarctica to lie in its being an important component of the Earth's climate system (fig. 3d). While there is little overall support for Antarctica as a

³ Notwithstanding the absence of landings, large scale ship-based tourism can still have environmental impacts; while interesting and extremely relevant, such a discussion is beyond the scope of this present article.

tourist destination (fig. 3c), there is more support for small to medium ship-based tourism among respondents below the age of 40 compared to those above the age of 40 (fig. 4a). One possible hypothesis could be that the older population may consider visiting Antarctica to be less of an option for themselves, but this cannot be verified on the basis of the survey. Respondents under 40 years old were especially supportive of art projects being conducted in Antarctica (fig. 4b). Fishing, which received support from under 40% of all respondents, was particularly supported by respondents below 20 years old (fig. 4c). For the other activities that were supported by the majority of respondents, i.e., educational trips and new stations, there was little difference in the responses according to age groups. For the activities that were supported by 15% or less of all respondents, it is difficult to draw significant conclusions on the age distribution of responses, as sample sizes of supporters become small. While the majority from each age group did not support these activities, it appeared that more respondents from the lower age groups supported the activities of fishing (fig. 4c), mining (fig. 4d), large ship-based tourism, and the construction of roads than those from higher age groups. For other activities, such as whaling, land-based tourism (fig. 4e), and

the construction of airstrips (fig. 4f), there appeared to be little difference between the responses from different age groups. However, these trends should only be interpreted as indicative because of the limited sample size.

Perception of Wilderness (Part IV)

In part IV, respondents were invited to express their opinions on wilderness, in general, and on wilderness in Antarctica, specifically, through four questions:

- *In your opinion, what is the meaning of the word 'wilderness'?*
- *What should not be allowed in a wilderness?*
- *What should be allowed in a wilderness?*
- *According to you, what is the meaning of the phrase 'protecting the wilderness values of Antarctica'?*

The majority of the respondents shared a similar understanding of the word 'wilderness.' Many respondents described it as a place with no or few people; where there is no or little human impact or interference or disturbance. The lack of infrastructure is often cited, as well as the quality of silence and solitude. Some respondents specified that

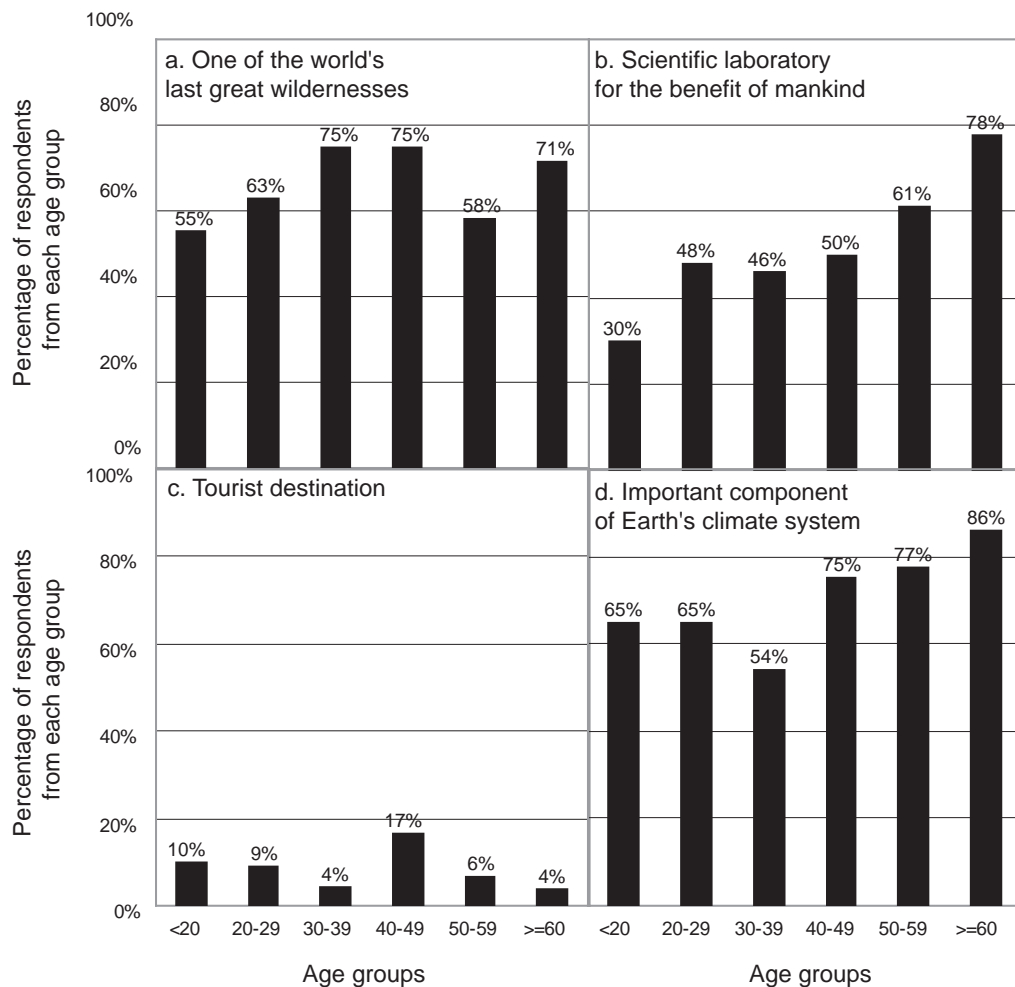


Figure 3—Respondents' perceptions of the importance of Antarctica, according to age groups.

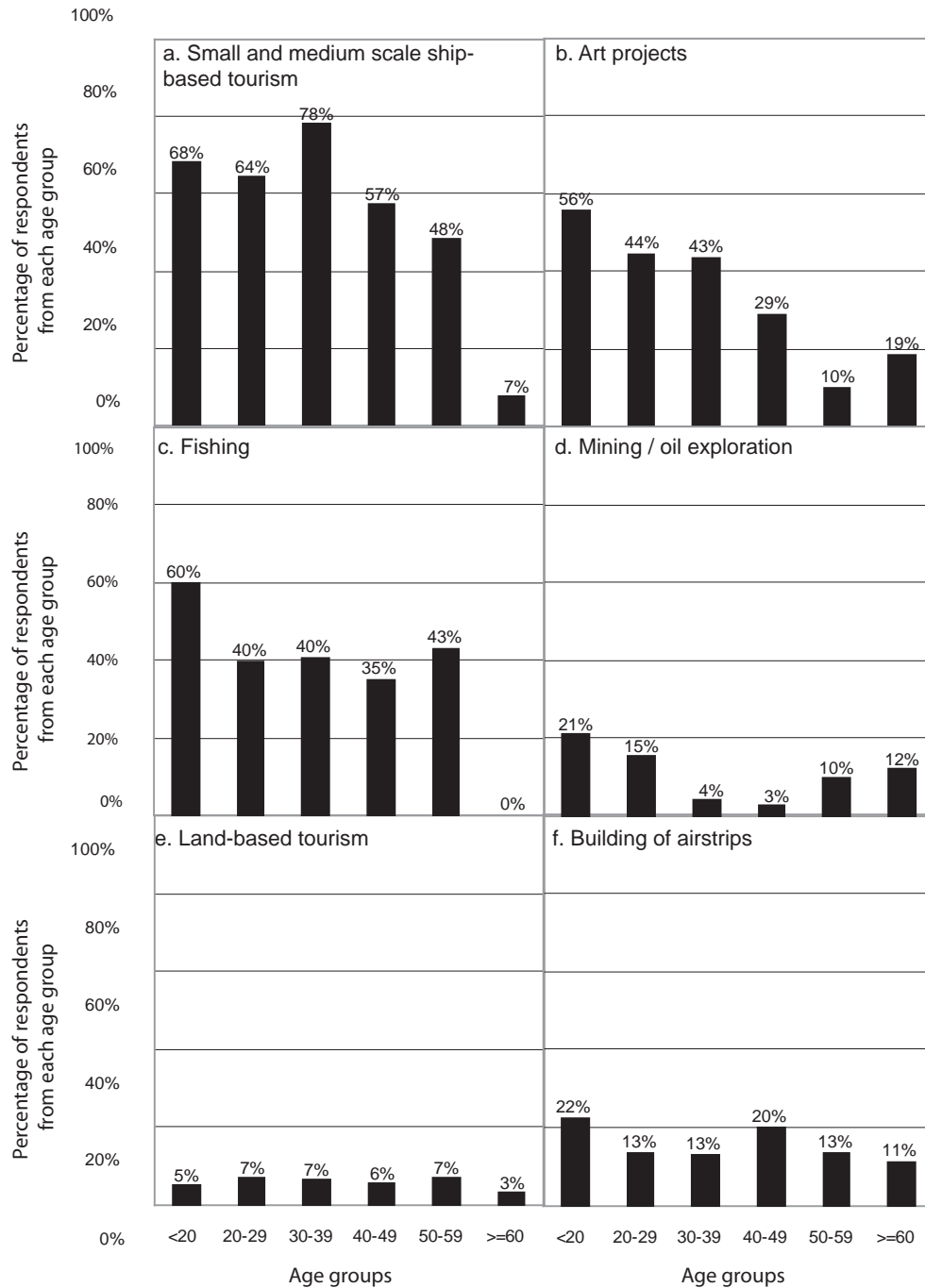


Figure 4—Respondents’ support of activities in Antarctica, according to age groups.

wilderness should be large areas while others indicated that they can be small. Overall, the respondents’ perception of the word ‘wilderness’ can be summarized as a place where *“nature goes its own path without human intervention.”*⁴ Some examples of wilderness areas commonly mentioned were: rainforests/the Amazon, high mountains, deserts, oceans, the Polar Regions, Africa, and Australia.

⁴ Quote from respondent. All text in quotation marks and italicized from this point on are direct quotes from respondents.

Respondents were then asked what activities should or should not be allowed in wilderness. The emphasis of these two questions is not on Antarctica, but rather is on wilderness in general. Respondents suggested a wide range of activities that should be prohibited in wilderness. The most widely cited response was of the generic type, which excluded activities that *“disturb the natural balance,”* or *“pollute,”* or *“damage the wilderness.”* Of the specific suggestions, hunting, infrastructure, industry, logging, natural resource exploitation, including mining and oil and gas exploitation,

were frequently mentioned. Overwhelmingly, tourism—specifically, mass tourism—was indicated as an activity that should be prohibited in wilderness. The prohibition of commercial activities or any human intervention is also frequently mentioned. Respondents frequently mentioned that “*as little [human activity] as possible*” should be allowed to take place in wilderness and that only “*activities that add value and have only minimal impact*” or would “*allow nature [to] take its course*” should be permitted. Research, tourism, and education—all on a small scale—were among the activities that the respondents thought should be allowed to take place in wilderness.

The final question brought earlier questions together and asked the respondents for their thoughts on Antarctica as wilderness. Respondents were asked what the phrase ‘protecting the wilderness values of Antarctica’ meant to them. Responses were not very specific. This could be an indication that the respondents were unfamiliar with the subject matter or the concepts involved, or that the question was not worded clearly. To many respondents, ‘protecting the wilderness values of Antarctica,’ as mandated under Article 3 of the Protocol, meant the need to change Antarctica as little as possible, “*ensuring that Antarctica remains as far as possible in its original condition,*” and that it does “*not become a tourist destination but just a piece of unspoiled nature, the way it was before it was discovered.*” In response to this question, respondents thought that ‘protecting the wilderness values of Antarctica’ would mean prohibiting tourism; some level of scientific research should continue; large-scale human activities should be prohibited; and all other human activities should be avoided or kept at as small a scale as possible.

Linking Findings with Ongoing Management Debates

The results of this study provide a glimpse of the opinions of a small cross-section of the Dutch population (predominantly young, highly educated, and highly localized in the southern part of the Netherlands). Future surveys among populations of different cultural backgrounds will be needed to verify the universality of the results from this first phase of the study. While recognizing the limitations of the project, the authors also recognize the new insight that this study will bring. Most previous surveys have been conducted among target groups who have a certain level of knowledge about Antarctica, notably tourists or other visitors (Enzenbacher 1995; Davis 1999; Maher 2007) or other people on their way to Antarctica (Roura and Del Acebo Ibáñez 2000). Few have sought out the opinions of people who do not have any direct links with Antarctica. It is true that one might question the validity of the opinions of a general public that knows little about Antarctica, and we recognize that such opinions should not dictate decisions. Nevertheless, since Antarctica is a global commons, we hope that public opinion can at least be integrated as one of the numerous components that are taken into account in the decision making process. In that respect, the findings from this study provide some unique information on the views of a small part of mankind, which can potentially benefit from the management of Antarctica

but currently does not participate actively in the decision making process.

Respondents clearly supported protecting Antarctica as a wilderness, and acknowledged the importance of Antarctica as part of the Earth’s climate system and an important science laboratory for the benefit of mankind. There was general support for scientific research activities and educational trips (activities that are not driven by profit) and small-scale tourism activities (although it was not considered acceptable to develop Antarctica into a tourist destination). Large scale tourism, land-based tourism, mineral resource activities, whaling (for-profit commercial activities) and the construction of roads and airstrips all received little support. For respondents, protecting Antarctica’s wilderness means ensuring Antarctica remains as close as possible to its original condition.

Since the Consultative Parties to the Antarctic Treaty frequently state that they manage Antarctica ‘for the benefit of mankind,’ the general public’s opinion on management issues should be considered relevant information for the decision making process within the Antarctic Treaty System. If this information was to be fed into decisions regarding the management of Antarctica it would mean that, generally speaking, management should ensure that (a) there are no large-scale human activities in Antarctica, (b) Antarctica should remain in its original condition as much as possible, and (c) small scale activities should take place for the benefit of non-profit purposes, notably, science and education and not for commercial purposes.

In general, these findings match well with existing ATS instruments. For instance, scientific research is accorded priority over other types of activities (Art.3(3) Madrid Protocol), the importance of education has been underlined (Resolution 2 (1996), ATCM XX, Utrecht) and Art. 6(1)(a) of the Protocol), mineral activities for non-scientific purposes are prohibited (Art.7 Protocol), and the wilderness values of Antarctica have been given legal protection (Art.3(1) Protocol, online: http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1991.php). However, a closer look makes clear that there are several discrepancies between the opinions expressed in this survey and today’s management of Antarctica.

First of all, on-the-ground implementation of wilderness protection has attracted little attention (Tin and Hemmings, this proceedings; Bastmeijer 2009). One often cited reason is that the concept of wilderness protection is too vague and subjective. However, for respondents in this study, wilderness appears to be a concept that is quite well defined. In fact, respondents’ perceptions, which can be summarized as a place where ‘*nature goes its own path without human intervention*’ is very similar to the International Union for Conservation of Nature’s definition (IUCN) (Dudley 2008) of a wilderness area (Category 1b protected area). The results show that there are parts of ‘mankind’ who clearly want Antarctica’s wilderness values to be protected and their perception of Antarctica as a wilderness is neither vague nor abstract.

The current system of tourism management in Antarctica also shows differences with the public’s views expressed in this survey. Relevant to this discussion, the cross-section of Dutch population sampled considers Antarctica to be more

important as a wilderness area and a scientific laboratory for the benefit of mankind than as a tourist destination. In fact, many of our respondents feel that tourism should be kept out of wilderness. If this information is to be taken into account in the management of Antarctic tourism, it would lead to the conclusion that steps need to be taken in order to avoid tourism activities having adverse impacts on science programs or the wilderness values of Antarctica. Such steps may include the prohibition of permanent facilities for tourism in Antarctica, a subject that has been debated within the ATS over the past 5 years without a final decision. In view of the outcomes of the survey, one could also think of instruments to limit a further increase of tourism numbers (in Antarctica, in certain regions of Antarctica and/or at certain Antarctic sites), and to adopt measures with respect to the types of tourist activities that should be allowed (e.g., focus on small to medium scale, ship-based tourism using the Lindblad model of cruising, with an emphasis on education of visitors). Such measures could be considered during the process of developing a joint vision on the future of Antarctic tourism, a process that has started with the adoption of a number of general principles for Antarctic tourism at the Baltimore ATCM, 2009 (Resolution 7 (2009), ATCM XXXII, Baltimore).

Currently, mining activities for non-scientific purposes is prohibited under the Protocol and commercial whaling is prohibited under the International Whaling Commission (IWC). However, these bans could be revisited in the coming decades as a result of the scarcity of fossil fuels, or a reverse in the decision of the IWC. According to the results from this study, such activities are currently not supported by the Dutch public, although it is not possible to know whether they will hold the same stance in the future.

Last but not least, this study shows that the general knowledge of the Dutch public about Antarctica is low. In view of the position of the Netherlands as a Consultative Party to the ATS, this may constitute a reason for the government to develop programs to promote and increase the knowledge of Antarctica among its population.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

Wilderness—Between the Promise of Hell and Paradise: A Cultural-Historical Exploration of a Dutch National Park

Koen Arts, Anke Fischer, and René van der Wal

Abstract—‘Wilderness’ is often seen as an ideal state in contemporary debates on ecological restoration. This paper asks what is left of ‘wilderness’ in present-day Western Europe and explores this question by drawing on a case study of the Hoge Veluwe National Park in the Netherlands. An overview of intellectual histories of wilderness ideas is used as a backdrop to analyze how an area such as the Veluwe has been perceived and shaped by land use through history. It is argued that historical and contemporary land use is characterized by inherently paradoxical ideas that can be conceptualized as a dichotomy of the ‘hell’ and ‘paradise’ sides of wilderness. Both sides are essential in constituting the attraction of wilderness. Ecological restoration policies focusing on just one side of the paradoxality of wilderness are likely to miss the character of the very place they aim to restore.

Introduction and Approach

Wilderness can be manifest in different shapes and sizes, and one can recognize wilderness-like qualities in natural areas other than those in International Union for Conservation of Nature (IUCN) category Ib; even in a crack of the pavement (Birch 1990). The distinction between wilderness as an object of desire, a biophysical entity, or a cultural construct is at times useful, but unsuitable when looking at cultural histories in which these distinctions were seldom made, and when aiming to understand the broad role that the concept of wilderness plays in contemporary cultures and land management.

We consider wilderness here as a subcategory of ‘nature,’ as an interpretation of the natural environment that holds extreme promises. We explore what is left of the wild in contemporary Western European culture by means of a case

study of the Hoge Veluwe National Park in the Netherlands, and address three main goals: (1) to analyze Western cultural-historical relationships with wilderness from conceptual and local land use perspectives in order to (2) diagnose current relationships with wilderness and to (3) explore implications for contemporary wilderness restoration practices. This is done by mirroring a seven-step conceptual history of the idea of wilderness, first with a land use history of the Dutch natural area the Veluwe, and more specifically the Hoge Veluwe National Park, which is situated within the Veluwe (fig. 1). Building on this, we explore what is left of the wilderness of the Hoge Veluwe and what this means for contemporary relations to wilderness; and finally, we discuss implications for wilderness restoration.

Rather than adding to primary research in the cultural history of wilderness ideas or the land use of specific areas, we bring these often separated strands together, using a variety of (secondary) sources, and aim at a synthesis of histories to come to new insights into contemporary wilderness issues.

Case Study Selection

Wilderness desire in Dutch society is bound to be ambiguous; there are almost 400 people per km², every piece of land is altered by humans, and were there no dykes, over half of the Netherlands would fall victim to the wilderness of the sea. In this paradoxical setting, an examination of the wilderness of the Hoge Veluwe promises to be particularly interesting. The Hoge Veluwe is a 50 km², privately owned national park within the largest Dutch natural area on land, the Veluwe (1,000 km²; fig. 1). Building on a century-old history, the Hoge Veluwe National Park has become a national icon, constituted by a remarkable combination of art (e.g. the internationally renowned Kröller-Möller Museum), nature, and tourism. Given its relatively small size, long history of land use, the art collection, and a strong tradition of intensive conservation management, the park is by no means a biophysical wilderness. Yet, it is all the more interesting as both its history and contemporary features exemplify many ambiguities of the ongoing wilderness (restoration) debate.

Historical Wilderness Perceptions in Seven Big Steps

An examination of the history of the concept of wilderness reveals that wilderness projections often reflect extremes of the same spectrum: danger-safety, dark-light, bad-good,

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Figure 1—From left to right: The Netherlands, the Veluwe, and the Hoge Veluwe National Park.

original Eve-fallen Eve, pristine-Fall, hell-paradise (also pointed out for nature in general by Glacken 1967; Worster 1977; Schama 1995; Merchant 1996; Schouten 2001).

Prehistory: Duality of Home and Hazard

Both Nash (1973) and Oelschlaeger (1991) suggest that hunter-gatherers—like many contemporary indigenous hunter-gatherers—probably did not conceptualize wilderness as such, simply because they were part of it. In this context of the “Paleolithic wilderness mind” Oelschlaeger (1991) speaks of a 200,000 year hegemony of “the Great Hunt” during which prehistoric people lived in an “Eden-like condition.” By contrast, Nash (1973) thinks that prehistoric people were foremost occupied with fear and security.

Whoever may be right, it seems safe to say that hunter-gatherers lived in a wilderness that was a continuous threat to, but at the same time the primary source of, their livelihoods. Wilderness was both home and hazard at the same time.

Neolithic: A First Conceptualization

Hunter-gatherers’ livelihoods evolved toward a more agricultural and sedentary way of living in the Neolithic. In the Mesopotamian epic *Gilgamesh* (around 2100 BC), the

hero crushes the forest guardian to subsequently use his timber for building beautiful cities (Schouten 2001). The epic symbolizes not only the triumph of civilization over wilderness, in which wilderness provides the raw material for (agri)culture, it also shows how wilderness was perceived from another realm, namely the city, and from there defined as such. By denoting a sphere separated from, and possibly forming a threat to, culture, a first concept of wilderness was born.

Antiquity: A Mirror for Society

In antiquity, wilderness remained a loathed sphere for most: Earth swarms with wild beasts and its woods are filled with anxious terrors, says Lucretius in the first century BC (Nash 1973). But the rich ancient Greeks and Romans also created so-called paradises: pieces of wild land protected by a wall, used for fishing and hunting (Hughes 2003). In a paradise, one could catch a rosy glimpse of the wild, as it was stripped of most fearful elements. Yet, many Romans perceived the wilderness (especially the woods in the North; Caesar translated 2003) as a dangerous place, sheltering hostile tribes. At the end of the 1st century AD the Roman historian Tacitus (translated 2006) holds a mirror for his own decadent society. He still talks of dreadful woods and swamps, but implicitly glorifies the happy, primitive and

virtuous German warrior tribes in the northern woods. The wild, in the form of noble savages, obtained for the first time in history a positive connotation of pure and original.

Middle Ages: Restoring Paradise and Soul

Just as it must have been the case in antiquity, medieval times show a large gap between the wilderness of the poor and the wilderness of the elite. In view of the clerical elite, the relationship with God had been disturbed by the fall of man, and humankind was moved away from the garden of Eden to the wilderness of uncultivated land. To restore the pre-fall paradise, many monastic orders set out to cultivate wilderness and make it productive and orderly again, thereby having an enormous impact on the natural environment (Schouten 2001). Medieval hermits on the other hand, following biblical examples, used the direct physical hardship of the wilderness to restore their relationship with God (Bratton 1988; White 1972; Williams 1962). The two pathways to God could not be more contrasting. Although with a specific aim in mind, the hermit accepted the wilderness and its satanic features; wilderness was encountered without the need to change it. The restorers, on the other hand, followed the Greeks and Romans and altered wilderness according to an image of paradise.

Early Modernity: Gradual Changes

Voyages of discovery, not uncommonly also searching for the actual Garden of Eden (Mabey 2005), marked the early modern period of the rise of nation states and the accompanying political tumult and warfare. In these times wild forests became an important symbol for early German (Schama 1995) and Dutch-nationalist sentiments (Breman and Hofman 2009). Building on the strand of primitivism and the first conceptualizations of the sublime, a more favorable attitude towards wilderness developed in the 17th century (Cronon 1996). The sublime landscape had a religious connotation: John Ray described mountains, previously regarded as waste lands, as “the handiwork of God if not His very image” (Nash 1973). However, these transitions came about only partly and in any case gradually: about 50 years later, around 1750, De Buffon still said that mountains had the appearance of old age and decrepitude (Botkin 1992).

A Place of Direct Desire

The religious side eventually gave way to more secularized interpretations of sublime, wild landscapes in the Romantic Movement. Romantic authors like Shelley, Coleridge, Wordsworth, and a bit later in America, Emerson, Thoreau and Muir created a personal relationship with the natural world, away from quantification and laws. This was a search for beauty, divine presence, knowledge of the dark side of the self, and answers were found in a transcendental wilderness (Oelschlaeger 1991). Indeed, the longing for the wild at times reached the level of a theology (Cronon 1996; Schouten 2001). The brutishness of the wilderness changed into mystery and wonder (Adams 2004) and wilderness became a place of direct desire.

19th and 20th Century

Building on the Romanticists’ reaction to the Industrial Revolution, and accelerated by the work of Perkins Marsh, the 19th century saw the rise of the environmental movement. A science-based awareness arose that humankind was vulnerable and that its survival rested on the survival of the Earth as a functioning entity. Legal protection for wilderness areas was formulated and national parks were created (the first was Yellowstone in 1872). Ever since, science became more dominant in general wilderness perceptions, leading up to today’s discussions about in what way wilderness protection relates to, for instance, the conservation of biodiversity (Sarkar 1999; Willis and Birks 2006). Interconnected with this development, national parks and other wilderness areas became a real attraction for recreation and tourism, and these in turn an essential part of modern life. In recent years, both environmental awareness and tourism globalized (Adams 2004); the last biophysical wildernesses have become dearly cherished symbols that need to be recovered “if we hope to save the planet”—as Cronon (1996) ironically puts it—and turned into hot spots for science and tourism.

Between Paradise and Hell

The themes of hell and paradise are particularly striking and seem to subsume the above identified attributes (table 1). This is not only the case because they have frequently passed by in the preceding historiography, but also because they cluster a whole range of paired opposites, and seem to imply that the threat of hell can be avoided and the promise of paradise realized. In line with this, some even claim that attempts to rebuild paradise have shaped people’s relationships with their ‘natural’ environment just as much as they have influenced the broad development of Western civilization (Mabey 2005).

History of Veluwean Land Use

The Rise of Marks and Drift Sands

Human presence in the area of the Veluwe goes back many millennia, and perceptions of hell and paradise can be found throughout the Veluwean history. The earliest traces of hunter-gatherers date from the Mesolithic (8800-5300 BC; Derks and others 2007). Thereafter, Beaker and Iron Age cultures settled (Derks and others 2007). Throughout the reign of the Roman Empire, the Veluwe was a borderland (Hegener 2002), imaginably a hell for the scared legionary on the frontline. Medieval sources show that the area was a dry and dangerous place. Many roads were impassable for travelers and it was said that there were more wolves and foxes than people and homes (Venema 1933).

Between the 6th and 13th century, poor settlers increasingly populated the Veluwe, but because of the dry soils and low water table they generally would go no higher than the borders of what is known today as the Hoge Veluwe (meaning the “High Veluwe”; fig. 1). To regulate the use of common heath land and forest, the 13th century saw the rise of agricultural commons or ‘marks’ (Beukenkam and Sevink 2005). This system, based on sheep, was basically the only agricultural possibility on the infertile lands of the Veluwe,

Table 1—Summary of historical projections of wilderness between hell and paradise.

Era	Hell-like aspects	Paradise-like aspects
Prehistory	Constant threat to life and livelihood	Primary source of life and livelihood
Neolithic (revolution)	Threat to culture	Raw material to cultivate and use for culture
Antiquity	Home to human hostility and brutishness	Raw material to create physical paradise, mirror for society, projections of virtue, simplicity and originality
Middle Ages	Land deprived of God, purgatory, antithesis of useful land	Anteroom to paradise, cultivatable to earthly paradise
Early Modernity	Shelter for hostile resistance, old age and decrepitude	The handiwork of God, national symbol
Romanticism	Dark side of the soul	Place for (theological) desire, transcendence
19th And 20th century	Symbolic reminder of the destruction of planet Earth and humankind	Epitomizing environmental movement, precious object for science and recreation

but eventually took its toll. Grazing, cutting of heath sods, deforestation, and burning led to an ongoing degeneration of the vegetation. Although the larger drift sands arose partly because of climatic changes (Koomen and others 2004), human activities triggered and maintained drift sand formations (Riksen and others 2006). A first mentioning of drift sands dates from the 10th century, when settlements were abandoned because of the devastating effects of the encroaching sands (Beukenkam and Sevink 2005). In the following centuries, sand formations continued to increase in number and size. In the last half of the 19th century, a desert of about 150 km² (1/7th of the total area) marked the Veluwe, possibly constituting the biggest desert in Europe (Snijders 1984).

Brighter Practices

Not everybody saw the Veluwe as wasteland. Dukes hunted at the Veluwe since the Middle Ages and so did the Dutch Royals from the mid 17th century up until the end of the 20th century. One of them literally spoke of the Veluwe as a paradise (Snijders 1984). There were also others who saw the Veluwe in that light. But strikingly, just as with the aristocratic hunters, their livelihood was not depending on a physical working relationship with the land; they were in many ways just visitors. Nineteenth century artists painted old oaks and some poets got inspired by the wild land of the Veluwe (Paasman and Van der Vlist 1989). Interestingly, the inhospitable sandy wilderness of the Veluwean core was never an important inspiration for Dutch artists (Wigman 1957).

In the 19th century the Veluwean waste lands became the focus of concerted economic development. The idea slowly spread that the only way of controlling the sands, cultivating the land and its people, and making a profit, was through forestry (Beukenkam and Sevink 2005). New landowners came in, sheep largely disappeared because of the collapse of the mark system (Haak and Hofman 1995), the drift sands

were successfully controlled (Derks and others 2007), and the Veluwe became wooded again.

One of those new landowners was millionaire Anton Kröller. By 1921 he had bought around 50 km² of hunting ground in the core of the Veluwe. Contrary to her husband, Helene Kröller-Müller put most of her energy into collecting art, which is nowadays displayed in a museum in the centre of the area (fig. 1). Ultimately, the land was designated as the Hoge Veluwe National Park. With both the land and museum open to the public, recreation became the most important connection between park and society (Van der Windt 2005).

The Hoge Veluwe and Contemporary Relations to Wilderness

Fencing Culture

Shortly after his acquisitions, Kröller placed a 40-km fence around his grounds. As such it was a direct continuation of Stadholder Willem II's hunting fence in 1648, but in broader terms an act deeply rooted in Veluwean history. For millennia, early versions of fences, namely embankments, physically separated wilderness from culture (Hegener 2002). However, the peculiar thing about Willem II and Kröller's fences was that these were supposed to protect rather than exclude the wild, thereby materializing the shift from wilderness as a threat to wilderness being threatened. Today, the fences are still in place but become more controversial as many feel that they separate the natural Veluwean heart from its body (Hegener and others 2007).

Nature-culture divides were also put in place in another way. In 1910, a handful of poor farmers were generously bought out (Haak and Hofman 1995), and when the writer Den Doolaard as a boy brought groceries and saw Madam approaching, he hid in the bushes because she didn't want to see people in her park (Den Doolaard 1975). These examples bear resemblances with so-called fortress conservation, in

which the wild is preserved by separating (local) people from nature (Adams 2004), but no racial or violent aspects against local people cling to this history. Indeed, initial symptoms of snobbism turned, perhaps out of financial necessity, into an unequalled, intellectual and physical legacy to Dutch society.

The Hoge Veluwe derives its identity largely from its unusual and explicit combination of culture and (wild) nature. The Hoge Veluwe is a nature area that is defined, protected and accessible as such, but at the same time a place where culture deliberately steps back to allow for the enjoyment and relishing of the otherness of nature. This paradoxical tension, so typically illustrated by the fences that protect wild nature from its environment and vice versa, makes the Hoge Veluwe simultaneously a place devoid of, and defined and protected by, culture.

Access and Danger

From the start Kröller was looking for an ideal collection of game species. Today 200 red deer, 300 roe deer, 50 wild boar and 200 mouflons roam in the park (De Hoge Veluwe 2009). These numbers are set for an optimal visibility in line with the perceived carrying capacity, and closely managed by a hunting club (Hegener 2002). Although none of the mentioned large game species are predators (for Dutch standards unusually good), the possibility of seeing large wild mammals is the most important attraction for the average visitor (Zwetsloot 1978).

With 1700 freely available white bikes and 43 km of paved bike path, cycling in the Hoge Veluwe is a particularly odd but popular activity (Van Essen and Pelzers 2005). In 2007, the Hoge Veluwe had more than 500,000 paying visitors. Such a number on a total area of 50 km² requires regulation, and although there is no limit to the number of visitors allowed at the Hoge Veluwe, the visitors' behavior is carefully guided with observation posts, museums, restaurants, three entrances to the park, and bike paths.

By contrast, what makes the Hoge Veluwe almost one of a kind in the Netherlands is the possibility to enter the wilderness (save a few sanctuaries) wherever one pleases; the park is open to those who wish to saunter in solitude like Thoreau and Muir. Then, the sphere of culture disappears. Death may be encountered in the form of animal corpses, protective wild boar mothers and ticks carrying Lyme disease should be watched out for, and one can—rather special for the Netherlands—even get lost for a half a day or so. Although most visitors settle for wilderness-like aspects that can conveniently be enjoyed, those who are looking for the wild only, may find it.

There are thus two partly intermingling and paradoxical tensions inherent to what the park offers. First, the opportunity to encounter the wild and its otherness while others look for only a rosy glimpse of the wild, is striking; the Hoge Veluwe is a friendly home and refuge and, at the same time, a potentially dangerous and alienating place. Second, one can experience the wilderness of the park in solitude, without losing out on accessibility and facilities, while on the other side one can come across hundreds of cyclists without being deprived of wilderness experiences.

Restored Drift Sands

By 1905, as a result of the reforestations at the end of the nineteenth century, half of the area of the Hoge Veluwe was afforested drift sand (Van der Windt 2005), but after World War II, the sands slowly became valued for aesthetic reasons (Hofman and Haak 2006). In 2001, by order of the park authority, about 1 km² of drift sand was restored (De Hoge Veluwe 2009; fig. 1). The restoration was controversial, not only in the context of today's worldwide, and the Veluwean centuries-long, combat against desertification. An argument arose around how this local wilderness should look (Turnhout 2004). The Foundation for Critical Forest Management argued that the Veluwean wilderness should be a natural, autonomous forest. But the National Park authority had different ideas about its own land, and wanted to restore a drift sand area for several reasons: drift sand had cultural-historical value, was an important habitat for rare flora and fauna, and had recreational appeal as a special landscape (De Hoge Veluwe 2009; Turnhout 2004). By restoring the sands, a balance was sought between natural autonomy on one hand and cultural heritage, biodiversity and species protection (such as tree grayling and tawny pipit) on the other.

The drift sand restoration of the Hoge Veluwe illustrates not only that the protection of natural autonomy, endangered species, biodiversity, and (historical) landscapes are fundamentally related (although not necessarily concur), and often lead to different interpretations of what represents 'true' wilderness; it also makes clear that the act of wilderness protection and restoration is deeply paradoxical, which already speaks from the fact that bulldozers were used to recreate a specific type of natural autonomy.

Contemporary Paradoxes of Wilderness

What makes the Hoge Veluwe a wilderness lies foremost in the above-identified paradoxical frictions, constituted by a Western history of the idea of wilderness as well as a long local land use history. Table 2 lists paradoxical sets of opposites, and is organized according to the hell and paradise themes.

It seems appropriate to ask to what extent the Hoge Veluwe is different from other natural areas, and thus to what extent the identified paradoxes apply to other natural areas as well. We argue that these wilderness paradoxes can be recognized in any natural area that is labeled as such. What makes the Hoge Veluwe rather unusual is that its paradoxes are extremely well materialized and, therefore, well recognizable.

Table 2—Wilderness paradoxes derived from the Hoge Veluwe case study.

The 'paradise side' of wilderness		The 'hell side' of wilderness	
Danger and otherness	↔	Home and refuge	
Solitude	↔	Accessibility	
Devoid of culture	↔	Defined and protected by culture	
Natural autonomy	↔	Conservation management	

Conclusions: Wilderness Restoration and Acknowledging the Paradoxical Nature of Wilderness

Contemporary relationships with wilderness are generally inherently paradoxical (see also Drenthen 2005 for wilderness as a paradoxical moral boundary concept capable of giving meaning), as seemingly contradictory elements simultaneously characterize and constitute what is valued about a wild place. Given the deep historical roots of the paradoxical nature of wilderness, we argue—rather than ignoring, neutralizing, or problematizing—to accept this paradoxicality as a strength of our contemporary Western relation to wilderness.

But how then can restoration practitioners productively make use of this paradoxicality? This will depend on a wide range of factors, such as local history and culture, the extent to which one is willing to articulate the paradoxicality, and the general conservation aims of the area. In this respect there always will, and should be, a plurality of wildernesses. But if both sides of the paradoxes are essential in constituting the attraction of wilderness, it follows that a unilateral orientation on the ‘paradise side’ of wilderness can easily lead to a lack of unpredictability, mayhem and renewal that Mabey (2005) experienced in the constructed indoor biomes of the Eden project in Cornwall. More generally it could mean missing out on the productive potential and ‘dark’ appeal of wilderness. Alternatively, given the cultural-historical roots of wilderness, it is deceptive to believe that the restoration of the ‘wild side’ of wilderness automatically means that relationships with wilderness are thereby restored as well. If wilderness has been, throughout history, characterized and constituted by the tension between hell and paradise-like aspects, ecological restoration that reduces wilderness to one of its extremes might miss the character of the very place it aims to restore.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

Roles of and Threats to Yoruba Traditional Beliefs in Wilderness Conservation in Southwest Nigeria

Fola D. Babalola

Abstract—The Yoruba of southwest Nigeria are constantly conscious and acknowledging of God's divine lordship over the whole earth. This fact keeps them aware that they ought to be careful how this earth is treated. Yoruba religion and mythology is a major influence in West Africa, chiefly in Nigeria, and it has given origin to several New World religions. The Yorubas have a number of deities that they believe serve as intermediaries between them and the supreme god. This paper focuses on the roles of and threats to Yoruba beliefs in wilderness conservation in southwest Nigeria. Sacred groves and wilderness are seen as symbols of identity for all Yoruba people and probably the last in Yoruba culture. Recent development resulting from urbanization and differences in the beliefs of modern religions like Christians and Islam (with belief in Almighty God) and Traditional religions (with belief in Deities) have led to reduction of wilderness. Vast areas of some wilderness have experienced significant reduction through their conversion to infrastructural facilities, worship venues, and prayer camps. This is advancing at an alarming rate. Effort should therefore be geared toward protecting the remaining wilderness. It is noteworthy to mention that this paper neither shows preference nor condemns any religion over the other but rather creates awareness of the contribution of traditional beliefs among the Yoruba of southwest Nigeria to biodiversity conservation. Recommendations of ways to harmonize the beliefs with other religions are also noted.

Keywords: wilderness, Osun sacred grove, Christianity, Islam, traditional beliefs, Yoruba, deity

Introduction

Humans use forests for many purposes, and the products derived from forests, and their benefits, are referred to as 'forest goods and services' (MEA 2005). Generally, the services fall into four groups: supporting, provisioning, regulating, and

cultural services (Diaz and others 2005; Fischlin and others 2007). With a rich knowledge and practical understanding about the use and conservation of animals, plants and the ecosystem as a whole, traditional knowledge systems and associated practices, embedded in traditional cultures, have become the social and technical foundations for mutual coordination and sustainable development for local inhabitants and their local environment (Xu and Liu 1995; Zhang 1995; Pei 1996; Rao 1996).

Several recent studies have drawn attention to the role of indigenous knowledge and cultural beliefs in biodiversity conservation (Rao 1996; Liu 2006; Louman and others 2009; Luo and others, in press). Indigenous people in many parts of the world imbue headlands, springs, trees and forests with religious meanings (Lauwrence 2003). For instance, the interrelationship between traditional culture and biodiversity conservation has been documented over the last 10 years in China (Chen and others 2008; Pei 1996; He and He 2000; Xu and Liu 1995). These studies have documented how, through historical processes, local ethnic groups have developed very close interrelationship with local animals, plants and forests, and formed distinct diversified indigenous knowledge systems and traditional cultural beliefs. Cultural sites, particularly sacred sites, are ecologically unique and important for conservation on varying scales of landscape, community, and species (Salick and others 2007). In their study on the role of traditional beliefs of Baima Tibetans in biodiversity conservation in China, Lou and others (in press) found that the perspectives of community people toward the function of sacred trees, mountains, and animals are diverse. Over half of a local community regard the worship of the Mountain God, sacred trees, and animals as connected with environmental protection. They believe that if they can protect the sacred mountain and sacred trees well, then this will protect the village and wildlife of the forest, and also bring rain and provide general protection of the environment. Other people in the study of Lou and others (in press) acknowledge the role of a sacred mountain and sacred trees for wildlife and the environment, but they consider their protection important mainly to bring good luck and fortune, and to avoid the God's punishment.

A problem for integration of traditional beliefs is the refusal of many scientists to recognize traditional ecological knowledge as science because of its spiritual base, which they regard as superstitious and fatalistic (Ogunade 2005). Many discussions implicitly or explicitly assume that biodiversity conservation is possible only within protected areas. Yet most of the world's biodiversity is in areas used by people

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(Berkes and others 2000; Berkes 2004). What they fail to recognize is that spiritual explanations often incorporate important ecology, conservation, and sustainable development strategies (Johnson 1992). Local people have incentives to conserve biodiversity when their livelihoods depend on a multitude of products and values produced by biodiversity (Bhagwat and others 2005; Dudley and others 2006). Hence, to conserve biodiversity, we need to understand how human cultures interact with landscapes and shape them into cultural landscapes (Davidson-Hunt 2003). In fact, to a large extent, the world's biodiversity depends on maintaining patterns of resource use that facilitate the continued renewal of ecosystems. Many traditional systems of forest use do this, showing subtle understandings of how forest ecosystems work. The study of cultural landscapes and indigenous use of non-timber forest products (NTFPs) provides an arena in which discussions of biodiversity, traditional management systems and cultural landscapes can be brought together.

Sacred Groves

There is a growing interest in the natural world, and protected areas provide us with opportunities to interact with nature in a way that is increasingly difficult elsewhere. They give us space that is otherwise lacking in an increasingly managed and crowded planet (Dudley 2008; Stolton and others 2008). Protected areas also represent a commitment to future generations (Borrini-Feyerabend and others 2004). Most people also believe that we have an ethical obligation to prevent species loss due to our own actions. This is supported by the teachings of the large majority of the world's religious faiths (Dudley and others 2006). Protecting iconic landscapes and seascapes is seen as being important from a wider cultural perspective as well, and flagship protected areas are important to a country's heritage (Dudley and others 2006).

Sacred groves vary in size from a few hectares to a few kilometers. Protected by local communities as being the sacred residences of local deities and sites for religio-cultural rituals, they have served as valuable storehouses for biodiversity. Sacred groves are forests that have been protected since the ages by traditional societies. In the past, sacred groves were present in numerous parts of the world on nearly every continent, and were entities held sacred by communities with different religions and different forms of economic and social organization. Most of the world's sacred groves have disappeared and few remain today (Anup 2006).

The concept of 'sacred' species provides a basis not only for natural resource management, but also for rehabilitation of degraded ecosystems with community participation. Thus, a system of incentives needs to be worked into the system to reward communities for conserving sacred groves. Sacred groves perform useful environmental tasks not merely for the immediate vicinity but for a much larger audience. Given the importance of sacred groves, a look at their conservation status is necessary. Of late, a decline in traditional beliefs has led to a decline in practices and rituals associated with sacred groves (Anup 2006).

Results of a comparison between sacred groves and formal reserves have shown that sacred groves shelter a high diversity of medicinal plants and have more vigorous regeneration of trees than do formal reserves (Boraiah and others 2003).

Sacred groves also have higher tree species diversity than do formal reserves (Bhandary and Chandrashekar 2003; Jamir and Pandey 2003; Ramanujam and Cyril 2003).

Osun Sacred Grove

There are many sacred groves in southwest Nigeria with varying sizes, species compositions, and cultural/social relevance. The principle behind these sacred groves is pro-conservation. Osun-Osogbo sacred grove located in Osun State, Nigeria, was selected for this study. In 2005, UNESCO named the sacred Osun grove a World Cultural Heritage site (Wikipedia 2009a; UNESCO 2009). This inscription was the culmination of a 50-year campaign spearheaded by a group of artists, Yoruba priests, and an Austrian artist named Susanne Wenger. The Osun cultural festival is a unique annual celebration in honor of the river goddess, popularly called Osun. The festival has acquired an international status witnessed by both domestic and international tourists. River Osun was believed to have provided the water of life that saved the inhabitants of ancient Osogbo town from hunger, pestilence, and religious war centuries ago. It is still believed to provide protective guidance today. The annual celebration is, therefore, done in reverence and appreciation of the goddess of fertility.

Yoruba Religion and Mythology

The southwest states of Nigeria are dominated by Yoruba tribes. Yoruba people are actually one of the largest ethnolinguistic or ethnic groups in West Africa. The majority of the Yoruba speak the Yoruba language. The Yoruba constitute about 30 million individuals throughout West Africa and are found predominantly in Nigeria, at approximately 21 percent of its total population (Wikipedia 2009b).

Yoruba religion and mythology is a major influence in West Africa, chiefly in Nigeria, and it has given origin to several New World religions such as Santería in Cuba and Puerto Rico and Candomblé in Brazil. 'Itan' (tale) is the term for the sum total of all Yoruba myths, songs, histories, and other cultural components. These mostly originate from the 'ese' (verses) of the *Odu Ifa*. After the Oya empire collapsed and the region plunged into civil war, ethnic Yoruba were among the largest in number of African people who were enslaved and taken by European traders to Cuba, Puerto Rico, Brazil, Haiti, Trinidad, and the rest of the New World (chiefly in the 19th century). The enslaved Africans carried their Orisha religious beliefs with them. These concepts were combined with preexisting African-based religions, Christianity, Native American mythology, and Kardecist Spiritism into various New World lineages: Lucumí (Cuba, Puerto Rico), Oyotunji (U.S.), Anago (Nigeria), Candomblé (Brazil), Umbanda (Brazil), Batuque (Brazil) and Kaaro oojire (Nigeria) (Wikipedia 2009b).

Yoruba deities include "Oya" (wind/storm), "Ifá" (divination or fate), "Eleda" (destiny), Orisha or Orisa "Ibeji" (twin), "Osanyin" (medicines and healing) and "Osun" (goddess of fertility, protector of children and mothers), and Sango (God of thunder). The places of worship (shrines) could be in towns or forests. When the shrines are outside the towns, it is forbidden for non-adherents to enter such places except during open festivals. At times, such places are permanently

out-of-bounds to female gender. One is the “*Oro*” festival where females are neither allowed to enter the shrine nor witness the festival (Wikipedia 2009b).

The Yoruba Beliefs and Wilderness Conservation

The Yoruba of southwest Nigeria are constantly conscious of and acknowledging God’s divine lordship over the whole earth. They also believe that “man is a tenant on God’s earth” (Idowu 1978). This fact keeps them aware that they ought to be careful how this earth is treated. The idea that God is the Creator of the Universe is held by most religions of the world. The argument that the Universe is created and designed by a Being is further supported and demonstrated by ontological and ideological arguments (the philosophical theories that all of creation is designed for a purpose) (Ogunade 2005). This Being is invisible, ubiquitous, and immortal. The idea of the creation of the Universe and all that is there is fundamental to the basis of the religious beliefs of Yoruba people. Respect for the environment has always been with them.

The Yoruba do not usually tamper with nature carelessly (Ogunade 2005). Despite the indiscriminate destruction of forests and the unsustainable harvesting of forest products, the traditional cultural system of the studied communities showed evidence of in-situ conservation. The fact that the respondents believed that trees such as *Adansonia digitata*, *Bombax buonopozense*, *Newbouldia laevis* and *Melicia excelsa* are sacred and are preserved in their natural environment buttresses this fact. Plants like *Newbouldia laevis* are considered very important in Yoruba culture, most especially for installation of ‘Oba’ (King), traditional rulers, and chiefs. Such plants, among others, are highly protected and prevented from going into extinction. The establishment of shrines and groves where cutting is prohibited is highly contributory to conservation and biodiversity of these communities. The fact that indigenes could mention some plants as scarce and becoming rare to collect contradicts the belief by the indigenous people that plants are always available in the forests for collection.

Modernization has taken its toll on this aspect of wilderness conservation, just as it has affected all other aspects of the Nigerian life. All features in nature are created and placed there for a significant purpose. The sole aim is to create a healthy and beautiful habitat for human beings. Some of these natural features also serve as abode for a category of the divinities (Awolalu and Dopamu 1979). These are no more than personifications of natural forces and phenomena. For instance, the myriad spirits (Awolalu and Dopamu 1979) that populate the world of the Yoruba are associated with hills, mountains, rivers, rocks, caves, trees, brooks, lakes, and thick forests. These features are later termed sacred groves. The Osun grove in Osogbo, whose forest and river are forbidden for hunting and fishing, is an example of care for the environment (Ogunade 2005). The environment and the people are in close relationship in such a grove.

Because of the spiritual presence that is palpable in the Yoruba community and the environment, any violation of nature’s integrity requires some rituals to appease some of the spirits that dwell in the environment. This view is difficult for the West to understand (Some 1999). Attempts to protect and preserve the environment in the West are often for aesthetic and sometimes

economic reasons. This Western influence has devastated and choked most of our cities in Nigeria of their once beautiful habitat. This is not the case in the villages where life is green and healthy. Indeed, longevity is a direct consequence of a fresh and unpolluted environment.

Furthermore, the Yoruba concept of the environment is all-embracing; the humans, animals, plants, and “non-living beings” form the entire human society or community. Therefore, for a peaceful co-existence of all of these beings, the humans, who consider themselves to be in charge, must be careful not to provoke or destabilize their environment and their “co-tenants.” For instance, the tiniest of insects is regarded as having rights to life, while the chameleon is a sacred being that cannot be killed in Yorubaland (Ogunade 2005).

Another dimension to the interconnectedness between the Yoruba and their environment is the step they take in rituals to correct a violation in nature. The Yoruba see the physical world as a reflection of a more complex, subtler, and more lasting, yet invisible, entity called energy (Ogunade 2005). It is as if they are the shadows of a vibrant and endlessly resourceful intelligence, dynamically involved in a process of continuous self-creation. Nothing happens here that did not begin in that unseen world. If something in the physical world is experiencing instability, it is because its energetic correspondents have been experiencing instability (Some 1999). The Yoruba understanding is that the material and physical problems that a person or community encounters are important only because they are an energetic message (Opoku 1978) sent to this visible world. Therefore, people go to that realm to try to repair whatever damages are being done there, knowing that if things are healed there, things will be healed here (Ogunade 2005). Ritual is the principal tool used to approach that unseen world in a way that will rearrange the structure of the physical world and bring about material transformation. They are usually very careful about what they do with nature because rituals are also expensive (Ogunade 2005).

Finally, adherents of Yoruba religion fully appreciate the fact that many human catastrophes have their origin in the misapplication of science and technology. Thus, they think of the ecosystem as reciprocating, to keep its action in balance. In this light, their activities are guided by the *Orisa* and the benevolent beings. They also appreciate the great difference between this Yoruba belief and practice and that of the West where there are ideas and feelings that nature could be tamed and the environment controlled scientifically.

Threats to Traditional Beliefs in Wilderness Conservation

Religious institutions address the moral and ethical challenges of human society (Awoyemi 2008). Anthropologists of religion, such as Rappaport (1979, 1999), consider religion a primary regulator of human behavior and capable of controlling impulses toward short-term individual gain in the interests of the long-term collective good. Religion sets the context for pivotal decisions and daily living for many Africans (Awoyemi 2008).

In this study, the two commonly practiced and identified modern religions in such local communities are Christianity and Islam. In sub-Saharan Africa, Christianity is a dominant

force, with the majority of countries that lie in critical areas for biodiversity conservation heavily populated by Christians (Central Intelligence Agency 2007). Recent development resulting from differences in the beliefs of the Christians (with belief in Almighty God) and Traditional religions (with belief in Deities) have led to reduction of the areas of wilderness. In the past, entrance into some highly endemic sacred wilderness and forests for any activities were protected by traditional beliefs. The local communities are of the belief that certain gods reside in such scared places (forests, rocks, rivers, etc.), therefore, only visitations by the local priests and selected people were allowed to make sacrifices and other rituals. These practices have indirectly served for pro-conservation that facilitates wilderness protection. However, in recent times, traditional beliefs tend to be on the decrease as people who have converted to the modern religions see these beliefs as superstitions and fallacy.

In recent times, some of the potential future Chief Priests and custodians of sacred groves have been converted from the traditional religion to modern religion. Anup (2006) also discovered that that there was a decline in traditional beliefs, leading to a decline in practices and rituals associated with sacred groves. Moreover, vast areas of some wilderness have experienced significant reduction through their conversion to worship venues. The wildernesses have been seriously destroyed by the modern religions with the belief of casting out "evil spirits" from such places. Another dimension to this is the pressure from modern religions to create secluded places in the form of prayer grounds and camps at the expense of many forest lands and landscapes. These developments, which are advancing at an alarming rate, are located in places far from civilization where the remaining endemic wilderness can be found. Effort should, therefore, be geared to protecting the remaining wilderness, which is invariably the local heritage.

Conclusions

As the impacts of modern religion on wilderness are advancing, efforts should be geared toward protecting the remaining forests and landscapes. The foundations of these modern religions actually supported conservation and protection of natural resources, but recent developments are contradictory. Efforts should be initiated to conserve the remaining wilderness, while conversion of wilderness into any religious activities detrimental to conservation ethics and efforts should henceforth be prevented. There should be harmony between traditional worshippers and modern religion worshippers on biodiversity conservation, as we all share the same environment and ultimately share the consequences of its wanton destruction.

If humanity wishes to create a better environment and attain greater comfort, as well as to achieve appreciable advancement in civilization, humans should discontinue the practice of wanton felling of trees, desist from uncontrolled breaking of rocks and mountains, and end all forms of harshness to nature of any kind. Indeed, this is an era when care for the environment can no longer be considered unnecessary. Care for the environment is very important if we are to have a peaceful, healthy and beautiful world. Instead of wilderness encroachment and destruction for development of worship centres, existing open fields, stadiums, public auditoriums,

halls, etc., could be recommended as alternative worship grounds to these religious bodies if they need places for special programmes.

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Threats and Changes Affecting Human Relationships with Wilderness: Implications for Management

Robert G. Dvorak, William T. Borrie, and Alan E. Watson

Abstract—For wilderness managers, the ability to recognize threats and changing conditions is vital. While these threats are typically associated with resource and social conditions, they can also be investigated relative to wilderness relationships. This paper explores how threats and changes may be affecting human relationships with wilderness and the possible implications for management. Previously, threats have been conceptualized as affecting ecosystem integrity or stakeholder values. This paper suggests these conceptualizations should be expanded to also consider the meanings and relationships attributed to wilderness. From such a lens, threats such as global climate change, wildland fire, and invasive species can dramatically influence both the wilderness landscape and the meanings associated with its character. They fundamentally alter the place in ways that conflict with personal histories and previous experiences. Thus, managers must be charged with finding ways to protect and foster these human relationships. Addressing threats to these relationships may also require managers to develop approaches that mitigate or adapt to these relationships over time. These approaches need to proactively define and protect a diversity of meanings and values to ensure ongoing human relationships with wilderness.

Introduction

For wilderness and protected area managers, the ability to recognize external threats and changing conditions is vital for responsive and proactive management. Threats such as global climate change, habitat fragmentation, invasive species, and wildland fire, among others, are

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increasingly affecting and influencing wilderness landscapes and character. While such threats and changes have typically been associated with impacts on natural resource and social conditions, a growing view in wilderness research is to investigate the effects of these threats and changes on human relationships with wilderness. This view suggests that to define and protect wilderness character, managers must go beyond monitoring aspects of wilderness itself to instead describe, monitor, and understand human relationships with wilderness (Watson 2004).

The purpose of this paper is to explore how external threats such as climate change may be affecting human relationships with wilderness. It examines how threats and changes are uniquely characterized from a relationship perspective, and investigates several examples of these threats. Finally, it considers how the current and future role of wilderness and protected area management may be shaped by these external threats.

Wilderness Threats and Relationships

Conceptualization of Threats

The idea of external threats to wilderness is in itself not a new concept. A large body of literature exists that examines how various threats and external factors influence both resource and social conditions in wilderness. Scoping and identifying current and potential threats are also important components of wilderness and protected area planning. However, to conceptualize these threats relative to human relationships with wilderness is a slightly different notion. It is, therefore, appropriate to first characterize more traditional views of wilderness threats before examining these issues from a relationship lens. This is not to say that these views are wrong, inappropriate or even mutually exclusive. Instead, it is to demonstrate how thinking and research has progressed to investigate and address wilderness threats.

Because one of the primary purposes of wilderness designation has been the protection of natural ecosystems (Cole and Landres 1996), examining threats relative to ecosystem integrity has been a dominant view. This view investigates the linkage between external threats and ecological wilderness attributes and provides direction for future action and management. For example, Cole and Landres (1996) have previously suggested that some of the most significant

threats to wilderness ecosystems include the introduction of invasive species, recreational use, and wildfire management. Dawson and Hendee (2009) have described other potential threats to wilderness that include habitat fragmentation and isolation, urbanization, and technological developments. Together these researchers have emphasized the need for further research and knowledge regarding the influence and outcomes of these threats.

Another common view of external threats to wilderness has been from a values perspective. This perspective prioritizes external threats to wilderness relative to stakeholder values. While attributes such as intact ecosystems and unmodified landscapes remain important, these qualities of wilderness have been negotiated and defined by different stakeholder groups. For example, Shroyer and others (2003) identified the high priority values in a South African context as wilderness-type experiences, intact/unmodified landscapes, and sacred pools/landscapes. Threats to these values included privatization, commercialization, off-road vehicles, and pressures to produce incomes or subsistence. In a Brazilian wilderness context, Magro and others (2007) discussed clean air, clean water, and cultural values as import qualities to protect. These qualities need defense from pollution, external activities on adjacent lands, and invasions on historical and cultural resources. While the identification of these threats obviously relates to an ecological perspective, it also demonstrates the importance of contextualizing values and threats within the local cultures and community. Thus, the value of wilderness, and the reasons to protect it, become more than the ecological processes and services provided.

Human Relationships with Wilderness

While previous views of wilderness threats have focused on monitoring social and biological changes related to ecological integrity and individual values, we would argue that such perspectives are not fully comprehensive. This is not to say that previous views are not valuable. The knowledge and experience that has been gained by focusing on wilderness threats is extremely important for wilderness stewards to meet their mandates and responsibilities. Continuing to mitigate impacts on social and biological changes also remains important. However, we argue that managers are responsible for other things beyond setting conditions. There has always been “something intangible” about wilderness that lies at the heart of its meaning and character. It is these things that we believe can be addressed by considering the human relationship with wilderness that individuals create.

The notion of a relationship can be conceptualized in many different forms. From interpersonal connections to buyer-seller interactions, it demonstrates characteristics such as trust, commitment, and loyalty. However, a relationship at its core is constituted by dynamic interactions between two individuals or entities that exist over time. It does not form from a chance meeting, but instead is an ongoing exchange where both parties are interdependent on one another. The experiences that exist between the two have created trust and meaning that is valued by both. When applied in a wilderness context, such a relationship represents the ongoing connection that individuals form with the landscape. It has been created by the interactions we have within a wilder-

ness setting and encompasses the meanings that we imbue within wilderness features.

A relationship perspective shifts management focus from single visits by users and visitors to understanding the ongoing connection stakeholders have with a wilderness. Because the importance of short term outcomes decreases when considering relationships, management must instead consider changes in values and meaning over time. More specifically, Watson and Borrie (2003) have suggested the importance of long-term monitoring in understanding the quality of experiences and changes in meanings. Thus, to protect wilderness character, monitoring changes in values and meanings is critical. This gives threats to these meanings as much importance as external threats to social and biological conditions. However, when threats are contextualized relative to wilderness relationships, they may impact individuals in ways that social and biological forces do not. This creates a situation where wilderness and protected area managers may be unskilled or uncomfortable to manage beyond social and biological aspects. It is, therefore, important to build on the typical knowledge of threats to wilderness by characterizing the effects of external threats on human relationships with wilderness.

Threats to Human Relationships

Climate Change—No external threat resonates more with this relationship perspective than global climate change. While commercialization, water quality, and loss to ecosystem integrity can individually be considered as important threats, the global scope of influence that climate change has on wilderness relationships is impossible to ignore. We argue that climate change is the precursor and driving force to many of the most critical threats facing wilderness and protected areas today. It is responsible for changes in patterns and cycles that are being witnessed globally. Thus, many threats that appear as isolated conditions can be found to correlate with climate change.

One instance of how climate change threatens relationships with wilderness is its effects on temperature sensitive species (Locke and Mackey 2009). For example, rising global temperatures are causing rising ocean temperatures. These increases lead to coral reef bleaching that destroys critical fish habitat. This loss can then lead to the absence of iconic species such as the clown fish, made internationally recognizable by the popular movie *Finding Nemo*. Thus, the absence of such species can change the character of these marine wilderness areas. The meaning individuals associate with them may change because the characteristics that they attribute to them have disappeared. Other examples of temperature sensitive species influenced by climate change are the mountain-dwelling pikas and pine bark beetles of the Pacific Northwest. In the case of the pine bark beetles, changing seasons and the lack of extended periods of bitter cold allow bark beetles to complete multiple reproductive cycles in a single season. This is leading to larger infestations and epidemic loss of pine stands. With forests overwhelmed by brown, dead, and dying trees, so too may be the many species that utilize and value these forests. The meanings and values of a forest are altered with such a dramatic change and the images in the visitor's mind might be difficult to reconcile with the changed landscape before them.

Another example of the effect of global climate change on wilderness relationships is its influence on wildland fire regimes. Research has documented the correlation between climatic changes and the frequency and intensity of wildland fires (McKenzie and others 2004; Westerling and others 2006). With spring coming earlier, summers lasting longer on average, and dry seasons perpetuating, the risk of catastrophic wildfire remains very real. In the instances where fires have occurred, the alterations to the landscape are severe. Individuals who have used these forests for subsistence or as a refuge of solitude may look upon their special places and see how different they have become. These places imbued with so much meaning and experiences now have to be reconstructed and negotiated within the individual. While one can argue that wildfires and fire regimes are natural processes that do change, it is difficult to assume that each stakeholder can accept these changes without accepting some loss in the meanings that previously existed. Their relationships have arguably been altered and may continue to change over the long term.

Biodiversity and Species Loss—While climate change acts as a driver for coral reef bleaching, fire regimes, and cyclic changes of temperature sensitive species, other examples of threats to wilderness relationships can also be considered. As previously considered for ecosystem integrity, habitat fragmentation and species invasion are both serious threats to wilderness resources. They also influence relationships as the landscape is altered by loss of habitat, destruction of contiguous land tracts, and invaders outcompeting indigenous species. Nowhere is this more present than in the protected areas of Australia. Mackey and others (2008) have described the challenges of biodiversity conservation in Australia. They explain how habitat fragmentation and degradation has occurred due to commercial logging, agriculture, and pastoral practices. They further describe how invasive species threaten endemic populations and species richness in one of the most biologically diverse countries in the world. For example, feral cats, foxes, and amphibians have contributed to major extinctions across the continent and continue to have dramatic effects.

As these changes occur, the meanings and images across the landscape also change. Degraded forests represent degraded relationships where individuals must come to terms with the loss of what they once knew and understood. The purpose of a place changes as it might no longer represent a source of subsistence, spirituality, or solitude. As the endemic and iconic species disappear, so does the uniqueness of the place. Individuals have to come to terms with wilderness overrun by feral fox, deer, and plants. Thus, the situation described by Mackey and others (2008) exemplifies how the dramatic changes that result from these threats can have great effects on numerous wilderness stakeholders.

Management Implications

Such changes might not all be under management control, but they represent external factors with great potential to alter the connections and meanings people have for a wilderness context. They may also directly affect the expression of relationships over time as they vary from onsite visitors to stakeholders to socially responsible advocates. Therefore,

acknowledging and understanding the potential impacts of these threats will be important for wilderness managers striving to foster and protect wilderness relationships. In essence, it is not just considering the threat to wilderness, but what the outcome to wilderness relationships will be if changes continue to occur.

As wilderness managers continue to explore and understand wilderness relationships, it may be useful to consider approaches that have been suggested to address threats to wilderness and protected areas. Locke and Mackey (2009) have suggested that to address climate change two approaches are necessary: mitigation and adaptation. Mitigation refers to efforts to prevent and reduce changes influenced by climate change, while adaptation is the way individuals would adjust to changes that have or will inevitably happen despite our best efforts. While both these approaches are very logical and relevant to both ecological and social values, how would they function from a relationship perspective? How would they apply to managers who are attempting to facilitate ongoing relationships with wilderness? In terms of mitigation, making efforts to prevent or reduce changes that would negatively affect human relationships with wilderness seems reasonable for wilderness stewards. In many ways we already do this by addressing threats that influence wilderness character. To protect an ongoing relationship, the outcome for these mitigation efforts is not that fundamentally different.

Adaptation, however, is much more difficult to contemplate. How as wilderness managers do we ask individuals to adapt their relationship? How do we ask them to negotiate the personal histories and experiences that have accrued in a given wilderness? Asking someone to adapt their meanings and connection to a place does seem very extreme and significant, but it might be idealist and naive to not consider such an approach. In fact, the threat of climate change has shown us that some change is inevitable and that managers may be required to accept some threats and their impacts upon relationships. Acknowledging this inevitability, however, means that to protect relationships, the goal should be to maintain the overall strength or existence of those relationships. While some threats can only be monitored and documented, efforts must focus on those that may be managed directly with actions aimed at what we can control and influence. This is what must be considered by wilderness managers as strategies continue to be developed to address external threats. Thus, a comprehensive approach is one that considers both the direct and indirect changes to relationships in the face of some inevitable change.

As society changes, so does the responsibility of wilderness managers within the limitations of legislative intent. Keeping the importance of these responsibilities in mind, we now charge them to also be stewards of the human relationships that are formed with wilderness. These relationships represent the diverse connections we as humans make with wilderness. Therefore, the consequence of accepting responsibility for these relationships is the long-term monitoring of quality experiences, and meanings instead of short-term outcomes and visitor satisfaction. It requires efforts to understand the symbolic attachments and spiritual connections humans have with wilderness landscapes and developing means to address them. This is a new challenge for managers, but being able to address these concepts also provides managers with a different constituency. By showing

that wilderness stewards value all meanings of wilderness and try to represent them as best we can, we cultivate trust and commitment from individuals who value wilderness. We may go beyond “managing users” to developing wilderness partners, stakeholders, and advocates. It shifts the outcome of management actions to the creation of a shared, vested interest among the public.

Conversely, it is important to reflect on the consequences of not considering wilderness relationships. Strategies would continue to address the management of social, biological, and managerial conditions, but without emphasizing the quality of relationships. This perhaps may lead to changes in the experiences and meanings attributed to wilderness by individuals. Off-site benefits such as symbolism and connectedness may decline or become absent. Thus, it raises the question, “What will be lost?” Arguably, it would be the “intangibles” of wilderness that exist but are all too often difficult to articulate and comprehend. It is the essence of wilderness character that managers are trying to maintain and protect.

We are only beginning to understand and monitor these wilderness relationships. Baselines are just now being established and much still needs to be learned about how, more so than why, relationships are changing. To accomplish this, meanings and experiences need to be examined longitudinally. Personal histories, stories, and experiences need to be explored to see what has changed, whether it is individuals’ definitions of wilderness or their connections with it. Monitoring relationships in such a way may present unique challenges, but would assist us in learning and understanding how these relationships exist and function. In the meantime, we as wilderness managers can agree that part of our responsibility is in protecting wilderness meanings and character. Even if it is unclear how threats and changes are affecting meanings, we can take efforts to proactively define and protect these meanings. With this kind of action, we may be better able to prioritize management actions and adapt to threats like climate change and invasive species as they continue to alter wilderness landscapes.

There are many different threats to wilderness ecosystems and the meanings ascribed to them. Many iconic examples can be described, but none more emblematic than the polar bear in a melting Arctic Sea. In the case of the polar bear,

the image shows the threat of global climate change to this species and the arctic ecosystem. However, it also represents the threat to a relationship that indigenous people, wilderness visitors, and advocates have formed with this place. This is just one of many things that can be lost if we as wilderness stewards do not place importance upon protecting the meanings and character of this and every individual wilderness.

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Human Relationships to Fire Prone Ecosystems: Mapping Values at Risk on Contested Landscapes

Kari Gunderson, Steve Carver, and Brett H. Davis

Abstract—A key problem in developing a better understanding of different responses to landscape level management actions, such as fuel treatments, is being able to confidently record and accurately spatially delineate the meanings stakeholders ascribe to the landscape. To more accurately understand these relationships with the Bitterroot National Forest, Montana, U.S.A., local residents were asked to identify specific places, why they valued them, and how fuel treatments affected these values. Resulting maps displayed variation in the spatial scale and differences in terms used to describe attachments to places they have visited and those they have not. This paper and pencil exercise failed to adequately capture intensity of meanings. To address this issue, a computer-based mapping exercise was used with residents on the Flathead Indian Reservation, Montana, U.S.A., to capture the intensity and spatial distribution of meanings associated with proposed fuel reduction projects on this landscape. This paper will present two different mapping approaches and discuss challenges in mapping meanings.

Introduction

To successfully improve forest health and restore fire in fire prone ecosystems, natural resource management agencies, tribal governments, and the public need to work together to find solutions to increasingly threatening fuel buildups. Land managers need to understand how proposed actions impact values at risk assigned by local residents and describe a prioritization process that addresses publicly perceived threats to build trust and acceptance among local

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residents in fire prone communities. Community meanings (or values at risk) could include loss of homes, changes in vegetation or scenery, wildlife and water quality, cultural meanings or recreational uses. One of the key problems in developing a better understanding of different responses to resource management proposals, such as the fuel treatments dealt with here, is being able to faithfully record and accurately spatially delineate the meanings that stakeholders ascribe to the landscape in question. This needs to be done in a consistent and repeatable manner if cross-comparisons are to be made between different stakeholder groups and/or different areas. This paper will present two different mapping approaches used to ascertain the meanings people attach to geographic areas. Both of these approaches were developed in an attempt to provide public input into proposed landscape-level fuel treatments. The mapping approaches provide important tools for land managers with implications for improved decision-making and trust building on contested landscapes. This work picks up on some criticism leveled at GIS for being too technocratic and divorced from community level realities of life on the ground (e.g., Pickles and others 1995; Craig and others 2002) by applying spatial data models that approximate more closely the way that people perceive and understand the landscapes in which they live and work.

Background

The Bitterroot Front

The Bitterroot National Forest (BNF) is located in Montana, U.S.A. The Bitterroot Front, approximately 400,000 acres, features an east to west continuum, beginning with developed private lands in the valley floor, transitioning to the wildland/urban interface, then to roaded U.S. National Forest lands, then upslope to roadless non-wilderness areas, and finally reaching the Selway-Bitterroot Wilderness to the west. Since 2000, wildfires have burned large tracts of public and private land on the Bitterroot Front; the effects of these fires were perceived negatively, resulting in significant portions of the public who do not fully trust the fire and fuels decisions that managers make (Watson 2001; Liljeblad and Borrie 2006). In response to these concerns, a study was conducted to more accurately understand the personal and community meanings and values attached to important places on the Bitterroot Front by local residents and determine how BNF actions interact with those values in fire management decisions. Figure 1 shows a map of the Bitterroot Front.

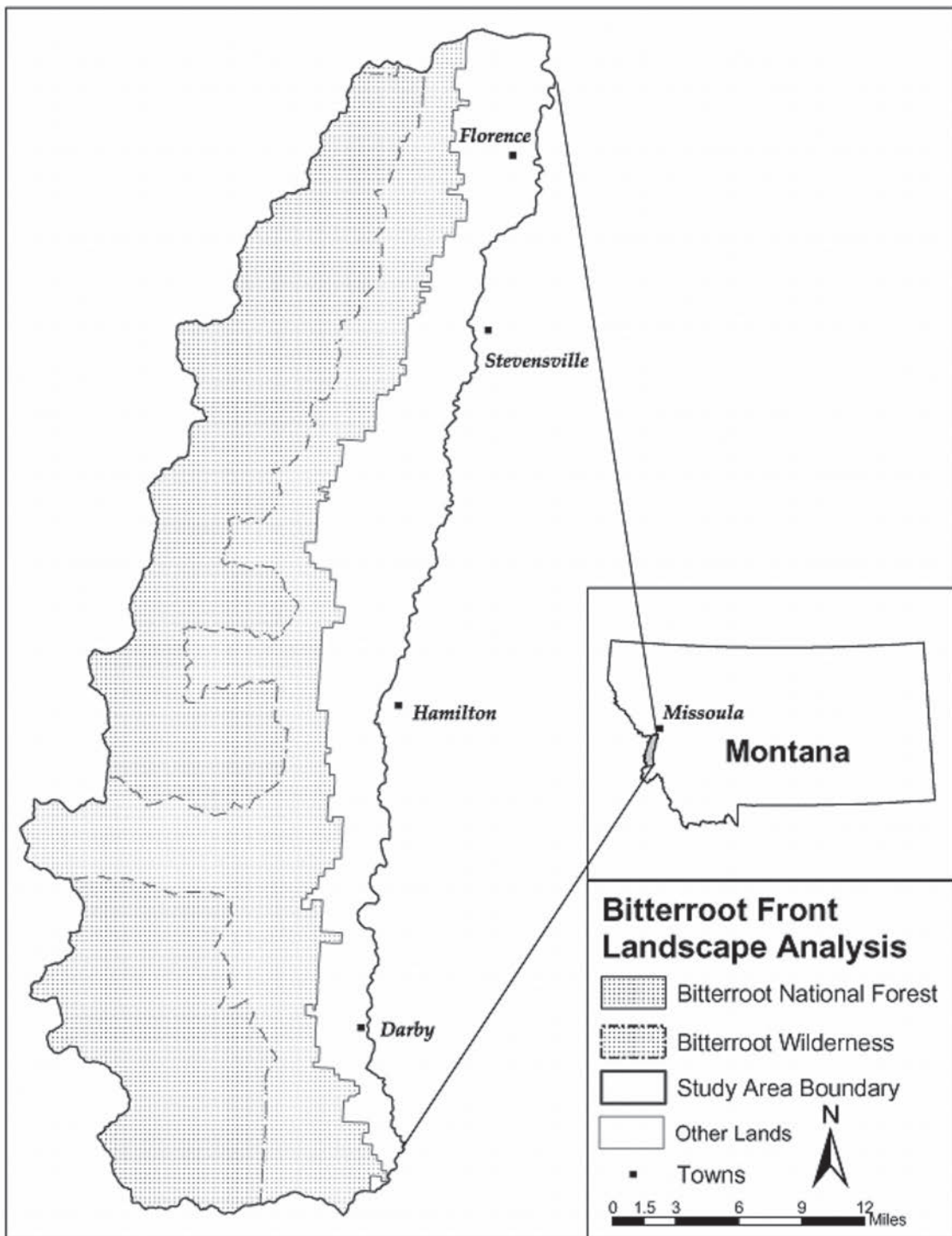


Figure 1—Bitterroot front.

The Mission Mountains Tribal Wilderness Buffer Zone

On the Flathead Indian Reservation in Montana, the Mission Mountains Tribal Wilderness (92,000 acres) is bordered on the east, across the Mission Mountain divide, by the U.S. Forest Service Wilderness (Flathead National Forest, Mission Mountains Wilderness—74,000 acres) and on the west between the Wilderness and the Reservation community, with about 22,000 acres of land in a unique protected status. When originally established, it was listed as not available for commercial timber harvest. The “Buffer Zone,” originally designated to protect the Wilderness from human activities

extends along the wilderness boundary and contains some homes and a few roads, therefore, remaining a working landscape within the community. Both the Wilderness and the Buffer Zone are broadly considered protected cultural, as well as natural, landscapes. Thus, major decisions about management of these areas are subject to review by the Tribal Cultural Committee, the Tribal Council, and the Tribal member public. To successfully improve forest health within that Buffer Zone and increase opportunities to restore fire in the Wilderness, the Tribal Forestry Department and the public needed to work together to find solutions to increasingly threatening fuel buildups. Figure 2 shows a map of the Mission Mountains Tribal Wilderness and the Buffer Zone.

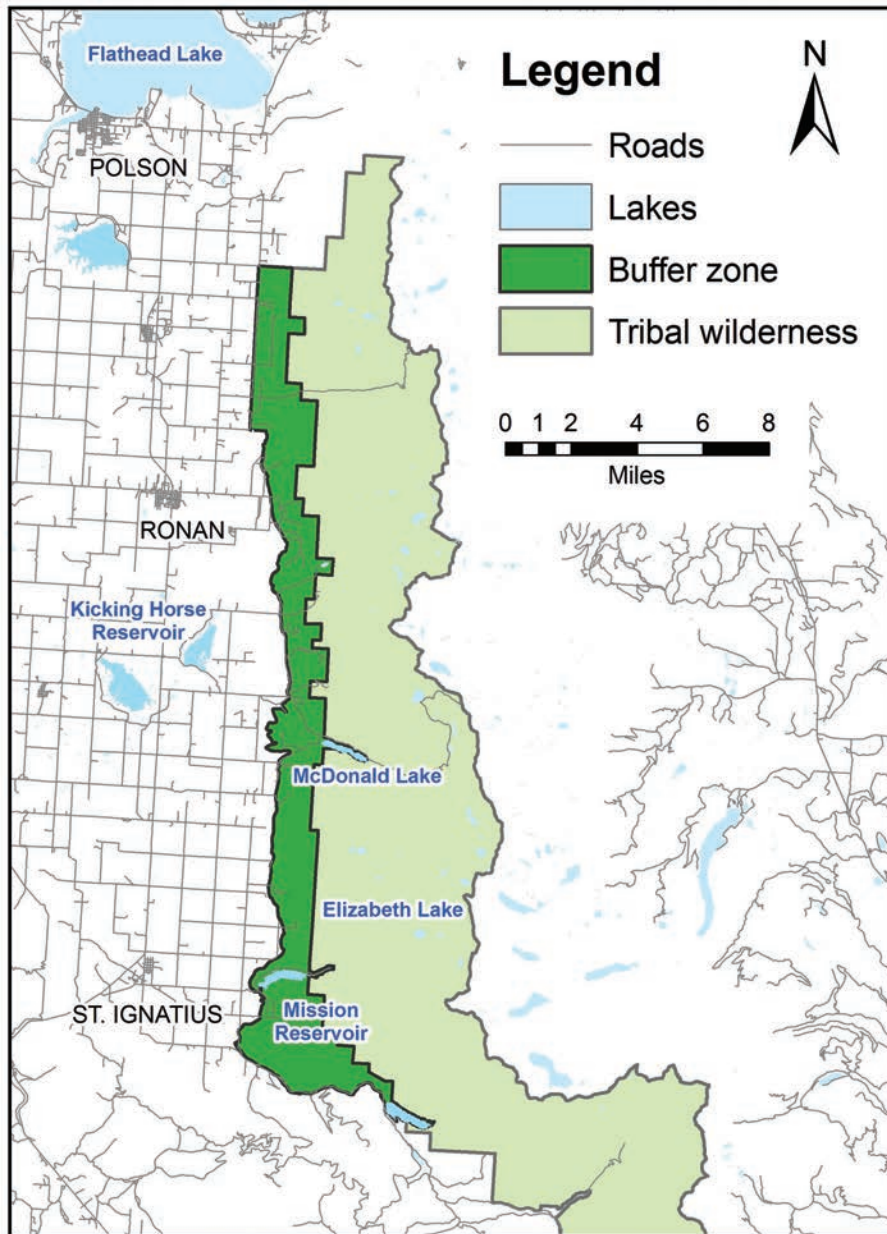


Figure 2—Mission Mountains Tribal Wilderness and Buffer Zone, Montana.

Participatory Approaches to Understanding Values at Risk

A key challenge to develop a better understanding of different responses to landscape level management actions, such as fuel treatments, is to confidently record and accurately represent, in a spatial manner, the meanings stakeholders assign to the landscape. If cross-comparisons are to be made between different stakeholder groups and/or different areas, this needs to be done in a consistent and repeatable manner. An individual's relationship with the local landscape is spatially fuzzy and cannot be easily captured using traditional map-based features or entities such as points, lines and polygons. Where these places begin and end is difficult to express in definitive terms and, therefore, is not easily captured and incorporated within the strictures of Cartesian-based GIS data models. Inevitably, when given a map and a pencil and asked to define areas that have value or meaning, respondents will adopt a variety of approaches ranging in scale and detail from broad sweeping circles that indicate an approximate area to small, crisply outlined regions that attempt to follow the landscape as closely as possible.

Being able to actually map and compare different meanings people place on the landscape has a number of advantages over more general place-based approaches, such as offering a list of potential meanings to the study participants and asking study participant to rank how important each value is (Rokeach 1973; Brown and Reed 2000; Cordell and Stokes 2000; Haas and others 1986). The advantages of mapping and comparing different meanings include the ability to link meanings to specific locations or landscape units, and to perform advanced analyses on responses by looking at spatial relationships based on proximity, adjacency, containment, connectivity and visibility. "Hot spot" areas have been delineated in past studies through categorizing information such as the number of people indicating a particular spot is important, the type of feeling or value people associated with a geographic area, and the specificity of the area indicated. Of particular need for improvement with this type of methodology was the ability to increase the number of people engaging in this map-based activity while retaining good scale representation and capturing the intensity of the meanings and identifying perceived threats to those meanings. An individual's relationship with a local landscape is not spatially exact and cannot be easily captured using traditional map-based features. So, while scale has sometimes been estimated, it has not been captured efficiently, and the intensity of meanings attached to places has not previously been captured at all. The two mapping projects highlighted in this paper offer an expanded approach to mapping meanings, with greater accuracy at capturing intensity of these meanings.

Methods

Work on mapping landscape values and meanings relative to landscape level fuel treatments on the Bitterroot Front was carried out in cooperation with the Bitterroot National Forest. Researchers on this project conducted a baseline assessment of individual and community meanings attached to the Bitterroot Front using a rapid appraisal methodology (Gunderson 2006; Gunderson and Watson 2007). Semi-

structured interviews, key informant interviews of community leaders, and focus group interviews were conducted with local residents to talk about their local landscape, to differentiate between the meanings associated with places they commonly went to and those they have seldom or never visited, and to discuss how these meanings interact with alternative fuel treatments. As part of these interviews, respondents were asked to spatially define these areas and the meanings attached to them by drawing on paper base maps. These were then digitized and imported into GIS for analysis and integration into the decision-making process alongside existing ecological modeling efforts used to evaluate alternative fuel treatments on the Bitterroot landscape. This research project allowed managers to better understand the relationship between the social and ecological data being used to develop fuel treatment plans on the Bitterroot Front.

Some challenges were identified in the map-based aspects of these methods used in the Bitterroot Front project. These include the varying degrees of detail used by respondents when circling areas on a paper map and the labor-intensive nature of the digitizing process (Carver and others 2009). People usually talk about places they know, use, or have visited either by name or in more vague terms such as 'the head of valley beyond the lake' or 'the woods out the back of my acreage' (Evans and Waters 2007). Where these places begin and end is difficult to express in definitive terms and, therefore, is not easily captured and incorporated. Inevitably, when given a map and colored marking pens and asked to define areas that have value or meaning, respondents will adopt a variety of approaches ranging in scale and detail from broad sweeping circles that indicate an approximate area to small, clearly outlined regions that attempt to follow the landscape as closely as possible.

In order to address the challenges described in the Bitterroot Front project, the Tribal Buffer Zone project adopted more fuzzy methods of capturing the landscape areas that people value or for which they hold a particular meaning. This was based around the application of a Java-based mapping applet called "Tagger" that used a spray-can tool, similar to that found in most desk top image processing/ manipulation packages, to allow users to define areas over a base map in a manner that allows them to easily vary the intensity of meanings, extent, and shape of the sprayed area. This is used to capture information about fuzzy spatial concepts such as vagueness and approximation in defining spatial pattern and extent, as well as (un)certainly and importance in the relative values and meanings attached to these. The system was used both online over the Internet and offline on a stand-alone laptop by tribal and non-tribal members of the Flathead Indian Reservation. Internet-based GIS have been used to solicit public opinion about a growing range of spatial decision problems (Carver and others 2002). Figure 3 provides spray pattern examples.

A combination of qualitative, culturally sensitive research and a web-based mapping exercise employing fuzzy mapping methods was used to develop understanding of the meanings Tribal members attach to the Buffer Zone, articulate trust issues, and describe perceived threats to these meanings. An important element in developing this understanding was describing contrasting meanings associated with both the Wilderness and the Buffer Zone by both Tribal and non-Tribal residents. Results guided focus group discussions with

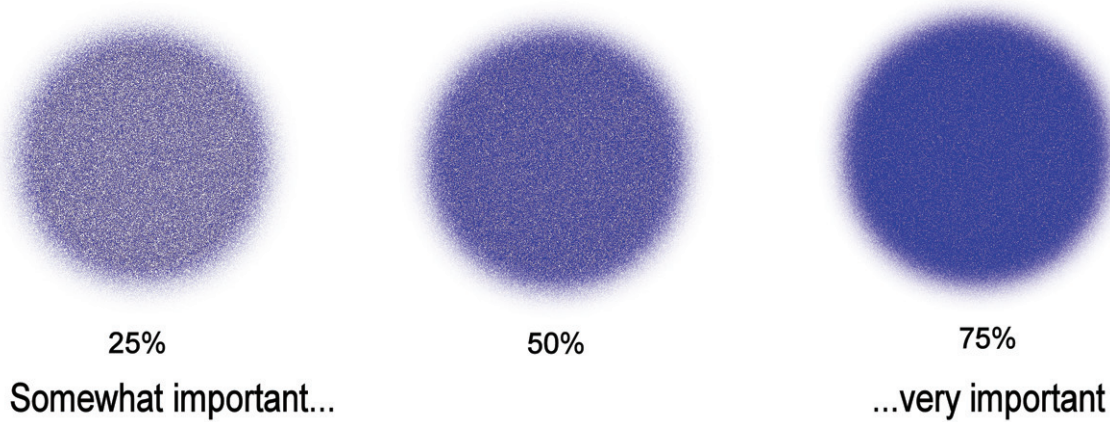


Figure 3—Spray pattern examples.

forest managers, Tribal members, and the Tribal Council about proposed fuel treatments.

The actual methods used to capture spatially fuzzy regions and their assigned attributes draw strongly on previous work on mapping place meanings and on participatory GIS (Carver and others 2009). These methods were brought together in developing a fuzzy GIS-based tool for collecting qualitative, but spatially referenced, local knowledge and meanings from a range of recognized community leaders, or key informants, and local people. Place meanings were analyzed by creating composite maps of the fuzzy attribute-tagged maps generated by survey respondents and linking these to more in-depth transcripts from interviews with recognized community leaders. Data were collected in a way that generated five map layers of themed meanings. These were driven by the key informant interviews and collected to represent the meanings of the Buffer Zone for themed topics covering ‘wilderness protection,’ ‘wildlife and water values,’ ‘recreation,’ ‘access,’ and ‘personal and cultural meanings.’ Participatory GIS methods were used to display the range, types, intensity and spatial distribution of the meanings associated with the Buffer Zone.

Results

The results from the Tribal Buffer Zone mapping exercise could be displayed in five themed topics plus a composite of all meanings for all users. These data represent an initial effort at obtaining public participation in this process. A mixture of online (web-based) and offline (laptop-based) participants were included and results monitored to assure quality of presentation, data capture, and to plan more complex analyses that make the distinction between Tribal and non-Tribal groups as well as standard geo-demographic differences of age and gender. After preliminary data collection with community leaders, the wider public was invited to participate in this process via the local media including announcements in the local weekly newspaper and on the tribal government intranet website appearing on every employee’s start-up login page. The resulting composite maps

displayed differences in spatial patterns and intensity of meanings associated with the five themes. Hot spots represented areas of higher levels of importance and specificity of areas indicated by participants. The composite maps were presented to the Tribal Council by members of the Tribal Forestry Program, resulting in a decision to approve a pilot fuels reduction project in the Tribal Buffer Zone.

Conclusions

The two projects highlighted in this paper have demonstrated that these mapping approaches are well suited to developing a better understanding of peoples’ relationships with the land, and are particularly useful for contrasting meanings attached to different classifications of land. They indicate participants’ beliefs about what is worth protection, what it should be protected from, and how it is viewed by people from different cultures and/or stakeholder groupings.

We learned that the paper and pencil exercise used on the Bitterroot Front failed to adequately capture intensity of meanings. Computer-based mapping used on the Flathead Indian Reservation increased the number of people involved; retained good scale representation; captured intensity of meanings; and possessed an ability to better visualize where meanings fit into the landscape, as well as understand perceived threats to these meanings. There are pros and cons for each method described in this paper. The Bitterroot Front project was easier to implement but suffers from variability and a non-fuzzy nature, whereas the Buffer Zone Project is more involved and requires high-level programming skills to implement, but produces better and more easily manipulated results. On a technical level, the Tagger software used in the Tribal Buffer Zone project could be developed to work with commonly used web mapping interfaces such as *Google Earth*. This would make the tool more readily available to a larger audience and make it easier to incorporate into a wider range of applications.

Many indicator-based planning systems are successful at providing focus on the higher-order values at risk in the relationships people have with a particular landscape.

In this manner, if interested parties can agree on which of these values (or meanings) are most important to protect and to what degree they are willing to have them impacted in order to realize some of the other desirable benefits, a system of managing and monitoring tradeoffs can often be realized.

The positive experiences and results from the work described here would indicate that the approach adopted will find wider application across a range of spatial problems requiring an element of public participation involving vague or spatially fuzzy concepts (Carver and others 2009). The Bitterroot Front and Buffer Zone mapping projects provide promising participatory approaches for land managers and stakeholders with implications for improved decision-making and trust building on contested landscapes.

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Understanding the Transformative Aspects of the Wilderness and Protected Lands Experience upon Human Health

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Abstract—Wilderness and Protected Landscapes (WPLs) have long been considered special areas for a variety of reasons including baseline data, impact analyses, protected zones, and other tangible and intangible values. Another salient, and some would argue, a more important value offered through WPLs is that of human transformation. Accordingly, three theories have provided the bulk of the explanatory framework regarding the connection of WPL to human health: (1) attention restoration theory (ART), (2) psycho-evolutionary theory (PET), and (3) intentionally designed experiences (IDE). Transforming experiences associated with WPLs are often strongly related to emotion, affect, and social cognitive variables, such as developmental/therapeutic health, physical health, self-sufficiency, and educational, spiritual, and aesthetic/creativity benefits. The relationship between these types of experiences and transformations of attitude, beliefs, and behaviors in human populations is presented. The Eastern religions, such as Hinduism, Taoism, and Buddhism, and their erudite philosophers, have a long historic link to health, spiritualism, and wilderness environments. In response to this fact, this paper will discuss wilderness and human transformation from both the familiar Western concepts as well as an international (Asian) perspective on wilderness and transformative experiences.

I'm a city person, born and raised in New York City. My interest in outdoor environments and wilderness seems to stem from a primordial hunger to get back to roots, to nature, to peace and quiet... I have a deep conviction that the source and strength of our lives is in the wilderness, that it is a place of renewal physically and psychically . . . The wilderness, like music, touches something universally felt and experienced by people and perhaps has the power to heal them and bring them together.

Sydney Fine, Wilderness Psychology
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Introduction

Wilderness and Protected Landscapes (WPLs) have long been considered special areas for a variety of important reasons, including providing ecological baseline data for the establishment of protected zones, understanding impact analyses, and other tangible and intangible values. Another salient, and some would argue more important, value offered from WPLs is that of human transformation. That is, these areas provide avenues, either through the landscape itself or the types of activities typically engaged in there, to change human attitudes, belief systems, and behaviors. This paper describes the transformational process within a wilderness context through three avenues: (1) the connection of wilderness and other undeveloped landscapes (WPLs) to human health, (2) the development of WPLs as areas of transformative experiences, and (3) an international (Asian) perspective on wilderness and transformative experiences.

As an underlying framework for this discussion, *health* is defined as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (World Health Organization 1948). Likewise, in accordance with Curtis (2008), WPLs are considered to contain aspects of place (e.g., location such as geographical position relative to other places), specific and often unique attributes of that location, and personally held and imagined characteristics that are imbued with specific social, cultural, and intrinsic meanings leading to a “sense of place” (Curtis 2008; Tuan 1974). Finally, transformative experiences are considered to be those events, either planned or unplanned, that lead to a change in an individual, either behaviorally, psychologically, or emotionally. Transformative experiences are often accompanied by feelings of freedom, sense of harmony or union with some higher power, absorption in the moment, or a sense of overcoming limits or barriers associated with an individual’s life (Williams and Harvey 2001). As will be discussed, a number of authors suggest that WPLs serve a critical role in facilitating both benefits to health and the transformative experience (Laski 1961; Mitchell 1983; Poudyal and others 2009; Pretty and others 2003).

Wilderness and Human Health

A number of well-documented and seminal studies such as Ulrich’s (1981, 1984) work on length of hospital stay, and Kaplan and Kaplan’s (1989) identification of the restorative

effects of natural settings, delineate the effects of outdoor natural settings on both individuals and groups. WPL-based programs and experiences within natural settings have become increasingly employed to enhance the health and quality of life for hard-to-reach populations such as adjudicated youth, the chronically ill, and people with disabilities. Moreover, Ewert (2003) suggests that natural environments such as WPLs are increasingly connected to quality of life, wellness, and human health.

The relationship between humans and natural environments originates with humans having spent literally thousands of years adapting to natural environments, but only a relatively limited number of generations living in urbanized settings (Maller and others 2006). Indeed, Frumkin (2001) suggests that if the last 2 million years of our species' history were scaled to a single human lifetime of 70 years, then the first humans would not have begun to settle into villages and towns until 8 months after their 69th birthday. Further elucidating on this point, biologist E.O. Wilson states:

It would... be quite extraordinary to find that all learning rules related to that world [natural environments] have been erased in a few thousand years, even in the tiny minority of peoples who have existed for more than one or two generations in wholly urban environments (Wilson 1993, p. 32).

Within a North American context, numerous wilderness proponents have advocated the connection between WPLs and the human condition. For example, John Muir thought of wilderness as a "restorative place," where people could restore their mental and physical well-being (Fox 1981; Miles 1987). Contemporary writers have also made the connection between natural settings and human health including Leopold's ecosystem integrity (Gobster 1995), Olmstead's benefits to city dwellers of parks and open space (Nash 2001), Orr's (2004) integration of environment, education, and the human condition, Ulrich's (1984) connection to nature and recuperation, and Louv's (2005) nature deficit disorder. More recently, Mayer and others (2009) report that after almost three decades of study and the use of a variety of methodologies and measures, research has shown that exposure to the natural world provides for health benefits such as decreases in aggression and stress, and increases in positive outcomes such as improved affect, cognitive capacity, and wellness.

Moreover, numerous studies have shown a number of psychological and physical benefits connected with wilderness experiences (Davis 2004; R. Kaplan 1984; Miles 1987; Scherl 1989; Weinstein and others 2009). Kaplan emphasizes the peace and simplicity of life, which allows for reflection and may ultimately transfer back to everyday life. Miles emphasizes the healing aspects of the wilderness environment, encompassing not only psychological benefits but spiritual, emotional and physical as well. More recent literature has focused on the theoretical dimensions of psychological well-being, and its connection between natural and WPL environments and human health (Weinstein and others 2009).

Theories Associated with Human Health and WPLs

Can the pursuit of these health-related benefits be what draws so many users to the wilderness environment? Two

theories have provided the bulk of the explanatory framework regarding the interface between natural environments, such as wilderness, and human health: (1) attention restoration theory (ART) (R. Kaplan and Kaplan 1989; S. Kaplan 1995), and (2) psycho-evolutionary theory (PET) (Ulrich 1984; Ulrich and others 1991).

Attention Restoration Theory (ART) was first developed by Kaplan and Kaplan (1989) and focuses on directed attention, which requires mental effort and can be fatigued from overuse. Directed attention fatigue can lead to negative consequences such as inability to focus, performance errors, inability to plan, social incivility and irritability (Herzog and Strevey 2008). Restorative settings enable the recovery of directed attention fatigue, with natural environments often thought to be the best example of restorative settings (Kaplan and Kaplan 1989). In fact, studies utilizing attention restoration theory have shown better performance on attention-demanding tasks by people exposed to natural settings (Kaplan 2001; Kaplan 1995; Taylor and others 2001). The authors have also suggested that ART may be related to improved self-control, reduced attention deficit disorder (ADD) symptoms, and improved mood and memory.

Psycho-evolutionary Theory (PET) emphasizes emotions and how exposure to nature can reduce stress reactions. In this case, stress is considered a physiological response to situations that threaten well-being, and stress recovery occurs in settings that evoke interest, pleasantness and calm, such as natural environments like WPLs (Ulrich 1984). Studies utilizing PET suggest that nature may be therapeutic, in part, by providing positive distractions that reduce stress responses (Ulrich and others 1991). For example, an early study indicated that recovery time decreased for hospital patients following gall bladder surgery who had rooms with natural views (Ulrich 1984).

PET is related to a third theory, the biophilia hypothesis, that also connects human health with natural environments (Wilson 1984). PET and biophilia both invoke humankind's historical relationship with the natural environment as creating an ingrained affinity that is key to our well-being. Related to this, biophilia was originally defined by Wilson as "an innate tendency to affiliate with natural things" (Kahn and Kellert 2002, p. 1). Biophilia further suggests that contact with nature promotes well-being as well as an increased understanding of nature, which can lead to stewardship beliefs and behaviors. Conversely, disconnections from nature are harmful to the individual, as well as for societies and cultures (Pretty and others 2003). In addition, Kellert (1993 p. 42) links biophilia to quality of life in suggesting that "the human need for nature is linked not just to the material exploitations of the environment but also to the influence of the natural world on our emotional, cognitive, aesthetic and even spiritual development."

Intentionally Designed Experiences (IDEs)

One of the major issues that arise in terms of wilderness experiences involves the importance of simply *being* in the wilderness environment versus *doing* structured activities in the wilderness. Several researchers have proposed that a major factor in the efficacy of wilderness programs is simply being in *contact* with the natural environment itself (Bardwell 1992; Mitten 1994). It has also been suggested,

however, that structured programs work to “focus the power” of nature, and that highlighting this relationship could work to further enhance health-related outcomes (Mitten 2009).

More specifically, benefits from both PET and ART are typically based on simply being exposed to the natural environment (e.g., wilderness). That is, simply being in a wilderness will create the potential for a positive connection to human health through PET and/or ART. However, another way of enhancing the relationship between humans and natural environments, such as WPLs, and creating subsequent health benefits, is through the use of Intentionally Designed Experiences (IDEs) (Sheard and Golby 2006). Similar to Mitten’s (2009) idea that wilderness programs may serve to focus the benefits of nature, the idea of IDEs is that programming in the natural environment can, and should be, purposeful in its planning and implementation in order to achieve specific benefits. In this way, wilderness-based programs become a type of vector for the benefits imbued by the more passive theories of the psychological and physical benefits of nature such as ART, PET, and biophilia (fig. 1).

The type of benefits resulting from participation in an IDE can be separated into two orders or levels. First order benefits can be considered major outcome variables that occur from participation in an IDE in a WPL setting and include achievement, restoration, empowerment and resilience. Second order benefits emerge from the occurrence of these first order outcome variables and include benefits related to self-systems (e.g., esteem, concept, awareness, efficacy), stress reduction, identity formation, and social support.

The idea of the IDE posits that the purpose, type, specifics of the program, and the type of clients all impact the outcome. The IDE is an active mechanism that, depending on its design, incorporates many of the theoretical

underpinnings of the human-nature benefit interaction (such as ART, PET and biophilia) into a program or experience that ultimately contributes to health and/or quality of life. Some examples of IDEs include Outward Bound, NOLS, Wilderness Inquiry, and University-based outdoor programs.

Wilderness as Transforming Experiences

Theoretically, wilderness experiences may be especially beneficial because they entail *engaging* with the landscape rather than *viewing* it (Frumkin 2001). This immersion may lead to a sense of “wilderness rapture,” including feelings of awe, wonder, humility, comfort in and connection to nature, increased appreciation of others, and a feeling of renewal and vigor” (Cumes 1998, in Frumkin 2001, p. 237). The idea of rapture is similar to the transcendent experience, as described by Williams and Harvey (2001) in relation to forest environments. Both of these concepts suggest a spiritual connection that takes place within a wilderness environment. According to Williams and Harvey, characteristics of a transcendent experience may include aspects such as a strong positive effect, overcoming personal limits, a sense of union with the universe, absorption in the moment, and a sense of timelessness. Transcendence has also been identified as a limitless experience, one that goes beyond the “essential being” (R. Fox, 1999, p. 457).

Williams and Harvey (2001) ultimately identified six different types of forest experiences, two of which—diminutive and deep flow—can be classified as transcendent. The diminutive experience was characterized by high fascination, high

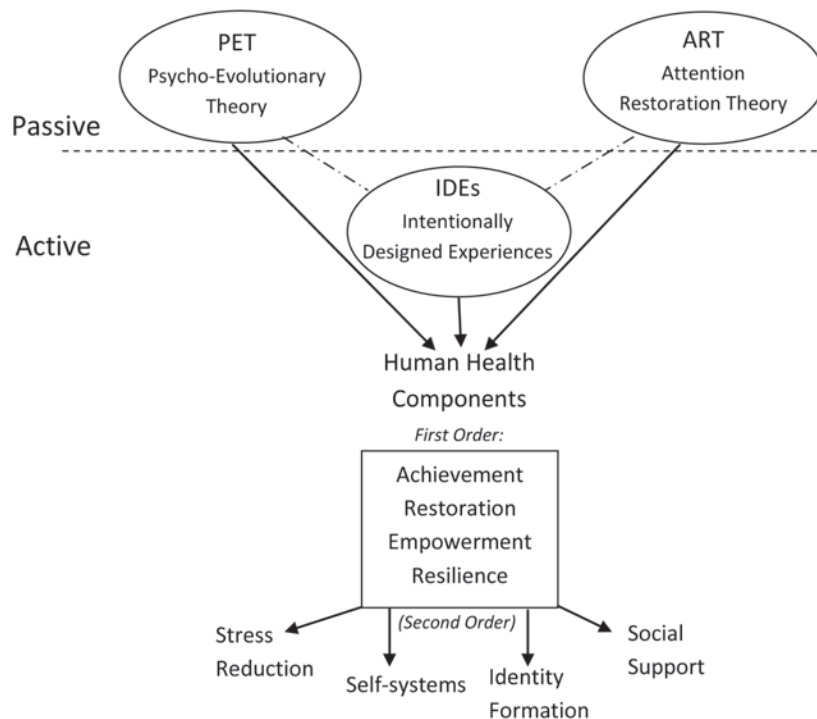


Figure 1—Natural Environment and Human Health Outcome Model.

novelty, low compatibility, and high levels of transcendence, and was likely to include feelings of insignificance and humility. The deep flow experience was different in that it included high compatibility and moderate novelty, and was likely to be described as relaxing or creating a sense of belonging. The other four types of experience—non-transcendent, aesthetic, restorative-familiar, and restorative-compatibility—contain similar characteristics as those deemed transcendent, but could not be distinctly categorized as such.

Williams and Harvey's (2001) work on the transcendent forest experience is important because it provides empirical data that links the spiritual experience with Kaplan's (1995) restorative environments work. Specifically, the authors posit that the concept of fascination may be influential in both restorative and transcendent experiences in nature. Thus, this study not only brings additional credence to the ART theory that has been utilized for a number of decades, but it adds much needed theoretical and empirical knowledge to the existing spirituality literature. Transcendent experiences have also been related to other theories currently used to describe the outdoor recreation experience, including flow (Csikszentmihalyi and Csikszentmihalyi 1990), and the peak experience (Maslow 1962).

The idea of wilderness transcendence has often been thought of as a type of spiritual experience in wilderness, but it may also be regarded as a transformational aspect. One way of conceptualizing this may be to examine the constructs of Fredrickson's (1998, 2001) broaden-and-build theory. Fredrickson's model posits that negative experiences narrow peoples' thought-action responses, while positive experiences broaden them. As such, new resources are built physically, intellectually, socially, and psychologically by these positive experiences. These new resources may facilitate coping with stress and adversity (Fredrickson and Joiner 2002). As the idea of the transcendent experience is built around experiencing intensely positive emotions triggered in a wilderness setting, Fredrickson's theory helps to explain how these experiences are then translated into the benefits so often touted as being a result of time spent in the wilderness.

In a similar fashion, Roggenbuck and Driver's (2000) taxonomy of wilderness benefits includes: developmental, therapeutic/mental health, physical health, self-sufficiency, independence, social identity, educational, spiritual, and aesthetic/creativity benefits. The literature generally tends to agree that wilderness experiences imbue benefits such as those listed in the above taxonomy (Ewert and McAvoy 2000; Fox 1999; Miles 1987; Scherl 1989; White and Hendee 2000). However, the exact meaning and role of the wilderness setting with regards to the benefits and outcomes of adventure programs remains largely unknown. Fredrickson and Joiner (2002) propose an upward spiral of positive emotions that lead to emotional well-being for the individual, and that these feelings accumulate and compound over time. Thus, the wilderness experience could be a first step in creating these positive emotions. This is an area in need of future investigation by wilderness researchers.

It is very possible that many of the benefits that have resulted from IDEs are due, in part, to the wilderness environments in which they take place. Knowing that this is the case may allow us to more fully harness or focus the

power of nature through intentional design. For example, Stringer and McAvoy (1992) suggest that programs might set aside more structured reflection time, allow for group discussion on the spiritual nature of the experience, provide for emotional challenge and the testing of personal limits, teach more about the natural history of an area in which a group is travelling, and facilitate personal connections among group members. A greater understanding of specific types of wilderness benefits, such as the transcendent experience, coupled with a greater understanding of the ways in which IDEs can help to facilitate those benefits may ultimately result in enhanced outdoor experiences for those who participate.

Many of the theories discussed thus far, such as ART and PET, represent a Western perspective, and a North American ideology of what constitutes a transformative experience in wilderness areas and other protected lands. It is significant to note, however, that many of the underlying frameworks for health and restorative relationships with wilderness take their roots from historic civilizations in the Eastern regions of the world, primarily in Asia. Religions, such as Hinduism, Taoism, and Buddhism, and their erudite philosophers have a long, historic link to health, spiritualism, and wilderness environments. The following section explores the significance of these ancient religious tenets and their foundational connection with wilderness lands.

Asian Perspectives on WPLs and Experiences

In Asia, people have strong connections with natural environments and consider the human being as part of nature, not separated from it (Hayashi 2002; Plummer 2008). Asians view the wilderness as the resource of basic energy from the earth. The earth provides all human beings with various materials to meet their survival, medical, aesthetic, and spiritual needs. In this section, the belief systems of Hinduism, Taoism, and Buddhism will be explored and discussed regarding their influence and impact on Asians' perspectives concerning wilderness and the transformative experience.

Hinduism

From Hinduism's point of view, the universe is God's body and a human's relationship with the Earth is inseparable, like that of children and their mother (Beelman 2005). Hindu dogma teaches people that the divine is in every aspect of nature—mountains, rivers, forest, animals, and planets—and that nature is valued and respected (Arsene 2007). For example, Hindus believe that taking ritual baths in the Holy Prayag River on specific days gives them great health benefits, since the water of the river can purify their bodies and minds. In addition, some natural places have spiritual resonance for the Hindu people. For instance, the Himalayas are sacred places for Hindus and they believe that sacred places can give them spiritual energy. As suggested by Frumkin (2003), these places [nature] seem to enhance well-being and may even promote good health.

Taoism

Taoism is a nature philosophy that emerged from the reflections of Taoist thinkers' reflections, and was inspired by the spiritual essence of the interaction between humans and nature. Simultaneously, they rejected the works of civilization. Zhuang Tzu, one of the founders of Taoism, created the notion of following the natural order of things and withdrawing from worldly reality (Menzie's 1994). Thus, a spiritual retreat into the mountains or forests became a practice of Taoism, and the wilderness became a place for Taoists to develop and pursue their beliefs (Soper 1941). In addition, other significant Taoist spiritual concepts such as Yin/Yang, chi, and Wu Xi (the five elements: gold, wood, water, fire, and land) also were inspired by the wilderness (Menzie's 1994). These Taoist concepts have influenced Asian cultures for thousands of years and become embedded magnificently in the spiritual and attitudinal aspects of people's everyday lives. These concepts demonstrate the substantial influence of the wilderness on the emergence of ancient Taoism and its subsequent impact on Asians' beliefs.

Buddhism

The Buddhists believe that life is full of pain and suffering that result from cravings or desires. The wilderness is seen as a path to obtain spiritual freedom and release people from this suffering. In ancient times, monks and nuns left their homes and lived isolated in the wilderness to pursue their spiritual freedom and overcome their desires. Living in a tranquil forest taught them to find peace and happiness despite a harsh life, and to conquer their original sensual cravings (Ramanathapillai 2009). Today, some Asian cultures that practice Buddhism have inherited this tradition. For example, people in Sri Lanka view the wilderness as a source of inspiration to heal tangled minds (Alwis 1999). Also, in Thailand, every young man is expected to be ordained as a monk for a short period of time before getting married. These individuals make a spiritual journey by walking into the jungle and sitting in meditation for days. Most people who have experienced these spiritual journeys and accomplished their tasks, found themselves transformed into more mature people (Hutanuwatr 1999). Hutanuwatr, a former Buddhist monk, stated:

This primordial energy (from the wilderness) is very vital for supporting our inner energy and harmonizing it with universal energy. Enhance the healing, the recovery of health, and the deep meditation (Hutanuwatr 1999, p. 35).

The influence of Buddhism on people's spiritual health is obviously significant. It not only leads people to pursue peace in their minds but also impacts their attitudes and beliefs towards their lives. If we track the essential origin of Buddhism, we see that the core notions were stimulated and inspired by the power of the wilderness, a place which guides people to pursue spiritual peace.

As can be seen from the previous descriptions, the belief systems of the Eastern religions have a stronger and more foundational connection to wilderness than those espoused by traditional religions of Western cultures. Transformative experiences are drawn from a personal relationship with the natural landscape and the inner most core of the

individual. Depending on the specific belief system, it is nature, rather than a perceived deity, that can heal "tangled" minds and provide a forum for obtaining spiritual energy. This enhanced spiritual energy is what moves the individual toward greater personal development or spiritual "completeness." These transformations can occur by simply being in the wilderness, which resembles the notion of withdrawing into the wilderness (Taoism), or by intentionally engaging with wilderness such as the belief that taking a bath in the Holy Prayag River purifies the body and mind (Hinduism), or meditating in the jungle for personal maturation (Buddhism). In addition, we can use the Natural Environment and Human Health Outcome Model to examine how WPL facilitates health benefits and transformative experiences (fig. 1).

Conclusions

This paper has explored the concept of wilderness as a setting from which to create a transforming experience. In support of this discussion, the Natural Environment and Human Health Outcome Model illustrates the connection between natural environments (e.g., WPLs) and salient, human health-related outcomes including sense of achievement, resilience, empowerment, and restoration. Integral to this model is the belief that WPLs can be facilitative in creating benefits to human health and transformative experiences because of the long-standing connectivity of humans to natural environments. This historic connection is particularly evident when exploring the Eastern belief systems, and their heavy reliance on wilderness and nature in the transformation of an individual toward a higher level of development and spirituality.

Attention restoration theory (ART), psycho-evolutionary theory (PET), and biophilia are theories used to explain the *passive* ways of connecting with nature. On the other hand, intentionally designed experiences (IDEs) demonstrate the *active* approaches used to enhance health-related outcomes by engaging with WPLs. The use of IDEs augments this connection by providing structured and facilitated experiences in WPLs that further enhance the positive outcomes from interaction with natural environments. Similar IDEs can be seen through an Asian cultural lens, in the purposeful acts of retreating into wilderness, personal testing, and spiritual cleansing rituals.

A growing body of research findings points to the importance of not only visiting the wilderness and other protected lands but also using structured experiences to heighten this connection to human health components. These components of human health speak to the importance and value we currently ascribe to wilderness, its pervasive, historic significance in long-standing Eastern cultures, and to the benefits it will continue to provide to those of future generations.

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Challenges in Protecting the Wilderness of Antarctica

Tina Tin and Alan D. Hemmings

Abstract—Since 1998, the wilderness values of Antarctica have been among those given legal recognition under the Protocol on Environmental Protection to the Antarctic Treaty. Despite the legal obligation, on-the-ground implementation has attracted little interest. The term “wilderness” and its consequential operational implication, including the designation of Antarctic Specially Protected Areas and the drafting of Environmental Impact Assessments, is still poorly conceptualized in Antarctic Treaty System discourse. Many possible factors underlie the lack of attention to the protection of wilderness in Antarctica. There is the perception that wilderness is in overabundance in Antarctica and hence does not require special protection. Setting areas aside, out of bounds of infrastructure development, may be perceived as threatening to national ambitions and the accepted ideas of freedom of movement. There is no formal definition of either term in the Protocol or elsewhere in Antarctic Treaty System (ATS) instruments, and the concept of wilderness (as other terms in the Protocol) seems often to be cast as too complex or philosophical to be applied in practice. We ask the question of how existing environmental measures within the ATS and non-Antarctic wilderness management tools could be used to achieve on-the-ground protection of the Antarctic wilderness.

Introduction

If wilderness “refers broadly to the most intact, undisturbed, wild natural areas—those last truly wild places that humans do not control and have not developed with roads or other industrial infrastructure” (Kormos 2008)—then, at least until we see real application of the concept to the

world’s oceans and sea-floor, the Antarctic is today its greatest exemplar. On any objective basis, the Antarctic is our least obviously modified area and, in global terms, subject to still low levels of human activity. If we cannot safeguard wilderness in the Antarctic, we shall not do so anywhere. A continent with no indigenous population, relatively few commercial and national interests, and managed collaboratively by 28 countries, the wilderness of Antarctica should theoretically be easier to safeguard than wilderness areas on the other six continents. However, Antarctica’s extreme isolation from human settlements, which has protected its wilderness character, has been progressively eroded over two centuries (Hemmings 2007). When it comes to wilderness, a certain complacency is evident in the Antarctic, despite increasing pressures from scientific research, fishing, tourism, and other commercial interests (Tin and others 2008). Under the fragile international governance regime operating in Antarctica, with its diverse geopolitical interests, cultures, and capabilities, a more robust consideration of wilderness is not easy. This paper seeks to examine the challenges in protecting the wilderness of Antarctica at the end of the first decade of the 21st Century.

The Antarctic

Antarctica is variously bounded, but here it will be taken to mean the entire land and marine area south of 60 degrees south latitude. This excludes a large part of the Southern Ocean and also the subantarctic islands but coincides with the area subject to the 1959 Antarctic Treaty and some subsequent instruments of what is termed the Antarctic Treaty System (ATS), which provides the focus for Antarctic governance (Hemmings 2011). These limitations in coverage offer the advantage of simplifying the complex juridical and conceptual framework within which the concept of wilderness has arisen, and puts the main focus on the land area of Antarctica. This area is governed internationally under the ATS, by a culturally diverse group of 28 countries, using four official languages. The original Antarctic Treaty was signed in 1959 and stipulated the prohibition of military activities and nuclear testing and required Treaty Parties to take measures regarding the preservation and conservation of living resources in Antarctica. Over the next 50 years, the ATS expanded to include the Antarctic Treaty and three other legal instruments. Its latest addition, the Protocol on Environmental Protection to the Antarctic Treaty (signed in 1991, and more commonly referred to as the Madrid Protocol) brought in explicit protection for Antarctica’s wilderness values.

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Wilderness in the Antarctic Regime

Appearance of Wilderness in the Antarctic Regime

While wilderness was a concept and term easily applicable to the Antarctic, its first formal appearance in the Antarctic regime only occurred in 1988—perhaps ironically as a consequence of the decade-long debate around the acceptability of minerals resource activity in Antarctica—with the adoption of the Convention on the Regulation of Antarctic Mineral Resource Activity (CRAMRA) (<http://www.state.gov/documents/organization/15282.pdf>).

The Preamble to CRAMRA noted the “unique ecological, scientific and *wilderness* value of Antarctica and the importance of Antarctica to the global environment” and Article 2: Objectives and General Principles “acknowledge[d] the special responsibility of the Antarctic Treaty Consultative Parties for the protection of the environment and the need to [*inter alia*] respect Antarctica’s scientific value and aesthetic and *wilderness* qualities” (emphases added). Substantively, Article 4: Principles Concerning Judgements on Antarctic Mineral Resource Activities states that “No Antarctic mineral resource activity shall take place until it is judged, based upon assessment of its possible impacts on the Antarctic environment and on dependent and on associated ecosystems, that the activity in question would not cause [*inter alia*]: degradation of, or substantial risk to, areas of special biological, scientific, historic, aesthetic or *wilderness* significance” (emphasis added) (<http://www.state.gov/documents/organization/15282.pdf>).

CRAMRA was abandoned and in its place a new instrument, the Protocol on Environmental Protection to the Antarctic Treaty, generally referred to as the Madrid Protocol, was adopted in 1991 and entered into force in 1998. It is in, and subsequent to, the Madrid Protocol that wilderness has seen its fullest development in the ATS. But aside from its first use of the term, CRAMRA’s legacy to the Protocol was both a continued lack of clarity about what wilderness was considered to be (let alone a definition) and an invariable coupling of wilderness with another concept, *aesthetics*. Approaching 20 years on from the drafting of the Madrid Protocol, this legacy continues and, we argue, is one of the critical constraints on the full operational realization of the legal duties toward Antarctic wilderness.

Wilderness is now used in the Antarctic system in two rather different ways—as a generalized and essentially political assertion about the overall state of the Antarctic environment and in the narrower technical sense of a particular value to be taken into consideration under the Madrid Protocol (Tin and others 2008).

Wilderness Under the Madrid Protocol

One of the major developments evident in the Madrid Protocol was the expansion of morally considerable issues, with a broadening of both *values* and *activities* beyond the previous focus of the ATS instruments on scientific and directly related activities. Critically, in Article 3: Environmental Principles, wilderness became one of a range of considerations that were to be “fundamental considerations

in the planning and conduct of all activities in the Antarctic Treaty Area.” The difficulty was that this was achieved in a conceptually confused manner, with wilderness not only coupled with aesthetics but ambiguously situated within the further concept of “intrinsic value”:

1. The protection of the Antarctic environment and dependent and associated ecosystems and the intrinsic value of Antarctica, including its wilderness and aesthetic values and its value as an area for the conduct of scientific research, in particular research essential to understanding the global environment, shall be fundamental considerations in the planning and conduct of all activities in the Antarctic Treaty area [http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1991.php].

Not one of these terms is defined in the Protocol, and within this jumble it is not really clear what understanding of wilderness is intended. The diplomatic joke about the weight of commas is here exemplified. Is wilderness intended to be solely an intrinsic value or is it more? Does the coupling with aesthetic carry inevitable meaning? In a multi-lingual and culturally diverse international system like the ATS, ambiguity hardly helps consistent interpretation. However, the second paragraph of Article 3 at least directs Parties to plan and conduct activities so as to limit adverse impacts and to avoid, *inter alia* “degradation or substantial risk to, areas of biological, scientific, historic, aesthetic or wilderness significance.”

As a framework convention, the substantive technical obligations of the Protocol are placed in updatable Annexes. There are presently six, although only five are in force. Interestingly, wilderness is referred to explicitly in only two of the Annexes, and one of these—Article 3 of Annex III: Waste Disposal and Waste Management—was an interim injunction pending the ending of open burning, which has long been achieved. Under Annex V Article 3—Area Protection and Management—“Any area, including any marine area, may be designated as an Antarctic Specially Protected Area to protect outstanding environmental, scientific, historic, aesthetic or wilderness values, any combination of those values, or ongoing or planned scientific research” and Parties are enjoined to identify within a systematic environmental-geographical framework, *inter alia*, “areas of outstanding aesthetic and wilderness value” (http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1991.php).

Beyond these limited and explicit requirements, wilderness obligations in relation to the Annexes seem to rely on an implied duty traceable back to the Principles (Article 3) in the main body of the Protocol, and, like much else therein, to a resulting integrated environmental management approach. Accordingly, in the application of Annex I: Environmental Impact Assessment (EIA), which is probably the single most important environmental gatekeeper under the Madrid Protocol, consideration of wilderness depends on a voluntary interpretation of what should be addressed for the mid-level EIA termed an Initial Environmental Evaluation and, in the case of the high-level Comprehensive Environmental Evaluation (CEE), on the indirect “consideration of the effects of the proposed activity on the conduct of scientific research *and on other existing uses and values*” (emphasis added) (Annex I Article 3(i)).

The picture here is of not terribly well-resolved obligations toward wilderness, patchily referred to, and often arrived at through implied or indirect routes. These obligations are, however, connected to the two principal operational tools for Antarctic environmental management: Protected Areas and EIA.

Wilderness and the Antarctic Protected Areas System

The Antarctic Protected Areas system emerged within 5 years of the adoption of the Antarctic Treaty. It is one of the earliest manifestations of environmental awareness in Antarctica and is now the management tool with the greatest case-history (Goldsworthy and Hemmings 2008). The current system substantively rests on two area categories (see Goldsworthy and Hemmings 2008 for details): a collaborative management mechanism termed an Antarctic Specially Managed Area (ASMA), of which there are seven with a total area of approximately 44,250 km²; and a more conventional protected area termed an Antarctic Specially Protected Area (ASP), of which there are 71 with a total area of approximately 3,075 km² (Antarctic Protected Areas Database 2009). The Antarctic continent alone is approximately 14,000,000 km² and so a mere 0.02% is presently in ASPAs. While ASMAs may include wilderness areas, wilderness area designations would largely be achieved via ASPAs. However, from the foregoing figures it is clear that no substantial area has yet been designated.

Searching the Antarctic Protected Areas Database (2009) reveals the limited realization of active wilderness protection in the areas so far designated. While a general search throws up many references to “wilderness,” this is an artefact of the mechanism termed a “Measure” whereby Management Plans have been adopted since 2004. The preamble of the Measure includes a variation on the phrasing: “Recognising that this area supports outstanding environmental, scientific, historic, aesthetic or *wilderness* values, or ongoing or planned scientific research, and would benefit from special protection ...” (emphasis added). The majority of Management Plans include no substantive consideration of wilderness.

Only one ASMA (ASMA 2: McMurdo Dry Valleys, Southern Victoria Land) and three ASPAs (ASP 119: Davis Valley and Forlidas Pond, Dufek Massif; ASP 164: Scullin and Muray Monoliths, MacRobertson Land, East Antarctica; and ASP 168: Mount Harding, Grove Mountains, East Antarctica) appear to include explicit reference to wilderness issues in their Management Plans. Even then, the consideration need not be extensive.

The 40-page Management Plan for ASMA 2 makes two references, confined to its first two pages. The description of the area notes that the “...Valleys are also valued for their wilderness quality. They represent a nearly pristine environment largely undisturbed and uncontaminated by humans” and the aims and objectives require “special management” to ensure that its various values including wilderness are protected (http://www.ats.aq/documents/recatt/att208_e.pdf). On this slender basis, the detail in the rest of the Management Plan must be assumed to apply generically to wilderness.

The picture is the same in the ASPA Management Plans. For ASPA 119, the 15-page plan includes two references: in the description of values to be protected and in the section on permit conditions. The latter requires that “the actions permitted will not jeopardize the physical, ecological, scientific or aesthetic and wilderness values of the Area, nor the pristine value of the Area and its potential as a largely undisturbed biological reference site” (http://www.ats.aq/documents/recatt/att208_e.pdf). The 17-page plan for ASPA 164 actually includes a paragraph specifically on “Aesthetic and wilderness values” within the description of values to be protected:

Aesthetic and wilderness values

In addition to the outstanding ecological and scientific values already identified, the Area possesses outstanding aesthetic values in the geomorphology of the two Monoliths and the spectacular nature of the glaciers descending from the Continental plateau that flow around the Monoliths ending in calving glaciers. The near-vertical aspects of both Monoliths dropping to the sea, used by a high number of seabirds for nesting, represent an unique landscape in the Antarctic.

The very large breeding assemblage of undisturbed seabirds in a setting of high aesthetic and wilderness values warrants the highest level of protection [http://www.ats.aq/documents/recatt/Att281_e.pdf].

However, this is the only explicit treatment of wilderness in the Management Plan. The primary focus of the ASPA is protection of important seabird colonies. For ASPA 168, the 18-page Management Plan makes four references to wilderness. The introduction refers to scientifically important glacial-geological features and “rare wildness [sic] and aesthetic values” for which “disorderly human activities would cause perpetual, unrepairable damage.” In the description of values, the aim of the ASPA is “to preserve its scientific, aesthetic and wilderness values”; and a subsection on “Aesthetic and wilderness values” appears as in ASPA 164:

2(ii) Aesthetic and wilderness values

A legacy of the various magnificent landscapes remains in this area, from pool of melted water, icecore moraine, ice-core pyramid to ventifacts. Human beings have visited for many years this area, other area within Grove Mountains region to conduct for a range of scientific activities. It mainly includes scientists and support staff from China, Australia and Russia. In the future, especially during the 2007-2008 IPY, human activities perhaps will increase in this area [http://www.ats.aq/documents/recatt/att386_e.pdf].

Finally, in the section on management activities, roche muttonnees in the area are noted to be “peculiar in shape, have a large number of footprints of ice flow on their surfaces, and possess very high wilderness, aesthetic and scientific values.”

The picture that emerges from this necessarily brief survey is of a very limited explicit attention to wilderness in the present Antarctic protected areas system, one of the key mechanisms of Antarctic environmental management. The

limitations arise in relation to both the number of Management Plans attending to the issue, and the seemingly shallow treatment even in those which do. Of course wilderness protection may be provided incidentally in areas whose plans make no mention of wilderness. But most Management Plans for Antarctic protected areas seem to pay little attention to wilderness—and possibly to other values recognised by the Madrid Protocol that are beyond the scope of this paper.

The small proportion of ASPAs and ASMAs addressing—even perfunctorily—wilderness may be contrasted with the global picture from the World Database on Protected Areas (2009). While this is a partial database (some states do not make their data available), it shows that globally there are 1331 nationally designated and 3 internationally recognised, protected areas “whose designation in whole or part includes protection of wilderness values.”

Wilderness and Antarctic EIA

Under the Madrid Protocol, a three-tier environmental impact assessment (EIA) system is established. The highest level EIA is termed a Comprehensive Environmental Evaluation (CEE) (Hemmings and Kriwoken 2010). Major activities such as station or airstrip construction and the very largest scientific projects are subject to CEE (Hemmings and Kriwoken 2010). Attention to wilderness values is only explicitly required for CEEs. Accordingly, we shall consider wilderness only in the context of CEEs. Many of the CEEs are available at another database maintained by the Antarctic Treaty Secretariat, (Antarctic EIA Database 2009). A total of 19 CEEs have been prepared since 1988. The EIA category of CEE predates the Madrid Protocol, so only the 13 CEEs submitted after its entry into force in 1998 are legally required to be compliant with it.

In addition to the generic obligations towards wilderness found in the main body of the Madrid Protocol, Annex I: Environmental Impact Assessment (http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1991.php) establishes specific duties in relation to CEEs that must be taken to relate to wilderness. The CEE “shall include” *inter alia*: the activity, alternatives (including not proceeding), the initial environmental reference state and a prediction about the effect of the activity on the future state, estimation of the nature, extent, duration and intensity of impacts, consideration of the effects on not only the conduct of scientific research but “other existing uses and values,” which is an allusion to the “values” including wilderness established in the Article 3: Environmental Principles of the main body of the Madrid Protocol.

However, an examination of the actual CEEs reveals that, as with the Management Plans for ASMAs and ASPAs, wilderness is only lightly addressed. Even in CEEs that make reference to wilderness value (generally under the rubric “wilderness and aesthetic”), this is generally in the course of noting the obligation. Most do not substantively assess the impact, far less amend the proposed activity to prevent or minimize impact. Bastmeijer and Roura (2008) suggested, on the basis of their review of the case history of actual EIAs and examination of the hortatory EIA guidelines produced by the Committee for Environmental Protection, that wilderness and aesthetics were considered perfunctorily in Antarctic EIA. We concur in relation to the CEEs. As with

the discussion of protected areas, it is likely that wilderness values have sometimes been incidentally secured through other strengths in the CEE process. But at the level of formal consideration in CEEs, wilderness fares poorly.

Antarctic Wilderness and Other Environmental Management Mechanisms

The two previous sections demonstrated that the operational tools for Antarctic environmental management are neither strong nor specific enough to protect Antarctica’s wilderness or prevent its fragmentation. Here, we explore some potential options that could help bring us closer to the goal of achieving on-the-ground protection of wilderness in Antarctica. These options can be roughly divided into two categories:

1. Application or improvement of existing Antarctic environmental management mechanisms; and
2. Borrowing from management tools in use in other parts of the world (of particular relevance to the World Wilderness Congress).

One way of protecting wilderness in Antarctica is to set aside areas under ASPAs or ASMAs, explicitly for the purpose of protecting the wilderness values of the area concerned. Although precedence still has to be set, the ASPA and ASMA mechanisms are theoretically capable of designating large areas for wilderness protection. Wilderness ASPAs could be designated. The ASMA mechanism could be used with zoning provision to provide for a wilderness core area where access is strictly controlled, surrounded by zones permitting varying levels of human activities. While this could set a precedent in the explicit protection of Antarctica’s wilderness values that can have important tangible and symbolic significance, it is likely to be much more difficult to use these mechanisms to achieve the setting aside of an area that can truly encompass the essence of the last wilderness continent on the planet: a wilderness of outstanding size, integrity, and isolation that is difficult to find anywhere else on Earth. This would require protection of a significant portion of the continent to encompass representative ecological and geographical units: a continuum that includes the high, cold polar plateau, the ice-free coastal areas that provide critical habitat, the sea ice zones (which are seasonal zones of high biological activity), as well as the unique atmospheric, subglacial, and underwater environments. Considering that ASMAs and ASPAs combined have set aside only a tiny fraction of Antarctica’s surface area over the past 20 years, significant change in the use of these mechanisms will be necessary if they were to be used to set aside wilderness areas of significant size.

Setting aside land to protect its wilderness values leaves the fate of the land outside the protected area boundary open to question. Is land outside the boundary of a protected area immediately up for grabs for development, as is common practice on the other six continents? The Madrid Protocol provides protection to the wilderness values of *all* of the Antarctic Treaty area. Here, experience from outside Antarctica may be useful. European and North American countries have been increasingly using Strategic Environmental Assessment (SEA) and strategic-level Cumulative Effects

Assessment (CEA) to integrate environmental considerations into policy-making and planning (Therivel and Ross 2007). SEA has been advocated as a tool to manage Antarctic activities in order to meet the long-term conservation goals set down by the Madrid Protocol (ASOC 2002). Strategic-level planning covers a long time span, a large geographical area, and multiple existing and future activities and can be used to decide, in coherence with the long-term vision of the protection of Antarctica's wilderness values, what activities should take place. This is then coupled with an improved version of the existing project-level EIA to determine how each activity should be carried out. An improved project-level EIA would include substantive assessment of the impacts of the proposed activity on wilderness values with the assessment having significant bearing on the final decision of how the activity should be carried out. Key elements of the strategic-level planning would include discussions of the optimal size of the human footprint in Antarctica, whether (semi)permanent tourist facilities should be allowed (Bastmeijer and Roura 2004), and defining acceptable forms of activities in particular environmental settings. These questions also lend themselves well to the application of Limits of Acceptable Change (LAC), a visitor management model that has been adopted for the national parks in the United States and Australia for over two decades. Davis (1999) concluded that LAC lends itself to a general application in Antarctica and could be useful in devising an appropriate visitor management model.

Conceptual Challenges With Antarctic Wilderness

Appropriate management tools aside, fundamental conceptual challenges underlie the difficulty in protecting the wilderness of Antarctica. First, since wilderness management is the management of human activities, it is in conflict with the received ideas of freedom of sovereign states, commercial entities, and individuals to exercise their activities on this continent that belongs to no one and hence, to everyone.

On top of this is added the cultural and linguistic diversity of 28 countries, each of which has a different interpretation, understanding, and value system for the concept of wilderness. For some of the AT countries, wilderness is considered as a rare commodity that is protected domestically under their national legislation, while in others, wilderness is an unused area of little value that should be conquered and utilized. Even among those who support wilderness protection, there are still differences in the interpretation of how much wilderness there is in Antarctica, and how much needs to be protected. The spectrum can span from, to quote Rolston (2002), the desire to "leave this wonderland place sacrosanct," to being satisfied with small, discrete units of protected wilderness, to considering that wilderness in Antarctica is abundant and does not require additional protection. In addition, national government representatives involved in the ATS are trained as lawyers or scientists and do not always have knowledge of, or interest in, wilderness protection or management. Last but not least, the coupling of wilderness with aesthetic and intrinsic values in the Madrid Protocol renders the implementation a complex concept that is even more challenging.

Conclusions

Although wilderness is a considerable value for an ASPA designation, it is important to note that the Madrid Protocol does not employ the International Union for Conservation of Nature (IUCN) protected area categories, nor has it created, even informally, analogous categories. So, with the absence of any definition of the concept within the ATS, it could be instructive to compare the situation in Antarctica with IUCN categories. ASPAs are very similar to IUCN's Ia "strict nature reserves," which are:

... strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring [<http://data.iucn.org/dbtw-wpd/edocs/PAPS-016.pdf>].

Many authors have argued that all of Antarctica should be defined as wilderness unless modified or degraded by human activities from within Antarctica (Bastmeijer and van Hengel 2009; Summerson and Riddle 2000; Codling 1997). This would be analogous to putting the rest of Antarctica, with the exception of ASPAs and areas that are modified by human activities, under IUCN's Ib "wilderness area" which:

... are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition [<http://data.iucn.org/dbtw-wpd/edocs/PAPS-016.pdf>].

While the absence of a clear definition certainly has its downsides, it is also reasonable to ask whether the Ib conception around this definition is a particularly good one in Antarctica. Indeed, there is a wider question about fitting Antarctic protected areas within the IUCN framework given a recent narrowing of its generic definition of what constitutes a protected area (Dudley 2008).¹ In relation to its Ib category, the IUCN "Primary objective" to "protect the long-term ecological integrity of natural areas that are undisturbed by significant human activity, free of modern infrastructure and where natural forces and processes predominate, so that current and future generations have the opportunity to experience such areas" seems appropriate enough. With the "Other objectives," however, things become potentially problematic (<http://data.iucn.org/dbtw-wpd/edocs/PAPS-016.pdf>):

- To provide for public access at levels and of a type which will maintain the wilderness qualities of the area for present and future generations;

¹ A protected area is: "A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values". "... only those areas where the main objective is conserving nature can be considered protected areas; this can include many areas with other goals as well, at the same level, but in the case of conflict, nature conservation will be the priority" (Dudley 2008).

- To enable indigenous communities to maintain their traditional wilderness-based lifestyle and customs, living at low density and using the available resources in ways compatible with the conservation objectives;
- To protect the relevant cultural and spiritual values and non-material benefits to indigenous or non-indigenous populations, such as solitude, respect for sacred sites, respect for ancestors, etc.;
- To allow for low-impact minimally invasive educational and scientific research activities, when such activities cannot be conducted outside the wilderness area.

In an area with (1) no indigenous or even conventionally resident population, (2) powerful commercial interests (fishing, tourism, biological prospecting), (3) contested and entirely unresolved territorial sovereignty issues, and (4) a thin, consensus-based international governance regime, there may be some challenges in Antarctica in ensuring that these elsewhere reasonable secondary objectives are not deployed to stymie effective wilderness protection.

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5. MONITORING AND PREDICTING CHANGE



Photo courtesy of the WILD Foundation

Climate Change and Ecosystem Services: The Contribution of and Impacts on Federal Public Lands in the United States

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Abstract—The Intergovernmental Panel on Climate Change (IPCC) (2007) reports a likely 2 °C to 4.5 °C temperature rise in the upcoming decades. This warming is likely to affect ecosystems and their ability to provide services that benefit human well-being. Ecosystem services valuation (ESV), meanwhile, has emerged as a way to recognize the economic value embodied in these services that is not currently reflected in markets. To contribute to better understanding of how U.S. conservation lands may be affected by climate change, we outline a method and preliminary estimates of the value of ecosystem services harbored or produced in abundance on those lands as well as how that value may change under climate change scenarios. We combine GIS analysis with the benefits transfer method to estimate potential global-warming-induced changes in the economic value of ecosystem services produced by U.S. conservation lands. Using conservative assumptions, the overall trend indicates that the majority of ecosystem services values decreases as temperature increases. While some ecosystem service values increase in the 2 °C scenario in several regions, the values markedly decrease in all but one region under the 4.5 °C scenario. These results are consistent with other major studies, such as the IPCC and the Cost of Policy Inaction reports, and indicate the important role of public conservation lands in providing ecosystem services and the need for policy action to avoid major economic losses were climate change to impair the health of those lands.

Introduction

The importance and contribution of healthy ecosystems to human well-being has gained increasing awareness and attention in recent years. Ecosystems are defined as “a dynamic complex of plant, animal, and microorganism communities and the nonliving environmental interaction as a functional unit” (MEA 2005). The components of ecosystems, such as soil and trees, interact in complex processes that create functions that produce environmental goods and services. Ecosystem services are the benefits that people obtain, directly and indirectly, from ecosystems. There are various types of ecosystem services, including provisioning services, such as food, water and timber; regulating services that influence climate, water quality, floods and diseases; supporting services, including soil formation, photosynthesis and nutrient cycling; and cultural services that provide recreational, spiritual and aesthetic benefits (MEA 2005). See table 1 for descriptions and examples of ecosystem services.

The Millennium Ecosystem Assessment (MEA), a comprehensive work of over 1500 scientists from across the globe, provides a global, integrated evaluation of the current changes and consequences occurring in ecosystems. Intended for use by decision makers and the public, the assessment highlights the vital role of ecosystems as they “contribute to human well-being and poverty alleviation” (MEA 2005). However, despite the wide-scale acknowledgement that ecosystems are fundamental to Earth’s life-support systems and vital to human welfare, the majority of the benefits yielded by ecosystem services are currently not accounted for in the economic system. As a partial result, their value is not equally weighted in decisions that directly impact their functioning and well-being (Costanza and others 1997; Straton 2006; Turner and others 2003).

For example, healthy forests slow water runoff and, when combined with sufficient flood plains, they protect against flooding. When forest cover is lost and flood plains are filled, flooding downstream is increased. If natural flood prevention functions (previously provided for free) are destroyed or diminished, then flood damage will exact costs on individuals and communities. Private individuals, firms, and governments will either suffer the costs of flood damage or they will have to pay for engineering structures and storm water infrastructure to compensate for the loss of ecosystem flood prevention. Without healthy ecosystems, taxpayers, businesses, and governments incur damage or costs to repair or replace these ecosystem services.

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

Table 1—Ecosystem functions, processes and services^a.

Functions	Ecosystem Infrastructure and Processes	Goods and Services (Examples)
<i>Regulating Services</i>		
Biological control	Population control through trophic-dynamic relations	Provides pest and disease control, reduces crop damage
Climate regulation	Influence of land cover and biologically mediated processes on climate	Maintenance of a favorable climate promotes human health, crop productivity, recreation, and other services
Disturbance prevention	Influence of ecosystem structure on dampening environmental disturbances	Prevents and mitigates natural hazards and natural events, generally associated with storms and other severe weather
Gas regulation	Role of ecosystems in biogeochemical cycles	Provides clean, breathable air, disease prevention, and a habitable planet
Pollination	Role of biota in movement of floral gametes	Pollination of wild plant species and harvested crops
Soil retention	Role of vegetation root matrix and soil biota in soil retention	Maintains arable land and prevents damage from erosion, and promotes agricultural productivity
Waste treatment	Role of vegetation and biota in removal or breakdown of nutrients and compounds	Pollution control/detoxification, filtering of dust particles through canopy services
Water regulation	Role of land cover in regulating runoff and river discharge	Provides natural irrigation, drainage, channel flow regulation, and navigable transport
<i>Supporting Services</i>		
Navigational services	Variety in nature with navigational value	Use of bodies of water, land and natural objects for movement, travel, trade, etc.
Nutrient regulation	Role of biota in storage and recycling of nutrients	Promotes health and productive soils, and gas, climate and water regulations
Soil formation	Weathering of rock, accumulation of organic matter	Promotes agricultural productivity, and the integrity of natural ecosystems
<i>Provisioning Services</i>		
Food	Conversion of solar energy into edible plants and animals	Hunting, gathering of fish, game, fruits etc.; small scale subsistence farming and aquaculture
Genetic resources	Genetic material and evolution in wild plants and animals	Improve crop resistance to pathogens and pests
Medicinal resources	Variety in (bio)chemical substances in, and other medicinal uses of, natural biota	Drugs, pharmaceuticals, chemical models, tools, test and assay organisms
Nursery function	Suitable reproduction habitat	Maintenance of commercially harvested species
Raw materials	Conversion of solar energy into biomass for human construction and other uses	Building and manufacturing, fuel and energy, fodder and fertilizer
Refugium function	Suitable living space for wild plants and animals	Maintenance of biological and genetic diversity (and thus the basis for most other functions)
Water supply	Filtering, retention, and storage of fresh water (e.g. in aquifers and snow pack)	Provision of water for consumptive use, includes both quality and quantity
<i>Cultural Services</i>		
Aesthetic information	Attractive landscape features	Enjoyment of scenery
Cultural and artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, painting, folklore, national symbols, architecture, advertising etc.
Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	Resources for fashion, handicraft, jewelry, pets, worship, decoration and souvenirs
Recreation	Variety in landscapes with (potential) recreational uses	Travel to natural ecosystems for ecotourism, outdoor sports etc.
Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions, etc. Use of nature for scientific research.
Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (i.e., heritage value of natural ecosystems and features)

^aAfter de Groot, et al. 2002.

Ecosystem Services Valuation

In a 1997 seminal work, Costanza and others (1997) argue that ecosystem services should be embodied within the complete economic worth of the Earth, and estimated that 17 ecosystem services produced or supported by 16 biomes are worth, on average, \$33 trillion annually, with most of this value accruing outside traditional markets. For comparison, global GNP was approximately \$18 trillion. Ecosystem Services Valuation (ESV) has since emerged as an ecological-economic approach to identifying and valuing the functions, goods, and services produced by ecosystems that benefit human populations but that are not currently traded, and therefore ascribed value, in markets (Costanza and others 1997). The approach is increasingly gaining recognition as a way to integrate the value of natural systems into an otherwise incomplete set of analyses and decision making processes (Foster and Gough 2005; Straton 2006). ESV attempts to capture the aspects of ecological impact that have previously gone unacknowledged in frameworks of costs and benefits that are used in development, land use, and other projects. Successful projects, such as the Payment for Ecosystem Services program currently being conducted on a national level in Costa Rica, highlight ESV as a valid and more complete approach to decision making on the basis that human well-being is entirely dependent on healthy ecosystems, for which there is no absolute substitution (May and others 2002; Pagiola 2002).

Climate Change and Federal Public Lands in the United States

ESV can contribute to better understanding of the potential costs of climate change and, therefore, can inform climate change mitigation and adaptation measures. Perhaps chief among these measures are policies and actions affecting how we manage public conservation lands where many ecosystem

services are harbored or produced in abundance. Therefore, in this study we apply ESV to examine the current contribution of U.S. public lands to ecosystem services value and the potential change in that value due to climate change.

Methods

We estimated the value of ecosystem services using a refined “benefits transfer method.” Benefits transfer is a way to estimate economic value for ecosystem services by transferring available information from studies already completed in one location and/or context to the area or context in question. In our refined version we calibrated every input as much as possible with specific information for our study. The overall process consists of four steps:

1. Allocate the U.S. Public Lands (defined as the land under the stewardship of the Forest Service, National Park Service, Fish and Wildlife Service, and Bureau of Land Management)—approximately 275 million hectares (ha) in all—to eight biomes (Open Water, Rock and Ice, Urban, Forest, Shrub/ Scrub, Grassland, Crops and Wetlands).

2. Establish indicators of baseline ecosystem health and baseline productivity for 24 ecosystem services (see table 1 for a list and description of these services).

3. Ascertain changes in biome health / ecosystem service productivity under two temperature change scenarios: +2 °C and +4.5 °C.

4. Apply dollar-value estimates of the value of the ecosystem services per hectare and multiply hectares by productivity (baseline and scenarios), and by dollars to generate estimates of total ecosystem service value.

These steps, described in more detail below, were repeated for each of fifteen large bioregions, for which we used National Land Cover Database “zones” as proxies (Multi-Resolution Land Characteristics Consortium (MRLC) 2008) (fig. 1).

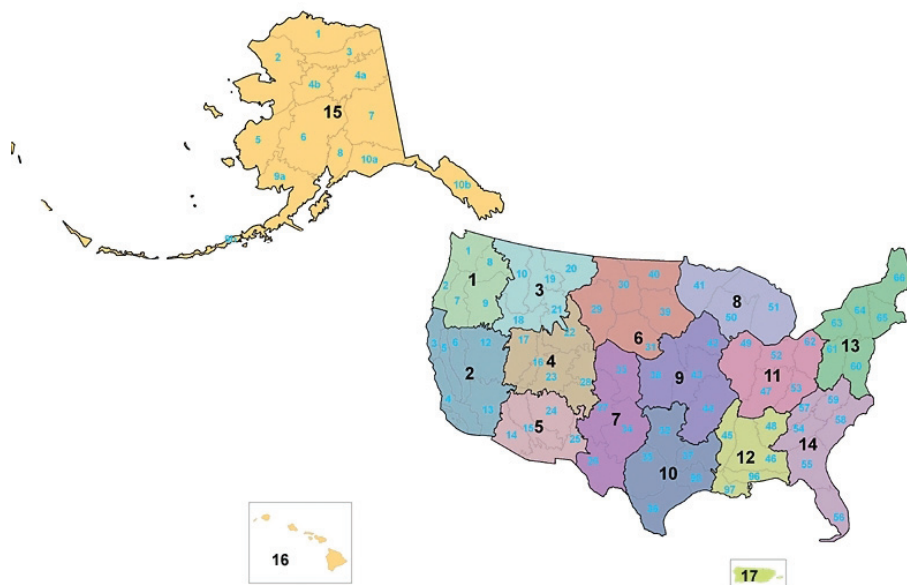


Figure 1—National land cover database zones (ecoregions) (MRLC 2008).

Allocation of U.S. Public Lands (Federal lands) to biomes was accomplished by overlaying the National Land Cover Dataset with a Federal lands layer. We retained attributes of each 30 m² (0.09 ha) grid cell to enable later identification of each cell according to the agency responsible for its management and whether it was designated wilderness.¹ The result was a map of the U.S. Federal lands classified by land cover type (21 classes), management agency (4 classes) and wilderness (yes/no). We then assigned each cell to one

or more of eight biomes: Open Water, Rock and Ice, Urban, Forest, Shrub and Scrub, Grasslands, Crops/Agriculture, and Wetlands.

For most land cover types, all hectares represented by the cells were assigned to one biome (table 2). The exceptions were Woody Wetlands, which was divided 50:50 among Forest and Wetlands biomes; and Herbaceous Wetlands, which was divided 50:50 among Grassland and Wetlands. Figure 2 depicts the resulting distribution of Federal wilderness and non-wilderness lands among these eight biomes. Wilderness has relatively more rock and ice, and less forest, grassland and shrub/scrub than non-wilderness lands.

¹ Due to the size of the Alaska (NLCD zone 15) data set, we used a 990 m² (approximately 98 ha) grid cell size.

Table 2—Allocation of land cover to biome.

NLCD Value	Land cover type	Biome							
		Open water	Rock and Ice	Urban	Forest	Shrub/ Scrub	Grass land	Crops	Wet lands
11	Open Water	1.00	-	-	-	-	-	-	-
12	Perennial Ice/Snow	-	1.00	-	-	-	-	-	-
21	Developed, Open Space	-	-	1.00	-	-	-	-	-
22	Developed, Low Intensity	-	-	1.00	-	-	-	-	-
23	Developed, Medium Intensity	-	-	1.00	-	-	-	-	-
24	Developed, High Intensity	-	-	1.00	-	-	-	-	-
31	Barren Land	-	1.00	-	-	-	-	-	-
32	Unconsolidated Shore	-	1.00	-	-	-	-	-	-
41	Deciduous Forest	-	-	-	1.00	-	-	-	-
42	Evergreen Forest	-	-	-	1.00	-	-	-	-
43	Mixed Forest	-	-	-	1.00	-	-	-	-
51	Dwarf Shrub (AK Only)	-	-	-	-	1.00	-	-	-
52	Shrub/Scrub	-	-	-	-	1.00	-	-	-
71	Grassland/Herbaceous	-	-	-	-	-	1.00	-	-
72	Sedge/Herbaceous (AK Only)	-	-	-	-	-	1.00	-	-
73	Lichens (AK Only)	-	-	-	-	1.00	-	-	-
74	Moss (AK Only)	-	-	-	-	1.00	-	-	-
81	Pasture/Hay	-	-	-	-	-	1.00	-	-
82	Cultivated Crops	-	-	-	-	-	-	1.00	-
90	Woody Wetlands	-	-	-	0.50	-	-	-	0.50
95	Emergent Herbaceous Wetlands	-	-	-	-	-	0.50	-	0.50

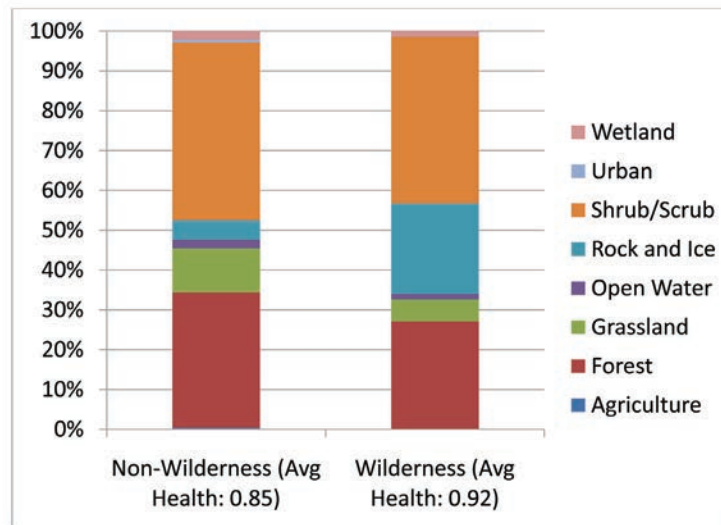


Figure 2—Distribution of federal wilderness and non-wilderness lands among biomes.

Next, ecosystem health and baseline ecosystem service productivity were established for each cell. We developed a proxy for ecosystem health based on a subset of the “indicators of wildness” previously used to identify the areas of the United States that are most wild (Aplet and others 2000). Using the methods of Aplet and others we combined the relative “Solitude,” “Remoteness,” and “Lack of Pollution” for the same 30-m cells used to assign land cover to biome.² These indicators served as reasonable proxies for the degree to which a given piece of land was free from anthropogenic influences that could degrade ecosystem function. Each indicator was measured on a 1-to-5 scale, which, when summed, produced a combined score between 3 and 15. Dividing each score by the maximum possible (15) produced an indicator of ecosystem health on a 0-to-1 scale. These health indicators were unique for each combination of ecoregion (zone), land cover type, biome, management agency and wilderness status. As noted in figure 2, the average health for areas within designated wilderness was slightly higher than for areas outside. Average health for each zone-biome combination is presented in table 3.

²Aplet et al. (2000) also use “Natural Composition,” “Unaltered Structure,” and “Uncontrolled Processes” to indicate wildness. We did not employ these here, each for its own reason. The authors measured Natural Composition using the same land cover data by which we assigned areas to biomes, thus the Natural Composition indicator did not add to our model. The measure for Unaltered Structure is the location of cities, roads and other infrastructure, and would serve much the same purpose as the Solitude and Remoteness indicators that we used—that is the impact of the presence of people and the primary infrastructure that connects them (roads)—as a proxy for decreases in ecosystem health. Finally, Uncontrolled Process was indicated by a lack of dams, and without additional indicators of the extent and location of fire suppression or other means by which humans control natural processes across many or at least more biomes, we were concerned that including Uncontrolled Process would bias our model and its results toward those ecosystem services produced or delivered by waterways.

Baseline ecosystem service productivity by biome was extracted or, in some cases, interpolated from Costanza and others (1997). These figures indicate the relative effectiveness of the various biomes for generating or harboring each of 24 ecosystem services. So, for example, Forests scored a 1 for the ecosystem service of climate regulation, meaning forests do as well as any biome could to regulate climate. The Shrub/Scrub biome, by contrast, only scored 0.8.

These biome-ecosystem service productivity ratios were then applied to each grid cell to produce an estimate of ecosystem service productivity for every combination of ecoregion (zone), land cover type, health, biome, management agency and wilderness status.

Because we were addressing federally managed lands, we made a further adjustment to our model to account for the fact that certain ecosystem service values would not be realized due to the protective nature of their management. Namely, because extractive activities are generally proscribed in wilderness areas, we set the productivity of designated wilderness to 0 for food and raw material production.

In step three, we employed results from the literature to adjust the baseline ecosystem health indicator to reflect possible changes in ecosystem service productivity for each biome/ecosystem service combination for two warming scenarios: a 2 °C and a 4.5 °C temperature increase. For example, the IPCC (2007) predicts that climate change will likely increase forest sensitivity to disturbances in both low and high warming scenarios, decreasing the productivity of regulating services. This reduction is anticipated to stem from increased flood occurrences as well as a potential invasion from the Southern beetle migrating north due to warmer temperatures. Thus, in the 2 and 4.5 °C scenarios, based on IPCC predictions, the new figures reflect declines in ecosystem productivity. Estimates were based on the degree of certainty of the IPCC predictions (usually low, medium, or high). The change in productivity is expressed as a percentage change from the baseline, or current conditions.

Table 3—Average health (weighted by area), by zone and biome.

Zone Name	Agriculture	Forest	Grassland	Open Water	Rock and Ice	Shrub/Scrub	Urban	Wetland
	----- Percent -----							
Alaska	64.98	93.85	95.81	94.84	94.54	96.14	73.47	94.79
Central & Southern West Coast	59.11	81.11	79.07	70.60	82.94	83.86	62.08	66.71
Central Midwest	56.77	67.07	63.48	55.03	70.39	66.74	63.80	55.59
Central Rockies	77.40	79.25	81.97	77.98	85.06	84.32	71.32	80.11
Great lakes	62.09	76.23	67.24	74.21	59.92	76.55	63.26	73.39
Midwest	54.34	55.56	53.24	52.16	55.60	55.34	51.86	52.42
New England & Mid-Atlantic	48.83	58.69	54.91	53.10	59.97	57.79	52.22	52.36
Northern Plains	80.25	76.77	84.47	78.70	80.25	84.37	74.59	80.75
Northern Rockies	77.87	84.76	87.19	80.85	86.92	86.26	71.41	85.03
Pacific Northwest	67.68	79.38	84.57	74.47	85.57	90.48	71.72	80.41
Southeast	54.30	56.84	60.03	64.76	53.07	55.52	49.60	69.03
Southwest	58.50	80.13	79.86	73.09	85.16	77.37	60.07	69.39
West Texas & Southern Plains	83.44	72.33	84.63	78.35	86.51	87.58	74.87	76.44
Western Gulf	66.74	63.24	61.87	67.38	73.42	66.25	59.12	69.30

Finally (step four), we extracted a range of minimum and maximum dollar values per hectare for the 24 ecosystem services from current literature. The Millennium Ecosystem Assessment (2005), IPCC: North America (2007), Field and others (2007), and the *Cost of Policy Inaction: The case of not meeting the 2010 biodiversity target* (Braat and ten Brink 2008) are our primary data sources. Values were also updated from the Costanza and others (1997) paper to 2009 dollars using the Consumer Price Index. In the interest of producing only the most conservative possible estimates, we used only the lower end of the range of dollar-per-hectare estimates.

Multiplying hectares per biome (from step one) by ecosystem service productivity per biome and then ecosystem service value per hectare yielded an estimate of the total value for each ecosystem service in each NLCD zone.

We repeated the baseline ecosystem service value calculation using the percentage change in productivity (from step four) to adjust baseline productivity, so, our formula becomes:

$$\begin{aligned} & \text{hectares per biome (from step one)} \\ & \text{times } \textit{baseline} \text{ ecosystem service productivity per} \\ & \quad \text{biome and ecosystem service} \\ & \text{times percentage change in productivity for the warm-} \\ & \quad \text{ing scenarios} \\ & \text{times ecosystem service value per hectare.} \end{aligned}$$

This calculation was repeated for each ecoregion (NLCD) zone, biome, and ecosystem service for both the 2 °C and 4.5 °C scenarios to yield dollar-value estimates for each ecosystem

service for each scenario. Comparison of the results for each scenario yielded an estimate of the cost of inaction on climate change, at least as translated through the ecosystem service value of U.S. Federal conservation lands.

A sensitivity analysis was also performed to determine the percentage of the value of individual ecosystem services that contributed to the total value. This enabled a refined understanding of which inputs are most influential in the total value figures (see table 4 for an example of the sensitivity analysis for zone 1).

Results and Discussion

Using conservative estimates for the values, the overall trend indicates that the majority of ecosystem services values decrease as temperature increases. While value increased for several individual ecosystem services in the 2 °C warming scenario, overall ecosystem service value declined in all zones by a total of \$14.5 billion per year. In the 4.5 °C scenario, the value of all ecosystem services as well as overall value in each zone also declined, with total potential loss being \$36.1 billion (see figs. 3 and 4 and table 5 for a summary by bioregion; see fig. 5 and table 6 for a summary by ecosystem service). These results are consistent with other major studies such as the IPCC and the *Cost of Policy Inaction*. In addition, they indicate the important role of public conservation lands in providing ecosystem services and the need for policy action to avoid major economic losses were climate change to impair the health of those lands.

Table 4—Sample of the sensitivity analysis, for the 4.5 °C change scenario in Zone 1.

	Open Water	Rock & Ice	Urban	Forest	Shrub / Scrub	Grassland	Agriculture	Wetlands
	-----Percent-----							
Gas regulation	1	0	0	1	1	0	0	1
Climate regulation	27	29	0	41	32	11	0	55
Disturbance prevention	0	0	1	0	0	0	0	0
Water regulation	29	27	0	41	0	0	0	0
Water supply	0	0	0	0	0	0	0	0
Erosion control	0	0	0	0	0	0	0	0
Soil formation	0	0	0	0	0	0	0	0
Nutrient regulation	9	0	0	0	4	18	4	19
Waste treatment	2	0	0	0	0	1	0	8
Pollination	0	0	0	1	1	7	0	2
Biological control	0	0	0	0	0	1	0	0
Refugium function	1	1	0	1	0	1	0	1
Nursery function	0	0	0	0	0	0	0	0
Food	17	41	0	9	58	31	90	5
Raw materials	0	0	0	1	0	0	1	0
Genetic resources	0	0	0	1	0	0	0	1
Medical resources	0	0	0	0	0	0	0	0
Ornamental resources	0	0	0	1	0	1	0	0
Aesthetic information	0	1	1	0	0	2	0	1
Recreation	5	0	31	0	0	1	0	1
Cultural and artistic information	1	1	6	1	0	0	0	2
Spiritual and Historic information	0	0	0	0	0	0	0	0
Science and education	0	0	1	0	0	0	0	0
Navigational services	8	0	60	3	3	25	5	2
Total	100	100	100	100	100	100	100	100

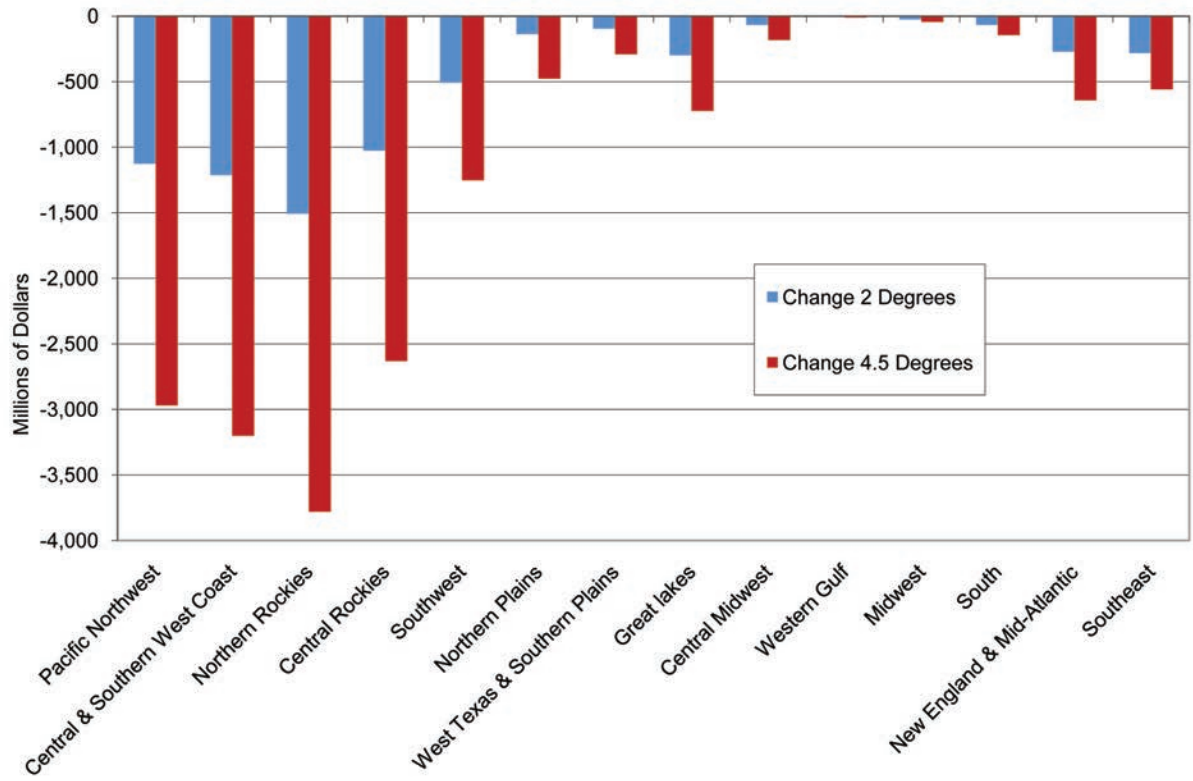


Figure 3—Change in ecosystem service value of U.S. Federal lands under 2 and 4.5 °C warming scenarios, conterminous United States, by region.

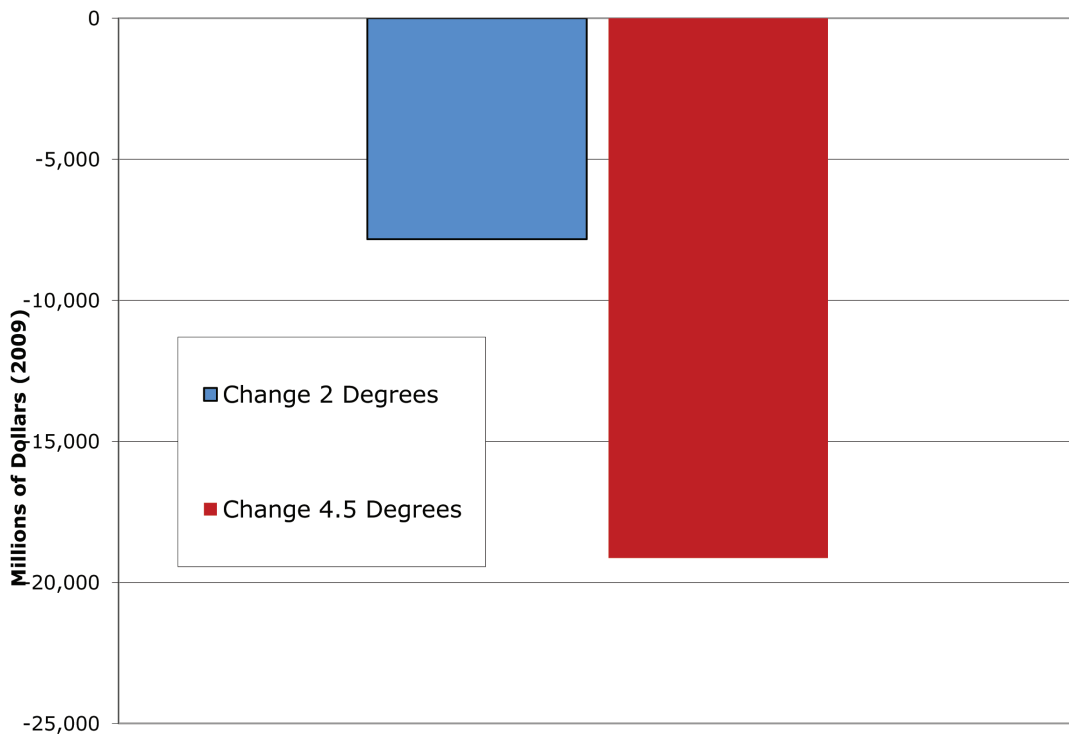


Figure 4—Change in ecosystem service value of U.S. Federal lands under 2 and 4.5 °C warming scenarios, Alaska.

Table 5—Ecosystem services value of U.S. Federal lands: baseline and under 2 and 4.5 °C warming scenarios, by region.

Region (NLCD Zone)	Baseline \$millions	Change 2 °C \$millions	Change 4.5 °C \$millions
Pacific Northwest	20,748	(1,125)	(2,970)
Central & Southern West Coast	32,414	(1,212)	(3,202)
Northern Rockies	25,426	(1,507)	(3,782)
Central Rockies	33,026	(1,026)	(2,632)
Southwest	14,879	(507)	(1,252)
Northern Plains	3,735	(138)	(477)
West Texas & Southern Plains	3,133	(95)	(292)
Great lakes	4,048	(298)	(723)
Central Midwest	2,169	(66)	(183)
Western Gulf	101	(5)	(9)
Midwest	1,230	(26)	(44)
South	1,173	(67)	(144)
New England & Mid-Atlantic	1,908	(272)	(643)
Southeast	3,215	(281)	(559)
Alaska	94,202	(7,827)	(19,132)
Total:	241,407	(14,452)	(36,044)

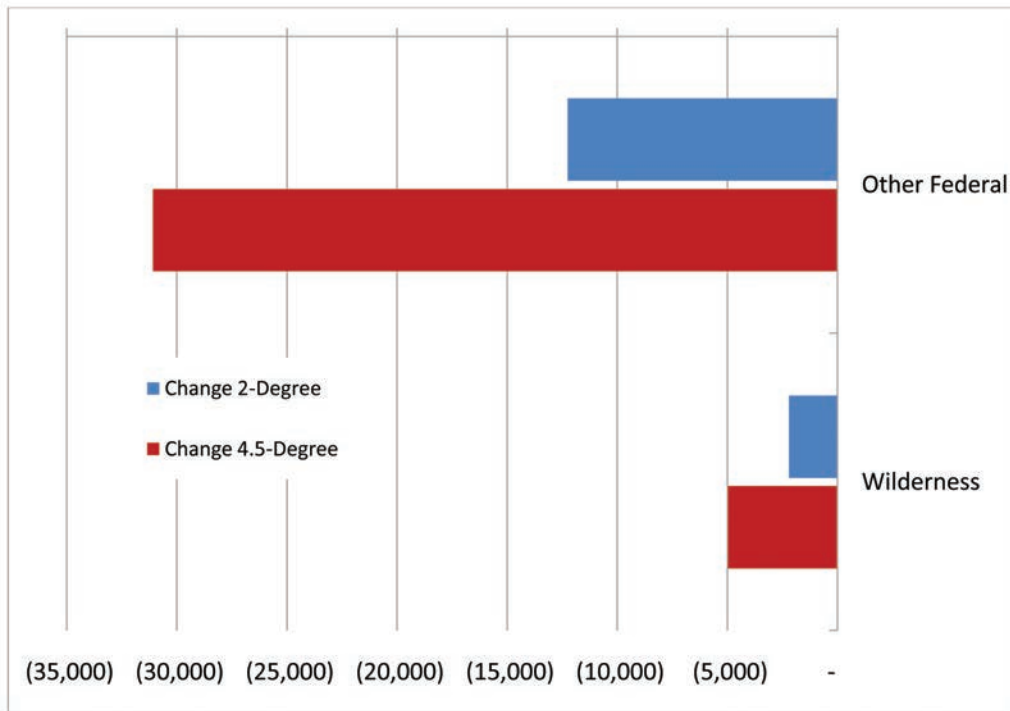


Figure 5—Change in ecosystem service value of U.S. Federal lands under 2 and 4.5 °C warming scenarios, by service.

Table 6—Ecosystem services value of U.S. Federal lands: baseline and under 2 and 4.5 °C warming scenarios, by service.

Ecosystem Service	Baseline \$millions	Change 2 °C \$millions	Change 4.5 °C \$millions
Cultural			
Aesthetic information	713	11	(82)
Cultural and artistic Information	1,438	10	(157)
Ornamental resources	565	8	(59)
Recreation	744	(15)	(64)
Science and education	209	(4)	(22)
Spiritual and historic information	125	1	(13)
Provisioning			
Food	79,697	(2,449)	(7,864)
Genetic resources	649	37	(54)
Medical resources	382	13	(34)
Nursery function	276	2	(29)
Raw materials	417	27	(34)
Refugium function	1,357	50	(128)
Water supply	40	(2)	(11)
Regulating			
Biological control	87	(6)	(12)
Climate regulation	90,238	(7,337)	(14,929)
Disturbance prevention	32	(2)	(6)
Erosion control	134	(12)	(25)
Gas regulation	1,256	(98)	(201)
Pollination	2,524	(183)	(370)
Waste treatment	1,063	(64)	(163)
Water regulation	42,528	(4,894)	(9,963)
Supporting			
Navigational services	8,822	358	(827)
Nutrient regulation	7,976	87	(990)
Soil formation	136	12	(8)
Total	241,407	(14,450)	(36,045)

For those ecosystem services values that first gained (at 2 °C warming), then lost (at 4.5 °C), it is plausible that the functions tipped. Nutrient regulation and soil formation, for example, showed a substantial increase in value under the 2 °C scenario, as one might expect with warmer conditions and longer periods during which plants, microbes and other biota can effectively fix nutrients, break down leaf litter and other organic material, and build soil. But under the 4.5 °C scenario, that gain was reversed, perhaps as some other process already impaired by climate change—water supply, for example—limited nutrient cycling and soil formation capacity. Considering such interactions in a dynamic context, as opposed to the simple, static model presented here, would shed additional light on where and how such tipping points might operate.

One of the biggest factors behind regional differences in ecosystem service value (and its potential loss) from the Federal estate is obviously the size of the Federal estate in a given region. Alaska, for example, is in a class (and in a graph) by itself (fig. 4), and western regions generally have more Federal land and generally more total ecosystem service value at risk due to climate change. But other factors are important as well, especially the particular mix of biome and initial land health. Biome is important in the model because it is linked to the production of individual ecosystem services. Land health is important, because for

a given biome, the healthier the hectare, the higher the productivity. Regions with relatively more Federal land in forests—a biome with high potential productivity—or where more land is in a natural or undisturbed state provide more (and could lose more) ecosystem service value than would be indicated by Federal land area alone.

The same sort of phenomenon can play out as one considers the wilderness status of these areas. Designated wilderness represents just 15 percent of the Federal land included in this study. And, recall from figure 2 that relatively less designated wilderness is in forests, grasslands, and other highly productive areas. Thus, one might expect wilderness areas to produce disproportionately less ecosystem service value now and risk losing relatively less value under the climate change scenarios. The first of those assumptions appears to be true in that wilderness areas represent just 10.4 percent of baseline ecosystem service value of the Federal estate. This is due to the legal exclusion of the realization of some of the more valuable ecosystem services from wilderness areas, not because those values are not present.

The second result, however, is not evident, since wilderness areas could lose 8.8 and 19.8 percent of their value under the 2 and 4 °C climate change scenarios, respectively, while non-wilderness areas stand to lose just 5.7 and 14.4 percent of their ecosystem service value in those scenarios (see fig. 6). We infer that this is due to the greater relative

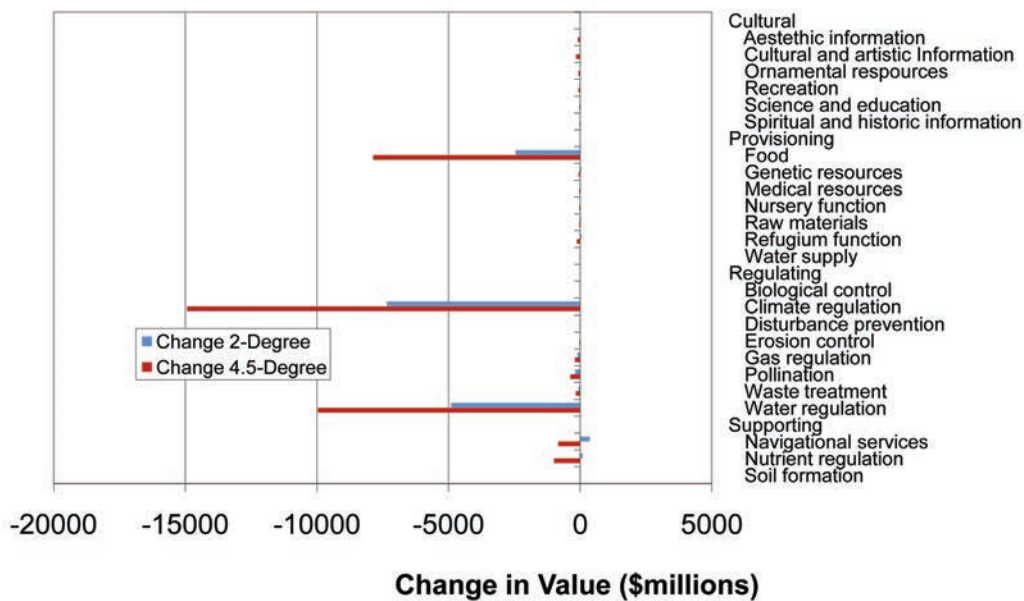


Figure 6—Change in ecosystem service value of U.S. Federal lands under 2 and 4.5 °C warming scenarios, for wilderness and non-wilderness lands.

health of wilderness areas at the outset, which produces a larger change in productivity due to climate change.

Clearly, action on climate change is necessary to ensure continued ecosystem services for and from all Federal lands (not to mention private, state, and other lands). Within the Federal estate, the results suggest that areas managed for their wilderness character are particularly important, both because they provide a model for healthy, productive ecosystems that more intensively managed lands might emulate, and because they could have more to lose from climate change.

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How Do You Know Things Are Getting Better (Or Not)? Assessing Resource Conditions in National Parks and Protected Areas

James D. Nations

Abstract—The National Parks Conservation Association’s Center for State of the Parks uses an easily explained, fact-based methodology to determine the condition of natural and cultural resources in the United States National Park System. Researchers assess and numerically score natural resources that include water quality and quantity, climate change impacts, forest fragmentation, wildlife communities, non-native species, poaching, and land use history. Evaluated cultural resources include archaeology, historical structures, relations with indigenous communities, and cultural landscapes. By using the same methodology to determine resource conditions in every park, the team is able to define systemic threats to the National Park System, prompting policy and management changes to counter them. The author explains the assessment process, outlines the lessons learned during the first 80 park assessments, and describes how the methodology could be adapted for use in parks and wilderness areas in other regions of the world.

Introduction

Over the past decade, the National Parks Conservation Association has developed and applied a methodology to assess the condition of natural and cultural resources in national parks of the United States. The following pages discuss how the methodology works, report our research findings, and suggest ways the methodology might be adapted for protected area systems and wilderness areas in countries other than the United States.

The National Parks Conservation Association was founded in 1916 by the first director of the United States National Park Service, Stephen Mather, who realized that national parks should have not only a government agency to protect them, but also a citizens’ group independent of changing administrations and focused exclusively on promoting the national parks. Using his own funds, Mather helped establish the National Parks Conservation Association 90 years ago.

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Because NPCA is an independent, non-profit organization, we can lobby the U.S. Congress to improve park protection and to increase funding for the National Park System.

One of the several departments of NPCA is the Center for State of the Parks, which carries out scientific and historical research on U.S. national parks. We direct the results of our research to decision-makers in the National Park Service, the U.S. Congress, and to state and local governments. Through the media, we also inform the American public about how they can help counter threats to the national parks.

Overall, 53 percent of U.S. national parks lands are classified as wilderness areas—around 44,500,000 acres of the total 84,000,000 acres (www.wilderness.nps.gov). If we consider that two-thirds of America’s 392 national park units are cultural or historic sites, most of them relatively small when compared to nature-dominated parks, it becomes clear that wilderness areas are a major geographical feature of the U.S. National Park System.

Assessment Process

If your goal is to protect national parks, wilderness areas, or any other protected areas, the first question you have to ask is, “What condition are these areas in right now?” To answer that question for the United States National Park System, NPCA’s Center for State of the Parks created a standardized research methodology that uses 214 metrics to assess the condition of natural and cultural resources in individual national park units. State of the Parks assessments measure natural resources by analyzing the condition of each park’s plant and wildlife species, the condition of air quality, water quantity and water quality, and the impacts of environmental stressors such as habitat loss, forest fragmentation, poaching, and the impacts of park visitors. We score these individual elements numerically by assigning one of four possible classifications:

- 0 The threat is ubiquitous, chronic, and permanent
- 1 The threat is widespread, or uncontained, or multiple
- 2 The threat is isolated and/or limited and singular
- 3 No threat

We also take into account the absence of data when that occurs.

- No data to determine the degree of threat (ND)
- Not applicable (N/A)

Using this scoring system, if natural resources are not seriously threatened, they receive higher scores. A serious resource threat results in a lower score. As the researchers

roll up the individual scores into subcategories and then into an overall rating, they establish a composite score for the park's natural resources that can be labeled critical, poor, fair, good, or excellent.

The methodology for cultural resources operates in much the same fashion, looking at factors such as the condition of historic structures and the extent of archaeological research. We also evaluate the park's relationship with living tribal communities or traditional populations in or around the park. We score cultural resources on a finer numerical scale of 0 to 10, but at the end of the analysis, the park's cultural resources also receive an overall classification of critical, poor, fair, good, or excellent.

Our resource assessments are carried out by a team of NPCA ecologists and historians, or by ecologists and historians we hire for specific studies. The researchers interview National Park Service staff, analyze scientific reports, read the parks' resource reports, and walk the ground with park staff to view resource conditions on the ground. The resulting reports identify threats and provide a baseline analysis that allows the park staff and other researchers to track changes through time.

We begin each park resource assessment with a workshop with park staff and the NPCA research team. During the workshop, the park staff discusses the threats the park is facing, and they point the researchers to publications and information that will aid them in documenting resource conditions and threats. Following the workshop, the NPCA researchers spend four months or more absorbing material provided by park staff and university researchers, researching published scientific and historical literature, and talking with specialists in universities or park friends groups. The NPCA researchers complete two detailed technical studies—one on natural resources, one on cultural resources—that may be 25 to 70 typed pages long. Working with the original field researchers, staff at NPCA's Center for State of the Parks then use the two technical studies to produce numerical scores for each of the resource metrics. The key point here is that rigorous analysis underlies the simple scoring system and resulting findings.

The Center's writers and editors subsequently merge the two technical studies into a shorter, final report (called a public document), which is designed to provide a concise overview of the park's resource conditions for political decision-makers and the general public. We print the finalized public documents with maps and photographs in bound booklets and distribute them to the U.S. Congress, the National Park Service, and local communities and politicians. NPCA's communications team works with newspaper, radio, and television journalists to place stories about the parks in regional and national media.

The raw data from the assessments are stored in the Center for State of the Parks field office in Fort Collins, Colorado. The resulting database allows us to analyze the condition of park resources by region, by type of ecosystem, and by the frequency and severity of threats reported.

Findings

By Fall 2009, the Center for State of the Parks team had completed resource assessments for 80 of the 392 units of the National Park System. This represents a 20 percent sample

of all national park units in the United States. The 80 park units do not form a random sample, but a representative sample based on balancing the type of park unit (national seashore, national battlefield, national historic sites), visitation numbers, geographic location, ecosystem type, and the period of history represented. Because we use the same methodology and the same questions to evaluate resource conditions in all park units, we can survey data from the individual park reports to obtain an estimate of resource conditions in the National Park System as a whole. This undertaking is the first ever system-wide field assessment of U.S. national parks, based on actual ground level data.

Based on the combined information from the 80 individual park assessments we've completed, we are beginning to get a composite picture of the most serious threats in the U.S. National Park System. According to this analysis, the five most serious threats to natural resources and cultural resources are as follows:

Natural Resources (n = 59 parks)

1. Habitat loss and/or loss of species
2. Non-native plant species
3. Adjacent land development (oil, gas, logging, mining)
4. Fragmentation of habitat (roads, previous land use)
5. Water contamination

Cultural Resources (n = 77 parks)

1. Gaps in research and documentation of cultural resources
2. Incomplete archaeological surveys
3. Insufficient funding and staff to protect cultural resources
4. Inadequate preservation of historic structures
5. Inadequate museum/archival storage

One of our major conclusions is that the staff of the U.S. National Park Service, while working diligently to hold the line against resource loss, are limited in how much they can achieve due to finite funding and staffing. There are not enough park staff as desired by many parks to combat invasive species, fix land use abuses that predate establishment of the parks, provide law enforcement and maintenance, and interpret the parks for visitors. For example, some historic structures in the parks are deteriorating due to inadequate funding to repair them and limitations on staff to protect them from the elements. Structures like the historic Spanish mission of San Antonio Missions National Historical Park in San Antonio, Texas, are cracking and falling into disrepair, a future that could be changed with additional funding and workers to maintain them.

Some of the problems that U.S. national parks face can be solved through increased funding and additional staff, and NPCA continuously lobbies Congress to provide these. The need for funding is especially crucial for cultural resources, where the application of added funding and staff could begin to show results very quickly.

At the same time, an increasing number of serious threats to America's parks cross into park boundaries from the outside world. Invasive, non-native species, air and water pollution, and climate disruption are threatening natural ecosystems in the parks and damaging the visitor experience. U.S. national parks are increasingly threatened by the development of adjacent lands for oil and gas development,

mining, housing and commercial development, and even landfills.

As an example, the territorial outline of Olympic National Park in Washington State (95 percent of which is declared wilderness area) is clearly visible from the space shuttle, because the adjacent national forest lands have been clear-cut flush with the park's legal boundary, leading to the degradation of native forest along the edges and changes in the prevalence of some wildlife species within the park.

NPCA's research indicates that almost half of our national park units have experienced a loss of habitat and the elimination of one or more animal species. Most of these parks have lost a key species or top predator, such as wolves or mountain lions. While some native species are declining, other species are becoming too numerous, and their overpopulation threatens entire park ecosystems. For lack of natural predators such as wolves, populations of native white-tailed deer are out of hand in many eastern parks. In Rocky Mountain National Park in Colorado, native elk roam the park at will and overgraze the ecosystem without fear of their natural predator, the wolf.

Invasions of non-native species are damaging park ecosystems by killing or displacing native plants and animals. Seven million acres of parkland have been invaded by non-native species, especially Asian insects and African grasses. Hemlock woolly adelgids, non-native pests originally from Japan, are killing thousands of hemlock trees in Shenandoah National Park and Great Smoky Mountains National Park, much the way the chestnut blight wiped out between three and four *billion* chestnut trees in America's eastern forests during the early 20th century.

Controlling non-native species in our national parks is partly a function of preventing potentially invasive plants and animals from entering the country. But once the organisms exist within our boundaries, controlling them is a function of park staff and money.

Systemic Problems

A 1999 study of the 89 terrestrial ecoregions of the United States found that only 52 percent were well represented within the National Park System (Sierra Club 1999). Some of the missing ecological regions are protected in National Forests or National Wildlife Reserves, but this implies that protection might be increased through cooperation among these agencies. Since 2001, only a handful of new park areas have been added to the National Park System—most of them small units representing important historic events.

In the face of climate disruption, we also need to create biological corridors. We have been effective at preserving park boundaries, but as climate change shifts plant and wildlife habitat, organisms are beginning to move upward and northward. We need to know where they will likely go, who owns the land there, and what needs to be done to ensure they survive. Creating corridors and connectivity between protected areas is an effective adaptation to this problem.

Conclusions

The bottom line is that adequately funding and staffing the National Park System will help solve many of the

current and future threats facing America's national parks—for example, shoring up historic structures, controlling invasive species, and preventing poaching and vandalism. But solving the problems that enter the national parks from the outside world requires not just funding for research and staff, but also years of policy work and education. It requires a paradigm shift in park relations with neighbors and with society at large. Our goal within the Center for State of the Parks and NPCA in general is to help supply the information and education that can help create that needed change.

In a nutshell, studying the condition of natural and cultural resources in a national protected area system allows us to establish priorities for addressing the most serious threat, deciding which parks to focus on, and deciding what needs to be done first. A 2008 global study by the University of Queensland, Australia, and the United Nations Environmental Program World Conservation Monitoring Centre discovered 40 different methodologies in use for assessing the effectiveness of protected areas (UNEP 2009). Of these 40 programs, only six included cultural resources as well as natural resources. This is disconcerting, considering the growing number of World Heritage Sites and the need to monitor and protect the planet's globally significant cultural sites as well as natural areas. NPCA's Center for State of the Parks methodology was the only one of the 40 studies focused on the U.S. National Park System, which is the largest and best-funded of the park systems on the planet.

Our study indicates that, despite the fact that the U.S. park system is the best funded protected area system in the world, insufficient staff and funding are the most frequently reported threats to U.S. National Parks. Personal experiences and reports from colleagues around the world lead us to believe that lack of staffing and funding is also one of the most common problems in the rest of the world's protected areas. Ironically, the U.S. National Park Service budget—in Fiscal Year 2009, around \$2.9 billion—is almost as much as the total amount of government spending on protected areas in the rest of the world—\$3.2 billion (Martin 2004).

Under its newly elected administration, the U.S. is gradually ramping up the amount of funding going into the National Park System, adding more than \$100 million additional dollars per year. So the message is that persistence pays off. Having solid data to back up your calls for additional funding and staffing helps build your case; and knowing what the priority threats are to protected areas and protected area systems can help you use new funding wisely.

What are the lessons we've learned in carrying out resource assessments of 80 U.S. national park units?

- Most parks like having their story told to the outside world and appreciate being able to provide feedback on that story, but park staff don't like being graded and don't like being scored.
- Staff at smaller parks appreciate having someone pay attention to them, while staff at larger parks complain that the resource assessments take too much time.
- Park staff in some park units point out that they appreciate being brought together to talk with one another about resource issues, something they otherwise don't always have time to do.
- A park's budget—and the Park System's budget—is the key factor in resource protection. Even invasive species can be controlled with sufficient money and staff.

What lessons have we learned that might be of use in other countries?

- Keep the methodology as simple as possible, while remaining scientifically accurate.
- Communicate with park staff and involve them in the development of the methodology and process.
- Explain the linkages between threats, trends, and constraints, rather than just the final scores. Park specialists will appreciate seeing the big picture.
- Make the evaluation process clear and transparent.
- Communicate your findings.
- Make clear, concrete recommendations.
- Use a standardized methodology that allows you to compare parks and build a picture of the park system as a whole.

Given these lessons learned, we invite researchers from other countries to examine the complete methodology on our website and adapt it, cannibalize it, or change it to fit the needs of your parks and wilderness areas. To examine the complete methodology, go to npca.org/stateoftheparks.

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Monitoring Recreational Impacts in Wilderness of Kamchatka (Example of Kronotsky State Natural Biosphere Preserve)

Anya V. Zavadskaya

Abstract—This paper describes an assessment and monitoring program that was designed and initiated for monitoring recreational impacts in a wilderness in Kamchatka. The framework of the recreational assessment was tested through its application to a case study conducted during the summers of 2008 and 2009 in the Kronotsky State Natural Biosphere Preserve (Kamchatka peninsula, Russia). A detailed assessment of different components of natural complexes of the Preserve and the maps of their ecological conditions showed that some sites had been highly disturbed. Management implications for Caldera of Uzon volcano and other significant geothermal areas that allow any type of recreational activity were explored.

Keywords: recreational impacts, monitoring, protected areas, wilderness, Kamchatka

Introduction to a Problem

Kamchatka peninsula is comparable to the best regions in diversity and wealth of recreation resources. Protected areas (PAs), commonly considered to be wilderness, cover over 14 percent of the surface of the region (fig. 1) and provide a wide range of recreation opportunities—from bathing in hot springs and bear watching to kayaking and scientific tourism. Most of these areas have extremely fragile ecosystems (geothermal, tundra, and alpine ecosystems); therefore, current managers are faced with the problem of recreational impacts manifesting in the loss of vegetation, soil erosion, associated aesthetic degradation, etc.

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Different types of protected areas in Russia, particularly in Kamchatka, have peculiarities that influence development of recreation and recreational impacts management on these territories. For instance, Zapovedniks or Preserves (strictly protected federal PAs) have the main goal to conserve natural resources and only educational and scientific ecotourism in small groups is allowed there. These PAs have scientific staff that can develop and implement recreational monitoring programs. On the other hand, regional protected areas—mainly nature parks that were developed specifically to provide different types of nature-based recreation and that receive the most recreational pressure in Kamchatka—often don't have any programs or staff for providing recreational monitoring or information for managing recreational impacts.

In the last few years, the number of tourists traveling to Kamchatka has grown significantly (fig. 2). On one hand, this emphasizes the attractiveness of the region, but on the other hand it reveals very serious problems. The rapid growth of tourism occurs under conditions of absence of effective tools and programs for recreational management at most destinations. In such situations, the development of recreation monitoring programs to provide assessment of the state of conservation resources and the severity of threats and measures of success in management responses (Buckley and others 2008) becomes very relevant to Kamchatka environmental practice.

Short Literature Review

In the Russian traditional works devoted to recreational impacts and the practice of wilderness management, a normative approach is applied for solving the problem of resource conservation when the area is used for different types of recreation. This approach focuses on the search for precise quantitative standards for carrying capacity or the level of use, e.g., the “safety” length of a route, correlated with the total land area, or the number of visitors per day (per month, season, year) that can be received on the route without damage to nature. However, studies by some authors show that there is no direct relationship between the amount of use and level of impact, especially in protected areas with established trail systems (Chizhova 2002). Although the term carrying capacity suggests that the number of users is the main concern, the carrying capacity is also a function of other use conditions, such as type of use, timing and location of encounters between visitors, and visitor behavior (Stankey and

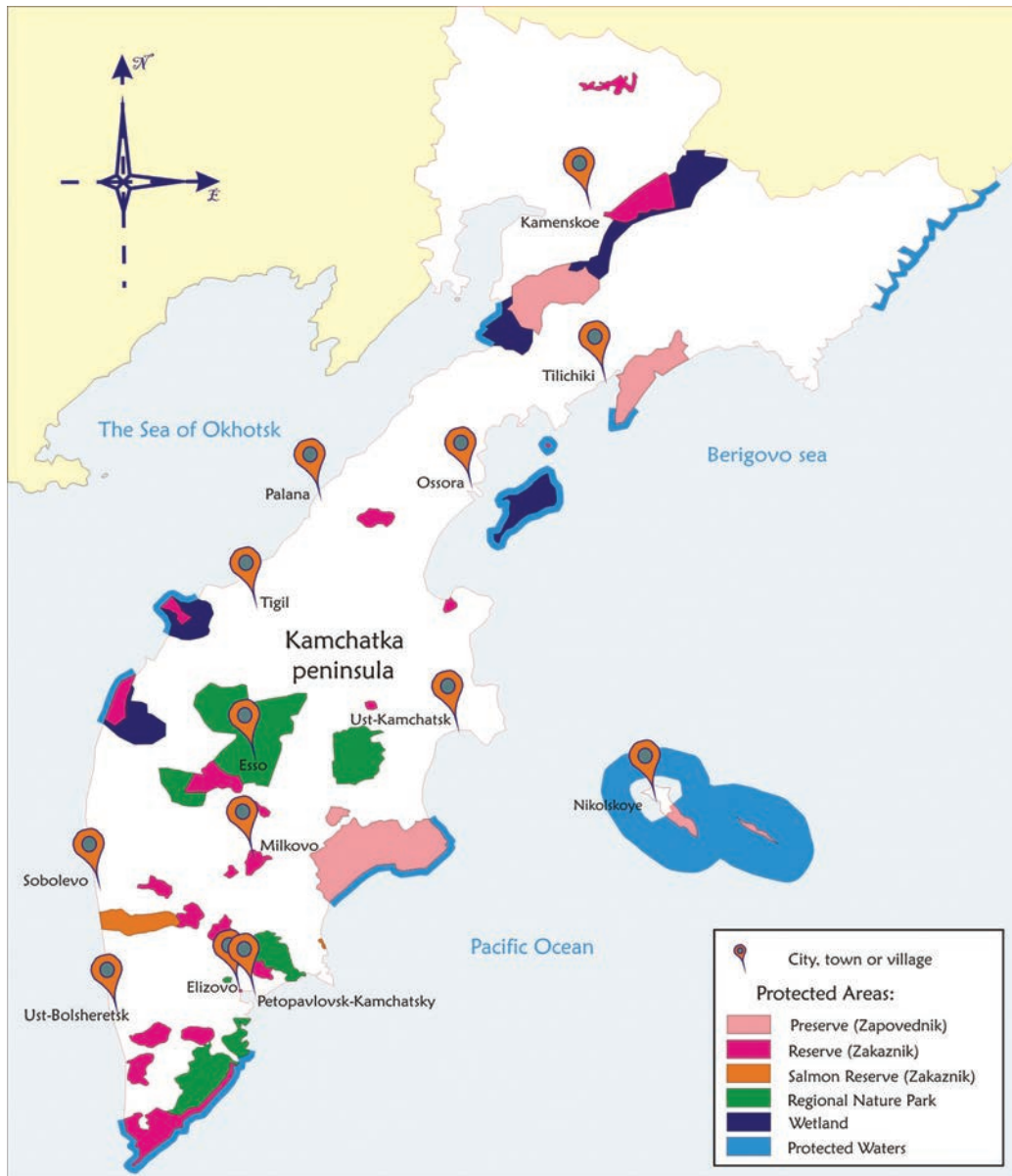


Figure 1—Protected areas of Kamchatka.

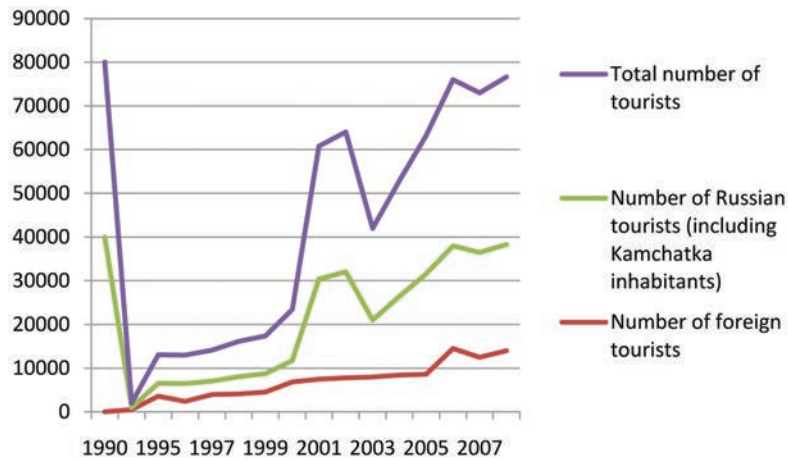


Figure 2—Annual numbers of tourists coming to Kamchatka.

Manning 1986). Therefore, it is necessary to turn to another approach that is based not on the establishment of allowable visitor numbers but on the long-term planning and analysis of a recreation opportunity spectrum, forms and types of recreation activities, and different models for development of recreation (Chizhova 2007). This approach is realized in the LAC (Limits of Acceptable Change) framework (Eagles and others 2002; Lucas 1985; Stankey 1998; Stankey and others 1984; Watson and Cole 1992), which was developed to address the issue of recreation carrying capacity and to manage recreation impacts (Cole and Stankey 1998; Stankey and McCool 1984).

The initial impact assessment and monitoring programs provide an essential element for the LAC recreation resource planning and management framework (Marion 1998). They offer managers the most objective tools for setting objectives for natural conditions and processes, and evaluating the extent of human influence and subsequent results of implemented actions (Cole 1983, 1989; Marion 1991). The capabilities and management utility of such programs are attracting increased international attention due to dramatic expansions of ecotourism worldwide (Marion 1995).

The LAC methodology and associated programs for recreation monitoring have already been applied and effectively used in some Russian natural areas (Chizhova 2007; Ivanov and Labutina 2006; Ivanov and others 2006; Kalikhman and others 1999). This paper describes our attempt to design and implement such a program for Kronotsky State Natural Biosphere Preserve. It discusses one aspect of a recreation monitoring program: the monitoring of resource conditions. The framework for recreational impact assessment and monitoring was tested through its application to a case study, conducted during the summer of 2008 in Uzon-Geyzer region of the Preserve.

The overall objective of this case study was to inventory all camping areas and trails along the route to assess the existing recreation impact and establish a network of key sites for subsequent long-term impact monitoring. This paper discusses the preliminary findings of our assessment work. Future evaluation of these sites will allow us to examine changes in campsite and trail conditions over time and attempt to relate these trends to changes in the amount, type, and distribution of visitor use.

Study Area

Kronotsky Preserve is recognized for its importance in the conservation of the Earth's natural resources. It has Biosphere Reserve status and is in the List of World Heritage sites. The Preserve is located in the eastern part of Kamchatka and is known for various types of volcanic activity: active and extinct volcanoes, geysers, and thermal sources. It contains such unique nature monuments as the Valley of Geysers, the Caldera of Uzon Volcano, the Death Valley, Burlyaschiy (Bubbling) Volcano, Lake Kronotskoye, the Semyachiksky Estuary, glaciers of the Kronotsky Peninsula, and the unique Sakhalin fir grove.

The area in our study lies in the Uzon-Geyzer region of the Preserve and is located along the former all-Union tourist route to the Valley of Geysers through Burlyaschiy Volcano and the Caldera of Uzon Volcano (fig. 3). The region

is a volcanic-tectonic depression with heights from 350 m to 1000 m above sea level and has vulnerable types of vegetation coverage: swamps and areas of geothermal communities, lichen, lichen-shrub and shrub tundra, alder elfin wood, and mountain pine.

The development of unplanned and unmanaged recreation in the 1960s and the operation of the all-Union tourist route from 1962-1976 produced a heavy negative impact on different components of natural complexes along the route. The annual visitation of the route was only about 3,000 persons per year; however, given the conditions of the extremely fragile ecosystems of the region and the absence of any recreational planning and visitor management, this has become a threat to the safety of the unique natural features.

The route has been closed and nowadays the tourist activity in the Preserve is concentrated in the Valley of Geysers and in the Caldera of Uzon Volcano, in strict compliance with the requirements for preserving the natural landscape. The fulfillment of these requirements is controlled *only* in the Valley of Geysers by preserve scientists through annual ecological monitoring. Today, the other part of the Preserve, including the former all-Union route, is sometimes visited for the purposes of ecological education and scientific tourism, but the state of its resources has not been assessed or managed.

Methods

In 2007-2008, using the methodologies of different authors (Cole 1989, 1991; Cole and others 2008; Manning and others 2006; Marion 1995; Marion and others 2006), a multiparameter campsite and trail condition assessment system was developed for monitoring resource conditions of the routes in the Kronotsky State Natural Preserve. Procedures and protocols for assessing inventory and resource condition parameters were developed. The resource condition parameters (e.g., campsite size or trail width, exposed soil, etc.) documented the site conditions, while the inventory parameters (site number and name, site location (GPS coordinates), description of landscape, type of vegetation cover, soil type, relief, character of boundaries, distance from river) documented the site location or the resource attributes. The study involved detailed examination of trails and campsites along two parts of a once integrated tourist route, stretching from the famous Valley of Geysers to Burlyaschiy Volcano (fig. 3). The campsites were assessed on 12 resource condition parameters and 9 inventory parameters, and the trails on 5 resource condition parameters and 8 inventory parameters. Measurement accuracy and precision were enhanced through training and supervision of qualified field staff and the use of specially developed protocols.

Campsite Impact Assessment

Along the route, we searched for campsites, which were marked by the evidence of a campfire. Campsite boundaries were defined by pronounced changes in vegetation cover, vegetation height/disturbance, vegetation composition, or, more rarely, topography. In cases when the understory vegetation was sparse and it was difficult to establish an accurate border, the boundary was defined hypothetically.



Figure 3—Location of the study area.

For assessment of the campsite condition and measurement of the campsite areas we employed the radial transect method (Cole 1982; Marion 1991, 1995). A point was established near the center of the disturbed area of the campsite, and distances from this point to the first significant difference in vegetation were measured along 16 cardinal directions. This defined the central disturbed area. Within this area, four 1-m² quadrats were located along north, south, east, and west transects, halfway to the edge of the core (Cole and others 2008). These procedures were applied to all selected within campsite areas with different degrees of disturbance (defined by difference in vegetation).

Approximately 18 to 20 1-m² quadrats were randomly located along transects in the campsite perimeter. Within each quadrat the following parameters were estimated or counted:

- Percentage cover of vegetation, medium height of plants and the number of sick and oppressed plants of each vascular plant species;
- Number of shrubs rooted in each quadrat;

- Total number of species;
- Total percentage cover of live vascular vegetation;
- Number of ruderal species;
- Organic litter; and
- Various soil parameters (bulk density, penetration resistance, infiltration rate, and moisture).

All these parameters were also estimated for adjacent, environmentally similar but undisturbed control sites that were selected to represent conditions in the absence of the campsite influence.

Within each campsite boundary, we also counted the number of trees with scars clearly caused by humans, number of trees with roots exposed by trampling, and number of social trails that connected the campsite to the trail, other campsites, or water. The extent of the development (for example, seats and fire rings) and the cleanliness of the site were also noted. Finally, we took photos of each site to document impacts and mapped the total site area (total impacted area) and selected areas with defined differences in vegetation, mineral soil exposure, and other visible characteristics.

Trail Impact Assessment

Trail impact assessment included both the assessment of the trail condition and the assessment of components of natural complexes in the zone of trail impacts. As one of the purposes of this study was to inventory trails, we have carefully examined the entire trail condition. Each 50 m we measured the width and depth of the trail and its vegetation cover. We also identified and investigated eroded areas, as well as highly disturbed areas on or near the trail (so-called “windows of trampling” (Chizhova and Sevostianova 2007)), confined mainly to the points of sightseeing and intersections with other trails.

As in the case with assessing the campsites, when the trail lied in clinker and it was difficult to establish its accurate boundary, the width was defined hypothetically. Measurements of soil eroded sites included the following parameters: coordinates of the site, soil texture, slope length and steepness, average width and depth of the main gully, and total area of the eroded site. To assess the influence on “windows of trampling,” we used the same methodology as for campsites.

For detailed assessment of different components of natural complexes in the zone of trail impacts and for the subsequent long-term monitoring of their dynamics, several permanent key sites have been established on the trail in every natural complex, using methodology by Chizhova and Sevostianova (2007). Several transects were located on both sides of the trail, running 10 m in length and perpendicular to the trail. Similar to the campsites impact assessment, distances from the middle point of the trail to the first significant difference in vegetation were measured and 1-m² quadrats were located along these transects in areas with different degrees of disturbance. The list of estimated parameters and characteristics was the same as that in the evaluation of the campsites impacts (see above).

Data Analysis

As a measure of the level of impact on different components of natural complexes in the zone of the trail and campsite influence we used the level of their disturbance, estimated by comparison of the results of field studies in disturbed areas with those in the control sites. The main indicators of such disturbance were the following: absolute vegetation cover loss, loss in species composition, vegetation depression, total number of sick and oppressed plants, tree damage and root exposure ratings (Monz 1998), mineral soil exposure, depletion of organic litter, number of social trails and fire rings, and changes in soil parameters. These characteristics were used for the campsite and “windows of trampling” impacts assessment, as well as for assessment of the components of natural complexes on the key sites in the zone of trail impacts. For evaluation of trail disturbance we estimated its total length, average and maximum depth, the development of soil erosion (average width and depth of main gully, total area and length of eroded site), total number and area of “windows of trampling” and total vegetation cover.

To get an overall evaluation of the intensity of impacts (level of impact) and the ecological condition of trails and campsites, we developed a rating scale of 5 points, and simultaneously introduced a 0 through 4 condition class scale: (1) light im-

act—site is barely discernible, but is distinguishable as a campsite or trail; (2) moderate impact—significant change (approximately 20 to 50 percent) of the natural characteristics; (3) heavy impact—high degree (50 to 80 percent) of changes; (4) severe impact—the highest possible impact and changes of the natural characteristics (>80 percent). For areas with no apparent impact we introduced the Class (0).

Results

The campsites and trails along the Valley of Geysers-Burlyaschiy Volcano route were assessed in summers 2008 and 2009. We found a large range of campsite and trail conditions with the median condition class being 1 for campsites, 3 for trails, and 1 for trail’s key sites (table 1). This indicates that sites tend to be lightly to highly impacted.

We have assessed 6 separate camping areas in two parts of the route (table 1). Campsites were found mainly in lichen and lichen-shrub tundra. The impacted area of campsites ranged from 181 to 526 m² with the median campsite size being 297 m², comprised mostly of moderately and lightly impacted areas.

Inventories and condition class assessments were completed for 42 km of trails. While 18.3 km (43.6 percent of the total) were classified as having no impacts or being in a lightly impacted condition and barely distinguishable (Class 0 or 1), 17.8 km (42.4 percent) were assessed as being heavily or severely impacted with highly eroded treads (Class 3 and 4) (figs. 4a and b). We developed 7 key sites for assessment of components of natural complexes in the zone of the trail impacts. The detailed assessment of key areas revealed a surprisingly restricted spread of trail impacts on adjacent areas. In the major number of key sites the impact zone was only 1.5 m wide with mostly lightly impacted areas (1st Class condition). At the same time, the study of “windows of trampling” at the most popular and interesting sights on the route showed perilous results. Over 40 percent of the area of the key site near the mud hole “Sculptor” in the Uzon Caldera was identified as heavily and severely disturbed (fig. 5). The detailed assessment of different components of natural complexes of the Kronotsky State Natural Preserve along the researched route allowed us to compose field maps of the ecological conditions, where we separated areas with different levels of recreational impacts (fig. 6).

Discussion and Conclusions

Discussion

The primary objective of this study was to assess the level of impact on a system of trails and campsites along the Valley of Geysers-Burlyaschiy Volcano route. There was no significant recreational activity on most of the route for more than 30 years, but in spite of this, the general conclusion of our research is that the examined system of trails and campsites in the Kronotsky Preserve is moderately to heavily disturbed. We have revealed some long stretches of highly eroded trails and identified numerous severely disturbed “hot spots.” We also identified a significant number of areas at the most popular sights along the route as heavily to severely disturbed.

Table 1—Summary of the campsite and trail impacts in two parts of the route the Valley of Geysers–Burlyaschiy Volcano.

Impact characteristic		Part of the route	
		Valley of Geysers–Caldera Uson	Caldera Uson–Burlyaschiy Volcano
Campsites	Number of sites inventoried	2	4
	Total area of all sites, m ²	363.05	1418.03
	Condition Class	1	1
	Percentage of 4 th class areas	1.2 (0.4–2.0)	4.75 (0.0–18.0)
	Percentage of 3 rd class areas	9.4 (1.0–17.8)	13.75 (5.0–24.0)
	Percentage of 2 nd class areas	22.5 (13.0–32.0)	23.75 (8.0–33.0)
	Percentage of 1 st class areas	62.0 (49.8–75.0)	57.25 (53.0–68.0)
Trails	Total length of the trail, km	16	27
	Average width of the trail, cm	32.0	28.6
	Average depth of the trail, cm	18.5	15.3
	Condition Class	3	3
	Percentage of 4 th class trails	13.2	12.6
	Percentage of 3 rd class trails	26.7	29.6
	Percentage of 2 nd class trails	18.4	14.8
	Percentage of 1 st class trails	23.0	24.1
	Percentage of 0 class trails	18.7	18.9
Trail's key sites	Number of sites developed	3	4
	Total area of all sites	180.03	243.18
	Condition Class	1	1
	Percentage of 4 th class areas	1.1 (0.0–2.1)	3.8 (1.4–4.6)
	Percentage of 3 rd class areas	7.5 (2.8 – 14.5)	4.2 (3.6–8.2)
	Percentage of 2 nd class areas	25.1 (15.3–34.6)	32.3 (14.5–40.1)
	Percentage of 1 st class areas	66.3 (48.5–82.1)	59.7 (52.8–61.4)

Note: Values are medians followed by minimum and maximum values observed in parentheses. The percentage of the different class areas for campsites and trail's key sites is estimated with no account taken of the areas without impact.

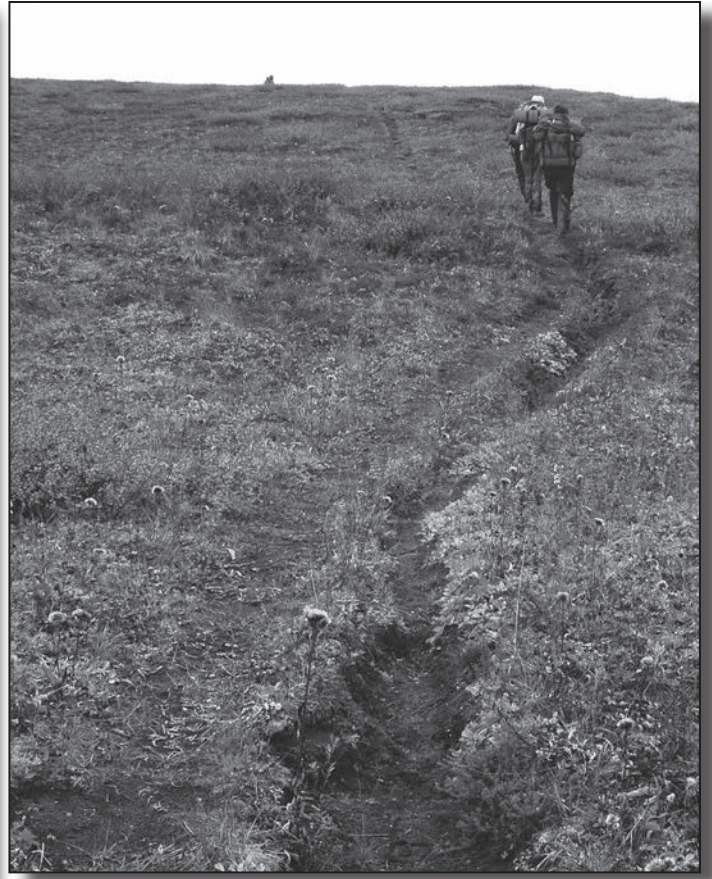
The condition of the trails and campsites depends on several factors: their immediate environment, design, maintenance, and the amount, type, and timing of the use they receive. There is abundant evidence that use characteristics are the least important out of these influential factors (Cole 1991; Helgath 1975; Tinsley and Fish 1985). This is vividly illustrated by the results of our research.

The main problems on the route were: absence of any engineering arrangement at some popular sights, widespread wet and muddy areas (geothermal areas, swamps, valleys of streams), high vulnerability of tundra and geothermal communities along the trails and in campsites, and easily washed sandy soils, provoking the development of scour erosion even on small slopes. In most cases, the changes in condition of natural complexes in the Kronotsky Preserve are provoked not by the present amount of use, but by breaking of ecosystem stability during the Soviet period of active use of the route. Today we are witnessing the processes of recovery of natural complexes in some sites, as well as the processes of erosion and gully development in other sites.

Consequently, the critical factors that influence trail and campsite conditions are most likely to be related to environment (for example, soil characteristics or slope steepness) rather than use. This suggests that the principal solutions to trail and campsite impact problems involve increasing the ability of these sites to withstand use (through improved design and engineering) or changes in their location to places that are more capable of withstanding use (Cole 1991).

Prospects

Currently, we are working on the development of a GIS-based methodology for estimation of recreational impacts and condition classes of campsites and trails in Kronotsky State Natural Preserve. Using this methodology, the analysis of data for the above mentioned separate impact parameters will allow us to improve knowledge of the boundaries of sites with different degrees of disturbance, selected in the field, to calculate the level of impact and to give a complete integral campsite and trail condition assessment.



Figures 4a and b—More than 40 % of trails were assessed as being heavily and severely impacted with highly eroded treads.



Figure 5—The key site near the mud hole "Sculptor" in the Uzon Caldera.

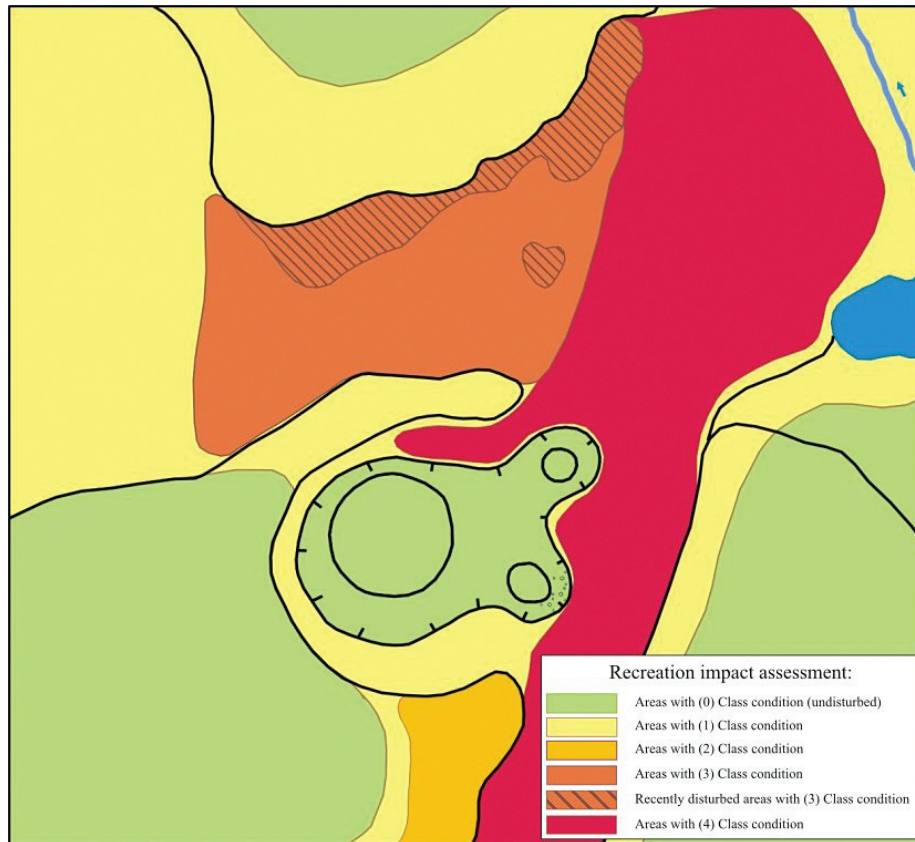


Figure 6—Illustration of ecological condition map depicting level of recreation impact.

Kamchatka's wilderness should provide solitude and silence. Therefore, it's very important to monitor crowding and quality of recreation experience in general. The results of our research will be useful not only for Kronotsky preserve, but also for other wilderness areas—particularly for the new process of protected area planning. Moreover, developed monitoring protocols and systems of indicators seem appropriate, and with some modifications, can be applicable to many ecosystem types at Kamchatka.

Conclusions

While describing the current condition at individual “problem” sites and quantifying the subsequent progression of the impact trends are beyond the scope of this paper, this research is important preliminary work necessary to complete this task in the future. It is one of the first studies on environmental assessment of the recreational areas of Kamchatka, but even the preliminary findings of our initial work corroborate the importance of basing wilderness management programs on knowledge about trail and campsite impacts, and emphasize the necessity of adopting the recreation assessment and monitoring framework to the practice of decision-making.

The situation along the all-Union tourist route to the Valley of Geysers is a revealing example of the consequences of

unplanned or poorly planned and implemented tourism and a striking demonstration of the importance of developing campsite and trail monitoring programs to preserve resource conditions while simultaneously allowing for visitation. Properly implemented, recreation impact monitoring programs provide a standard approach for collecting and analyzing resource conditions data over time. Analysis of the data from periodic reassessments enables managers to detect and evaluate changes in resource conditions. Deteriorating conditions can be revealed before severe or irreversible damage occurs, giving time for implementing corrective actions. Analysis of recreation impact monitoring data can also describe relationships between resource conditions and the influential use-related and environmental factors. Finally, a recreation impact monitoring program is indispensable to the new protected area planning and management frameworks, including the limits of acceptable change (LAC) (Stankey and others 1984).

In conclusion, the values of Kamchatka protected areas are inextricably linked to their naturalness. Trampled vegetation and the proliferation of trails, campsites, and fire rings have potential to impair ecosystem function and quality of visitor experiences. Recreational impact monitoring programs offer managers a tool for assessing such changes and provide an essential basis for making resource protection decisions (Marion 1995).

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Protection of the Wilderness and Aesthetic Values of Antarctica: Geographical Information Systems (GIS) as a Tool

Rupert Summerson and Tina Tin

Abstract—Antarctica is designated by the Antarctic Treaty System as a “natural reserve devoted to peace and science” (http://www.ats.aq/index_e.htm). Multiple, and sometimes conflicting, values are protected. In a place where wilderness protection and certain forms of human activity are both prized, a discussion of the protection of the Antarctic wilderness necessarily leads to the question of the present and future human footprint in Antarctica. A comprehensive and systematic assessment of the human footprint in Antarctica has never been done, and in this paper the authors explore the opportunities and challenges in conducting such an assessment. On examining the exchange of information conducted under the Antarctic Treaty System, one finds that the information on human activity in Antarctica is relatively centralized, and that with the right permissions, together with dedicated and significant effort, it should be possible to assemble all information in one place. After that, the next challenge lies in the representation of this data in a coherent manner that would be useful for planning purposes. Geographical Information Systems (GIS) are a useful tool for representing this data; however, much work still needs to be done to arrive at a system that is clear, transparent, and reproducible and can illustrate the impacts of human activities on wilderness character or values.

collectively by 28 countries under the Antarctic Treaty System (ATS), which designates Antarctica as a “natural reserve devoted to peace and science” (http://www.ats.aq/index_e.htm). Its environment and ecosystems are protected under the terms of the Protocol on Environmental Protection to the Antarctic Treaty (the “Madrid Protocol”) which was ratified in 1998, and so is its intrinsic value, “including its wilderness and aesthetic values and its value as an area for the conduct of scientific research, in particular research essential to understanding the global environment” (http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1991.php). Thus, multiple, and sometimes conflicting, values are protected, and thus far, there has not been any explicit articulation of the hierarchy of these values. Historically and conventionally, though, science has taken precedence over all other human activities. In a place where wilderness protection and certain forms of human activity are both prized, a discussion of the protection of the Antarctic wilderness necessarily leads to the question of the present and future human footprint in Antarctica. Perhaps a bit surprisingly, a comprehensive and systematic assessment of the human footprint in Antarctica has never been done. In the following sections, we consider the opportunities and challenges in conducting such an assessment.

Introduction

Antarctica is the biggest and most intact terrestrial wilderness left on Earth. However, like the rest of the world, increasing globalization, mobility, and search for commercial gains are putting pressure on even this, the most remote of all continents (Tin and others 2008). Antarctica is managed

Assessing the Current Human Footprint in Antarctica

Defining the Footprint

Infrastructure (buildings and structures) and activity (people doing things or in transit) are the two major components of a human footprint. Infrastructure often has a lifetime of many years. The establishment of infrastructure almost invariably results in major long-term impacts on the visible landscape, such as tracks established around buildings, building footings and anchor points, the establishment of pipelines and cables, spillage of hydrocarbons, sewage outfalls, etc. Even when infrastructure is removed, there will inevitably be a legacy, sometimes in terms of visible elements, others in terms of chemical traces that are not necessarily readily detectable, such as spillage of hydrocarbons and discharge of sewage.

Activity, by contrast, is transient. A scientific field party moving through an area may leave no trace apart from vehicle tracks in the snow. Where scientific research has

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been conducted, there may be the minor scarring, such as where rock samples have been taken. An aircraft flying from A to B is an activity, though an established route with regular scheduled flights could be considered infrastructure. In terms of representing infrastructure and activity on a map, all have to be represented with symbols that make it difficult to separate them in the mind of the user. Once the location and type of infrastructure have been compiled and the distribution and intensity of activity established, it will be possible to define the footprint accurately.

Data Acquisition

Human activities on the Antarctic continent and in the Southern Ocean falls under three broad categories: (1) scientific research and its associated logistics run by national Antarctic programs of Parties to the Antarctic Treaty; (2) tourism activities; and (3) commercial fishing. Tourism and commercial fishing are both organized by commercial entities. The majority of human activities take place during the austral summer, from November to February. Scientific research and its associated logistics is the only activity that takes place year-round, though most activity also takes place during the austral summer.

Scientific Research and Its Associated Logistics—Ever since the first Antarctic Treaty Consultative Meeting in 1961, there have been numerous measures and resolutions to promote the exchange of scientific and logistical information among Treaty Parties, i.e., those countries that have acceded to the Antarctic Treaty. The Council of National Antarctic Programs (COMNAP) maintains a list of the facilities being operated by national Antarctic programs (<https://www.comnap.aq/facilities>). These include active and a few disused research stations and seasonal (summer) facilities. In 2008, the Electronic Information Exchange System on the Antarctic Treaty Secretariat's website began operation, providing a central location for the operational and logistical information of all 28 Antarctic Treaty Parties (<http://www.ats.aq/e/ie.htm>). Prior to each season, Parties submit information on the stations that they will be using, the ships that will be going to Antarctica, the numbers of voyages and areas of operation of each ship, as well as types of aircraft, planned number of flights, periods of flights, and flight routes. This new system can potentially provide vast amounts of information that can be used to build a map of the footprint of scientific research and its associated logistics. However, interpreting, entering, and processing the logistical information of 28 countries that are not always provided in the same format is no small feat. It is not an exhaustive list, however, and does not cover the activities carried out away from research stations. Thus, the true extent of activities carried out by national Antarctic programs is not represented. It is certain that national Antarctic programs retain records on the extent of their field programs, but because they are not required for Antarctic Treaty exchange, they have not been promulgated.

Tourism—A similar information system also exists for tourism activities. The International Association of Antarctica Tour Operators (IAATO) is an industry group comprising the large majority of Antarctic tour operators. Prior to each season, IAATO members provide information

to the association and collectively make use of a web-based ship scheduler to pre-schedule visits of each of their cruise ships to tourist sites. In addition, since 2008, the majority of IAATO vessels participate in a vessel tracking system (<http://www.iaato.org/operational.html>). Therefore, de facto, IAATO acts as a central repository of information on the capacity of tourist cruise ships, the routes they take, the numbers of visits at each site and the numbers of passengers landed there. While the information on the ship scheduler and the vessel tracking system is not publicly available, IAATO does collate and publish information on the sites visited and the numbers of tourists landed at each site at the end of each season.

Commercial Fishing—Commercial fishing activities are controlled through the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Each year, the CCAMLR Secretariat receives information from their member countries on where, when, and how their fishing vessels fished. Depending on the area and the type of fishing that takes place, the information that is provided to the Secretariat varies. The details of the licensed fishing vessels are accessible to the public. The rest of the information is held by the CCAMLR Secretariat, and member countries can request the information following established rules of data access (Reid, personal communication; Graham, personal communication). Again, similar to the case of tourism activities, the CCAMLR Secretariat is to be a central repository for information on the trajectory of fishing vessels. However, due to its commercial sensitivity, the accessibility of this information is to be restricted.

Data Representation

A Geographical Information System (GIS) provides a powerful tool to compile, integrate, and analyze this information. Maps derived from the GIS can be used to represent the locations of research stations and intensities of activity. First, however, the information compiled in the Antarctic Treaty Secretariat's Electronic Information Exchange System must be re-formatted into data that can be loaded into a GIS. This is not a trivial task because of the complexities in converting the location coordinates into a GIS format, and a data model must be constructed for the descriptive data (the "attributes"). Once that has been done, the next challenge will be in representing it coherently so that it can be used for planning and decision making. The activities described above vary not only geographically but also in their duration, intensity, and, ultimately in their impacts on the environment, such as air quality, sight, sound, chemical residue, and wilderness values. A data model and a database can be constructed to store data representing these different features but representing them all on a map presents a severe challenge. Temporal elements, such as a fishing vessel that changes location during the one month that it is in the Southern Ocean, must be represented differently than a permanent research station.

Calculating the impacts of different activities must begin with understanding the nature of the activity and then observing or measuring the impact. Impacts on ecosystems can be measured by one of several well-established routines (e.g., Underwood 1994). Calculating the impact of an activity

on value systems such as wilderness values, however, means defining what is meant by “wilderness values” and establishing a measure of impact. Some tentative steps have been made toward proposing some definitions (Summerson and Riddle 2000; Codling 2001) but further research is needed. Calculating the intensities of impact of research stations with their resident populations and associated activities and those of tourists who arrive at specific sites over a period of 3 months, but not at all during the other 9 months of the year, represents a formidable challenge. This is complicated by the fact that while the location and intensity of tourist activities on land are well represented by the data compiled by IAATO, equivalent data on the activities of national Antarctic programs is not readily accessible. Distinguishing between infrastructure and activity reveals that the infrastructure of national Antarctic programs is well documented whereas the sites of field operations (activities) are not.

Figure 1 displays a small proportion of the data that are currently available on human infrastructure and activities in Antarctica. The data have not been weighted in any way and the information represented on the map is not to any scale. Only the geographical information is represented. Despite the simplicity and shortcomings of this figure, we hope that it demonstrates the potential power of such a tool.

Conclusions

We wrote this paper with more questions than answers in our minds. It appears that the good news is that information on major, current human activity in Antarctica is both accessible and reasonably well-maintained. However, the accessibility of this information varies greatly. From a purely technical standpoint, the first step in constructing a model of

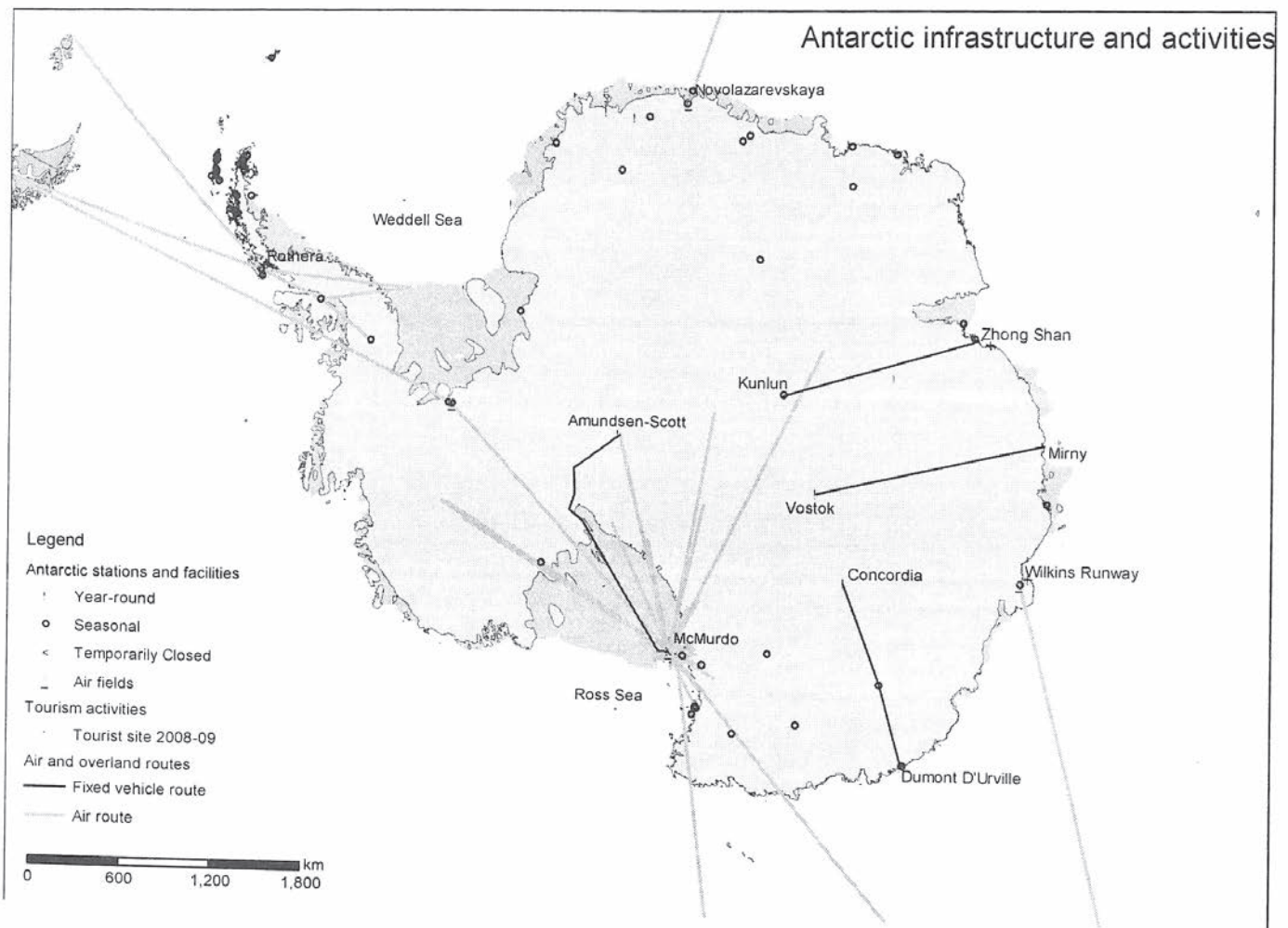


Figure 1—Map displaying a small proportion of the data available on human activities in Antarctica. Infrastructure and activities are represented by symbols that are not to scale. (Data sources: COMNAP, Scientific Committee on Antarctic Research (SCAR) Antarctic Digital Database, Australian Antarctic Division, Antarctic Treaty Secretariat, IAATO.)

the human footprint in Antarctica and the Southern Ocean consists of compiling data from the different information repositories in a common format. While this is not a small task, it only needs to be repeated once every 5 or 10 years, for the purposes of monitoring and planning. While it certainly does not paint a complete picture, if the infrastructure and activities of the national Antarctic programs could be assembled, maintained and disseminated, then a large part of the human footprint in Antarctica could already be defined more clearly and in a more transparent fashion.

In the course of the 9th World Wilderness Congress, the authors found that similar questions arise in the consideration of the impacts of human activities on the wilderness character of designated wilderness areas in the United States. Other researchers concur that GIS is a worthwhile and useful tool to help address this problem and agree that a great deal of research still needs to be done to arrive at a system that is clear, transparent, and reproducible and which can represent the impacts of human activities on wilderness character or values. However, our present examination of the case in Antarctica reveals that building the GIS database of infrastructure and activity is the first formidable challenge.

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**6. NEW DIRECTIONS IN WILDERNESS
STEWARDSHIP**



Photo courtesy of Steve Carver

The National Landscape Conservation System: A Model for Long-Term Conservation of Significant Landscapes

Dave Harmon and Jeff Jarvis

Abstract—The Bureau of Land Management administers over 256 million surface acres, more than any other U.S. public agency, the vast majority of which is in the western half of the United States. A land protection system was initiated in 1970 with the creation of the King Range National Conservation Area. In 1976, the Federal Land Policy and Management Act (<http://www.blm.gov/flpma/>) changed the BLM's mission from land disposal and management for resource production to uses that included protective designations including Wilderness. In 2000, the BLM responded to the growing concern over management of protected areas with creation of the National Landscape Conservation System (NLCS) (<http://www.conservation-system.org/conservationsystem/>). Wilderness Areas, Wilderness Study Areas, National Conservation Areas, National Monuments, Wild and Scenic Rivers and National Scenic and Historic Trails are all components of the NLCS. In 2009, legislation codified the NLCS, and gave it permanence under the law. Pure, unmodified wilderness occupies one end of the spectrum. At the other end of the spectrum, National Monuments, National Conservation Areas and similar designations can be found, containing recreational and interpretive developments to facilitate public understanding and appreciation of protected landscapes. These different protective designations provide a range of opportunities and experiences to the public and to generations to come. When a decision must be made on how to proceed with conservation of natural areas, the NLCS provides a helpful example of a range of possible designations.

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Introduction To The Bureau Of Land Management

With over 256 million surface acres, the Bureau of Land Management (BLM) is responsible for managing more public land than any other agency in the United States. The vast majority of this land is located in the arid western third of the United States and in Alaska. These lands include canyons, deserts, cacti of the American Southwest, the open landscapes of the short grass prairie, the isolated tundra, the wide open landscapes that surround western towns, and the isolated retreats that often form the image of the American West.

The public lands managed by the BLM are those Federal lands left over from the early years of western expansion. In the country's first 150 years, our national policy was to dispose of Federal lands in an effort to build a strong nation, raise funds, and encourage settlement of new territories. Lands were sold or given to settlers, homesteaders, veterans, towns, colleges, private corporations, and states. Some of the land was set aside to become National Parks, National Forests, Wildlife Refuges, Indian Reservations, or Military Bases. During the disposal era, over 1.1 billion acres of public lands were transferred out of Federal ownership.

The disposal era ended for the BLM in 1976 with passage of The Federal Land Policy and Management Act. This law changed the course of BLM management in numerous ways, including directing that public lands be retained in Federal ownership. The lands that remained are the 256 million acres that are now managed by the BLM. BLM-managed public lands are a priceless legacy and long-term investment for the American people. Prized originally for their commodity values, today the public lands offer much more: unparalleled recreation opportunities, wildlife reserves, opportunities for scientific study in relatively undeveloped landscapes, and in the increasingly crowded American West, one of the last guarantees of open space.

Wilderness Protection

In 1964, the Wilderness Act became law, creating the National Wilderness Preservation System. These wilderness lands have the highest level of protective management on the nation's public lands. In 1964, the BLM was not included in the wilderness legislation, but in 1976 The Federal Land Policy and Management Act gave BLM wilderness stewardship responsibilities for the first time,

directing the agency to inventory, study, and report on its remaining roadless areas with wilderness characteristics. BLM became the fourth and final Federal agency to receive wilderness stewardship responsibilities under this legislated wilderness system. In 1991, Congress received BLM's recommendations for new wilderness designations. Today, BLM manages 222 Wilderness Areas totaling 8.7 million acres.

Wilderness Study Areas (WSAs) consist of an additional 545 areas totaling 12.8 million acres. These are undeveloped lands that BLM believes meet at least the minimum qualifications of wilderness (roadless, usually larger than 5,000 acres, in a natural condition, with outstanding opportunities for solitude or a primitive and unconfined type of recreation). Future Wilderness Area designations may come from some of these WSAs or from other undeveloped lands identified by the public.

Other Special Values

Congress began to recognize the need to protect some of the natural, historical, and cultural resources on these public lands through legislation nearly 40 years ago, and took a major step in creation of a BLM land protection system in 1970 by establishing the King Range National Conservation Area on California's northern coast. At numerous times in the following decade, Congress expanded the areas protected under national designations. The 10.6 million acres within the California Desert National Conservation Area were set aside in 1976. The Steese National Conservation Area, which contains 1.2 million acres in east-central Alaska, was designated in 1980 to protect wild and scenic rivers, crucial caribou calving grounds, and Dall sheep habitat. Additional protective designations were passed into law for the rugged lava flows on New Mexico's El Malpais "badlands" (1987), the rich wildlife and riparian area along Arizona's San Pedro River (1988), and other areas throughout the West. In total, Congress has created 16 National Conservation Areas in eight western states.

In 1996, BLM was entrusted with the responsibility of managing its first National Monument with the presidential designation of the Grand Staircase-Escalante National Monument in Utah. Grand Staircase-Escalante National Monument was designated to protect the area's objects of historic or scientific interest including geologic treasures, world class paleontological sites, extensive archeological resources, and outstanding biological resources. Since then, the BLM's responsibilities to manage protected lands have continued to expand. Congress or the President has since created an additional 15 National Monuments in seven additional states.

In addition to Wilderness Areas, Wilderness Study Areas, National Monuments, and National Conservation Areas, Congress used several additional protective designations to recognize the natural values of other landscapes including Wild and Scenic Rivers and National Scenic and Historic Trails. This explosion in land protection led to numerous changes in the BLM. The agency began to gradually change from an agency responsible for disposing public land and managing for resource use and consumption to an agency with an additional new mission: the long-term conservation

of public lands. New employees were hired with skills in wilderness management, outdoor recreation planning, archaeology, and other specialties that were needed to manage and protect these new resource management responsibilities.

These new land designations, ranging from classic wilderness preserves to generally natural landscapes that occasionally included developed recreation and interpretive sites, created a pattern of special areas where the overriding objectives became long-term conservation, restoration of the land, and protection of biological diversity. Wilderness Areas are managed to strictly prohibit any activities that might impact their untrammeled, undeveloped and natural qualities. In the National Monuments and National Conservation Areas, a set of common management prescriptions emerged: withdrawal from disposal, more intensive management focused on providing visitor services and interpretation, and restoration priorities. Many of the areas are also withdrawn from mineral entry. The designations can be viewed as a spectrum of protected lands—with undeveloped wilderness at one end and, at the other end, those designations including some developments that enhance public understanding and enjoyment of the protected landscapes.

During development of these conservation designations, Congress and the BLM learned that not one type of designation was appropriate for all situations and no single designation was adequate to protect all the landscapes that deserved protection. In some cases, wilderness was the most appropriate designation. In other situations, a National Conservation Area designation did a better job of protecting an area's values while allowing certain existing uses. In some cases it is appropriate to have more than a single designation for a special landscape. This most often occurs when a Wilderness Area, Wild and Scenic River or National Trail is located within a National Conservation Area or National Monument.

National Landscape Conservation System

BLM manages its Wilderness Areas under established manual and regulatory guidance; however, the expanding collection of other special areas did not have an organized management approach. In 2000, the BLM responded to the growing concern over management of many of these protected areas with creation of the National Landscape Conservation System (NLCS) (<http://www.conservationssystem.org/conservationssystem/>). The NLCS brings into a single system BLM's most protected landscapes. By putting these special lands into a single system the agency hoped to improve management of these treasured areas, improve public benefits that flow from a well-managed system of conservation areas, and increase public awareness of their scientific, cultural, educational, ecological, and other values. The NLCS includes the BLM's National Monuments, National Conservation Areas, Wilderness Areas, Wilderness Study Areas, Wild and Scenic Rivers, and National Historic and Scenic Trails.

The BLM manages these treasured landscapes of the American West with a set of common principles that emphasize conservation, protection and restoration:

- The conservation of natural values is of primary concern.

- Areas are managed in partnership with surrounding communities. In developing management plans, the BLM is working with local communities, particularly with regard to amenities such as food services and lodging. The BLM does not provide food, lodging, or intensive visitor services within the areas. Instead, visitors are encouraged to see the landscape in the context of the history and tradition of the entire region. Intensive services are provided by the surrounding communities.
- Conservation areas and monuments often include within their boundaries wilderness and wilderness study areas or wild and scenic rivers where motor vehicles are excluded. Outside such areas, the maintenance of roads and use of motor vehicles is managed to protect fragile soils, riparian areas, and other plant communities and wildlife habitat. Vehicles are restricted to designated routes.
- Valid existing rights such as existing mineral leases are recognized.
- Traditional uses such as grazing and hunting will continue, provided that these activities are consistent with the overall purpose of the area. BLM recognizes that in many instances these uses can be compatible with good wildlife management, protection of biodiversity, and enhancement of natural values.
- Many of the areas are unavailable for development under the Mining Act of 1872 and various other general lands laws that are incompatible with long-term protection of our natural environment.
- Management plans are prepared, or existing plans reviewed and updated, to reflect the importance of the conservation principles for which the place has been recognized.

Legislative Success

The Omnibus Public Lands Management Act of 2009 (P.L. 111-11) became law on March 30, and with it came the codification of the National Landscape Conservation System as a legislated system under the law, rather than as the previously existing administrative system subject to change by a future agency initiative. As a legislated system, the public visibility and public support for protecting and managing the variety of lands and designations within the System has increased, and will likely continue into the future, as population grows and competition for uses such as energy development on lands outside of the NLCS increases.

The NLCS contains some of the West's most spectacular landscapes. They are managed under a mission to conserve, protect, and restore nationally significant landscapes recognized for their outstanding cultural, ecological, and scientific values. Today the NLCS includes over 886 Federally recognized areas and approximately 27 million acres. The NLCS is diverse. It encompasses red-rock deserts and rugged ocean coastlines, deep river canyons, and broad Alaskan tundra. Many areas are remote and wild but others are surprisingly accessible. The NLCS also reveals and protects our cultural legacy. It safeguards American Indian cliff dwellings and cultural sites, and preserves the remaining traces of our Nation's historic trails and pathways.

Public interest and support has been outstanding, as evidenced by the passage of this year's legislation that not only legislatively codified the NLCS, but simultaneously added 928,000 acres of Wilderness Areas, one National Monument, four National Conservation Areas, 363 miles of Wild and Scenic Rivers, and 40 miles of National Scenic Trails for a total of 1.2 million acres of new designations. Numerous national publications including the *National Geographic*, *Audubon*, *Sunset Magazine*, *Sierra*, *Sky Magazine*, *Wilderness Magazine*, *Backpacker*, and *USA Today*, as well as many local newspapers, have celebrated formation of the NLCS and discussed some of the more outstanding landscapes protected under the umbrella of the system.

NLCS Benefits

The benefits from such a vast and varied system of protected lands are multiple, but one area is emerging that has received little attention in the past: the benefit of these lands for the advancement of scientific understanding of the natural world. The NLCS provides an important land base for scientific research and discovery that is anticipated to receive more attention from the scientific community in the future. A national symposium on NLCS-based science will be held in May 2010, highlighting important scientific research associated with these protected landscapes. Topics of interest include the discovery of new species, such as bacteria recently found in New Mexico's Snowy River Cave that may prove helpful in cancer research. In Las Cienegas and San Pedro Riparian National Conservation Areas, migration patterns of neotropical birds benefit land managers on both sides of our borders. Studies of geology in Grand Canyon Parashant National Monument and Grand Staircase-Escalante National Monument in Utah are being used as analogues to understand the formation of the Martian landscape. Paleontological discoveries abound and the history of the Cretaceous period is being rewritten from research on NLCS lands in Grand Staircase-Escalante National Monument in Utah and the Bisti Badlands Wilderness Area of New Mexico. Cultural resource research, such as the identification of prehistoric and current agave fields provide information for indigenous peoples. Studies of mountain lion populations in the urban interface at Ironwood National Monument are helping communities better understand and deal with this elusive creature.

The Future of the NLCS

In an increasingly crowded American West, NLCS lands are special. They are havens of solitude and a reminder of the American West as it appeared hundreds of years ago. The BLM is proud to be a steward of these treasured landscapes. As we continue to improve our long-term conservation management of these landscapes, we will assure the increased benefits that flow from a well-managed system of conservation areas.

Wilderness preservation is often painted in terms of "all or nothing." Either wilderness is saved or it is lost. The National Landscape Conservation System provides a working model of a spectrum of protected lands existing under a broad

legislative umbrella. Pure, unmodified wilderness occupies one end of the spectrum. At the other end of the spectrum can be found National Monuments, National Conservation Areas, and similar designations containing recreational and interpretive developments to facilitate public understanding and appreciation of protected landscapes. These different protective designations provide a range of opportunities and experiences to the public and to generations to come. When a decision must be made on how to proceed with conservation of natural areas, the NLCS provides a helpful example of a range of possible designations.

Conservation Areas

With nearly 900 units in the NLCS, it is not possible to describe them all. Summarized below, however, are a few of the areas in the System (<http://www.conservationssystem.org/conservationssystem>).

National Monuments

Agua Fria (January 11, 2000). An hour north of Phoenix, Arizona, Agua Fria's 71,000 acres host one of the most significant systems of late prehistoric sites in the American Southwest.

California Coastal (January 11, 2000). This National Monument includes all the islands, rocks, and pinnacles off the 840-mile California coast. These areas provide essential habitat for an estimated 200,000 breeding seabirds.

Canyons of the Ancients (June 9, 2000). Located in southwestern Colorado, this 163,000-acre area contains the richest known concentration of archaeological sites in the United States.

Carrizo Plain (January 17, 2001). Remnant of a once-vast grassland astride the San Andreas Fault zone, this unit's 204,000 acres in central California are a critical refuge for several endangered and threatened animal and plant species.

Cascade-Siskiyou (June 9, 2000). The convergence of geologically young and old mountain ranges gives this 53,000-acre Monument in south-central Oregon an extraordinary degree of biological diversity.

Craters of the Moon (November 9, 2000). The 272,000 acres of this remarkably preserved volcanic landscape on Idaho's Snake River Plain contain an array of exceptional features, including cinder cones and vast lava fields.

Grand Canyon-Parashant (January 11, 2000). This 808,000-acre unit contains outstanding geological and paleontological features in northwestern Arizona.

Grand Staircase-Escalante (September 19, 1996). Labyrinthine red rock canyons, high plateaus, and dramatic cliffs and terraces make up this stunning 1.9-million-acre area in southern Utah. About one third of the area is designated as Wilderness Study Areas.

Ironwood Forest (June 9, 2000). This nearly 130,000-acre area protects a unique ironwood forest and a wide array of bird and animal life in southern Arizona.

Kasha-Katuwe Tent Rocks (January 17, 2001). This area in northern New Mexico protects over 4,000 acres of cone-shaped rock formations resulting from volcanic eruptions and erosion that first built up and then wore down this landscape.

Pompeys Pillar (January 17, 2001). William Clark of the Lewis and Clark Expedition carved his name on this sandstone butte overlooking the Yellowstone River, adding to a rich record of historic inscriptions now protected as a 51-acre area in central Montana.

Santa Rosa and San Jacinto Mountains (October 24, 2000). This 86,500-acre, congressionally designated National Monument in southern California hosts over 500 plant and animal species, including the Federally listed Peninsular bighorn sheep. The mountain core is designated wilderness.

Sonoran Desert (January 17, 2001). Wide valleys separated by rugged mountain ranges offer dense forests of saguaro cactus—excellent habitat for a wide range of wildlife species—in this nearly 500,000-acre area in southwestern Arizona.

Upper Missouri River Breaks (January 17, 2001). The breathtaking limestone bluffs along this 149-mile, 370,000-acre stretch of Missouri River in central Montana remain almost exactly the same as when Lewis and Clark described them in their expedition journals. The opportunities for solitude are protected in several Wilderness Study Areas.

Vermilion Cliffs (November 9, 2000). An outstanding assemblage of deep, narrow wilderness canyons makes the nearly 300,000 acres in this northern Arizona Monument ideal for hiking and exploring.

National Conservation Areas

Black Rock Desert-High Rock Canyon Emigrant Trails (December 21, 2000). This area includes nearly 1,200,000 acres in northwestern Nevada. Ten wilderness areas provide additional protection to the rugged interior mountain ranges in the area. A National Historic Trail protects wagon ruts and historic inscriptions, largely unchanged from when pioneers moved westward through the area in the 1800s.

McInnis (October 24, 2000). From saltbush desert to the spectacular canyons of the Black Ridge Wilderness, this diverse area in west-central Colorado encompasses over 122,000 acres, including more than 75,000 acres of wilderness.

El Malpais (December 31, 1987). Over 262,000 acres of rugged lava flows in west-central New Mexico display some of the Nation's most significant geological, cultural, scenic, scientific, and wilderness resources.

Gila Box Riparian (November 28, 1990). This 22,000-acre desert oasis contains cliff dwellings, historic homesteads, Rocky Mountain bighorn sheep, and more than 200 species of birds in southeastern Arizona.

Gunnison Gorge (October 21, 1999). A variety of natural and geologic features and unsurpassed recreational opportunities are on display in western Colorado's Gunnison Gorge, a 57,727-acre area. This unit supports a diverse range

of uses such as whitewater rafting, big-game hunting, and domestic livestock grazing. The inner gorge is designated wilderness.

King Range (October 21, 1970). West of Arcata California, 35 miles of remote coastline comprise the 60,000-acre King Range, the nation's first National Conservation Area.

Las Cienegas (December 6, 2000). This area's 42,000 acres of desert grasslands and rolling oak-studded hills in south-central Arizona are home to a great diversity of plant and animal life, including several threatened or endangered species.

Red Rock Canyon (November 16, 1990). This 196,000-acre area outside of Las Vegas boasts unique geologic features, plants, and animals that represent some of the best examples of the Mojave Desert. The area offers spectacular climbing, and hiking opportunities. The most remote mountain areas within the NCA are also designated Wilderness Study Areas.

San Pedro Riparian (November 18, 1988). This 58,000-acre area in southeastern Arizona supports over 350 species of birds, 80 species of mammals, and 40 species of amphibians and reptiles.

Morley Nelson Snake River Birds of Prey (August 4, 1993). Home to the largest concentration of nesting raptors in North America, this 485,000-acre area in southwestern Idaho provides a complete and stable ecosystem where both predators and prey occur in extraordinary numbers.

Steens Mountain (October 30, 2000). Officially called the Steens Mountain Cooperative Management and Protection Area, these 425,500 acres in southeastern Oregon include volcanic uplifts, glacier-carved gorges, wild rivers, wilderness, and diverse plant and animal species.

Steese (December 2, 1980). This 1.22-million-acre area in east-central Alaska contains a Wild and Scenic River, crucial caribou calving grounds, and Dall sheep habitat.

Headwaters Forest Reserve (March 1, 1999). These 7,400 acres in northern California, co-managed with the State of California, protect old-growth redwood stands that provide habitat for threatened species such as the marbled murrelet, a seabird, and Coho salmon.

Wilderness and Wilderness Study Areas

BLM manages 222 Wilderness Areas totaling 8.7 million acres, and 545 Wilderness Study Areas (WSAs) totaling 12.8 million acres. Wilderness Areas are managed to protect their natural and undeveloped character as well as their outstanding opportunities for solitude and primitive and unconfined recreation. Wilderness Study Areas are managed to protect their wilderness characteristics until Congress makes a determination whether or not to classify them as Wilderness Areas. They represent an array of America's most pristine and spectacular wilderness landscapes remaining on the public lands.

Wild and Scenic Rivers

The NLCS includes 67 Wild and Scenic Rivers accounting for a total of over 2,400 river miles. These offer unparalleled opportunities for recreation on free flowing rivers throughout the American West.

National Scenic and Historic Trails

BLM-managed portions of the National Scenic and Historic Trails are also part of the NLCS. Ten Historic Trails totaling over 5,300 miles, including those followed by Lewis and Clark and pioneers heading to Mormon Country, commemorate the nation's cultural heritage. An additional five Scenic Trails, including the Continental Divide and Pacific Crest Scenic Trails, offer over 660 miles of some of the country's most spectacular mountain settings.

The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

The Verification of Wilderness Area Boundaries as Part of a Buffer Zone Demarcation Process: A Case Study from the uKhahlamba Drakensberg Park World Heritage Site

Sonja C. Krüger, Ian A. Rusworth, and Kirsten Oliver

Abstract—Wilderness areas are by definition free from the sights and sounds of modern man. The boundaries of wilderness areas have traditionally been defined based on the management authorities' perceptions of which areas have wilderness quality. Experience shows that many areas classified as wilderness do not actually have wilderness qualities and do not provide a true wilderness experience, while other areas not classified as wilderness may indeed provide a wilderness experience. In addition, there are many cases where areas that previously provided a wilderness experience no longer qualify as wilderness as a result of developments that have taken place outside the protected area.

This paper describes the methods employed to re-define the boundaries of the wilderness areas of the uKhahlamba Drakensberg Park World Heritage Site based on visual impacts of existing developments, using a Digital Terrain Model and Viewshed Analysis in a Geographic Information System. This action is required prior to embarking on a process to delineate a buffer to protect the pristine wilderness of the Park. A field verification using a random sample of points was used to confirm the revised boundaries, and an error matrix was compiled. The analysis indicates that 19,701 ha classified as pristine wilderness no longer have wilderness qualities, and, likewise, 42,492 ha not classified as wilderness could qualify as pristine wilderness. The zoned pristine wilderness area of the Park is 34,026 ha, but a pristine wilderness experience can be had in 56,817 ha of the Park.

The focus of the buffer zone demarcation is in the pristine wilderness zone and the management team will not compromise on the true wilderness qualities of this zone. However, the results of the error matrix were not satisfactory for the pristine wilderness

category. We recommend that the Viewshed Analysis is re-run at a higher resolution to identify 'true' pristine wilderness. This process will ensure that the realignment of wilderness zone boundaries is accurate. A process can then be implemented to identify areas outside the protected area that need to remain in their current undeveloped state to buffer the pristine wilderness areas and prevent any further erosion of the size of these areas.

Introduction

The uKhahlamba Drakensberg Park (hereafter referred to as the Park) was designated by UNESCO as a World Heritage Site (WHS) in November 2000 and gazetted as a WHS on July 11, 2008. The Park is managed by Ezemvelo KwaZulu-Natal (KZN) Wildlife, a provincial conservation organization.

Since being gazetted, a number of planning tools required to manage the Park have been developed. These include an Integrated Management Plan (Ezemvelo KZN Wildlife 2005a) incorporating a wilderness area management plan, a concept development plan, and a business plan. These plans have focused principally on areas within the designated protected area.

Given concerns that development and land use changes outside protected areas can have negative impacts on the purpose and values of protected areas, South African legislation (National Environmental Management: Protected Areas Act No. 57 of 2003 and World Heritage Convention Act No. 49 of 1999) makes provision for the establishment of buffer zones outside protected areas with the purpose of protecting the values for which these areas were gazetted. A process to establish an appropriate buffer zone was initiated in 2006. The approach of Wild and Mutebi (1996) was adopted where the buffer zone is an area that is managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighboring communities and of neighboring communities on conservation.

The primary purpose of the buffer zone is to protect the purpose and values of the protected area. The core values of the Park include the value of the natural heritage, cultural heritage, water production, eco-cultural tourism, and wilderness (Ezemvelo KZN Wildlife 2005a). The value of

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wilderness is reflected in the purpose of the protected area as providing access for the public to the area and its resources, including the spiritual values provided by wilderness areas. In order to protect and enhance the wilderness experience of park users, the buffer objective relating to wilderness was to safeguard wilderness values from additional negative impacts. The secondary objective was to mitigate existing negative impacts on wilderness users.

Prior to embarking on a process to delineate a buffer zone to protect the Park's wilderness values and qualities, the current boundaries of the Park's wilderness areas needed to be validated. The management team recognized that land use changes since the proclamation of the Park's wilderness areas in 1973 and the zonation of the Park in 2006 may have significantly eroded the qualities and values of the Park's wilderness areas. This paper focuses on the methods used to re-define the boundaries of the wilderness areas of the Park based on the visual impacts of existing developments. This verification process will improve the accuracy of the Park's zonation boundaries, which will ensure that the buffer zone process conserves opportunities for people to experience solitude and spiritual renewal in pristine wilderness areas of the Park.

Study Area

The uKhahlamba Drakensberg Park is a 242,813 ha protected area situated in the KwaZulu-Natal Province of the Republic of South Africa and is part of the Drakensberg mountain range in south-eastern Africa (fig. 1). The Park's western boundary lies on the international boundary with the Kingdom of Lesotho. The Park is a national and international asset due to its unique natural and cultural value and, as such, it has been listed as a World Heritage Site of dual significance.

The Park has a diverse range of ecological niches with rich biodiversity and large numbers of endemic species. In addition, it is home to thousands of rock art paintings, a product of the San's long historical relationship with this mountain environment (Mazel 1989). The Park also plays a key role in the economy of KwaZulu-Natal and South Africa, through the production of high quality water from its dense network of wetlands, and as an anchor for regional tourism development (Ezemvelo KZN Wildlife 2005a).

The Park is crescent-shaped with an approximate total length of 158 km and width of 28 km at its widest point. The height above sea level extends from approximately 1,200 m to 3,408 m. The mean annual temperature of the Drakensberg is about 16 degrees Celsius and annual precipitation varies between about 1,000 mm in the foothills to 1,800 mm at the escarpment (Tyson and others 1976).

Wilderness Areas

The Park contains four legally proclaimed wilderness areas that comprise 48.5 percent (117,765 ha) of the Park. An additional 17 percent (41,388 ha) has been zoned as wilderness based on various criteria (Ezemvelo KZN Wildlife 2005b).

The wilderness areas are managed according to the Wilderness Area Management Plan (Ezemvelo KZN Wildlife 2005b) that forms part of the Integrated Management Plan

(Ezemvelo KZN Wildlife 2005a) of the Park. Both management plans refer to the wilderness zones of the Park that were zoned using the Recreation Opportunity Spectrum (ROS) method (Clark and Stankey 1979; Buist and Hoots 1982).

Park Zonation

The zonation of the Park, according to the ROS, was undertaken as a desktop exercise based on the experience and knowledge of the management team. The ROS system enables the protected area to be zoned, in context, according to seven categories that are spread along a continuum from wilderness to rural recreational development: pristine wilderness, primitive wilderness, semi-primitive wilderness, semi-primitive non-motorized, semi-primitive motorized, roaded natural, and rural. Of the seven categories, the pristine wilderness, primitive wilderness and semi-primitive wilderness zones fall within the wilderness areas and collectively form the Wilderness Opportunity Spectrum (WOS) within the ROS. Each category within the WOS and ROS is defined in terms of activity, setting, and experience opportunities, which guides both the manager and the recreationist.

It is recognized that sections of proclaimed wilderness may no longer possess the wilderness qualities that allowed them to be designated as such over 30 years ago.

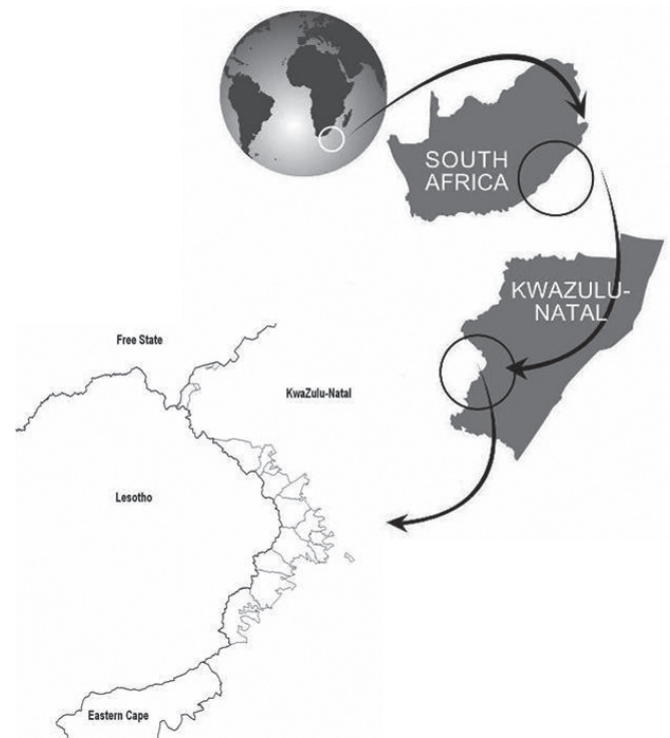


Figure 1—Location of the uKhahlamba Drakensberg Park World Heritage Site in the KwaZulu-Natal Province of the Republic of South Africa. Lines within the Park indicate separate management units.

Methods

The validation of the Park zonation was achieved using a Viewshed Analysis in a Geographic Information System (GIS) to analyze the extent of the existing visual impact of man-made features (developments) inside and outside the Park. A field based exercise to ground-truth the accuracy of the computer analysis at a series of random points was then conducted, with the categories of activity, setting, and experience opportunities assessed for each sample point.

Viewshed Analysis

The computer verification of the zonation categories took the form of a Viewshed Analysis using a Digital Terrain Model (DTM) to confirm the exact boundaries of the various zones digitally. The shuttle SRTM 90 m resolution DTM was used (Jarvis and others 2008). The Viewshed Analysis was calculated in ArcGis 9.1 (ESRI, Redlands, CA) using datasets containing information on the infrastructure and land use within and adjacent to the Park that may impact wilderness. Datasets representing the following man-made features were used: roads, paths, households, towns, medical facilities, schools, recreational facilities, buildings, powerlines (medium and high voltage) and landcover (built up areas). (Details of these datasets are available from the corresponding author.)

A model was run using shapefiles of the above infrastructure datasets to determine whether they had a visual impact on wilderness users in the Park. All data sets were clipped to a 20 km buffer of the Park boundary, which was taken to be the maximum visible distance from the Park boundary that would have a direct impact on the zonation of wilderness areas (Higuchi 1975). It was assumed that anything outside this range would not be visible and, therefore, would not have any direct impact on the zonation of wilderness areas. This reduced the number of points that would be used in the viewshed and significantly reduced computer processing time. All line features (e.g., roads and powerlines) were converted to point features using 1,000 m spacing for all points. Polygon features (e.g., timber plantations) were converted to point features by creating points at 100 m intervals along the polygon perimeter.

The Viewshed tool in ESRI's Spatial Analyst ArcToolbox allows for the inclusion of visibility parameters that can be added to enhance the Viewshed Analysis. Viewshed control parameters were included in the attributes of input shapefiles to include the height factor of both the observer points (e.g., the height of an average person) and the points within the dataset (e.g., the height of a building). Visual parameters denoting the range of human visual perception were also included. The parameter denoting the middle distance range of visibility was used. Visibility parameters that indicate the depth of human sight are not well-researched. Visibility is a variable factor that depends on an extensive number of inconsistent inputs such as weather and quality of sight of the observer. The indices of Higuchi (1975) were used because they were based on changes in weather conditions, and thus were found to be the most informative indices.

A Viewshed Analysis was run for each of the above mentioned datasets using a 20 m resolution DTM. All Viewshed

Analyses were run using the same resolution, apart from the large 'households' dataset where a lower resolution was used (by multiplying the output raster cell size by 100) to reduce processing time. Following the viewshed process, each output file was reclassified into a Boolean format so that each cell showed either visible (1) or not visible (0).

To obtain an overall picture of the cumulative impacts of all observation features, the reclassified layers were summed using the 'weighted sum' tool in ArcGis 9.1. This tool allows the user to specify weights for multiple rasters, which are multiplied by their individual given weight and then summed together. Weights for each parameter were generated using the eigenvectors derived from a pairwise comparison matrix undertaken by a group of agency staff. The eigenvector of weights for the parameters used in this exercise were ranked from highest to lowest impact as follows; recreational accommodation (0.2995), towns (0.2725), roads (0.1369), households (0.1230), schools (0.0415), clinics (0.0277) and powerlines (0.0159 and 0.0216 for medium and high voltage respectively).

Field Validation

The field validation exercise took the form of an accuracy test of the Viewshed Analysis. The field verification was conducted in six of the 15 management units of the Park. Four of the six management units had a pristine wilderness zone. Where possible, ten points were randomly generated in a GIS within each zonation category in each management unit. The manager navigated to each location using a Global Positioning System and verified the zonation category according to the description of the activity, setting and experience opportunities of that zone. A description of the attributes of the pristine wilderness zone is presented in table 1.

Results and Discussion

The numerical values in the output of the Viewshed Analysis indicate the number of separate features visible from that grid cell. Where the cell value is zero, there is no current visual impact from man-made features and accordingly where it would be possible, from a visual perspective, to have a pure wilderness experience (fig. 2). The weighted sum of visual impacts indicates that several areas currently proclaimed or zoned as pristine wilderness in fact have significant visual impacts from developments outside or inside the Park.

The Viewshed Analysis suggests that 24 percent (56,817 ha) of the Park is pristine wilderness whereas only 14 percent (34,026 ha) of the Park is currently zoned as pristine wilderness (table 2). In the Cobham management unit, pristine wilderness is predicted to be 19 percent (5,632 ha) of the size of the management unit, whereas only 8 percent (2,210 ha) was zoned as such. Similarly, in the Witteberg management unit, pristine wilderness is predicted to be 28 percent (6,307 ha) whereas only 5 percent (999 ha) was zoned as such. In the Injisuthi management unit, pristine wilderness is predicted to be 29 percent (4,551 ha) and only 11 percent (1,797 ha) was zoned as such. On the other hand, the predicted results for Hillside's pristine wilderness (21 percent, 2,205 ha) are similar to the actual results

Table 1—A description of the activity, setting, and experience opportunities for the pristine wilderness category in the uKhahlamba Drakensberg Park World Heritage Site.

Opportunity	Description of opportunities
Criteria or activity	Purest form, unmodified, no development, not impacted by any sights or sounds of people. No closer than 100 m to either side of existing trails. No formalized paths and no signage.
Setting descriptions	Area characterized by essentially unmodified natural environment of fairly large size. Area managed to be free from evidence of human-induced restrictions and controls. Motorized use not permitted. Interaction between users is very low, and evidence of other users is minimal.
Experience descriptions	Extremely high probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility and self-reliance through the application of outdoor skills in an environment that offers a high degree of challenge and risk.

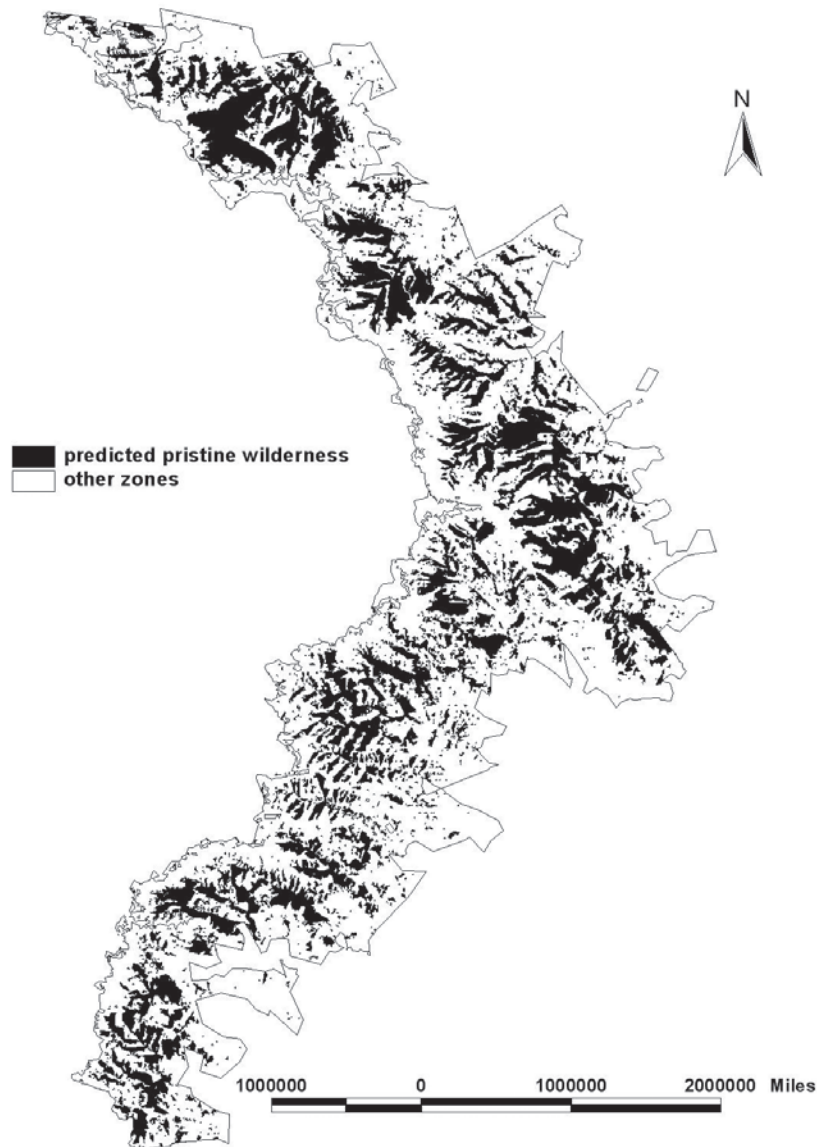


Figure 2—The results of the Viewshed Analysis indicating the predicted Pristine Wilderness areas of the uKhahlamba Drakensberg Park World Heritage Site.

Table 2—The percentage of zoned pristine wilderness compared to the predicted percentage of pristine wilderness.

Management unit	Zoned pristine wilderness	Predicated pristine wilderness
Cobham	8 (2,210 ha)	19 (5,632 ha)
Hillside	20 (2,095 ha)	21 (2,205 ha)
Witteberg	5 (999 ha)	28 (6,307 ha)
Injisuthi	11 (1,797 ha)	29 (4,551 ha)
Kamberg	0	19 (1,242 ha)
Rugged Glen	0	0.03 (0.24 ha)
The Park overall	14 (34,026 ha)	24 (56,817 ha)

(20 percent, 2,095 ha). Although no pristine wilderness was identified by managers in Kamberg management unit, the Viewshed Analysis predicted that 19 percent (1,242 ha) could be pristine wilderness. The results for the Rugged Glen management unit suggest that this area was zoned correctly; no pristine wilderness was identified and only a small amount (0.03 percent, 0.24 ha) of pristine wilderness was predicted.

The field verification exercise confirmed that for all six management units, the randomly selected points (n = 160) all conformed to the Park’s existing zonation, thereby making it possible to compare actual to predicted zonation.

Overall, one third (33 percent, n = 15) of the points predicted to be in pristine wilderness were assessed in the field to be in pristine wilderness, whereas two-thirds (67 percent, n = 15) were predicted to be in non-pristine wilderness. The results for non-pristine wilderness were much better in that 88 percent (n = 145) of the points predicted to be in non-pristine wilderness were actually in non-pristine wilderness and only 12 percent (n = 145) were in pristine wilderness (table 3). However, a large amount of variation was experienced in the results between the management units.

Conclusions

This case study has detailed an approach used to validate the zonation of a protected area. Pristine wilderness was highlighted because no additional visual impact from developments would be tolerated in this zone and current impacts would be mitigated where possible. This study has focused on visual impacts in wilderness, and has not considered audio impacts. It is recommended that the audio impacts are also assessed when validating zonation boundaries.

The Viewshed Analysis predicts that a much larger percentage of the Park is pristine wilderness, nearly double

the amount originally zoned. This prediction is, however, not substantiated in the field where only half the points predicted to be in pristine wilderness were assessed as being pristine. Based on the results, the analyses do not appear accurate enough for re-defining the pristine wilderness zones at the resolution of the DTM (90 m) used in this study. We surmise that the Viewshed Analysis is over-predicting the amount of pristine wilderness and, therefore, recommend that the Viewshed Analysis is revised and the highest possible resolution is used to run the model (20 m DTM based on 1:50,000 contour data is the highest resolution available for this area). Although processing time will increase significantly, it is necessary to run the model at the highest possible resolution to obtain the most accurate results where pristine wilderness is concerned. In addition, the field verification exercise should include a larger sample size of random points, particularly in pristine wilderness. One additional potential source of errors is the misallocation of zone category by the field assessors; therefore, it is essential that all persons undertaking the assessment are adequately trained to ensure consistency.

The areas identified in the revised analysis that are not impacted by man-made features will be demarcated and categorized as pristine wilderness. The pristine wilderness zone will then in turn be used to delineate the boundaries of the Park’s buffer zone to ensure that wilderness values are protected, and opportunities to experience solitude and spiritual renewal exist. This will be undertaken by running a Viewshed Analysis looking from the re-defined wilderness areas outward to identify those currently undeveloped areas that need to remain undeveloped to maintain the current extent of wilderness. Once a buffer zone is demarcated, a buffer zone management plan and a combination of management interventions will be necessary to ensure achievement of the buffer zone objective of safeguarding wilderness values.

Table 3—The percentage of actual points from the field verification exercise that conform to the predicted zonation.

Zone	Predicted pristine wilderness	Predicted non-pristine wilderness
Assessed (actual)		
Pristine wilderness (n = 15)	33	67
Assessed (actual)		
Non pristine wilderness (n = 145)	12	88

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Protecting Marine Parks and Sanctuaries from Aquatic Nuisance Species Releases from Ballast During Emergency Response Events

Phyllis A. Green

Abstract—Commercial shipping activities that release aquatic invasive species are recognized globally as a dominant transport vector for marine invasions. Aquatic nuisance species (ANS) introductions have resulted in billions of dollars of damages and immeasurable biological devastation within the Great Lakes. National Park Service managers are working with United States Geological Survey scientists to develop and refine emergency response options for ballast from high risk ships. This is to aid Parks in reducing risk from high risk ships either during an emergency response or when de-ballasting as part of ship operations within Park waters. The National Park Service is working on developing a salvors' guide to provide guidelines for emergency treatment of ballast within Park waters if conditions require ballast discharge. Discharges of live non-native species are currently prohibited within U.S. National Park boundaries, but permanent treatment of ballast to comply with this regulation may be as far off as 2021. Having potential tools to treat ballast on a short term basis will allow ship owners/operators to comply with mandatory regulations within Park boundaries or to participate voluntarily. In addition, accidental groundings make it imperative that procedures are developed to (1) assess whether the ballast is high risk, and (2) ensure management as part of an emergency incident in a timely way. This paper will present a review of a prototype draft risk assessment, methods previously used to treat ballast, and a summary of future work designed to address this critical need. Case studies of emergency treatment will be reviewed and lessons learned discussed.

Introduction

Invasive nuisance species are estimated to cost the United States \$97 billion dollars annually. In the Great Lakes alone, environmental and economic harm (both damage and control costs) are annually estimated to be \$5.7 billion dollars (Pimentel 2005). Controlling Aquatic Nuisance

Species (ANS) spread in the fresh water environment has been limited. Many of the ANS are small and their effects may be hidden for years, making detection and response before they gain a biological foothold difficult. Management jurisdictions to address the problem are often fragmented and uncoordinated. Because current mandatory actions like ballast exchange and salt water flushing are less than 100% effective (Johengen and others 2005) and implementation of stringent U.S. or International Maritime Organization (IMO) standards are estimated to be years away, developing some means to significantly reduce risk is critical. This paper highlights National Park Service (NPS) efforts to create cost-effective means to reduce the risk of damaging invasions and determine situations where additional first lines of defense can make a difference in both salt and fresh water environments.

Every year there are over 800 ship groundings in the United States. Risk assessment protocols for dealing with cargo and hazardous man-made chemicals are in place. But one potential risk not often evaluated as part of the emergency response (and one that can permanently alter the aquatic environment) is aquatic nuisance species. In the Great Lakes there has been no successful eradication of any pest or pestilence once it has gained a biological foothold. As a result, this risk needs to become a key consideration for our management of marine and freshwater Parks (Whelan, personal communication).

If a Park has shipping lanes running through or near its boundaries, assessing risk and preparing to interdict when a high risk situation occurs is critical. Some countries have required ballast treatment as simple as pouring chlorine into a ballast vent. For example, Argentina requires chlorine to be added to ballast tanks of ships that are arriving from ports where cholera is present. But data on the efficacy of their methods has not been available. In addition, when the National Park Service required treatment of the Igloo Moon, a stranded ship with a hazardous cargo, many questions were raised relative to the efficacy of treatment and how to improve upon the techniques used (Mearns and others 1999).

Three Case Studies Where Treatment was Required

In February 2009, an owner of a submersible dry dock barge purchased from China with un-exchanged ballast, voluntarily worked with State of Washington Department of Fish and Wildlife to treat ballast water prior to discharge.

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Submersible pumps were used to pull the water from separate ballast compartments into the treatment system. Using a treatment facility outside the ballast tanks may have limited applicability, depending on the availability of pumps, timing, and the treatment equipment; but it is reported the manufacturer of the UV system used to treat the ballast water on this barge may develop and size the system to respond to emergency applications in the future (Smith, personal communication).

In the fall of 2007, the NPS vessel Ranger III was first treated with low dosages of sodium hypochlorite to ensure that a targeted ANS species, Viral Hemorrhagic Septicemia (VHSV), a deadly fish virus, was not transferred to Isle Royale National Park. The first method of introducing the biocide (bleach) and neutralizer (ascorbic acid) was simple; both were added at appropriate times through the vent tubes. Because of the properties of the chemicals used, chemical dispersal, and the transit action of the vessel, the chemicals reached the target dosages for toxicity and subsequent neutralization. The Ranger III subsequently installed an in-line pump for the injection of both chemicals for under \$800 and in 2008 treated approximately 72,000 gallons of water for a cost of less than \$80. The biocide only represented 10% of the cost. The neutralizer was the most expensive. Discharges met or exceeded state standards for vessel discharge. NPS staff is evaluating options for a permanent installation to treat the ship and target a broader spectrum of ANS.

In November of 1996, a liquid petroleum gas tanker got stranded in Biscayne National Park in Florida. This case study will be examined in detail as some of the questions raised by the incident team in the Mearns report (Mearns and others 1999) have been addressed through time, and some of the questions may be answered in the future by incorporating adaptive management techniques and monitoring into emergency response actions as they occur and treatment is used.

During the stranding, 1.1 million gallons of ballast was treated at levels of 50-100 ppm of calcium hypochlorite, to prevent the accidental release of an ANS species onto the reef environment. After treatment, the ship was successfully floated off the reef with no loss or release of cargo. In 1996, this event resulted in a test of the newly implemented incident command structure for the USCG and the documented first spill response with ballast treatment. The team raised the following questions after the event:

1. Should ballast water risk assessment be included in response procedures?
2. Was biocide treatment necessary?
3. Can on-site sampling for risk assessment be conducted?
4. If documentation of mid-sea exchange is lacking, how can this be factored into risk assessment?
5. Can probable disease mortality within the tank be calculated and factored in?
6. How important is the distance of the ship to the resource to be protected?

In every event, the best course of analysis will be convening a subject matter expert panel for site specific analysis. Since 1996, there are new tools and studies available to the panels or incident managers to help respond to the questions raised above. There are also opportunities to pre-load risk assessments based on current knowledge through the Net

Environmental Benefits Assessment planning process by identifying and incorporating known high risk ballast origin sites into the analysis. I will provide a response to the incident team's questions from an NPS manager's perspective.

1. Given the current cost of ANS mitigation in the United States and the freshwater environment of the Great Lakes, I recommend that ballast water should always be considered and evaluated as part of the response. For areas with high standards for protection, such as National Parks and marine conservation areas, it is essential.
2. Live ANS are prohibited to be released within NPS jurisdictional areas per both NPS and USCG regulations. If the ship's transit records indicate that the ship took on ballast in an area that has ANS, any release of ballast with live ANS will be in noncompliance with NPS rules and policy, and any release of unmanaged ballast will be in violation of USCG regulation. Treatment will be a critical component of risk reduction, and the ability to implement treatment within the parameters of an emergency response will need to be accounted for. If not, the responsible party could be held liable for the subsequent appearance of an ANS that damages park resources. There is a list of species identified as having the opportunity to become established for the Great Lakes and there are internationally recognized diseases that have the ability to cause significant harm in the event of an accidental release. The spread of these species in particular should be slowed by the most effective method available.
3. VHSV, which is an international disease of concern, is very difficult to isolate from a large ballast water tank and can take weeks of lab analysis for verification. For many species, culturing or finding the species in large volumes of water will not be practical under emergency response timelines. On-site risk assessment can review ballast records and ports of uptake and make their best assessment.
4. Documentation of ballast exchange has greatly improved since 1996. Within the Great Lakes' system, the Great Lakes Ballast Water Working Group reports that 30 percent of the ships arriving within the system still have "minor" compliance issues with ballast management practices including documentation. With increased compliance checks they are seeing a rapid improvement in this area. It is important to note the Environmental Protection Agency's (EPA, 2008) findings that ballast records need to be maintained for long periods of time, because each tank may be managed differently; ballast uptakes, five ports previous and/or last port of uptake, may influence a risk assessment (Johengen and others 2005). The USCG is requiring ballast records to be stored on board for 2 years, which should provide better risk assessment.
5. Though some ANS mortality occurs within the tank during transit, studies have shown residual viability of organisms within tanks. Thus, each situation has to be evaluated with respect to risk of release of viable ANS. The use of treatment against residual ANS measured against the harm to native biota from the subsequent release of either treated (with or without biocide neutralization) or untreated ballast will be critical to address.

6. Distance from the specific resource of concern will require site specific analysis by subject matter experts. Data on this issue may be limited, but should always be considered when available.

In summary, for the Biscayne National Park incident, the natural resources trustees were satisfied that the risk reduction by biocide treatment was warranted and significant. In fact, the current Superintendent has stated that if faced with a similar situation he would follow the same process to determine appropriate risk reduction, and biocide treatment would be considered. Subsequent dye studies have provided data on the dilution effects of direct discharge from a ship which will enable managers to better assess the effects of a direct residual biocide release without neutralization on native aquatic species. Doing a better job of risk assessment should be a focus of all emergency responders, by using adaptive management techniques to learn from each incident.

Protecting Marine and Freshwater Parks in the Future

The effects of the wrong species entering your park at the wrong time can be devastating to natural resources. An invasive species issue can escalate rapidly; the expansion of zebra mussels and quagga mussels in the Great Lakes provides a dramatic example. We are in the process of crashing the deep water fisheries of both Lake Michigan and Lake Huron, having allowed these mussels into the system. In addition to the effect of invaders on natural resources, cultural resources can also suffer.

So how do you become the last place to be invaded by ballast transferred ANS? How would you slow the spread into your park? The NPS assembled a team of scientists from the USGS, naval architects, marine engineers, and industry leaders; to create an *Emergency Response Guide for Handling Ballast Water to Control Non-Indigenous Species* (Reynolds and others 2010) and to test it on the largest of Great Lakes ships. Indeed, the only commercial ships larger in the world are supertankers. The guide addresses two situations: (1) when a ship runs aground in your park; and (2) when you know a ballasted ship is coming in from an area with high risk ANS transfers and you would like to treat it before allowing it to come in.

The techniques are designed to work with equipment that is typically on board a ship, including small pumps, hoses, fittings, and drums. The study gathered the data to be able to rank methods of delivering a liquid into a ballast tank to distribute it evenly. The Argentina vent dosing techniques were ranked with three other techniques. For empty tanks, the easiest and most effective method is in-line mixing. Full tank dosing is more difficult to mix and requires working with the ship owner prior to arrival, in order to encourage or mandate that full tanks be treated before arrival and release.

The emergency handbook can enable managers who have the authority to protect resources to show how ballast can be treated using equipment that is typically found on a ship and is readily accessible. In the case of groundings, the U.S. National Park Service does not allow for the release of live ANS into NPS waters; thus, when the Igloo Moon grounded in Key Biscayne, NPS required that no live ANS be released

and worked with a team to find a temporary solution. The emergency handbook also documents how to approach a ship situation when you know it will want to discharge ballast as it offloads people or cargo within your Park. Some options for treatment are captured in the guide as well as a prototype risk assessment document to help you evaluate and develop a risk assessment tailored to your situation.

Risk assessment should occur before an emergency event occurs, but if ballasted ships are currently visiting your protected area, you should start the analysis right away. Knowing where the ship is coming from and the risks associated with live species in its tanks is critical. Ship information is available from the U.S. Coast Guard and many port authorities have web sites with ship arrival details. You need to identify areas of concern. After you know the area of concern, you need to identify chemicals that can kill the species of concern while meeting regulations related to chemical use in your country.

The result of the first draft on risk assessment is captured in the guideline. This guide documents current options for mixing biocides in ballast tank and their limits and options for neutralization. It is intended to stay as a draft and includes a system for modifying it as new information is obtained.

NPS will continue to work with the development of the salvors' guide in order to develop a process to document (1) how to monitor the treatment efficacy when it occurs; and (2) how to improve future results by incorporating the monitoring information into the emergency response system. Please access this guide at www.nps.gov/isro (search for ballast emergency guide). The intent is to keep the draft updated and current on a web site and to add information and results as the techniques are implemented. This first draft included solid data on how to treat tanks that are empty and promising data on treating tanks that are full. We will be conducting shipboard trials on ways to enhance mixing in full tanks during spring of 2010 and will incorporate the information at that time. We are also taking the National Park Service guidebook to a subcommittee of the U.S. National Taskforce on aquatic nuisance species to be reviewed for adoption by all Federal agencies.

What can you do if you don't have the legal authority to require treatment for park protection? There is no harm in asking for voluntary treatment. At least with this guidebook you can offer the generic means to deliver a chemical and hopefully, after discussions with scientists, offer suggestions for chemicals that would disinfect for the ANS you are most concerned about. At this point, the choice of what chemical to use should always rest with the ship owner/Captain who knows the fittings and coatings of the ship's tanks and piping, and the training and materials handling capacity of the crew.

Summary

Have a marine or freshwater park review your authorities to know if you can mandate treatment, or need to work pro-actively for voluntary treatment.

You can use this guide to outline ways to treat the ballast if one of these scenarios occurs: (1) a ballasted ship runs aground in your park, or (2) a ballasted ship is arriving from an area of concern for ANS transfers. The actual treatment could be (1) conducted voluntarily under the responsibility

of the Captain or ship owner, (2) initiated by your country's emergency response personnel when they have the authority, or (3) required through concession contracts or legal mandates. Enhancing the protection of our salt and freshwater parks from the most common dispersal methods for international aquatic pests is an achievable goal.

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Planning for People? An Evaluation of Objectives for Managing Visitors at Wildlife Refuges in the United States

Jeffrey J. Brooks and Robert Massengale

Abstract—This study evaluates the quality of planning objectives for visitor services as written in Comprehensive Conservation Plans for the National Wildlife Refuge System of the United States. Planners in the U.S. Fish and Wildlife Service are predominantly writing public use objectives that address wildlife recreation and education. Results indicate that planners are writing visitor services objectives that are achievable and results oriented. Overall quality of objectives has improved since the Refuge Improvement Act of 1997. The highest quality objectives identified target audiences, accounted for monitoring, and were accompanied by detailed rationales and literature citations. More work is needed to write objectives that are specific, measurable, time limited, and credible. Implications for refuge planning are discussed, including changes in monitoring strategies and expertise as the focus of visitor services planning potentially shifts from providing opportunities to enabling the experiential outcomes that are desired for refuge visitors.

Introduction

We believe that in its broadest sense, conservation planning has three main purposes that are equally important: planning for the maintenance of ecological function, biological diversity, and visitor services for the indefinite future. This paper is about visitor services planning, which generally addresses people's access to, enjoyment and use of, and learning about conservation areas. Effective project planning in general and conservation planning in particular require knowing specifically what our goals and objectives should be and how to measure progress in reaching them

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

(Lewis 2002; Meretsky and others 2006; Salafsky and others 2002; Schroeder 2006; Tear and others 2005). Likewise, an important part of visitor services planning is writing specific objectives to guide how we provide and manage opportunities and enable experiences for people who visit wildlife refuges and other conservation areas (Adamcik and others 2004; Schomaker 2008). Attaining our objectives for visitor services is important because successfully doing so can enable visitors to understand their roles in conservation and the value of wildlife refuges (Meretsky and others 2006). The purpose of this paper is to examine how well conservation planners in the United States Fish and Wildlife Service (FWS) are writing planning objectives for visitor services.

Planners in the FWS are directed by laws and policies to plan for visitor services and recreation activities such as hunting, fishing, wildlife viewing, and education. The Refuge Improvement Act of 1997 states that recreation activities that are compatible with refuge purposes and focused on wildlife resources are legitimate and appropriate public uses of refuges. The overarching goal of the FWS policy on visitor services is to enhance access to quality experiences and opportunities for recreation that is based on wildlife resources (FWS 2006). The FWS uses a planning process to develop a Comprehensive Conservation Plan (CCP) for each refuge. The CCP is the official document used by FWS to fulfill the mission of the National Wildlife Refuge System (NWRS), describe the desired future conditions or goals of refuges, and provide long-term guidance and direction to achieve the purposes for which the refuges were established. Planners are directed to write goals for visitor services and develop objectives to address each goal in each refuge's CCP. Planners need to articulate objectives so that what the FWS should measure to assess progress toward attainment (FWS 2000) is clear.

The purpose of writing high quality objectives for visitor services is to have more effective and successful visitor management plans and, ultimately, citizens who better understand their roles in conservation at wildlife refuges. Publishing planning objectives that are specific and measurable allows the FWS to document its progress and defend its conservation practices when it is challenged on contentious issues (Meretsky and others 2006). To be competitive with the many other goals and objectives of a political society, conservation objectives, including those for visitor services, must be evaluated against and meet established principles and criteria (Schroeder 2006; Tear and others 2005). Evaluating planning objectives allows planners and policy makers to

track effectiveness and improvement over time and allocate limited resources to well-designed conservation strategies and visitor services programs that have been successfully implemented in the field.

To assess the condition of visitor services planning for the FWS, we evaluated the quality of visitor services objectives published in 1997 through 2009 as part of the CCP process. We focused on objectives written to address public recreation, education, and enjoyment and use of wildlife resources at refuges across the NWRs. We adapted an evaluation tool from the literature for the analysis.

Methodology

Evaluation Framework

To understand the essential properties of effective objectives for visitor services planning and determine the appropriate criteria for evaluation, we conducted an Internet search for previously published work using <http://www.google.com>. We found scant literature that specifically evaluated visitor services goals and objectives for planning at national

wildlife refuges. However, a number of authors, writing in both academic and applied outlets, described frameworks for writing and evaluating planning objectives for biological and ecological conservation goals. For example, Schroeder (2006) evaluated conservation objectives in refuge CCPs that address ecological restoration, and Tear and colleagues (2005) used case studies to highlight fundamental principles and standards for setting conservation objectives.

Project managers, planners, and analysts have used various adaptations of a common framework to judge the essential qualities of planning objectives (table 1). The framework is called SMART, and the acronym generally denotes five criteria that characterize objectives that are well written: Specific, Measurable, Attainable, Realistic, and Time Limited (Lewis 2002). Margoluis and others (1998) defined effective planning objectives as detailed statements that describe the specific outcomes or accomplishments of a project and possess the SMART qualities. Tear and his colleagues (2005) outlined five fundamental principles for setting effective, science-based objectives in the field of conservation biology, including writing planning objectives that are measurable by some standard scale.

Table 1—Summary of evaluation frameworks found in the literature and used by conservation professionals to judge the quality of effective planning objectives.

Source and arena	Objective defined	Principles, standards, and criteria
<p>Lewis 2002 Corporate project management</p>	A statement that tells a manager what result is to be achieved; it defines the desired end state.	The desired result must be valid for the person or group that will work toward meeting the objective. Objectives must be Specific, Measurable, Attainable, Realistic, and Time Limited .
<p>Margoluis and Salafsky 1998 International development and conservation biology</p>	A detailed statement that describes the specific accomplishments of a project.	<p>Specific: The objective is defined so that all project participants have the same understanding of what the terms in the objective mean.</p> <p>Measurable: The objective is defined relative to a certain standard scale such as a number, percent, ratio, or fraction.</p> <p>Practical: The objective is clearly achievable and appropriate within the context of the conservation area.</p> <p>Impact Oriented: The objective is written so that it is clear that its attainment will produce a change or impact in the target condition.</p> <p>Time Limited: The objective will be attained within a specific period of time.</p>
<p>Adamcik and others 2004; Schomaker 2008; Schroeder 2006 Conservation planning in a federal land management agency</p>	A concise statement of what a manager wants to achieve.	Objectives are derived from planning goals and are used to determine and evaluate the success of management strategies. Objectives must be Specific, Measurable, Achievable, Results Oriented, and Time Fixed ; based on sound, documented science; and supported by a clear rationale.
<p>Tear and others 2005 Conservation biology and ecology</p>	A statement that specifies a quantifiable area or number of individuals/populations identified in a conservation plan or vision.	Conservation planners must state clear but general goals, define measurable objectives, separate science from feasibility, use the scientific method, and anticipate change.

Planners in the FWS are directed to write measurable objectives based on scientific and expert knowledge, cite appropriate literature, write detailed rationales, and develop implementation strategies to explain and support their objectives (Adamcik and others 2004; FWS Manual 2000). The FWS published a handbook in 2004 for planners in the NWRS titled *Writing Refuge Goals and Objectives* in which it defined objectives as concise statements derived from planning goals of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work (Adamcik and others 2004). The FWS handbook outlined a variation of SMART to define the essential properties that CCP objectives should possess, and Schroeder (2006) applied the framework in an evaluation of FWS planning objectives for ecological restoration. Based on this literature, we developed an adaptation of the SMART framework as our core evaluation tool and crafted appropriate definitions for each criterion to guide this analysis (table 2).

Sampling

We used a cluster sampling design, proportionate to size, with stratification (Scheaffer and others 1996; Watson and others 2000). We randomly selected 54 CCPs as clusters of objectives, and within CCPs, we evaluated all objectives

($n = 352$) that addressed visitor services. We sampled from a list of all CCPs ($n = 196$) that were finalized and published in 1997 through 2009, 1997 being the year that the Refuge Improvement Act became law. We stratified the sample proportionately to account for different numbers of refuges within regions and urban and rural areas in the NWRS. In other words, we selected a number of CCPs from each of eight regions (strata) proportionate to the total number of CCPs that were finalized in that period for each region. To account for differences in population size near refuges, we selected CCPs proportionate to the total number of urban and rural refuges in each region that had published a final plan in that period. Urban designations were given to refuges that were within 10 miles of a centralized population of 50,000 people or greater (U.S. Census Bureau 2002). Approximately 20 percent of the CCPs sampled came from urban refuges.

Analysis

To ensure consistency in judging the quality of objectives (Schroeder 2006), one investigator independently reviewed the appropriate sections of the CCPs and read and scored each objective that pertained to visitor services against each SMART criterion in table 2. The analyst independently coded the content of each objective either “yes,” “partial,” or “no”

Table 2—Evaluation framework, based on the SMART criteria, with definitions used to judge the quality of visitor services objectives for refuge Comprehensive Conservation Plans, and supporting information examined in relation to quality.

Essential quality	Conceptual definition	Applied definition (Yes/Partial/No)
Adaptation of SMART		
Specific	A well defined, targeted objective that clearly states the issue at hand in an unambiguous manner.	Objective provides a clearly defined target issue to be addressed by an understandable course of action.
Measurable	A quantified target for managers to achieve.	Objective provides a numerical benchmark, standard, or tangible product envisioned as an outcome.
Achievable	Establishes realistic and reasonable expectations for meeting the objective.	Objective communicates a reasonable, practical action that makes sense in the context of the goal and rationale.
Results Oriented	Outlines a specific outcome as a result of an action or response to an existing issue.	Objective presents a clear outcome resulting from the proposed action on the target issue.
Time Limited	Establishes a defined time line or benchmark for achievement of the objective.	Objective specifies a date or time limit for initiation, implementation, or completion.
Supporting Information		
Visitor Target	What public group is being addressed?	Objective specifies a defined type of visitor or audience such as children, adults, hunters, or anglers.
Citations	Is objective based in credible academic, management, or policy research?	Objective contains citations of previous work for support.
Monitoring	How do we know if we met the objective?	Objective discusses some means of evaluating progress toward attainment.
Rationale	Why is the objective important and necessary?	Objective is supported by a discussion that provides background and justification.

based on the extent to which it satisfied each criterion. “Yes” signified that an objective clearly and adequately satisfied a criterion based on our definitions in table 2. A partial score signified that an objective had met some of the property of the criterion but was incomplete or inadequate. “No” was coded for objectives that did not meet the definition of the criterion in any way. That is, a score of “no” meant that the essential quality was altogether missing from the objective. The analyst also independently examined each objective, with its underlying strategies, for the documentation of supporting information such as citations and monitoring strategies (table 2).

Results and Discussion

Wildlife Recreation

We evaluated a total of 352 planning objectives. We found that 79 percent of these addressed one of six activities directly related to wildlife on refuge lands, including hunting, fishing, wildlife viewing, photography, education, and interpretation of wildlife resources. These activities are priority public uses of the NWRS as identified in the Refuge Improvement Act of 1997. Our analysis indicated that planners in the FWS are publishing a majority of visitor services objectives that address wildlife recreation and related activities.

The SMART Criteria

Overall results for the SMART evaluation of visitor services objectives are presented in figure 1. We found nearly all objectives (97 percent) to be achievable in that they communicated a realistic and reasonable expectation for attainment. We found over 60 percent of the objectives to be results oriented in that doing the proposed action would produce a clear outcome relevant to the target issue. An additional 20 percent were judged to partially meet the Results Oriented criterion. We found over 40 percent of the objectives to be time limited in that the wording of the objective defined a timeline or benchmark for attainment. We found 37 percent of the visitor services objectives to be measurable and 30 percent to be specific as judged against the definitions in table 2. Our results indicated that more work is needed on the part of FWS planners to write visitor services objectives that provide a clearly defined target to be addressed by specific management actions and that can be measured using standard metrics. We suggest, however, that FWS planners are paying attention to the level of specificity with which they write objectives for visitor services as evidenced by our finding that 33 percent of the objectives partially satisfied the Specific criterion (fig. 1).

Initially, we used the SMART criteria to evaluate the wording of each objective in combination with the wording of any implementation strategies that were written in support

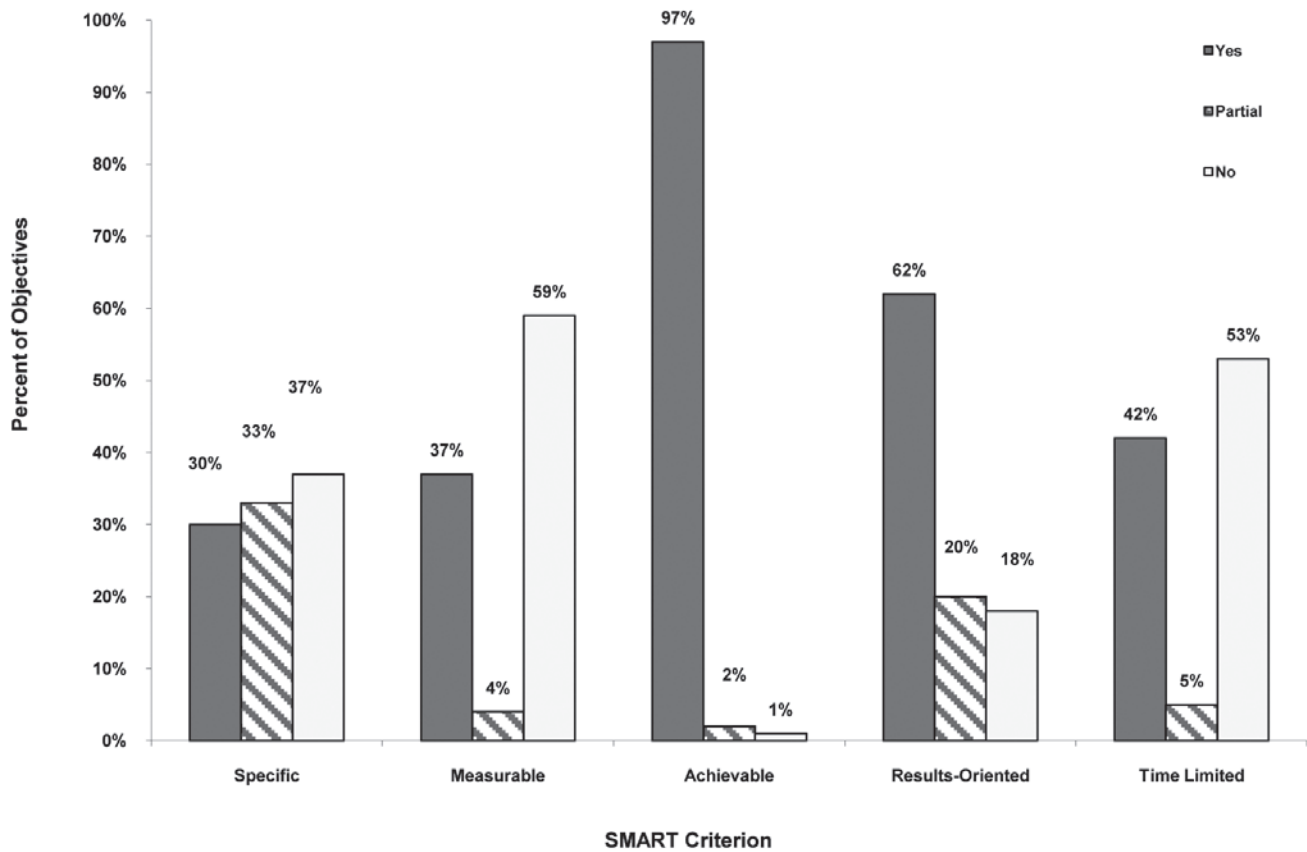


Figure 1—Overall results of the SMART evaluation for visitor services objectives for refuge Comprehensive Conservation Plans (n = 352).

(Schroeder 2006). We believe that including the strategies in the evaluation resulted in an overly optimistic estimate of quality for visitor services objectives. That is, we initially found a higher level of positive outcomes on the SMART criteria than was reflected by reading only the wording of the objectives. Although we would recommend writing strategies as an important part of CCPs, it may often be the case that policy decision makers and other stakeholders only have time to read the objectives apart from the accompanying strategies. Executive summaries, for example, usually do not include such details, and some CCPs do not include strategies. For these reasons, we decided to evaluate the wording of each objective by itself on the SMART criteria. When we compared results, we found substantial differences for all criteria except Achievable (fig. 2). When strategies were included in the SMART evaluation, we judged a greater number of objectives to meet the criteria of Specific, Measurable, Results Oriented, and Time Limited. We suggest that this finding highlights the need to write higher quality, stand alone objectives for decision makers and other stakeholders who may never see or read strategies.

Supporting Information

To provide a broader understanding and deeper description of the qualities of effective objectives for visitor services, we examined the relationship between quality, based on the SMART criteria, and the presence of four types of supporting information described in the literature and FWS policy

directives. These included visitor or audience target, cited references, an account of monitoring, and a rationale used to explain and justify the objective (table 2). We used figure 3 to show the relationship between the quality of objectives and the presence of this supporting information. We determined that 14 percent of the sample of objectives that we evaluated satisfied all five SMART criteria (n = 49). These are the highest quality objectives. All 49 identified a type of visitor or group of people as the target of or audience for the proposed action (fig. 3), which contributed to the specificity of these objectives. All of the top SMART objectives were accompanied by a rationale that explained or justified the objective. A substantial number of the highest quality objectives (82 percent) documented a plan or strategy for monitoring progress toward attainment. Only 39 percent of the objectives cited references, indicating a need for planners in the FWS to write visitor services objectives that are more clearly linked to academic, management, and policy research.

Improvement Over Time

We suggest that one purpose of conducting evaluations of planning objectives for visitor services is to track progress or improvement through time. We examined improvement over time in this study by comparing the percentage of objectives that satisfied all five SMART criteria by year of CCP publication (fig. 4). No objectives published in 1997 through 2001 completely satisfied SMART.

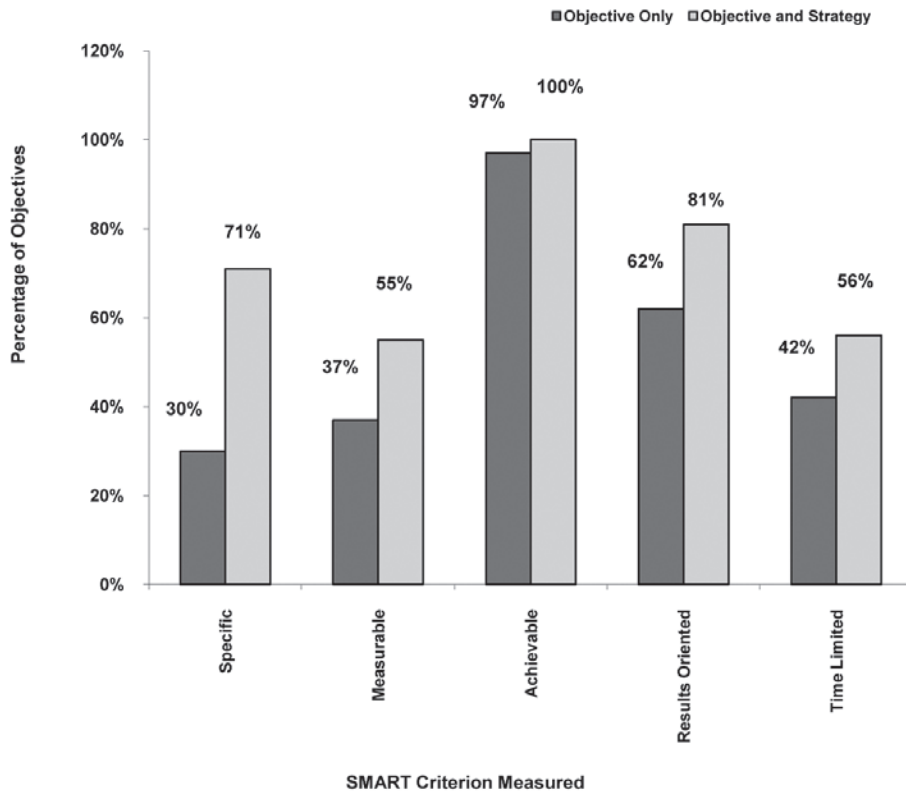


Figure 2—Comparison of results of SMART evaluation for visitor services objectives, wording of objectives only and objectives combined with supporting strategies (n = 352).

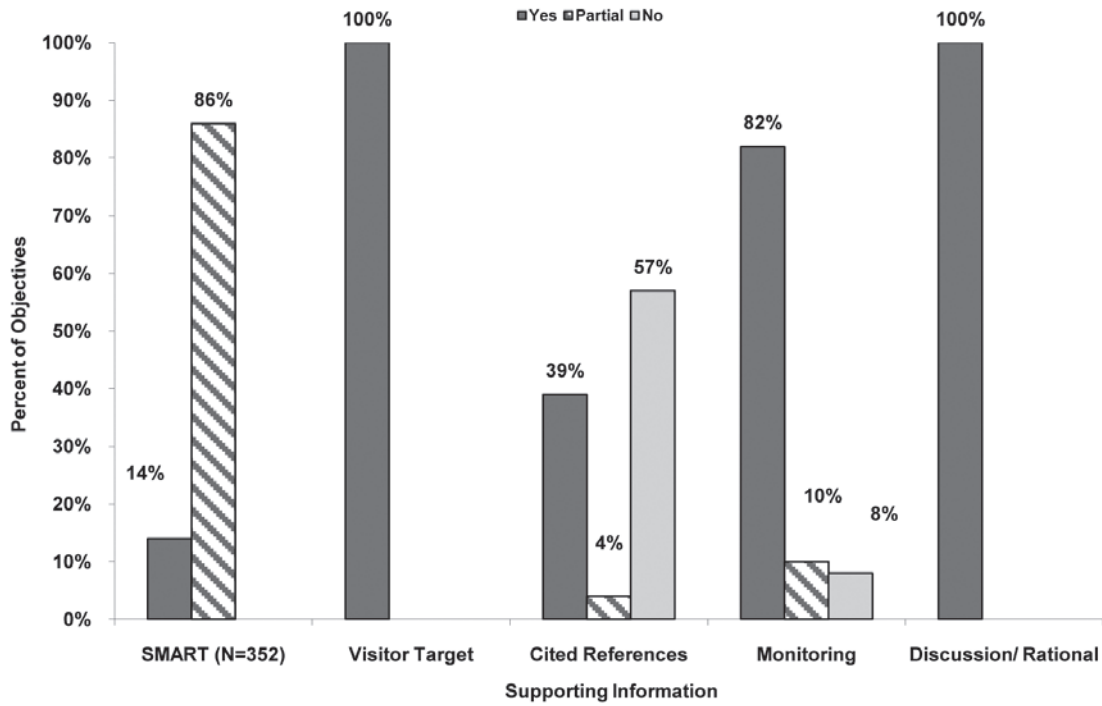


Figure 3—Documentation of supporting information to accompanying visitor services objectives for objectives that satisfied all five SMART criteria (n = 49).

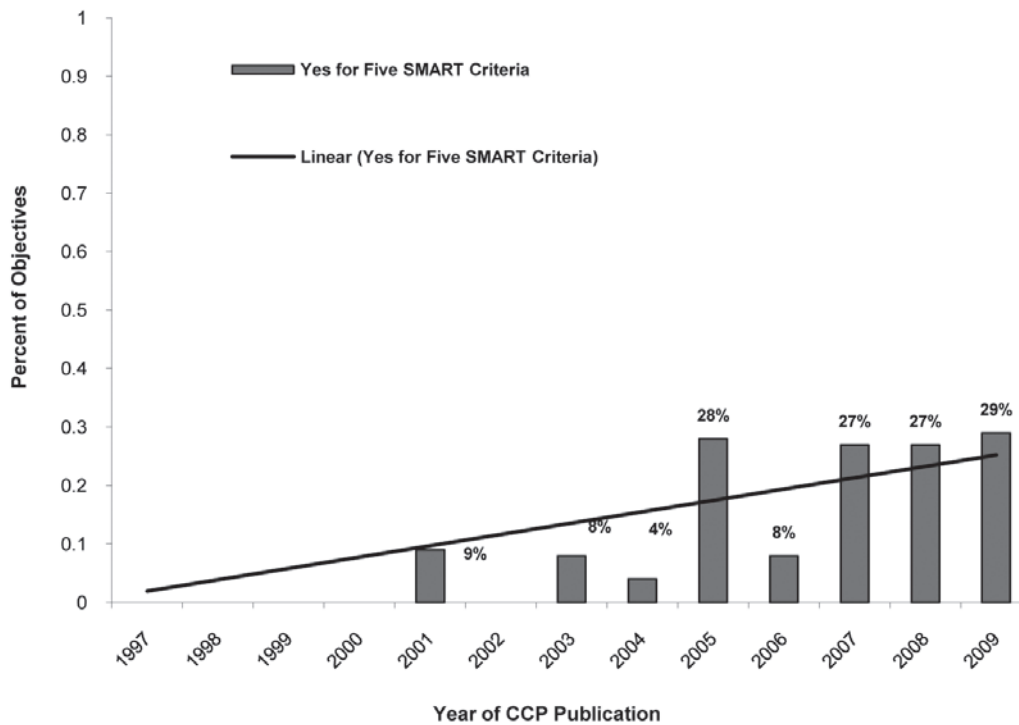


Figure 4—Increase in the percentage of visitor services objectives that satisfied all five SMART criteria, showing a linear trend of improvement over time in quality for objectives in refuge Comprehensive Conservation Plans (n = 49).

For 2002 to 2009, the percentage of highest quality objectives meeting all SMART criteria varied somewhat but showed an overall trend toward improvement with a range of 9 percent in 2002 to 29 percent in 2009. We found this trend in improvement to be consistent with Schroeder (2006) who documented similar improvement over time for biological objectives published in refuge CCPs in 1997 through 2004.

Opportunities and Experiences

Visitor services management generally involves providing and maintaining opportunities and facilities for visitors; managing the settings in which visitors interface with the landscape; and working to understand, provide, and facilitate the experiences that visitors desire and find satisfying. We examined each objective to determine if it identified a target facility, opportunity, or setting to be developed or managed for visitor use. We also checked each objective to see if it identified an experiential outcome for visitors in which an impression, knowledge, or experience could be gained by visitors as a result of doing the proposed action. We found that 56 percent of the objectives that we evaluated focused on providing opportunities or facilities for visitors, and only 10 percent focused on experience outcomes for visitors (fig. 5). We suggest that this result indicates that planners in the FWS need to pay more attention to the types of experiences that people are having at refuges. The FWS also needs to track whether or not visitors are having the kinds of experiences that FWS expects them to have as a result of implementing planning objectives. Finally, it is important to point out that 21 percent of objectives were coded partial for identifying an experience outcome as a target of management (fig. 5).

Implications and Conclusions

Overall, these results indicate that planners in the FWS are doing well at writing visitor services objectives that are achievable and results oriented. However, planners in FWS need to continue to improve the writing of their objectives to be more specific, measurable, and time limited. We presented evidence that the quality of visitor services objectives in refuge CCPs has improved since the Refuge Improvement Act became law in 1997. The greatest amount of improvement in quality occurred after 2004, which was the same year that FWS published guidance for writing planning goals and objectives (Adamcik and others 2004). Figure 4 shows evidence of a correlation between improvement in quality of objectives and year of CCP publication. We recommend that more research be done to investigate this correlation and to better estimate the impact of the guidance handbook and other policy directives on the quality of visitor services objectives in refuge CCPs.

The SMART evaluation framework that we applied in this study can serve as a useful method for evaluating the general quality of planning objectives for visitor services. We believe that more work needs to be done to refine SMART for use with refuge CCPs. The individual criterion used in SMART may not indicate quality for objectives in an equal manner. In other words, some of the criteria are most likely not independent or mutually exclusive. For example, we suspect that the criteria Specific and Results Oriented are closely related. In this study, the Achievable criterion did not differentiate well among objectives; 97 percent of the objectives were judged to be achievable. We found little variance across the sample of objectives on the Achievable criterion. We suggest that planning objectives that are specific, measurable, focused on results, and that have a completion

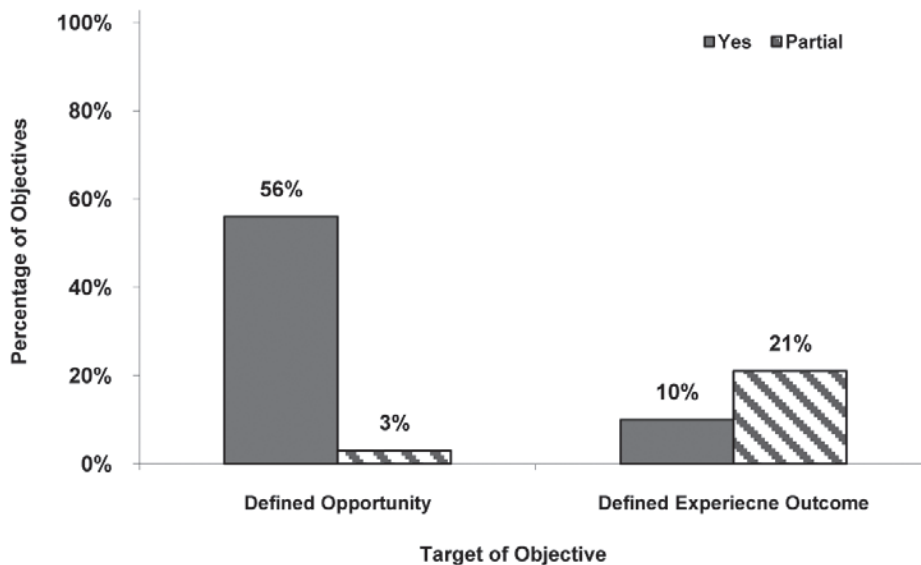


Figure 5—Percentage of visitor services objectives that addressed visitor services opportunities or facilities compared to objectives that addressed experiential outcomes for visitors (n = 352).

date should almost always be achievable given adequate resources. For refuge CCP objectives, we recommend that the Achievable criterion be replaced with a criterion used to indicate accountability to refuge purposes and goals and to the mission of the NWRS. This criterion could be labeled “Accountable” and the SMART acronym would be retained.

To further refine the SMART framework for evaluating the quality of visitor services objectives written in refuge CCPs, we recommend that the analyst define the five criteria at a level of specificity appropriate for the long range, comprehensive, and often general nature of refuge CCPs. The tool used to measure quality of planning objectives must match the context and purposes of the planning document in which the objectives appear. In addition, we recommend that analysts apply the SMART framework to the wording of the objectives apart from their underlying strategies for implementation and other information used in support of the planning objectives. We suggest that doing this will minimize cases in which analysts overestimate the quality of visitor services objectives and their potential impact on the reader. Finally, we recommend that planners create and use a consistent document format to present visitor services objectives in sections of their conservation plans. We found that document sections that used bullets and clear headings and subheadings were easier to review, understand, and evaluate. We advise that readability and a concise presentation style are of great importance to busy decision and policy makers and others who have a stake in conservation.

Figure 3 shows evidence that the objectives of highest quality identified target audiences or specific types of visitors, accounted for monitoring progress, and used rationales to explain and justify objectives. We suggest that investing the time in developing information to support visitor services objectives is related to writing quality objective statements. This includes reading and summarizing relevant literature that has been published about visitor services planning and management. We found that only 7 percent of the objectives that we evaluated cited references. However, we found that nearly 40 percent of the objectives that met all SMART criteria included citations (fig. 3). Effective visitor services objectives written for conservation plans must be scientifically and professionally credible, where expert experience and opinion are corroborated by appropriate scientific procedure and knowledge (Adamcik and others 2004; Schomaker 2008; Schroeder 2006; 2008; Tear and others 2005). We recommend that visitor services planners in the FWS write a detailed rationale or narrative in support of each objective to explain their assumptions and reasoning and cite the available literature or data that they use to develop and write each objective. We understand that it takes effort and time to find what information is available for a specific issue or proposed management action, but we suggest that making the investment to find and use relevant sources can improve the quality and credibility of visitor services objectives.

For decades, social science researchers have been conducting studies and theorizing about the relationship between recreation settings and the experiences of people who visit and recreate in those settings (Borrie and Birzell 2001; Williams 2007). Our results suggest that planners in the FWS are writing more objectives that target opportunities, facilities, and settings for visitors than objectives that address

the experiences of visitors (fig. 5). We suggest that planning and managing for both opportunities and experiences is important and necessary for effective conservation at refuges. Moreover, we believe that it is critical that conservation planners and managers within FWS work toward better understanding the relationships between opportunities and visitor experiences across the NWRS, which will require more training and hiring of staff who possess expertise in the social sciences.

We found that 21 percent of these objectives were written to partially address visitor experiences (fig. 5). We suggest that this finding is evidence that planners in FWS are beginning to invest more effort in planning for visitor experiences but not yet at the same level as for opportunities and facilities. The implications of a shift to planning for experiences are substantial in regard to monitoring attainment. The emphasis in monitoring will need to shift from counting visitors to talking with visitors using surveys, interviews, and focus groups to determine the nature of their experiences and the extent to which visitors are gaining the experiential outcomes that the FWS desires (Adamcik and others 2004). For example, objectives that target school aged children for education on wildlife species or populations can only be monitored by somehow measuring how much the children have learned as a result of participating in the education programs outlined by such objectives. Likewise, the FWS will need to periodically define and measure satisfaction levels for hunters and anglers to monitor success in planning for these activities at refuges.

Over time, researchers developed diverse approaches that have been used to define and monitor the quality of visitor experiences (Borrie and Birzell 2001; Williams 2007). We echo these authors by reminding planners and managers in FWS that visitor experience is multidimensional, complex, and often highly meaningful for individuals. We concur that no one approach to defining and monitoring the experiences of visitors across the NWRS will be adequate. Those who monitor attainment must understand what models and methods are appropriate for specific planning targets and desired outcomes. We recommend that the FWS recommit to and reinvest in training and hiring personnel as a strategy to increase its expertise in the social and economic sciences across the NWRS.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

Wilderness: An Unexpected Second Chance

Jerry Magee and Dave Harmon

Abstract—The Federal Land Policy & Management Act of 1976 directed the Bureau of Land Management (BLM) to inventory its lands for wilderness characteristics and to protect identified areas as “wilderness study areas” (WSAs) until acted upon by Congress. BLM conducted these inventories and studies between 1976 and 1991, finding nearly 800 areas totaling 9.6 million hectares to possess wilderness characteristics. The remaining areas, released from “interim management” protection, were expected to be further degraded by uses not allowed within WSAs. In the ensuing 20 to 30 years, however, a surprising number of formerly unqualified areas have now been found to meet minimum wilderness criteria. Using Oregon public lands as an example, this paper highlights events, prompted largely by non-governmental organizations conducting “citizen inventories,” and renewed wilderness inventory efforts conducted by the BLM, that have led to an unexpected second chance to recognize new areas with wilderness characteristics.

Introduction

The Bureau of Land Management (BLM), which administers 105 million hectares of Federal surface and 283 million hectares of subsurface mineral estate in the United States, was belatedly added to the list of agencies authorized, through the 1964 Wilderness Act (<http://wilderness.org/content/wilderness-act-1964>), to inventory, study, and manage wilderness areas. The Federal Land Policy & Management Act of 1976 (FLPMA) (<http://www.blm.gov/flpma/>), which firmly established the BLM as an agency that would manage lands “in perpetuity,” included a provision directing BLM to inventory the public lands under its management for areas possessing wilderness characteristics and to manage such “wilderness study areas” to preserve their wilderness character until such time that Congress either designates them as wilderness or releases them from further wilderness study.

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Areas deemed to have wilderness characteristics must meet the minimum Wilderness Act criteria of (1) size—roadless areas of at least 2,024 hectares or of a manageable size, (2) naturalness—generally appears to have been affected primarily by the forces of nature, and (3) opportunities—provides outstanding opportunities for solitude or primitive and unconfined types of recreation. Wilderness characteristics and wilderness values are used synonymously in this paper. BLM conducted these inventories and studies between 1976 and 1991, finding nearly 800 areas totaling approximately 9.6 million hectares to possess wilderness character. Today, BLM manages 224 Wilderness Areas totaling 3.5 million hectares, and 545 Wilderness Study Areas totaling 5.2 million hectares.

Areas not found to possess wilderness characteristics were released from “interim management” protection. Over time, it was presumed that, in the absence of special protection, lands outside WSAs would be further degraded by uses not allowed within WSAs. In the 20 to 30 years that have elapsed since the original inventories, however, circumstances have combined in a surprising number of areas to reverse factors that formerly precluded them from meeting minimum wilderness criteria.

Play It Again, Uncle Sam: Why Are Updated Inventories Finding Wilderness Values Among Previously Unqualified Lands?

Among the many factors causing areas to revert to more wild conditions, we’re finding that three factors dominate. First, natural revegetation has occurred over large swaths of public lands that were mechanically treated over 30 years ago to restore productivity on overgrazed lands. Disked and drill-seeded rows of non-native grasses are no longer visible due to infilling of sagebrush and other native shrubs. Human imprints need only be “substantially unnoticeable” for an area to be considered “natural” for wilderness inventory purposes. Second, some former land uses no longer occur on formerly occupied lands (e.g., abandoned, reclaimed mining operations or road access to now unused developments). The third factor involves acquisition of non-Federal lands, either adjoining existing WSAs or blocking up formerly scattered lands so that they now meet the minimum size requirement.

BLM is updating its original inventories to support project analyses and land use planning efforts. In eastern Oregon, BLM has so far discovered over 92,000 hectares of additional lands with wilderness characteristics. Inventory updates are planned for an additional 2.6 million hectares of lands that previously failed to meet minimum wilderness criteria.

The Only Constant Is Change: How Are Trends in Wilderness Characteristics Changing on BLM- Administered Lands? _____

In general, population growth in the United States has been greatest in the 11 western states that include most of the land under BLM management. In eastern Oregon, we are finding that development pressures and use increase with proximity to growing population centers, while “wildness” has increased in the remotest areas. But circumstances are rapidly changing in many remote areas as the United States embraces renewable energy. Proposals for wind and solar energy are multiplying in areas not previously subjected to energy development for lack of oil, gas, or coal resources. Mixed ownerships exacerbate the potential effects as private landowners, surrounded by Federal lands, seek economic opportunities that renewable energy offers, placing pressure on adjoining Federal lands for expanded development or, at a minimum, transmission line rights-of-way.

Coping with Change: How is BLM Responding to These Trends? _____

BLM’s stewardship responsibilities require careful evaluation and consideration of multiple-use proposals in light of the multiple values existing on public lands. Accordingly, we maintain current inventories of resource values, including wilderness values, on the public lands (as per FLPMA, Section 201). We assess environmental impacts of land use proposals on resource values, including wilderness values (as per the National Environmental Policy Act). And, we plan for the protection and use of natural resources, including wilderness resources (as per FLPMA, Section 202).

Conclusions _____

Through our inventory, analysis, and planning processes, these newly recognized wilderness resources can now be considered for protection through land use plans. Whether expected or not, these areas may become future candidates for addition to the U.S. National Wilderness Preservation System.

The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.

Examining Visitors' Behavioral Intentions and Behaviors in a Taiwan National Park

Chieh-Lu Li and Garry E. Chick

Abstract—In 2007-2008, some visitors to Taroko National Park in Taiwan were surveyed to allow testing of a behavioral prediction model in the context of national park recreation. This model includes three constructs: values (a cultural anthropology factor), perceptions of service quality (service marketing factors), and perceptions of crowding (a national park recreation factor). We obtained a sample of 1,080 visitors. Multiple regression analysis was used to test the predictive power of values dimensions, service quality dimensions and a crowding index on behavioral intentions and behaviors. From the behavioral intentions testing, the model was significant at the 0.001 level, and the model R-square equaled 0.50. Findings were consistent with previous research. For the behavior testing, in contrast, the R-squares of multiple regression models were between 0.029 to 0.036. We concluded that the weak practical significance of the findings of behavior testing may be explained as a validity problem with self-reported data. The actual behaviors questions (e.g., how many times and days respondents visited national parks) that researchers normally used to solicit respondents' memories in questionnaires may be invalid.

Introduction

Visitors to national parks are not homogenous. Different visitors have different intentions and engage in different behaviors. The factors affecting visitor behavior are multi-dimensional, and visitor behavior can be influenced by factors such as perceptions of service quality. For example, visitor dissatisfaction with visits to a destination may be because of a lack of facility quality, service, or information about

that destination. As a result, visitors may not visit the same destination on future trips. Visitors may also communicate their dissatisfaction to friends and relatives and discourage them from future visits (Reisinger 2009). Similarly, diverse visitors have diverse values and these values can be considered as one explanatory independent variable influencing visitors' behavior (Chick 2009). For example, if visitors have a more hedonistic set of values, their core values tend to be positive for excitement, fun, or enjoyment and they might tend to take outdoor recreation trips including places such as national parks. In addition, national parks provide a sort of low density and dispersed recreation and tourism opportunity. Evidence shows that perceptions of crowding are one of the determinants of behavior for visitors to national parks. Therefore, understanding how factors such as service quality, values, and crowding affect visitors' behavior is important as managers must provide quality services to meet the needs of their diverse clientele (Li and others 2007b).

In this study, we proposed a theoretical model comprised of three constructs: values as a cultural factor, perceptions of service quality as service marketing factors, and perceptions of crowding as a national park recreation factor (Li 2009). We then used these three constructs to predict behavioral intentions and behavior. Previous research (e.g., Li and others 2007a) has shown interrelationships among these constructs. However, detailed relationships, such as dimension to dimension relationships among the constructs, remain unknown (Li and others 2008). Therefore, the purposes of this study are twofold: (1) to examine the predictive power of service quality, values, and crowding dimension/index with respect to visitors' behavioral intentions; and (2) to use the same aforementioned independent variables to predict visitor behavior in a Taiwanese national park context.

Methods

Visitors to Taroko National Park in Taiwan were surveyed in 2007-2008. Taroko National Park is a mountainous national park located on the eastern coast of Taiwan, covering an area of 920 km² and providing opportunities for outdoor recreation and enjoyment to both local residents and international visitors. We used a convenience on-site sampling approach at sites known to be heavily used by visitors. Overall, we obtained a sample of 1,080 subjects. In the questionnaire, we employed a Likert response scale and included five constructs: values, service quality, crowding perceptions, behavioral intentions, and behavior.

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Watson, Alan; Murrieta-Saldivar, Joaquin; McBride, Brooke, comps. 2011. Science and stewardship to protect and sustain wilderness values: Ninth World Wilderness Congress symposium; November 6-13, 2009; Meridá, Yucatán, Mexico. Proceedings RMRS-P-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 225 p.

Independent Variables

The List of Values (LOV) developed by Kahle (1983) was adopted to measure possible values differences on a nine-point response scale. LOV includes 9 items, is parsimonious in its approach and easy to administer. Cronbach's alphas of the four dimensions (harmony, respect, achievement, and hedonism) ranged from 0.75 to 0.92, and the composite reliability of the four dimensions was 0.83. To measure service quality, 21 service quality items developed by Burns and associates (2003) were customized to fit the situation of Taiwan and measured on a five-point response scale. The four service quality dimensions including facility, service, information, and management were relatively reliable across different outdoor recreation settings. Our previous research demonstrated that the four service quality dimensions tend to be stable across studies but the items within the dimensions need to be adjusted to fit the specific study. The Cronbach's alphas of the four dimensions ranged from 0.63 to 0.87, and the composite reliability of the four dimensions was 0.85. Three crowding variables formatted on a nine-point scale were used for direct comparison of perceptions about crowding conditions across studies, areas, and time (Manning 1999). The Cronbach's alpha value of the three crowding items was 0.95 (table 1).

Dependent Variables

Five items were used to operationalize behavioral intentions, including passive, active, private, and self recommendations on a five-point scale (Zeithaml and others 1996). The Cronbach's alpha value of the five items was 0.80. To operationalize visitors' behavior, two indices were created, combining on-site (i.e., how many times/days respondents visited Taroko National Park) and general (i.e., how many times/days respondents visited other outdoor recreation areas similar to Taroko National Park) participation rates. The average number of visits per year was 8 and the total recreation days spent at Taroko was 14 days in a year (table 2).

Results and Discussion

With confidence in the reliability of instruments, we further tested for relationships among the hypothesized constructs. Multiple regression analysis suggested that the combined effects of the LOV, service quality, and crowding dimensions/indices significantly predict behavioral intentions with a model R-square of 0.50 (table 3). The findings showed strong practical significance of the model and are consistent with our former research elsewhere. The results indicated that

Table 1—Mean, standard deviation and reliability alpha of service quality, values, crowding and behavioral intentions.

Construct/dimension	Mean	Standard deviation	Alpha	Composite alpha
Service quality ^a	3.60	0.62		0.85
Facility	3.73	0.58	0.86	
Service	3.53	0.72	0.87	
Information	3.66	0.78	0.83	
Management	3.50	0.83	0.63	
Values ^b	6.92	1.44		0.83
Respect	7.08	1.69	0.88	
Harmony	7.24	1.44	0.85	
Achievement	6.86	1.67	0.75	
Hedonism	6.56	2.13	0.92	
Crowding ^c	3.90	2.34	0.95	
Behavioral Intentions ^a	3.82	0.83	0.80	

Table 2—Mean and standard deviation of behavior measure.^a

Item	Item mean	Item standard deviation
Total recreation visits during last 12 months	7.9	11.1
Total recreation days in a typical year	14.3	18.8

^a Items show the self-reported recreation visits and self-reported recreation days. Both total recreation visits and total recreation days combine on-site and general experience measures.

Table 3—Multiple regression model of values (respect, harmony, achievement, hedonism), service quality (facility, service, information, management) and crowding on behavioral intentions.

Dependent variables ^b	Behavioral intentions index ^a				
	Beta	P-value	Model F-value	Model P-value	Model R-square
Respect	0.078	0.023			
Harmony	-0.157	<0.001			
Achievement	0.163	<0.001			
Hedonism	0.392	<0.001			
Facility	0.026	0.389	111.11	<0.001	0.504
Service	0.136	<0.001			
Information	0.098	0.003			
Management	0.001	0.976			
Crowding	-0.132	<0.001			

^a Behavior intentions served as the independent variable.

^b Same dimension/index measure as table 1.

visitor values tended to be more important than service quality in predicting visitors' behavioral intentions, according to the beta values in the model. Additionally, we found the hedonistic values dimension to be more important than the other three values dimensions. Therefore, we conclude that, in terms of a set of broad values measures to understand the patterns of visitors' behavioral intentions, values such as "fun and enjoyment" and "excitement" were key variables in explaining visitors' behavioral intentions in their national park visits.

Second, the results from two multiple regression models predicting behavior revealed that the models were significant but accounted for little of the variance, with model R-square equaling 0.036 and 0.029 for the total reported recreation visits model and total reported recreation days model, respectively (tables 4 and 5). The behavior model R-squares showed

discrepancy with the result from the behavioral intentions model and appear to be of little practical significance. This finding needs further investigation. However, we argue that the weak practical significance of the behavior model may be because of the inaccuracy of self-reported participation rates (Kaikati and Torelli 2009).

A substantial amount of research has demonstrated that memory may distort reality, changing the details of actual experiences (Braun-LaTour and others 2006). Research has shown that post-event suggestion can contaminate what a person remembers. Moreover, suggestion can lead to inaccurate memories being injected outright into the minds of people (Loftus 2003). For instance, Chase and Godbey (1983) concluded that more than 75% of the respondents in a study of participation at a swimming club overestimated their frequency of participation. Thus, we might expect that

Table 4—Multiple regression model of values (respect, harmony, achievement, hedonism), service quality (facility, service, information, management) and crowding on behavior (total recreation visits).

Dependent variables ^b	Behavioral (total recreation visits) ^a				
	Beta	P-value	Model F-value	Model P-value	Model R-square
Respect	0.101	0.041			
Harmony	-0.151	0.002			
Achievement	0.085	0.128			
Hedonism	0.093	0.057			
Facility	0.084	0.051	3.793	<0.001	0.036
Service	0.005	0.912			
Information	-0.022	0.636			
Management	-0.045	0.308			
Crowding	0.025	0.515			

^a Behavior (total recreation visits) served as the independent variable.

^b Same dimension/index measure as table 1.

Table 5—Multiple regression model of values (respect, harmony, achievement, hedonism), service quality (facility, service, information, management) and crowding on behavior (total recreation days).

Dependent variables ^b	Behavioral (total recreation days) ^a				
	Beta	P-value	Model F-value	Model P-value	Model R-square
Respect	0.063	0.212			
Harmony	-0.104	0.034			
Achievement	0.102	0.071			
Hedonism	0.107	0.031			
Facility	0.006	0.887	3.009	0.002	0.029
Service	0.014	0.760			
Information	0.002	0.961			
Management	-0.046	0.313			
Crowding	0.058	0.137			

^a Behavior (total recreation days) served as the independent variable.

^b Same dimension/index measure as table 1.

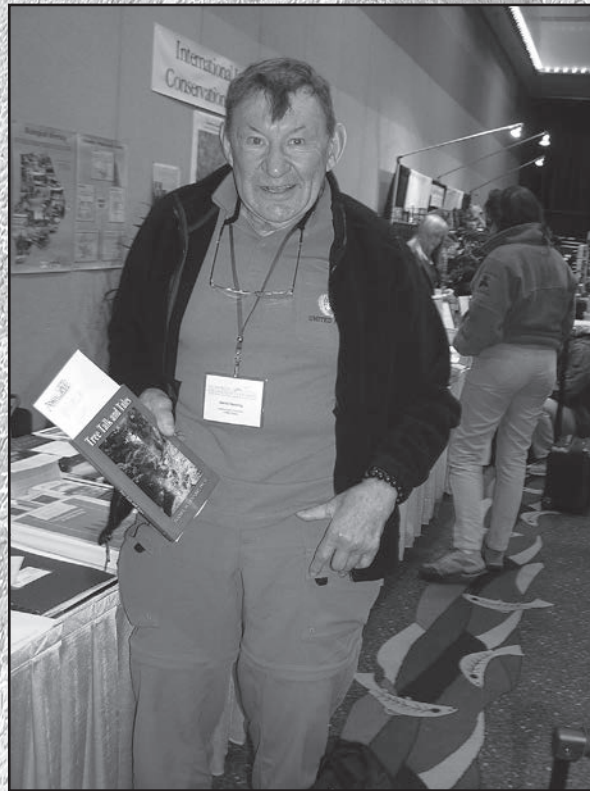
memory biases such as self-reported information would affect the transmission of information, since such a process relies on each person remembering a fact accurately (Bernard and Killworth 1984). In our study, the accuracy of participation rates derived from self-reported surveys is unknown. Without further knowledge of the accuracy of respondent recall, the utility of participation data is suspect. A more complete understanding of the validity and usefulness of self-reported data in operationalizing actual behavior will require additional research, comparing objective measures of behavior with recall data, with multiple national park recreation populations. This line of research warrants future attention.

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7. TRIBUTE



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Natural and Near Natural Tropical Forest Values

Daniel H. Henning

Abstract—This paper identifies and describes some of the values associated with tropical rain forests in their natural and near-natural conditions. Tropical rain forests are moist forests in the humid tropics where temperature and rainfall are high and the dry season is short. These closed (non-logged) and broad-leaved forests are a global resource. Located almost entirely in developing countries, where populations are expected to double in the next 25 years, tropical forests are extremely important to all life everywhere on the planet.

Introduction

Tropical forests are the richest and most diverse expression of life that has evolved on Earth. Their continuous history spans more than 50 million years in some areas. Tropical forests approximate the primeval forest biomes (communities of particular living organisms) from which they originally evolved, and contain more than half of the world's estimated 10-100 million species of plants and animals.

Tropical forests are complex and fragile ecosystems with webs of interlocking, interdependent relationships among diverse plant and animal species and their non-living environments. Irreversibly, tropical forests are literally disappearing within our lifetimes. Nearly half of the original areas of tropical forests have either been destroyed or degraded over the past 100 years. At the current accelerating rate, only fragments of tropical forests are expected to remain by the middle of this century. The Earth's closed or non-logged tropical forests currently occupy a land area equivalent to that of the United States. Each year we are destroying or degrading tropical forests approximately the combined size of England, Scotland, and Wales, at a rate of approximately 100 acres per minute, or the equivalent of one football field per second.

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In Memoriam, "Wilderness Dan" Henning (1931–2009).

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Major causes of this tropical forest destruction are:

1. shifting cultivation that is responsible for nearly half of the total of forests destroyed each year;
2. clearance for cattle raising, the second most important factor in forest destruction in Latin America (the majority of the meat produced on this land becomes North American hamburgers);
3. clearance for new settlements; and
4. timber extraction for fuel, paper, construction, furniture, and imports (Japan, South Korea, the United States and Western Europe are major timber importers).

Most tropical forests are too complex and their species too diverse to regenerate themselves from this destruction or to be managed on a sustained yield basis. Thus tropical forest destruction must be considered permanent and irreversible.

Worldwide recognition of the fact is growing that, in addition to the conservation efforts of the tropical countries, tropical forest destruction is an urgent *global and transnational problem* that requires international action and assistance. In addition, greater awareness of the value of tropical forests is required by the public, thought leaders, and decision-makers. It is vital to address not only the destruction but the reasons why we should not destroy the oldest, richest, most productive ecosystems on Planet Earth.

If we maintain intact tropical forests in as close to natural conditions as possible, they can make immensely diverse, productive, and valuable contributions to all life on Earth, and on a long-range basis. Present and future protected areas and natural or near-natural parks and wildlife refuges may well be the only feasible and permanent way of saving some of the remaining tropical forests and their rich biological diversity. By permitting the rapid destruction of tropical forests, the human species contributes to rather than prevents the destruction of the vital means of survival on Earth. Because the loss of tropical forests is irreversible, so are the negative consequences, the most obvious being the removal of land from productivity, species removal, flooding, and erosion. These negative impacts on life-based values also need to be addressed.

Tropical Forest Values

Values are individual and collective concepts with emotional, judgmental, and symbolic components that we use to determine what is important, worthwhile and desirable. Thus values contain, and at the same time evolve from, judg-

ments and beliefs about what is 'good or 'bad' and 'right' or 'wrong.' Values, therefore, can significantly influence human behavior regarding the conservation or destruction of tropical forests. Values must also be considered when regarding the *consequences* of both the conservation and the destruction of tropical forests.

By their very nature, values are complex in both interpretation and influence. This is particularly true in regard to tropical forests, which involve both anthropocentric (man-centered) and biocentric (ecology-centered) values. The tangible as well as intangible values of tropical forests are difficult and sometimes impossible to define, formulate, and quantify. Tangible values may be more readily recognized because they involve greater demands on the environment in forms such as timber production and industrial use. Intangible values, such as water conservation and education, may be less discernible in terms of economic and other material benefits.

There are, however, numerous high-value interrelationships within intact and natural tropical forests that are as yet minimally disturbed by development. In addition to these varied and complex natural interrelationships themselves, some of the values manifest themselves as the very ecosystems that are tropical forests. These dynamically interrelated values cannot be listed here in any particular order of importance because each is so interdependent with all the others. The values discussed here emerge from interviews with experts, residents, and participants in tropical forest management studies (including recent studies in national parks and reserves of Costa Rica and Thailand) and from surveys of literature on the subject.

Biological Diversity

Tropical forests are the most diverse and complex biomes on Earth, from both an ecological and general biological perspective. More than half of all species on Earth live in tropical forests. Yet tropical forests cover only 6 percent of the planet's land surface. The Earth's tropical forests are estimated to contain between 10 and 100 million species of plants and animals. However, we are losing more than 250 species per day. No more than 1.5% of tropical forest species have been given Latin names, and most are as yet unknown. A typical four-square-mile area of a given tropical forest may contain up to 1,500 species of flowering plants, 750 species of trees, 125 species of mammals, 400 species of birds, 100 species of reptiles, 60 species of amphibians, and 15 species of butterflies. The tropical forests of Costa Rica (approximately the size of West Virginia) contain more than 12,000 species of plants, 237 species of mammals, 850 species of birds and more than 360 species of reptiles and amphibians.

As the most complex and diverse ecosystems on Earth, tropical forests are rich webs of interlocking and fragile relationships among plant and animal species, and among these species and their 'non-living' environment. Most species in tropical forests are scattered and highly specialized, with very low population density. For example, only one tree species may be present in a given sample area. Without adequate areas to sustain reproduction and vital ecological interrelationships, tropical forests are extremely susceptible

to extinction. Tropical forest diversity also correlates directly with vulnerability in that even small areas are not comparable. If one species becomes extinct, or if a small area is damaged and destroyed, other interrelated and dependent species will also suffer extinction as the web of life of the ecosystem deteriorates.

In turn, the great variety of plant and animal species of any small area of tropical forest is a miniature version of the diversity found from area to area, region to region, and continent to continent. Virtually all leading scientists verify the incapacity of tropical forests to regenerate themselves in their former primary forms of diversity. It has even been found that tropical forests, with their high rainfall and high diversity, do not respond to any form of human intervention. Indeed, human attempts to restore damaged tropical forest ecosystems and parts of ecosystems have resulted in further destruction and even greater reductions in their diversity. This diversity may well be the tropical forests' most valuable contribution to humankind and other creatures and plants.

Regarding this phenomenon, Paul Ehrlich (1981) stated:

Unfortunately, however, the most important reason for preserving diversity is also the least-known and least well-understood. That is that populations of species of other organisms are all working parts of the vast ecological systems that provide humanity with an irreplaceable set of 'free public services.' Included among these are the maintenance of the quality of the atmosphere, the control of the hydrological cycle (and the supplying of fresh water), the amelioration of the climate, the generation and maintenance of soils, the disposal of wastes, the recycling of nutrients essential to agriculture, the control of the vast majority of pests of our crops and carriers of human disease, and the maintenance of high-yield agriculture. Therefore, when humanity exterminates populations of species of other organisms, it is in essence 'popping the rivets' on its own spaceship.

In order to understand biological diversity better it will be approached here from two perspectives: (a) genetic diversity, and (b) species diversity. A consideration of each follows.

Genetic diversity—Existing within biological diversity, genetic diversity is extremely important. Tropical forests have the highest range of genetic material of all the Earth's organisms. The world's scientists are unanimous in their conclusion that tropical forests are the largest reservoir of unexploited genetic traits on the planet. Only 1.5 million of the estimated 10-100 million species (mostly insects) in tropical forests have been catalogued, while only 15 percent of tropical forest species have been screened and examined for their medicinal and other benefits and values to society and the world's economy. However, because of the rapid rates of tropical forest destruction, many thousands of species and their genetic material (DNA) are disappearing before they can be biologically studied.

Preservation of this as yet unquantified genetic diversity and range of genetic material is, alone, vital reason enough for preserving and maintaining intact tropical forests. The protection of genetic material is a matter of insurance and investment for continued life on Earth. Genetic diversity provides the materials necessary for breeding programs that are necessary for the protection and improvement of

cultivated plants and domestic animals, and for sustaining and improving other forms of agriculture, forestry, wildlife, and fisheries. In addition to keeping options available in the future, the genetic pool in tropical forests serves a vital buffer against as yet unforeseen harmful environmental changes. Especially with numerous recent and complex breakthroughs in genetic engineering, genetic diversity provides innumerable raw materials for scientific and industrial innovations, as well as security for industries that depend on living natural resources. These realities and potentials exist only because the Earth's genetic resources are the very foundation of the evolutionary process.

Species diversity—Because the diversity of species is dependent on biological diversity, species diversity is determined by the quality of maintenance and stability of the ecological processes of tropical forests. Each species is bound together with all other species in a maze of complex interactions in tropical forest ecosystems. The abundance of different species of plants and animals is the central determinant characteristic of tropical forests and the source of their innumerable benefits.

Yet, the GLOBAL 2000 report to the president (an international environmental study by the Council on Environmental Quality and the U.S. State Department (1980)) estimates that at least one million tropical forest species will become extinct before the end of the century if current deforestation rates continue. This disappearance of species would not only result in the loss of Earth's most complex biological communities, but also millions of years of evolution that is not yet understood.

Species diversity, the uniqueness of species and populations, is essential for the ecosystem functions of tropical forests. Some species may serve as 'keystone' species in the complex structures and diverse interactions with other species. The removal of a 'keystone' or link of these counteractions and interactions may result in numerous other species becoming extinct, thus producing a 'domino effect' of negative consequences for the entire ecosystem. Ironically, because of the uniqueness of each species, its population, and ecosystem, these complex repercussions and their impacts are difficult to research and predict.

Species Protection

The value of preserving known and unknown species of plants and animals is of rapidly growing importance. The intimate and complex linkage of tropical forest species to numerous others requires more attention given to habitat preservation than is necessary in temperate areas. The protection of species and their natural habitat is one and the same process.

Each species is a unique original, just like a rare and original painting— and for each, extinction is forever. While the good and potential good that tropical species provide are justification enough for their protection, many believe that plants and animals have a right to exist for no higher value than for their own sake. Also, the better known or more spectacular species (flagship species like elephants and tigers) attract public support for the habitat of the lesser-known or unknown species.

Charles Elton (1958) believed that a primary reason for conservation is an almost spiritual one. He writes:

There are some millions of people in the world who think that animals should have the right to exist and be left alone, or at any rate, that they should not be persecuted or made extinct as a species. Some people will believe this even when it is quite dangerous to themselves.

As the current results of millions of years of evolution, tropical forest species continue to evolve and to provide useful and inheritable genetic resources. Besides the species themselves, populations within species must be saved from extinction so that they will continue to evolve. By remaining contestants in the co-evolutionary race, plant and animal populations continue to develop and strengthen the genetic variability necessary for natural selection. In turn, this provides the evolving diversity within each species necessary for its contributions to the world's genetic resources, including the variability of genetic types required for human developed artificial selection.

The loss of individuals as well as populations of a given species will profoundly and negatively affect this process. In addition to species and genetic relationships, each plant and animal is a unique and contributing representative of its species, with its own individual characteristics. Most individual species in tropical forests, particularly trees, are rather sparsely distributed among the millions of other diffused species. Each individual of any given species is one of many possible participants in the vast pool of species and their interactions.

This unfathomable diversity of genetics, species, and individuals requires unfathomably dynamic conditions that cannot be duplicated outside of undisturbed tropical forests. Each individual tree, for example, is genetically different from any other tree of the same species. Thus, it has its own unique contribution to make to genetic variability and co-evolutionary interactions.

Agriculture

Only about 20 of the many thousands of edible plants provide most of our human food. Plants that are currently cultivated require large genetic pools for the development and production of more useful strains or for restoration of vigor to inbred varieties. This narrow and vulnerable range of food crop species does not come close to representing the rich potential of the world's great storehouse of plant species: tropical forests. Despite these known facts, the vast scale and rapid speed of tropical forest destruction virtually guarantees that more than a million species of plants and animals will have recently become extinct before the beginning of this century. If this destruction is not stopped soon, much of its genetic diversity and variability will be lost forever.

The International Union for the Conservation of Nature (IUCN 1980) states:

Tropical forests may harbor some 50 million species, representing huge stocks of genetic resources of immense value, both actual and potential, to agriculture, medicine, and industry....The now famous perennial corn (*Zea diploperennis*) was recently discovered growing in a montane forest area of southern Mexico. A promising new food crop

is the fast-growing, protein-rich winged bean (*Psophocarpus tetragonolobus*), which is native to the humid forest ecosystems of Southeast Asia. Tropical forests are also a source of many plants, fish, and wildlife that are an essential source of food for local people.... Tropical forests are important also to advances in forestry and other fields of applied biology.

The genetic material or 'capital' in tropical forest species is essential for breeding programs for domestic crops and animals. Continued improvements in pest and disease resistance, adaptability, yields, nutrition, durability, flavor and other qualities are dependent upon genetic diversity and variability. This is particularly true in plant breeding to protect against pests and diseases that develop resistance to pesticides used on standard crops.

Because many tropical plants are adapted to living without direct sunlight below the canopy and adapt well to indoor situations, they are also of high ornamental value or can be bred for home or garden. Tropical forests are also rich sources of biological controls such as predatory insect insecticides from plants such as the tuba root.

With more accurate identification and scientific analysis, many more applications of tropical forest species will become available for agriculture and other financially profitable uses, certainly including new species of plants more resistant to diseases and pests than present crops. Although the economic value of many tropical plants is unknown— either in fact or potential— we are continuing to lose uncounted and uncountable species at an increasing rate, even before they can be discovered and studied. It is estimated that over one third of the tropical forest species will be extinct within this decade, and their extinction will accelerate the loss of many more species in ensuing decades.

Medicinal

More than 40% of the world's drugs—with a commercial value of more than \$50 billion per year—are obtained from wild plants or are synthesized from wild derivatives, yet only a very small percentage of plants and animal species have been examined for their medicinal value. Herbal traditional medicine provides the primary health care for 80-90% of the rural population of the world. The World Health Organization has identified over 20,000 medicinal plant species. Plant drugs are usually inexpensive as well as an accepted part of the culture of many countries.

It is estimated that only one percent of tropical forest species have been scientifically investigated for possible medicinal benefits. Tropical forest plants provide valuable medicines for treating diabetes, high blood pressure, schizophrenia, and chemical prophylactics. Because armadillos, found in the tropics, are the only animals apart from human beings to contract leprosy, armadillos are proving to be valuable aids in medical research into curing this disease. An example of another surprising and recent discovery is the Madagascan Periwinkle (*Catharanthus roseus*), a tropical plant that yields drugs used in the treatment of leukemia and lymph gland cancer. Annual sales of these drugs total several billion dollars.

Members of the periwinkle and other plant families have been used to treat cancer since the time of Hippocrates who lived four centuries before Christ. We do not know how many

other undiscovered tropical plant species produce their own unique mixture of chemicals with current and potential medical use.

Animal species also offer unique and reliable contributions to medicine, including anti-cancer compounds produced from insects, and medical research conducted with tropical forest monkeys. Clearly, unless both plant and animal species (particularly the as yet unknown ones) are protected within natural or near natural tropical forests, they will not make their medical contributions to human health.

Industrial

Tropical forests provide a wide range of materials for industry, including diverse genetic materials necessary for industrial innovations. A partial list of the most common of these materials includes rubber, gum, camphor, resins, tannins, turpentine, dyes, rattans, bamboos, and essential oils— used in the production of many oils for modern living, such as foods, polishes, lubricants, furniture, glue, gums, detergents, and deodorants. Although known and unknown tropical forest species undoubtedly hold a great deal of potential for new materials and products, their extraction from their complex and delicate ecosystems must take place with only a minimum of ecological disturbance, which may or may not happen.

As petrochemical costs increase, the global chemical industry is also increasingly seeking alternate supplies of organic raw materials. Worth more than half of the global armaments industry, the global chemical industry is now turning to tropical forests in particular as sources of phytochemicals (plant compounds). As Norman Myers (1980a) notes, "Technology is available to manufacture 95 percent of synthetic products from selected plant materials. Salient instances include plastics, fibers, adhesives, polyisoprenes, and surface coatings." An example of the potential for industrial products from tropical forests species is illustrated by the tree *Copaifera langsdorffii*, a tree that grows in the Amazon basin. It was recently discovered that the sap from this tree can be used directly as fuel in diesel engines.

Tropical Forest People

Approximately 200 million people live within or on the margins of tropical forests. Tropical forest environments provide these people with food, (e.g. fruits, wild animals, nuts, fish, and honey) and raw materials for fuel, wood, clothes, buildings, and medicine. Indigenous forest-dwelling tribal people are distinguished by their special relationships with tropical forests; they are completely dependent upon tropical natural forests for their livelihood and welfare. Their cultures have evolved in harmony with this environment and their identity and lifestyles are tied to living in tropical forests permanently. Development in tropical forests brings pressures on traditional forest dwellers with disastrous results for their survival and culture. Inevitably, native tribes fall prey to outside diseases, weapons, technology, alcohol, and drugs imported by outside cultures. Thus, entire tropical societies and their native knowledge and wisdom about their tropical forest environment are rapidly disappearing as their natural role in these ancient ecosystems is destroyed.

These tribal people are an irreplaceable source of vital information about the natural history and use of tropical forest species. Their detailed and sophisticated knowledge of tropical forests is respected and sought by scientists. Local tribal people's knowledge of not only the diverse plants but of the periods of their life cycle stages when they are most useful is unobtainable from any other source. A classic example is curare, from the Brazilian vine (*Chondrodendron tomentosum*), which was originally used as a poison by tribal forest hunters. Curare contains tubocurarine, which is now essential as a relaxant in delicate surgery. Not incidentally, the Paraguayan Indians prepare food with a forest plant that tastes 300 times sweeter than sugar but contains virtually no calories. This wealth of intimate and growing knowledge is rapidly being removed forever with the loss of tribal people as their tropical habitat is damaged and destroyed. Their knowledge and lifestyles need special protection.

Maintenance of the Web of Life

Ecological interactions in tropical forests impact life and conditions throughout the world. Destroying a link in these delicate interactions produces repercussions that can sometimes be observed, such as serious disturbances in bird migration far into the northern and southern hemispheres. Most repercussions are, however, difficult to predict. For example, the removal of a tropical forest may result in increases in insect, rodent, and other pest infestations in nearby crops, grazing areas, or other human settlement areas. Natural predators of these pests may also have depended on forests for their survival. The economic wealth and security of entire nations are related in many ways to tropical forest ecosystems. The maintenance of ecological processes that depend on intact tropical forests ensures the sustainable utilization of natural resources.

The Office of Technology Assessment (OTA) (1984) reports that many U.S. funded development projects are currently being undercut by flooding, pest outbreaks, and other problems directly associated with deforestation. Food and jobs in developing countries are also impacted as a result of deforestation. The OTA states:

Tropical forests also provide habitats for many of the world's migratory birds and various endangered species. About two-thirds of the birds that breed in North America migrate to Latin America or the Caribbean for winter. Some of these migratory birds play an important role in controlling agricultural pests in the United States.

Scientific Research

In their natural or near-natural states, tropical forests represent the oldest, most diverse and complex ecosystems for scientific research. Charles Darwin and Alexander von Humboldt are only two of the many great scientists whose scientific contributions depended primarily on their tropical forest experiences. These forests offer insights into the ecological and evolutionary processes for basic and applied research, such as a specific relationship between a fig tree species and a particular wasp that pollinates it. Investigations at La Selva Biological Station indicate that few trees were self-pollinated, and that most rely on cross-pollination.

One tree species was even found to be pollinated by a mouse. The fact is clear: tropical forests contain the answers to basic scientific questions that have not yet been formulated.

Regarding applied science, research of tropical forests can contribute knowledge of plants, animals, genetic material, and chemicals for agriculture, medicine, industry and many other areas. Studied tropical species have already made valuable contributions to society, such as agricultural crops, anti-cancer drugs, and insects used in integrated pest management. Unstudied species thus offer great potential for pest control, plant breeding, and other biotechnologies.

Although scientists are developing techniques for cloning plants and micro-organisms to screen for production of useful new chemicals, Peter Raven (1982) cautions:

Several speakers have mentioned that two-thirds of all species live in the Tropics. Of these, about 500,000 have been named, meaning that there are millions unnamed, uncatalogued, and uncharted species in the Tropics. There are at present in the entire world only about 500 systematic biologists-taxonomists capable of dealing with these unknown species. The rate of forest destruction leads most of us to conclude that virtually all of them will be gone in 30-40 years. Many of us have concluded that one-quarter to one-third of this diversity might be gone in the next 30-40 years. This means that if we want to learn anything about these unknown plants or press any of them into our service, we are going to have to set some very definite priorities."

Gerald Budowski (1972) believes that the loss of tropical forests to the scientific community would be irreparable. He considers tropical forests to be "living laboratories" and a "factory and storehouse of evolutionary diversity," that contains "incredible variations of which we know very little at present....(where) new discoveries take place every day."

It is only in natural tropical forests that the full range of species and an undisturbed ecosystem can be scientifically studied in its true evolutionary and ecological uniqueness. Thus, tropical forests present exceptional opportunities for scientists to work on the 'cutting edge' of research. Much of UNESCO's Man and Biosphere (MAB) Program is based on biosphere reserves, with many of them located in tropical forests. This international MAB Program is directed at the application of human scientific knowledge to harness biological processes that can improve human conditions. But the scientific community is extremely concerned that entire 'laboratories' for this vital research—the tropical forests themselves—are being destroyed long before their highly promising research can even begin.

Climatic Global Warming

By their physical presence on the planet's continents, tropical forests make essential contributions to local, regional, and global climate. The influences of tropical forests on climate is another area that is not fully understood. It is recognized, however, that tropical forests serve as moderating and maintenance influences on climatic stability. Through their role in evapotranspiration, tropical forests may generate local rainfall in some countries. At the global level, however, destruction of tropical forests will adversely affect climate by increasing the level of atmospheric carbon dioxide and by increasing the amount of reflected sunlight. These climatic

changes will very likely result in severe consequences for worldwide agriculture, as well as a substantial rise in ocean levels as the Antarctic, Greenland, and other global ice fields melt. With increasing global warming concerns (and crises) on a worldwide basis, it would appear crucial and timely to intensively investigate and implement tropical forest protection programs.

Myers (1980a,b) believes that tropical forests create a "buffering effect" that stabilizes a number of important environmental processes, including water flow. However, he considers the role of tropical forests as safeguards of the global climate to be most significant. If tropical forest cover is maintained, predictable and historical climatic patterns will continue, while any changes will be modulated by the forests' effects. With the removal of this forest cover, climatic changes can be abrupt and extreme. Yet, little knowledge is available with which to predict the nature and scope of these climatic changes from deforestation. The clearing and burning of tropical forests releases their stored carbon dioxide, adding to the ambient atmospheric carbon dioxide. Scientists fear that this is causing the still mysterious and feared 'greenhouse effect' that could trap heat and adversely warm the Earth.

Water Conservation

Tropical forests protect watersheds. In their natural or near-natural states, they retain water and release it gradually throughout the year. Tropical forest watersheds are thus able to maintain and restore reliable supplies of high quality water that benefits surrounding and downstream agriculture, industry, human consumption, and hydroelectric facilities. More than 40% of farmers in developing countries live in villages that depend on the sponge-like effects of tropical forests to absorb and slowly release water.

Mangrove ecosystems within intertidal zones provide a nursery area for marine life and reduce coastal erosion and storm impacts. Mangrove areas also provide protective habitat for many plant and animal species, including fish, shrimp, and oysters.

Tropical forests reduce the frequency and extent of floods and droughts. Deforested areas are particularly noted for their flash floods that can cause serious damage to human life, agriculture, and property. In southern Thailand, a flash flood due to illegal logging resulted in the deaths of 200 villagers and the destruction of two villages and their crops. Indonesia has experienced numerous similar flooding events due to tropical forest logging.

Deforested, unprotected slopes do not absorb and transmit water into the soil, thus rapidly increasing the sudden impact as well as the long-term damage sustained whenever there is a prolonged dry spell in lower areas. The campaign to save the tiger in India resulted in the establishment of forest reserves that contain valuable watersheds. This single conservation decision also assured the steady flow of water for agriculture and other uses as well as a significant reduction in age-old flood problems. Protecting and maintaining tropical forests in as natural a condition as possible is the most effective method of protecting watersheds, and is the least costly in terms of both money and effort.

Soil Protection

Tropical forest soils are poor quality, fragile, and unsuited for agriculture. Almost all the nutrients are found in living vegetation rather than in the soil. With deforestation, the thin layer of topsoil washes away quickly. The remaining soils rapidly deteriorate and lose their fertility, leaving hard-packed clay or sand that is limited to only one or two more poorly nourished crops or to very short-term grazing. Thus, the very productive land of tropical forests becomes a virtual desert when its poor soil is exposed.

Tropical forests shelter the soil from rain, stabilize it, and prevent erosion. Soil erosion renders land unfit for agriculture or other uses. IUCN (1980) stated: "It has been observed that many tropical countries which would not wish to give up a square meter of their land are watching thousands of tons of soil wash away each year because of deforestation." Soil silt though erosion can destroy river and delta fisheries and fill reservoirs, greatly reducing hydroelectric production. The life span of a reservoir basically depends on forest cover to prevent erosion.

Outdoor Recreation

National parks and reserves of selected areas of tropical forests can provide outdoor recreation for the general public. With increased hours of leisure available, people find time to experience the unique form of outdoor recreation available in tropical forests. Increasing pressure and tensions from crowded and urban areas make it important to have natural areas of tropical forests conserved for public relaxation, enjoyment, and renewal. Although outdoor recreation in tropical forests is in its early stages, visits have increased significantly. The Caribbean National Forest near San Juan, Puerto Rico, has almost one million visitors annually. Tropical forest parks in Rancho Grande (Venezuela), Poas (Costa Rica), and Tijuca (Brazil) attract hundreds of thousands of visitors annually, to cite only a few examples in Latin America. Outdoor recreation in natural areas like this can draw on the rich diversity, superlative wonders, and unique scenery of tropical forests.

Education

The U.S. Interagency Task Force on Tropical Forests (1980) noted:

On a worldwide scale, tropical forests have unequaled scientific and educational value. The complexity of tropical forests for years attracted scientists and students in search of answers to basic questions about life processes. No other region on Earth offers so much material for study. The interactions among the components of tropical forests, and particularly the behavior of observable animal life such as mammals, birds, and insects, constitute assets of great scientific and educational value. As investigations enrich knowledge of the relationships and the findings are interpreted by laymen, visits to tropical forests by the general public are expected to increase greatly. Improved standards of living in developing countries also will expand this resource use.

Tropical forests can serve as living museums and inspiring classrooms for a variety of formal and informal educational activities. Developing naturalist interpretive programs for tropical forests and the general public may include self-guiding nature walks. New knowledge of the ecology and natural history of tropical forests will greatly contribute to and enhance the understanding, appreciation, and enjoyment of the public. This type of knowledge also motivates and increases public support for conservation in general, and for tropical forests in particular. Use of tropical forests for formal education is rapidly increasing in the form of field trips and studies at various levels. The Organization of Tropical Studies (1985), a consortium of four Costa Rican and 29 North American research universities, has provided advanced training in tropical ecology to more than 1,500 graduate students, field research access to thousands of scientists, and published literature on tropical biology. The OTS' La Selva Research Station and Biological Reserve provides unique courses and study opportunities for graduate students and faculties in natural tropical forest settings. The diversity and abundance of species and their complex ecology in these settings attract students from many areas of the life sciences.

Ecotourism

The new concept of combined tourism and nature (ecotourism) in tropical forests holds a great deal of promise. The focus of such tours is on ecology and natural history; university professors and naturalists from the tropical countries often serve as naturalist interpreters or nature guides. Budowski (1976) observed:

The appeal of the rain forest rather is in the diversity of forms it has to offer, the multitude and sometimes extraordinary relationship between plants and animals, often the small but nevertheless spectacular features found in insects, flowers, fruits, roots and branches of the life along the river banks. The incredible variety in birds and orchids, for example, the feeding habits of the forest animals, the dependence of some plants on some insects or birds for pollination or dispersal. Actually, some of the animals and their movements can be watched if a minimum of knowledge and care is displayed. Along the rivers and lagoons and lakes, there is a fascinating web of life and food chains which again must be seen with an eye of understanding. For there are thousands of features appealing to different tastes and different backgrounds, all able to give pleasure and entertainment to a large variety of people who might be attracted by this vast "firework in diversity."

Ecotourism could certainly engage large numbers of academics, tourists interested in natural history, and scientific visitors to tropical forested countries. Thousands of scientific visitors, some of them graduate students, annually 'invade' Costa Rica, and use it as a living laboratory and educational center. Ecotourism provides general and financial support for a tropical-forested nation's efforts to protect and to profit from their natural tropical forests. Natural tropical forests are often an undeveloped resource of great economic value as an export to the entire world, sometimes compared to the animal life of Central Africa in uniqueness. These forests, the world's most complex ecosystems, are valuable classrooms that interest students from around the world.

Cultural

Tropical forests are intimately related to the cultures of tropical peoples through diverse influences on the entire range of knowledge, traditions, and values of the cultures. These tropical forest influences may range from concrete, economic uses such as firewood to less tangible values such as scenery and 'atmosphere' in the lives and well-being of tropical people. Thus, tropical cultures are very much a product of the unique interface between people and tropical forests.

If present trends continue, many countries will lose almost all of their tropical forests in the not-too-distant future, beyond small pockets of protected areas which, in turn, are poached and illegally logged. With the continuation of these trends, it is estimated that tropical forests in South and Southeast Asia would be greatly reduced or removed by the year 2050. Thailand today has established protected areas in about 12% of its natural or near natural forest lands, but these protected areas, like those in other Asian countries, are severely poached and illegally logged.

About 70 years ago, Thailand was approximately 80% tropical forests with similar stories in other Asian countries. Damage to and loss of tropical forests is related to a measurable loss of significant cultural values and institutions. The most obvious damage is the destruction of tribal people and their lifestyles through deforestation, with obvious impacts on nearby villages. The impacts extend a ripple effect throughout entire cultures, removing and eroding original, authentic characteristics. The natural heritage of native plants and animals, the undisturbed landscape, and native identity disappear forever. Tropical countries and peoples lose much of their cultural and national identity in the absence of their tropical forests.

Creativity

The art, writing, photography, and other creative endeavors of a country draw upon its nature and environment. Tropical forests provide a unique, mysterious, and natural environment of complex, constantly changing, beautiful mosaics with great potential for stimulation of the soul as well as the senses, and as a source of artistic inspiration. The wide diversity of tropical forest life forms and colors produces aesthetically rich landscapes and myriad images that can inspire one's natural sense of wonder and innate creativity, and refresh the human connection with nature. Contemporary tropical artists such as Deidre Hyde and Edwardo Stapelfeld of Costa Rica regularly seek the diverse beauty and essence of tropical forest life for their detailed paintings of its unique natural creatures and plants and incomparable scenery.

Joseph Conrad (*The Heart of Darkness*), Garcia Marques (*100 Years of Solitude*) and many other novelists have been drawn to forest settings and have depicted the majesty and power of the environment as a major element in their novels. A popular motion picture 'The Emerald Forest' dramatizes the lifeful energy and drama of tropical forests and tribal people. Primitive art in the form of rock paintings, carvings, and ceramic art are products of the unique blending of tropical forests and indigenous tribal people.

Spiritual

Human beings are innately spiritual creatures capable of and drawn to abstract thought. Although they are intangible, spiritual values and influences are clearly present and appreciated by human beings who travel in tropical forests. The prolific diversity and enormous variety of life forms in tropical forests create a powerfully spiritual environment, endlessly different and surprising, 'the essence of the magnificence of nature...the most mysterious of all natural worlds.' This spiritual response obviously has significant impact on virtually all human beings, regardless of their spiritual, social, or cultural backgrounds.

Spirituality connotes for each of us a broad and deep range of relationships that define our underlying sense of identity with ourselves, others, life, the Earth, the universe, and with a higher power. As with all human societies, tropical forest people have their own spiritual beliefs. Developed during the course of humankind's evolution, many of these spiritual beliefs and wonderments reflect and include the deep connections with nature found so abundantly in tropical forest surroundings. These spiritual beliefs take the form of myths and rituals that help to explain natural phenomena or to provide spiritual protection. Spirituality in tropical forest cultures is often expressed in an elegant complexity of tribal activities that include dances, decorations, prayers, and rituals. Many of their spiritual beliefs and activities explain mysteries of life in the tropical forests, maintain order and cooperation for survival, and provide hope, tradition, and meaning to visitors and observers as well as to native participants.

Non-tribal people from host or other countries often find tropical forests to have spiritual significance that blends into their own spiritual heritage and beliefs. Myers (1980b) observed, "Perhaps what most stimulated me about a tropical forest is the notion that its diversity, its interactions, its sense of wholeness, all are so advanced that it (*sic*) is far beyond the scope of my imagination—let alone my intellect—to grasp how advanced they are. I feel cut down to size, even as I feel I stand taller than before." Often, the luxuriant beauty and teeming life of a tropical forest awakens a deep sense of satisfaction in the realization of one's role in the natural scheme of the forest, the planet, and the universe.

With their settings of stunning natural beauty, free from the pressures of civilization, tropical forests provide undisturbed solitude and tranquility where human beings feel closer to creation or discover many dynamic aspects of spirituality. These types of experiences awaken in some people a renewed belief in a supreme creator whose energy is somehow responsible for the grandeur of tropical forest life, and a profound appreciation for the presence of life itself on this planet. In this regard, Karl Eymert (1985) comments: "The value of the tropical forest is the very essence of life for all. It is God's creation. They are part of me. They are part of my beingness, part of God—a vital part of physical, mental and spiritual life that sustains all life on earth."

Scott Heywood (1985) also comments on "the power of a unique ecological system to spiritually refresh a chaotic, hectic, confused mind, body, and soul...the humbling reminder of man's frailties, vulnerabilities, and mortality by comparing them to a system's natural and unique past, its existing presence, and its living future."

Future Generations

Concerns and responsibilities for tropical forests must extend to future as well as present generations because these threatened ecosystems are highly susceptible to irreversible removal or very serious and damaging reductions, resulting in loss of human and other natural values and options for survival and quality of life. It is not possible to predict what tropical species may be discovered as useful before they are destroyed. However, the moral obligation to protect tropical forests for future generations of one species in particular, *homo sapiens*, must extend to future generations of all species, known and unknown. In short, the active, ongoing protection of natural tropical forests for their own sake is essential.

Future generations of all forms of life require that tropical forests must be protected in an intact and natural state. Humankind needs tropical forests. But tropical forests could survive quite well—in fact, better—without human presence and impact. It is only within an intact natural tropical forest environment that diverse and interdependent forest species can carry on their struggle for survival and evolution. In addition to any conservation measures to protect Earth's tropical forests, efforts need to be increased to safeguard tropical forests for future generations by establishing and maintaining national parks and reserves.

The following situation, described by Iltis (1981) continues to repeat itself in various forms everywhere in tropical forest countries:

Let me take you to the foothills of the Andes, in a Peruvian valley, overwhelming in its greenness, where I stood in 1963, and watched from a narrow hanging bridge as a troop of spider monkeys jumped from one tree to the next, eating orange fruits from a gigantic fig tree a hundred feet up, as brilliantly blue giant Morpho butterflies sailed erratically and iridescently through a sun-flecked opening in the forest, as a pair of toucans sat motionless on a branch, watching a scene straight out of Genesis. No more of this, today. None of it, for with a U.S. AID development grant, some eager young man bought the land and the Indians living on it cut down the forest and planted coffee on 45 degree slopes. In three months of field work, we saw only one spider monkey—a pet on a silver chain in a tourist lobby.

The Organization for Tropical Studies (1985) warned, "A hundred years ago, tropical forests blanketed an area about twice the size of Europe. Today, way less than half remains, and it's going fast."

The values associated with tropical forests deserve understanding, appreciation, and emphasis, for in them we find deep values for the immediate present and for countless future generations of all life: the protection of natural tropical forests as a vital part of Earth's biosphere. We must ensure that generations to come benefit from tropical forests and share their dynamic values for the survival and quality of all life on Earth.

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