


RETHINKING PROTECTED AREAS IN A CHANGING WORLD

# Proceedings

The George Wright Society Conference on Parks, Protected Areas & Cultural Sites

March 14–18, 2011 • New Orleans, Louisiana

## Edited by Samantha Weber


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&
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RETHINKING PROTECTED AREAS IN A CHANGING WORLD

# Proceedings of the 2011 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites

## Edited by Samantha Weber

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**On the cover, frontispiece:** Photos of New Orleans and surrounding area, all courtesy of Samantha Weber.

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*(Note: Papers are presented in alphabetical order by the lead author's last name, with the exception of a set of articles originating in the session "Knowledge All around You: Cultural Landscapes Management from a Landscape Point of View," which are presented at the end.)*

# Introduction and Acknowledgments

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The 2011 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites took place in New Orleans, Louisiana, March 14–18. It was the sixteenth in a series of conferences whose origins date back to 1976. The first US National Park Service science conference was held in New Orleans during the nation's Bicentennial year; another followed in 1979. Beginning in 1982, the GWS has organized the conferences, expanding them to all kinds of parks, protected areas, and cultural sites. The GWS biennial has become the USA's largest interdisciplinary conference in the field. It is the only such conference to actively seek participation from across the entire spectrum of disciplines and activities that are necessary for successful protected area management. Attendance at GWS2011 exceeded all past meetings, with over 1,100 present.

This proceedings volume contains more than 60 papers that are broadly representative of those presented at the conference. For the first time, we are publishing it in digital form only. One advantage (among several) is that this has allowed us to publish all graphics in color.

We are indebted to many people for making GWS2011 a success. Samantha Weber has again done a fine job of editing this proceedings volume, and we appreciate her hard work. As always, the Conference Committee labored over many months to shape a large, interdisciplinary program. Chaired by Melia Lane-Kamahele, the committee's other members were Brad Barr, Carol Clark, Rebecca Conard, Rolf Diamant, Sandee Dingman, Dee Hewitt, Brent Mitchell, Rebecca Stanfield McCown, Stephanie Toothman, Jan van Wagtendonk, John Waithaka, and Robert Winfree. Equally important are our two principal organizational sponsors, both of whom have worked with us for many years: the US National Park Service and the US Geological Survey. This time we were very pleased to add Parks Canada Agency and United South and Eastern Tribes as conference supporters.

Beyond that, the GWS thanks all the people who organized the slate of field trips and the service projects—too many to name individually, but our gratitude is sincere. We also express our appreciation to all the institutions and individuals who helped sponsor the George Melendez Wright Student Travel Scholarships and the Native Participant Travel Grants; here, we particularly thank Gillian Bowser and Sharon Franklet, respectively, for their leadership on behalf of these programs. Beyond this, many others provided assistance on various aspects of the conference, and we extend our sincere appreciation to all of them.

The next conference will be held March 11–15, 2013, in Denver, Colorado.

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# Making a Difference Against Invasive Plants on the Appalachian Trail

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Along the Appalachian National Scenic Trail invasive plant control is relatively new in spite of the long history of volunteer-led trail management. With increasing public awareness of negative impacts associated with invasive species, there is increasing energy to tackle invasives along the Trail. The nascent short-term volunteer program along the Northern Virginia section is a model for other sections of the Trail.

### Meeting the challenge

The Appalachian National Scenic Trail (Trail) inaugurated its Short-term Volunteer Project with Earth Day 2008. Need for a program became apparent when funded management efforts through the Mid-Atlantic Exotic Plant Management Team (EPMT) could not keep up with the existing and expanding invasive species situation along the Trail. Cooperating with the National Park Service (NPS) and Appalachian Trail Conservancy (ATC), the Mid-Atlantic EPMT formed the pilot program to focus on the Northern Virginia section with two goals: increase public understanding about invasive threats and accomplish work in the field to protect Trail resources. The pilot is a collaborative venture in setting priorities, garnering support, reaching the public, and conducting fieldwork.

Several invasives are emblematic of the growing threat to natural and cultural resources. Mile-a-minute vine is a relative newcomer to America, accidently introduced from Asia. It spreads like a wildfire in two ways. Its own vegetative expansion is very rapid. It also produces thousands of berries from mid-June through September, which birds eat and pass through their digestive tracks to deposit out ahead of the main infestation.

The Blue Ridge Mountains are also impacted by new species that were originally planted to enhance game bird habitat. Recognized too late as invasive, they now dominate large areas. In the northern Virginia stretch of Trail, such species include autumn olive, multiflora rose, and wineberry, among others. Many plants were introduced for a variety of reasons and are now problematic.

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**Figure 1.** Mile-a-minute vine invades the Trail near Front Royal, VA. Here, children from Friends of the National Zoo Nature Camp pull down the invader, July 2008.

### Getting results

During the period April 2008 to November 2010, the pilot program generated more than 1,350 volunteers who contributed 3,960 hours to invasive plant control. The pilot is made up of three aspects: group events by appointment, special events open to the general public, and a speaker's bureau to provide talks in the public square.

*Events by appointment.* Group appointments draw the largest source of volunteer field help, 93% of all volunteer time. Direct recruiting of groups by telephone is effective in generating first appointments. A localized database of potential volunteer organizations and individuals was created by the Mid-Atlantic EPMT and now contains 432 records. Groups include middle and high schools, colleges, summer camps, special interest organizations, and clubs. School and college groups are most available in spring and fall, while summertime sees more scouting groups, youth camps, interest groups, and clubs.

Repeat events by groups are common. Once a group experiences its first field event, 64% of them make room for more in their future. That indicates strong identification with the NPS mission and keen interest in these events as service learning opportunities for their members.

Group events generated over 1,250 volunteers who contributed more than 3,400 hours of their time controlling invasive plants. Groups helped control garlic mustard, Japanese stiltgrass, Oriental lady's thumb, mile-a-minute, Oriental bittersweet, wineberry, autumn olive, and Japan -

ese barberry, among others. Work groups help protect native species and preserve natural and historical landscapes.

*Special events.* Earth Day is nationally observed April 14 each year. The Trail participates by recruiting school groups to work on the 14th itself and by setting up special events on Saturdays near the date. Earth Day events serve as a seasonal kick-off for the program. Spin-off benefits include increased Trail visitation during the typically low spring period of attendance and creating an opportunity for spring wildflower appreciation. In springtime, volunteers uproot invasive garlic mustard that threatens state-rare assemblages of nodding trillium nearby.

National Public Lands Day (NPLD) is held on the last Saturday in September. It is an excellent opportunity to capitalize on the national advertising of the NPLD organization. The Trail's project work site is listed in the NPLD website and draws people from Northern Virginia and surrounding areas. In the fall, volunteers uproot Oriental lady's thumb and Japanese stiltgrass, and cut invasive shrubs and trees.

Special events draw about 7% of all volunteers, contributing over 530 hours of labor. Though that is a small part of the project's total, special events are important in two ways; they offer a venue for individuals to plug into who are not part of a group, and create media advertising which increases public awareness of invasive species threats.

*Public Speaking*. Long-term volunteers and the Mid-Atlantic EPMT director provide talks to schools and other public forums. Most often, presentations are on the topics of invasive species biology, general ecology, NPS careers, and benefits of volunteerism. There have also been radio and TV interviews regarding invasive species challenges and upcoming volunteer events.

In the three years of the Trail's short-term volunteer project, public speaking efforts reached several thousand people. Speaking engagements included media interviews, school presenta-

**Figure 2.** One of several groups that attended Earth Day! events, April 2010.

**Figure 3.** National Public Lands Day volunteers proudly stand behind a mountain of stiltgrass, wineberry, and Oriental lady's thumb, September 2010.

tions, professional conferences, and public forums with clubs, community fairs, and colleges. Long-term volunteers are to date most comfortable giving brief talks at volunteer events and working at community fairs where they hand out literature and engage the public in conversations about their own roles in volunteerism.

These efforts help inform the public about invasive species problems and indicate how people can help reduce future invasive problems at home by use of native nursery stock in their own gardens. Our hope is that people not only become energized to join volunteer field events but also change their own buying and planting habits and advocate for programmatic initiatives for early detection and landscape restoration.

### Long-term volunteers

A spin-off of the short-term volunteer program is development of individuals who are willing to become long-term volunteers to help run volunteer events and speak to the public. To date, five people volunteer their time in that way, contributing many hundreds of hours. On several occasions they also led field events without NPS assistance.

### Assessments: An honest look at the pilot

*Public outreach.* The means for conveying information to the public is highly varied. The project utilized both direct and indirect communication methods for several kinds of external audiences.

*Direct communication*. The project reached volunteers at events with informal project orientations and introductions to invasive species issues. Literature was handed out in many cases. There were 56 volunteer events where we reached 1,345 volunteers with this kind of messaging.


**Figure 4.** James Åkerson speaks to an ecology class at Eastern Mennonite High School in Harrisonburg, VA.

We gave public talks with slideshows at schools and clubs (i.e., garden clubs, Rotary) on 16 occasions. These efforts reached 1,334 people. More formal yet, we delivered professional talks to NPS, interagency, and special interest groups (i.e., VA Association of Forest Health Professionals, and Natural Areas Association) on four occasions, reaching 399 people.

*Indirect communication*. We created and disseminated poster papers and reports for professionals and special interest groups. These reached a potential of 5,600 people.

Media outreach, the most indirect of all, took two forms during the period. Eight media interviews reached a potential of 541,700 households; and five media op-ed releases reached a potential of 1,185,200 households (from targeted circulation estimates of newspapers, radio, and TV outlets).

*Steps to the future*. Public outreach is not an easy thing to master. Our efforts to date have probably made a positive difference as measured by the number of people reached through volunteer events and the percent of repeat groups. Outside of that indicator, however, it is hard to gauge our effectiveness in conveying our message. In the near future we hope to evaluate our PR efforts in more formal fashion. Occasional pro bono PR assistance would greatly assist our effort.

### Volunteer trends of the project

Volunteer events increased during the period, but more importantly, the relative amount of volunteer time increased, increasing from 2.4 hours to 3.2 hours per volunteer.

*Steps to the future*: Volunteer programs nearer to metropolitan areas have cultivated corporate groups as an important source of assistance. That remains an opportunity for the Trail project. Schools and universities remain the strongest link for signing up future groups. There remains a large source of candidate schools and other groups to cultivate in the database.

An effective group recruitment method has been to initiate dialogue by offering to speak to groups on topics of ecology and invasive species concerns. Willingness to schedule a first field event often follows. Outreach by the project's speaker's bureau is therefore an important link to cultivating new group participation.

There is no intent to increase the number of special events at this time. One springtime and one fall special event appears sufficient to create publicity for the overall program. Experience also shows that group events harvest more volunteers and hours of fieldwork than special events.

**Barriers and aides to future development**

A number of factors are at play with the development of the short-term volunteer program pilot.

*Current barriers include the following*:

1. Work accomplishment with short-term volunteers is admittedly inefficient, where relatively much time is spent in orientation and training compared to actual work. Though tempting, scheduling longer work periods (more than two to three hours) for most groups does not play out well. Volunteers are rarely able to perform stooping hand labor beyond a three-hour period. This is where as event managers we utilize lunches or hikes as an means for a break, and determine if a second work period is possible.
2. We would like every volunteer to have the opportunity to take home high quality printed materials on the issues surrounding invasive species. Such literature is expensive, requiring donations or grants to keep up a supply. That becomes a sizable task in making a successful program.
3. Fieldwork areas have tended to be within 20 minutes walk of trailheads (rather than longer distances). That helps capture more of the available volunteer time for actual invasive plant control. Consequently, more remote areas are not being treated at this time.
4. We have been surprised that neither Boy Scouts nor Girl Scouts have shown consistent interest in the project. Scouting is highly focused on achieving merit badges. We believe a stumbling block for Boy Scouts is the lack of a specific badge for invasive species management. That is not an easy problem to address at the local level.
5. Commuting to and from the Washington metro area is a stumbling block for developing weekday group field events. Much greater success has come from scheduling groups from local communities on the western fringe of the metro area.
6. Four of the five current long-term volunteer leaders reside in areas more than 45 minutes from targeted worksites. Two of the further away leaders speak of limiting their time to the program due to travel distance and expense. In the dark economic times of 2008-2011 and foreseeable future, it is not likely we will be able to assist with those costs. The NPS and ATC should consider establishing a support fund for these activities.
7. Resource managers with both the NPS and ATC have been slow to embrace invasive plant management with their own organizations. This is largely due to limited budgets and programs. In the case of the ATC, they may also see such a program as mission creep away from their clear mandate to maintain the tread-path and property boundaries. An invasive plant management program will admittedly require large capital outlay and sizable volunteer base with people excited for that aspect of resource protection. ATC should establish or increase a grant base specific to invasive plant management.
8. Resource managers with the NPS and ATC are reluctant to have volunteers working near documented rare species. It comes down to trusting volunteers with location information, and to work around such sites without causing harm by their field activities. Prior to the short-term volunteer pilot project, there was very little field management taking place,

other than periodical survey. The NPS and ATC should determine whether volunteer management activity is possible (on a case by case basis). The alternative is inevitable habitat impairment by invasive species.

9. The volunteer pilot is being led by the Mid-Atlantic EPMT due to their keen interest in providing invasive plant management along the Trail. Their time is limited due to the shared workload with 17 other parks. It is incumbent upon the NPS and ATC to find other means of programmatic support.

*Positive aides include the following*:

1. Volunteer leaders help make the program sustainable. Their efforts and commitment are rewarding to witness. They help with on-the-ground leadership and public speaking engagements.
2. Even the limited time spent on sponsorship support has met with positive results. That is especially true when seeking in-kind items such as snack and drink supplies for volunteer events.
3. The Shenandoah National Park Association has provided bookkeeping services for the modicum of cash donations.
4. The high world repute of the Appalachian Trail makes it easy to recruit volunteer groups. People look forward to visiting the Trail and getting in the "wilderness" found there. The Northern Virginia section is the closest section to the DC-metro area, making it a desirable and sustainable location for groups to commit to for volunteer events planning.

## Conclusion

The Appalachian Trail has a long and proud history of volunteer management. The short-term volunteer pilot produced impressive results in its first three years of operations. Infested areas are being treated. The public is learning more about invasive species impacts to American habitats and rare species. Both personal and environmental safety is emphasized at every volunteer event. A growing number of groups and schools are becoming long-term partners for habitat protection through invasive plant management. Volunteer leaders are stepping up to help manage events and the overall program. The pilot program stands as a benchmark by which other programs can both benefit from and expand.

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# Addressing Invasive Exotic Insects Affecting Eastern Parks

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## Abstract

Four National Park Service (NPS) regions of the East co-released an electronic document in 2010, Rapid Response to Insect, Disease and Abiotic Impacts: Practical Guidance for Field Practitioners, that assists field practitioners and decision-makers to identify, understand, and manage invasive insect, pathogen, and abiotic threats. Though targeted to NPS staff, people outside the NPS will benefit from several of its helpful features. The focus is upon invasive exotic species. Several native and abiotic threats are also included to aid identification discernment. The text advocates monitoring and planning prior to pest outbreaks to improve management outcomes. It also emphasizes the importance of collaborating with outside agencies to increase knowledge, gain operational inertia, and obtain project funding.

The document is most powerful in its electronic format, with hundreds of outside resources available through internet links, as well as internal hot links for fast navigation within the document. A few of the resource features include the following:

1. Dichotomous key to determine likely pest problems.
2. Robust appendix of pest descriptions and associated internet links.
3. Summary of law and policy for pest management.
4. Summarized process of integrated pest management.
5. Checklist for setting up and implementing pest/pathogen response plans.
6. Technical assistance contact lists and email links.

## Introduction

Invasive exotic species introductions are occurring at an increasing rate, many believe, due to increased international trade, and the United States government's laisez-faire customs administration (Campbell and Schlarbaum 2002). Both cultural and natural resources are threatened by invasive exotic insect and pathogen epidemics. Where the NPS is obliged to preserve and protect its resources, it cannot afford to allow invasives to degrade and impair cultural landscapes, his-

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toric and archeological sites, rare species and communities, and natural ecological functioning. Field practitioners need ready access to the information that can help them work through the phases of pest identification, rallying experts to respond and develop action plans, obtaining project funding, and implementing subsequent suppression or containment projects.

The NPS released an electronic document in August 2010 that addresses these needs. Four eastern NPS regions approved and co-released the document, including Northeast, Midwest, National Capital, and Southeast regions. The focus was to assist managers of eastern forests, but the resource has utility for practitioners throughout the country.

### Design and features

The electronic resource has the following features:

- Table of contents with hot links to jump within the document.
- Dichotomous key to quickly determine the pest/disease/abiotic factor causing recognized tree problems. There are hot links to jump to specific pest descriptions, with additional navigational links to jump back to the key if continued decision analysis is necessary.
- Pest descriptions with maps of pest infestation range, biological descriptions, and management alternatives (if they exist). Internet hot links are provided for accessing much more additional information.
- Tables of step-by-step procedures to conduct IPM analysis, prepare forest pest treatment projects, conduct an environmental clearance process, and acquire project funding through the U.S. Forest Service.
- Summary of law and NPS policy in the main body, with full texts in the appendix. This can be helpful as practitioners write grant and funding proposals to copy/paste pertinent sections into their proposals.
- Technical assistance lists and training opportunities with internet links to obtain additional information. The listings include contacts within the NPS, USFS, U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), cooperative extensions, and universities—all specific to each NPS region.
- Necessary forms to apply for funding assistance through the NPS and USFS.

This document is appropriate for the following audiences:

- Persons outside the NPS will benefit from the dichotomous key and pest descriptions in appendix C. Appendices B, E, and F will also be helpful.
- NPS decision-makers interested in policy aspects should skim the main body and appendix D.
- NPS resource practitioners should generally become familiar with the entire document.

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# Veve of Afa: A Case Study For Development Options and Progress, Palma Soriano, Cuba

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> Place incarnates the experiences and aspirations of a people. Place is not only a fact to be explained in the broader frame of space, but it is also a reality to be clarified and understood from the perspectives of the people who have given it meaning. (Yi Fu Tuan, *Space and Place,* [Minneapolis: University of Minnesota Press, 1997], 149)

**During the past six years, the Veve of Afa community development project, in the** protected area at the confluence of the El Cauto and Yarayabo Rivers in Palma Soriano, Cuba, has had many challenges in terms of financial support and project development. Needless to say, sheer determination has been the only motivating factor keeping this project standing. From lack of transportation to water supply for the nurseries, the uphill battle manifests itself on a daily basis. The acquisition of a grant is crucial in reaching the primary goals and later expansion. The Grupo Taller Experimental Ennegro (the leading entity) will request funds from the COMPACT program of United Nations Development Program for the year 2012. Presently, this is the only available option for funding. So far, private donations have provided for a very limited budget that assists in some tasks. Some basic portable agricultural equipment has been obtained through private donations, but there is great need for more equipment, a vehicle for transport, and primary infrastructure on the site, like water wells.

The project is not far from a world heritage site, as stipulated by the guidelines of the COMPACT program. The site of the project is relatively close to the Archaeological Landscape of the First Coffee Plantations in the southeast of Cuba, located between the Santiago and Guantanamo provinces, in a region where the impact on biodiversity has been great due to the deforestation for agricultural purposes, and later economic stagnation that left much of the land fallow, thus increasing the chance of soil degradation and erosion. There is a strong association in theme and context of the project with the world heritage site, since Grupo Taller Experimental Ennegro's ethnic background is Haitian, and relates to the ethnicity of the world heritage site population. Although the project is not going to include the agricultural cultivation of coffee, there are other agricultural uses that are deemed more appropriate in terms of topography and economic value to the city of Palma Soriano. They include the cultivation of medicinal plants, in addition to the harvesting of fruit crops like mamey, mango, and avocado among others.

It is very important to consider the site's proximity to Palma Soriano, and the opportunity it

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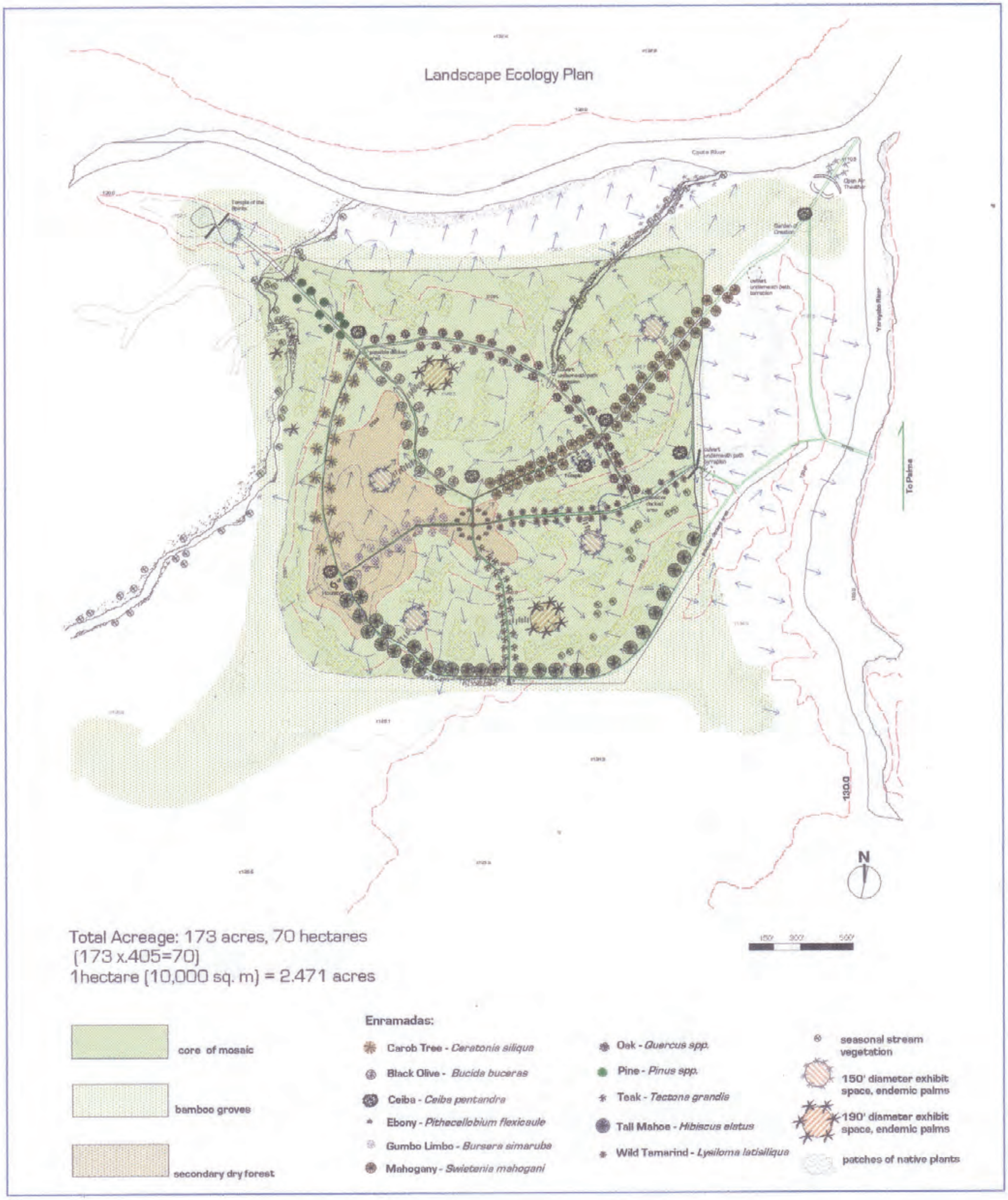


**Figure 1.** Landscape ecology plan.

offers as the only nearby natural preserve (i.e., the forest component of the project) both terrestrial and aquatic in character, and so close to an urban center. At a regional scale, there are no parks or preserves near to the Palma Soriano; this is mostly an agricultural region for coffee and minor crops, with some limited cattle ranching in the flat lands. The land use for the project is agricultural, cultural, and recreational, with a significant ethnic historical background.

After the financial support issue, the most important concern that remains is water supply—either through a system of wells, the harvesting of rain water with cisterns, production of water through the condensation of humidity from the atmosphere, or some combination of these methods. The project needs more than one system to come into play, since reliance on one way of sourcing water is not going to be successful for the primary operations of the project and the needs of the population living in the site. The experimental concept of photovoltaic panels is being considered as a good alternate option for water production that is appropriate in such an open site.

**Figure 2.** Building materials sourced from the site.

As far as the architectural component for the project, the main emphasis is on building materials that can be sourced straight from the site, with minimal transportation expense. The two types of construction methods that are best suited for the project are adobe-timber, with rock/concrete foundation and bamboo for the structures of the forest area. A series of workshops starting July of this year for working with bamboo will be given by Professor Juan Manuel Pascual Menendez and his team, from the Department of Architecture at the University of Oriente in Santiago. The workshops will address bamboo planting and harvesting, cutting, storage and treatment of the bamboo culms, and the techniques of building with this material. A great deal of work has been done with bamboo in Latin America, mainly in Colombia, Mexico, and Costa Rica, through techniques implemented by such architects as Simon Velez, Marcelo Villegas, and Jules Janssen. At the site, the species *Bambusa vulgaris* (possible species for construction) is readily available, and timber can be brought from plantations in the Sierra Maestra.

For the outlying structures, adobe and timber construction with either a rock or concrete foundation has been suggested. This type of construction, using rammed earth, mixed with some aggregate to give it body and pliability, has been successful in projects in Central America. The foundations need to be rock or concrete since high humidity and rainfall are considerations in such climates.

The main endeavor for the year has been the treatment for the existing gullies due to soil degradation and subsequent erosion. A series of low rock walls and vegetative fencing have been erected to stop water runoff, and soil transport from higher elevations, away from the site during the wet season. This also halts possible downstream river sedimentation.

With the acquisition of more financial support, this project can fulfill its development goals, while fostering to a greater degree, a unique historical legacy that benefits both urban and rural communities in the surrounding areas in the province of Santiago.

# An Interdisciplinary Discussion about Fire/Fuels Science and Management

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## Introduction

Fire and fuels management have become increasingly challenging in the last three decades due to climate change, invasive species, urbanization and development, increased land use, and the effects of these factors on fire size and frequency (Westerling et al. 2007; D'Antonio and Vitousek 1992). Often, the science and information needed to carry out best management practices are lacking or difficult to find (Simpson 2009; Wright 2004). Fires do not stop burning at jurisdictional boundaries, and land managers must work with the complexities of differing agency missions, policies, resource values, social concerns, and costs (U.S. Congress 2009).

To address these challenges, many agencies and organizations have begun to adopt collaborative efforts to increase communication and share resources. These partnerships and interactions can be a cost-effective method of achieving collective goals in natural resource management (Lubell et al. 2002; Prell et al. 2008). Such efforts include the Department of Agriculture and Department of Interior Joint Fire Science Program (JFSP) network of knowledge exchange consortia. This network of regional consortia aims to connect managers and researchers within contiguous ecological regions (JFSP 2010). Participating regional consortia conducted needs assessments for fire managers during summer and fall 2009. The results of these needs assessments indicated that a common hurdle to implementing best management practices stems from the different perceptions of information consumers (resource managers) and information producers (researchers), as well as a lack of interdisciplinary and interagency communication (Kocher et al., forthcoming).

The challenges of working in an interdisciplinary environment were illustrated during a recent study of influences on the success of fire science delivery. Asked about barriers to the use of science, National Park Service (NPS) and Bureau of Land Management (BLM) fire managers often cited the different perspectives of resource managers as a barrier. For example, one fire man-

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ager explained, "And many of us are also, compared to the natural resource culture, doers. The natural resource culture in the Park Service, most of their job has been to stop things from happening. To protect the resources. And fire people, in contrast to that, are 'let's go get something done.'" (V. Wright, unpublished data).

Building relationships and two-way communication so that both managers and researchers across a range of disciplines have input into information generation, and improved access to results, will be important to the success of interdisciplinary interactions in fire and resource management. The "Interdisciplinary Discussion About Fire/Fuels Science and Management" sharing circle at the George Wright Society (GWS) Conference on Parks, Protected Areas, and Cultural Sites on March 14, 2011, was organized to facilitate dialogue about interactions between managers and researchers, as well as interdisciplinary communication among managers. This paper summarizes the two-hour discussion.

### Participants

GWS conferences predominantly draw NPS managers and scientists; thus, the participants and discussion centered on the context of NPS fire and resource management. The sharing circle's ten participants represented three JFSP knowledge exchange consortia (Northern Rockies, Southwest, Midwest Oak Woodlands) and included three university representatives (including one cooperative ecosystem studies unit), three national-level NPS fire program staff, one national-level NPS wilderness program staff, two park-level resource management chiefs, and one graduate student studying climate change communication.

Participants in the 2011 GWS sharing circle session were interested in learning more about the JFSP knowledge exchange consortia. They supported the mission of the JFSP Consortia to improve connections between fire science and fire management, and were interested in broadening the discussion to include natural resource managers and other interdisciplinary positions that work with fire management, either directly or indirectly.

### Sharing circle introduction

The session facilitator and principal investigator of the Northern Rockies Fire Science Network, Vita Wright, began the sharing circle with an overview of the JFSP knowledge exchange consortia, including both active and planning-phase regional consortia. The vision of the JFSP knowledge exchange consortia network "is a national network to accelerate the awareness, understanding, and adoption of wildland fire science information by federal, tribal, state, local, and private stakeholders within ecologically similar regions." Recognizing the JFSP's commitment to incorporating input from the management community, Wright described the needs assessment phase as important for each regional consortium to determine the most appropriate and relevant science-delivery products and methods for their stakeholders. The needs-assessment phase was highlighted as an opportunity to establish a flow of communication among stakeholders so that important relationships could be established in preparation for the transition to an active consortium. Wright explained that some of the eight currently active regional consortia have focused their needs assessments specifically on fire and fuels managers, whereas others (for example, Great Basin) have expanded beyond this focus to include an interdisciplinary audience. The focus of the GWS sharing circle discussion was, therefore, to help guide the needs assessment for the Northern Rockies Fire Science Network, which is currently in its planning phase, and to provide input to the national consortia network. It was framed as: "What does it mean for the consortia to involve a more interdisciplinary audience?"

### Suggestions for improving science communication

Participants began the sharing circle discussion by brainstorming potential activities and products of the JFSP consortia, and discussed the related issue of how to address current barriers to effective communication between scientists and managers. Websites, natural resource topic summaries, fact sheets, journal article databases, social media, and workshops were discussed as potentially useful consortia products. These suggestions are consistent with the results of earlier consortia needs assessments (Kocher et al., forthcoming). NPS participants noted that accessing journal articles was quite difficult, and that providing centralized access to online articles would be helpful.

Several participants suggested that engaging university extension specialists, or reaching university partners through existing CESU agreements, could be an effective way to bridge the gap between researchers and end users in fire management, and other NPS resource areas. Supporting the current approach to consortia development, participants agreed it is important for the consortia to assess how managers currently access information before determining how to improve this access, and many were in agreement that the current model was not effective. Participants also recommended that information produced by the consortia should be targeted to diverse user groups, both within the fire management community and among fire management agencies, so that the information would not be too broad to be useful.

Wright described an ongoing social network analysis conducted by the Northern Rockies and Southwest consortia as a potential tool to identify how people in different roles within fire management communicate about fire science information.

### Serving an interdisciplinary audience

The session facilitator guided the next part of the discussion by asking, "What would it mean for the JFSP to serve a broader, more interdisciplinary audience?" The JFSP's science delivery strategy identifies the largest group of consumers of JFSP products as federal "specialists and line officers (GS-7 to GS-15) who plan and implement activities associated with wildfire and natural resource management on federally administered land, and their counterparts who manage state and private lands" (JFSP 2007, 3). Many of the JFSP knowledge exchange consortia have initially focused on fire managers, including roles such as fire management officers, assistant fire management officers, fuels specialists, fire ecologists, fire planners, staff officers, and line officers. In order to serve the group described in the science delivery strategy, these consortia might need to broaden to also serve natural resource managers (for example, wildlife biologists and botanists).

Participants shared their interdisciplinary interactions from their careers, citing differences in work culture and educational background between fire and natural resource managers. Zion National Park was used as an example of an interdisciplinary approach that worked well, in which fire operations managers and natural resource managers regularly communicated by having a fire liaison at natural resource meetings and vice versa. In this park, the fire ecologist role was given a prominent voice and was used as a means to bring applicable fire science to fire operations managers. The resource management and fire programs in Zion were able to work collaboratively to respond to a large fire and broadscale herbicide treatment project, which allowed them to realize further commonalities between fire and resource managers. One participant responded to this example by suggesting that often the fires which become crisis situations at the national level are the ones in which the different program areas or agencies have established only weak lines of communication between disciplines. Participants agreed that scheduling opportunities to meet and collaborate on projects was a key factor to move fire management into a more interdisciplinary context. However, participants recognized that time, funding, and institutional support were necessary drivers to promote such collaborations. Participants also suggested that the JFSP consortia develop case studies, where there has been good communication and collaboration between researchers, management, and interdisciplinary audiences, in order to identify "best practices."

Participants noted that within fire management, there was a wide spectrum of use and understanding of current fire science and ecology concepts. Fire operations managers were seen as less connected to fire science, and one suggestion for increasing their awareness of fire science and ecology was to have certain upper level courses required as training for fire operations positions. This would promote a common platform of concepts, language, and terminology that would in turn facilitate communication among different fire management positions, different resource disciplines, and even different agencies.

### Potential consortia activities

Participants identified potential consortia activities to facilitate communication among interdisciplinary audiences. A primary idea was an interdisciplinary workshop bringing managers from different disciplines together to develop case studies about the use and application of science, and possibly to engage in role-playing scenarios. Another idea was to encourage natural resource managers and fire managers to work together by having a pot of research money to specifically fund interdisciplinary fire management research projects. For example, the JFSP funded several interdisciplinary studies in Zion National Park. Other suggestions included creating JFSP briefs tailored to managers of different resource areas, and compiling a robust, searchable database with regional case studies.

When asked to identify activities that would make the consortia appeal to a broader audience than fire and fuels managers, participants responded by revisiting the idea of a highly specialized workshop or web seminar that was promoted as a go-to resource and information clearinghouse, at the cutting edge of interdisciplinary fire management. Some participants advocated having such a workshop organized around a main "hot topic," such as a cross-discipline whitebark pine management strategy, or around a crisis situation requiring an interdisciplinary solution. Another suggestion was a workshop specifically addressing differences in the language and terminology used to communicate fire science and management concepts.

Participants recommended several ways to encourage participation in these proposed activities, including providing travel grants for workshop attendance, actively recruiting potential attendees from diverse disciplines, suggesting attendance as part of a resource manager's career development plan, and collaborating with already-established and well-respected conferences and workshops.

### Three themes

Near the end of the session, the group identified three themes emerging from the discussion:

1. How do fire and resource managers engage each other and provide the right education and training to do so?
2. Where can we find expertise and information to inform fire management decisions and tackle interdisciplinary issues?
3. Can we look at case studies at a regional level and engage people from different resource areas around a topic or species?

### Southwest Consortium workshop

Andi Thode offered insights from her perspective as the principal investigator of the Southwest JFSP Consortium, which is an active consortium. The Southwest Consortium had recently conducted the Southwest interagency fuels workshop, which drew 155 managers and researchers from across disciplines and agencies. At this workshop, participants joined breakout sessions about lessons learned, new research, and the future, in each of five vegetation types. Feedback from the workshop suggested that fuels treatment and restoration information was effectively disseminated across an interdisciplinary audience of resource and fire managers in the Southwest. This inspired the Southwest Consortium project team to expand their activities beyond the original planning-phase mission, of bringing fire researchers and managers together, to include a more interdisciplinary audience, and to change the composition of their executive board to include specialists from other disciplines. In addition, based on recommendations from this initial large workshop, the Southwest Consortium is considering organizing additional specialized workshops and synthesis materials to serve interdisciplinary audiences.

### Sharing circle conclusion

The session concluded by reviewing the sharing circle discussion and welcoming additional suggestions for the JFSP consortia. The sharing circle had been an opportunity to explore some of the contemporary challenges to communicating science within the fire and resource management communities, and to brainstorm methods to get relevant information and ideas to fire managers, and managers from other disciplines involved in fire or fuels management. Participants concluded the session by applauding the regional emphasis of the JFSP consortia, and by requesting that JFSP funding structure be shifted to emphasize more regional research, collaborative projects, and workshops centered on the networks created by each regional consortium. They also expressed support for the planned evaluation of the consortia's activities.

### Follow-up

Session organizers summarized the GWS sharing circle discussion for the national network of JFSP consortia principal investigators and coordinators at the 2011 annual consortia principal investigator meeting. The GWS session was timely, as the JFSP consortia network is exploring how to engage and provide fire information for people outside the traditional fire community (for example, natural resource managers). At the annual meeting, the consortia continued to consider ways reach resource managers, including inviting them to participate in workshops and conferences about fire and fuels science and management, an approach that the Southwest Consortium had used for the Southwest Interagency Fuels workshop. The consortia reiterated their commitment to being inclusive to all parties interested in fire and fuels science. Several regional consortia have defined themselves as interdisciplinary consortia (for example, the Great Basin, California, and Lake States), soliciting input from resource managers during their initial needs assessments. In addition, the Great Basin Consortium has resource managers on both their steering committee and advisory board, and the Southwest Consortium has decided to add resource managers to their executive board.

In conclusion, one resource manager queried during the Northern Rockies Fire Science Network's needs assessment stated that "at the end of the day, fuels management occurs in an interdisciplinary environment" and said fire and resource managers will be most effective if they identify research needs collaboratively, and draw from the same science sources. The JFSP consortia offer a promising venue for facilitating this goal.

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# Year-Round Hydrologic Monitoring of Subalpine Lakes in Great Basin National Park

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## Introduction

Lakes have many characteristics that make them excellent ecosystems for monitoring long-term changes, such as climate change (Adrian et al. 2009). They integrate landscape and atmospheric changes, and are responsive to environmental changes (Williamson et al. 2008). In the case of high-elevation lakes in protected areas, few confounding factors are present, due to limited anthropogenic stressors (Figure 1). Lakes are also excellent at storing information about past climate conditions. Lake sediment studies show that sub-alpine lakes in the western U.S. have had numerous temperature fluctuations over the past 7000 years (Reinemann et al. 2009; Porinchu et al. 2010).

The National Park Service (NPS) Inventory and Monitoring (I&M) program is charged with developing a long-term monitoring program for elements of national parks that are considered vital. The Mojave Desert Network I&M program includes Great Basin National Park. One of the goals of the Streams and Lakes protocol is to monitor lake levels, water temperatures, and the length of the ice-covered period, and determine trends for these parameters.

Six sub-alpine lakes, at elevations ranging from 2915 m to 3292 m, are located within Great Basin National Park (Figure 2). All are relatively small, with volumes ranging from 600 $m^3$ to 15,000 $m^3$, and with maximum depth running up to 4.9 m. Four of these lakes nearly freeze solid during the winter (Metcalf et al. 1989).

## Methods

In order to record lake temperature and pressure, HOBO U-20 data loggers were installed in four

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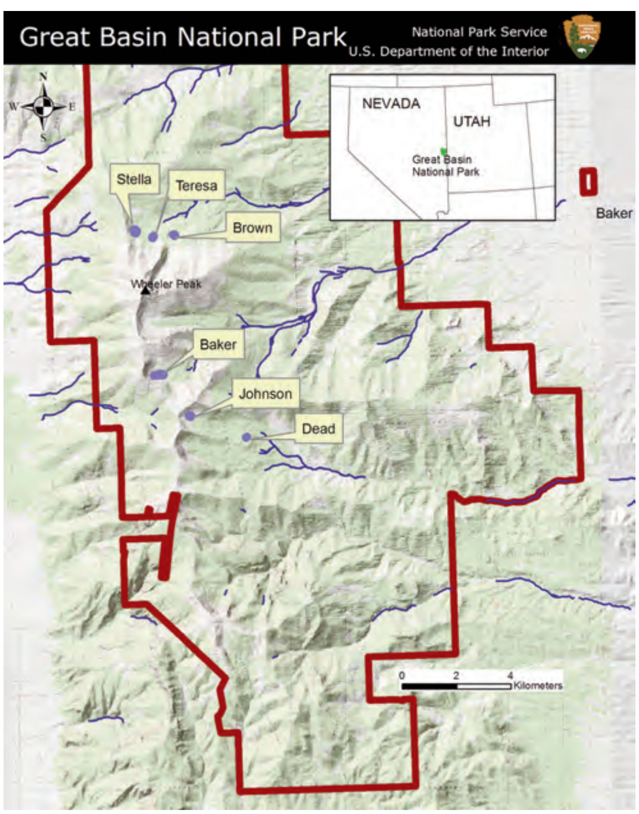


**Figure 1 (above).** Stella Lake, Great Basin National Park. This sub-alpine lake is protected from many anthropogenic effects, thus making it an ideal study location for climate change. NPS Photo.

**Figure 2 (left).** Location of six sub-alpine lakes in Great Basin National Park.

lakes in 2009, Baker, Johnson, Stella, and Teresa. The pressure of the water above the data logger was comparable to the depth of water above the logger. Data loggers in Baker and Johnson lakes were programmed to record data twice daily, at midnight and noon. Data loggers in Stella and Teresa lakes were programmed to record at 15-minute intervals.

Data loggers were placed in PVC stilling wells attached to steel fence posts, and secured to the lake bottom in water approximately one meter deep, which approximated the deepest a crewmember could install a data logger without submerging him- or herself. Additional data loggers were placed in trees near the lake shore as controls, to account for barometric pressure changes, as recommended by the manufacturer. The location of the data logger was determined using GPS and surveyed using the line level method (Hoffman et al. 2005). The area was sketched, and water quality was measured.

Data loggers were retrieved in September 2010, when water levels were near minimum, but access to the lakes did not require any special equipment. The data was downloaded using Hoboware software, and then exported to Excel for analysis.

## Results

**Water temperature and water levels**. Data loggers at Baker and Johnson lakes recorded data for almost an entire year, while the data loggers at Stella and Teresa lakes stopped recording February 13, 2010, due to a full memory. The data show that water temperatures varied significantly over the course of the year (Figure 3).

**Figure 3.** Water temperatures in four sub-alpine lakes.

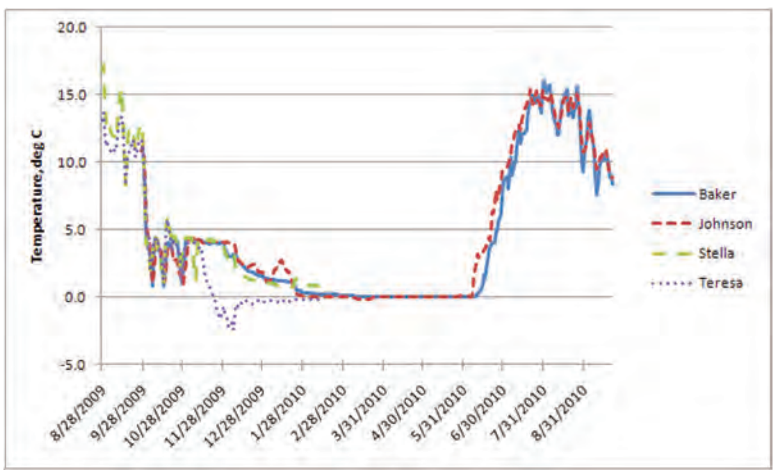


**Table 1.** Water temperature and water level averages and ranges for four sub-alpine lakes. Note that the data for Baker and Johnson lakes span nearly one year; for Stella and Teresa lakes it spans 5.5 months.

| Lake | Dates of Record | Average Temp (°F) | Temp Range (°F) | Average Water Level (ft) | Water-Level Range (ft) | Ice-covered Days |
|---|---|---|---|---|---|---|
| Baker | 9/26/09–9/23/10 | 39.3 | 27.9 | 3 | 3.8 | 201 |
| Johnson | 9/26/09–9/22/10 | 39.8 | 28.9 | 3.3 | 4.8 | 199 |
| Stella | 8/27/09–2/13/09 | 40.0 | 29.7 | 1.9 | 1.5 | na |
| Teresa | 8/27/09–2/13/09 | 37.4 | 28.9 | 4.6 | 14.3 | na |

Daily average water levels were similar for both Johnson and Baker Lakes. Maximum water levels occurred in early June for both, with minimums in November and December. Water temperatures were similar for all three lakes (Table 1). The daily maximum temperature occurred in late July and August for Baker and Johnson lakes. Minimum daily temperatures for the year, based on the available data, occurred from December (Teresa Lake) to April (Baker Lake). Seasonality influenced the diurnal temperature ranges. During the winter, when the sensor was likely frozen, the temperature ranges varied the least.

**Ice-out and ice-over.** Ice-out (absence of ice on the lake) was determined for both Baker and Johnson lakes by looking at water levels, which rapidly changed from near-constant levels to increasing values in early summer. Ice-out was on or about 5/31/2010 on Johnson Lake, and 6/2/2010 on Baker Lake. Water temperatures lagged 5–7 days to show an increase from near-freezing to above-freezing.

Ice-over (presence of ice over the entire lake) when the entire lake is was more difficult to determine. Large temperature drops occurred at the end of September and the end of October, likely causing periodic freezing on the lakes. Subsequent water and air temperatures were above freezing. Complete ice-over for the year was determined by noting a decrease in daily temperature variation. This occurred on all four lakes on or about November 13, 2009.

### Discussion

Over the past 150 years, ice-over dates in Northern Hemisphere lakes and rivers have averaged 5.8 days per 100 years later, and ice-out dates have averaged 6.5 days per 100 years earlier (Magnuson et al. 2000). Although the period of ice-cover on Great Basin National Park lakes currently exceeds six months, it is likely to change. An increase in the ice-free period on the lakes may alter aquatic food webs by changing seasonal timing of predator-prey relationships (Winder and Schindler 2004) and increasing primary production (Regier et al. 1990) due to accelerated warming of the open water in comparison to snow and ice (Williamson et al. 2008).

Ice-out and ice-over dates have been found to be closely correlated with air temperatures one to two months beforehand (Livingstone 1997). Further studies will examine temperatures and LANDSAT imagery to compare how park lakes compare. Additional methods may be employed to better detect ice-over and ice-out, including strings of data loggers suspended in the lakes and remote cameras.

Although the data loggers in Stella and Teresa lakes did not provide a full year's data, the 15-minute-interval data they recorded was analyzed to determine the optimum sampling frequency. We recommend a minimum sampling frequency of two hours, because longer sampling intervals resulted in changes to estimated daily mean temperature.

Current predictions of climate change are for warmer temperatures, which will result in earlier snow pack disappearance, greatly affecting the hydrology of these lakes. Long-term, year-round monitoring will help detect these changes, and determine how they affect water chemistry and biological communities.

### Acknowledgements

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# Parknership: A Twenty-first Century Model at Keweenaw National Historical Park

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In the formative years of the National Park Service (NPS), I'm sure that Stephen Mather never thought for a moment that his strategy for bringing America's national parks to prominence among the citizens of the United States would be equally applicable in the twenty-first century, some ninety-four years in the offing. He relied upon key partners to promote the national park idea, instill pride in the hearts of America's citizens, and to develop infrastructure that would both increase visitation and elevate visitor appreciation for our nation's most significant natural and cultural resources.

Mather needed a way to bring visitors into the national parks, and the nation's fledgling railroads needed to expand services to the west, increasing ridership along the way. Bryce Canyon Lodge and Grand Canyon Lodge are examples of the Union Pacific's "Loop Tours" building program. Those, together with Old Faithful Inn and Paradise Inn at Mt. Rainier, provided accommodations that were hard to resist for an American public growing eager to travel.

Even though there were many cultural national park units across the country, Mather's grand solution was to develop partnerships that emphasized the vast expanses of natural resources in the west to capture the imagination of the American public. And that solution worked in dramatic fashion. But perhaps it worked too well.

Once the national parks developed a strong connection with the American public, those partner relationships became less critical to the survival of the NPS and to individual park units. National park units developed an aura of autonomy: we neither needed nor really wanted the help of others outside of the agency. National parks could stand strong, proud, and forever on its own resources – natural, cultural, and human resources. The NPS was a proud bunch, and rightfully so considering its tremendous accomplishments and the dedication of its ranks. But perhaps a bit too proud for its own good.

As scientists such as George Wright and advocacy groups such as the Sierra Club educated, coerced, and, at times, forced the NPS to be ever more vigilant about caring for its resources using the best possible methods—methods based in solid science—the NPS once more found itself in need of relationships different than those to which it had grown accustomed.

Nearly one hundred years after Mather's foray into the partnership arena, we once again find

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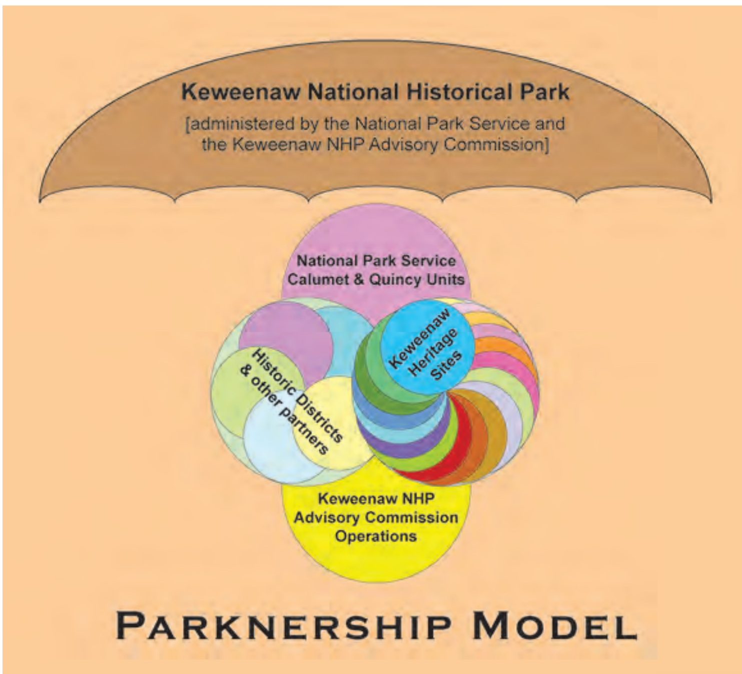
ourselves needing to establish strategic partnerships—albeit very different from those in the past—if we are to continue to accomplish the mission of the National Park Service.

It is time to go back and re-examine the tenets of the Organic Act, and rethink how we could best fulfill the mission of the NPS. Congress provided direction by legislating, in a variety of ways, the engagement of partners to fulfill our mission—to do the important work of the National Park Service, but without the inordinate amount of federal funds previously available for such work.

Enter Keweenaw National Historical Park (NHP), established in 1992 through a tenacious grassroots effort by the people of the Keweenaw Peninsula in Upper Michigan's Copper Country. Although the "park" encompasses only 1,860 acres within the legislated boundaries of its two units—and owns less than 150 of those acres—it has legislatively mandated influence across more than 800,000 acres of the region in Michigan's Upper Peninsula that provided critical resources to America's—and the world's—great Industrial Revolution. There are hundreds of historic resources throughout the Keweenaw, and a myriad of intangible heritage resources to be preserved and interpreted for the public. It is, after all, the largest "small park" in the system. The congressional intent of the legislation was to provide a way to care for the nationally significant resources that document the nation's first major mineral rush, without overburdening taxpayers with the funding required to accomplish such a monumental task.




The mission of Keweenaw NHP is to preserve, protect, and interpret the natural and cultural resources relating to the copper mining industry for the enjoyment and benefit of current and future generations *through cooperative efforts and partnerships* with state and local governments, public and private entities. The NPS at Keweenaw NHP is the facilitator in this grand partnership scenario.

There are four key components that comprise Keweenaw NHP:

1. The National Park Service.
2. The Keweenaw NHP Advisory Commission, which was the first permanent commission in the national park system.
3. Copper Country communities, including residents, businesses, nonprofit organizations, historic district commissions, and other state and local government agencies.
4. The Keweenaw Heritage Sites, a collection of nineteen private, nonprofit organizations, universities, state parks, and commercial entities that preserve twenty-six sites and the historic resources under their care, providing the vast majority of the interpretive opportunities for visitors.

Together, the four components provide a cohesive national park experience while preserving the local passion for its heritage resources.

In this twenty-first century national park model, the National Park Service is no longer considered to be "the park." Rather, we prefer "the National Park Service *at* Keweenaw National Historical Park" to more accurately describe our relationship in the park. We illustrate this concept graphically with Keweenaw NHP—"the park"—portrayed as an umbrella, and the component parts beneath it, none emphatically more important than its other partners. Since it is a national park, we start with the NPS as the administrative component of the park, providing both focused direction for the broader concept and professional technical assistance to its various—and numerous—partners.

Continuing with the legislated mandates of the park, the second component of the model is the Keweenaw NHP Advisory Commission, authorized by the park's enabling legislation to "carry out historical, educational, or cultural programs which encourage or enhance appreciation of the historic resources [with]in the park['s legislated boundaries], surrounding areas, and on the Keweenaw Peninsula." This authorization expanded the ephemeral boundaries of "the park" beyond the two units, to now encompass more than 800,000 acres across Upper Michigan's Copper Country.

The third component under the umbrella takes in all of the communities across the Copper Country, including the residents, businesses, nonprofit organizations, historic district commissions, and other state and local government agencies with which the NPS engages in both formal and informal partnerships. Currently, the National Park Service at Keweenaw NHP actively partners with forty to fifty of these key entities to protect the vast cultural and natural resources throughout the park. These partners engage in district- and community-specific projects, as well as region-wide initiatives that bring together twenty-five, thirty, or more partners in concerted, collaborative efforts that benefit each of them.

The final component of this twenty-first century partnership model is the Keweenaw Heritage Sites group: nineteen non-federal organizations that administer twenty-six sites, providing the bulk of the park's interpretive experiences. While the Keweenaw Heritage Sites cover an area greater than 110 miles in length, they are marketed as a single destination through a variety of media. Visitors are directed to each site through an NPS-coordinated wayfinding system that is indicative of the symbiotic relationship between the Keweenaw Heritage Sites and the National Park Service at Keweenaw NHP.

The four components that comprise Keweenaw NHP result in a partnership that is unique within the National Park System. It is so unusual that we have devised a special term for it: this concept is most accurately described as a "parknership," a national park that embraces a concept of *mutual benefit for all partners* involved in broad-ranging collaborative efforts.

While the National Park Service is no newcomer to partnering, it has never addressed partnerships with such a holistic approach. Broad-ranging relationships, such as the "parknership" that is Keweenaw NHP, are becoming the new way of doing business for the NPS. The federal government no longer has perennially deep pockets to care for the nation's natural treasures, nor its cultural heritage. This new model has all partners contributing to the mix, whether financially, or in-kind, or simply with a passion for the resource. America needs a new, collaborative stewardship model to care for its great places, and the "parknership" model demonstrates successful collaboration. Challenges abound on the road to the right mix, defining roles and responsibilities along the way, but the prize lies in the proper care and feeding—and perpetuation—of our irreplaceable resources. Partnerships—or, more accurately, *Parknerships*—are key to continuing the successful accomplishment of the mission of the National Park Service.

# The Indigenous Cultural Landscape of the Eastern Woodlands: A Model for Conservation, Interpretation, and Tourism

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IT IS UNIVERSALLY RECOGNIZED BY THOSE CONCERNED WITH THE PRESERVATION AND RESTORATION of treasured landscapes, such as the Chesapeake Bay or other major waterways, that widespread public buy-in can be best achieved by appealing to the citizens' appreciation of those areas in their relatively natural state. The immediate corollary is that to appreciate such waterways, one needs to have access to them, or to the lands adjacent. Those lands will be best appreciated if they are already preserved and protected from some of the encroachments of modern life, and especially if those lands and access points have scenic, historical, or cultural significance.

The concept of the indigenous cultural landscape as useful in land conservation programs and interpretation arose from considering what an indigenous person's perspective of the Chesapeake Bay region might have been when John Smith first explored the bay and its tributaries. It has more recently been recognized as applicable to other indigenous peoples' lands, if their pre-contact lifestyles were similar. This construct recognizes and respects that Indian cultures lived within the context of their environment, although not in the stereotypical sense of "living in harmony with the environment." American Indian peoples lived around major waterways within large, varied landscapes, with which they were intimately familiar. They used different parts of those landscapes in different ways: for food, medicine, and clothing procurement, for making tools and objects related to transportation and the household, for agriculture, and for settlements.

A brief glimpse into the lifestyles of the American Indian peoples of the Chesapeake Bay region at the time of early European contact might be helpful here, as an example. Although those many nations had somewhat different cultures and sociopolitical structures, their life ways were similar throughout the bay area, and indeed were shared by nations in most of the Eastern Woodlands. They practiced agriculture, and lived for some parts of the year in permanent towns and communities. The communities were often fairly widely dispersed. Houses were not stationary, but moved as agricultural lands became fallow, so that communities drifted spatially over the years. Men and women had differing duties, and the duties of both connected them with their broader surroundings, and took them away from their permanent communities during some periods of the year. Men were primarily responsible for hunting, and procuring food from fish and

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shellfish. They were also the principal tool makers for tools made of stone. The women were primarily responsible for agriculture, for gathering plant materials used for food, housing, medicine, and clothing, and for processing animals for food and clothing.

To be effective in such a society, both men and women had to be familiar with very large areas of land and water, and be able to remember and travel to the appropriate places for gathering particular plants, acquiring stone for tools, or hunting particular species of animals. This was the indigenous person's world of the time; in area it far outstripped what is generally understood today as an "Indian community" according to the dots on the early explorers' maps. This view of the world one inhabited and lived with, was the indigenous cultural landscape.

The construct of the indigenous cultural landscape is particularly pertinent to land conservation and interpretation in the East today, for two major reasons. It embraces an aspect of America's cultural heritage that has widespread appeal for the geotourist. People of all ages and backgrounds are intrigued by native history and culture, and are eager to learn more about what life was like for Indians, especially before Europeans in the Chesapeake region changed the Indian world. This fact is acknowledged by one of the major themes of the National Park Service's Captain John Smith Chesapeake National Historic Trail, which embraces respect for, inclusion of, and education about the Indian communities of the Chesapeake.

In addition, the use of such a construct does more than capitalize on the public's great interest in American Indians and their cultures, and the emotional ties such interest brings to the conservation of natural resources. It also recognizes that these indigenous communities still exist, and that respecting them and their cultures is a valid and central goal of any land or water conservation effort. Furthermore, the construct re-emphasizes the values that American Indians have toward natural resources, including an attachment to place, and thereby encourages that attachment to place, which will further efforts to help save and protect eastern waterways and their watersheds.

In the past, American Indian cultural conservation and curiosity has focused primarily on archeological sites, not on the full landscapes in which these cultures existed prior to, and for some decades after, European contact. Conservation and preservation of native archaeological sites is indeed critical, but our efforts should not be limited to such sites. Instead, they should be expanded whenever possible to embrace known archaeological sites—or areas of high potential for precolonial archaeology—and their surrounds, preferably in units of land large and natural enough to accurately reflect the cultural life ways of the communities that lived within them. Such an approach strengthens the arguments for preserving, conserving, and restoring larger cohesive landscape units, which may include uplands, forests, natural openings and meadows, as well as riverine, estuarine, and marine waters, in connected blocks and corridors.

This approach also brings both equality and visibility to the descendents of the indigenous cultures who inhabited these lands historically. If we conserve for both indigenous cultural and ecological reasons, along with scenic and aesthetic reasons, we build a greater meaning for these landscapes, and for the people who were, and still are, culturally attached to them. We build opportunities for the public to interact with and learn about these communities, which furthers their attachment to those lands and waterways. In addition, we include these indigenous peoples, who are today largely absent from the greater "conservation communities" of the eastern United States, as equal partners, consultants, educators, and interpreters.

The descendent indigenous groups of the East should participate in the process of selecting and prioritizing culturally significant indigenous landscapes, which are currently under-represented in our federal, state, and regional databases. These groups will be those who descend from the original indigenous peoples, and who have maintained their American Indian identity through the centuries. Such participation would not be linked to their recognition by the federal government, or the states, as tribes. Federal recognition by these groups is usually problematic, because their treaties with European nations preceded the formation of the U.S. government, and were not subsumed by the United States of America at its formation. Nevertheless, these American Indian groups still use, protect, respect, and enjoy the rivers and tributaries that often share their names, and they will want to help in efforts to conserve the related lands of those watersheds.

Additionally, it will be useful, for conservation and interpretation, to define indigenous cultural landscapes, even where there is no extant descendent native community that acknowledges a historic connection to the area. These landscapes can be readily identified by knowledgeable American Indian scholars, working in consultation with trusted archaeologists and anthropologists experienced in recognizing areas of high probability for precolonial use and habitation.

Finally, the indigenous cultural landscape approach can be applied to protected lands no matter who manages them. The added value of the indigenous cultural landscape lies in its particular suitability for educational, and engaging, interpretation wherever public access, whether private or public, limited or unlimited, is permitted on preserved lands. To know the people's history, one must know the landscape and how it was used. Presenting information about the historical use of the landscape offers further opportunity for underserved American Indian communities to enrich the field of heritage tourism by sharing their stories and their perspectives on the lands being conserved.

### Indigenous Cultural Landscape Team

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# An Inventory of Paleontological Resources from Glacier Bay National Park and Preserve, Alaska

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## Introduction

Glacier Bay National Park and Preserve (GBNPP), at the northern end of Southeast Alaska, constitutes a spectacular array of mountains, tidewater glaciers, and fjords. The complex geologic story of the Glacier Bay area is dominated by accretionary terranes (fragments of crustal blocks which have been tectonically transported significant distances, hundreds to thousands of km from their origin source area), and more recently by the action of glaciers and coastal processes. The first report of fossils from Alaska, as well as the first documented fossils from western North America, are tied to a discovery of fossil bivalves (pectinids) in 1797 by French explorer La Perouse near Lituya Bay (La Pérouse 1797). U.S. Geological Survey (USGS) cartographers have mapped hundreds of fossil localities, and made large collections of fossils from within the areas now administered by GBNPP. Santucci and Kenworthy (2008) compiled some initial baseline paleontological resource data for GBNPP. Despite the rich fossil record preserved at GBNPP, the park had not been the focus of rigorous paleontological research.

## Paleozoic paleontology of Glacier Bay

The Glacier Bay area is primarily composed of an extraordinary thick sequence of Paleozoic rocks associated with the Alexander terrane, an accreted terrane which comprises much of southeastern Alaska. These rocks represent rifted continental rocks of Siberian origin (Blodgett, Rohr, and Boucot 2002; Blodgett et al. 2010). Five Paleozoic formations mapped and described by Rossman (1963) are exposed in GBNPP: Willoughby Limestone (late Silurian); Tidal Formation (late Silurian); Pyramid Peak Limestone; Rendu Formation; and, Black Cap Limestone (Early and Middle Devonian). An unnamed Permian limestone unit has been identified within GBNPP by Dave A. Brew and others in subsequent geologic mapping.

The Willoughby Limestone is a massive Late Silurian limestone unit which measures more than 5,000 feet thick in GBNPP (Rossman 1963). The type section (a type section is designated by the author of a new formation as being its most typical representative outcropping) for the Willoughby Limestone occurs on Willoughby Island within GBNPP (Figure 1). This formation

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represents a thick accumulation of warm, shallow-water calcareous sediments with substantial invertebrate megafauna. Fossils discovered in this formation are extremely large (some bivalves approach 0.2 meters in length) suggesting their existence during a period of extremely high bio-productivity in a shallow-water, high energy reef environment. The largest known Paleozoic bivalve, *Pycinodesma giganteum* (Figure 2), was collected by USGS paleontologist Edwin Kirk in 1917 from a small island situated about 150 m northeast of Willoughby Island (Kirk 1927). The Willoughby Limestone also preserves a number of brachiopods, gastropods, sphinctozoan sponges, as well as large thumbnail-sized ostracodes. Kirk's original collections from Willoughby Island have yielded a number of additional type specimens, including the gastropods *Bathmopterus* Kirk, 1928 (Figure 3), *Kirkospira* Rohr and Blodgett, 2003, named in honor of Edwin Kirk, and a new species of gastropod *Coelocaulus karlae* Rohr, Blodgett, and Frýda 2003. Similar fauna are documented on Drake Island and Gloomy Knob to the north within Glacier Bay; however, these fossils are slightly more altered or metamorphosed.

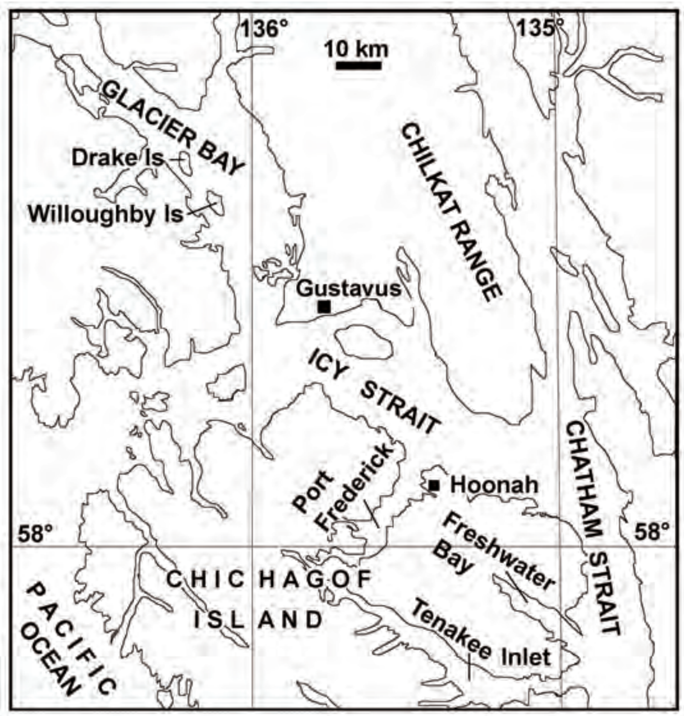


**Figure 1.** Index map showing Glacier Bay and immediately surrounding area in Southeast Alaska.

**Figure 2.** Various views of the upper Silurian bivalve *Pycinodesma giganteum* (Kirk).

The Tidal Formation is a very thick Late Silurian unit consisting of thin-bedded argillite (mudstone), calcareous greywacke (sandstone), and limestone. This unit contains dipping sedimentary structures which indicate a turbidite-fan complex, and may represent a deep water environment. The Tidal Formation is exposed in the Tidal Inlet region of GBNPP, where the section measures over 10,000 feet in thickness (Rossman 1963). Although the unit is largely lacking in fossils, tabulate corals (*Favosites* sp. and *Striatopora*? sp.) were reported by Edwin Kirk from the Sandy Cove area.

Both the Pyramid Peak and Rendu formations are reported as being largely unfossiliferous, Late Silurian through Early Devonian, carbonate units. These formations may be in part deep-water, laterally equivalent lithologic units of the shallow-water Willoughby Limestone. The Rendu Formation contains some fossils, including conodonts and rugose corals. Colonial rugose corals were documented at a locality in the Rendu/Queen Inlet area of GBNPP (Santucci and Kenworthy 2008).

Collectively, the Willoughby Limestone, Tidal Formation, and basal portions of the Rendu and Pyramid Peak formations may represent the thickest known sequence of Silurian rocks in North America, perhaps the world.

The Early and Middle Devonian Black Cap Limestone is a massive, dark gray, fine-grained carbonate limestone which is widely exposed on the east side of Glacier Bay. This formation is interpreted as a shallow-water carbonate shelf environment, and is represented today by approximately 4,500 feet of thickness in southeast Alaska (Rossman 1963). The Black Cap Limestone is quite fossiliferous, and extensive collections were obtained between 1966 and 1972, including rugose corals, brachiopods (see Figure 4 for photographs of a new rotund atrypid brachiopod species found in the summer of 2010 in Adams Inlet by a NPS field party), gastropods, ostracods, and the calcareous green alga *Coelotrochium* (Blodgett, Rohr, and Boucot 2002). The brachiopod taxa included at least two species of "*Atrypa*" and the genus *Warrenella*.


**Figure 3.** Various views of the upper Silurian gastropod *Bathmopterus liratus* (Kirk).

In 1966, E.M. MacKevett Jr. made a collection of fossils from the Black Cap Limestone, at a locality on the west side of Red Mountain, east of Muir Inlet. Stromatoporoids, tabulate corals, and some undetermined rugose corals, were obtained from the locality. The stromatoporoids were identified as *Amphipora* sp., and the tabulate corals include *Alveolites* sp., *Aulocystis* sp., *Favosites* sp., and *Thamnopora?* sp.

Conodonts were collected from the Black Cap Limestone, at Tidal Inlet south of Black Cap Mountain. The locality is described as a recrystallized algal-crinoid-gastropod bank with minor corals. The conodont collection included *Belodella resima, Panderodus* sp., paltodontiform elements, a neoprionidiniform element, a plectospathodan element, and an ozarkodinan element.

An unnamed Permian age limestone unit was reported by retired USGS geologist Dave Brew. The fossil locality occurs on the south side of the entrance to Adams Inlet and is interpreted as Permian, based on the fauna, including brachiopods, bryozoans, and echinoderm debris. These fossils were evaluated by USGS geologist J.T. Dutro who assigned the collection to Permian (most likely late Leonardian). The brachiopod taxa include *Septacamera stupenda, Spiriferella* sp., and *Stenoscisma?* sp., part of a fauna known from Permian Pybus Formation, also occurring in Southeast Alaska.


**Figure 4.** Six views of a new rotund atrpyid brachiopod species from Middle Devonian strata of the Black Cap Limestone.

### Cenozoic paleontology of Glacier Bay

Cenozoic rocks along the outer Pacific Ocean margin in the Lituya Bay area, which are associated with the Yakutat terrane, have been more intensively studied relative to the stratigraphy and paleontology. Numerous fossil localities are rich in marine bivalves (MacNeil 1961; Marincovich 1980), gastropods (Marincovich 1980), echinoids (Wagner 1974), decapods, and to a lesser degree, land plants (Wolfe 1977). The principle formations containing these fossils include the Yakataga Formation, Topsy Formation, and Cenotaph Volcanics.

Quaternary and Holocene glacial deposits in GBNPP preserve the well-known standing stumps of the fossil forests (Herrick 1892; Wik 1973).

### Future paleontological work at Glacier Bay

An in-depth paleontological resource assessment has been completed to document all known fossil localities within Glacier Bay National Park and Preserve. This work included the compilation of a comprehensive bibliography, and compiling all paleontology and stratigraphy studies published on GBNPP, along with a complete PDF library of all known internal USGS fossil reports undertaken by USGS paleontologists. The latter reports are also known as E&R (examination and report) reports, and constitute a tremendous source of unpublished paleontological resource data. Finally, we have compiled an Excel spreadsheet listing all known fossil localities (nearly 600 in number) and their taxonomic content within the park. This effort is intended to provide baseline information for future geologic mapping within the park, and to focus researchers on areas needing additional studies, as well as to document and protect its paleontologic resources.

Future planned studies include field work on the Paleozoic rocks in Glacier Bay proper during the summer of 2011, with the aim of better documenting their fossil content, community paleoecology, and paleogeographic setting. As noted above, this work will also bring about collaboration with various paleontologists to cover as many of the fossil groups as possible, from among those represented at GBNPP. Another probable future study may include a visit to the former USGS Paleozoic fossil collections, now housed in the Smithsonian Institution. This evaluation will enable a better understanding of the scope, significance, and taxonomic content of past fossil collections from GBNPP. Many of these collections were made in 1917 by Edwin Kirk, and later in the 1950s and 1960s by D.L. Rossman, D. Brew, and other USGS geologists. Further inventory should also take into account the vast former USGS fossil collections made in Cenozoic age strata of GBNPP, now housed at the University of California Museum of Paleontology, in Berkeley.

One of the primary objectives for the 2011 summer field season at GBNPP will be to undertake a detailed taxonomic study of all fossil groups represented in various Paleozoic formations (notably the Willoughby, Tidal, Rendu, and Black Cap), and to describe the contained fossil communities and their paleoecological setting. This effort will obviously include the participation of many paleontologists in the complete inventory of the fauna.

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# Engaging Under-represented Minorities in the Sciences

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IN MARCH 2010, GILLIAN BOWSER AND MARK BROWN OF COLORADO STATE UNIVERSITY were awarded a grant from the National Science Foundation to develop the Rocky Mountain Sustainability and Science Network (RMSSN). The overarching goal of the network is to help develop the next diverse generation of globally-minded leaders who are prepared to address future issues related to climate change and environmental sustainability. That goal is grounded in four subgoals for which the network has recruited partners (Table 1) with specific expertise in global leadership, collaborative partnerships, science, and education.

The RMSSN places a significant emphasis on recruiting under-represented students to the sciences. This emphasis is highlighted in network's overarching goal to develop *diverse* leaders. Why the emphasis on diversity? Under-represented minority students have a low rate of entry and retention in science disciplines. Further, the number of under-represented minority students in the *environmental sciences* is alarmingly low, and the number who persist in related careers is even lower. Several studies highlight four priorities for engaging under-represented students in the sciences (Boyd and Wesemann 2009; Taraban and Blanton 2008; Hathaway, Nagda, and Gregerman 2006; Kuh et al. 2005). These include research experiences, professional development, bridging programs, and social networking and support.

The hallmark of the RMSSN is a summer academy which ultimately leads to a certificate in global leadership and environmental sustainability. This academy provides a weeklong, structured experience through which the network addresses the four priorities (highlighted above) and provides a foundation upon which the network builds supporting programs that further those priorities.

The RMSSN held its first academy at the Shortgrass Steppe Longterm Ecological Research Station adjacent to the Pawnee National Grasslands in eastern Colorado. To

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| Academic Institutions | |
|---|---|
| Autonomous University of the Yucatan | Colorado State University |
| George Washington University | Institute of American Indian Arts |
| Metropolitan State College of Denver | Salish Kootenai Tribal College |
| Texas A&M University | University of Colorado |
| University of Montana | University of Nairobi |
| University of Northern Colorado | University of Wisconsin, Whitewater |
| University of Wyoming | University of Wollongong |
| Utah State University | |
| **Agency Partners** | |
| Bureau of Land Management | National Park Service |
| United States Geological Survey | |
| **Organizational Partners** | |
| American Museum of Natural History | Association for Advancement of Sustainability in Higher Education |
| National Phenology Network | Student Conservation Association |
| Wyoming Conservation Association | |

**Table 1.** RMSSN partner institutions, agencies, and organizations.

address the network's emphasis on developing globally-minded leaders, the RMSSN recruited a broad group of participants, including 32 students from throughout the United States and Mexico (Figure 1). Over 72% of the 2010 academy participants were under-represented minorities. One can imagine the surprise of students coming from New York, Washington, DC, San Diego, or Mexico's Yucatan—who have this romantic idea of what the Rocky Mountains of Colorado will look like—when they arrived at Denver International Airport and were promptly driven to what looks like a desert in eastern Colorado! However, it was rewarding for the network to see the students' impression change as they explored the area, and found that even those arid plains of Colorado have a wealth of ecological diversity including bald eagles, prairie dogs, horned lizards, and wide range of grasses and succulents.

The basic format for the RMSSN Academy involved lectures that led into field activities. These are some examples: Dr. Mike Antolin, Director of the Research Station, provided an introduction to the unique ecology, geological and cultural histories of the shortgrass steppe ecosystem, followed by a field excursion where he provided real-world examples of the topics from his lecture; Mark McCaffrey from the University of Colorado provided a short lecture on climate literacy, and this was linked to another field activity that made the points in his lecture more tangible. Through these kinds of field experiences, over the course of the week students increased their scientific literacy in climate change, learned biological field protocols, learned how to keep a field journal, and more. Other academy lectures included presentations from the National Park Service, the National Forest Service, the United States Geological Survey, and the Bureau of Land Management.

One requirement for all academy participants was an internship on public lands, or an environmental research experience that summer. Since each of the students would be entering an internship after the academy, Flip Hagood, Vice President of the Student Conservation Association, provided a short workshop (Figure 2) on how the students

**Figure 1.** The 2010 RMSSN Summer Academy included 32 diverse students from throughout the United States and Mexico.

**Figure 2.** Flip Hagood, Vice President for the Student Conservation Association, provides an internship workshop for participants of the 2010 RMSSN Summer Academy.

could get the most from their internship experiences, and how, in turn, they could provide the most to their internship supervisors.

With an emphasis on creating a long-term network among these students, and knowing that following the academy, the students would be scattering in 32 different directions to conduct their summer internships, the RMSSN wanted to provide at least one mechanism through which the participants could all continue to work together on a common project, long after they left the academy. To this end, Jake Weltzin, from the National Phenology Network (NPN), trained the academy participants to make basic phenological observations, and how to report those observations to the national phenology network using the NPN citizen science public interface, *Nature's Notebook*. The NPN uses this data as a mechanism for monitoring climate change across the United States. As part of their certificate, participants were required to make a certain number of observations over the course of their summer internship so that all across the country, at each student internship site, NPN would receive data, and the students would be united in a common effort.

Toward our objectives for developing leaders, the RMSSN had its students learn about, and practice, communicating with diverse audiences. Alice Madden, chief of staff and climate change advisor for Colorado's Governor Ritter, provided a session on how to communicate with politicians, how to communicate with the media, how to communicate with stake holders, and how to communicate with a disbelieving audience. Tara Trujillo (Figure 3), communications director for Senator Udall's office, co-facilitated this session with Alice. Also toward our leadership objective, Dr. Elizabeth Davis from George

**Figure 3.** Tara Trujillo, Communications Director for Senator Udall's office, trains RMSSN Academy participants on the art of communicating with stakeholders and politicians.

Washington University conducted a Myers-Briggs Personality Inventory for each student, and provided a workshop on how each personality type functions as a leader. What was particularly valuable about this session is that Dr. Davis also had the participating faculty, agency representatives, and other presenters take the inventory so the students could observe in the RMSSN partners, examples of personality types in current leaders. To put the participants' leadership skills into practice, the academy spent a day at Colorado State University's Mountain campus on a leadership-oriented challenge course. The participants started on low ropes challenges which taught them to function as a unit and to support one another. In the afternoon, participants moved on to high ropes challenges which taught them to push themselves as individuals, with support and input from their team. The confidence within individuals and the cohesiveness among the group members that these activities generated was exceptionally positive.

To assess the outcomes of the summer academy, the network developed a quasi-experimental research model designed to measure indicators associated with global leadership, cultural awareness, environmental literacy, professional networking, and internship preparation. This model included pre- and post-self-efficacy analyses for academy participants who later conducted an internship, versus students who conducted internships without having participated in the academy. Across all 60 indicators of the study model (e.g., understanding of the concept of sustainability, connectedness to leaders in their discipline, connectedness to peers in their discipline, familiarity with scientific method and field sampling protocols, alternative energy, science of climate change; communication and leadership indicators) on a 10-point scale, the students averaged a 2.8 point improvement. This evaluation was led by Colorado State University and the University of Wisconsin, Whitewater. The RMSSN is currently conducting a student network analysis led by RMSSN partners at Texas A&M University. Finally, all participants agreed to respond to annual surveys to allow the network to gather longitudinal data related to persistence in STEM disciplines and retention to graduation, entry into graduate programs, and career choices.

To facilitate regular communication among participants, the academy website can host student blogs. It also provides contact information for the undergraduate participants, as well as graduate, faculty, and other professional presenters from the academy. The site also includes a page for organizations to post internship opportunities and, by posting on this site, which is restricted to RMSSN Academy participants, these organizations know that there will be a high probability that those positions will be filled by under-represented students. Finally, the RMSSN sends out regular email announcements and has a seasonal RMSSN newsletter in which current activities of the students are highlighted.

As previously highlighted, the National Phenology Network (NPN) provides RMSSN with a common project through which all academy participants remain connected. That activity has been taken a step further by establishing an outreach program through which academy participants are trained to train other students, outside the RMSSN, to collect and report data for NPN. For example, on the weekend leading to the GWS annual conference, several academy graduates worked with NPN to provide training for a group of GWS Fellows. The academy graduates also provide NPN training to high school students in an effort to reach out to the next generation of academy prospects.

Dissemination of our findings has occurred via several mechanisms. A 2010 academy graduate from St. Lawrence University drafted a beautiful description of his experience, which was published in the *Journal of Undergraduate Research and Scholarly*

*Excellence.* That journal has offered to publish a special edition next fall, highlighting the experiences of *all* of the academy participants. As the principal investigators for this network, Dr. Bowser and Dr. Brown have submitted a manuscripts to a journal of assessment and evaluation in higher education, a journal on sustainability, and an international journal of assessment. These are all currently under review.

Regarding next steps, the 2011 RMSSN Summer Academy was to be held in Moose, Wyoming, at the Murie Center, and Grand Teton National Park. To extend our outreach beyond undergraduates, the network received funding from USGS to establish a graduate mentor program. Thus, for the 2011 academy, the RMSSN selected a group of graduate students to arrive two days early, thereby allowing the network to train them to run certain aspects of the academy. This is an invaluable training experience for those graduate students. To provide the graduate students with credentials for their training, the network has coupled that experience with the Graduate Teaching Certificates Program at Colorado State University. In the summer of 2011, the RMSSN will be applying for funding from NSF to establish a Summer Research Experiences for Undergraduates (REU) Program associated with the academy, and to establish an international REU program for academy participants. Dr. Bowser and Dr. Brown are currently waiting to hear back on supplemental funding requested for RMSSN to host International Sustainability Conferences at two of the network's international partner institutions, Autonomous University of the Yucatan, and the University of Nairobi.

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# Wilderness and Climate Change: Mitigating Conflict by Confronting the Human–Nature Relationship

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## Abstract

It is becoming increasingly clear that humans will always affect ecosystems at all levels. However, the historical interpretation of the human-nature relationship has been one of separation. That is, the processes of the biophysical and the social worlds are distinct, where the former is natural and the latter is unnatural. We argue that this understanding is the impetus for much of the tension between wilderness policy and practice, and through conceptualizing a combined biophysical and social "natural," a theory posited by many before us, tensions between wilderness policy and practice are mitigated. Further, the decision to mitigate or adapt to climate change impacts in wilderness is made at the policy level and will impact wilderness management ubiquitously. Therefore, understanding the influence of the perceived human-nature relationship on wilderness policy is imperative, as agencies question wilderness' role in climate change strategies.

## Introduction

Designated wilderness is intended to provide the appearance of naturalness, the feeling of untrammeled land, and opportunities for solitude. Yet, the beliefs to which wilderness advocates subscribe are no more real than any religious ideals (Cronon 1996). Terms such as natural are difficult to concretize because they are socially constructed qualities ascribed to wilderness, with meanings unique to the individual. Managing wilderness under this ambiguity can be a contentious task.

In this paper we use an analogy of the scientific method to show that the Western construct of naturalness (humans as separate from nature), while once true, has become false as science and understanding of global ecosystems have progressed. Our hypothesis is that wilderness policy is based on a static, romantic theory of humans separate from nature, that no longer fits with a dynamic scientific and cultural understanding. We use case studies in management to test our hypothesis, and as a final test we apply a modern

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understanding of climate change to the human-nature relationship to show that the theory no longer holds.

### The historical human-nature relationship

Wilderness, as defined by the Wilderness Act, exists as the archetypal contrast to "those areas where man and his works dominate the landscape." Wilderness is where primeval, spontaneous nature prevails (Rolston 1991) and thus separates humans from nature. The Western conceptualization of the human-nature relationship presupposes a perceived degree of control over the non-human world, and thus sets apart humans from nature. Indeed, science supported the notion that a natural space existed free from human interaction. Nearly fifty years of wilderness management provides ample evidence of the misfit between the traditional human-nature relationship and our current reality.

Over time, scientific and cultural understanding have begun to accept that humans are perpetually intertwined with nature (Sprugel 1991). Wilderness managers have been unsuccessfully fighting to erase unintentional human impacts in wilderness to satisfy the social need for the perceived sense of naturalness. The result is tightened control on the resource that is intended to be free.

Now, climate change is an undeniable rebuke to the Western construct: there is nowhere on earth unaffected by humans. This is most troubling for the foundational theories of the wilderness preservation system. If wilderness is a place without human impacts, then climate change erases the philosophical and geographical boundaries containing wilderness. Wilderness is now struggling to find an identity that can bridge modern science and romantic notions of natural, untrammeled land.

### Testing the human-nature relationship using the scientific method

In the following paragraphs we consider three management scenarios to test our hypothesis that humans are no longer separate from nature. The Western construct of the human-nature relationship is the model to be tested, the Wilderness Act is the hypothesis, and management is the test of the hypothesis.

In the late 1990s, scientists found that St Mary's Wilderness, in George Washington and Jefferson National Forests, was affected by acid deposition. Stream acidity was high enough that many of the native species could no longer survive. The human-caused acid deposition was threatening the wilderness character of the area (Cole and Yung 2010). Managers were faced with the dilemma to intentionally manage, or trammel, to mitigate the effects of the deposition, or hands-off managing and intentionally letting the ecosystem "degrade" for the sake of preserving the untrammeled quality. This case shows that in at least one wilderness area, wilderness has been unintentionally impacted by exogenous human behavior. Management responded by liming the streams to directly treat the impact. The localized affect of human-caused acid deposition shows that these ecosystems are not natural, nor are they untrammeled, due to management decisions.

Fire is one of the most difficult and complex management problems in wilderness and non-wilderness. Our understanding of the role of fire in forest ecosystems has evolved considerably and remains at the forefront of forest policy debate today. Where we once believed fire was a destructive force that we needed to mitigate at all costs, we now know it is essential to healthy ecosystems (Pyne 2004). We have also learned that Native Americans were igniting fires long before the first wilderness area was protected, bringing into question the entire notion of pristine ecosystems (Sprugel 1991). In many wilderness areas managers are now faced with a trammel versus natural dilemma; actively managing to reduce fuel loads or accept the ecological effects of historic fire suppression. High fuel loads and resulting fire potential are evidence that wilderness is not free from human impacts. That active management is necessary to protect ecosystems and humans from catastrophic fire proves we can no longer untangle human action from ecosystem processes.

Our third example is in the High Uintas Wilderness of northeastern Utah. Prior to its Wilderness designation, 13 streams were dammed in the High Uintas to regulate valley irrigation water. Eventually, the dams reached a state of disrepair that fell outside safety guidelines, and posed a risk to human life and downstream infrastructure outside the wilderness boundary. The Forest Service needed to act; improve the dams to current standards or remove them. Extensive planning and careful consideration ensued, comparing the impacts of primitive versus modern tools to achieve the same goals, and the impacts of no action. As contradictory as it seems, the analysis pointed towards using helicopters, excavators, and bulldozers as the minimum tool to complete the project. In this scenario, policy mandates trammeling to change a body of water from a utilitarian reservoir to a high-mountain lake. While the latter is arguably more natural, both are designed with human intent.

The examples presented above serve two purposes. They show wilderness areas have been, and will continue to be, impacted by humans, forcing managers to trammel in order to remove unintended impacts. They also illustrate how the theory of humans as separate from nature could persist at the policy level because the challenges to wilderness theory occurred at the management level.

### Climate change and wilderness

Although many have argued that human behavior is intertwined with ecosystems throughout the world (Latour 1993), the omnipresent anthropogenic effects of climate change are even more difficult to deny. While some of the effects of climate change may be localized, such as species migration or drought, climate change on the whole is global, and thus is no longer simply a localized management decision but a national-level policy problem. Anthropogenic climate change challenges and defeats the fundamental notion that there exists a natural, pristine ideal nature to be achieved through removing a sufficient number of human-caused impacts on wilderness areas. A definition of natural informed by the Western construct no longer exists. Climate change forces us to reconsider the socio-cultural understanding of all things natural, from how we define a well-functioning ecosystem, to untrammeled wilderness areas. Climate change, the ultimate test of the wilderness hypothesis, irrefutably proves the theory is false: humans are not separate from nature.

Unfortunately, the answer to reconciling climate change and wilderness is not simple. The authors of the Wilderness Act left much to be interpreted and reinterpreted in wilderness policy. Managers are tasked with managing an area for the appearance of naturalness, but are left to define the meaning of natural, and how to achieve its appearance. Whether or not managers should actively trammel to mitigate the effects of exogenous, unintentional human impacts, such as climate change, remains unclear.

That humans have impacts on nature is not new. The language of the Wilderness Act has been massaged and reinterpreted ad nauseam to help justify various actions or inactions in wilderness. We draw two conclusions regarding wilderness and climate change management from an idea posited by Mosse (2004) to distinguish between good policy and good management.

First, where management operates at the ground level, policy operates at the level of theory. Since climate change presents problems at a national scale, policy makers are now facing the inconsistencies traditionally faced by land managers. The role of wilderness in climate change mitigation and adaptation (CCMA) is a question asked at the policy level and is thus a theoretical challenge.

Second, we argue that management action to mitigate imminent threats to an ecosystem's resilience has created a cultural norm within management agencies of doing: taking action, or trammeling, to preserve ecosystem resilience. Due to our faith in our ability to understand and define well-functioning ecosystems, managers now face more political and social risk in not managing than in managing (Landres 2010).

A trammel here and there to improve the appearance of naturalness does not challenge the idea of wilderness at a national or global level. However, the conditioned responses, when aggregated at the national level, bias and inform the policy makers in favor of action. Thus, a single conditioned response at the management level has far less impact on wilderness management as a whole, but the sum of all responses has profound effects at the policy level, and on the Wilderness idea. The decision to actively or not actively manage climate change impacts in wilderness at the policy level sets a national precedence for wilderness management in all 757 wilderness areas. Because of climate change, policy makers are facing new pressures and the direction they take is vitally important both for defining and preserving the values that make wilderness unique. If acted upon hastily, wilderness and climate change management will result in restoration efforts to specific threats at specific times. However, climate change and wilderness management are not temporally or spatially explicit. We should instead think about long-term management of dynamic anthropogenic influences in all wilderness areas.

### Conclusion

Cole and Yung moved the discussion forward by drawing attention to an undeniable and ubiquitous human influence on the global environment, and debating whether the term natural is an adequate management objective for wilderness (Cole and Yung 2010). Their recommendations to focus instead on ecological integrity, resilience, historical fidelity, and the autonomy of nature provide a picture of the complexities that remain, even after natural is deposed as a management objective (Cole and Yung 2010). Managing for ecological integrity and resilience implies trammeling whereas managing for historical fidelity and the autonomy of nature implies a 'hands off' approach. Thus, wilderness managers are still forced to decide the relative importance of untrammeled and natural. The remaining tension indicates there is more to uncover in reconciling climate change and wilderness management.

Although science and knowledge are slowly breaking down the barriers between humans and nature, naturalness remains enigmatic because the romantic foundation of creating a place where humans are separate from nature persists. Naturalness lives in the collective psyche of our society and in the minds of our children. Where a scientist sees a forest ecosystem impacted by climate change or fire manipulation, another visitor may see a pristine wilderness. The wilderness manager must live knowing that the wilderness area under their care has been trammeled but the visitor only sees what appears natural in contrast to their daily lives. There is still profound importance in wilderness, and we must call upon management to preserve what is most commonly valued in our wilderness preservation system. Wilderness is unique because it provides the appearance of a place to experience solitude, serenity, naturalness, and all other attributes each individual professes wilderness provides. Wilderness management may or may not change, but one thing is clear, we can no longer justify our action or inaction in wilderness areas as preserving nature without humans. We must accept that humans impact nature and wilderness.

The theory that humans are separate from nature has been the impetus for much of the tension between wilderness policy and practice. Conceptualizing a combined biophysical and social natural relieves some of the inherent tensions in removing the appearance of human impacts in wilderness. Wilderness can play two roles in climate change management. First, it can provide for measureable observation of untrammeled ecosystem change. Alternatively, wilderness managers can attempt to retain the appearance of natural ecosystems by actively managing to mitigate climate change impacts. Neither alternative is more correct, nor are they mutually exclusive. Unless we accept unintentional human impacts on the natural world, both alternatives perpetuate a tension between managing wilderness and the theory that humans are somehow separate from nature. Understanding humans are part of the natural world allows management to justify their actions to care for the unique qualities wilderness areas provide.


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# Moving Toward Integrated Resources Planning

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### Integrated resources planning needs integrated resources language

INTEGRATED RESOURCES PLANNING, WHICH ADDRESSES "RESOURCES," RATHER THAN "CULTURAL resources" and "natural resources," can help managers work through apparent resource management conflicts. Starting with studies like environmental histories, integrated resource planning interrelates human and non-human influences, and uses an approach where park resources can be perceived as cultural and natural at the same time. The "natural/cultural" dichotomy can be divisive, just as the "public/private" and "feminine/masculine" dichotomies can be divisive within the social sciences. The Resource stewardship strategy (RSS) process at Pecos National Historical Park (Pecos NHP; Figure 1) is a case study of how integrated resources language can be developed into integrated management strategies (Pecos NHP and CSU PLHC 2011). An important factor in developing an integrated and holistic approach is the language and terminology we use.

What do we mean by "integration?" Within a National Park Service context, integration refers to effectively coordinating the holistic preservation and management of cultural and natural resources. Park resources are inherently inter-related and inter-dependent in the field; we only need to "integrate" when they've been teased apart by agency structure and language (Daniel J. Jacobs, chief ranger, Pecos NHP, pers. comm.). Within the Pecos RSS process, the team wanted to develop an approach that addresses how resources exist in the field, rather than how resources are separated through professional specialization, terminology, and funding sources.

Consider an area within Pecos NHP where a ranch road crosses Glorieta Creek (Figure 2). If we distinguish between cultural and natural resources to describe this site, we could say that the road, bridge, and signs are cultural elements, and that the creek, creek bed, and riparian vegetation are natural elements. However, this way of describing the resource artificially separates elements that overlap and are integrated in the field. Not only do cultural and natural resources exist in an integrated state, resources can be both cultural and natural at the same time, for instance, a historic tree. And, the terms "natural" and "cultural" are heavily nuanced, often defined in terms of each other (Sorvig 2002).

We could describe this same site by identifying "integrated resources" as a third category, describing the resource as a "creek crossing," as well as identifying individual natural and cultural elements. This may be helpful, but doesn't quite reach the Pecos RSS goal of integrated lan-

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**Figure 1.** Pecos National Historical Park encompasses a wide range of resources (J. Cowley 2010).


**Figure 2.** A ranch road crosses Glorieta Creek within Pecos NHP (J. Cowley 2009).

guage. The goal is to talk about "resources" holistically, to identify resources for what they are rather than categorizing as cultural or natural. The term "resources" encompasses elements of all types, e.g., ethnographic, social, historic, physical, biological, tangible or intangible, biotic or abiotic (Figure 3). The site in question can be referred to holistically ("where the road crosses the creek") or its constituent elements can be referred to individually (e.g., landform, creek, road, sign, bridge, vegetation, historic use and meaning, ecosystem values).

We can think in terms of a range of different levels of integration: recognition, separate but equal, inclusion, relationship, and integration (Figure 4). These different levels are not necessarily better or worse than others; each can have its own valid applications. Recognition refers to a mention only. For example, let's consider two hypothetical documents, a vegetation management plan, and a historic structures report. The former states that "this Vegetation Management Plan addresses plant species within the riparian corridor. Some historic exotics have also been identified in this area." The latter states that "the historic site is comprised of the historic plantation forest grove and the farmhouse. The plantation grove has also been identified as spotted owl habitat." In separate but equal, cultural and natural resources are addressed at an equivalent level of detail, but in two separate and parallel sections. For example, within an RSS, each section may refer to the other type of resource, but cultural desired conditions and strategies are only addressed within the cultural resources section, and natural desired conditions and strategies only addressed within the natural resources section. Inclusion involves more than a mention, but

**Figure 3.** The term "resources" can encompass a wide variety of types of resources (J. Cowley 2011).

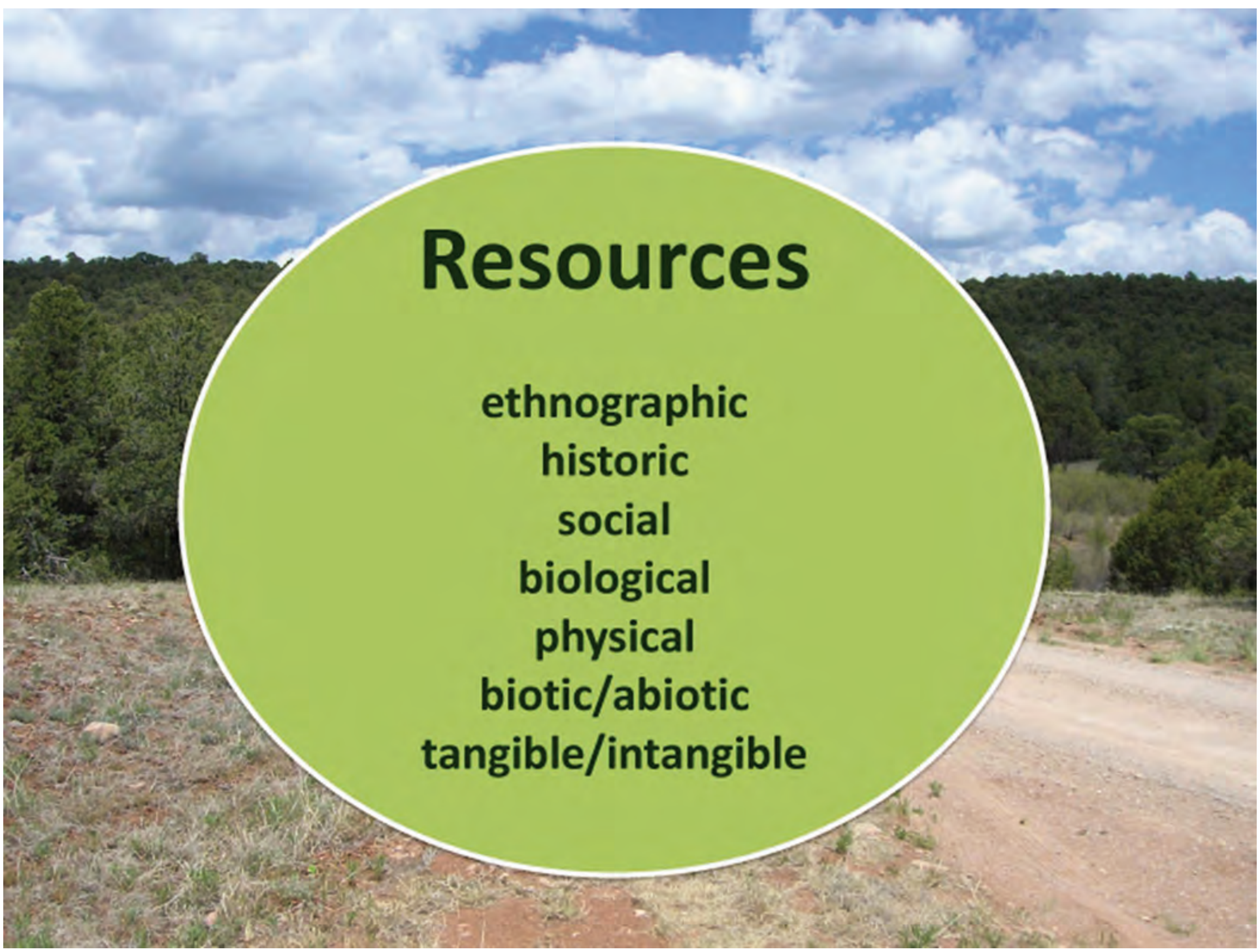
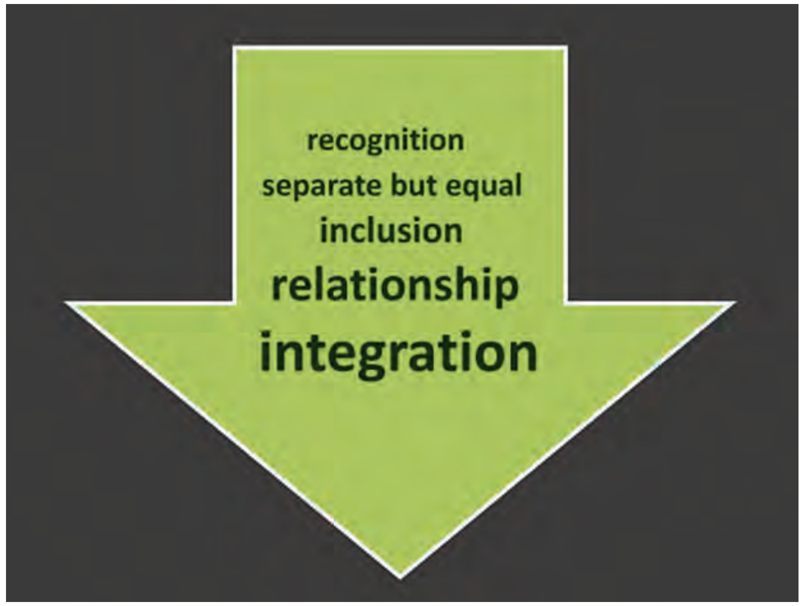


Figure 4. Levels of Integration (J. Cowley 2011).




cultural and natural resources are still addressed separately, for example "this Vegetation Management Plan includes a list of historic exotics, and proposed management of these plants, in Appendix A," or "this Historic Structures Report includes a plant list, and proposed management of these plants, in Appendix A." The hierarchy and main purpose of the document is clear.

Relationship and integration go further in expressing the interactions and interdependencies of different elements within the landscape. An example of relationship is "the course of the natural riparian corridor determined the route of the historic road which in turn influenced the location of cultural landscapes." This could be restated to reflect the integration level: "Over time, vehicular circulation running along the river corridor changed from wagon road to paved highway, with farms and ranches growing up along the road, and both native and introduced trees planted for windbreaks." With integration, the terms "natural" and "cultural" are not used, and the more specific terms give a richer and more accurate depiction of the landscape and its elements.

### Case study: Pecos National Historical Park resources stewardship strategy

Within the National Park Service's park planning process, a general management plan (GMP) and foundation plan cover the park as a whole, the GMP addressing visitor use and operations in addition to resources management, and the foundation plan focusing on significance, fundamental resources and values, and desired conditions. A resources stewardship strategy (RSS) is one of a number of more detailed plans that address a specific area of park management, in this case, resources management. The goal of an RSS is to bridge the qualitative guidance in the GMP or foundation plan and the measurable objectives in park annual work plans. An RSS document is comprised of the following sections: description of fundamental and other resources and values; statements of significance and interpretive themes; summary of the status of resource knowledge; determination of attributes (measurable resource characteristics), indicators (metric used), and target values (long-term goals for metrics); statement of desired future conditions; current conditions; and management strategies (clusters of action items to move from current to desired conditions). Because the RSS addresses all resources, it is an ideal document within which to develop an integrated approach (Pecos NHP and CSU PLHC 2011).

**Setting the stage for integration.** How resources and their significance are identified and described is critical in establishing an integrated approach for the whole document. For example, the Pecos RSS uses the following overview description: "The geography, topography, and landscape features that created the travel corridor, and the confluence of topography and water, made travelling through this area a physical necessity. Different modes of transportation and travel stops evolved through time." The terms "natural" and "cultural" are not used, but each of the terms "geography," "landscape features," "travel corridor," "confluence," and "travel stops" refers to a combination of natural and cultural resources. In addition, using a holistic landscape approach to organize the description of resources and resource significance helps set up an integrated approach. To apply a landscape approach, the Pecos RSS uses "resource contexts" and "landscapes" to structure the description of resources.

Resource contexts group fundamental resources and values around a historic theme. Resource contexts relate to park significance and stories, and are park-wide because resources relating to the theme can be found throughout the park. For example, the Gateway context "… reflects the importance of the Upper Pecos valley's geographical position and environment to the development of its history. The Upper Pecos Valley has served as a cultural crossroads for many different peoples and cultures, all of whom have been affected by the environment and influenced the environment in turn" (Pecos NHP and CSU PLHC 2011, 13).

Landscapes divide the park into discrete geographical areas identified by a combination of landform, ecology, and extant resources related to specific interpretive themes. For example, the riparian/riverine landscape includes the geomorphology of the Pecos River, and the flora, fauna, archeological sites, and remains of historic settlements within the river corridor. As systems of interrelated resources, landscapes are inherently integrated. Notice that the definitions of the Gateway context and the riparian/riverine landscape do not use the terms "natural" or "cultural." The Pecos RSS process started with traditional resource categories (flora, fauna, cultural landscapes, surface water, archeological resources, etc.) and shifted to "landscapes" to help achieve integration.

Within the development of attributes, indicators, and target values, language in some cases needs to separate between cultural and natural because existing resource inventories and monitoring processes are already divided between cultural and natural, and the park needs to use these already developed processes. For example, the cultural landscape inventory is used to document and monitor cultural landscapes, the rangeland health indicator evaluation matrix is used to document and monitor soils, and the New Mexico Night Sky Standards are used to document and monitor night sky visibility. Even so, some degree of integration is possible. For example, attributes related to each landscape include: historic condition and integrity; community composition, health, and integrity; soil quality and function; and the integrity of ethnographically significant resources. A condition rating, the primary indicator for cultural landscapes, considers the stability of structures, and the health of vegetation.

Desired condition and strategy statements can return to using integrated language. For example, "the landscape is documented, preserved and protected, and receives treatment consistent with its historic and ecological significance and interpretive value," "erosion is diminished or under control," and "a balance of traditional use access and resource protection is identified, maintained or improved" are three desired condition statements from the Pecos RSS. Here, as in earlier RSS sections, "resources" is used rather than "natural resources" and "cultural resources," and each desired condition statement refers to a combination of cultural and natural resources. Pecos RSS strategy statements include the following: "complete cultural landscape report," "continue soil erosion monitoring," and "continue tribal consultation and interpretive programs." "Complete cultural landscape report" is an integrated strategy, even though the title of the document includes the term "cultural," because the document itself addresses both cultural and natural resources, within a National Register of Historic Places context. Soil erosion can affect river banks and roads. Tribal consultation can address a wide variety of issues and resources, including plants and archeological sites.

In addition to integrating resources, the Pecos RSS integrates strategy statements, within a strategy integration table. It is not enough to define a linear sequence of strategies that built on the completion of previous strategies. Instead, the Pecos RSS shows, through the strategy integration table, how multiple strategies, completed simultaneously or in succession, could accomplish one or more desired conditions (Cori Knudten, research associate, Colorado State University Public Lands History Center, pers. comm.).

The RSS also address "dependencies." Some strategies need to be implemented before others can start. For example, under park-wide information needs, the strategy calling for a coordinated GIS system for all resources addresses four related desired conditions. An information needs strategy: work with region to develop useable database for spatial and GIS data. Associated desired conditions addressed include the following:

1. All five landscape units: landscapes are documented, preserved, protected, and receive treatment consistent with their historic and ecological significance and interpretive value.
2. A diverse range of safe visitor experiences exist within the context of the resources associated with the Forked Lightning Ranch unit.
3. Archeological sites, artifacts, pictographs, and petroglyphs are identified, evaluated for their significance, and protected in place.
4. Fuels are managed to protect park neighbors, visitors, and resources from unwanted fire (Pecos NHP and CSU PLHC 2011).

In addition, specific desired condition statements can be addressed by multiple strategies.

### Conclusion

Integrated resources planning needs integrated resources language. The terminology and language set forth in this paper is one example of language that can be used to enhance the integration of park resources management planning. The Pecos RSS plan is an experiment in using integrated language, and implementation will be an experiment in applying the plan to on-going or new on-the-ground integrated resources management. As the park implements the RSS, benefits and drawbacks of an integrated planning approach may emerge. One benefit of this approach that has become obvious during development of the Pecos RSS is that resource specialists who are part of the Pecos RSS team are developing a better understanding of each others' language, terminology, perspectives, and priorities.

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# Making Science Relevant for Parks and People

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How have Inventory and Monitoring (I&M) networks helped to increase science literacy and enhance public participation in resource preservation in parks? Panel members framed challenges and highlighted successes in science communication between the Heartland I&M Network (Heartland Network) and its member parks and partners. The panel provided specific examples of interpreting science in predominantly cultural parks. These projects facilitated interdivisional collaboration, and emphasized the role of science in park management, within the context of each park's primary interpretive themes. Making scientific information relevant to park visitors and stakeholders developed the public's connection to park resources. Connecting inventory and monitoring results to place, park resources, and visitor experience helped managers attain the goals of their individual parks and the National Park Service (NPS).

The NPS needs to engage the public in the process of defining the relevance of its resources and stories. Despite our policies and plans, we alone (the NPS) cannot determine what is relevant about our parks. The NPS needs to engage society in determining what is interesting and relevant within each park. To do that, the NPS must be willing to change in order to meet the pub-

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lic's interest and understanding. This is particularly true in science communication, when the public has a poor understanding of the scientific process and results.

For example, people's belief in the existence of climate change has shifted over time. The public wants proof that climate change exists before engaging the problem. The majority of people now believe that climate change does exist, but they are unwilling to pay tax money, or change their lifestyles to correct it, because they do not perceive it as a problem. Scientists must help the public understand how science works in order to give the public the proof they need to engage the problem on a personal level.

Parks can plant the seeds of how science works in order to inform the public, and engage their interest. One way to do this is to tie the science and issues to a place. This plays directly into interpretation in the parks. People agree that a site is worth saving, but their reasons for saving it may be diverse. Therefore, the personal relevance of that resource or issue varies, depending on the individual's perspective and values. Yet, it is necessary to make the resource issue relevant before the public will engage in change. Tanaka Shozo, a Japanese conservationist said, "The care of rivers is not a question of rivers, but of the human heart." The public must care about the resource before it can care for the resource.

The Heartland Network convened a communication work group to guide communication activities, and evaluate progress in effective science communication. The work group consisted of Heartland Network staff, the regional chief of interpretation, and park resource and interpretation managers. The original Heartland Network Communication Plan 2006 focused on products for the public, but the work group changed the focus to improving science communication between the Heartland Network and its member parks. It accomplished this in several ways:

1. Resource briefs, one-page report summaries, sent to resource management and interpretation, tell what, where, why, when, and how of monitoring, and provide several encapsulated results from the particular report.
2. The newsletter, The Weather Vane, creates general awareness of Heartland Network program activities and Science in Parks, giving the program a sense of place by relating the program to park resource issues.
3. A website appeals to various audiences, but places a priority on interpretation by linking park Nature and Science pages to the Heartland Network site, connecting the program to a place and a resource issue; the Heartland Network site contains reports, protocols, and interpretation products for park staff and the public to download (http://science.nature.nps.gov/im/units/htln/aboutus.cfm).
4. Scientific auditing, and sharing of best practices in interpretation, improve the quality of park programs; Heartland Network park interpreters use a SharePoint site for discussion and for sharing materials, and they participate in Heartland Network biennial meetings to learn about the monitoring programs and accomplishments.
5. Programs presented by Heartland Network staff for park staff and the public provide opportunities for face-to-face encounters between scientists and all park staff.

These communication efforts, together with building cross-training opportunities and sharing student-interns across park divisions, strengthened the partnership between the Heartland Network and park staff. This resulted in successful communication of scientific information to a variety of park audiences. Examples highlighted in this session included the Junior Ranger, Kids in Parks, and Distance Learning Programs, that had been augmented with updated scientific information. Additionally, highly skilled Citizen Science volunteers, trained in using Heartland Network survey protocols, contributed to scientific databases for the parks, while they became envoys between their park and the public. The data became part of interpretive materials for park visitors, such as wildflower and bird checklists. Interpreters worked with resource managers to create other interpretive products from sound, scientific information, such as the "Eco-box," an audio wayside exhibit that utilizes a variety of science-based messages to inform visitors of current issues and potential threats to natural resources.

Scientists and interpreters become most effective when working together to use good science to support the interpretation program. Scientists provide quality information, and interpreters encourage visitors to use this new information to shape their core beliefs about a resource issue. This change in core paradigm brings the visitor to caring about the resource.

Partnerships outside of the NPS have contributed to connecting resource issues to a place, and to nurturing the caring about and for park resources. The Heartland Network collaborated with Erica Cox and Dr. Janice Greene, of Missouri State University (MSU), to hold a teacher workshop. Participants, including local middle school and high school science teachers, network scientists, and park staff, were challenged to incorporate actual Heartland Network data and real world management questions into lesson plans. The example from the workshop focused on a high school lesson, To Burn or Not to Burn. Theresa Johnson, science teacher at Miller High School created this lesson. The town of Miller is located on the edge of the western Missouri prairie. Johnson worked closely with Diane Eilenstein, Park Ranger at George Washington Carver National Monument (GWCNM). The lesson began with a discussion of George Washington Carver's boyhood, his passion for exploring nature, and what Diamond, Missouri, may have looked like when Carver was a boy. Cox served as editor for the project and worked with all groups. Sherry Leis, Fire Ecologist with the Heartland Network, provided technical information about prairie management techniques, and developed graphics for the lesson.

The lesson contained two parts. First, an in-class lesson on prairie and prairie management, has high school biology students interpret data and maps of burn units from the park. The follow-up lesson, a field trip to GWCA, involves students in reviewing an inventory of prairie species within the burn areas as designated on maps that they had previously used. Eilenstein has purchased materials to be used in an adaptation of the lesson planned for this summer with the Junior Ranger program. It is anticipated that small revisions may be necessary, following trials of the lesson with students and groups.

Science interpretation in cultural and historical parks can address global challenges by connecting the science and issue to a place. Just as we connect the story of slavery to a Civil War site, we can connect science issues to that same site. For example, interpreters tell the story of how slavery was justified by slave owners 150 years ago, because it improved the owner's life and society found it acceptable. Similarly, we justify our carbon footprint today, because things that contribute to our footprint improve our lives. Furthermore, elements of society use the public's lack of science literacy to tell us that society accepts a large carbon footprint as inevitable. We can make people aware of their lifestyle choices with interpretive exercises that ask questions, such as, "what was George Washington Carver's boyhood carbon footprint?" and "how does that compare to an average youth's carbon footprint today?"

The Heartland Network supports the parks, enhancing decision-making and interpretation. The parks are a portal to the public for science literacy and an example for implementing best management practices. It starts with the high quality information from science that is processed through good science communication practices for use in park resource management and interpretation. We need to meet the audience where it is in understanding the issues. In evaluating the effectiveness of our communication, we must engage the visitor by listening to the values that the visitor brings with them and the meanings that they take away with them. We must instill the awe of the place and the resource in the visitors so that they care about the resource. We cannot achieve that awe if the visitor is merely the recipient of facts. Science alone is not enough to carry the day. However, interaction between quality scientific information and the interpreters' abilities to make that information relevant to the public affects caring for the park resources.

*The late David Larsen, NPS Interpretation and Education Training Manager, Harpers Ferry Center, Harpers Ferry, West Virginia, was to have presented in this session. The panel organizers wish to acknowledge his contributions to the panel, and dedicated this session to his memory.*

# Big Dams and Park Resources: Water Management in the Colorado River Basin

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## Abstract

The water of the Colorado River system is a precious commodity. Diverting and storing that water to support human activities (agriculture, hydropower, urban growth) is central to life in the seven states served by the river. In the twentieth century, immense dams were built on the Colorado and its tributaries to store water and promote a reliable supply. The operation of these dams has profoundly affected natural and cultural resources in some of America's most revered national parks, a factor generally overlooked in water management decision making. The National Parks Conservation Association's Center for Park Research summarized the impacts of dam operations on select park resources in five basin parks, Dinosaur National Monument, Black Canyon of the Gunnison National Park, Canyonlands National Park, Glen Canyon National Recreation Area, and Grand Canyon National Park. Our research considered impacts to natural and cultural resources, finding a complex web of effects that cannot easily be resolved.

## Introduction

In the arid West, water is a precious resource in high demand. In the Colorado River Basin, archaeological evidence indicates prehistoric peoples who lived in the Arizona region practiced floodwater farming along the lower Colorado River, and possibly ditch irrigation in the Grand Canyon. Spanish missions practiced some irrigation in the seventeenth and eighteenth centuries, also mostly on the lower Colorado River, along what is now the border between Arizona and California. Over the course of the nineteenth and early twentieth centuries, the rivers comprising the Colorado River system were manipulated and altered via a series of diversions and small dams; then, construction of major dams in the twentieth century radically altered the flow of the Colorado and its tributaries. Today, the Colorado River and its major tributaries are parts of a highly regulated system.

Prior to extensive and large scale diversions and dams, the Colorado River and its tributaries supported an array of habitats and human endeavors within the river's corridor. Natural resources included geological structures, habitats formed by alternating floods and low flows, and

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a diverse endemic fish fauna, to name a few (Schmidt 2007). Archaeological remains of prehistoric and historic peoples, and remnants of ranching and mining operations tell the stories of the many people who depended on these rivers (Geib 1996; Graham and Kupel 2000). The efforts to regulate and store water for users in the Colorado River Basin and beyond, which culminated in the dam building era of the nineteenth and twentieth centuries, have resulted in changes to, and degradation of, many natural and cultural resources along the rivers of the Colorado River Basin.

Many spectacular resources of the Colorado River Basin are contained within national parks managed by the National Park Service (NPS). The NPS manages nine units along the Colorado River and its major tributaries: Rocky Mountain National Park, Dinosaur National Monument (Dinosaur), Curecanti National Recreation Area, Black Canyon of the Gunnison National Park (Black Canyon), Arches National Park, Canyonlands National Park (Canyonlands), Glen Canyon National Recreation Area (Glen Canyon), Grand Canyon National Park (Grand Canyon), and Lake Mead National Recreation Area (NPS 2009, see Figure 1). The Center for Park Research examined selected natural and cultural resources in five of those parks: Dinosaur, Black Canyon, Canyonlands, Glen Canyon, and Grand Canyon. Our findings describe the impacts of water management activities through the lens of park resource condition. This research informed a published report that seeks to bring national parks and their resources into the broader discussion of water management in the Colorado River Basin.

## Summary of major resource findings

From the perspective of natural resources, large dams in the Colorado River Basin have altered resources by fundamentally changing the ecological and environmental processes at play. In most cases, these changes have been mediated through the novel and highly unnatural flow regimes resulting from dam operating plans rather than natural hydrological cycles. Parks directly downstream of dams (Dinosaur, Black Canyon, Grand Canyon, and the short downstream stretch in Glen Canyon) have been affected by novel flows, including reduced peak flows, enhanced base flows, and the absence of a consistent and predominant spring flood. The implications of these flow changes are far reaching, affecting river geomorphic processes, riparian zone vegetation communities, and native fish reproduction. For example, Flaming Gorge Dam regulates the Green River through part of Dinosaur, and the riparian habitats in Browns Park, just outside Dinosaur, for example, have changed greatly compared to the riparian habitats along the undammed Yampa River, which also flows through Dinosaur (Merritt and Cooper 2000). While the immediate downstream effects might be obvious and dramatic, dam impacts are not limited to river stretches directly below the dam but instead can be observed hundreds of miles downstream. Canyonlands, at the confluence of the Green and Colorado Rivers, has lost riparian, as well as adjacent floodplain, habitats due to reduced floods.

Another major effect of basin dams has been to fragment the linear nature of these rivers. Before the dams were built, snowmelt from the Rocky Mountains would have thundered downhill, collecting and depositing sediment and nutrients along the way. Within the river, native fishes like the endangered Colorado pikeminnow (*Ptychocheilus lucius*) would have travelled up-stream to spawn, and the larvae would have drifted back downstream to nursery grounds. Now, however, the dams throughout the basin have pinched off these pathways. Water is held behind dams until released. Sediment is trapped in upstream reservoirs. Native fish can still migrate, but migratory ranges are truncated. In effect, processes that in the past connected one end of the basin to the other, 1800 miles long (Schmidt 2007), are now constrained to a few hundred river miles.

The research findings also show that concern over declining populations of native Colorado River Basin fish has driven efforts to modify dam operations. These fish, evolutionarily adapted to the warm, muddy waters of the Colorado River, had faced a series of ecological challenges even before the dams were built, including direct fishing pressure, and competition with nonnative


**Figure 1.** Colorado River Basin and associated national parks.

sport fishes. Then, after dam construction, the river changed from a warm, sediment rich environment, to a cold, clear-water one. The altered temperature extremes and patterns influenced fish reproduction, and the resulting reproductive decline was exacerbated by the concomitant degradation of spawning and nursery habitat. The plights of four native fish led to endangered species listings, and the Endangered Species Act provided the strongest leverage to research river flows and alter dam operations to benefit these fish and, by extension, other resources. Unfortunately, the process of altering and revising flows, as it has played out at Grand Canyon and Dinosaur, has been a slow, somewhat adversarial one, and has provided at best an incremental benefit to resources.

Research also highlights the fact that our understanding of the impacts of dam operations is not equal among parks throughout the basin; this inequality mirrors the different distribution of financial resources and programs across the basin. For example, most attention has focused on Grand Canyon, and much of our understanding of dam impacts comes from the extensive research and monitoring program focused on that park, because of the Glen Canyon Dam Adaptive Management Program (GCDAMP). Just upstream of the dam, however, Glen Canyon receives much less attention and research. All the national parks along the river have unique resources, and spreading attention across those parks will only deepen our understanding of dam impacts, and potentially lead to other effective management strategies.

Many of the changes to the river environment known to affect natural resources impact cultural resources as well. Altered flow regimes and changes in the movement of sediment have created different erosion and deposition patterns that impact archaeological and historic sites and structures along the river bank. The extent to which these changes negatively impact cultural resources is not well understood; of the five parks in this study, only Grand Canyon (because of GCDAMP) has a monitoring program in place to assess these impacts (Fairley 2003), and even there, insufficient information exists, about patterns of erosion prior to dam construction, to clearly quantify the dam's impact. At Dinosaur, Canyonlands, and Glen Canyon, there are gaps in the survey and documentation of cultural resources in the river corridor, and no formal monitoring program to assess impacts. Black Canyon is the unusual park in the group from a cultural resources perspective: archaeological survey, the historic record, and Native American tradition all indicate there are no tangible cultural resources known to exist in the river corridor (Carpenter and Stiger 1980).

For the four parks with known cultural resources in the river corridor, there is a major indirect effect of water management impacting cultural resources: inadvertent damage and vandalism caused by river recreationists. While looting of archaeological sites was known to occur in pre-dam days at all of the parks, regulation of the river has brought as much as a thousand-fold increase in visitors, and changes in water levels, especially in Glen Canyon's Lake Powell, have made previously inaccessible sites into destination attractions. Cultural resource managers do not have the staff to monitor and protect these resources, and must rely on the ranger staff, concessionaires, and private river guides to educate visitors and report damage.

Finally, at Glen Canyon, there is no formal policy that determines which federal agency, the NPS or the Bureau of Reclamation, is responsible for management of resources exposed by the lowering of the water level in Lake Powell. A number of cultural resources that were inundated by the lake when it reached full pool are now partially or fully exposed above the present water line, and predictions of future lake levels indicate they will remain exposed. Without a determination of management responsibility, these resources, some of which may be nationally significant, are highly susceptible to erosion, wave action, and visitor impacts.

## Recommendations and concluding thoughts

The regulation of the Colorado River and its tributaries has played a central role in the development of the American West. The waters of the basin irrigate rich and productive agricultural lands from Colorado to California to Mexico. Those same waters also provide drinking water to major urban areas within the basin, including Las Vegas and Phoenix, as well as outside the basin, in Denver and San Diego. The hydroelectric energy generated at the dams has powered homes and businesses across the West.

Despite their economic importance, the operation of the major dams of the Colorado River Basin has damaged and degraded natural and cultural resources, including those protected in national parks. Concerns about some of those resources, such as the native fishes of the basin, or the sandbar habitats and camping beaches inside Grand Canyon, have led to research, and attempts to change how we operate these dams in order to reverse the declines in resource conditions. Other resources, including other riparian habitats and river corridor cultural resources, are understudied, yet appear to have declined in both direct and indirect response to river management.

The search for solutions to resource and water management issues in the Colorado River Basin must be approached holistically, instead of on a site-specific, dam-specific, or park-specific basis. Natural, cultural, and recreational resources all must be taken into account. Changes in dam operations affect both upstream and downstream resources, and especially for the largest dams, effects can reach well beyond the immediately adjacent parks. Our best hope to preserve resources throughout this fragmented landscape is extensive and real cooperation between federal, state, and local entities, as well as private landholders and citizens.

Resources and their condition, whether declining, improving, or unknown, need to have a seat at the table in any discussions on water management. The environmental impact statement process under the National Environmental Policy Act provides an access point for resource discussions, both quantitative as well as qualitative. The research on and study of dam operations and endangered fish exemplifies the utility and value of this administrative approach. Nonetheless, other resources, including cultural resources, must receive similar attention. Specifically, cultural resource monitoring programs need to be established at Dinosaur, Canyonlands, and Glen Canyon to gather data on the direct and indirect effects of water management activities on resources, and these research programs could be funded from the revenues generated by the dams of the Colorado River Storage Project. Natural resource monitoring must continue as well, but it must be more equitably spread across the basin. That said, natural and cultural resource research and monitoring should not be an end in themselves; both should feed directly into park management decisions and discussions that inform dam operations.

Recreational resources provide another access point for stewardship. The extent of private recreation makes it impossible for the NPS to reach the majority of river recreationists with existing stewardship programs, even with the help of park concessionaires. A community-based program of resource stewardship education could be established to reach that river recreation community and other water users. Resource stewardship education should focus on the natural and cultural resources within protected areas, as well as the water resources protected and managed by the dams and reservoirs, to help users understand the interrelationship of water, resources, and recreation in these national parks.

From the vantage point of a park, the resource concerns arising from a large upstream dam may seem daunting indeed. Unnatural flows and water temperatures, and sediment-hungry water alter river habitats, disrupt fish reproduction, and erode archaeological resources, to name a few well-documented impacts. A park manager, or any other land manager for that matter, will immediately consider ways to ameliorate or address those localized resource impacts.

Our research across several parks, though, suggests a more holistic approach to the problem. Managing resources under highly fragmented circumstances is difficult, and inter-park cooperation and sharing of information can assist in this process. Parks across the basin demonstrate convergent resource themes, and they would benefit from more inter-park exchange on those issues.

From our position supporting an advocacy organization, understanding the problems at individual parks will always be a priority. Nonetheless, the next phase of resource management within the basin necessitates an integrated perspective, requiring better documentation and understanding of resource topics, a broader view of resource condition and the factors operating at larger scales, and then continual effort to advocate for those resources in all management discussions. This research is the first phase of a project that will seek to protect national park resources in cooperation with other organizations and water users throughout the Colorado River Basin.

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# A New Challenge for Resource Advisors: Preventing the Spread of Aquatic Invasive Species During Fire Operations

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## Introduction

WITH THE DISCOVERY OF QUAGGA MUSSELS (*Dreissena rostriformis bugensis*) in the Lower Colorado River, United States, in January 2007, containment of spread of this notorious invasive species became a high priority for many state and federal agencies. Most of the focus was on boats, which are a widely recognized vector for spread between hydrologically disconnected water bodies. Many effective containment and control strategies have already been developed in the Great Lakes region and eastern waterways. However, the distribution of this highly invasive and destructive organism into western waters highlights a vector rarely considered by the aquatic invasive species community: wildland firefighting operations and equipment.

In the ten-year period between 2000 and 2009, 28,050,090 ha (69,313,271 acres) burned in 785,490 wildland fire incidents in the United States of America (NIFC 2010a), most of which were unplanned ignitions occurring in public lands in the western states. With potential impacts resulting from climate change, such as longer fire seasons and lower fuel moisture conditions, coupled with fuel accumulations due to a century or more of fire suppression in fire adapted ecosystems, the prognosis is for more and larger fires in many western states in the future (NWCGEB 2009). An increase in fire frequency means an increase in the number of fire incidents, leading to a greater possibility of fire operations and equipment serving as vectors. Similarly, larger fires mean more Type I (national) and Type II (national or regional) fire management organizations mobilizing over large geographic areas. Overall, an increase in fire means an increase in the opportunities for fire incident operations and equipment to spread aquatic invasive species.

Water is a key fire suppression tool. Most use of water during a fire incident is delivered aerially and by engines, hoses, etc., to either extinguish flames or to wet the fuels ahead of the flame front and curtail fire growth. There are no statistics on the amount of water used annually on wildland fires. If chemical retardants are any indication, however, the amount is substantial. For example, in 2008, nearly 21 million gallons of chemical retardant were delivered in more than 13,000 drops from helicopters and fixed-wing aircraft (USDA 2009).

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### Mechanisms of invasion during fire operations

In the terminology of invasive species biology, the *reservoir* for aquatic invasive organisms is the raw water source used in firefighting operations, meaning a natural water source (e.g., river or lake), or a human-made water source (e.g., reservoir or stock tank) that has not been treated for municipal use or human consumption. It should be noted that municipal water supplies distributed via hydrants may also be used in firefighting operations, and are not considered as reservoirs of invasive species. Raw water sources serve as reservoirs that may harbor a variety of aquatic invasive species from several different taxa, including quagga mussels (*D. r. bugensis*), zebra mussels (*D. polymorpha*), New Zealand mud snails (*Potamopyrgus antipodarum*), whirling disease (*Myxobolus cerebralis*), didymo*Didymosphenia geminata*), hydrilla (*Hydrilla verticillata*), Eurasian watermilfoil (*Myriophyllum spicatum*), giant salvinia (*Salvinia molesta*), as well as many vertebrate species. In some cases, the occurrence of aquatic invasive species is well known but for many western waters such information is incomplete or nonexistent. There could also be incipient invasions that are not yet detectable by the survey or monitoring methods in use.

The *vectors* are the actual pieces of firefighting equipment that contact and/or transport raw water, such as portable pumps (including floatable pumps), portable tanks, helicopter buckets, and internal tanks of fire engines, water tenders, helicopters, and fixed wing aircraft. Typically, the components of the equipment that cannot be drained and dried completely are most likely to harbor invasive organisms, and thus serve as vectors.

The *pathways* of invasion operate on multiple scales. Within an incident, raw water is routinely moved between tertiary and sub-tertiary watersheds, and sometimes even secondary or primary watersheds (e.g., when a fire straddles the Continental Divide or the Pacific Crest). Typically, major water bodies, such as lower elevation reservoirs, serve as a primary water source to fill various types of firefighting equipment. The equipment then transports and disperses that water across the landscape directly on, or in front of, the fire. Rarely, water loads may be dropped well away from the fire when an aircraft aborts its mission and must jettison its load prior to landing. A very common tactic in many fire incidents is the use of helicopters equipped with snorkels and internal tanks or buckets to dip or draft water from raw water sources, then transport it to higher elevation areas affected by fire. In this way, infested downstream water is transported to upstream sites and dispersed across the landscape where it may enter isolated headwaters and springs, and introduce aquatic invasive organisms. While most of the water lands on the fire, vegetation, or soil, some may enter natural water sources.

The sharing of firefighting equipment between incidents provides pathways for invasion in even larger geographic areas, and particularly between primary watersheds. Most firefighting equipment is highly mobile during fire season, often being re-assigned from incident to incident, sometimes hundreds or even thousands of miles apart. The well-established interagency coordination of firefighting on federal, tribal, and sometimes state lands provides a highly efficient and effective framework to quickly move equipment and personnel where needed. A piece of equipment contaminated by AIS in the Lower Colorado River can be working on a different fire incident in the Columbia River drainage within a matter of days, or even hours. Similarly, equipment such as fire engines can be released from an incident and returned to their home unit in a different state, thus potentially bringing invasive organisms into a landscape that isn't on fire, or otherwise at risk to invasion by aquatic invasive species in firefighting equipment. Similarly, some firefighting equipment is moved around between geographic areas outside of fire incidents to provide coverage for equipment that is down for service (e.g., cover engine), or to provide extra response capability during periods of high fire danger (e.g., severity detail).

The risks posed by aquatic invasive species to utility infrastructure, ecological systems, and recreational opportunities are well documented (Nalepa, Fanslow, and Lang 2009; Schloesser et al. 2006; Vinson and Baker 2008). What is less well recognized is the risk posed to firefighting equipment. While it varies by organism and life stage, as well as by equipment design, some hard-bodied organisms, such as dreissenid mussels and New Zealand mudsnails, may foul tanks, pumps, and virtually any hard surface that doesn't drain and dry completely. If the equipment uses raw water that contains veligers, and then is not used for a few days or weeks, those veligers may mature into adults, attach to hard surfaces, and clog the plumbing even after they die, rendering the equipment inoperable when it is next used. Considering that the primary use of firefighting equipment is during emergency situations, the potential risk of inoperable equipment caused by fouling by aquatic invasive species is a concern to the firefighting community.

### Preventing the spread of aquatic invasive species during fire operations

The U.S. Forest Service (USFS) Region 4 recognized this risk and first took action in early 2007 with the creation of an internal guidance document, entitled "Preventing Spread of Aquatic Invasive Organisms Common to the Intermountain Region, Technical Guidelines for Fire Operations" under the direction of Cynthia Tait. After the discovery of quagga mussels in the Lower Colorado River system, an interagency working group was formed to develop similar guidelines for use in the southwestern United States, under the direction of Brenda Smith from the U.S. Fish and Wildlife Service (USFWS). The southwestern guidelines included some of the same species as those included in the Forest Service's Intermountain Region, as well as a few additional species that are more problematic in warm and alkali southwestern waters. The southwestern guidelines also included a short "Operational Guidelines," meant to aid fire incident managers in effectively establishing protocols and decontamination processes to prevent the spread of aquatic invasive species. In 2010, the issue gained national attention with the inclusion of prevention practices in the Interagency Standards for Fire and Aviation Operations 2010 (NIFC 2010b), which serves as the primary policy implementation guidance for almost all of the federal firefighting agencies in the United States. In addition, the National Wildfire Coordinating Group was established as sub-committee to evaluate and prescribe prevention practices and engineering solutions to be used nationally (Ryan Becker, subcommittee chair, pers. comm.).

The guidelines currently in place recommend the application of sanitation solutions using quaternary ammonium compounds, commonly referred to as "quats." Quats are well known and readily available disinfectants commonly used in industrial cleaning applications, such as hospitals and schools, to kill bacteria, fungi, and viruses. Quats are marketed under several trade names, but are essentially compounds with various ratios of carbon to nitrogen and chlorine, including alkyl dimethyl benzylammonium chlorides (ADBAC) and diecyl dimethyl ammonium chloride (DDAC). When used according to the label, quats are relatively nontoxic and do not damage fabric, most metals, or gaskets (USFS 2010), which are advantages over the use of bleach solutions for disinfecting applications. A few quat products have been systematically tested on some aquatic invasive species (Hedrick et al. 2008; Johnson et al. 2003). Most notably, the effectiveness of quats had not been tested on dreissenid mussels as of 2008, when the sanitation guidelines began seeing widespread application.

In 2009, the NPS and USFWS partnered with The University of Texas at Arlington to conduct laboratory trials to evaluate the efficacy of the recommended Sparquat 256 [a molluscicide] sanitation solution in killing various life stages of quagga mussels under various concentrations and contact times (Britton and Dingman 2011). Results suggest that exposure time affects quagga mussel veliger survival, which appears to be negatively correlated. Five minutes of exposure to a 3% solution of a quaternary ammonium solution was not sufficient to kill all veligers by the end of that treatment. However, after removal from the treatment solution, 60 minutes later most, but not all, veligers had perished.

These results suggest that exposure to a 3% solution of Sparquat 256 for 5 minutes is insufficient for a complete kill, but that 10 minute exposure to 3% Sparquat 256 is sufficient to kill quagga veligers, at least on a small scale under laboratory conditions (e.g., ambient temperature near 22 °C). However, time is required post treatment for the quaternary ammonium solution to work, and 10 minutes may approach the minimum time necessary for a complete kill. Although this research supports the idea that existing decontamination procedures using quaternary ammonium solutions should be effective, this laboratory analysis suggests that the prescribed dosage and/or treatment duration may not be leave much room for error.

More research is needed to incorporate a rigorous survival analysis. Such a study should include zebra mussel veligers as well as quagga mussels veligers, as there may be subtle difference in tolerance to quaternary ammonium solutions. Additionally, quaternary ammonium solutions other than Sparquat 256 should be tested to ensure that others are equally effective. Experiments should also be conducted under a range of temperatures conditions that might be encountered in a wildland fire setting to account for any differences caused by thermal tolerance of the veligers, or temperature effects in quaternary ammonium solutions.

In the interim, fire incident resource advisors should be aware of the potential for spread of aquatic invasive organisms during fire operations and, where possible, incorporate measures to either avoid the potential for spread, or sanitize equipment exposed to raw water prior to demobilization. Additional information and "how to" guidelines are available at www.fs.fed.us/r4/resources/aquatic.

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# Government-to-Government Consultations with Native Peoples: From the Rhetoric of Respect to Real Results

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*[Ed. note: Dr. Dorough addressed the plenary session of the conference on Tuesday, March 15.]*

I WANT TO DRAW YOUR ATTENTION TO THE WORDS OF THE 1996 STATEMENT OF THE CHITIMACHA Nation, which I found on the internet when preparing my remarks today. This 1996 statement reflects many of the shared values of indigenous peoples around the globe. The statement provides that "[w]e must preserve and protect our natural resources, our people, and all Native Americans" and that "[w]e must always exist as a Nation by preserving our cultural heritage." When I read these words, I immediately thought of how the whole of the Americas are the shared cultural heritage of our people. We have a huge responsibility, and hopefully through our words today, we can begin to share that responsibility with each of you.

We have been asked to address the "importance of consultation as well as help to explain the very different legal situations in Canada and the USA," and to highlight actual "consultation techniques." Clearly in the time designated to do so, we won't be able to exhaust the matter. However, I trust that we'll be able to draw your attention to some of the essential principles.

For a range of reasons, I would like to share with you the importance of the international human rights standards established in 2007, with the General Assembly's adoption of the United Nations Declaration on the Rights of Indigenous Peoples (the declaration). This international human rights instrument reflects 25 years of dialogue, debate, and negotiation between indigenous peoples and nation-state representatives from across the globe. The document establishes the minimum standards necessary to promote and protect the basic human rights and fundamental freedoms of indigenous peoples worldwide. The declaration may be regarded by some as a non-legally binding document. However, it must be noted that it includes a number of important provisions which *have* been accepted as customary international law. It is safe to say that the declaration is one of a kind, and it is the first international instrument to be created on the basis of a constructive and reciprocal relationship between UN member states and indigenous peoples directly.

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As some of you may know, 144 countries approved the declaration on the floor of the UN General Assembly; 11 countries abstained from voting, while four countries voted against. Those four countries were the Unites States, Canada, New Zealand, and Australia. However, within a few short years, Australia endorsed the declaration, then New Zealand, followed by Canada. Most recently, on December 16, 2010, President Obama affirmed the U.S. government's support for the declaration. We have now entered a new era, where this document has an undisputed, universal legitimacy.

I want to quote a very important sentence from President Obama's speech expressing US government support for the declaration, one that I wholeheartedly agree with. President Obama stated: "I want to be clear: what matters far more than words—what matters far more than any resolution or declaration—are actions to match those words." Therefore, in relation to the theme of this panel, it will be the future actions of all those responsible for parks, parklands, and place-based conservation and management that will be the measuring stick for going beyond rhetoric and engaging in genuine consultation with indigenous peoples.

Before addressing the declaration standards on consultation and consent, I want to underscore the significant characteristics of human rights that are crucial to taking any actions "to match" the words of the declaration. The first element is the fact that human rights are indivisible, interdependent, and interrelated. This means that one right cannot be exercised and enjoyed without all other rights being recognized and respected. In addition, human rights are universal, and apply to all individuals and all peoples equally, no matter what their status, condition, race, creed, or color happens to be. And, finally, consistent with the distinct cultural context of indigenous peoples, the declaration makes explicit reference to a broad range of collective or group rights, as well as their individual human rights.

Now let me turn to the main clusters of declaration articles addressing consultation and consent that are relevant to the theme of this panel. First of all, there are a number of provisions within the declaration that provide the framework for good governance in decision-making processes, and the necessary partnerships between leaders, our citizens, and others, including non-indigenous governments, and other third parties. The first cluster addresses the right of self-determination and the right of self-government. In particular, article 3 of the declaration states the following:

> Indigenous Peoples have the right to self-determination. By virtue of that right they freely determine their political status and freely pursue their economic, social and cultural development.

The right of self-determination is regarded as the prerequisite for the exercise and enjoyment of all other human rights, and it is a fundamental right for all peoples, including indigenous peoples. Further, article 4 provides the following:

> Indigenous peoples, in exercising their right to self-determination, have the right to autonomy or self-government in matters relating to their internal and local affairs, as well as ways and means for financing their autonomous functions.

This language dramatically contrasts with the notion of being merely "participants of conservation initiatives," especially when read in relation to all of the other declaration articles and in particular, article 29, paragraph one:

> Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources. States shall estab-

> lish and implement assistance programmes for indigenous peoples for such conservation and protection, without discrimination.

The second cluster deals with indigenous peoples and their profound relationship to their environment and their right to lands, territories, and resources. In regard to rights to lands, territories, and resources, actual land ownership and substantively addressing outstanding such claims, the declaration articles 25, 26, 27, 28, 29 (again), and 32 focus upon these critical collective indigenous human rights. When one takes into consideration the interrelated nature of human rights, the intersection of the right of self-determination and rights to lands, territories, and resources essentially leads us to the third cluster of articles: the need for dialogue and consultation with Indigenous peoples to ensure their free, prior, and informed consent, which have been addressed in articles 18 and 19 of the declaration:

> Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions.

> States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them.

The concept of free, prior, and informed consent (or FPIC) is an essential dimension of our right to self-determination. Too often, consent is replaced with free, prior, and informed c*onsultation*. FPIC is about the right to give consent or to not give consent. For a broad range of reasons and not solely on the basis of the past history of indigenous/non-indigenous relations, our peoples should never be disenfranchised of this element of the right to self-determination. Specifically in relation to consultation, consent, and the indigenous right of self-determination within the context of parks, parklands, and place-based conservation, the following matters of are all relevant for inclusion and consideration throughout consultation processes:

- Subsistence hunting, fishing, and gathering rights (article 20),
- Indigenous knowledge and medicinal plants, etc. (articles 24, 31),
- Human remains, sacred sites, and repatriation (articles 11, 12, 34 spiritual practices),
- Treaties, agreements, and other constructive arrangements, including those concluded between states and inter-governmental organizations (preamble paragraphs, and article 37),
- The accurate reflection of indigenous histories (article 15),
- Our right to establish our own priorities for development (article 23),
- Transnational borders, including international parks and protected areas (article 36),
- Access to technical and financial resources (article 39),
- Partnerships (preamble and article 46), and
- Research and transfer of knowledge.

The remaining articles that I want to specifically refer to are articles 27 and 32. Article 27:

> States shall establish and implement … a fair, independent, impartial, open and transparent process, giving due recognition to indigenous peoples' laws, traditions, [and] customs

> … to recognize and adjudicate the rights of indigenous people pertaining to their lands, territories and resources, including those which were traditionally owned or otherwise occupied or used.…

Article 32, paragraph two:

> States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands, territories and other resources, particularly in connection with the development, utilization or exploitation of minerals, water or other resources.

These articles are central to any and all decision-making and consultation processes. Even in Alaska, the examples of indigenous/non-indigenous consultation range from non-existent to woefully inadequate. It is difficult to generalize, and even more difficult to provide an exhaustive list of case studies. In relation to the ANILCA, direct consultation with Alaska Native people should have taken place to ensure that our distinct rights and interests were actually being protected, especially in regard to subsistence hunting, fishing, and gathering rights. Even more difficult to resolve are the perennial issues surrounding the Arctic National Wildlife Refuge and the rights and interests of Alaska's first peoples, and those of the conservation and development stakeholders. This represents an extraordinary array of conflicting world perspectives. However, it is clear that effective processes are ones that are designed to be proactive, open, and understandable to the people on the ground. They must be inclusive of the perspectives, customs, practices, opinions, worries, and visions of indigenous peoples. And, they must respect the rights and interests of the indigenous peoples concerned.

In regard to taking the action that President Obama stressed, the future challenges of implementation of the declaration, either in the context of place based conservation or any other subject matter, are great to be sure. However, partnerships, consultation, and the actual accommodation of the basic human rights of indigenous peoples are all at the heart of any successful consultation process. This is where the rubber hits the road. Each of you has the opportunity to educate yourselves about the declaration and to utilize the human rights standards embraced by this unique document as guidelines for your work. In this way, the implementation of the declaration can begin in the specific context of place-based conservation initiatives and throughout the parks, reserves, and lands that each of you identify yourselves with. You can begin to make a difference out there and on the ground. Along with indigenous peoples you can begin to breathe life into the worlds of the declaration.

Only through constructive partnerships, that allow us to openly and respectfully discuss our differences, can we reach open and fair consultation processes. Only through respect for our diverse values, and through the mutual exchange of knowledge about these values, can we build a solid foundation for future consultation, which will ultimately foster lasting and good relations. And, I believe that the UN declaration is a central, substantive, and comprehensive starting place for understanding, and for the realization of those good relations.

# Overnight Visitor Use and Computer Simulation Modeling of the Yosemite Wilderness

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## Introduction

Yosemite National Park uses a trailhead quota system to manage wilderness visitors. Park scientists set zone capacities and subsequent trailhead quotas using travel patterns with the aid of a computer simulation model in the 1970s. Data were collected over four years to associate zone use with trailhead of origin, and trailhead quotas were set in 1977 (van Wagtendonk and Coho 1986) using the Wilderness Simulation Model first developed by Smith and Krutilla (1976).

Limiting how many visitors start daily at a trailhead maintains overnight zone use within capacity, if trip characteristics (party size, trip duration, spatiotemporal itinerary adherence) remain similar to the 1970s. Evidence suggests that travel patterns have changed since this system's inception. Data on which the original trailhead quotas were based, and the data on itinerary adherence, are nearly forty years old, and the supposition is that visitor use consists of a larger number of shorter-duration trips. Consequently, travel zone capacities are being exceeded in some zones on many high-use nights. An accurate account of wilderness use and itinerary deviation to develop a contemporary model may inform quota recalibration to enhance resource management.

Wilderness trips from May 1 through September 30, 2010, into the Yosemite wilderness were evaluated in regard to party size, trip duration, and spatiotemporal itinerary adherence (the degree to which groups adhered to their stated trip route and duration). Using a simulation model, we analyzed visitor use scenarios, and resultant zone use patterns to inform resource managers.

## Methods

To evaluate itinerary adherence, we compiled all intended trip itineraries from the park's wilder-

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ness permit database. A sample of actual routes and campsite locations was collected via map diary surveys distributed to visitors on randomly sampled dates, selected in proportion to visitation at these sites, as determined by the 2009 visitor use data. Respondents returned surveys before leaving the park, or by mail. Multiple e-mail follow-ups were sent to late respondents to facilitate a greater response. After passage of a certain amount of time without response, we considered outstanding surveys as non-responses. Subsequent communication with non-respondents, when possible, consisted of asking only for their actual trip duration, for the purposes of assessing non-response bias.

Travel data for trips that originated from outside the park were also collected. Nine Forest Service permit stations, and three in Sequoia and Kings Canyon National Parks distributed the surveys to all parties that intended to enter the Yosemite wilderness from May 1 through September 30, 2010. Those surveys were returned to the permit issuing station, to Yosemite, or by mail.

### Data analysis

There were 2,755 permits issued on sample dates, and 1,134 useable returned surveys. Assuming that all permitted parties received a survey, this represents a 41.2% response rate. Table 1 shows that comparison of trip attributes between the 1970s and 2010 indicates that current trips are shorter in duration, and that parties are now smaller.

The proportion of the non-respondent sample that deviated temporally from their stated agenda was 35/75 = 0.4667, and the proportion of the respondent sample that deviated temporally was 417/1123 = 0.3722. A two-sample proportion test indicated this difference was not significant ($z = 1.36$, $p = .111$). A Kolmogorov-Smirnov test showed the distribution of temporal deviations was not significantly different between respondents and non-respondents ($D = 0.0825$, $p = .7425$). A Mann-Whitney test showed there was no significant difference in median deviation between respondents and non-respondents ($W = 41042$, $p = .6701$). Therefore, there is no evidence that non-respondents behaved differently with respect to temporal deviations than survey respondents.

Assessment of the degree to which parties deviated from intended itineraries enables application of an adjustment to the intended itineraries in the park's permit database to produce a more accurate estimate of visitor use based on actual trip durations. Of all sampled parties, 67% deviated spatially and/or temporally, and a small portion (3.6%) reporting not even taking their trips. Linear regression showed that actual trip duration depended significantly on party size ($p < .001$) and intended trip duration ($p < .001$). The regression equation was *actual duration* = $0.270 + 0.0433p + 0.695X$; where p = party size and X = intended trip duration ($R^2 = 0.622$, residual standard error = 0.927, df = 1120).

An estimated 870 surveys were distributed at external distribution sites to parties intending to enter the park. Of those, 147 returned surveys were received, a 16.9% response rate. The only difference found between trips originated outside rather than inside the park was that the mean group size was greater, by 0.4 people, for trips originating from outside the park.

### Wilderness visitor use modeling

A travel simulation model of Yosemite wilderness visitor use was created using the Extend software platform, developed by Imagine That, Inc. (Diamond et al. 2007). The model is based on the Yosemite permit database (adjusted for deviation), survey data from non-Yosemite originated parties, and National Park Service-informed estimates of Pacific Crest Trail visitor flows.

The model consists of rule-based "blocks" performing defined functions (Figure 1). A "generator block," for example, represents the arrival of wilder-

**Table 1.** Yosemite wilderness trip attributes, 1970s and 2010.

| | 1970s | 2010 |
|---|---|---|
| Mean Group Size (persons) | 3.2 | 2.9 |
| Mean Intended Duration (nights) | 2.9 | 2.4 |
| Mean Actual Duration (nights) | 2.4 | 2.1 |

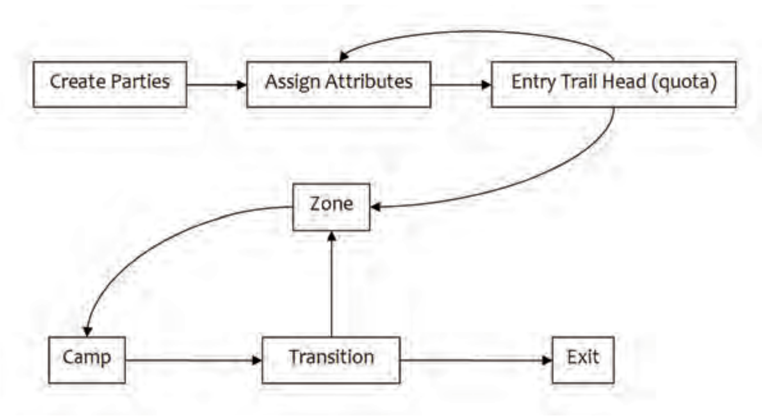



**Figure 1.** Generalized simulation model block structure.

ness visitors to the park. The "generator block" is linked to a block ("assign attributes") that assigns attributes to the party, such as size and entry trailhead, based on probabilistic distributions. The next block applies trailhead quota rules so that if the daily quota for a particular trailhead has been reached then a new trailhead is stochastically assigned to the party. The model simulates parties moving from trailhead to campsite zone to campsite zone to exit, dependent on the probabilistic determination of nightly zone use, based on the 2010 itinerary database (corrected for spatiotemporal deviation). One may then modify the model under alternative visitor use scenarios, by increasing or decreasing visitor use or trailhead permit quotas, to simulate how different scenarios and the resulting use patterns affect visitor nights in each of the management zones.

For each scenario, 1,000 simulations were run to capture any stochastic nature, and to generate meaningful statistics. All scenarios were run for 153 time-steps representing May 1 through September 30. The main output for each scenario is a table containing the mean and standard deviation across all stochastic simulations of visitor nights spent in each zone on each night across the entire season, and a second table containing how many visitor nights each trailhead contributed to each wilderness zone. Since the mean over a large number of simulations smoothes out the high and low points of the data, output was also produced detailing the frequency with which each zone is over capacity on each night. The frequency is the number of simulations in which each zone is at a given exceedance of capacity on each night. When divided by the total number of simulations, this gives the probability of exceeding capacity at a given use level in that zone on that night.

Five simulation scenarios were executed for the high use period. A *validation scenario* ensures the model is running correctly and accurately simulates observed phenomena. It uses data only from the permit itinerary database, with no spatial or temporal adjustment. Outputs include the number of parties that completed a trip and the total number of nights each party spent in the park. Statistical methods were used to compare distributions of party size, trip duration, and entry trailhead between the model and permit data. We also compared model-predicted use to intended use and verified that 1,000 stochastic replicates were sufficient to accurately estimate variances and capacity exceedance probabilities.

The *baseline scenario* reflects the best attempt at simulating actual Yosemite wilderness visitor use patterns, parameterized by trailhead of entry, entry date, party size, trip length, and probabilistically simulated travel throughout the wilderness zones. The baseline scenario also incorporates additional usage from trips originating at trailheads outside the park. Output categories mimic those of the validation scenario. The distribution of spatial deviations predicted by the model was compared to that observed in the sample of survey respondents to validate the spatial deviation algorithm.

The aim of the reduced use scenario is to reduce use in zones that are frequently over capacity by removing parties at trailheads. In this scenario, when a party draws an entry trailhead with full quota, the party is denied entry, and leaves without spending any nights. Based on entry trailhead contribution output from the baseline scenario, quotas were reduced on trailheads that contribute heavily to the overused zones, until satisfactory levels were achieved. In this case, "satisfactory use" is defined as no zone exceeds capacity, on any given day, in more than 30% of the simulations. Additional output for this model includes the number of parties and persons denied entry.

The trailhead reassignment scenario redistributes parties to less-used park zones, instead of denying entry. When a party draws a trailhead with full quota, it is reassigned to a new trailhead from a distribution in which the least popular trailhead has the highest probability of selection and the most common choice has the lowest probability, which forces parties to less-used parts of the park. Additional output includes the numbers of parties and persons redistributed.

The maximum use scenario evaluates maximum visitor use by allocating maximum daily visitor entries at every trailhead, as allowed by the current quotas, for every day of the high use period. Since the same number of visitors enter every day, there is no longer a dynamic component; therefore, this scenario represents a stable equilibrium of wilderness visitation.

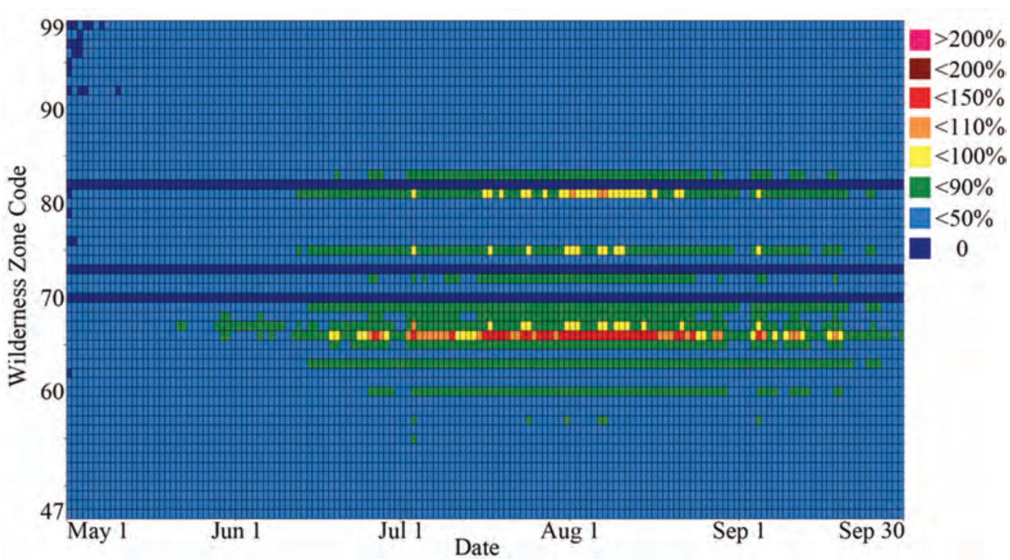
### Analysis of simulated visitor use and user capacities

The distribution of party sizes and trip durations resulting from the validation scenario was compared with the permit database. One season-long model simulation was used to generate these parties. Sample size was 15,133 for both the model and the permit database. A Kolmogorov-Smirnov test was run to test for equality of distributions, and Welch's t test was run to compare means. There was no significant difference in either the distribution or the mean between party sizes in the model and the permit database. Relative frequency histograms showed very similar distributions for trailhead usages in both the database and simulation trial.

For season-total use across all zones, the modeled 95% prediction interval was 106,468 ± 4,135, and the observed intended use from the database was 107,677. The observed intended use falls within the prediction interval, indicating that at alpha = 0.05, we do not reject the null hypothesis that observed use belongs to the model-predicted population. For use by zone by night ("zone-night"), we performed the same type of analysis, adjusted for multiple comparisons over all 8,109 zone-nights (53 zones x 153 nights). At 95% confidence for each zone-night, we expect observed zone-night use to fall outside the 95% prediction interval in 5% of the zone-nights. Observed intended use fell outside of the modeled 95% prediction interval in less than 1% of all zone-night combinations, indicating that there is no significant difference in spatiotemporal use distributions between the model and permit database.

The baseline scenario indicates that mean use in three zones exceeds capacity on many nights during the peak season (Figure 2). The same zones are the only ones with nights with a

**Figure 2.** Percent zone capacity averaged over 1,000 simulations of baseline scenario.



greater than 50% probability of exceeding capacity on given nights (Figure 3). The number of zones with mean use exceeding capacity is greatest July 3 and August 1, 6, and 7 when use in two zones, on average, exceeds capacity.

The model outputs from the reduced use scenario indicate that by reducing the quotas of the trailheads contributing most to zones with nights exceeding capacity, resultant visitor use is such that, on average, no zone exceeds capacity, and overnight use in any zone on any given night exceeds capacity in no more than 20% of all simulations. The frequency with which zones exceed 110 or 150 percent of capacity is no greater than 10% over the 1,000 simulations.

Output from the trailhead reassignment scenario was similar to that of the reduced use scenario. There were no nights on which mean use exceeded capacity. There were a few zone-nights in which it is probable use may exceed capacity but none in more than 50% of simulations. Just three zone-nights were likely to exceed 110% of capacity, and none in more than 30% of simulations. This scenario has no nights in any zone in which use exceeds 150% of capacity in over 10% of the 1,000 simulations.

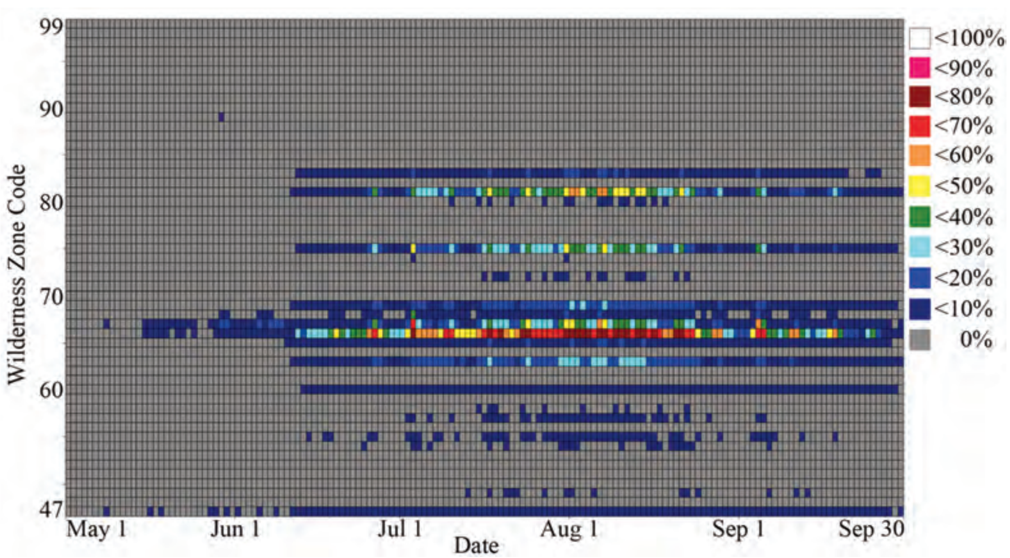
The maximum use scenario indicates three zones in which average use exceeds 150% of capacity nearly every night. The predominant travel patterns are such that, despite maximum use conditions, use in many zones do not, on average, reach 50% of capacity, and many of those same lesser-used zones have no nights on which the model predicts any chance of exceeding capacity. The results indicate a 100% probability that use exceeds 110 and 150% of capacity in two zones on nearly every night. The current quota scheme limits maximum daily wilderness visitation to an average of 2200 visitors in this scenario, whereas the sum total of all zone capacities is 4200, making the maximum allowed use 52.4% of total capacity at full trailhead quotas.

### Discussion

The results of this simulation model allow the park to quantitatively understand the existing conditions. With this model, the park will be able to evaluate the effectiveness of alternative management strategies more efficiently and with less risk than trial-and-error methods. They may evaluate potential visitor use demands and develop informed plans to prepare for those potential conditions (Lawson 2006).

The Yosemite trailhead quota system is designed to allow visitors the freedom to roam, and gives visitors the right to alter their plans serendipitously. It provides maximum freedom to visi-

**Figure 3.** Probability of exceeding 100% capacity over 1,000 simulations of baseline scenario. Percent zone capacity averaged over 1,000 simulations of baseline scenario.



tors, consistent with wilderness experience and resource constraints (van Wagtendonk and Coho 1986). This characteristic may increase the potential of Yosemite wilderness experiences to provide visitors with a sense of inspiration, escape, and autonomy.

This study found strong evidence that visitors are altering their trips in both time and space; thereby demonstrating both the necessity for managers to allow for, and proof of visitors exercising those rights to, logistical freedom. This study also found that that on some nights, a portion of the wilderness management zones likely receive use exceeding their user capacities. This study produced a management tool for Yosemite National Park. It is up to the park to decide how best to implement the modeling tool provided, but it may be worth noting that a previous study using stated-choice modeling found that Yosemite visitors would be willing to accept a lower chance of receiving a permit in order to gain improvements in other conditions, such as having fewer encounters with other visitors during their trips (Newman et al. 2005). Another study in Oregon and Washington found that wilderness visitors are more supportive of use limits if the rationale given for limits is protection of the environment rather than protection of visitor experiences (Cole and Hall 2008). Therefore, if the park implements an alternative quota configuration reducing use then actual visitors are likely to accept it in regard to what they may gain experientially, while the public may be more likely to support it in consideration of resource preservation.

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# Climate Change and Coastal Refuge Dynamics: The Case of Cape Romain National Wildlife Refuge

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Climate change is the most compelling conservation challenge of our time. Accelerating climate change will affect our nation's fish, wildlife, and plant resources in profound ways. While many species will continue to thrive, some populations may decline and in some instances, go extinct. Others will survive in the wild only through direct and continuous intervention by managers. This defining challenge for the conservation community requires the U.S. Fish and Wildlife Service (USFWS) and its employees and partners to apply the skill, determination, creativity, and commitment to conserving the nation's natural resources that have defined the American conservation movement since its inception more than 130 years ago.

The USFWS draft Climate Change Strategic Plan establishes a basic framework within which the USFWS and its employees will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, and habitats in the face of accelerating climate change. The plan employs three key strategies to address climate change: adaptation, mitigation, and engagement. Adaptation refers to planned management actions the USFWS will take to help reduce the impacts of climate change on fish, wildlife, and their habitats. Mitigation involves reducing our carbon footprint by using less energy, consuming fewer materials, and appropriately altering our land management practices. Engagement involves reaching out to Service employees; local, national, and international partners in the public and private sectors; key constituencies and stakeholders; and the broader citizenry of this country, to join forces and seek solutions to the challenges to fish and wildlife conservation posed by climate change.

Cape Romain National Wildlife Refuge (refuge) is 66,287 acres of land that extends 22 miles along the South Carolina coast. The refuge is comprised of barrier islands, salt marshes, tidal flats, and open water, all of which lie to the east of the Intracoastal Waterway. The elevation of most of these lands is less than 5 feet above mean sea level. Nearly 29,000 acres of the refuge is federally designated wilderness. The refuge was originally established for the protection of migratory birds, because of its importance on the Atlant -

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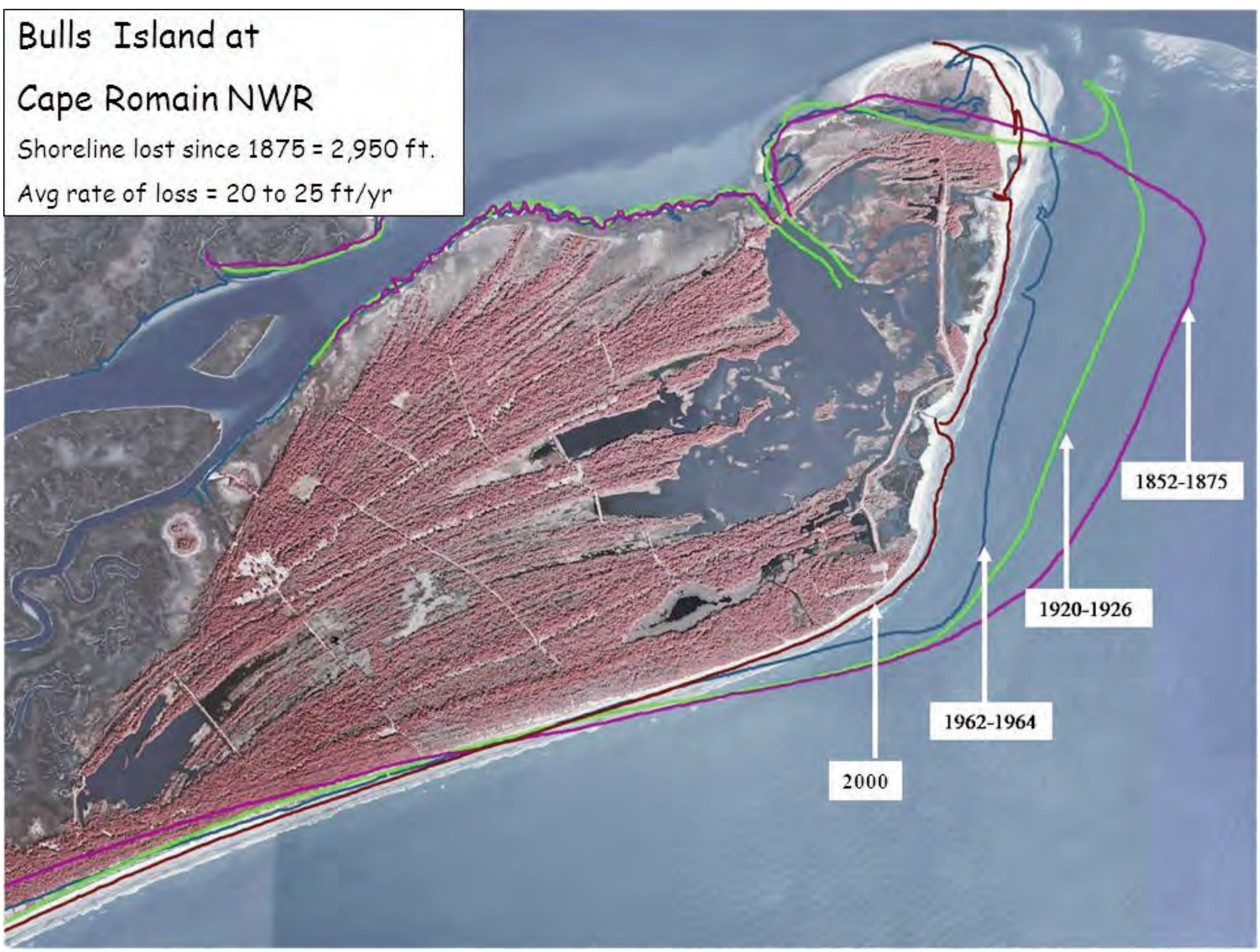
ic migratory flyway. The refuge is also home to the largest nesting population of loggerhead sea turtles north of Florida.

The effects of a changing climate on the refuge will mostly be from a rising sea level, causing accelerated beach erosion, submergence of extensive salt marsh habitats that account for 45% of the refuge, and conversion of salt marsh to tidal flats and open water. The coastal zone is dynamic, and the response of coastal areas to sea-level rise is more complex than simple inundation. Erosion is a natural process from waves and currents, and sea-level rise exacerbates coastal change by accelerating erosion rates. These effects of climate change are currently altering habitats, and adding pressure to vital habitats for threatened species, such as the loggerhead sea turtle and piping plover.

Accelerated rates of sea-level rise will inhibit some of the major functions of salt marshes and coastal beaches. Coastal development, hardened barriers, and dredged boat channels now prevent landward migration of these coastal habitats. However, there are many tidal creeks and wetlands on adjacent lands that may provide future habitat for wildlife to adapt to these changing conditions. There are many vulnerable species that rely on these habitats, including several species of migratory birds, such as the American oystercatcher, and commercially important fish and shellfish.

### Accelerated beach erosion

Accelerated beach erosion will destabilize and fragment the islands within the refuge. This will decrease suitable nesting beaches for sea turtles and seabirds, and more nests



will be subject to inundation. Tropical storms and even strong prevailing winds can push water over islands, or create escarpments that cut into the fragile dunes, thus reducing the overall available habitat for trust species (federal trust species includes migratory birds, threatened species, endangered species, inter-jurisdictional fish, marine mammals, and other species of concern). Maritime forest on Bulls Island has been affected as the beach retreats inland, and a levee around the refuge's most significant freshwater impoundment is at risk from rising sea levels. Loss of the impoundment will reduce wintering habitat for several waterfowl species.

### Salt marsh submergence

Under normal conditions, salt marshes can keep pace with a moderate level of sea-level rise from sediment inputs and the detritus that builds up within a marsh. As the rate of sea-level rise increases, salt marshes will not be able to keep pace, and gradually degrade and become submerged. Three key determinants of future tidal marsh acreage are the capacity of the marsh to raise its surface to match the rate of rising sea level, the rate of erosion of the seaward boundary of the marsh, and the availability of space for the marsh to migrate inland.

A recent study determined that headward erosion within tidal creeks in the salt marsh is occurring at a rate of 1.9 meters per year (Hughes et al. 2009). Where tidal marshes become submerged or eroded, the loss of habitat would negatively affect numerous wetland-dependent species. Bird species that rely on island habitat for protection from predators would be forced to abandon key nesting areas.

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# Katmai National Park and Preserve Economic Significance Analysis and Model Documentation

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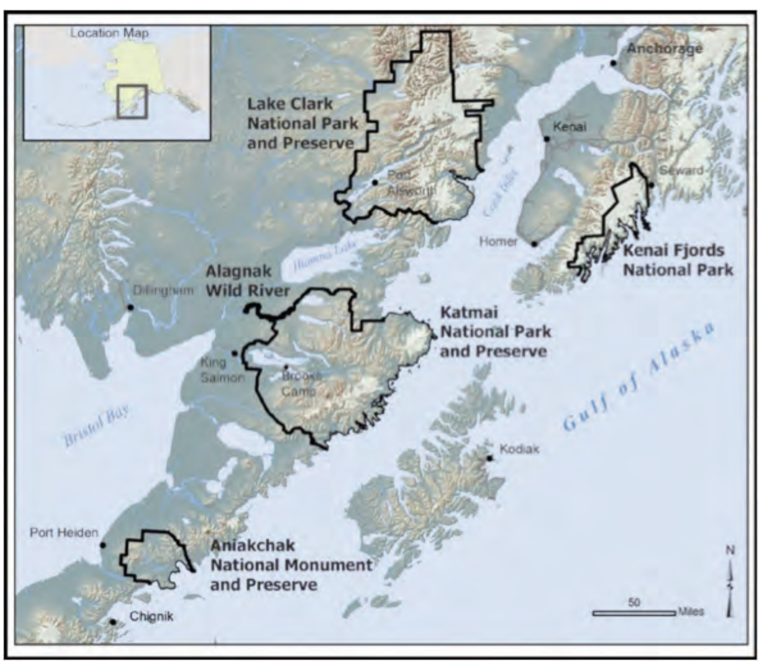
**The purpose of this study is twofold.** The first is to conduct an economic significance analysis of visitation to Katmai National Park and Preserve (Katmai NPP), using a standard economic input/output model. The second, and equally important, objective is to compare the National Park Service's (NPS) Money Generation Model (MGM; http://web4.msue.msu.edu/mgm2/default.htm) methodology with this more general and adaptable approach (input/output model) to assessing economic significance of national parks in Alaska.

Katmai NPP is located on the Alaska Peninsula, west of Kodiak Island. Park Headquarters is in King Salmon, about 290 air miles southwest of Anchorage (Figure 1). Katmai is becoming best

**Figure 1.** Katmai National Park and Preserve and environs (source: NPS, Southwest Area Network).

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known for its brown bears, that congregate at Brooks Falls for the salmon run, as well as in the coastal meadows to feed on rich plant life. Approximately one-third of visitor days in Katmai NPP occur at Brooks Camp. Another 15% of visitor days occur along the coast, especially Hallo Bay and Geographic Harbor, for late spring and early summer bear viewing; this coastal visitation, however, is growing. Estimates of visitor days from Commercial Use Authorization (CUA) permit holder reports averaged 25,000 annually, from 2005 through 2007. Estimates based on adjustments for visitors who arrive via their own planes and boats, visit under concession contracts, or are not otherwise required to be reported, raises the average to 41,000 visitor days annually. Visitation, both temporally and spatially, tends to follow the timing of fish returns, which attracts both anglers and bears for viewing. For the park as a whole, visitation is highest in July, and second highest in August.

Several commercial airlines provide daily flights into King Salmon, as there is no road access. King Salmon is the gateway for trips into the western portion of the park, including Brooks Camp, and the Valley of Ten Thousand Smokes, accessed by bus from Brooks Camp. The Katmai Coast is accessed by float, wheeled planes, and boat from Homer, Kenai, other Kenai Peninsula communities, and Kodiak Island. Primary access to Katmai NPP is via small planes landing on lakes, rivers, beaches, and sand bars, which accounts for the widely dispersed visitation patterns, despite the lack of road access. Given the range of mountains running between the interior of the park and the coast, and the often inclement weather, visiting Brooks Camp and the park interior from the west, and the coastal area from the east, would normally be accomplished during two separate trips into the park.

Visitors to Katmai NPP include both day visitors and overnight visitors; visitors come both guided and unguided. An example of an unguided day visitor is someone who visits for the day at Brooks Camp to view bears. This person could fly their own plane, or arrive in their own boat, or be dropped and picked up by a CUA permit holder (a commercial business that has permission to operate within the park boundaries). Guided day visitors, for example, are people who hire a guide to take them to Hallo Bay for the day to view bears. Overnight visitors stay for at least one night in the park, and include people who stay at the campground in Brooks Camp, at one of the lodges in the park, or camp in the back country. Overnight visitors may be guided or unguided.

As a result of the logistical complexities of visiting Katmai NPP, many visitors purchase packages for both day and overnight visitation. Typical day packages include transportation to and from the park, as well as guide services in the park. Overnight packages usually include transportation to and from the park, meals, lodging, and guide services. Many visitors use guide services both for the guides' local knowledge of fishing and bear viewing locations, and because of safety considerations due to the dense population of brown bears. Most visitors are highly motivated to view bears, but are unfamiliar with their presence and behavior.

Table 1 shows the estimates of economic impacts resulting from the money spent in Alaska by visitors to Katmai NPP, during 2007. This study's model estimates that Katmai NPP visitors spent nearly $50 million (in 2007 dollars) in Alaska, with almost one-quarter of that spent inside Katmai NPP. Expenditures occurring inside the park are relatively high for a remote Alaska park, because of the location of Brooks Camp, which receives a significant portion of Katmai NPP visitors, and the concession operations at Brooks Camp, as well as other locations within the park. The visitor expenditures generated $73 million in total output, supported 647 jobs (average annual jobs, not full time equivalents), generated $23 million in labor income, and added a value of $37 million to the Alaska economy. These values are significantly higher than those generated by the course-scale MGM national estimates for the 2007 National Park Visitor Spending and Payroll Impact Report, despite that study's assumption of much higher visitation levels. We believe this illustrates the importance of portraying the uniquely Alaskan economy through an

| Visitor Use Estimation - 2007 | Total | Day Trip n=152 | Day Package n=160 | Overnight in Katmai NPP n=129 |
|---|---|---|---|---|
| Visits in 2007: | 22,792 | 8,449 | 7,666 | 6,677 |
| Visitor Days in 2007: | 40,908 | 8,449 | 7,666 | 24,793 |
| Expenditure Group Size | | 2.9 | 2.5 | 2.6 |
| LOS - days in park | | 1.0 | 1.0 | 3.7 |
| Reported visitors | 14,300 | 5,360 | 4,863 | 4,078 |
| Reported visitor days | 25,310 | 5,360 | 4,863 | 15,087 |
| Total rate of unreported visitor days | | 18% | 17% | 54% |

**Table 1.** Case study visitor use estimation, Katmai NPP, 2007.

approach to impact analysis that uses park-specific visitor data along with a general software package such as IMPLAN, or a modified, more customizable MGM user interface.

Table 2 summarizes the estimates of economic impacts resulting from the money spent in the five-borough region around Katmai NPP, during 2007, by visitors to the park and preserve (Figure 2; model includes five boroughs, Bristol Bay, Kodiak Island, Lake and Peninsula, Kenai Peninsula, and the minicipality of Anchorage). This study estimates that Katmai NPP visitors spent $31 million in the region, with more than a third of that spent inside Katmai NPP. The visitor expenditures generated $46 million in total output, supported 390 jobs, generated $15 million in labor income, and added a value of $23 million to the regional economy. This represents nearly two-thirds of the value added to all of the Alaskan economy by Katmai NPP visitors in 2007.

**Table 2.** Expenditure margining for IMPLAN analysis of 2007 visitation to Katmai NPP.

| IMPLAN sector name | 2007 IMPLAN sector number | Basis | Margin | Allocation from survey category | Total annual expenditures while in Alaska by visitors to Katmai NPP* | Total annual expenditures in the local five-borough region by visitors to Katmai NPP* |
|---|---|---|---|---|---|---|
| Petroleum refining | 115 | Commodity | household | 98% | $2,714,312 | $1,399,023 |
| Lubricating Oils and Greases | 118 | Commodity | household | 2% | $63,444 | $32,701 |
| Food and bev stores | 324 | Commodity | household | | $1,594,295 | $885,027 |
| Clothing retail | 327 | Commodity | household | 20% | $524,511 | $301,711 |
| Sporting goods retail | 328 | Commodity | household | 20% | $524,511 | $301,711 |
| General merchendise retail | 329 | Commodity | household | 60% | $1,573,532 | $905,134 |
| Air transport | 332 | Industry | | 85% | $13,397,817 | $9,468,506 |
| Water transport | 334 | Industry | | 10% | $1,576,214 | $1,113,942 |
| Passenger ground trnsport | 336 | Industry | | 5% | $788,107 | $556,971 |
| Scenic and sight seeing | 338 | Industry | | | $3,789,926 | $2,434,585 |
| Amusement, gambling, rec | 409 | Industry | | | $1,767,125 | $1,104,530 |
| Hotels | 411 | Industry | | | $13,724,382 | $7,352,320 |
| Other accom | 412 | Industry | | | $760,941 | $472,736 |
| Food services | 413 | Industry | | | $5,425,452 | $3,142,935 |
| Donations - advocacy | 424 | Industry | | 70% | $104,658 | $67,156 |
| Donations - organizations | 425 | Industry | | 30% | $44,853 | $28,781 |
| | | | | | $48,374,080 | $29,567,771 |

* This is an intermediate modeling table with survey-year 2006 dollars and model-year 2007 visitation levels


**Figure 2.** Five borough area of economic significance.

Visitors to Katmai NPP spend more per trip in Alaska than other Alaska visitors. While they represent approximately 2% of total visitors to Alaska, they account for 3% of visitor expenditures. The average visitor expenditure per person per trip in Alaska is estimated to be $992 (in 2009 dollars; McDowell Group et al. 2007). In addition to spending more per trip, it is also likely that a higher proportion of Katmai NPP visitor expenditures remains in and benefits the Alaska economy, because a high proportion of businesses supporting Katmai NPP visitation are owned and operated by Alaska residents (USDI NPS various years).

Our study of Katmai NPP visitor economic impacts used an approach modified from the more common methods used in the NPS, in order to better account for the unique situation of this remote region. MGM modeling, based on visitor surveys of the type administered at Katmai NPP by the University of Idaho (U of I) in 2006, is the standard approach to estimating National Park economic impacts throughout the United States. The MGM approach uses IMPLAN-generated multipliers, along with an estimation model developed specifically to capture National Park visitor's recreation behavior. However, at Katmai NPP, conventional assumptions do not work well, and we took a more adaptable approach. This custom economic model derives impact estimates directly from IMPLAN software, rather than through the MGM-assisted process.

The following observations were made about the Katmai NPP economic modeling process and its use of IMPLAN, rather than MGM, software:

- The measure of 'visitor nights' — defined as 'nights spent in the local area' in the MGM modeling process was a problem for the Katmai NPP model. Visitors to the park often spend only one day inside the park, and do not typically return after leaving. Most access is by airplane, and the night before and/or after the visit is likely to be spent a substantial distance from the park. MGM software develops estimates based on visitor nights in the area, thus accounting for multiple excursions into the park on the same overall visit. The modeling approach that we took at Katmai NPP uses a 'visitor trip' accounting system to more accurately portray visitor flow and expenditures. The length of stay in the local area, which stemmed from Katmai NPP visits, was difficult to determine from the survey data. However, following a similar approach to that used in MGM modeling, visitor trips and expenditures for the Katmai NPP economic impact model were calculated separately for the three primary types of visitors (single day private, single day package, and multi-day).

- Accurate and complete survey expenditure data is difficult to collect in any study. This was particularly apparent in the Katmai NPP visitor survey. The remoteness of Alaska, and its unique adaptations to economic challenges, increase the difficulty of measuring expenditures within appropriate categories, and attributing them to correct locations. The Katmai NPP visitor survey collected substantial expenditure data on package tour visits. This is not a standard economic sector, or MGM expenditure category, and the survey did not collect sufficient information to accurately allocate package expenditures to appropriate economic sectors. In addition to these types of measurement errors, nearly 20% of the survey respondents did not provide any usable expenditure information.
- The U of I Katmai NPP visitor survey included spending categories of packages, guide services, and donations that are not usually measured on standard NPS visitor surveys. These are not standard MGM spending categories, and the MGM software did not provide the ability to add them to the model; whereas, they could be bridged and margined to economic sectors with the IMPLAN software. If attempts are made to further refine the NPS visitor survey process to better account for differences found in Alaska, it may be necessary to further adapt the spending categories and adjust the model sector category methods. Unless this type of custom modeling is available within MGM software, it would be advantageous to continue to develop the IMPLAN modeling approach for Alaska national park units.
- To determine whether the issues related to the MGM model and the U of I survey were confined to remote wilderness parks, as opposed to road accessible parks, we reviewed the results of the 2006 Denali National Park and Preserve (Denali NPP) U of I survey, and its applicability to MGM or IMPLAN modeling. We found that the survey administration resulted in a sample that was significantly different from existing Denali NPP data on its visitor population (Brigham, Fay, and Sharfarz 2006). A large portion of Denali NPP visitors come on package tours, which would have been even more confusing to survey respondents, and problematic for economic modeling, than the Katmai NPP survey was. For this reason, the Denali NPP staff chose not to include visitor expenditure questions in the 2006 U of I survey instrument (Charlie Loeb, Denali NPP planner, pers. comm.).

In summary, we have three critiques of the use of the MGM modeling process for Alaska national parks:

- The gross MGM approach using secondary data, and a standard national model, is inadequate, and severely underestimates impacts, because visitors to Alaska parks spend considerably more on average than visitors to lower-48 parks.
- The customized MGM modeling approach is difficult to use in Alaska, because the software does not easily allow for adjustments to fit Alaska's unique situation, whereas IMPLAN is easier to adapt.
- The U of I survey instrument and sampling method need to be significantly modified for Alaska, with more sample points, true random sampling, and Alaska-appropriate questions.

We did not calculate the total economic value of Katmai NPP in this study. Economic value is a measure of the annual amount of money that people would be willing to pay to maintain the existence of the park, or any of its component parts, or characteristics, for all purposes, including recreation, habitat for commercial, personal and subsistence fish resources, as well as non-use values.

Our measures of expenditures associated with park recreational activities provide a lower bound estimate of the total value of the park for recreation, since they reflect the amount people actually paid to engage in those activities. Some people probably would have been willing to pay more than they actually did, in order to engage in those recreational activities. The total economic value of the park for recreational purposes would be the sum of actual expenditures and this additional willingness to pay. This additional willingness to pay is also known as the net economic value for recreational purposes.

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# Effective Organizations for Management Effectiveness: Another View of Protected Areas Development

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## Introduction

In the Caribbean, protected areas development has been driven primarily by funding from external sources, mainly bilateral and multilateral agencies. In such cases, it is customary for management interventions to focus on conservation strategies, with the explicit assumption that the national government or management entity will subsequently develop funding mechanisms to support institutional development.

The reality in the Caribbean is that protected areas management institutions have generally foundered with the termination of project financing, constantly searching for new funding, struggling to keep staff, and generally failing to protect the resources within the protected areas for which they are responsible. To complicate matters, protected areas in the Caribbean are increasingly being designated to meet multiple objectives, in which community livelihood issues are given as much weight as conservation issues. Without the resources to develop and maintain the institutional structures and support systems necessary to achieve effective management, these sites appear to be stuck in an early phase of development.

## Status of protected areas in the Caribbean

The status of protected areas development in the Caribbean can be summarized:

1. Institutional arrangements—most countries operate management systems wherein protected areas are managed by central government agencies, though there is a growing tendency towards delegation of management responsibilities to non-government organizations. Even in centralized management systems, protected areas are typically designated under different laws and managed by different agencies. Some agencies are responsible for only one site, while others are responsible for multiple sites. Stakeholder and community involvement varies widely, though there is a growing tendency towards more structured involvement in planning and operations. Institutional coordinating mechanisms are generally lacking, though there is increased awareness of the need for protected areas management institutions to develop working relationships with regulatory agencies.

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2. Management status—sites vary in size from one acre to thousands of acres. There are a large number of sites without active management, and most sites have only minimal management activities. The status of the natural resources in most sites is generally unknown.
3. Major issues—there is typically an inadequate management framework (policy, legal, and institutional), inadequate financial resources, inadequate institutional capacity, and minimal support from adjacent communities. There is generally a high level of threat from anthropogenic sources, and an increasingly high level of threat from natural causes.
4. Institutional capacity—management teams range from large professional teams to small, inadequately-resourced teams. The majority of management teams are small, and funding is available mainly on a project by project basis. Staff is usually dedicated, but inadequate to meet obligations identified in national thematic, or sector, development strategies and multilateral environmental agreements.

### Development stages of protected areas in the Caribbean

Protected areas development in the Caribbean is influenced by a range of factors, such as political demand, level of influence of the protected area management institutions, level of use for tourism activities, and availability of financing. However, the main factor driving designation and establishment of new protected areas is external financing.

Conditions attached to financing from such sources usually dictate that site development activities are focused primarily on conservation strategies. Such conditions therefore shape the design of the institutional arrangements, the type and number of personnel, the management activities, and ultimately, the long-term development of the protected area.

In addition to financial resources, the level of management intervention is usually dependent on the degree of political and community support, and the capability of the management institution. Five stages in protected areas site development can be identified: stage 1, paper park; stage 2, start-up; stage 3, mature; stage 4, senescent/stagnant; and stage 5, discarded.

Each stage can be characterized by factors identifiable in both the internal and external environments of the management entity. In stage 1, the site is legally designated, but not actively managed. Any protection measure is implemented through other land management processes, such as land use planning. Stages 2 and 3 exhibit the most intense and broadest range of management interventions, and in fact are the stages where the issue of management effectiveness is most relevant. A site usually enters stage 4 when there is organizational failure in the management entity. The management team reverts to a small staff complement with limited skill sets and resources. If the management entity is only responsible for one site, activities may become focused on institutional survival, having minimal impact on the status of the resources within the site. Where the management entity has other responsibilities, the site may slip further, into stage 5. In this stage, the site reverts to the status of a paper park, is used to support other development initiatives, or is formally delisted.

Most protected areas in the Caribbean appear to be stuck in the start-up phase; characterized by under-developed management systems, inadequate public engagement processes, unsustainable financing arrangements, and general inability of the management institution to adequately address threats to site integrity (Table 1). Only a small number of protected areas can be said to have entered a mature stage of development (Table 2), and these are sites that are the singular focus of an institution, sites that are heavily used for tourism, or sites that are part of a larger central management system.

Management capacity is inadequate in most protected areas in the Caribbean, and the challenges faced by the sites are largely unresolved. The need to improve success of management interventions has increased the call for the use of adaptive management processes. However, successful application of adaptive management approaches is dependent on the availability of ade-

| Parameter | Characteristics |
|---|---|
| Organizational capacity | • Small project team/staff.<br>• Senior staff usually not trained managers.<br>• Detailed policies and operational guidelines generally lacking.<br>• Limited capacity for development or establishment of standard management systems. |
| Management activities | • Activities designed as projects, and usually undertaken by consultants or mixture of consultants and project staff.<br>• Activities typically include stakeholder consultations, preparation of management plan, public education and outreach, and enforcement.<br>• Monitoring tends to be limited and basic (water quality, coral coverage, bird counts, fish counts, user activities). |
| Institutional arrangements | • Institutional arrangements identified in project document.<br>• Some start-up activities (e.g., site designation) undertaken by other (non-project) institutions.<br>• Post-project arrangements tend to be informal and opportunistic. |
| Community engagement | • Stakeholder inputs takes place primarily through initial consultations for plan preparation.<br>• Stakeholder advisory committee, where established, tend to have limited impact on management priorities and activities.<br>• Limited community engagement. |
| Financing | • Project financing, usually restricted to equipment purchase, monitoring, outreach, and enforcement.<br>• Limited allocation of resources from public budget.<br>• Financing plan not usually developed. |
| Political support | • Community support varies from hostile to supportive (site specific).<br>• Usually limited support from policy makers. |
| Integration into local, regional, or national development plans | • Site usually identified in land use plans, but operations not integrated into development planning and development control processes. |
| Status of resources within the protected area | • Management activities generally have little impact on the status of resources within the site. |

**Table 1.** Characteristics of start-up stage.

quate capacity in the management institution, as well as the responsiveness of the overall management framework. As such, the management institution still has to be an effective organization, which can only result from more attention being paid to its organizational development needs.

## Organizational effectiveness

There are many definitions of organizational effectiveness, and the term is often used interchangeably with organizational performance. However, most researchers agree that organizational effectiveness extends beyond organizational performance (market share, profits, return on investment, or efficiency) to embrace measures such as customer service and social responsibility. Campbell (1976) identified thirty possible indicators of organizational effectiveness. While there are several ways to measure organizational effectiveness, selection of the appropriate criteria depends on the primary purpose of the organization—that is, whether it is focused on internal priorities (such as return on investment) or external outcomes (such as contribution to society).

Protected areas management institutions mostly manage public lands (or private lands under agreement with private or community owners) for the production of public benefits. As such, for the purpose of this paper, organizational effectiveness is defined as "*the extent to which an organization achieves the outcomes it is mandated to produce.*"

| Parameter | Characteristics |
|---|---|
| Organizational capacity | • Large, highly trained and specialized staff.<br>• Professional management.<br>• General and operating policies established.<br>• Use of standard operating procedures.<br>• Management systems operational (planning, budgeting, evaluation, reporting, etc.).<br>• Demonstrated ability to respond to threats and emergencies. |
| Management activities | • Activities directly linked to management plan.<br>• High degree of success in threat mitigation.<br>• Provision of technical assistance to other environmental management initiatives. |
| Institutional arrangements | • Majority of management interventions undertaken by management institution.<br>• Institutional arrangements include both formal and informal arrangements. |
| Community engagement | • Demonstrated ability to involve public and community organizations in planning and management interventions. |
| Financing | • Sustained level of budgetary support.<br>• Financing plan operational.<br>• Established mechanism for community financial support.<br>• Ability to fund capital projects, including infrastructure. |
| Political support | • Fairly high level of community support. |
| Integration into local, regional, or national development plans | • Site usually listed as supporting sector development strategies (e.g., tourism).<br>• Site usually identified in physical plans.<br>• Management institution often included in review of external projects that may impact on the site. |
| Status of resources within the protected area | • Ecosystems generally display higher levels of "naturalness" and integrity than ecosystems outside the boundary of the protected area.<br>• Some attention given to maintaining integrity of cultural and historical resources. |

**Table 2.** Characteristics of mature stage.

Mullins (1989) noted that an organization can only perform effectively through interactions with its external environment. That implies that the organizational structure, management systems, and processes must be designed to cope with the factors that are inherent to that external environment. This principle is at the core of the National Capacity Self Assessment program developed by the Global Environment Facility for its participating countries. The program is based on the understanding that successful environmental management interventions require adequate capacity at the systemic, institutional, and individual levels.

Determination of organizational effectiveness for protected areas management institutions must therefore consider the following:

- Purpose of site designation—such as provision of environmental services, tourism support, community livelihoods.
- Purpose of the management institution—to ensure that protected area resources continue to deliver the benefits for which the site was designated (economic, social, ecological, spiritual).
- Internal environment—appropriate personnel, establishment of appropriate management systems and standard operating procedures, availability of resources for routine or standard operations, mechanisms for maintaining resource values of the protected area, and institutional design.
- External environment—policy and legal framework, institutional arrangements, stakehold-

er/community support and use of resources, input of political and business leaders, development planning processes, physical planning and development control processes, and environmental processes affecting the protected area.

The external environment is an over-riding consideration in the Caribbean context, as the islands are too small for protected areas to be isolated from human interference, and the external land management practices and socio-economic needs exert considerable influence on protected areas resources. The regulatory framework for control of that external environment does not reside within the protected area management institution. Hence, management effectiveness is dependent on effective interaction with the external environment.

Unfortunately, most protected areas management teams in the Caribbean consist of a manager, two to four rangers, a public education and outreach officer, and less often, a science officer. This personnel composition suggests a focus on activities within the boundary of the site, and clearly does not include adequate personnel and skill sets to function effectively in the external environment. Two cases are used to illustrate the point.

### Case 1: Montego Bay Marine Park, Jamaica

The Montego Bay Marine Park was designated in 1992. The park is 15.3 sq km, and extends from the high water mark to approximately 100 m in depth. The landward boundary of the park is 9 km of coastline, bordering the entire frontage of the city of Montego Bay. Human activities (on land) beyond Montego Bay impact park resources (Montego Bay Marine Park Trust 1998), as non-point source pollution from the city and beyond is transported to the park by storm drains, two large rivers, and a large number of streams.

Montego Bay is the third largest city in Jamaica, and the regional centre for the western half of the country. Social infrastructure inside the park includes a trans-shipment port (with storage facilities for a range of goods, including crude oil) and a cruise ship dock.

The park management institution has no authority beyond the boundary of the park, and due to the location of port facilities within the park, it has limited authority even within its own boundaries. Management interventions are focused on park resources, mainly monitoring (water quality, beach, and ecosystems) and use management (primarily fishing and scuba diving). Public engagement is conducted through education outreach activities and operation of a local advisory committee.

In the case of the Montego Bay Marine Park, the external environment exerts tremendous influence on the state of the park. Effective management of the park is therefore determined mainly by the extent to which the management institution is able to work with regulatory agencies, and economic and political forces, to mitigate the impacts of external land uses on the park.

### Case 2: Pointe Sable Environmental Protection Area, Saint Lucia

The Pointe Sable Environmental Protection Area was designated in 2007. The protected area is approximately 1,038 ha, encompassing a narrow coastal strip and adjacent marine space. The designated area is heavily used by the community for livelihood and recreational purposes. The primary purpose for which the site was designated, its mission, is "*protecting the natural beauty or interest in the area*." Additionally, the funding source for site establishment stipulated that the site must have the dual objectives of biodiversity protection and support for community livelihoods. An important aspect of management planning was therefore the definition of "natural beauty" and "interest in the area," as well as identification of community livelihoods.

In addition to identification of issues in the legal and institutional frameworks that needed to be addressed, the management plan also identified the area of influence for management interventions as extending beyond the boundaries of the protected area. Those management interventions required institutional resources and support systems spread across several agencies (Gardner 2009).

However, the site management agency planned to hire only one person, the site manager, for the first two to three years of site development.

The objective of the management institution in this case was clearly to get the site designated and establish a presence. The institutional design required to fulfill the site mission was apparently not a priority. Unfortunately, this approach to protected area development is not uncommon in the Caribbean, and many sites are seemingly stuck in this start-up phase of development.

## Conclusion

Evaluating management effectiveness is increasingly used to determine the success of protected areas management interventions. The framework developed by the World Commission on Protected Areas (Hockings et al. 2006) focuses on six defined steps in the management cycle, and provides criteria for assessing each step. The first two steps, understanding the context (diagnosis) and planning, are referred to as the design component of the management process. The evaluation framework also identifies the need to conduct management planning within the context of the external environment.

However, there is little focus on the design of appropriate institutional structures, support systems, and institutional arrangements needed to operate effectively within that external environment. The guide states that "*A protected area that suffers from fundamental design flaws is unlikely to be effective*," (page 18, section 3.3). The same principle applies to the design of the management institution, as an inappropriately designed and staffed institution cannot adequately carry out the assessment and design tasks required in management planning.

We conclude that better understanding of the organizational development requirements would result in improved planning of protected areas, increased mobilization of resources, and increased potential for achieving site and system objectives.

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# Climate Friendly Park Employees: A Climate Change Training Needs Assessment for the National Park Service Intermountain Region

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## Abstract

The National Park Service (NPS) Intermountain Region partnered with the University of Arizona to assess climate change training needs for over 5,000 Intermountain Region employees. The assessment team evaluated baseline climate literacy and employee training preferences, and outlined plans for climate change training. In the literacy assessment, the team identified adequate understanding of key climate phenomena, such as El Niño, but a lack of discernment between climate variability and trends, and little knowledge of climate projections for the Intermountain Region. Analysis of surveys and interviews showed that Intermountain Region employees are concerned with the following training program implementation issues: information communication technology, funding, clear guidance on actions and policy changes, and communication with climate change skeptics. Intermountain Region employees recommended that training connect global changes to regional impacts and local solutions, and demonstrate relevance to job duties. They preferred interactive, group, and hands-on learning experiences, but agreed to use

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electronic media, if costs constrain program development. They identified information overload as a problem. To meet diverse needs, within fiscal constraints, we recommend a modular program, leveraging existing, well-vetted information resources. From a website evaluation exercise, we found adequate online training for climate change literacy, but a lack of training on topics such as mitigation of, and adaptation to, climate change.

### Introduction

The NPS Intermountain Region contains diverse coastal, desert, mountain, and prairie ecosystems. Climate change and vanishing landscapes were among the top five Intermountain Region challenges enumerated in an unpublished 2009 report. To prepare for these challenges, the Intermountain Region engaged University of Arizona scientists to collaboratively assess needs for workshops and training to provide Intermountain Region employees with information that they could use to manage resources, mitigate greenhouse gas emissions, and plan to adapt to climate changes. The project goals were the following:

1. Assess the climate change knowledge level of a representative sample of Intermountain Region employees.
2. Determine the content, look, feel, and communication media of training modules for employees.
3. Develop a road map that links current and anticipated Intermountain Region climate change information needs.
4. Determine how to best leverage existing climate change information resources, and to reconcile information coming from different sources.

### Methods

To evaluate climate change literacy and training preferences, the team used: a 21-question, structured online survey, using Likert-scale, multiple preference, and open-ended questions, and an 18-question, semi-structured interview protocol. The interviews were conducted after analysis of the survey, and interview questions were informed by survey results and knowledge gaps. Of the 5,379 Intermountain Region employees given the survey, 609 (12.6%) responded to the survey. The sample represented each of the 31 workforce roles, condensed by the research group from 166 unique NPS occupational series. Fifteen interviews were conducted with key informants, selected to represent a spectrum of job roles. Interview questions focused primarily on aspects of a training program, and secondarily on organizational challenges.

**Survey and interview results: climate literacy.** Eighty-three percent of respondents rated themselves as having fair or good knowledge of climate change. The majority of poor/very poor climate literacy self-ratings came from administrative assistants, office staff, budget and accounting, contracting and purchasing, facilities management, human resources, park manager, park ranger, and law enforcement. The self-ratings suggest initial areas to devote climate literacy training efforts. Most respondents correctly identified climate change impacts observed in the Intermountain Region, but could not correctly identify projected changes for the Intermountain Re - gion. Whereas 90% of respondents correctly identified definitions of key terms, such as the greenhouse effect, and mitigation of, and adaptation to, climate change, fewer correctly matched seven examples of actions with the terms "mitigation" and "adaptation." Survey results also indicate the need for training on distinctions between climate variability, climate trends, and weather.

**Survey and interview results: training and information communication preferences.** Analysis of surveys and interviews shows that Intermountain Region employees prefer in-person climate change training, if cost is not an issue. Interviewees recommended mixed-method training programs that involve hands-on or on-the-job learning components, and interaction with fellow employees. Few Intermountain Region employees advocate online training, unless cost limits choices. A relatively small number of Intermountain Region employees identified internet access or connection speed as a limitation to the use of online training. In other cases, work schedule constraints may impede participation in group training. Based on these considerations, a flexible program is needed, with options that accommodate work schedule constraints, the remote locations of some employees, and technology limitations. Interviewees noted concern with information overload; thus, information must be tightly packaged (e.g., executive summaries, fact sheets, targeted presentations).

For climate change information to be adopted by Intermountain Region employees, survey and interview participants put a high priority on ensuring that information sources are transparent, credible, and legitimate. They recommended providing information that relates global phenomena to local phenomena, in a manner that is relevant to job duties and individual parks. To increase effectiveness and efficiency, participants recommended avoiding duplication of existing efforts by other federal agencies, and connecting with existing NPS training initiatives and conferences.

**Survey and interview results: challenges to implementing a training program.** We queried interviewees about challenges to implementing an Intermountain Region climate change training program. The interviewees noted inadequate information dissemination technology and communication networks, a lack of funding (e.g., for education, or for implementing actions to reduce impacts), the need for clear guidance on actions and policy changes, the importance of developing and disseminating clear, consistent, convincing messages, and improving communication with climate change skeptics, whether the skeptics are NPS staff, or members of the public. From long answer comments to the survey question "What information do you most urgently need to address climate change in your work?" we found that some Intermountain Region employees raised issues regarding the evidence for human-caused climate change; several others expressed faith-based objections to the notion of human-caused climate change. Interview results also indicated disagreement on whether a climate change training program should be mandatory. Resistance to a mandatory program would pose challenges to training program coherence and effectiveness.

**Suggestions for a training program.** We developed several tools for targeting climate change training with associated employee categories, and to meet their work-related needs. These include core topics for employee training (Tables 1 and 2), and curricula (Table 3) that outline key concepts, decision trees that associate topics with employee categories and suggest pathways for training (not shown), and criteria for vetting climate change training resources (Table 4).

We categorized NPS jobs into five broad groups: operations and administration, interpretation and education, research scientists, planners and engineers, and managers. We recommend that all employees receive training in the core topics of basic climate literacy, policies and responses by their parks, and essentials of mitigation actions that relate to their job duties and their park. For employees who interact with the public as part of their job duties, we suggest training in communicating climate change information.

For each of the five employee groups, we listed core training topics and reasons for including those training topics (Table 1). Park interpreters serve as the primary NPS interface with the public, and they could serve as key resources on climate change training for other employees. Consequently, we recommend that interpreters and educators receive training in a wide range of topics, which would include adaptation to climate change, and a deeper level of training in the core topics, in order to effectively communicate climate change principles and answer questions from the public and fellow employees.

In contrast, in their jobs, planners and engineers design infrastructure used to mitigate or adapt to climate change, and they inform mitigation compliance actions and develop adaptation

| Category | Training Rationale | Sample Curricula |
|---|---|---|
| Operations and administration | Inform mitigation behavior; prepare for casual engagement with public | Climate literacy; National Park Service climate change policy and actions; workplace mitigation actions; procedures for addressing questions from the public |
| Interpretation and education | Primary interface with the public; support mitigation compliance efforts; train other employees | In-depth climate literacy; National Park Service climate change policy and actions; workplace mitigation actions; adaptation planning and actions; in-depth procedures for addressing questions from the public |
| Research scientists | Inform research practice and methods; inform development of science information for mitigation and adaptation decision making; lay groundwork for collaboration with other scientists; prepare for casual engagement with the public | Technical climate literacy; science to support mitigation planning; adaptation planning and actions; procedures for addressing questions from the public |
| Planners and Engineers | Inform mitigation compliance and development of adaptation strategies; inform approaches for addressing uncertainty in decision making; prepare for casual engagement with the public | Technical climate literacy; mitigation planning and compliance regulations; in-depth adaptation planning and actions; frameworks for addressing uncertainty in decision making; procedures for addressing questions from the public |
| Managers | Depending on level of management: inform mitigation and adaptation strategy policy and program development; inform approaches for addressing uncertainty in decision making; prepare for engagement with the public; prepare for partnerships and collaboration | In-depth climate literacy; mitigation planning and compliance regulations; in-depth National Park Service climate change policy and actions; adaptation planning and actions; frameworks for addressing uncertainty in decision making; in-depth procedures for addressing questions from the public |

**Table 1.** Climate change training job categories, rationales and abbreviated curricula.

| Topic and course | Motivating questions |
|---|---|
| Climate Literacy | |
| Climate Literacy 1 | What is the evidence for global climate change and how does it relate to historic change in my local situation? |
| Climate Literacy 2 | At a deeper level, what does the evidence show, and what do climate models project for my region? |
| Climate Literacy 3 | What information do National Park Service scientists need for their investigations? |
| Communication | |
| Communication 1 | How do I address climate change questions from park visitors? |
| Communication 2 | How do I address questions from policy-makers, public officials, and skeptics? |
| Responses | |
| Adaptation 1 | How can we adapt? |
| Adaptation 2 | What strategies should I consider for my Park? |
| Mitigation 1 | What can I do (in my job)? |
| Mitigation 2 | What can we do (National Park Service, regionally, society)? |
| Mitigation 3 | What are the relevant mitigation compliance and planning regulations, protocols, and considerations? |
| Decisions | |
| Climate Change Decisions 1 | How should I deal with the uncertainties associated with climate change? |
| Climate Change Decisions 2 | What is the scientific background needed to support decision making? |
| Parks | |
| Parks 1 | What's going on in my park? |
| Parks 2 | What's going on in the National Park Service and in the parks? |
| Parks 3 | What policies, actions, and collaborations pertain to my park and throughout the National Park Service? |

**Table 2.** Core topics and motivating questions for Intermountain Region climate change training.

| Course | Curriculum Outline |
|---|---|
| Climate Literacy 1<br>Rationale: Basic climate change science for laypeople, that highlights the connections between global-scale climate system changes and their local manifestations | Title: Climate change: global to local<br>What changes climate? (natural factors, greenhouse effect, past climates)<br>Evidence of change (global temperature, oceans, snow and ice, drought, ecosystems, greenhouse gas emissions)<br>How sure are scientists? (observations, paleo-climate, models, confidence)<br>Local historic context (local and traditional knowledge of historic climate and extremes)<br>U.S. initiatives (National Park Service, Department of Interior, Landscape Conservation Cooperatives, Climate Science Centers) |

**Table 3.** Sample climate literacy curriculum outline.

strategies. We recommend that planners and engineers receive training in the core topics, but at a level specific enough for the plans and decisions that they make. We also suggest training in adaptation, climate change uncertainties, and in scenario planning and other decision frameworks. The kind of climate literacy required for planners and engineers might, for example, include a deep understanding of how climate and hydrology model projections are developed and the uncertainties associated with model projections. Training for planners and engineers would also require an understanding of any changes to the details of federal regulations for compliance with environmental standards.

**Website assessment.** We evaluated over 150 websites containing climate change training, information, and resources, with a focus on climate literacy mitigation and adaptation planning. We made a distinction between training and information. Training has obvious beginning and ending points, a well-defined and consistent structure geared toward education, and provides a structured flow from topic to topic. In contrast, there is abundant information, which is often loosely organized, and lacks a clearly defined structure for guiding users through related materials; thus, guiding NPS employees toward information, even if it is well articulated, would be counterproductive for a training program.

In our initial screening, we divided web resources based on whether or not they provided training. In our secondary screening, we evaluated websites and training materials, using criteria, modified from a review form developed by the Climate Literacy & Energy Awareness Network (http://cleanet.org). Our overarching criteria include accuracy of scientific information, evidence of pedagogic considerations, website usability and technical quality, assessment of its match to our audiences, and an overall rating (Table 4). The reviews document decisions for recommending training materials to the Intermountain Region.

We learned that most online climate literacy training is geared toward the general public and would be suitable for what we have referred to as "Climate Literacy 1" (Tables 2 and 4). The COMET program website (http://www.comet.ucar.edu/) contains Climate Literacy 1 training, and some material suitable for more detailed climate literacy training; COMET, a partnership between the University Center for Atmospheric Research and the National Weather Service, also provides in-person training for a fee, which may be useful to meet the training preferences of Intermountain Region employees, given ample budgets.

We found substantial gaps in training on decision making under uncertainty, vulnerability assessment, and climate change adaptation planning. Much of what constitutes training on adap-

| Category or questions |
| --- |
| Scientific accuracy |
| Is an attribution provided that represents a credible source, such as a university or government agency? |
| Has the resource been developed and/or reviewed by trained professionals, i.e., scientists? |
| Resource includes reference to IPCC 2007 |
| Does the resource present valid and/or accurate concepts? |
| Are links to the original data sources provided? |
| Where appropriate, are references, bibliographies, and other supporting material provided? |
| Do citations contain peer-reviewed material published since 2007? |
| Pedagogic effectiveness |
| Has the resource been developed and/or reviewed by trained professionals, i.e., teachers? |
| Are learning objectives clearly stated? |
| Does the training include different forms of presenting information (e.g., text, graphics, audio, video, interactive exercises)? |
| Are prerequisite skills and understandings accurately indicated? |
| Is there any indication that common preconceptions and/or misconceptions are addressed? |
| Is there testing on the material learned? |
| Does the resource provide a vehicle for asking questions, or seeking further information beyond the activity? |
| Does the resource provide clear and comprehensive guidance for teachers to effectively teach the activity (ONLY for training the trainer)? |
| Ease of use and technical quality |
| Is the resource free of distracting or off-topic advertising? |
| Has the website won any relevant awards? |
| Are hyperlinks functional and up-to-date? |
| Do hyperlinks take the learner offsite for any components of training? |
| Are training materials and tools freeware? |
| Does the resource meet technical criteria that make it ready for use? |
| Is necessary material available in printable hand-out form? |
| Audience |
| Operations and administration |
| Interpreters, education specialists, trainers |
| Planners, designers, engineers |
| Research scientists |
| Resource "on-the-ground" management |
| Upper management (users of executive summaries) |
| Overall rating of relevance |
| High priority (resource likely to be included in collection of excellent resources) |
| Medium priority (resource meets basic standards) |
| Low priority (resource meets basic standards, but is of lower priority) |
| Hold for later review (keep in pool for another review at later stage) |
| Excellent but incomplete (excellent and relevant, but needs improved activity sheet) |
| Do not include (resource doesn't meet basic standards) |

**Table 4.** Criteria for climate change training resources.

tation planning is available from websites in the United Kingdom or Australia. The Intermountain Region could target resources toward subject areas for which there is little online training, or toward developing courses and training related to adaptation and decision making under uncertainty, as opposed to devoting resources to the already abundant basic climate literacy training resources.

## Conclusions

Based on survey results, we found that NPS Intermountain Region climate literacy training must focus on distinctions between climate variability and trend-driven change, future projections for the Intermountain Region, and nuances in terminology essential to the NPS Climate Change Response Strategy. Based on analysis of survey and interview results, we recommend flexible, low or no cost, modular climate change training for the Intermountain Region, such as existing well-vetted online resources. High-quality basic climate literacy resources exist, but topics, such as adaptation to climate change, exist only as information, and not well-bounded training. We developed tools for implementing climate change training, including key topics, curriculum outlines, and decision trees for matching content with job duties.

Two challenges for implementing climate change training are keeping pace with changing information in a dynamic and rapidly changing information environment, and producing sufficient NPS Intermountain Region-specific materials. We note several opportunities to leverage federal and NPS efforts to produce, implement, and maintain information and training. These include the Department of Interior Landscape Conservation Cooperatives and Climate Science Centers, and insights produced by George Melendez Wright Climate Change fellowship research. The upcoming U.S. National Climate Assessment effort will bolster Intermountain Region's efforts to develop region-specific and up-to-date materials.

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# Gwaii Haanas: Working Together to Achieve Common Goals

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*[Ed. note: Mr. Gladstone addressed the plenary session of the conference on Tuesday, March 15.]*

## Introduction and overview

I WISH TO SHARE WITH YOU THE STORY OF GWAII HAANAS, and how a federal government and aboriginal people can successfully work together to achieve common goals through mutual understanding, appreciation, and respect. I will begin with a short overview of aboriginal rights and the evolution of the legal duty to consult with aboriginal people in Canada. I will then discuss consultation from a Parks Canada perspective, using Canada's relationship with the Haida Nation in Gwaii Haanas as an example, and I will finish with some of lessons I have learned in my work at Gwaii Haanas, and as a Haida person.

## Aboriginal rights

Aboriginal people have occupied lands in Canada for many thousands of years prior to European contact. They lived in diverse organised societies, each with its own culture, customs and character. We know this through both oral histories and archaeological evidence.

Aboriginal rights can no longer be extinguished through the assertion of Crown sovereignty, and this has been confirmed in Canada's 1982 *Constitution Act*. There are a number of treaties that exist in various parts of Canada. Indian treaties are a unique form of agreement in Canadian law because they have constitutional status. The intent of each of these treaties is to provide a means for the Crown to secure control of aboriginal land by way of surrender of aboriginal interest.

Aboriginal people retain specific rights within each of these treaties. These include things such as harvesting, self-government, and economic rights; however, many aboriginal people feel that their ancestors did not have the same understanding of the implication of these treaties as did the government of the day. There are also many places in Canada where aboriginal people have continued to live off the lands for thousands of years and treaties do not exist. For example, in British Columbia, very few treaties exist, and uncertainty over 90 percent of the land in the province remains in legal limbo because of unresolved land claims.

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Regardless of whether there is a treaty in place or not, the Crown, when carrying out its business, must do so in a way that respects aboriginal and Treaty rights. This includes the duty to consult, and it applies in all areas where aboriginal people have asserted rights, even though the rights may not yet be proven.

### Evolution of duty to consult

There have been a number situations where aboriginal people have felt their rights were not respected by the Crown, and there have been a number of situations where the Crown has thought that aboriginal people have carried out activities that were beyond those that were considered aboriginal rights. Many of these situations have been brought before Canadian courts to seek clarification. This has set the stage for the evolution of the legal duty to consult in Canada.

The *Calder Decision (1973)* was the first of many turning points in Canadian law. It was the first time the courts recognised that aboriginal title can exist, even though it had not yet been granted by the Crown. This started the land claim process in Canada, and a way for aboriginal people to assert the title they believe they hold.

In 1982, the Government of Canada passed the Constitution Act. Section 35(1) of this act provides constitutional protection to the aboriginal and treaty rights of aboriginal peoples in Canada. "The existing Aboriginal and treaty rights of the Aboriginal peoples of Canada are hereby recognized and affirmed" (Constitution Act 1982). Since 1982, the Courts continue to interpret what this means.

In the *1990 Sparrow* and *1997 Delgamuukw* decisions, the courts set out tests that must be met to prove that aboriginal rights and aboriginal title exist. The courts also confirmed that aboriginal rights and title were not absolute, meaning that they could be infringed by government if it could be justified for things such as conservation and public safety. The Delgamuukw case is also significant in that the court gave greater weight to oral history rather than relying only on written evidence.

Twenty years after the Calder decision, things had not changed much in aboriginal communities. Aboriginal people had to spend many years in court or through the land claim process to have their rights determined.

In *2004, the Haida* challenged this and the courts determined that the Crown has a duty to consult, and potentially accommodate, aboriginal groups where they had asserted rights, even if these rights have not yet been formally established or agreed to by the Crown. The level of consultation and accommodation is determined by the strength of the claim and the significance of the impact.

### Parks Canada approach to consultation

Parks Canada is responsible for managing Canada's national parks, national marine conservation areas, and many of Canada's national historic sites. One hundred years ago, when national parks were first created in Canada, aboriginal people were not included. The traditional way of life that existed in the national parks at that time was no longer permitted, and in some cases aboriginal people were physically removed, and relocated to areas outside of national parks.

This continued for many years; however this is no longer the case. There has been significant work done since this time to heal the past, and to include aboriginal people in the operation and management of national parks and sites. For many years now, and certainly throughout my career, the Parks Canada agency has long been committed to building strong, effective, and mutually beneficial working relationships with aboriginal peoples. Consultation with aboriginal peoples on a wide range of initiatives has become a major element in the operational policies of the agency.

At Parks Canada, the legal duty to consult applies when the Crown is planning or carrying out conduct that may adversely impact aboriginal or treaty rights. Some of these include the following:

- Wilderness designations, zoning
- Establishing a park, national marine conservation area
- Changing regulations
- Management planning
- Species at risk recovery planning
- Projects and initiatives

While our legal obligations are one reason we should consult, there are many other policy and good governance reasons why we should do this as well.

Legal reasons include the following:

- Statutory requirements in the national parks agency and national marine conservation area
- Treaties, agreements, and contractual requirements
- S.35, common law requirements, honour of the Crown

Policy and good governance reasons:

- Make informed and appropriate decisions
- Improve and create working relations with all those affected
- Risk management

From my perspective, the most important reason is that decisions made through consultation and input from other perspectives result in more effective decisions. Canada's legal obligations have been set out and defined by the *Constitution Act*, legal statutes, and courts of law—however, building a trusting relationship must go beyond simply meeting the evolving legal requirement to consult. Ultimately, the interest of aboriginal peoples, Parks Canada, and the public are best served by aboriginal people's meaningful involvement in all aspects of park and site management.

### Beyond status quo

As such, the Parks Canada agency is committed to engaging in effective consultation with aboriginal peoples based on three principles:

1. That it is inclusive—the consultation process will ensure access of aboriginal peoples to the process regardless of community capacities, geographic location, language, socio-economic background, or physical capabilities.
2. That it is meaningful—results will stand the test of time, and all interests are taken into consideration in the decision-making process.
3. And that it is based on the values of trust and respect—a two-way exchange of ideas and information based on openness, trust, integrity and mutual respect.

This commitment is clearly expressed in the agency's corporate plan, through work undertaken by the agency's aboriginal affairs secretariat, and through a national aboriginal consultative committee that meets directly with the CEO of Parks Canada three times each year. The agency has also created resources, such as the Handbook for Parks Canada Employees on Consulting with Aboriginal Peoples, and a training program to help employees gain a common understanding of the Crown's legal duty to consult with aboriginal peoples. This course also provides staff with cultural awareness training and the tools to build meaningful relationships.

Aboriginal involvement in planning, management and operations of national parks and sites has contributed substantially to the quality of management of natural and cultural heritage resources, it has improved relationships between aboriginal groups and the government of Canada, and it has enhanced the experiences of our visitors have when they visit national parks and sites. Today, most parks and sites have some form of engagement process with surrounding aboriginal communities. Approximately 68 percent of the lands managed by Parks Canada are managed with the involvement of aboriginal people.

In 2011, Parks Canada will celebrate its one hundred year anniversary. In these celebrations, we will also celebrate the role aboriginal people and their histories play in Parks Canada today. One of the best testaments to the benefits of this is the establishment of Gwaii Haanas, where I have the privilege of working.

### Gwaii Haanas example

Gwaii Haanas, in the Haida language, means Islands of Beauty. It is located on Canada's west coast on southern Haida Gwaii, about 130 km off the coast of mainland British Columbia, and just south of Alaska. The area is designated as a Haida Heritage site, a National Park Reserve, and a National Marine Conservation Area Reserve. It also includes three National Heritage sites and one UNESCO World Heritage site.

Gwaii Haanas is a 5000 sq km (1930 sq mi) protected area that extends from the tops of the mountains to the ocean floor. It is known for its unique flora and fauna, its rich marine ecosystem, the continuation of Haida culture, and its cooperative management structure.

There are a number of political milestones that have led us to where we are today:

- In 1985 the Haida designated Gwaii Haanas as a Haida heritage site and led a protest, which resulted in ending logging activity that was taking place at the time in the area.
- This protest led to an agreement between the governments of Canada and British Columbia in 1988 to protect both the land and waters in Gwaii Haanas.
- Over the following five years the Haida and Canada negotiated the 1993 Gwaii Haanas agreement, which commits each to work together in managing the land in Gwaii Haanas.
- In 2010, Canada and the Haida entered another agreement. This second agreement builds on the first and speaks to how Canada and the Haida Nation will work together in managing the water surrounding the land.

### Gwaii Haanas agreement

For the purpose of today, I will focus on the first agreement, which was signed in 1993. This agreement, now 18 years old, is often referred to as an agreement before its time. When Parks Canada, on behalf of the government of Canada, and the Haida Nation entered into this agreement the relationship went beyond what was expected in the way of consultation. At the very heart of the agreement is actually an agreement to disagree. Both the Haida Nation and the government of Canada believe themselves to be the rightful owners of Gwaii Haanas. Both parties respect each other's views on this, and maintain their respective authorities under both Haida and Canadian laws. The agreement then goes on to talk about how the two will work together to protect the area. Canada and the Haida had different reasons for wanting the area protected, but the end result is the same.

Haida have an inseparable connection to the land and sea. They have protected Gwaii Haanas as an area where they can continue to carry out traditional activities and maintain the continuity of Haida Culture. And the Government of Canada has protected Gwaii Haanas as a representative natural and cultural area that will be preserved for all time through maintaining an intact ecosystem and a place for people to appreciate and learn from.

The agreement provides a structure for how Gwaii Haanas will be managed. The structure is referred to as the Archipelago Management Board. The board is made up of equal representation from the government of Canada and the Haida Nation, and is responsible for all issues related to the planning, management, and operations in Gwaii Haanas.

The agreement directs that a consensus decision making process will be used. So, when an issue is presented to the board, all members must either agree or disagree before a decision can be made. If agreement is not reached, the issue is set aside until it can be revisited. The agreement includes a dispute resolution mechanism, where issues can be raised to more senior levels in our organisations; however both the Haida and the Canada representatives work hard not to fall back to acting under one jurisdiction. They make the AMB process work.

Despite the dispute over ownership, a cooperative relationship has been developed, and both nations have brought resources and skills to the table that have provided for what I believe is more effective management than if one party or government were to do it on their own. The Haida bring an established presence and knowledge of the area that has been gained through many generations of living connected to the lands and seas. Park Canada brings resources, skills, and knowledge gained through 100 years of managing protected areas.

## Lessons learned

The relationship between Parks Canada and the Council of the Haida Nation now extends beyond the terms of the agreement in sharing management responsibilities. This has not always been the case. It was very challenging in the beginning, and I will share some of the things that were learned along the way.

The significant success we have achieved together is based on our success in developing relationships. Relationships take time to develop. It is important that you do not rush, and that you take the necessary time to get it right. It took five years to reach the Gwaii Haanas Agreement in 1993—the success of the agreement stems from good communication and the dedication of time to *earn* trust and respect.

Be prepared to put contentious issues aside until meaningful discussions can take place around them. It is important to engage aboriginal people from the beginning and to ensure there is something in it for them. Trying to get buy in after the fact is difficult. We have also found the process more successful when you include aboriginal people on your team.

Another point I would like to make is that when decisions are made through consensus and through our management structure, the public is much more supportive of them, and they are much easier to defend. Finally, I want to say that Gwaii Haanas is viewed nationally and internationally as a positive example of how a federal government and aboriginal people can successfully work together to achieve common goals through mutual understanding, appreciation, and respect.

I believe the Gwaii Haanas process works well for two main reasons:

1. We have an agreement that provides a process for the members of the management board to make shared decisions under our two separate authorities.
2. The individuals who have been chosen to represent Canada and the Haida Nation on the Archipelago Management Board. Each person at the table is committed to and believes that working together is the most effective way to manage Gwaii Haanas. We do not consult each other and cooperate because the courts have told us we have a legal duty to—we do it because we believe it is the right thing to do.

### Closing

In closing, I would like to leave you with this quote. It was part of a speech by the late Chief Skidegate, Louis Collinson, in 1966. It signifies the importance of working together. Thank you to the Collinson family for allowing this quote to be shared.

> People are like trees, and groups of people are like the forests. While the forests are composed of many different kinds of trees, these trees intertwine their roots so strongly that it is impossible for the strongest winds which blow on our islands to uproot the forest, for each tree strengthens its neighbor, and their roots are inextricably intertwined. In the same way the people of our Islands, composed of members of nations and races from all over the world, are beginning to intertwine their roots so strongly that no troubles will affect them. Just as one tree standing alone would soon be destroyed by the first strong wind which came along, so it is impossible for any person, any family, or any community to stand alone against the troubles of this world. (Chief Skidegate, Lewis Collinson, March 1966)

# Effective Science Communication

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THE PRESENTATION AND INTERPRETATION OF SCIENTIFIC DATA REQUIRES MORE OF INVESTIGATORS than a journal article and a presentation at a research conference. Though the primary audiences for the National Park Service's Inventory and Monitoring (NPS I&M) Program are park planners and resource managers, we must help *everyone* to understand the importance of the program and of the resources in their charge, if the I&M program is to build a long-term relationship with the parks we serve.

NPS management policies state that park natural resource information will be made broadly available to park employees, the scientific community, and the public (NPS 2006, 38), and that parks should, in balanced and appropriate ways, thoroughly integrate resource issues and initiatives into their interpretive and educational programs (NPS 2006, 93). The natural resources I&M guideline (NPS 1992) calls for inventory and monitoring efforts to be designed to provide information for park managers *and the public* (emphasis added). The Natural Resource Challenge (NPS 1999) repeats a mantra of communication to a variety of audiences. At its most concise, the challenge points out that NPS employees and scientists "have the responsibility to widely share our knowledge about park resources in order to enhance the public's ability to learn from, and to enjoy, its national parks." Finally, the NPS director's science advisor has created a set of strategic goals that includes linking science with education programs and activities, so that we promote both, while contributing to the visitor experience (Machlis 2009).

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Beyond agency policy and guidelines, there is a fundamental reason for communicating with a variety of audiences. Gruchow (1995) wrote that "we will love the earth more competently, more effectively, by being able to name and know something about the life it sustains." He meant that simply being able to identify plants and animals, and understand what affects them, is a way of building connections with places. From personal connection comes a sense of responsibility. This is the kind of public investment we need in the national parks.

### How should we communicate?

Fancy, Gross, and Carter (2009) felt that I&M networks should invest at least one-third of their resources in data management, analysis, and *reporting* (emphasis added). But they acknowledged that key challenges for many networks would be the development of integrated information products, and the ability to translate the large amount of complex, scientific data to decision makers, policy makers, and the general public. These challenges are compounded by tight budgets and busy staff.

Communicating to a broader public requires different formats and venues than technical reports and conference presentations. It also requires the dedicated time and energy of science communicators, interpreters, and teachers who can breathe life into the data, and who are skilled at translating the language of science into terms that are understandable, compelling, and relevant to a variety of audiences. We present here examples of written and electronic communications being used by I&M networks to do just that, and three venues in which a combination of these approaches is used.

### Written communication

Science communication best practices are well-accepted guidelines that are widely practiced by I&M networks nation-wide. They include the following: use of plain language, defining acronyms, stating the purpose of monitoring, acknowledging limits to data or conclusions, highlighting status and trends, using engaging images, involving partners and collaborators.

Three communication products from the National Capital Region I&M Network (NCRN) illustrate these practices. The network's newsletter, NCRN Natural Resources Quarterly, presents brief articles on the status and trends of natural resources. The purpose of monitoring is stated, and the limitations to data or conclusions are acknowledged. A short key to park acronyms is always included for the benefit of non-NCRN employees or new NPS staff. The Quarterly's comprehensive distribution strategy includes posting issues online, and emailing an issue overview and newsletter link to regional subscribers. Hard copies are also mailed to each park.

The network produced *A Photographer's Path,* a regional photography book that features a collection of gorgeous images from network parks. The book uses only short, plain language captions and a minimalist design, to keep the focus on the images. Natural resources in the urbanized National Capital Region are sometimes overlooked, but this book promotes both their value and beauty, in part by showing how both natural and cultural resources blend into a seamless whole. The book has been distributed to regional parks and offices, including that of the regional director, and has become a compelling calling card for the NCRN.

A series of natural resource-focused brochures highlights the extensive collaboration utilized in their production. Development of this series involved staff from the NCRN, park interpretive and natural resources staff, and the Urban Ecology Research Learning Alliance. An urban fossils brochure also involved a Geologists-in-Parks employee, and utilized information from NCRN's paleontological inventory report. Brochures use plain language to discuss resource status and trends, and acknowledge limits of available data.

These communication products take their strength from adherence to basic science communication best practices. In doing so, they become important long-term references that can deliver messages to any reader, support and inform resource management, foster cooperative relationships, and promote resource appreciation and stewardship.

### Electronic communication

Today's electronic communication comes in many forms. The NPS Pacific Island I&M Network (PACN) is using three web-based platforms for electronic communication: a standard NPS website, a coral reef and climate change educational web-project, and the Pacific Island Parks blog.

The PACN website is hosted and maintained by the NPS. The Network adds content to the website, including monitoring results, inventory reports, newsletters, and links to relevant NPS information. The website caters to a specific, knowledgeable audience of mostly natural resources managers. It serves a useful function for relaying information, but its reach is limited.

The coral reef and climate change educational website was developed with outside partners using NPS funds. The goal of this website is to offer current and detailed information on coral reefs and climate change within the Pacific islands, in an interactive and scholastically-relevant manner. The website has been reviewed and partially created by teachers and students, and is intended to be used in eighth through twelfth grade classrooms in Hawaii, Guam, and American Samoa. Games, materials, and activities following state and territorial teaching standards are employed throughout the website. Real-life examples for the materials come from the Pacific islands national parks, and reflect local cultural and environmental issues. Real data from the I&M program are incorporated into the educational program.

The Pacific Island Parks blog (http://pacificislandparks.com) was created by a park interpreter for use by all eleven national park sites in the region. It is used to relay regional NPS news in a modern and accessible fashion. An individual from each park, and one person from the I&M network, can post breaking news, scientific findings, events, or minor but compelling stories in this rapid and socially connected forum. The blog incorporates other functions, such as Twitter and YouTube, to host and relay its messages. It has attracted many loyal followers, and provides a broad-reaching interpretive platform previously inaccessible to national park personnel. In less than two years, the blog has been viewed over 160,000 times.

These three electronic communication platforms just scratch the surface of the possibilities that natural resource managers and stewards have at their fingertips. It is important to stay focused on your topic and audience, but have some fun and experiment with the right media for your needs.

### Virtual research learning center model

Research learning centers (RLCs) were created as part of the NPS Natural Resource Challenge (NPS 1999). There are about 20 RLCs nationwide, and they overlap geographically with I&M networks and Cooperative Ecosystem Studies Units, creating opportunities to initiate or strengthen regional and national partnerships. The mission of each RLC is to facilitate research efforts, support science education opportunities, transfer science information, and facilitate science-informed decision-making. Also critical to the mission is that they be supported by partnerships.

Partnerships among parks, programs, and non-profit, university, and corporate partners allowed the development and implementation of the model that is now being used by seven different RLCs. The virtual model addresses two key needs: how to manage the volume of information that is available about resources, and how to communicate with audiences that have different levels of resource knowledge.

The Greater Yellowstone Science Learning Center (GYSLC) is a virtual research learning center, based in the parks of the Greater Yellowstone I&M Network (www.greateryellowstone-science.org). The GYSLC has worked with the learning center of the American Southwest

(LCAS; www.southwestlearning.org) and other partners to develop websites that address the needs identified above. The use of web-based communication outlets allows networks to work with partners, who also create and manage content, and to better maintain and update resource information in the face of new science.

GYSLC and LCAS developed a suite of synthesis products and reports that bring together disparate university, non-profit, and government research papers, manuscripts, books, and book chapters, following I&M reporting requirements. They then made them accessible to managers, researchers, students, the media, and the public through the virtual RLC websites. Public access to this content allows for extended collaboration among stakeholders. For example, the sites were used to facilitate a series workshops focused on regional resource management issues. This type of facilitation leads to professional collaboration, but also to tangible resources like conference proceedings and a science agenda for the greater Yellowstone area.

Maintenance and development of the sites is web-based. Each website has the same underlying architecture, but centers have autonomy over web content and appearance, and have the flexibility to develop and add features. Those features can then be easily shared or updated, leveraging the efforts of each individual site to benefit the others, in a true partnership.

### Engaging park staff

The San Francisco Bay Area Network (SFAN) recently completed a survey-based natural resource communication strategy that revealed many ways to improve how science and natural resources information is shared among park staff and partner organizations (O'Herron 2009). The survey assessed existing communication methods, what obstacles people encounter when trying to get information, what kind of information they need, and the formats they most prefer. The overwhelming majority of people surveyed wanted information at different levels of technical depth, all housed in one place. Many thought available information was too technical and/or too long to be useful. A large number said they prefer interactive information sources like multimedia, brown bag presentations, and symposia.

SFAN has been making great strides in trying to meet the needs identified in its communication strategy, through partnerships with natural resources and interpretation staff, the I&M program, the Pacific Coast Science and Learning Center, and park-affiliated non-profit organizations. Accomplishments include the following:

1. A new virtual learning center (www.sfnps.org) brings together useful links, multimedia products, fact sheets, field season updates, briefings, reports, references, research projects, and management documents that had been in disparate locations. In addition to being a clearing house for existing information, new content is continuously being added.
2. Monthly I&M e-mail updates have been reformatted to be more appealing. They cover a broader range of natural resources topics from both the parks and their partners, and they are now more widely distributed.
3. Two-page resource briefings are reviewed by interpretive staff and subject matter experts to increase their appeal and relevancy to a broader audience.
4. The audience and range of speakers for the annual Science and Natural Resources Symposium has been expanded. In 2011, rather than just a day of science presentations, there was also a panel session where interpreters took a science topic presented earlier in the day and demonstrated how they would talk to the public about it. There were also presentations by educators about how they use the parks to teach science to kids.
5. Science topics are being included in more staff trainings and brown bag sessions.
6. Interns have added numerous multimedia pieces and photographs. The local PBS affiliate has provided free, relevant, professional-quality multimedia content.

7. Having a science communication specialist who can be a conduit for information, who can translate science to non-scientists, and who can dedicate time to work on materials and websites, has been absolutely essential.

### Citizen science

The Upper Columbia Basin Inventory and Monitoring Network (UCBN) is working with citizen scientists to monitor camas lily (*Camassia quamash*; *qem'es* in Nimiipuu, Nez Perce) at the Weippe Prairie site of Nez Perce National Historical Park in Idaho. Teachers and students from three local high schools have assisted in data collection for five years, providing valuable information on the current status of this native wetland prairie plant species.

The main objective of this program is to record information about camas plants, and other variables that may affect camas growth and reproduction. Learning components of the program are tied to state science standards, and students work alongside ecologists, natural resource managers, and interpretive rangers to learn about this important natural and cultural resource.

The program is divided into two parts: a pre-visit training, and fieldwork. First, UCBN and park staff visit the schools to provide information on camas ecology and its cultural importance, and to train students on the use of field equipment. Then, students visit the site and work with NPS staff to collect data, following scientific procedures from a peer-reviewed monitoring protocol. Information collected from defined areas includes number of camas plants present, number of camas plants flowering, and the presence of invasive weedy species.

To communicate the science involved in this camas lily monitoring program, it is important to identify the audience the UCBN will be communicating with, and to use a variety of techniques. Another key component is to work closely with interpretive staff who can assist in the delivery of this information. Final results are presented to park staff in the form of reports and resource briefs. Park rangers then transmit this information to the public in the form of interpretive programs and talks. A website was created to allow researchers, science communicators, and the general public to find information about this program. In addition, the park and UCBN staff collaboratively produced a video that showcases the importance of camas lily and the current efforts of citizen scientists.

Citizen science initiatives are becoming popular. By providing an opportunity for the public to be involved in scientific research, parks gain a long-term and sustainable monitoring project that can help establish an informed and concerned local citizenry. Data collected by volunteers provide valuable information about the status and trends of natural resources. This information can be used by park managers to make scientifically-informed management decisions.

### Conclusion

The primary goal of the NPS I&M program is to "improve park management through greater reliance on scientific knowledge." However, as scientists and NPS employees, we need to share scientific information in a way that helps people build personal connections with the parks. Using the tools presented here, we can make real progress toward that goal.

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# Acoustical Monitoring in Peregrine Falcon Territories at Bryce Canyon National Park

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## Introduction

Bryce Canyon National Park (Bryce Canyon) is located on the Colorado Plateau in southwestern Utah and is known for its outstanding natural beauty and unusual rock formations. Visitors to Bryce Canyon also recognize the soundscape as an important part of experiencing the park. With natural ambient levels that sometimes register below the "noise floor" of acoustic equipment, park staff have measured and recorded moments with no measurable sound. During the spring and summer of 2009 and 2010, Bryce Canyon staff conducted a soundscape monitoring study focused on the acoustic environment at nesting sites of the American peregrine falcon (*Falco peregrinus anatum*)—a species of management concern for the park. Monitoring systems (consisting of a Larson Davis 831 unit, anemometer, and Edirol MP3 recorder) were deployed throughout the park at seventeen front and backcountry locations where peregrine falcon territories were known to occur (Figure 1).

The primary purpose of this study was to gather baseline soundscape data for use in the development of soundscape and air tour management plans, as directed by the National Parks Air Tour Management Act of 2000. In addition to soundscape planning efforts, park staff conducted behavioral observations on nesting peregrine falcons to investigate if low flying aircraft (helicopters and propeller planes) caused negative effects on birds within their breeding territories. Data collection followed protocols developed by the National Park Service (NPS) Natural Sounds Program, and included documenting existing and natural ambient levels and percent-time-audible statistics for sound sources. Peregrine falcon monitoring followed U.S. Fish and Wildlife Service protocols, and also included documenting behavioral responses when aircraft were in close proximity to active nesting areas or perch sites. Acoustic systems were deployed for approximately 30 days at frontcountry locations, and approximately 15 days at backcountry locations, and they logged one-second sound pressure (decibel) levels and continuous audio recordings. Additional information on the acoustic environment was collected at each monitoring location using

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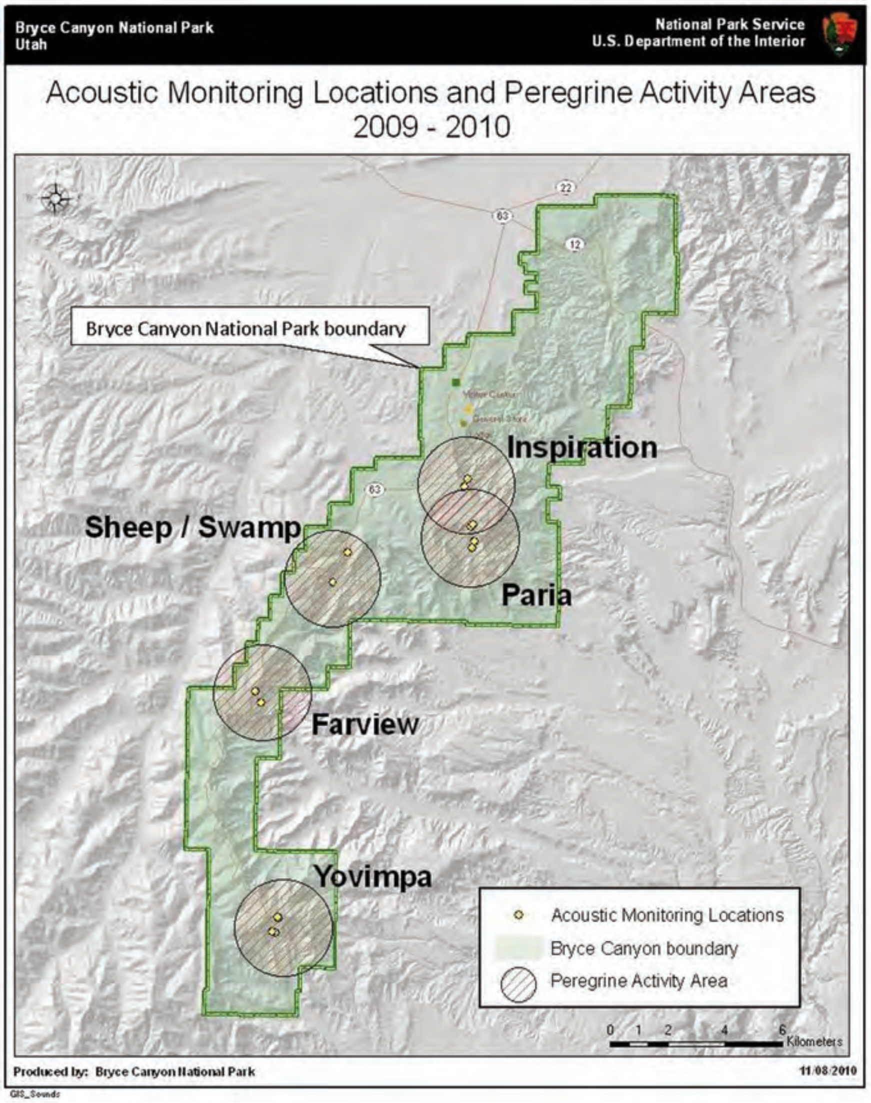


**Figure 1.** Acoustic monitoring sites and Peregrine Falcon activity areas 2009–2010, Bryce Canyon National Park, Utah.

on-site (attended) listening techniques. Each monitoring location documented existing ($L_{50}$, or median sound level) and natural ambient ($L_{nat}$) statistics in A-weighted decibels (dBA) for two time periods, day and night (Table 1). The A-weighted filter accounts for people's limited hearing response to higher and lower frequency sounds, and is frequently used when the primary concern is the effect of sound upon humans.

### Natural and existing ambient sound

The natural ambient sound levels at all sites were highest during the day when wind and bird song occurred. The Paria Frontcountry 2010 site proved to have the loudest daytime natural ambient levels (39.0 dBA) where fierce spring winds were common. The quietest natural ambient levels among frontcountry sites (23.7 dBA) occurred at the Inspiration Frontcountry 2010 location. Among backcountry sites, the quietest daytime sound levels occurred at the Inspiration Backcountry 2009 site (18.7 dBA), and were loudest at the Yovimpa Backcountry 2010 site (36.2 dBA), where a small stream elevated sound pressure levels for all hours. Wind was audible over 50 percent of the time at nearly all sites, and likely reduced the percent time extrinsic and natural sounds were audible due to the "masking" of sounds by wind noise.

Across all sites, the existing ambient sound levels during the day were highest at Farview Frontcountry 2010 and Paria Frontcountry 2009/2010, and lowest at Inspiration Backcountry

| | Nighttime Ambient (7pm – 7am) | | | | Daytime Ambient (7am – 7pm) | | | |
|---|---|---|---|---|---|---|---|---|
| Site Name | $L_{nat}$ | $L_{10}$ | $L_{50}$ | $L_{90}$ | $L_{nat}$ | $L_{10}$ | $L_{50}$ | $L_{90}$ |
| **FRONTCOUNTRY** | | | | | | | | |
| BRCA005 | 40.3 | 46.5 | 40.9 | 35.1 | 34.3 | 45.5 | 37.8 | 30.2 |
| BRCA006 | 38.8 | 46.4 | 40.4 | 34.0 | 31.8 | 45.8 | 37.8 | 30.0 |
| BRCA007 | 24.9 | 33.7 | 27.1 | 22.5 | 32.0 | 45.0 | 37.4 | 31.5 |
| BRCA008 | 31.0 | 38.3 | 32.4 | 26.8 | 27.1 | 37.7 | 30.6 | 24.7 |
| BRCA013 | 20.9 | 29.0 | 22.5 | 18.4 | 23.7 | 37.0 | 28.0 | 22.0 |
| BRCA015 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| BRCA016 | 39.3 | 44.5 | 40.2 | 35 | 39.0 | 46.9 | 41.0 | 34.4 |
| BRCA017 | 40.6 | 46.5 | 41.6 | 37.0 | 37.4 | 48.0 | 42.1 | 35.8 |
| BRCA018 | 24.4 | 32.1 | 26.0 | 21.9 | 27.0 | 39.7 | 32.4 | 25.6 |
| BRCA019 | 36.1 | 44.3 | 38.0 | 32.0 | 29.1 | 40.6 | 33.4 | 27.7 |
| **BACKCOUNTRY** | | | | | | | | |
| BRCA009 | 25.8 | 31.0 | 26.2 | 21.9 | 27.9 | 36.5 | 28.5 | 22.0 |
| BRCA012 | 24.1 | 31.9 | 25.0 | 19.7 | 24.5 | 35.1 | 26.1 | 20.5 |
| BRCA014 | 15.3 | 23.4 | 16.2 | 14.7 | 18.7 | 31.4 | 21.7 | 17.7 |
| BRCA020 | 22.3 | 29.2 | 23.2 | 18.2 | 31.2 | 38.9 | 32.4 | 26.9 |
| BRCA021 | 18.5 | 26.0 | 19.0 | 16.6 | 28.9 | 38.7 | 31.2 | 24.8 |
| BRCA022 | 15.8 | 23.0 | 16.0 | 14.6 | 21.5 | 33.5 | 23.7 | 18.4 |
| BRCA023 | 36.0 | 37.9 | 36.0 | 35.3 | 36.2 | 39.4 | 36.5 | 35.0 |

***The median existing ambient ($L_{50}$) describes the acoustical environment as is, including both natural and extrinsic (human-caused) sounds. The natural ambient ($L_{nat}$) offers an estimation of what the acoustical environment would sound like in the absence of extrinsic sounds. Median $L_{10}$ is the sound level exceeded 10% of the sampling period, with 90% of measurements quieter than $L_{10}$. Median $L_{90}$ is the sound level exceeded 90% of the sampling period, with 10% of measurements quieter than $L_{90}$.**

**Table 1**. Median natural and existing ambient* for all sites during day and night, Acoustic Monitoring Study 2009–2010, Bryce Canyon National Park, Utah.

2009, Farview Backcountry 2010, and Yovimpa Backcountry 2009. The combination of extrinsic sounds at the frontcountry sites, especially aircraft, vehicle, and visitor noise, as well as the prevalence of strong spring winds at the Paria locations, likely contributed to this result.

### Contribution of extrinsic sound

Across all sites, human-caused sounds raised the existing ambient levels more during the daytime hours than at night. Aircraft, especially high altitude jets, were the dominant extrinsic sound source at all backcountry locations. All frontcountry monitoring areas, except Farview and Sheep/Swamp (which were located next to the park roadway and were dominated by vehicle noise) showed aircraft to be the dominant source of extrinsic sounds. Peak aircraft activity occurred at most locations between the hours of 8:00 and 10:00 a.m., with some sites showing minor peaks in the evening between the hours of 7:00 and 10:00 p.m. Aircraft were audible over 50 percent of the time at the Inspiration Frontcountry 2009 site from 8:00 a.m. to 9:00 a.m., and at the Inspiration Backcountry 2009 site from 10:00 to 11:00 a.m. and from 4:00 to 5:00 p.m. Across all sites, low-elevation fixed wing aircraft were audible less than five percent of the time but had a more dramatic effect on $L_{10}$, which documents acute conditions (90% of all measurements were quieter than $L_{10}$).

The contribution of extrinsic sound was greatest at Sheep/Swamp Frontcountry 2009, Inspiration Frontcountry 2009/2010, and lowest at Paria Frontcountry 2009/2010, and Yovimpa Frontcountry 2009. This is likely due, in part, to both the combination of aircraft, vehicle, and visitor noise audible at each site, and to the distance of sites from roads, viewpoints, and parking areas. Among the quieter backcountry locations, the contribution of extrinsic sound was by far greatest at the Inspiration backcountry sites, followed by the Sheep/Swamp and Farview backcountry sites. This finding is likely due to the location of the Inspiration backcountry sites within the heavily visited Bryce Amphitheater, where extrinsic sound sources such as visitors and their vehicles were audible even below the rim.

The backcountry sites with the lowest contribution of extrinsic sound were Paria Backcountry 2009/2010 and Yovimpa Backcountry 2010. During the early morning hours at several of the backcountry sites (Inspiration 2009, Swamp Canyon 2010, and Farview 2010) the existing and natural ambient levels were within 10.0 to 15.0 dBA of the noise floor of the recording equipment, indicating that these sites were, at times, very quiet. In the absence of natural sounds such as wind and flowing water, which led to increased natural and existing ambient levels, it is likely that other backcountry locales would have displayed similar results.

There was considerable variation in the percent time extrinsic sounds were audible across sites. For example, at the Sheep/Swamp Frontcountry 2009 location, extrinsic sounds were audible nearly 54 percent of the time, while they were only audible 11.6 percent of the time at both the 2009 and 2010 Paria Backcountry locations. This variation is largely due to the proximity of roads or trails to the frontcountry locations where visitors and their vehicles are in close proximity. The presence of wind, which was ubiquitous throughout the study area, also reduced the percent time extrinsic sounds were audible.

Table 2 reports the percentage of time that measured sound levels were above those levels that have known negative impacts on human experiences or health (Haralabidis et al. 2008; EPA 1974), for each of the monitoring locations during daylight and nighttime hours. These values should not be construed as thresholds of impact, but rather sound levels which have been identified in scientific literature as having relevance to the human or wildlife experience in parks (e.g., noise levels that can cause increases in blood pressure and heart rate, or interfere with the perception of speech).

**Table 2.** Percent time above metrics for night and day, Acoustic Monitoring Study 2009–2010, Bryce Canyon National Park, Utah.

| | % Time above sound level (7pm - 7am) | | | | % Time above sound level (7am - 7pm) | | | |
|---|---|---|---|---|---|---|---|---|
| Site Name | 35 dBA | 45 dBA | 52 dBA | 60 dBA | 35 dBA | 45 dBA | 52 dBA | 60 dBA |
| **FRONTCOUNTRY** | | | | | | | | |
| BRCA005 | 76.47 | 23.11 | 8.93 | 0.42 | 56.49 | 11.64 | 3.97 | 0.39 |
| BRCA006 | 71.46 | 27.87 | 8.05 | 0.35 | 55.03 | 12.31 | 4.21 | 0.42 |
| BRCA007 | 16.82 | 0.39 | 0.01 | 0.00 | 59.27 | 14.65 | 2.70 | 0.10 |
| BRCA008 | 32.72 | 2.66 | 0.16 | 0.00 | 31.95 | 3.13 | 0.36 | 0.02 |
| BRCA013 | 5.53 | 0.24 | 0.02 | 0.00 | 20.45 | 1.79 | 0.20 | 0.01 |
| BRCA016 | 69.41 | 33.98 | 4.66 | 0.02 | 74.35 | 27.09 | 3.55 | 0.10 |
| BRCA017 | 72.13 | 37.38 | 5.64 | 0.06 | 77.48 | 29.73 | 3.99 | 0.11 |
| BRCA018 | 18.77 | 0.34 | 0.01 | 0.00 | 33.88 | 2.81 | 0.27 | 0.03 |
| BRCA019 | 57.18 | 22.39 | 2.84 | 0.03 | 39.45 | 7.94 | 0.79 | 0.05 |
| **BACKCOUNTRY** | | | | | | | | |
| BRCA009 | 61.12 | 0.80 | 0.00 | 0.00 | 22.51 | 2.88 | 0.56 | 0.01 |
| BRCA012 | 16.17 | 0.33 | 0.01 | 0.00 | 18.06 | 1.01 | 0.18 | 0.01 |
| BRCA014 | 1.51 | 0.05 | 0.00 | 0.00 | 5.74 | 0.47 | 0.07 | 0.00 |
| BRCA020 | 5.61 | 0.20 | 0.00 | 0.00 | 35.57 | 3.04 | 0.23 | 0.00 |
| BRCA021 | 3.59 | 0.05 | 0.00 | 0.00 | 29.25 | 1.82 | 0.13 | 0.00 |
| BRCA022 | 2.30 | 0.13 | 0.00 | 0.00 | 11.94 | 1.30 | 0.18 | 0.02 |
| BRCA023 | 95.24 | 0.25 | 0.01 | 0.00 | 83.72 | 2.27 | 0.39 | 0.06 |

### Peregrine falcon monitoring

Peregrine falcons were detected at all territories over both years of monitoring, with the exception of the Sheep/Swamp territory in 2009. Recruitment (visual or aural identification of juveniles) was recorded for 2 aeries in 2009 (2 juveniles observed), and 2 aeries in 2010 (3 juveniles observed). During over 100 hours of behavioral observations, no incidents of peregrine reacting severely to overflight events were recorded. Difficulty in sighting birds during overflight events, as well as limited aircraft activity (helicopter tours were not in operation during both field seasons due to staffing limitations of those air tour operators) may have affected the monitoring results.

### Conclusions and management implications

The results from this study present recent information on the acoustic environment at five peregrine falcon territories at Bryce Canyon. Because of the wide distribution of these territories, detailed records of ambient sound pressure levels throughout the park were documented at both front- and backcountry locations, and are a good representation of the park's overall soundscape. In conjunction with the percent time audible statistics, these data have been used to report existing ambient levels and have helped to estimate natural ambient levels in many areas of the park. As would be expected, frontcountry locations generally have higher existing ambient sound levels compared to backcountry locations. This result is consistent with visitor use patterns and the concentration of visitation at the park's viewpoints in the main Bryce Amphitheater.

Overall, this study found that aircraft, especially high-altitude jets, were the most frequently audible extrinsic sound at nearly all monitoring locations. In backcountry locations, aircraft (jets and propeller planes) were responsible for virtually all extrinsic sound. Extrinsic sounds at frontcountry locations were comprised of varying combinations of aircraft, vehicle, and visitor noise, with aircraft being the dominant extrinsic sound source at nearly all sites. Aircraft sounds were audible on average 21.2 percent of the time at frontcountry locations and 18.2 percent of the time at backcountry locations. Aircraft were audible over 50 percent of the time at the Inspiration monitoring locations during certain hours of the day. Across all sites, low-elevation fixed wing aircraft were audible less than 5 percent of the time, but had a greater impact on the acoustic environment than high-altitude jets.

The effects of noise on wildlife can be difficult to measure and interpret, and can take many forms (Barber, Crooks, and Fristrup 2010; Pater, Grubb, and Delaney 2009; Pepper, Nascarella, and Kendall 2003). Most researchers agree that noise can affect an animal's physiology and behavior, and if it becomes a chronic stress, can be injurious to an animal's energy budget, reproductive success, and long-term survival (Radle 1997). Previous research on the effects of aircraft overflights on peregrine falcon parental behavior detected subtle differences in activity budgets between overflight and control areas, but found no evidence that overall attendance patterns differed, depending on exposure to overflights (Palmer, Nordmeyer, and Roby 2003). While it is unclear if human-caused sounds can impact peregrine breeding success, continuous overflights of breeding territories may represent a chronic stress to animals, and could impact other important life cycle activities, such as inter-specific interactions for breeding-site selection (Sergio et al. 2004). Additionally, analysis of soundscape impacts on human hearing and experience may serve as a proxy for the potential impacts to other vertebrates, because humans have more sensitive hearing at low frequencies than most species (Dooling and Popper 2007).

Based on surveys at Bryce Canyon, a large percentage of park visitors (68%) value natural quiet and indicate that unwanted noise has led to detractions from their experience. Based on this finding and previous research on the effects of noise on humans and wildlife, it is clear that management decisions that attempt to minimize potential negative impacts to both visitors and wildlife are warranted at Bryce Canyon. Future data collection should focus on popular viewpoints such as Sunset and Bryce Points and under-the-rim trails within the Bryce Amphitheater.

Additional soundscape monitoring at the Visitor Center and within the park's historical district (specifically the Bryce Canyon Lodge area) should also be conducted to assess noise impacts in those locations. Impacts on the soundscape from vehicles, especially tour buses and the park's shuttle buses, were not well documented in this study due to the objectives of the research, and placement of the acoustic monitors. Further investigation in the park's heavily used frontcountry locations along Bryce Amphitheater is required to assess this impact to park visitors and wildlife.

Acoustical monitoring efforts at Bryce Canyon have yielded valuable results that will allow park managers to better understand the existing acoustic environment of the park, and plan for the challenges associated with soundscape conservation. Monitoring existing conditions and trends allows managers to take action to move towards desired future conditions. Contributions and impacts to the park's soundscape from aircraft, vehicles, visitors, and park-directed activities will require additional research, and will be influenced by management decisions and NPS directives. The acoustic data collected during this study provides baseline information for the development of acoustical indicators and standards in upcoming soundscape and air tour management plans.

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# Engaging Local Communities in World Heritage Sites: Experience from the Community Management for Protected Areas Program

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## Introduction

For the past decade, the Community Management of Protected Areas Conservation Project (COMPACT) has been testing an innovative model for engaging communities in conservation. An initiative of the United Nations Development Program (UNDP)/Global Environmental Facility (GEF) Small Grants Program, COMPACT is working with communities near current and proposed UNESCO world heritage sites in nine developing countries. Through extensive on-the-ground experience and a participatory methodology that takes a common systematic approach to all of the participating sites, COMPACT is demonstrating that community-based initiatives can significantly increase the effectiveness of biodiversity conservation in globally significant protected areas while helping to improve the livelihoods of local people. This paper presents the experience of COMPACT globally and in two countries: Tanzania and Mexico.

## The COMPACT model at the global level

COMPACT is a joint initiative of the Small Grants Program (SGP), the United Nations Foundation, and other founding partners, including the UNESCO World Heritage Centre. Since its creation after the Rio Earth Summit in 1992, the SGP now operates in over 120 countries around the world providing small grants averaging $25,000 to a wide range of civil society organizations (non-governmental organizations, community-based organizations, as well as directly with

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indigenous peoples). Over almost a twenty year period, the SGP has approved 13,500 small grants for biodiversity conservation, climate change mitigation, combating land degradation, protecting international waters, and eliminating persistent organic pollutants, totaling approximately $400 million from the Global Environmental Facility, leveraging $500 million more in third party cash and in-kind co-financing.

COMPACT was launched as an integral element of the SGP in 2000 with a fifteen-year vision of supporting community empowerment and sustainability for selected natural UNESCO world heritage sites, and overlapping biosphere reserves, recognized for their outstanding universal value. With an emphasis on "complementing and adding value to existing conservation programs," COMPACT has replicated the successful national model of the SGP by providing small grants to support clusters of community-based activities aiming to strengthen biodiversity conservation in and around the target protected areas. Now in its second phase of work, COMPACT focuses on eight globally significant protected areas (including one trans-boundary site), all of which are either current or proposed world heritage sites. These COMPACT sites are the following:

- Belize Barrier Reef Reserve System, Belize
- Morne Trois Pitons National Park, Dominica
- Mount Kenya National Park, Kenya
- Sian Ka'an Biosphere Reserve, Mexico
- Puerto Princesa Subterranean River National Park, Philippines
- Mount Kilimanjaro National Park, Tanzania
- The Djoudj-Djawaling Transboundary Biosphere Reserve and World Heritage Site, Senegal and Mauritania
- A cluster of five protected areas in South-West Madagascar anticipating World Heritage listing between 2010 and 2012

Working across sometimes quite large geographic areas, COMPACT takes a landscape approach—one based on supporting local communities in their stewardship of protected areas and the broader landscape/seascape (Brown, Mitchell, and Beresford 2005). Refined over a decade of work, COMPACT's methodology is designed to pilot the landscape approach in a wide range of ecological and socio-economic situations. Rooted in a common systematic approach, this methodology is also highly participatory in nature, seeking to engage local people and other stakeholders in consultation throughout the process (Brown, Currea, and Hay-Edie 2010).

The COMPACT methodology relies on three closely linked elements: a *baseline assessment*, which serves as the foundation for the COMPACT *conceptual model* and *site strategy* in that particular COMPACT country. This approach was designed to provide flexibility to local decision-makers while ensuring rigor, so the overall goals of the conservation of globally significant biodiversity remain clearly in focus. This first stage of the process guides the grant-giving program in the landscape surrounding the world heritage site, while providing the basis for future *monitoring* and *evaluation* (SGP 2004).

### The case of Mount Kilimanjaro in Tanzania

Mount Kilimanjaro in Tanzania is a UNESCO World Heritage Site designated in 1987. At 5,895 m, Mt. Kilimanjaro is the highest mountain in Africa, and quite often referred to as the "*roof of Africa.*" It is also the world's largest single standing mountain, and home to a number of rare and endemic flora and fauna species. Despite its location near the equator, its summit is ice-capped, making it a famous tourist destination.

The rich biodiversity on the mountain slopes includes 2,500 plant, 179 bird, and 140 mammal species, and the largest known population of globally threatened Abbot's duiker. The mountain is also a water tower for the surrounding landscape; hydrological flows from the mountain forest provide water for domestic use, irrigation, and livestock. It is also a source of major rivers in Tanzania and Kenya. In Tanzania, one of the main rivers flowing from Mt. Kilimanjaro is a key source of hydro-power.

During the 20 years prior to 2000, conservation of Mt. Kilimanjaro had been based on a formal "policing approach" led by the government. In an attempt to include participatory elements, methods like joint forest management (JFM) and community-based forest management (CBFM) had been tried, with mixed results.

In 2000, in the first phase of COMPACT, local communities participated in a baseline assessment of the socio-economic conditions and conservation status of the world heritage site. During the process, they explained that the policing approach had generally fueled enmity between the communities and the National Park authorities, while threats continued to degrade the mountain resources. During the consultative baseline assessment the communities accurately listed and described the main threats to the mountain ecosystem including forest fires, encroachment for farming, grazing, and human settlements and poaching.

In 2001, the SGP in Tanzania initiated COMPACT in Mt Kilimanjaro, in the belief that conservation cannot be undertaken without the involvement of people closest to the resources. In this regard, COMPACT was an approach that embraced the central role of local communities as stewards of the landscape. In addition, COMPACT focused on establishing new partnerships linking local communities, park management, local authorities, and other stakeholders in stewardship and sustainability.

Since its launch in Tanzania in 1997, the SGP has succeeded in engaging local communities to contribute to the conservation of protected areas in different parts of the country, including the Eastern Arc (one of 25 global biodiversity hotspots), the Rufiji Forest reserve and the Selous Game reserve (which is also a World Heritage Site). In adopting the COMPACT model for Mt. Kilimanjaro, SGP built on its experience with protected areas and its history of work with indigenous peoples, such as the Maasai and Hadzabe.

COMPACT's work in Mt. Kilimanjaro is undertaken by a local coordinator, assisted closely by a multi-stakeholder local consultative board with a non-governmental majority. As in each of the COMPACT sites world-wide, COMPACT Kilimanjaro completed three critical steps during its establishment: a baseline assessment, which provides a snapshot of the site; a conceptual model, which is a diagrammatic tool documenting site level processes, threats, and opportunities; and a site strategy that highlights major threats, opportunities, and priority actions. The site strategy was also used to select viable community-based conservation projects for catalytic support. Following that phase, COMPACT HAS awarded grants of up to $50,000 to local projects, based on review by the local consultative board, and approval by SGP's multi-stakeholder National Steering Committee.

After a decade of COMPACT work around the Mt. Kilimanjaro World Heritage Site, there has been a significant reduction of human-induced threats such as forest fires and poaching. Another achievement is participating local communities' improved livelihoods, according to a recent study that documented the role of COMPACT-supported activities in poverty reduction through increased food and income (University of Dar es Salaam 2009). Other notable results at Mt. Kilimanjaro through the COMPACT project include the following:

- Local communities are more aware of the importance of conserving the world heritage site on behalf of the global community.
- The landscape approach, linking people's needs and biodiversity conservation, is now

mainstreamed into local-level development planning processes.

- Cultural methods of biodiversity conservation are being revived and strengthened.
- There are improved relations between park authorities and local communities.
- Income-generating activities, agro-forestry, and improved irrigation infrastructure are contributing to the well-being of local communities through provision of environmental services.
- Local community organizations have improved their capacity, and become stronger and more confident.

### COMPACT's work in Sian Ka'an Biosphere Reserve, Mexico

Mirroring the experience of the Mt. Kilimanjaro over the last 10 years, COMPACT-Mexico has financed approximately 91 small grants projects in and around the Sian Ka'an Biosphere Reserve and World Heritage Site within thematic work areas related to the coast, the forest, and the preservation of Mayan culture.

One area of intervention is sustainable fisheries, through a series of inter-linked projects. Based on the successful experience of a fisherman's association in Punta Allen, the *Vigia Chico* Cooperative, lobster fishing sustainable practices (e.g., the use of shades instead of traps, and protection of nursery areas) have been extended to other fishing cooperatives, such as Maria Elena, and Azcorra in nearby Punta Herrero. The experience of the Integrated Association of Lobster Fishermen, CHAKAY, has been extended to three more cooperatives (Banco Chinchorro), linking two biosphere reserves. To help these groups with joint lobster marketing, COMPACT worked with the World Heritage-LEEP program to provide small grants to support lobster selection and packaging, including developing an origin label. In its first year, the cooperatives reached their target of jointly marketing 10 percent of their production.

In a key marine conservation initiative of regional importance, COMPACT worked over the past decade with three fishing cooperatives to protect fish aggregation and spawning zones within the Sian Ka'an Biosphere Reserve. In the second stage of the project, these partners are analyzing the potential to create marine protected areas, likely to take the form of fishing "no-take" zones (lasting at least five years), a proposal that is supported by key local fishing cooperatives.

Another thematic area is coastal tourism; Punta Allen is the principal point of attraction for tourism along the coast of Sian Ka'an. Through 10 years of COMPACT project support, four Punta Allen tourism organizations formed the Punta Allen Alliance, in collaboration with protected area authorities and international organizations, such as RARE. This was very important toward avoiding conflicts, and maintaining consistent prices for local tourism services and products (see www.puntaallenalianza.com/). In the next stage, COMPACT will work with the Punta Allen Alliance to organize a tour guide course for women.

COMPACT also supports four organizations linked to financing the transition from conventional to organic honey production; several organizations supported by COMPACT have successfully obtained organic certification. Currently COMPACT is working with *Flor de Tajonal*, which is leading landscape-level cooperation with various communities in the Mayan region. The next step will be to set up an *apiculture school* to involve young people, especially from local communities, to study the theory and practice of organic beekeeping. At the same time, a process of reforestation will be initiated with native honey plants to boost productivity.

In 2007, COMPACT initiated a carbon capture project in the *Ejido de Felipe Carrillo Puerto* focusing on a 1230 ha area. Called MUCH' KANAN K'AAX, the project has grown and become a pilot project for the entire region. In the next stage, COMPACT will finance bond certification (through the *Plan Vivo* foundation) and will support local REDD+ training and capacity building (see http://muchkanankaax.com/).

Since 2008, with the support of the United Nations Foundation and COMPACT, a partnership involving two NGOs and representatives of eight community groups is jointly marketing handicrafts, including items made from wood, seeds, and rattan, as well as embroidery and hammocks, under a common indigenous trademark. All participating groups come from Mayan communities with existing handicraft traditions. Collectively they are marketing their handicrafts under the *Ak Kuxtal* label (see www.kuxtalsiankaan.com/ak-kuxtal.php).

As an "integrating element" across all of the biophysical interventions, COMPACT has also targeted support for an "Academy of Mayan Language and Culture," assisting in the production of bi-lingual publications, traditional medicines, and other projects.

### Discussion

With a decade of experience in diverse settings, COMPACT demonstrates that community-based initiatives and improved livelihoods can produce direct benefits for biodiversity conservation in globally significant protected areas. Elements that make the COMPACT model effective follow:

- *COMPACT takes a landscape approach,* finding constructive ways to work with a diverse range of communities and stakeholders living in and caring for protected areas and the broader landscape. Conservation that links nature, culture, and communities can be most effective in addressing community-induced threats.
- *COMPACT uses a method that is rooted in science,* while being highly participatory, engaging local people and other stakeholders at every stage. COMPACT's experience with communities in Tanzania and Mexico has shown the value of this approach, and that communities will become actively involved in moving conservation forward, provided they see clear benefits.
- *COMPACT harnesses the power of synergy,* supporting a cluster of activities, including the provision of small grants, capacity-building activities, networking, and marketing support. Each COMPACT program employs a strategic approach to "finding the niche for community-based interventions in the landscape," and creating synergies among grantees/partners.
- *COMPACT builds on the strengths the GEF Small Grants Program—at the scale of an internationally significant protected area.* It builds on the experience of SGP, and its established track record, sustaining environmental benefits over time through local ownership, accountability, and the crucial role of social capital. A relatively small amount of funding can make a substantial difference in conservation impacts and local livelihoods.
- *COMPACT's institutional structures are based on principles of sharing power,* recognizing that supporting community-led initiatives requires trust, flexibility, and patience. Transparent processes and broad public participation are key to ensuring community engagement. Good governance is essential to the successful implementation of conservation initiatives.
- *COMPACT's scalability offers tremendous potential for future initiatives.* In the current target sites, COMPACT's approach of "keeping your lessons close to the Protected Area," makes it possible to track progress over time, and build outward from the protected area to local, national, and regional levels. Importantly, this scalability and COMPACT's experience provides valuable lessons for more effectively engaging communities and protecting landscapes, such as REDD+ planning processes, connectivity corridors, and trans-boundary situations.

### Looking ahead

The COMPACT experience is a compelling model within the GEF Small Grants Programme for how its country operations worldwide can maximize their impact of targeted small grants by using the landscape approach and strategic clustering of activities around in a particular landscape. During the 5th Operational Phase of the SGP (2011-2014), the COMPACT model can help the SGP meet its goals related to conservation of globally significant biodiversity, and ensure expected outcomes, such as *improved sustainability of protected areas and indigenous and community conservation areas through community-based actions.*

COMPACT offers valuable examples of involving communities in world heritage site, and other globally significant protected landscape, preservation. It is also applies to co-management and governance of other kinds of protected areas, as well as Indigenous and Community-Conserved Areas (ICCAs). The COMPACT approach has much to offer the CBD Program of Work on Protected Areas, particularly in community engagement, benefit-sharing, and governance. The experience of COMPACT can help guide new strategies for engaging with and supporting community stewardship of protected areas.

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# Without Controversy: The Development of Fort Pillow State Historic Park

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On April 12, 1864, approximately 1,500 Confederate cavalry under the command of Major General Nathan Bedford Forrest surrounded Fort Pillow, a West Tennessee Fort situated along the Mississippi River, and its Union garrison of about 600 black and white troops. After the Union garrison refused demands for surrender, Confederate forces stormed the fort and quickly overwhelmed Union forces. Over the next several hours Confederates continued to shoot down Union troops, despite their repeated attempts to surrender or flee. When the battle was over, fewer than two dozen Confederates were killed but nearly half of the Union garrison, including two thirds of the black troops, was dead. Although a decisive Confederate victory, the event became a media sensation, resulting in a highly publicized U.S. Congressional investigation. For nearly 150 years almost every detail of the event has been scoured, but the most controversial aspect of the debate continues to be how the event is defined. Was Fort Pillow a massacre? Although historians agree that a massacre occurred, many still refuse to accept this contentious label.

Only three years after the end of the Civil War, Forrest biographers became the first to explain the events of Fort Pillow. As such, the event was placed in the larger context of Forrest's life and military career, and tended to be centered on Forrest's involvement and responsibility. Many early historians attempted to frame Fort Pillow not as a massacre, but rather a ferocious and unorganized battle in which discipline and control were regretfully lost. One of the most popular Forrest biographies blames the inferior racial intelligence of African Americans as a reason for higher casualties.[1] The consistent yet disconcerting theme of the early Forrest biographers is their failure to adequately examine the actions of Confederate soldiers, and an overriding tendency to blame the Union garrison for its own demise. Some early historians, however, though differing from Forrest biographers, were also faulty in their description of Fort Pillow. The scholarly discussion reached a turning point in 1958, following an article by Albert Castel that carefully reexamined the evidence, and convincingly concluded that a massacre did indeed occur.[2] This article, combined with the rise in importance of African-American history, served to reopen the examination and study of Fort Pillow. Based on the totality of evidence, modern historians agree that racial atrocities did occur at Fort Pillow and few remain hesitant to label the event a massacre.

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Beginning with a land purchase, the early 1970s saw major milestones in the preservation of Fort Pillow, including its listing on the National Register of Historic Places in 1973, and designation as a National Landmark in 1975. The development of Fort Pillow began during a crucial time for the Tennessee state park system. The early 1970s not only saw the initial stages of the creation of Fort Pillow State Historic Area, but more importantly a fundamental reorganization of the Tennessee State Parks. Although the reorganization provided a new and much needed professionalism, and a commitment to embrace scientific and historical data from scholarly debate, this new management scheme was severely challenged by controversies that plagued the development of Fort Pillow State Historic Area.

In 1971, the Department of Conservation purchased 1,628 acres of land in Lauderdale County, including most of the Fort Pillow site.[3] After the property was acquired, the Department of Conservation requested a historical survey of the site from the Tennessee Historical Commission (which also serves as the State Historic Preservation Office).[4] The survey eventually evolved into a national register nomination for the Fort Pillow site, in 1973.

For the next two years, development of the Fort Pillow site continued, but attracted little attention. The calm was shattered when Fort Pillow was officially designated as a national landmark on November 19, 1975. Unlike the national register nomination, Fort Pillow's designation as a national landmark created a major controversy for both state and federal agencies. The designation involved an official ceremony at the Fort Pillow site, attended by a representative of the Department of the Interior (DOI) and National Park Service (NPS), Paul Swartz, chief of Cooperative Activates for the NPS Southeast Regional Office, and Buck Allison, commissioner of the Tennessee Department of Conservation. As part of the ceremonial designation, Swartz offered a few words to mark the occasion. After first noting the high integrity of the National Landmark Program, Swartz described Fort Pillow as "the place where more than 250 unarmed black Union soldiers were murdered and other atrocities committed… What happened here will forever shame us as a nation." Swartz characterized the events of the battle as a "lesson—deep, ominous and everlasting." In concluding his remarks, Swartz hoped that "the 'lesson' of Fort Pillow today might be to keep us utterly realistic about the enigmatic nature of man—ourselves—and what we are capable of if we let the beast be uncaged."[5] Unlike the national register nomination, Swartz's remarks would not go unnoticed.

The following month, Tennessee State Representative Edward F. Williams III, representing the 96th representative district, north of Memphis, wrote a scathing letter to Tennessee Department of Conservation Commissioner Buck R. Allison. Not only was Fort Pillow located within Williams' District, but more importantly, Williams sat on the House Conservation and Environment Committee, the committee that oversaw the Tennessee Department of Conservation. The letter vigorously disputed the massacre interpretation and tone of Swartz's comments and the NPS press release. Williams argued that the Tennessee State Parks should not interpret the event as a massacre, and took strong exception to the federal government telling the state how to interpret the past. According to Williams, "It appears that Federal officials are determined to continue to use Civil War propaganda, discredited more than a century ago, in their references to this Tennessee State Park…. I feel certain that you will agree with me that it is neither the duty nor the responsibility of the Tenn. Department of Conservation to aid the National Park Service in perpetuating erroneous propaganda which was manufactured more than 111 years ago."[6]

Commissioner Allison responded a week later. Allison's letter agrees with Williams sentiments, calling Swartz's comments "unjustified, stilted, and pedantic. The ground breaking was not the time to present such a biased view-point." Although both Williams and Allison were critical of Schwartz, Allison implied that the director of the National Landmark Program would soon issue a formal apology to the state. Remarkably, Allison concluded the letter by revealing that he has a personal connection to the battle: "You see, there was an Allison fighting alongside General

Forrest at Fort Pillow."[7] Despite the letter writing-campaign, it remains unclear if the NPS, DOI, or the National Landmarks program ever issued an apology.

In many ways the controversy established and hardened polar opposite versions of the Fort Pillow battle. For the NPS and others, such as the African-American Bicentennial Committee, the event was an unmitigated racist massacre and atrocity on the scale of a modern war crime. For others, particularly Tennessee state officials, such as Representative Williams and Commissioner Allison, a massacre interpretation of Fort Pillow was not only completely unacceptable, but a blight on the name of cherished ancestors, and a long-venerated Tennessee hero, Nathan Bedford Forrest. Despite serious factual errors in both versions, there appeared to be no middle ground, nor did there appear to be an interest in examining the evidence with an open mind or a neutral perspective.

By 1982, Tennessee State Parks completed museum exhibits and an audio-visual presentation.[8] Unlike the exhibits which did not discuss the 1864 battle in depth, the program addressed the battle with significant yet nuanced and accurate detail, based on a massacre interpretation reflected in current scholarship. On May 12, 1982, prominent Memphis attorney T. Tarry Beasley II wrote a scathing letter to Department of Conservation Commissioner Charles A. Howell III. Calling the audio-visual program "Yankee propaganda," Beasley suggested that the program be taken down and reviewed by local historians "to give you documentation for the correct presentation of the controversy."[9]

On June 2, 1982, Commissioner Howell sent a response letter to Beasley stating that the audio-visual program had been removed. Howell promised to order a review of the program and request input from Ed Williams to determine the "historical authenticity."[10] Despite his brazen antagonism and pro-Confederate bias, Beasley's request was completely and immediately granted. After a thorough review, the Department Interpretive Committee decided to make twelve changes to the program. The changes included the addition of an introductory disclaimer, the rewording of several battle descriptions, and the addition of a new ending "designed to leave the viewer with a purposeful feeling, and a conciliatory frame of mind." Two notable changes included a modification of language describing Forrest's involvement. The following quote by Forrest was removed: "The river was dyed with the blood of the slaughtered for two hundred yards … it is hoped that these facts will demonstrate to the northern people that Negro soldiers cannot cope with Southerners." Forrest's quote was replaced with a quote by Confederate Sam Caldwell: "They refused to surrender which incensed our men, and if General Forrest had not run between our men and the Yanks with his pistol and saber drawn, not a man would have been spared."[11] This change fundamentally changed how the program depicts Forrest.

Later, on October 5, 1982, Memphis resident Les Birchfield wrote a letter of complaint to Tennessee State Parks Director Don Charpio, arguing that a massacre did not occur, and the Fort Pillow State Park did not accurately interpret the battle. As support for his position, Birchfield included a photocopied description of the battle from John Allan Wyeth's biography, *That Devil Forrest*.[12] The letter is notable in that it elicited a response, which included a preliminary inter-office memorandum from Robert Mainfort to Tennessee State Parks Director Don Charpio. The Mainfort memorandum presents an unvarnished perspective that reveals how the Tennessee State Parks employees interpreted Fort Pillow after having dealt with the movie controversy earlier that year. In a memorandum, Mainfort refutes Birchfield's points, and dismiss Wyeth's interpretation stating, "Wyeth's discussion of the massacre has not stood up under the scrutiny of historians. This was made clear as long ago as 1958 (article by Albert Castel) and the new evidence published by myself and John Cimprich clinches the case for the occurrence of a massacre. The concept of presenting 'both sides' of the issue is invalidated by a mass of historical data."[13]

By 1989, Tennessee State Parks completed the first and only strategic management plan for Fort Pillow. The strategic management plan included a short section entitled "History of Park" which identified several secondary research sources. According to the management plan, "Included in the more outstanding of these were John A. Wyeth's biography of Nathan Bedford Forrest and John L. Jordan's interpretation of the Fort Pillow 'Massacre' published in the *Tennessee Historical Quarterly*."[14] Despite the fact that Mainfort had dismissed Wyeth's interpretation seven years earlier, by 1989 Wyeth had become one of the most important secondary sources for park management.

In 1993, Fort Pillow Superintendent Tom Shouse was quoted at length in an article in *Civil War Times Illustrated*. In an abrupt turn from Fort Pillow developer and scholar Robert Mainfort, Shouse described the events of Fort Pillow as a mystery and cast serious doubt as to a massacre. Specifically, Shouse cast doubt on the casualty numbers, described the Congressional Report as "propaganda," and presented the event as a two sided story in which the visitor must decide who is correct: the northern version or the southern version.[15] In his interpretation, Shouse directly contradicts not only the huge body of evidence and scholarship, but more importantly the interpretive development as previously stated by Robert Mainfort. Although the Tennessee State Park planners were initially successful in presenting a balanced interpretation based on sound scholarship, subsequent Tennessee State Park employees have abandoned that scholarship in favor of a version of the past more agreeable to Tennesseans interested in the history of the Fort Pillow incident.

Although it was not the war's only racial atrocity, nor was it the largest, Fort Pillow was the most publicized and perhaps the best-known racial atrocity of the conflict. The conception of Fort Pillow is largely thanks to its association with Nathan Bedford Forrest, yet his notorious legacy continues to confound and frustrate how this site is presented to the public. While the legacy of Forrest and racism generate significant difficulties, they also offer unique opportunities for the public to explore some of the most pertinent, enduring, consequential yet unapprised issues of the Civil War, including the meaning of freedom and the legacy of slavery and racism. Despite the controversial nature of Forrest or the contentious racial overtones of the Fort Pillow massacre, the greatest obstacle to effectively interpreting and preserving the parks is the state of Tennessee, which remains steadfast in its unwillingness to embrace the controversial past of Fort Pillow as a foundation for interpretive opportunities.

### Endnotes

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4. Tennessee State Parks, *Fort Pillow State Historic Park General Management Plan* (Nashville: Tennessee Department of Conservation, 1989), 9.
5. National Park Service press release, "Place of Civil War Massacre of Blacks Designated National Historic Landmark" (November 19, 1975). Tennessee State Parks Archive, Nashville.
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# NPS Herbaria Go Global (Virtually)

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Herbaria managers worldwide are revolutionizing how they provide access to herbarium specimens, and the National Park Service (NPS) is in the forefront of this change. Throughout the USA, regional consortia of herbaria are forming to provide integrated access to specimen images and data. To study the plants of a particular geographic area, users no longer need to visit or borrow specimens from herbaria in multiple, and often distant, locations. Instead they may access the specimens virtually through an integrated Internet search of the participating herbaria. In turn, the regional herbaria are building toward a U.S. Virtual Herbarium, which is likely to lead to a North American virtual herbarium, and so forth, across the globe.

Some park specimens are accessible through regional virtual herbaria, because the specimens are in a non-NPS repository that participates in a regional virtual herbarium. For example, park specimen data from the Pacific West Region are accessible through the Consortium of California Herbaria (see http://ucjeps.berkeley.edu/consortium/),[1] the Consortium of Pacific Northwest Herbaria (see www.pnwherbaria.org/index.php),[2] and the Consortium of Pacific Herbaria (see www.herbarium.hawaii.edu/cph/index.html).[3] Parks may also participate in a regional virtual herbarium by independently listing the park on-site herbarium as a collaborating partner in the consortium. For example, Grand Canyon National Park Herbarium is a participating partner in the Southwest Environmental Information Network (SEINet) (see http://swbiodiversity.org/seinet/index.php). As regional virtual herbaria consortia become operational, parks may join them and provide virtual access to park specimens in both NPS and non-NPS repositories.

## Benefits of virtual herbaria

Virtual herbaria offer new tools for resource managers, scientists, and interpreters to access and use herbarium data. For example, they expand access to park herbarium data to inform science and taxonomic studies, phenology and climate change studies, restoration of endangered species, removal of invasive species, and cooperative management of landscapes. They integrate information searches across organizations, giving researchers the ability to look at data using specific criteria, such as a single species over a geographic area, or all species from a specific park, or all specimens from federal lands (a virtual federal herbarium).

In addition, virtual herbaria preserve the original specimens by reducing handling and shipping involved in lending large numbers of specimens to researchers around the world. Re-

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searchers may use the virtual herbarium to meet many of their research needs and limit the number of specimens that must be borrowed for on-site study.

Currently, use of herbaria is basically limited to scientists. Virtual herbaria, however, open the herbaria to the general public. For the first time, anyone may access these herbaria from anywhere—their offices, schools, homes, backyards, and even along a park trail (with a smartphone application). The images and data are readily accessible to park staff and partner organizations, such as Landscape Conservation Cooperatives, university staff to enhance teaching and research, other members of the scientific community to facilitate research, school teachers and students, amateur botanists, garden clubs, and other members of the public, both in the USA and internationally. Such universal access helps to build public knowledge of, and support for, conservation.

Virtual herbaria enable users to place park plants in regional and global context, use interactive identification keys and checklists in the field, explore plant distribution and flowering in relation to climate change, identify native plants for use in gardening, learn about plants through educational games, involve youth in conservation activities, and a variety of other activities.

### Three challenges to parks going virtual

The first challenge to going virtual is that herbarium specimens must be cataloged in order for the park to participate in a regional consortium. Currently, seventy-six percent of NPS biological specimens are cataloged. Parks should give priority to cataloging the backlog of biological specimens (including herbarium specimens), and seek project funding to accomplish this task.

The second challenge is that virtual herbaria are most useful when specimens are represented by images, in addition to taxonomic, descriptive, locality, collection, and other written information, and most NPS herbarium specimens lack digital images. In addition, parks lack the equipment and skills to create the images. The equipment is expensive (for example, photographic equipment may be in the range of $9,000) and purchase for limited use in a single park's on-site herbarium may not be justified. Servicewide, regional, or repository-based digital imaging projects, such as the demonstration project described below, address this challenge.

A third challenge for parks is that regional virtual herbaria base their listings on the herbarium in which the specimen is physically located. This practice is compatible when the specimens are in NPS facilities—the specimens are listed under the park name when the park is a participating herbarium. Specimens in non-NPS repositories, however, are listed under the non-NPS repository herbarium, and duplicate listings under the participating park herbarium are not currently accommodated. Parks may work with regional virtual herbaria to establish standard search functions that enable users to search by park for all specimens regardless of physical location, as SEINet provides for its participating parks.

### Basic steps for NPS herbaria to go virtual

The basic steps for NPS herbaria to go virtual are as follows:

1. Catalog the voucher specimens in the park herbarium.
2. Create digital images of specimens.
3. Collaborate with non-NPS repositories with park specimens.
4. Post data and images on the NPS Web Catalog (at www.museum.nps.gov).
5. Join a consortium that serves data and images on the internet as a regional virtual herbarium.
6. Coordinate with the virtual herbarium to facilitate searches for park specimens regardless of physical location.
7. Create plant checklists and apps using the virtual herbarium.
8. Refer researchers, interpreters, educators, and visitors to the virtual herbarium.

### NPS virtual herbarium demonstration project

Arizona parks are participating in a demonstration project that virtually integrates park herbaria with collaborating federal, tribal, state, county, university, and non-governmental herbaria with collections from the American Southwest and Mexico. The NPS project, known as the Herbarium Imaging Project (HIP), is coordinated by the senior advisor for scientific collections in the office of the associate director, Natural Resource Stewardship and Science, Washington, DC. Beyond imaging 17,000 park herbarium specimens and making them electronically accessible, one goal of HIP is to develop examples of procedures and templates that parks may use to generate images of park specimens, and cooperate in their own regional virtual herbaria.

The Arizona project involves collaboration with non-NPS repositories to generate images of park specimens in both NPS and non-NPS repositories, and post the data on SEINet. NPS coordinates imaging tasks with non-NPS repository partners through the Cooperative Ecosystem Studies Units (CESU) cooperative agreement, and the Colorado Plateau CESU (CPCESU). The Natural Resource Preservation Program (NRPP) and the CPCESU are the primary funding sources.

SEINet is a specimen-based virtual herbarium of the American Southwest and northern Mexican (Sonoran) flora. It covers 1.7 million specimens housed in 20 herbaria in the region including 10 in Arizona, five in New Mexico, four in adjacent western states, and one in Sonora, Mexico. Specimens are also house in three consortia, and the New York Botanical Garden. SEINet features species checklists, an interactive identification key, interactive Google maps, an image library, and educational games and quizzes. Users may search one or many herbaria in a single search. Pre-set custom searches are available for federal agency specimens and projects.

Arizona State University (ASU) manages SEINet collaboratively with consortium partners. The non-NPS repositories that participate (or are committed to participate) in SEINet, and are HIP partners, are Museum of Northern Arizona (MNA), Northern Arizona University (NAU), and University of Arizona (UA). Twenty NPS units in Arizona are participating.[4]

The HIP images are created in three formats—one as a RAW (minimally processed) image file, one as a TIFF (tagged image file format) file at native resolution (at least 300 dpi) for research and publication, and one as a JPEG (compressed) file at 72 dpi for posting on the web. The park posts the images on the NPS Web Catalog, and collaborates with the cooperating partner to post the images on SEINet.

Each of the three partners has park specimens in its herbarium. NAU and the UA Herbarium are creating specimen images on site. The Western Archeological and Conservation Center manages park specimens that have been moved temporarily to the nearby University of Arizona Herbarium for imaging. In addition, the UA Herbarium has developed a mobile imaging unit that can travel to other partner locations and parks.

### Key herbarium imaging project tasks

The Arizona demonstration project involves the following tasks and specifications.

**Task 1**. Parks develop a photographic shoot tracking list as an Excel spreadsheet. The list includes textual catalog record data that will be provided to SEINet, as well as metadata that will be attached to the image, including NPS catalog number and non-NPS repository accession or catalog number, scientific name, ownership, and copyright information (generally NPS photos are in the public domain), photography credits, and contact information. In addition, it provides instructions to the photographer regarding sensitive locality information on the herbarium label that must be blurred before the image is posted on SEINet. The shoot tracking list travels with the specimen from the storage location to the imaging station and back. It provides space for staff comments and instructions.

**Task 2**. The herbarium staff retrieve the specimens to be imaged, and work with the photographer to pace the retrieval and refiling of specimens.

**Task 3**. The photographer images the specimens using a digital single lens reflex camera body, normal macro 60 mm f/2.8 autofocus lens, right angle viewfinder, copy stand, and other related equipment.

The photographer first completes a batch of 15 test images in RAW format, followed by two batches, each with 50 percent of the images. The specifications include instructions on layout, use, and placement of color and metric scales. After taking all the required RAW images, the photographer then saves the images in TIFF and JPEG formats, layers the blurring of sensitive locality data and insertion of a catalog number on a placard, and attaches the metadata provided on the shoot tracking list.

**Task 4**. In consultation with the park, a quality control specialist checks all test images, as well as a random sample of the large batches.

**Task 5**. The photographer provides the TIFF and JPEG image files to the park, and sends the RAW images to the Park Museum Management Program, in the Washington office, for archiving.

**Task 6**. The park posts the images and other catalog data on the NPS Web Catalog.

**Task 7**. The park or partner herbarium that houses the specimens posts the catalog data on SEINet and provides SEINet access to the images. Both the NPS catalog number and the partner's identifying number appear in the SEINet record.

**Task 8**. On an ongoing basis, the park and partner repositories coordinate with SEINet to update the records. As described in the SEINet discussion below, SEINet can update records through user feedback and annotations to the herbarium.

The shoot tracking list template, associated instructions, and a generic task agreement and scope of work are available from the senior advisor for scientific collections. The project is scheduled to run through 2013, when images and data for all 17,000 specimens will be available on the NPS Web Catalog and SEINet.

**How a virtual herbarium works**

SEINet serves as a good model to understand the technical workings of a virtual herbarium. Search parameters include taxonomic and locality criteria, geographic references, and collector and collection information. The list of specimens in the search results offers links to detailed information on specific specimens, including images of the herbarium specimen and the species in the wild, as well as general information about the species. Images of the living specimen in situ are especially useful for field identifications. The system allows searches on both scientific and common names.

An interactive identification key allows the user to select characteristics (such as "leaves opposite," "hairy stem") to narrow a list of many possible choices. For example, a list of all Asteraceae in a park may be narrowed to only a few options that can then be checked against the image library to identify the specific specimen.

ASU developed SEINet's open-source search engine, Symbiota, under a grant from the National Science Foundation, which has a program to support the development of virtual herbaria. SEINet and Symbiota use an international metadata standard, Darwin Core, and the DiGIR (Distributed Generic Information Retrieval) and TAPIR (Taxonomic Databases Working Group Access Protocol for Information Retrieval) client/server protocols to import, integrate, and display data. Such data standards and protocols are the first step toward interoperability. (See more on biodiversity information standards at www.tdwg.org.)

Symbiota (http://symbiota.org) can schedule automatic updates, providing that the source data are web-based. SEINet currently uses this function to update UA and ASU display data daily. The goal over the next year is to extend these interoperability features to all the collections currently integrated in SEINet.

Similarly, any researcher annotations or public comments received through SEINet can be forwarded by Symbiota to the data source node. The service-oriented architecture (SOA) not only passes data between nodes, but also can involve two or more services coordinating some activity, such as dynamically updating regional or state-level species checklists when new data are added from any one of the SEINet partners. It could send messages to update scientific names when changes occur, but is not currently performing this function.

**Spreading the word on virtual herbaria**

NPS units in Arizona have welcomed the opportunity to participate in the Herbarium Imaging Project, contributing staff time and funding to the joint effort. The Sonoran Desert Network is complementing the imaging work by creating park checklists, and posting them on SEINet with direct links to the specimen vouchers and images (see Coronado National Memorial example at http://swbiodiversity.org/seinet/checklists/checklist.php?cl=2541&proj=5&showvouchers=1).

The Bureau of Land Management, the U.S. Forest Service, and Valles Caldera National Preserve have joined the NPS to create a virtual federal herbarium prototype on SEINet, facilitating simultaneous searches of data from these federal lands. In 2009, the Biodiversity and Ecosystem Informatics Work Group (BioEco), under the National Science and Technology Council Committee on Environment, Natural Resources, and Sustainability (Subcommittee on Ecological Systems), selected the virtual federal herbarium prototype as a demonstration project, highlighting integration and interoperability of federal data.

At the 2010 National Mall Earth Day celebration in Washington DC, the public responded enthusiastically to a demonstration of the virtual federal herbarium prototype. Teachers spoke of how they could incorporate the virtual herbarium into school curricula. Gardeners asked whether they could use the virtual herbarium to identify native species to plant in their yards. Outdoor enthusiasts were excited by the prospect of a smartphone app that would allow them to identify plants along the trail. NPS resource managers and interpreters have endorsed the virtual herbarium as a useful new tool for stewardship and communication.

## Going global

As regional virtual herbaria consortia become operational across the USA, all national park sites are encouraged to collaborate with their non-NPS repository partners to make park herbarium specimens, in NPS and non-NPS repositories, virtually and globally accessible.

## Endnotes

1. Search for Cabrillo National Monument, Channel Islands National Park, Death Valley National Park, Joshua Tree National Park, Lassen Volcanic National Park, Mojave National Preserve, Redwood National and State Parks, Sequoia and Kings Canyon National Parks, Yosemite National Park.
2. Search for Crater Lake National Park, Mount Rainier National Park, Olympic National Park.
3. Search for Hawai'i Volcanoes National Park, Kalaupapa National Historical Park, War in the Pacific National Historical Park.
4. Canyon de Chelly National Monument, Casa Grande Ruins National Monument, Chiricahua National Monument, Coronado National Memorial, Fort Bowie National Historic Site, Glen Canyon National Recreational Area, Grand Canyon National Park, Montezuma Castle National Monument, Navajo National Monument, Organ Pipe Cactus National Monument, Pipe Spring National Monument, Petrified Forest National Park, Saguaro National Park,

Sunset Crater Volcano National Monument, Tonto National Monument, Tumacacori National Historical Park, Tuzigoot National Monument, Walnut Canyon National Monument, Western Archeological and Conservation Center, Wupatki National Monument.

# WWII Military Aircraft Incidents in National Park Service Units: A Preliminary Inventory

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## Introduction

During World War II (WWII), more than 7,100 air crashes involving United States Army Air Force (USAAF) aircraft occurred on American soil. Collectively these crashes resulted in the loss of more than 15,599 lives (Mireles 2006). Many of these military aircraft accidents occurred in remote, often mountainous, areas. This preliminary inventory presents basic information on the majority of WWII era (September 1, 1939, to September 2, 1945) military aircraft incidents which have been documented in areas administered by the National Park Service (NPS) (Hunt and Santucci 2011). The purpose of this preliminary report is to expand awareness of the WWII resources at NPS sites, and to further identify issues associated with their management, protection, and interpretation as cultural resources.

## National Park Service units

**Channel Islands National Park.** On July 5, 1943, a Consolidated B-24E Liberator crashed into Green Mountain on San Miguel Island, California, during low overcast conditions (Macha and Jordan 2002; Mireles 2006). The aircraft impacted the ground at cruising speed and the wreckage was widely dispersed and burned (Macha and Jordan 2002). Twelve airmen died in the crash. The accident site was not located until March 19, 1944. A second incident involved a United States Marine Corps (USMC) Grumman F4F, which crashed on Anacapa Island on an unknown date during the WWII (Macha and Jordan 2002).

**Death Valley National Park.** On August 1, 1944, six B-24 Liberators took off from Muroc Army Air Field for training in gunnery and formation flying. One B-24J collided with, and sheared off the tail of, a B-24D which immediately plummeted. Gunnery student Private Newton J. Steven was thrown from the B-24J and was able to parachute successfully. All the other eight aviators in the B-24J perished along with all eight airmen on the B-24D (Mireles 2006). Scattered debris from the crash is still visible in the park (Macha and Jordan 2002).

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On March 29, 1945, an AT-11 crash-landed on Devil's Golf Course, and the pilot survived (Farabee 2005). The remains of WWII Navy Goodyear FG-1, including machine guns and remains of its pilot, were discovered in the park by a hiker in 1967 (Macha and Jordan 2002). The exact date of this crash is unknown. On September 2, 1945, the last day of the war, a USMC Grumman F6F-5 crashed in Death Valley. The wreckage was not discovered until June 13, 1957 (Macha and Jordan 2002).

**Denali National Park.** On September 18, 1944, an Army C-47 left Anchorage for Fairbanks with a civilian pilot from Northwest Airlines, and 18 servicemen on board. The aircraft struck a mountain (now named Mt. Deception) 16 miles east of Mt. McKinley (Figure 1). Forty-four men traversed over twenty miles of rugged terrain to reach the crash site on November 10, to find the plane buried in ten feet of snow. They were unable to locate any bodies (DNPP, n.d.; Farabee 2005).

Figure 1. Excavation in December 1944 of crash site of C-47 Skytrain at Denali National Park (courtesy of Kirk Dietz).

**El Malpais National Monument.** A USAAF Consolidated 0A-10 (Army designation for Navy PBY-5A Catalina) was on route from Amarillo, Texas, to Mather Field, near Sacramento, on August 1, 1945. The aircraft crashed after having feathered one propeller (indicating an engine failure), killing all six crewmen (C. Fuller, pers. comm.; Mireles 2006).

**Golden Gate National Recreation Area**. Shortly after noon on May 4, 1945, a PBY-5A Catalina left Alameda, California, with a crew of eleven, and four depth charges. Barely five miles from Alcatraz Island, the aircraft encountered bad weather and the plane crashed on a hillside a few minutes later (Figure 2). Two of the crew, Aviation Machinist's Mate Harold R. Doyle and Aviation Ordnanceman Henri C. Tondreault, miraculously survived, but sustained third-degree burns (GGNRA, n.d.; C. Fuller, pers. comm.).

**Grand Canyon National Park**. On June 20, 1944, a B-24 with a five crew members was 24,000 feet over the Grand Canyon, Arizona, when all four engines died. The pilot ordered his crew to bail out, and three men exited through the bomb bay into the night. As suddenly as they stopped, the four engines restarted and the two pilots were able to nurse the plane to Kingman Army Air Field. All three crew members who jumped from the plane survived: Engineer Corporal Roy W. Embanks was uninjured; Lieutenant Charles Goldblum (bombardier) slid down a steep slope and his parachute snagged on the rocks; and Flying Officer Maurice J. Cruikshank, Jr. (navigator), hit a steep slope and broke bones in his foot. Cruickshank, with a makeshift crutch, was able to meet up with Goldblum in the morning, and eventually they found Embanks. Supplies were dropped to them by air, and they were finally led out of the canyon after 10 days (Ghiglieri and Myers 2001; Farabee 2005).

**Great Smoky Mountains National Park**. On Monday, January 31, 1944, A UC-78 left Charlotte, North Carolina, on route to Nashville, Tennessee, with four on board, including an Oak Ridge scientist. Witnesses reported a low flying aircraft with a sputtering engine over the mountains. Despite immediate and subsequent searches, no trace of the aircraft was ever found (Wadley and McCarter 2002).

**Guadalupe Mountains National Park**. On December 23, 1943, a Boeing B-17G took off from Roswell Army Air Field in New Mexico, with three senior flight instructors on board. The aircraft was flying in poor visibility, about 200 feet above a paved road, and struck the eastern slope of Guadalupe Peak. Engineer Private Nick A. Mardesich was in the radio compartment at


**Figure 2.** Contemporary photograph of wreckage of PBY-5A Catalina at Golden Gate National Recreation Area in 1945 (courtesy of Stephen Haller).

the moment of impact, was able to exit the burning wreck, and was the sole survivor. Some wreckage is still visible (GMNP, n.d.; Mireles 2006).

On the last day of 1943, a Consolidated B-24D left Biggs Field in El Paso, Texas, on an instrument training mission, and struck a hill west of Pine Top (Figure 3). The accident was attributed to icing, and all five members of the crew were killed. Extensive wreckage exists at the site today (GMNP, n.d.; Mireles 2006).

**Joshua Tree National Monument**. On Independence Day 1944, three Consolidated B-24Js left March Field for gunnery and bombing training. Two of the aircraft collided in flight, shearing off the tail section of one (Farabee 2005; Mireles 2006). Second Lieutenant George B. Smallfield was thrown from his aircraft, and managed to attach and deploy his parachute in free fall, but the remaining nine members of his crew perished (Farabee 2005; Mireles 2006). The pilot from the other plane, Second Lieutenant Gerald Solheid, ordered his crew to bail out. Seven airmen parachuted to safety, however, one was seriously injured. Subsequently Solheid and his co-pilot managed to land their aircraft at Palm Springs (Farabee 2005; Mireles 2006).

**Lake Clark National Park**. On June 1, 1942, a B-18 with a four man crew crashed into the 11,000 ft Mt. Redoubt, Alaska, which is now within Lake Clark National Park. Seventeen days

**Figure 3.** Contemporary photograph of wreck of B-24D Liberator on Bush Mountain in Guadalupe Mountains National Park (courtesy of David Bieri).

later, two of the crew, Sergeant Don Harris and Sergeant Charles Michaelis, had made their way to Anchorage. Both the pilot, Lt. Ed Clark, and co-pilot, Lt. Joe Donaldson, sustained injuries, but were eventually rescued from the remote site (Farabee 2005).

**Lake Mead National Recreation Area**. Lieutenant Laurence E. Wernberg was flying one of five new Vultee BT-13 Valiants to be delivered to Kelly Field, in Texas. On the first leg to Winslow, Arizona, on August 11, 1940, the aircraft developed engine trouble over Lake Mead. Wernberg glided towards the lake surface, but hit a cable and plunged into the water, near Hoover Dam (Farabee 2005).

**Olympic National Park**. Early on the morning of September 9, 1941, a Douglas B-18A was on a night navigation training flight when it collided with a cliff on Mt. Constance, in Olympic National Park. The entire crew of six was killed on impact. The wreck was not discovered for several weeks after the crash (Mireles 2006).

**Saguaro National Park**. At least four WWII military plane crashes are documented in Saguaro National Park. On July 30, 1943, a Consolidate B-24D Liberator hit the Tanque Verde Ridge in Saguaro National Park, and nine airmen lost their lives. Much of the wreckage was removed in 1960, under a Special Use Permit (SNP, n.d.; Farabee 2005; Mireles 2006).

An AT-6 crashed north of Paige Creek, just inside the park boundary, on December 28, 1942. An exchange officer from the RAF was killed in the incident. Very little debris remains at the site (SNP, n.d.).

On December 24, 1944, a Cessna UC-78B Bobcat took off from Yuma Army Air Field to fly to Deming, New Mexico, with a pilot and two passengers. The aircraft crashed into the base of the Rincon Mountains at an elevation of 6,400 feet, in a rainstorm with icing conditions. The engines and some fuselage pieces were retrieved by the Pima Air and Space Museum in 1979 (SNP, n.d.; Mireles 2006).

On January 20, 1945, a North American B-25D Mitchell struck Wrong Mountain at about 6,500 feet. The impact sparked a 510-acre fire, and the five crewmen on board perished. Most of the scattered wreckage remains because of the remoteness of the location (SNP, n.d.; Farabee 2005; Mireles 2006).

**Sequoia and Kings Canyon National Parks**. Several WWII military plane crashes have been documented in Sequoia and Kings Canyon National Parks. On October 24, 1941, 19 Curtis P-40 Hawks of the 57th Pursuit Group left March Field at Riverside, California, to fly to McClelland Field, in Sacramento, California. A short time after takeoff, the aircraft encountered heavy overcast conditions, and many of the aircraft became separated. Four planes went down in the area of Kings Canyon, resulting in one pilot being killed, and three pilots parachuting to safety. First Lieutenant Richard N. Long was killed in a crash near South Guard Lake.

Second Lieutenant John Pease bailed out, after losing oil pressure, north of Lake Isabelle, and he was rescued relatively quickly. First Lieutenant Leonard C. Lydon and Second Lieutenant Jack C. West both bailed out near Barton, California. The two pilots found each other, and were spotted several days later by a B-18 (Farabee 2005; Macha and Jordan 2002; Mireles 2006).

On November 18, 1942, a Beech AT-7 Navigator from Mather Field, near Sacramento, struck the Mendel Glacier in Darwin Canyon. The wreck site was not located until 1947. The partially mummified bodies of two airmen were found in 2005 and 2007, but the remains of the other two crewmen have yet to be found (Farabee 2005; Mireles 2006; Stekel 2010).

On December 5, 1943, a Consolidated B-24E disappeared over the Sierras on a celestial navigation flight with six crewmen on board. Investigators speculated that adverse weather may have been encountered. On July 7, 1960, the wreckage was found at Lake Le Conte. The aircraft had apparently struck the mountain near the top of a 12,500 feet ridge, then slid down into the lake. For a decade, the father of the 23-year-old co-pilot (Second Lieutenant Robert M. Hester) searched for the site of the crash. In December 1960 the lake was renamed Hester Lake (Macha and Jordan 2002; Farabee 2005; Mireles 2006).

A USMC Curtiss-Wright R5C-1 (incorrectly identified as a C-46 by Farabee [2005]) crashed during a winter snowstorm near Mt. Whitney, at about 11,000 feet, on February 2, 1945. It was five months before the wreck was found and the bodies of the eight crewmen were recovered. The almost intact wreck was removed by USMC helicopters in the summer of 1974 at the request of National Park Service (Macha and Jordan 2002; Farabee 2005).

**Shenandoah National Park**. On October 17, 1943, four P-47Ds were practicing high altitude formation flying when one was seen to enter a dive at 32,000 feet. The aircraft exploded on impact, seven miles southwest of Elkton at an elevation of 2,000 feet, and the pilot was killed (Mireles 2006).

**WWII Valor in the Pacific National Monument**. The only combat-related aircraft loss reported herein is from WWII Valor in the Pacific National Monument, and involves a B-24D Liberator that crash landed on Atka Island, Alaska. The B-24D participated in 18 bombing missions in the Aleutian Islands. On December 9, 1942, the aircraft was involved in a weather reconnaissance flight (such flights were considered combat missions). Bad weather prevented the B-24 from returning to Adak, and so it was forced to crash land in Bechevin Bay, on Atka Island. There was only one minor injury among the crew. The well-preserved plane is still fairly intact (Figure 4), and it was recently designated a distinct unit of WWII Valor in the Pacific National Monument (NARA, n.d.).

**Figure 4.** Current condition of wreckage of B-24D Liberator on Atka Island, Alaska, in WWII Valor in the Pacific National Monument (courtesy of Janis Kozlowski).

**Yellowstone National Park**. Just after midnight on May 23, 1943, a B-17F en route from Marysville, California, to Lewiston, Montana, crashed four miles south of West Yellowstone. Bad weather conditions prompted an order to bail out. Bombardier Second Lieutenant William F. McDonald immediately exited through the nose hatch, but the remaining crew and one passenger went down with the aircraft. McDonald was found by rescuers three days after the crash. The wreck was discovered in 1988, as a result of the fires in Yellowstone (Farabee 2005).

**Yosemite National Park**. On April 13, 1944, a USAAF Douglas P-70A from Hammer Field at Fresno, California, was involved in a radar training flight with another aircraft. The target aircraft had to return prematurely, and it lost track of the other plane, which subsequently crashed at Given's Creek (Farabee 2005; Mireles 2006).

Just a few months later on August 28, 1944, another USAAF Douglas P-70 (P-70B) from Hammer Field crashed into the summit of Quarry Peak, 15 miles west of Mono Lake. Three airmen were killed in the accident. The  cause of the crash was never determined (Mireles 2006). Wreckage was scattered over a 500 foot area, and is still in place (Macha and Jordan 2002).

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# The Relevance of National Parks

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*[Ed. note: Mr. Jarvis addressed the plenary session of the conference on Thursday, March 17.]*

It is interesting to note that the beginning of the national park system coincides with the waning days of the Western frontier. It seemed like America could sense the force of its own ambition and realized it needed to step back, think, and set aside a portion of its natural character and its cultural memory before it was too late. When you think of the passion it took to create the national parks—not to mention the vision—it's a bit sobering that we're here tonight to talk about their relevance. The fact that we are, is testament to a changing world. I believe that relevance is so important that I established it as one of my four top priorities as Director, along with stewardship, workforce and education.

I would be preaching to the choir to say that our natural and cultural legacy is eternally relevant. We know this is true. But the reality is that we have to *prove* our relevance in the twenty-first century. There are times when it seems as if the national parks have never been more passé than in the age of the iPhone. The parks must compete with high speed, high resolution entertainment, with instant access to seemingly everything in the blink of an eye. Young people—and many older people as well—are technologically attuned, but more separated from the natural world than perhaps any generation before them. Many immigrants come from places that have no history of parks, and they arrive with no cultural connection to places like Yellowstone or Gettysburg or Independence Hall. The national parks risk obsolescence in the eyes of an increasingly diverse and distracted demographic.

It is a common perception that the national parks are about the past, and that is true, to an extent, but they are also very much about the future. We face unprecedented social and environmental challenges. We struggle to achieve sustainability in the way we live and work and do business. We grapple with issues of public health and producing a citizenry that is informed and engaged. Not only are the national parks relevant to all of these issues, they offer solutions. The moniker "America's best idea" seems to be on the verge of becoming a cliché. But the bothersome thing about clichés is they can't really be dismissed, because they are often true.

It's my opinion that climate change is one of the most pressing challenges we face today, and where the national parks are perhaps uniquely relevant. We manage the most intact ecosystems in North America, an oasis of biodiversity in a fragmented landscape. The parks are home to a multitude of endangered species and hold a hidden wealth of life that is as yet undocumented. For some of these forms of life, the parks are a last refuge. For these reasons, they are critical to the

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health of the planet, not only in terms of biodiversity, but in restoring compromised ecosystems elsewhere. They are also the source of hope and optimism in these turbulent times.

We hear trendy buzz words like "green" and "eco-friendly" and it would be easy to dismiss this as a fad except that it signals a growing awareness of the natural world. National parks are not just relevant to this discussion but *critically* relevant, and we should take advantage of this trend to educate the public about the role parks can play in preserving critical systems like the hurricane-absorbing cypress swamps that once protected New Orleans.

The parks should be used both as classrooms and as research laboratories, as places where the effects of climate change can be observed, and as testing grounds for new green technologies and innovative ways to reduce our carbon footprint. We have enlisted the public in our stewardship mission through programs like the BioBlitz, which brings students and volunteers into the parks to work with our scientists and specialists to assess the condition of our natural resources, and the International Volunteers in the Parks program, which is training a new cadre of young scientists to deal with these issues in their own countries. Through these and a number of other initiatives, we educate people, winning advocates for the environment while fulfilling actual needs in the parks.

As climate change and other threats to the environment make themselves felt more acutely, the parks' relevance—both as laboratories and as biological treasures—should also gain wider recognition.

Without education, there can be no discussion of relevance. Without education, the parks' long-term viability is in doubt. Our parks contain not only the vast natural history of the nation, but the incredible narrative of its people. If one thinks of them as classrooms, of the national park system as one sprawling and vibrant American curriculum, its educational value is astounding. The lands in our care comprise everything from the physical sciences to the humanities. They contain not only all manner of natural processes and living things, they hold the places that are sacred to us as a people. They tell the American story in words no textbook can equal: those of the eyewitness. Our national parks are the tangible manifestations of these things. They represent one of the most powerful—and underutilized—educational resources in the country.

We know some intriguing things about the way kids react to the national parks when they're used as a teaching aid. Place-based learning has been shown to provide benefits that conventional teaching cannot match. Students are more motivated, have higher marks, and a better retention rate when participating in lessons at a park or historic site. Through our Teacher-Ranger-Teacher program, teachers spend a summer as park rangers, developing curriculum to take back into their classrooms. We have found that these teachers are re-invigorated by the real world manifestations of their subject matter, and they bring the amazing world of the national parks to their students. Young people may value what is virtual over what is real and true, mostly because technology has limited their experience of the authentic. The national parks change this perception.

We reach young people through a number of other mechanisms as well, such as the online Teaching with Historic Places, and the Junior Ranger program. Recently, the Secretary of the Interior announced a youth initiative, intended to help not only young people, but all Americans connect with the outdoors and, by default, culture and history.

We are currently examining ways to strengthen our educational role because we believe that the nature of the resources in our care make us uniquely suited to be a force in shaping the minds of coming generations. We have had discussions with the secretary of education and are exploring ways—through partnerships with government and the private sector—to fully realize our potential in this field. I have recently established the first position in my Washington Directorate solely devoted to interpretation and public education, not only in the parks themselves, but in classrooms across the country, and through the power of the internet.

Education is rapidly changing. The conventional learning environment of a generation ago is disappearing. Education today is less defined by the classroom and more by places like parks and museums. We are well-situated to take advantage of this change. What better places to form more civic-conscious, environmentally-aware Americans than where our highest ideals and our greatest treasures are commemorated and preserved? In these powerful settings, we can ask them, "Can you imagine being so moved by an idea that you would make the kinds of sacrifices these people did? Can you see the fragility of life on this planet and your responsibility to care for it?"

Economic relevance is an aspect of our national parks that probably doesn't get enough attention. Gateway communities—those cities and towns at the outskirts of the parks—benefit tremendously from park visitation. Some, in fact, depend on it. The money generated by the national parks has a more direct effect than any federal program could, since the funds go straight into the local community, where the benefit is immediate and tangible.

Urban parks, like New Bedford Whaling and Lowell, have helped revitalize cities whose traditional economies died long ago, leaving an empty urban core. And there is an antidote to the phenomenon of the shrinking, post-industrial American city in the ethos of the park idea itself. When manufacturing declined, cities like Detroit, Cleveland, Pittsburgh, and Baltimore emptied out as the jobs evaporated. With the plants and factories shut down, some cities found their historic fabric to be essential to a vital new identity. They discovered that the alternative to a bleak future was the past.

Historic districts, historic buildings, and the allure of the past have revitalized old downtowns and have made them economically viable. More developers understand that the cost of rehabilitating old buildings is actually an investment in the future, when these structures could be the showpieces of a revitalized city. The NPS administers the largest urban reinvestment tax credit program in the United States, bringing the values of the NPS right into many neighborhoods.

Whether this happens in the context of urban national parks or with local and private incentive, it is a hopeful trend. A public that embraces its built environment will understand the relevance of the national parks because there is a common sensibility at work, one that understands the value of preservation and heritage.

The parks have a role in our political and social discourse. They go to the heart of the American experience and American identity in all its diverse forms. When I served as liaison to the Second Century Commission, which was formed to draw out a vision for the National Park Service's next hundred years, a number of the country's best and brightest spent some time getting to know the parks and what they represent. One of them, former Supreme Court Justice Sandra Day O'Connor, wrote, "There's no better route to civic understanding than visiting our national parks. They're who we are and where we've been."

As many of you know, there has been a major change in the way the National Park Service tells the American story. We know that it is not one narrative, but many, and we have worked to tell the stories of those who have been ignored in the celebration of our past, of the once-disenfranchised, and the once-voiceless. We tell these stories at places like Manzanar with the Japanese-Americans who were denied their civil rights, at Cane River where we help keep the Creole culture alive, at Sand Creek where we tell of the massacre of native people, at Port Chicago where military racial discrimination came to an explosive end, and at Rosie the Riveter where women helped win the war. These stories reflect a more inclusive and more honest look at our history. At Civil War battlefields, the focus has shifted from maneuvers and tactics to the social, political, and economic conditions—such as slavery—that brought war in the first place.

These sites are powerfully symbolic, and they embody issues that are very much relevant to today: immigration, tolerance, the meaning of the Constitution, civil rights, war, labor, the environment. As such, they are critical to the nation's civic education and must be used in this way.

We're already doing that with place-based learning and lesson plans, such as Teaching with Historic Places. But the richness of the parks can be tapped a great deal more.

To emphasize the role parks in our society, we now regularly host citizenship ceremonies in partnership with the US Citizenship and Immigration Service, welcoming new Americans to their country and their national parks.

The social challenges we face as a nation will require the action of informed, engaged, open-minded adults. For instruction and inspiration, they can look to our national parks, where America's highest ideals are enshrined. Here, they learn about democracy, sacrifice, heroism, and hope, not just in the abstract, but in the very places where those concepts shaped our history. It would be difficult to come up with more relevant issues than these.

We are connected to our parks and public lands in ways that go beyond aesthetics and cultural meaning. Our national parks have always been loved for their symbolism and scenery, but their power to act as medicine and therapy is just beginning to be understood.

Our communities are built with convenience in mind: oriented to the automobile, the elimination of effort, and an abundance of high-calorie food. Obesity, heart disease, emphysema, diabetes, and cancer are the cost of sedentary modern living, of our increasing alienation from nature and the outdoors.

But what we are beginning to understand is how the outdoors can act as an antidote to the ills of modern living. More research is being done on how we respond to the natural world and on the surprisingly broad benefits of exercise outside.

Free of the limits of formal exercise routines, outside activity tends to be more varied and prolonged. By its nature, the outdoors encourages physical activity, and this is true especially for young people. The psychological benefit of natural light is well-known and there are indications that the outdoors can have positive effects on everything from stress to attention disorders to rates of healing.

I believe that our parks are a great untapped source of public health and that their benefits could be enormous. This is a critical point of relevance concerning the national parks that should be communicated to the public as often as possible. In fact, we are in the midst of promoting this new role for our public lands.

We recently established the National Park Service's Health Promotion Initiative, a broad effort to move public lands to the forefront of the discussion about public health and to bring lasting change in Americans' lifestyle choices, their nutrition, and their relationship with the outdoors. This is part of much broader movement, led by President Obama's America's Great Outdoors, and the First Lady Michelle Obama's Let's Move Outside, a multi-agency effort aimed at helping to conserve open space and reconnecting Americans, especially youth, to nature.

We are now working with health care providers to incorporate public lands into the treatments they prescribe for their patients. Under the Park Prescriptions program, physicians actually send patients to public lands for hikes, tours, and other forms of exercise. And of course, our longstanding Rivers, Trails, and Conservation partnership has been working for years to connect communities to their natural surroundings. Next month we will be participating in the Healthy Parks, Healthy People conference, part of a worldwide movement to link public health with public lands.

Given the unprecedented environmental challenges we're facing, the future will demand not only a new way of looking at the natural world and our place in it, but an understanding of how our physical well-being is tied to that of the environment. The national parks are going to be a critical factor in this equation.

While we are promoting healthy activity outdoors, we are also stressing that the outdoors itself must be cared for. We neglect the natural world at our own peril. There is a growing body of evidence suggesting that human health is linked to the health of our natural world. In encouraging people to get outside, two objectives are often achieved. People are not only healthier, but they can also begin to conceive of a natural order that is threatened. Through this realization, they might understand nature as an essential force that is part of being human, that we cannot exist in the absence of a healthy natural world.

Americans have always loved the parks. They might not always be able to tell you why this is, but the national parks have enjoyed an exalted status in the American mind, as if they were among the holy places of the nation. While this is no doubt a blessing, it is not one we should take for granted. A public that is unaware is indifferent, and an indifferent public will not support the parks in their time of need.

Relevance—and therefore, survival—means convincing the public that the national parks represent far more than an assembly of antique buildings and natural curiosities. They are national heirlooms that continue to teach us, which speak with the wisdom of the past, and can guide us through trials both present and future. They will be critical in helping us meet the critical needs of the future:

- A civil, informed social discourse and building a national community.
- An understanding of our vulnerable natural world and what we must do to maintain it.
- A model of sustainability where commerce and heritage are not mutually exclusive.
- An unparalleled, 85-million-acre national university that contains a wealth of teachable moments in every discipline from astronomy to literature.

We know that the relevance of the national parks is profound, that they hold limitless promise for our society, for our health, and for our planet. We in the National Park Service understand that it is our mission to communicate this to the world. We also know—and we're grateful for the fact—that the parks have a devoted constituency.

I look out at this audience and it's striking, the talent, the intellect, the innovation, and dedication that are represented in this society's members. In a word, the relevance of the national parks is transcendent. I am grateful to have you as allies in our effort to create a world where this is understood, embraced, and acted upon.

# The Ill-Fated NBS: A Historical Analysis of Bruce Babbitt's Vision to Overhaul Interior Science

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Nearly two decades have passed since the formation of the National Biological Survey (NBS)—adequate time to begin to examine from a historical perspective this turbulent crossroads for the U.S. Department of the Interior. The NBS was the creation of Bruce Babbitt who, by secretarial order, gathered nearly all research scientists from Interior's land management agencies into a new, independent bureau. The NBS was wildly unpopular from the start, both with the agencies that supplied the NBS its scientists, and a conservative Congress unwilling to fund the new bureau. Renamed the National Biological Service midway through its brief existence in the 1990s, the NBS did not survive the major political schism of its day. In 2011, as Congress and the Obama Administration battle over partisan ideologies and an unprecedented budget crisis, and with the possibility of a government shutdown looming over federal workers, echoes of the infamous 1995 to 1996 shutdown and the sharp partisan divide of that era, which defeated the NBS, are especially poignant—if not downright eerie.

The origins of the NBS date back to the 1980s, when ecosystem management emerged as the new paradigm in resource stewardship, at least in scientific circles. Agencies began to adopt this holistic approach to resource management only gradually, much to the chagrin of watchdog groups outside the federal government. Critics argued that both research priorities and resource protection were grossly inadequate across federal lands. In the case of the National Park Service (NPS), Richard West Sellars put this critique in historical perspective in his influential book *Preserving Nature in the National Parks*.

Much of the celebrated environmental legislation of the 1960s and 1970s—most notably the Endangered Species Act—had yet to be satisfactorily executed by federal land management agencies by the mid-1980s, and the patience of environmental advocates grew thin. Numerous lawsuits were filed against the U.S. government for failure to obey its own environmental laws. By the close of the decade, implementation of ecosystem management had effectively defaulted from the agencies to the courts. On a number of fronts, from the Florida Everglades to the old-growth forests of the Pacific Northwest, the fate of the nation's most vulnerable ecosystems depended upon the decisions of federal judges with no biological training. Court proceedings stalled, and increasingly judicial outcomes looked less likely to provide long-term solutions to critical envi-

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ronmental quandaries that pitted economic interests against saving species and landscapes. There had to be a better way. In this heated, contentious climate, a new political appointee in Washington decided that drastic times called for drastic measures.

Profound change came to the organization of the biological sciences within the Department of the Interior in 1993, with the arrival of the Clinton Administration. Soon after taking office, Interior Secretary Babbitt announced his grand plan to consolidate the biological research and inventory efforts across the department into one separate agency. The new NBS was to be independent from all the existing Interior bureaus. The NBS would parallel the U.S. Geological Survey (USGS) in its mission of collecting, analyzing, and disseminating scientific data without any entanglement in the regulatory and managerial responsibilities of its sister agencies. "What we are doing is strengthening the credibility of science," Babbitt said, by putting some distance between federal scientists and those in government who make policy and execute it. The NBS would also provide science to agencies beyond Interior, to state governments, to local governments, and to non-governmental organizations as well. Serving the gamut of science users, "NBS will provide the scientific knowledge America needs to balance the compatible goals of ecosystem protection and economic progress," Babbitt stated with confidence.[1]

Authorizing legislation for the NBS was introduced to both the House and the Senate in the summer of 1993. In support of the House bill, Babbitt testified that the swiftness with which he intended to transfer the department's biological functions into one agency was due in large part to mounting litigation challenging the Endangered Species Act. Getting on with a "systematic biological inventory of the entire nation at an appropriate scale and feasible level of detail" could help prevent future Endangered Species Act "train wrecks," such as the spotted owl case in the Pacific Northwest. This urgency aside, Babbitt was intent on consolidating his department's research capabilities and "getting good science across jurisdictional boundaries," a must for ecosystem management, he argued.[2]

But Babbitt didn't wait for congressional action to implement his idea. In September 1993, Babbitt established the NBS by secretarial order. The new agency was authorized to draw from existing personnel in the U.S. Fish and Wildlife Service (USFWS), the NPS, the Bureau of Land Management (BLM), the Minerals Management Service, the Office of Surface Mining Reclamation and Enforcement, the USGS, and the Bureau of Reclamation. Babbitt's order became effective in November with the passage of the 1994 Interior Appropriations Act, which allocated $163 million to NBS operations, most of which was transferred from the budgets of the research divisions of the other Interior agencies. Two-thirds of NBS appropriations for 1994 were drawn from the USFWS budget.

That fall, the House did pass a version of the NBS bill, albeit with amendments that Babbitt opposed. The Senate bill never left committee. The absence of an organic act for the new agency meant that the NBS's existence rode precariously upon a series of annual renewal orders from Secretary Babbitt's desk, and the budgetary whims of Congress, which did not, as it turned out, sanction funding for an independent NBS for long.[3]

When Babbitt approached University of Georgia ecology professor Ron Pulliam to be director of the NBS, Pulliam expressed concerns about Congress's poor track record of funding biological research in the Interior Department. Babbitt replied that with a Democratic president and a Democratic Congress, NBS support was a sure thing. The renowned ecologist reported for duty in Washington, in June of 1994. Personnel transfers from the various Interior agencies followed soon thereafter. Within a year, over 1,800 scientists and staff had been moved from the research divisions of other Interior bureaus into the NBS, the largest number—about 1,300 employees—coming from the USFWS. Most of its $110-million research program, the agency's largest single division, was transferred to the NBS. The NPS lost personnel, nearly 170 full-time positions and about $20 million in base funding. The BLM's science program was just gearing up in the early 1990s when the NBS "inherited" its 35 lead researchers, and $8-million annual science budget.[4]

At the start, Pulliam was optimistic that the NBS could be that objective scientific authority upon which federal and state land managers, as well as private landowners, could depend for data necessary for responsible and conscientious decision making.[5] Babbitt envisioned greater efficiency, and the capacity to tackle more complex, cross-jurisdictional ecological problems. He also stressed that a science delivery system independent of Interior policy makers and resources managers would more likely produce consistently unbiased data.

But almost immediately, a very vocal contingent of the American public came to view the NBS as the exact opposite of neutral or impartial. Many opponents of the NBS believed the new agency to be a troop of advocate scientists intent on locating endangered species on private property, and these scientists would serve as harbingers of dreaded Endangered Species Act restrictions, deflated land values, and even land seizure. As Pulliam traveled around the country to meet with groups of citizens concerned about the NBS and private property rights, he soon realized "an organized misinformation campaign" launched by "wise-use" proponents was one step ahead of him. "I was told that NBS scientists would soon be cutting fences in the middle of the night and trespassing on private property with the aid of hoards of untrained volunteers, most of whom were probably card-carrying members of radical groups like Greenpeace and Earth First," Pulliam recalled. Many people mistakenly believed that the NBS was to undertake a comprehensive new "ocean-to-ocean" survey of all the nation's plants and animals, across all public and private lands, an undertaking that far exceeded any possible combination of governmental fiscal resources. In fact, the NBS inventory program constituted less than 15 percent of the agency's efforts, while the bulk of its work was a continuation of research programs initiated by its parent agencies. Despite Pulliam's best education efforts, letters of protest against the NBS flooded U.S. congressional offices, and NBS support on Capitol Hill was anything but secure.[6]

In November of 1994, the Republicans won majorities in both the House and the Senate for the first time in four decades. In January 1995, Speaker of the House Newt Gingrich set about to implement his party's "Contract with America," a list of promises upon which a united Republican front rode to victory in the midterm elections. Among the conservative reform measures of the contract was the elimination of the NBS, and debates over the purpose and legitimacy of the NBS intensified in the 104th Congress. In a revealing memoir of his time as NBS director, Pulliam recounted a number of harrowing exchanges with the agency's most ardent opponents, both in Congress and across the country. These people considered the NBS "the private property owner's worst nightmare."[7]

The NBS was also extremely unpopular with many Department of the Interior employees. A common criticism from within Interior agencies was that the NBS goal to prioritize long-range, ecosystem studies would displace the short-term, site-specific research that resource managers relied upon most. While study of "the big picture" was commendable, park, refuge, and BLM managers still needed science-on-demand to address problems as they arose. Many NBS scientists did remain in their previous field locations, working on the same research for their parent agency, but in time the work of many of these people began to drift from what they had pursued as in-house researchers. Critics also called for some sort of rules securing the validity of NBS-produced science, including systematic training for volunteer data collectors, and peer review of NBS reports.[8]

Interior agencies were not happy to relinquish their science divisions to the NBS, and many of the scientists were disgruntled about their transfer into the NBS. These individuals were uprooted from the agency culture and mission they had been part of for years, often decades, to join forces with other scientists of differing agency cultures and priorities. "The human side of that equation," merging the Interior biological scientists into some sort of NBS solidarity, was a daily struggle for the new organization, recalled Denny Fenn, a former NPS scientist and administrator, who became Pulliam's deputy director. Some NBS scientists also found it hard to retain solid relationships with, and respect from, their former colleagues in their former agencies. "We were no longer one of them, we had become somebody else," Fenn said.[9]

Although Secretary Babbitt did not tinker with the organizational structure of the NBS, he did attempt to appease NBS critics by changing the agency's name to the National Biological Service in January 1995. The name change was intended to dispel the misperception that the agency's sole undertaking was a blanket survey of all biota across the nation, on both public and private lands—or worse yet, a fanatical drive to find endangered species and seize private property. The new secretarial order addressed other sticky issues as well, including, on the subject of private property access, the requirement of prior approval by land owners.[10]

But these terms did not move Congress. After funding the NBS at levels below the administration's requests for its first two years, both the House and Senate voted in the spring of 1995 to cut the fledgling agency's already barebones budget by almost nine percent. President Bill Clinton vetoed this bill, but in light of the new Congress's resolute hostility toward the NBS, Director Pulliam began to ponder which NBS facilities to shut down, should Congress succeed in slashing the NBS budget drastically the next fiscal year. Since the assembly of NBS scientists still lacked administrative support and any kind of cohesive structure, the new agency's viability depended upon "ramped up" funding from Congress. Yet the opposite trend was obvious. NBS opponents were also talking more forcefully about terminating the NBS altogether. They questioned Babbitt's authority to establish the NBS in the first place. In lieu of an organic act, Babbitt had collected an assortment of statutes sanctioning ecological research from across the Interior Department as authorization for the NBS. Congress could abolish the NBS by simply denying its appropriations.[11]

The NBS lasted as an independent agency only three years. After starving the NBS of funding for those three years, Congress excluded it altogether from the 1997 Interior budget, and in October 1996, the NBS ceased to exist. All NBS scientists merged into the USGS, forming a new USGS branch, the Biological Resources Division (BRD), which was later renamed the Biological Resources Discipline. Despite BRD's improved stability within the USGS, Interior agencies remained dissatisfied with BRD's ability to deliver them research that was relevant to their management needs.[12]

When Interior Secretary Babbitt and NBS Director Pulliam could see the end was near for the NBS, they lobbied moderate Republicans in Congress to salvage the department's doomed science program. Babbitt saw the USGS as an appropriate home for NBS scientists, since it operated independently from all regulatory and policy-making agencies within Interior. The transfer to the USGS was a good political compromise. "The Republicans could take credit for abolishing the NBS, but yet Interior's biological capabilities would remain intact, as part of the USGS," said Denny Fenn, who assumed leadership of the NBS scientists when Ron Pulliam resigned, and became the first USGS associate director of biology.[13]

Some people agreed with Fenn that Babbitt's NBS was an admirable idea, at least in theory, but the political timing of its implementation could not have been worse, and Babbitt was unable to effectively communicate his vision to an antagonistic Congress. Yet with failure came opportunity. As the Republican Congress reined in budgetary spending, the Clinton Administration encouraged all sorts of creative means to "reinvent" government. This reform effort, spearheaded by Vice President Al Gore, challenged agency employees to overhaul their operations so that government could "work better and cost less." For innovators within the Interior Department, Gore's "reinventing government" initiative provided fertile soil for new means of science delivery. "We had a wide open field to rethink things," said University of Idaho professor Gary Machlis, who together with Mike Soukup, natural resource chief for the NPS, devised the plan for the Cooperative Ecosystem Studies Unit (CESU) Network. Today, the CESU Network includes federal agencies beyond the Department of the Interior, and represents one positive, far-reaching legacy of the ill-fated NBS.[14]

*This paper is part of larger administrative history of the CESU Network, which facilitates partnerships between federal land managers and university researchers with natural and cultural resources expertise.*

## Endnotes

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# The Next Century of the World's First National Park Service

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*[Ed. note: Mr. Latourelle addressed the plenary session of the conference on Thursday, March 17.]*

THE FUTURE OF PROTECTED AREAS IS DEEPLY ROOTED IN THE PREMISE THAT OUR COLLECTIVE objective is to preserve not just the places and the things that remind us of who we are, but also the chance for our children to connect to those legacies in truly meaningful ways, and that in a more crowded world there will be even greater need for places of refuge and reflection—in the future, National Parks and National Historic Sites will become more important, not less. Wallace Stegner described wilderness as the "geography of hope." My fundamental belief is that hope matters—that future generations will need hope even more than those alive today.

Today we worry about nature and historic deficit in young people, the leaders of tomorrow, we worry about endangered species and their endangered habitats, and we are concerned about what will happen to our economies, ecologies, and stories in the face of rapid climate change.

In a mobile and urbanizing world, many people live where they were not born, are not as connected as we once were to the deep idea of home place, and defining moments of our country. We all know that mobility and urbanization are trends that will only increase. So what is the antidote to all this forgetfulness and all these worries?

We, the Parks Canada team, know what it is—the antidote is to keep, for all time unimpaired, the world's finest examples of its diverse ecosystems and its cultural heritage, and to use those national treasures to awaken wonder, inspire hope, build understanding, renew collective memory, and contribute to nation building.

This is a monumental task and challenge, but one that this generation of Parks Canada leaders are better equipped than ever before to take on, and show real, effective leadership. It will not be easy, but it will be rewarding, and our biggest reward will be the sense of accomplishment of having given our great, great grandchildren a future of hope, inspiration, and collective duty to protect the defining moments and iconic places that define who we are as a country.

National Parks and National Historic Sites are not just arks of conservation, keeping the world's living possibilities alive in the face of massive landscape change. They are places for people to find themselves, and one another, through inspiring experiences and shared endeavor.

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These are places of healthy physical activity, of mental stimulation, of spiritual and historical reawakening, and of renewal of our fundamental human-ness. They are places of hope.

I don't think this is new thinking to anyone in Parks Canada. But the challenge we share is this: what if we have what everyone needs, but nobody knows or cares? The days when we could count on most citizens being aware of their national parks and historic sites, and being inclined to experience them, are behind us. It is entirely possible to live out one's whole life today without ever once contemplating a visit to a park or historic site.

So are parks and sites heading for oblivion? The Canadian Oxford Dictionary defines "oblivion" as "the state of being forgotten or disregarded." For me, there is no doubt that parks and sites are headed that way, from an ecological, historical and societal perspective, unless we act decisively.

The reason they could be headed for oblivion is simply that our distracted, busy world is losing sight of them. It seems obvious to me that the case for conservation and investment in conservation will be harder to argue in the future as increasingly, population growth and resource depletion shift our sense of the world from a place of abundance to a place of shortages. The un-cut forests, un-dammed rivers, un-mined ore, and un-farmed soils of protected areas could, and I underline could, increasingly look like easy resource solutions in an ever-hungrier world.

In the same way, our heritage buildings and historic places could increasingly look like wasted real estate in a more-crowded world.

There are those who sit back and breathe sighs of relief once park or historic site legislation is passed, or a new national park is formally signed off on—but they fool themselves. Because they can be as easily unmade as they are made—they are, after all, only the result of a society's choices. Society's choices can change.

In the long run, the only real protection we can offer to these special places is a passionately engaged citizenry—people who have found, experienced, and bonded to their heritage, and see these places as being as essential as the family heirlooms they would never part with, no matter how dire their circumstances.

So it's a feedback loop: people need parks, and parks and sites need people. If people don't value them, then those parks and sites could eventually be decommissioned, and put to other uses. So is that just fear mongering? I say no.

Just look back at our history in Parks Canada. For example where four national parks were abolished in the 1930s and 1940s because it was felt at that time that they had met their objective of increasing bison populations. Also, during the last generation, we have lost 20 percent of Canada's pre-1910 heritage buildings.

The worst possible conservation strategy for parks and sites, then, is to keep people from them, or to fail to reach out and find the people who currently aren't involved with them. In the last century, we often heard about the conflict between protection and use. In this century, it is absolutely critical that we embrace the unity of protection and use… so that in the next century, when we need parks and sites more than ever, the biodiversity, cultural heritage, inspiration, and hope that collectively sit at the heart of the national park and sites idea, will persist. It is vital work, because a world that surrenders its protected places, is a world that has surrendered hope. My friends, if we surrender hope, we are cheating future generations of the best gift we can bequest to them.

Parks Canada team members are proud to have celebrated the 125th anniversary of the creation of Banff National Park last year. And we are equally proud to be celebrating the centennial of the Dominion Parks Service, as Parks Canada was originally called, this year. As we enter our second century of service to Canadians, our vision is clear: "Canada's treasured natural and historic places will be a living legacy, connecting hearts and minds to a stronger, deeper understanding of the very essence of Canada."

The Parks Canada team is delivering on our mandate, and implementing our vision through a three pronged strategy that has really challenged us to take a very serious look at our organization and our programs. The three elements are the following:

1. Protecting our parks and sites.
2. Connecting Canadians to their parks and sites on their terms.
3. Bringing our parks and sites to Canadians where they live.

In terms of protection, there are three tenets to our actions: protect, connect, restore. We are working to protect large, intact landscapes by creating large-scale protected areas, and then protecting the flora and fauna within them. We are protecting our level one cultural resources and their stories. We are working to connect landscapes by working with adjacent landowners, conservation organizations, and recreationalists to improve wildlife mobility and protect the sense of place of our National Historic Sites.

And we are restoring ecosystems and species though concrete, action on the ground activities. The restoration of the Garry oak ecosystem, and the reintroduction of the bison and the black-footed ferret on the Canadian prairie, in collaboration with Canadian and U.S. partners, is something that we can all celebrate. We have embarked on the most significant restoration program ever seen in our history. We currently have big scale restoration initiatives in 50 percent of our national parks through a $90 million investment over a five-year period. We have recently made multi-million-dollar investments to restore our national historic sites and those of our partners.

All of these initiatives are strongly supported by quality science, and citizen engagement programs that will allow us to measure the ecological and historical return on investment, and demonstrate the benefits of restoration. To give you a sense of the magnitude of our protection results, our partnerships with aboriginal peoples and other levels of government has allowed the Government of Canada to increase the area of lands and waters to be managed by Parks Canada by 48 percent since 2006, through legislation and signed agreements. To put it in perspective, this represents an area fifteen times the size of Yellowstone National Park in the USA, and twenty times the size of Banff National Park in Canada.

Our recent establishment achievements, to name a few, include the following:

- The six-fold expansion of Nahanni National Park Reserve, referred to by some as the greatest conservation achievement in a generation in Canada.
- The establishment of Gwaii Haanas National Marine Conservation Area Reserve and Haida Cultural Site, one of the first protected areas in the world that protects an ecosystem from mountain top to ocean floor.
- The creation of Lake Superior National Marine Conservation Area, the largest fresh water protected area in the world.
- A federal-provincial agreement to create a national park in the Mealy Mountains of Newfoundland and Labrador, an undertaking that will protect a massive swath of Canada's boreal forest, and help ensure the survival of traditional aboriginal knowledge and culture.
- Measures to protect and create Lancaster Sound, the most biologically productive area of Canada's arctic, and truly the Serengeti of the Arctic.
- And the protection of Sayou Edacho National Historic Site, the largest protected cultural landscape in the world.

I am very proud of the Parks Canada team's recent accomplishments. However, our job is still not done and we will do more in the years ahead. Because at Parks Canada, we are protecting these places with, and for, Canadians. Not from Canadians.

Indeed, virtually every national park that has been created in the past forty years has been achieved in direct collaboration with First Nations, aboriginal communities, and in partnership with diverse groups of interested parties. The same is true of our species recovery strategies and our national historic site cost-share program.

The second part of our strategy is to connect Canadians to their parks and sites, on their terms. Much can and has been said on the subject of connection, but I would like to refer specifically to the new generation, sometimes called "Generation Me," which must be a priority for us to ensure our parks and sites are not forgotten.

Much has been written about Generation Me's demand for services and products that are very specific to their individual desires. It is not a coincidence that the corporate world, in response, has given rise to names like iTunes, MySpace, Facebook where they chose their friends, and YouTube; and those companies provide the opportunity for consumers to alter products to their specific individual tastes.

For those of us in the business of conservation and presentation, we must ask ourselves how can we take that thinking and apply it to our business. Where is "MySpace" in a national park or national historic site? Where's the "iCanoe" or "iRe-ennact" experience that I have individually tailored to my needs? Where's the "YouExplore" opportunity? As we strive to ensure that more Canadians experience their national parks and national historic sites, we have moved from providing services, to facilitating memorable experiences as defined by our clients.

Accordingly, our visitor experience strategy is as follows:

- Identify target markets—identify the segments with long-term potential, giving special consideration to new Canadians, young families, young adults (18-34) and school-aged children.
- Diversify and renew—diversify and renew visitor experience opportunities to attract and grow target market segments (e.g. My Parks Pass, Xplorers program, renewal of our accommodation service offer, concert in NHS, etc.).
- Promote—promote visitor experience opportunities to target market segments through an increasing profile in national and regional media.

All of these new programs are based on solid social science knowledge. So why is increasing visitation so critical? I will just share with you one statistic from our recent national poll: the majority of Canadian national park and sites visitors (86 percent) would miss national parks and sites if they were gone, compared to just 39 percent of Canadians who have not visited. So, connecting the hearts and minds of Canadians to our national parks and sites starts with a physical connection, on site.

The third element of our strategy, to bring our parks and sites to Canadians where they live, includes the following goals:

- Increase awareness and reach, visibility, and initial connection. Expand Parks Canada's reach, increase its visibility, and provide relevant opportunities for Canadians' initial connection with Parks Canada, with a particular focus on urban and new Canadian audiences in Montreal, Toronto, and Vancouver.
- Increase interactions with younger Canadians. Provide increased opportunities for Canadians to interact with Parks Canada in their homes, schools and places of leisure, with a particular focus on youth (8-17), and young adults (18-34) in Canada's largest urban areas.
- Grow and diversify base of support. Grow and diversify Parks Canada's base of support by providing a range of relevant opportunities for the engagement of stakeholders and

partners in Parks Canada's activities in all program areas, in a manner that is aligned with their interests.

Programs we have developed to fulfill those goals include the following:

- My Parks Pass: A special entry pass provided to grade eight students across Canada that permits them free access to our parks and sites, a My Parks Pass website, classroom material, and class trips to parks and sites.
- Canada's Greatest Summer Job: A national initiative designed to immerse youth in parks, sites, or marine areas over the summer, and in turn have them engage with other youth. In 2010, the initiative involved hiring 32 budding student videographers to produce videos for Parks Canada's YouTube channel and website. A new format is forthcoming for 2011.
- Centennial Celebrations: A concert Series, 100th Anniversary Launch, in the heart of Toronto.
- Parks Canada: Experience camping.
- Cultural Access Pass. New Canadian citizens will be offered a Cultural Access Pass which offers them free entry into over 100 cultural attractions. This collaboration will give new Canadian citizens the opportunity to visit Parks Canada free of charge for one year.
- Contribute to development of Urban Natural Playgrounds.
- National Broadcast Initiatives: Broadcast initiatives featuring Parks Canada that are national in scope, covering multiple places across the country, or focusing on the mandate and responsibilities of the agency as a whole (e.g., A Park for All Seasons, National Parks Project, 15-part series on World Heritage Sites in Canada, etc.).
- Use of Social Media: Use of national social media channels (e.g., YouTube, Facebook, Twitter) or park- or site-specific channels (e.g., Point Pelee tweeting for the birds) to reach specific audiences that use these platforms.

In closing, during discussions with our team members about leadership, I often say that my definition of leadership is "someone who has the courage to dream and the ability to engrain that dream in the heart and mind of others." Through the leadership that I see firsthand, at all levels and in all functions of the agency, we are collectively assuming the leadership required by this generation of Parks Canada team members to ensure a future of hope for the yet unborn generations of Canadians. We are all individually doing so with passion, pride, and professionalism through our "one team, one vision" approach to our daily activities. As we start our second century, we should all take great pride in our historical accomplishments, as they were described in a recent Globe and Mail article: "Parks Canada oversees one of the most extensive, best managed, and highly respected park systems in the world … It should be a fantastic source of pride for all Canadians."

# Le Prochain Siècle du
# Premier Service des Parcs au Monde

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*[La note d'éditeur : M. Latourelle a adressé la session plénière de la conférence le jeudi 17 mars.]*

L'avenir des aires protégées tire ses racines profondes dans la prémisse que notre objectif commun est de préserver non seulement les endroits et les ressources qui nous rappellent qui nous sommes, mais aussi d'offrir l'occasion à nos enfants de se rapprocher de façon vraiment significative de ce patrimoine. Dans un monde où l'espace se fait de plus en plus rare, le besoin pour des lieux de refuges et de réflexion ira croissant. Les parcs nationaux et les lieux historiques nationaux gagneront ainsi en importance, pas le contraire. Pour Wallace Stegner, les aires naturelles représentent « la géographie de l'espoir ». Je crois fondamentalement que l'espoir est un atout précieux et qu'il le sera encore davantage pour les générations futures.

De nos jours, nous nous questionnons sur la protection de la nature et sur le déficit de connaissances historiques chez les jeunes, nos leaders de demain; nous sommes soucieux de sauvegarder les espèces en péril et leurs habitats en voie de disparition; nous sommes préoccupés de ce qui arrivera à nos économies, à nos écologies et à nos repères culturels en marge de rapides changements climatiques.

Dans un monde où les populations sont de plus en plus mobiles et urbanisées, une multitude de gens ne vivent plus où ils sont nés et ne se sentent pas aussi attachés qu'avant à l'idée profonde d'un chez soi et aux moments marquants de l'histoire de notre pays. Nous savons tous et toutes que la migration et l'urbanisation sont des tendances qui ne feront que s'accroître. Quel est donc l'antidote à tant d'oubli et de préoccupations?

Nous, les membres de l'équipe de Parcs Canada, connaissons cet antidote. Il s'agit de conserver intacts et à jamais les meilleurs exemples de nos écosystèmes si diversifiés et de notre patrimoine culturel si riche, puis de recourir à ces trésors nationaux pour engendrer l'émerveillement, susciter l'espoir, améliorer la compréhension, renouveler notre mémoire collective et contribuer au développement du Canada.

C'est là une tâche monumentale. La génération actuelle de leaders de Parcs Canada est toutefois mieux équipée que jamais pour relever ce défi et faire montre d'un véritable leadership. Ce ne sera pas facile, mais ce sera gratifiant. Notre plus grande récompense sera le sentiment de satisfaction d'avoir légué à nos arrière-arrière-petits-enfants un avenir offrant l'espoir, la motivation et le sens du devoir collectif nécessaires à la protection des moments marquants et des endroits remarquables qui façonnent l'identité de notre pays.

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Les parcs nationaux et les lieux historiques nationaux ne sont pas que des îlots de conservation sauvegardant des facettes de vie en marge d'immenses changements des paysages. Ce sont des endroits où, grâce à des expériences uniques et à des activités communes, les gens peuvent se ressourcer et mieux se connaître, seuls ou en groupe. Ce sont des lieux de saines activités physiques, de stimulation mentale, d'éveil spirituel, d'apprentissage de l'histoire et de renouvellement de notre humanité fondamentale.

### Des lieux d'espoir

Je ne crois pas que ce soit là une idée neuve pour qui que ce soit à Parcs Canada, mais notre défi est le suivant : peut-être avons-nous ce dont tout le monde à besoin, mais personne ne le sait ou n'y prête attention? Le jour où nous pourrons considérer que la plupart de nos concitoyens connaissent leurs parcs nationaux et leurs lieux historiques nationaux et qu'ils sont enclins à s'y rendre est déjà derrière nous. Il est tout à fait possible de nos jours de vivre toute une vie sans jamais même envisager une fois de visiter un parc ou un lieu historique.

Ces parcs et ces lieux sont-ils donc sur la voie de l'oubli? Le Multidictionaire de la langue française définit l'« oubli » comme le « Fait de perdre le souvenir de quelqu'un, de quelque chose ». Quant à moi, il ne fait aucun doute que cette définition est à même de s'appliquer selon une perspective écologique, historique et sociale, à moins que nous agissions de façon décisive.

Les parcs et les lieux pourraient en effet tomber sur la voie de l'oubli pour la simple raison que le rythme de vie trépidant de notre société fait en sorte que les gens y prêtent de moins en moins attention.

Pour moi, il est évident qu'il sera avec le temps sans cesse plus difficile de défendre la conservation et l'idée d'investir dans celle-ci, car la croissance démographique incessante et l'épuisement des ressources modifient notre perspective du monde, pour la faire ainsi passer d'une perception d'abondance à celle de pénurie. Les forêts et le minerai non exploités, les rivières non endiguées et les terres non cultivées des aires protégées pourraient, et je souligne ici le mot « pourraient », de plus en plus apparaître comme des solutions faciles à exploiter pour un monde toujours plus avide de ressources.

De la même façon, nos édifices et lieux patrimoniaux pourraient, dans un monde où l'espace se fait de plus en plus rare, être vus comme des surfaces occupées perdues.

Certains baissent la garde et poussent un soupir de soulagement lorsqu'une loi sur un parc ou sur un lieu historique est adoptée ou qu'un parc est officiellement établi; mais ils s'illusionnent. Ces mesures sont aussi faciles à révoquer qu'à mettre en œuvre. Elles ne sont, en fin de compte, que le résultat de choix de société. Et les choix de société peuvent changer avec le temps.

À long terme, la seule protection réelle que nous pouvons offrir à ces endroits spéciaux est un engagement social des citoyens, de gens qui ont pris contact avec leur patrimoine, qui en ont fait l'expérience et qui s'y sont attachés et qui voient ces trésors comme aussi essentiels qu'un héritage familial duquel ils ne se départiraient jamais quelle que soit la situation.

Cela devient donc une boucle de réaction : la population a besoin de parcs et de lieux / les parcs et les lieux ont besoin de la population. Si la population ne voit pas l'importance des parcs et des lieux, ceux-ci pourraient un jour être déclassés et servir à d'autres usages. Est-ce là de la simple paranoïa? Je ne pense pas.

Par exemple, en examinant un peu l'histoire de Parcs Canada, on peut constater que quatre parcs nationaux ont été abolis durant les années 1930 et 1940, parce qu'on avait jugé à l'époque qu'ils avaient rempli l'objectif initial de leur création, soit l'augmentation des populations de bisons. De plus, au cours de la dernière génération, nous avons perdu 20 pour 100 des édifices patrimoniaux qui avaient été construits avant 1910.

Par conséquent, la pire stratégie possible de conservation des parcs et des lieux est de ne pas en favoriser l'accès par la population ou de ne pas chercher à mieux communiquer avec nos concitoyens qui les connaissent peu ou pas. Au cours des cent dernières années, il a été souvent question du conflit entre protection et utilisation. Au cours du siècle à venir, il est absolument essentiel que nous préconisions l'intégration de ces deux concepts, de façon à ce qu'au fil des cent prochaines années, alors que nous aurons plus que jamais besoin des parcs nationaux et des lieux historiques nationaux, pourront persister la biodiversité, le patrimoine culturel, la motivation et l'espoir qui sont au cœur même du concept de ces parcs et de ces lieux. Il s'agit là d'une tâche cruciale, car un monde qui abandonne ses aires protégées renonce à l'espoir. Et mes amis, si nous abandonnons cet espoir, nous trahissons les générations futures et renonçons à leur laisser le plus beau cadeau que nous puissions leur offrir.

Les membres de l'équipe de Parcs Canada sont fiers d'avoir célébré l'an dernier le 125e anniversaire de la création du parc national Banff. Nous sommes tout aussi fiers de fêter cette année le centenaire de la création de la Division des parcs du Dominion, nom initial de Parcs Canada. À l'amorce de ce deuxième siècle au service de la population canadienne, notre vision est claire : « *Les trésors historiques et naturels du Canada occuperont une place de choix au cœur de la vie des Canadiens, perpétuant ainsi un attachement profond à l'essence même du Canada.* »

L'équipe de Parcs Canada met en œuvre notre mandat et notre vision grâce à une stratégie à trois volets. Cette stratégie nous a sérieusement mis au défi d'examiner en profondeur notre organisation et nos programmes.

Ces trois volets sont :

1. Protéger nos parcs et nos lieux.
2. Rapprocher les Canadiens des parcs et des lieux, en fonction de leurs propres besoins et exigences.
3. Permettre aux Canadiens de faire l'expérience des parcs et des lieux, à partir ou à proximité d'où ils vivent.

En matière de protection, nos trois principes d'intervention sont : protéger, rapprocher, restaurer. Nous travaillons à sauvegarder d'immenses territoires naturels en créant des aires protégées à grande échelle, puis en y préservant la flore et la faune. Nous protégeons nos ressources culturelles de niveau 1 et leur histoire. Nous nous appliquons à tisser des liens entre paysages en collaborant avec des propriétaires fonciers locaux, avec des organisations vouées à la conservation et avec des professionnels en loisir en vue de faciliter les déplacements fauniques et de protéger la valeur d'évocation de nos lieux historiques nationaux.

Et nous restaurons des écosystèmes et des espèces par des mesures concrètes sur le terrain. Le rétablissement de l'écosystème du chêne de Garry et la réintroduction du bison et du putois d'Amérique dans les Prairies canadiennes, en collaboration avec des partenaires canadiens et américains, sont des réalisations dignes d'être célébrées. Nous nous sommes lancés dans le plus important programme de restauration de notre histoire. Des initiatives de restauration d'envergure sont en cours dans 50 pour 100 de nos parcs nationaux grâce à un investissement de 90 millions de dollars sur cinq ans. Nous avons récemment effectué des investissements de plusieurs millions de dollars afin de restaurer des lieux historiques nationaux qui nous appartiennent et qui sont administrés par nos partenaires.

Toutes ces initiatives sont fortement soutenues par des programmes scientifiques et de mobilisation publique qui nous permettront de mesurer le rendement de ces investissements tant sur le plan écologique qu'historique et de démontrer les avantages de la restauration. Pour se donner une meilleure idée de l'importance de nos résultats en matière de protection, il faut noter que nos partenariats avec les peuples autochtones et avec les autres ordres de gouvernement ont permis au gouvernement du Canada d'accroître de 48 pour 100 la superficie des territoires et des eaux administrés par Parcs Canada depuis 2006, grâce à l'adoption de lois et à la signature d'ententes. Pour mettre les choses en perspective, cela représente une zone quinze fois plus grande que le parc national américain Yellowstone et vingt fois plus grande que le parc national du Canada Banff.

Nos réalisations récentes au chapitre de la création d'aires protégées comprennent ce qui suit :

- La multiplication par six de la superficie de la réserve de parc national Nahanni, ce qui selon certains constitue la plus grande réalisation en matière de conservation au cours de la dernière génération au Canada.
- L'établissement de l'aire marine national de conservation et du site du patrimoine haïda Gwaii Haanas, une des premières aires protégées au monde préservant un écosystème depuis la cime des montagnes jusqu'aux profondeurs des océans.
- La création de l'aire marine nationale de conservation du Lac-Supérieur, plus grande zone protégée d'eau douce au monde.
- Une entente fédérale-provinciale visant à créer un parc national dans les monts Mealy, à Terre-Neuve-et-Labrador, un projet qui protégera un immense couloir de forêt boréale canadienne et aidera à assurer la sauvegarde de connaissances et d'éléments culturels autochtones.
- Des mesures pour protéger et créer l'aire marine nationale de conservation du Détroit-de-Lancaster, la zone marine la plus productive de l'Arctique canadien et considérée comme le Serengeti de l'Arctique.
- La protection du lieu historique national Sayou Edacho, plus grand paysage culturel protégé au monde.

Je suis extrêmement fier des réalisations récentes de l'équipe de Parcs Canada. Il nous reste cependant beaucoup à accomplir et nous ferons encore davantage au cours des années à venir. Parce qu'à Parcs Canada, nous protégeons ces endroits avec la population canadienne et non contre celle-ci.

En effet, pratiquement tous les parcs nationaux qui ont été créés au cours des quarante dernières années l'ont été en collaboration directe avec des Premières nations et des communautés autochtones ainsi qu'en partenariat avec les divers groupes et intervenants concernés. Il en est aussi ainsi de nos stratégies de rétablissement d'espèces et de notre programme de partage des frais des lieux historiques nationaux.

Le deuxième volet de notre stratégie consiste à rapprocher la population canadienne de ses parcs et lieux, en fonction de ses propres besoins et exigences. Beaucoup a déjà été dit au sujet d'un tel rapprochement avec les parcs et les lieux, mais j'aimerais plus précisément parler de la nouvelle génération de Canadiens, quelquefois appelée la « génération moi d'abord », que nous devons prioritairement cibler pour veiller à ce que nos parcs et lieux ne soient pas oubliés.

Beaucoup a été écrit sur leurs exigences pour des services et des produits très adaptés à leurs désirs individuels. Ce n'est pas une coïncidence si le monde des affaires a donné suite à ces désirs en créant de noms mettant l'accent sur le soi, comme iTunes, MySpace, Facebook (où les utilisateurs peuvent choisir leurs amis) et YouTube. Ces entreprises permettent aux consommateurs de modifier les produits selon leurs goûts personnels.

Ceux et celles d'entre nous œuvrant dans le monde de la conservation et de la mise en valeur devons nous demander ce qu'il y a à retenir de cette façon de procéder et comment l'appliquer à nos activités. Où est « MySpace » [MonEspace] dans un parc national ou un lieu historique national? Où puis-je me dire « iCanoe » [jePagaie] ou « iRe-enact » [jeReproduis] une expérience que j'ai personnalisée selon mes besoins? Où est l'occasion pour pouvoir affirmer que

"YouExplore" [VousExplorez]? Pour être en mesure d'offrir à davantage de Canadiens la possibilité de faire l'expérience de leurs parcs nationaux et de leurs lieux historiques nationaux, nous sommes passés d'un concept d'offre de services à un concept d'offre d'expériences mémorables telles que définies par nos clients.

En conséquence, notre stratégie relative à l'expérience du visiteur est la suivante :

- Déterminer les marchés cibles—Identifier les segments de marché avec du potentiel à long terme, en portant une attention particulière aux nouveaux Canadiens, aux jeunes familles (18-34) et aux enfants d'âge scolaire.
- Diversifier et renouveler—Diversifier et renouveler les types d'expérience du visiteur en vue d'attirer et d'augmenter les segments de marchés ciblés (p. ex., Mon Passeport Parcs, le programme Jeunes Explorateurs, le renouvellement de notre offre de service en matière d'hébergement concerts dans les lieux historiques nationaux et autres).
- Promouvoir—Promouvoir des expériences auprès des visiteurs appartenant aux segments de marché ciblés, grâce à une visibilité accrue dans les médias nationaux et régionaux.

Tous ces nouveaux programmes ont été créés sur la base de solides connaissances en sciences sociales. Mais pourquoi est-il si important d'accroître le nombre de visiteurs? Je vous répondrai par une statistique tirée de notre récent sondage national : la majorité des visiteurs canadiens de nos parcs et lieux (86 pour 100) indiquent que ces endroits leur manqueraient s'ils venaient à disparaître, à comparer à seulement 39 pour 100 chez ceux qui ne les ont jamais visités. Par conséquent, le rapprochement émotif et intellectuel entre le public et nos parcs et lieux commence par un rapprochement physique sur place.

Pour ce qui est du troisième volet de notre stratégie, soit Permettre aux Canadiens de faire l'expérience des parcs et des lieux à partir ou à proximité d'où ils vivent, les éléments clé s'établissent comme suit :

- Mieux sensibiliser/communiquer, Visibilité et Prise de contact initiale—Améliorer la communication liée à Parcs Canada, accroître la visibilité et offrir des occasions pertinentes d'une prise de contact initiale avec Parcs Canada, en portant une attention particulière aux populations urbaines et aux nouveaux Canadiens à Montréal, Toronto et Vancouver.
- Interactions accrues avec les jeunes Canadiens—Offrir plus d'occasions aux jeunes Canadiens d'interagir avec Parcs Canada dans leur propre foyer, à l'école ou dans des lieux de loisir, en portant une attention particulière aux jeunes (8 à 17 ans) et aux jeunes adultes (18 à 34 ans) des principales régions urbaines du Canada.
- ccroître et diversifier la base de soutien—Accroître et diversifier la base de soutien à Parcs Canada en offrant une gamme de possibilités opportunes favorisant l'engagement d'intervenants et de partenaires envers les activités de Parcs Canada dans tous les domaines de programmes, en fonction de leurs intérêts.

Voici certains exemples de nos efforts :

- Mon Passeport Parcs—Un laissez-passer spécial offert aux élèves de secondaire 2 (8e année) des quatre coins du Canada, qui leur donne droit d'accéder gratuitement à nos parcs et lieux; le programme comprend également un site Web, du matériel pédagogique et des sorties de classe dans des parcs ou lieux.
- Le meilleur emploi d'été au Canada—Une initiative estivale nationale dans les parcs, les lieux et les aires marines, grâce à laquelle des jeunes travaillent dans ces endroits et

témoignent de leurs expériences pour susciter l'engagement d'autres jeunes envers ces trésors patrimoniaux. En 2010, cette initiative a permis l'embauche de 32 étudiants vidéo reporters chargés de produire des vidéos diffusés par YouTube et le site Web de Parcs Canada. Le programme sera reconduit en 2011, mais avec une nouvelle formule.

- Célébrations du centenaire—Série de concerts; lancement du 100e anniversaire au cœur de Toronto.
- Parcs Canada : Initiation au camping.
- Laissez-passer culturel : Les nouveaux citoyens canadiens se verront offrir un laissez-passer culturel leur donnant un accès gratuit à plus de 100 attractions culturelles. Cette collaboration leur permet pendant un an de visiter gratuitement des lieux patrimoniaux de Parcs Canada.
- Contribution à l'aménagement d'aires de jeux naturelles.
- Initiatives de diffusion nationale : Initiatives de diffusion de Parcs Canada de portée nationale portant sur différents endroits de partout au pays ou axées sur le mandat et les responsabilités de Parcs Canada dans son ensemble (p. ex., Un parc pour chaque saison, le National Parks Project, la série de 15 épisodes sur les lieux du patrimoine mondial au Canada).
- Utilisation des médias sociaux : Recours aux médias sociaux (p. ex., YouTube, Facebook, Twitter) ou à ces canaux spécifiques de parcs/lieux (p. ex., tweets sur les oiseaux de Pointe-Pelée) afin de communiquer avec des clientèles cibles au moyen de ces plateformes.

En terminant, j'aimerais mentionner que lorsque je discute de leadership avec les membres de l'équipe de Parcs Canada, je mentionne souvent que ma définition du leadership est d'« avoir le courage d'avoir des rêves et de savoir faire germer le fruit de ces rêves dans le cœur et l'esprit des autres ». Grâce au leadership que je suis à même de constater à tous les niveaux et dans toutes les fonctions de l'Agence, nous assumons collectivement le leadership que la présente génération de membres de l'équipe de Parcs Canada doit démontrer pour veiller à ce que les générations futures de Canadians puissent garder espoir. Dans le cadre de notre travail quotidien, nous faisons tous et toutes notre part avec passion, fierté et professionnalisme selon l'approche se résumant par « Une équipe, une vision ». À l'amorce de notre deuxième siècle d'existence, nous pouvons tirer une grande fierté des réalisations de Parcs Canada tout au long de son histoire. Comme l'indiquait récemment un article du *Globe and Mail* : « Parcs Canada administre un des réseaux de parcs les plus grands, les mieux gérés et les plus respectés au monde. Il devrait être une immense source de fierté pour toute la population canadienne ». [traduction]

# Prescribed Fire in Wilderness: Nature or Nurture?

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Wilderness areas are the closest approximation we have to ecosystems that exist unimpeded by management decisions. Wilderness designation protects species, habitats, ecological functions, and ecosystem services recognized as critically important. Manipulation to protect these values offers an intriguing contradiction to our longstanding notion of wilderness as a hands-off institution, and may threaten the very reason these areas exist in their current condition. Using prescribed fire in wilderness is one such example. Conflicting mandates of the Wilderness Act of 1964 illustrate the unique constraints in planning and implementation of this type of project (Parsons, Landres, and Miller 2003). This paper will investigate the complexities of stewarding fire in wilderness and highlight opportunities to learn from this type of management action. It focuses on policies and issues specific to the Forest Service and Park Service regarding ecological, sociopolitical, and organizational considerations for management ignited fire in wilderness.

## Background

There are currently 757 wilderness areas, spread over 100 million acres, ranging in size from 6 to 9 million acres. The National Park Service, Forest Service, Fish and Wildlife Service, and Bureau of Land Management manage these areas. The Wilderness Act of 1964 guides managers towards conflicting objectives of natural, primeval, and untrammeled qualities (Cole 2001). Differences between agencies, ecosystems, wilderness size, and political factors make it difficult to generate consistent policy for the greater wilderness preservation system. This leads to inconsistency in how policy is translated to implementation. Compounding this problem is the more philosophical debate surrounding active management in wilderness. As congressional wilderness designation is the gold-standard in protection for our federal lands it is not surprising that there is a long-running debate over what wilderness designation really provides – stewarding resources (maintenance of ecosystems, wildlife, water; human intent) or stewarding humans to allow for self willed nature (Cole 2001). Problems such as hazardous fuels buildup, insect outbreaks, and endangered species place managers in the difficult position of choosing if, when, and how to intervene (Landres et al. 2000). The gravity of these choices has the potential to be compounded with the addition of climate change. Restoration using prescribed fire surfaces many of these issues for reasons ranging from philosophical to ecological to political (Parsons, Landres, and Miller 2003). Fire and wilderness managers need to broaden the dialogue to address issues in project planning and developing resource management plans.

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### The role of fire

Fire is an essential part of most ecosystems in the western United States. Similar to wilderness, all fire is not the same. While some areas naturally have frequent low-severity fires others have high severity fires over 100 years apart. These are organized into fire regime groups based on severity and time and referred to as fire return intervals (Table 1). Human-induced changes caused by timber management, grazing, and fire suppression have altered these natural fire cycles (Noss et al. 2006). One way scientists and practitioners quantify this change and relative health and functionality of fire-adapted ecosystems is using fire regime condition classes. Fire regime condition class quantifies departure from these natural fire return intervals (Havlina et al. 2010).

For example, according to National Park Service Landfire Fire Regime Condition Class data the National Park Service has just shy of 9 million acres of wilderness in the continental United States with over 75% in condition class two or three (Table 2). While this 75% seems to be a call-to-action it is much more nuanced than that. Fire regime condition class is based on historic data that may, or may not, be representative of what we need for future targets (Hobbs et al. 2010). Furthermore, potential climate change impacts compound the issue by increasing the potential for catastrophic fire and proliferation of invasive species while challenging our ideas of what natural means (Stephenson, Millar, Cole 2010). Weighing the threat of a given wilderness area's fuels condition with the threat of human intervention is the challenge faced by wilderness and fire managers.

### Evaluating impacts to wilderness character

We do have methods in place to evaluate threats to wilderness. In the late 1970's and early 1980's increased pressure from recreation led to the *Limits of Acceptable Change System*, published by George Stankey, David Cole, and others, which addressed the need to balance resource and social values (Stankey et al. 1985). In the early 1990's the Wilderness Threats Matrix identified fire exclusion as the biggest threat to wilderness character (Cole 1994). Here, wilderness character elements were defined as elements such as air, water, rocks, animals, ecosystems, and wilderness experiences. 10 years later the Carhart Institute brought together elements of minimum tool and minimum requirements analysis into the Minimum Resources Decision Guide to assess the im-

**Table 1.** The five standard fire regime groups and descriptions used to determine departure from historical fire return intervals and resulting fire regime condition class (Havlina et al 2010).

| Group | Frequency | Severity | Severity Description |
|---|---|---|---|
| I | 0–35 years | Low/Mixed | Generally low-severity fires replacing less than 25% of the dominant overstory vegetation: can include mixed-severity fires that replace up to 75% of the overstory |
| II | 0–35 years | Replacement | High-severity fires replacing greater than 75% of the dominant overstory vegetation |
| III | 35–200 years | Mixed/Low | Generally mixed-severity; can also include low-severity fires |
| IV | 35–200 years | Replacement | High-severity fires |
| V | 200+ years | Replacement/Any Severity | Generally replacement-severity; can include any severity type in this frequency range |

pacts of humans on wilderness character elements; now defined as untrammeled, natural, undeveloped, and opportunities for primitive and unconfined recreation (ACNWTC 2010). The scope of this has since been broadened by Peter Landres and others through wilderness character monitoring taking the principles of the Minimum Resources Decision Guide and providing a framework to apply these tools to the greater wilderness preservation system (Landres et al. 2008). These methods are examples of how human impacts, and now intentional manipulation, have been evaluated and monitored in the past and present. Applying these methods across disciplines will require a more in-depth understanding of the priorities, constraints, and opportunities associated with managing each program. The remainder of this paper will highlight opportunities to achieve this integration with regards to prescribed fire in wilderness.

### Ecological factors

The first consideration is determining the size of the wilderness and scale of the treatment. Constraints on ecological inputs and outputs resulting from actual size or effective size, due to values at risk, may preclude the use of natural fire (Landres, Morgan, and Swanson 1999; Parsons, Landres, and Miller 2003). Next it is necessary to determine how fire has historically impacted both the treatment and surrounding areas. As we are moving from an age of fire exclusion to one of fire promotion it is important to ensure there is a need to change vegetative conditions and not assume everywhere is fire deprived. For example, many of our wilderness areas are relatively untouched because they were the most difficult to access. These moist, high elevation zones can have very long fire return intervals and suppression policies over the last 80 years would have had little impact (Noss et al. 2006). Determining historical baselines, establishing effective scope of impact, and identifying current values at risk could be used to inform whether deviation from the historic baselines is required. If deviation is required due to anticipated critical habitat, high fire danger or uncertainty, it would be helpful to define desired future conditions and ensure they are useful targets (Stephenson et al. 2010). Once desired future conditions are established managers should develop prescriptions representing targets at the landscape scale that capture as much ecological variability as possible (Stephenson, Millar, and Cole 2010). As we don't know what the most appropriate abundance, assemblage, and location of species will be under rapidly changing future conditions, one proposed climate change mitigation strategy is to have as many potential habitat types represented within an ecosystem's natural range of variability (Landres, Morgan, Swanson 1999). Projects and prescriptions should reflect this goal by going beyond simply having a mosaic of habitat types but also developing targets for a variety of successional states within those habitat types. Prescriptions should also allow for as much flexibility as possible so that when working on multiple year projects, principles of adaptive management can be applied from year to year within an ongoing project. In addition to these ecological factors, planning becomes more complex as well.

### Organizational factors: planning

When approaching potential projects involving wilderness it should be from the largest scale possible, assessing options and conditions beyond wilderness boundaries. Prior to looking at options of introducing fire within wilderness, all other choices should be exhausted. One way to help determine if there are no other options than to manage within wilderness is through the National Environmental Policy Act process. Interdisciplinary teams should assess projects at scales beyond wilderness boundaries with "no action" within wilderness boundaries as the preferred alternative. After it has been determined that a change in vegetative condition is necessary, the tradeoffs to wilderness character have been evaluated, and prescribed fire is shown to be the minimum tool a risk assessment should be completed to determine what type of organization is needed. Risk analysis should evaluate the increased logistical and monitoring requirements for intro-

| Park Name | FRCC 1 | FRCC 2 | FRCC 3 |
|---|---|---|---|
| Ansel Adams Wilderness | 27 | 439 | 46 |
| Badlands Wilderness | 71 | 22,235 | 6,120 |
| Bandelier Wilderness | 296 | 9,648 | 14,606 |
| Beaver Basin Wilderness | 155 | 4,003 | 6,528 |
| Black Canyon of the Gunnison Wilderness | 3,250 | 11,440 | 468 |
| Black Canyon Wilderness | 30 | 16,525 | 0 |
| Bridge Canyon Wilderness | 6,395 | 0 | 0 |
| Buffalo National River Wilderness | 2,691 | 1,284 | 27,364 |
| Carlsbad Caverns Wilderness | 12,943 | 15,312 | 3,212 |
| Chiricahua National Monument Wilderness | 4,178 | 1,995 | 5,943 |
| Congaree National Park Wilderness | 0 | 14,647 | 83 |
| Craters of the Moon National Wilderness Area | 116 | 2,534 | 368 |
| Cumberland Island Wilderness | 1,939 | 387 | 6,235 |
| Death Valley Wilderness | 361,375 | 1,998,587 | 103,620 |
| Eldorado Wilderness | 455 | 24,510 | 0 |
| Gaylord Nelson Wilderness | 2,702 | 3,832 | 25,361 |
| Great Sand Dunes Wilderness | 414 | 2,997 | 8,810 |
| Guadalupe Mountains Wilderness | 12,413 | 21,721 | 9,733 |
| Gulf Islands Wilderness | 1 | 2,431 | 598 |
| Indian Peaks Wilderness | 1,037 | 197 | 138 |
| Ireteba Peaks Wilderness | 7 | 9,519 | 0 |
| Isle Royale Wilderness | 80,703 | 32,470 | 14,179 |
| Jimbilnan Wilderness | 2 | 17,572 | 0 |
| John Krebs Wilderness (draft boundary) | 11,788 | 20,363 | 6,315 |
| Joshua Tree Wilderness (draft boundary) | 5,303 | 313,551 | 202,856 |
| Lassen Volcanic Wilderness | 750 | 69,115 | 4,787 |
| Lava Beds Wilderness | 153 | 13,022 | 7,907 |
| Marjory Stoneman Douglas Wilderness | 508,205 | 145,456 | 216,981 |
| Mesa Verde Wilderness | 26 | 6,597 | 1,402 |
| Mojave Wilderness | 63,863 | 611,704 | 9,639 |
| Mount Rainier Wilderness | 39,023 | 117,375 | 25,334 |
| Muddy Mountains Wilderness | 22 | 3,173 | 0 |
| Nellis Wash Wilderness | 1,543 | 10,063 | 0 |
| Olympic Wilderness | 237,652 | 407,202 | 172,183 |
| Organ Pipe Cactus Wilderness | 282,664 | 22,454 | 84 |
| Otis Pike Fire Island High Dune Wilderness | 6 | 1,052 | 189 |
| Petrified Forest National Wilderness Area | 1,916 | 22,548 | 11,917 |
| Phillip Burton Wilderness | 1,301 | 22,632 | 124 |

**Table 2.** The number of acres each park has in condition class 1, 2, and 3. It only includes acres with vegetation that supports combustion. Numbers are coarse estimates and are not to be used for project planning purposes without local verification.

| | | | |
|---|---|---|---|
| Pinnacles Wilderness | 1,782 | 10,153 | 3,971 |
| Pinto Valley Wilderness | 954 | 34,621 | 0 |
| Rocky Mountain National Park Wilderness | 95,345 | 61,172 | 18,213 |
| Saguaro Wilderness | 26,242 | 13,665 | 31,691 |
| Sangre de Cristo Wilderness | 14,071 | 17,177 | 6,888 |
| Sequoia-Kings Canyon Wilderness | 92,490 | 390,040 | 57,604 |
| Sequoia-Kings Canyon Wilderness (draft boundary) | 18,545 | 9,641 | 16,663 |
| Shenandoah Wilderness | 1,888 | 11,985 | 68,142 |
| Spirit Mountain Wilderness | 22,763 | 3,499 | 4 |
| Stephen Mather Wilderness | 224,824 | 291,683 | 79,210 |
| Theodore Roosevelt Wilderness | 19,809 | 3,971 | 2,060 |
| Upper Buffalo Wilderness | 243 | 0 | 2,153 |
| Yosemite Wilderness | 113,565 | 403,043 | 87,984 |
| Zion Wilderness (draft boundary) | 21,078 | 64,778 | 15,392 |
| Totals by Category | 2,299,014 | 5,316,020 | 1,283,105 |
| Total NPS Wilderness Acres | 11,084,094 | | |
| FRCC 1 | 21% | | |
| FRCC 2 | 48% | | |
| FRCC 3 | 12% | | |

**Table 2 (continued)**.

ducing fire in wilderness. The analysis should evaluate potential tactical safety issues posed by primitive tool limitations or the use of Minimum Impact Suppression Techniques in the event of an escape; especially if contingency plans based on catching the fire with primitive tools. These combined risk factors could increase the complexity beyond what is typical for this type of project outside of wilderness.

In order to effectively plan a prescribed fire in wilderness success needs to be defined for decision makers and people implementing the project on the ground. This definition may be extremely variable and could be measured by aesthetics, vegetative characteristics, resulting management such as allowing a natural fire to burn, or even positive post-fire effects after allowing a natural fire to burn post-treatment. Impacts to future management decisions could be as important to wilderness character as specific vegetative conditions. Restoration goals that achieve target vegetative conditions and require minimal repeated treatment are most desirable (Noss et al. 2006). For example, success could mean that in the future natural fires will be allowed to burn in this area unchecked. In contrast, success could be defined as a situation where objectives are achieved temporarily with inevitable future maintenance required, leading to such outcomes as finite or continual subsequent treatments such as rehabilitation, additional prescribed fire, or invasive species removal. The difference between these restoration goals is extremely important in wilderness; the former example enhances wilderness character elements where the latter lends justification for continual impacts. In addition to planning, these scenarios involve some important considerations with implementation.

### Organizational factors: implementation

If ecological targets and extensive planning point towards prescribed fire the next step is to develop a burn plan. Factors such as determining if, when and where mechanized equipment will be allowed, and when and where it can be used needs to be spelled out in advance with appropriate minimum tool analyses, permits, and exemptions in hand. This will influence ignition and holding plans. When possible, ignition plans and firing patterns should attempt to mimic natural burn patterns, ignition sources, and timing. If many lightning strikes at once are common for the area, the ignition pattern should reflect that. If fire generally moved in from grass and brush lowlands from some distance away, those fire effects should be captured. There are likely multiple types of fires that impact the landscape and ignition plans should try to achieve one or more of these. If not, justification should be provided for the alternative. Ignition plans that mimic natural ignitions should have complementary holding plans similar to management action points on a long-term fire being managed for resource benefit. Changes in fuel types, natural barriers, and opportunistic holding points should be identified in advance to slow or stop fire spread if necessary. Furthermore, monitoring and documentation should extend beyond the obvious ecological impacts of the burn itself and also look at things such as: length of intrusion, effects of personal camps and equipment, duration of area closure, and noise pollution. Lastly, documentation should be approached with the idea that the information is being provided for the entire wilderness system and fire program as a whole so we can better incorporate our successes and failures across geographical and agency boundaries.

### Sociopolitical factors

If it is reasonable that natural fire can achieve the desired resource objectives, management ignited fire is not an option. However, neither the National Park Service nor the Forest Service can use natural fire if it is not written into their respective land, fire, and sometimes wilderness management plans (FSM 2324.22, NPS-DO-41). Prescribed fire in wilderness for vegetative objectives is acceptable in the National Park Service, however this is not the case in the Forest Service, where planning would be limited to protection objectives (Parsons, Landres, and Miller 2003). Agency policy or what is, or is not, written into resource management plans may guide decision space from the outset. Furthermore, softer holding lines, primitive tools, and potentially larger scales liken prescribed fire in wilderness more to fire for resource benefit than traditional prescribed fire. Line officers, resources specialists, and the community need to be ready for impacts such as aesthetics and degraded air quality for extended periods of time. Increased awareness and understanding gained from an active fire history can facilitate the use of fire as a management tool, however historical impacts leading to a negative experience, can have the opposite effect making the current use of fire socially or politically unacceptable (Landres, Morgan, and Swanson 1999). Defining success to the public and the agencies will be crucial for future project acceptance (Parsons, Landres, and Miller 2003). Furthermore, agencies need wilderness plans in place to outline desired future conditions in terms of wilderness character, incorporate resource advisors experienced with fire, and ensure consistency with agency plans and priorities. These plans provide a valuable way to communicate new ideas of success and desired future conditions to other resource specialists and the public.

### Conclusion

In the late 1970s, Cole, Stankey, and the scientists at the Forest Service's Wilderness Management Research unit in Missoula stated their foremost concern with existing wilderness management plans was the absence of specific, achievable, management objectives for wilderness conditions (Cole and Stankey 1997). At that time, descriptions for desired conditions were very general and therefore it was difficult to articulate problems, develop management strategies, and define success. Since then, there have been great improvements in defining what and how to monitor wilderness character however defining desired future conditions and success following active management is still an issue.

By identifying the values we care about most, and those most threatened, at broad scales and incorporating adaptive management and resilience principles into our projects and resource management plans we will have the ability to both mitigate and adapt to uncertain future conditions. Consistent monitoring and documentation of these actions will increase the support for this type of project and thus the ability and speed at which we can change. Defining success in new ways will begin the mental transition beyond ecological boundaries incorporating wilderness character values and future uncertainty. Beyond preserving wilderness values, these considerations will also aid in clarifying the role of wilderness in climate change mitigation and adaptation strategies both as a refuge and as a comparison for more actively managed landscapes. Acting with restraint and only using fire as a treatment when necessary, while using wilderness as a control, will provide us the broadest range of ecological and social values so that we have ecosystems resilient to future change.

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# Could Ecotourism be an Effective Tool for Wetland Conservation in Florida?

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## Introduction

FLORIDA IS IDENTIFIED AS ONE OF THE STATES WITH THE GREATEST SHARE OF WETLAND LOSS IN the U.S., and only about one fifth of the existing wetlands are currently under the protection of the park and reserve system (Mitch and Gosselink 2000). At the same time, with rich biodiversity and valued ecosystems, Florida has become one of the most popular nature-based tourism destinations in the USA, and tourism has become its major source of tax revenue. For its focus on tourism-conservation symbiosis, ecotourism has been advocated internationally as an alternative economic activity benefiting wetland conservation since the last decade (Das and Syiemelieh 2009; Lim and McAleer 2005). First, considering ecotourism an alternative tool of environmental management (Jamal and Stronza 2009; Kay and Alder 2005), it is important to assess whether ecotourism involvement is significantly associated with major stakeholders' conservation contribution. Second, for the goal of collaborative and adaptive management, it is critical to know what incentives drive major stakeholders' (e.g., ecotourism industry) active engagement in natural resource management (Stein 2003). Natural resource managers will be better informed in applying proper measures to engage important stakeholders' participation during planning and management processes. While empirical studies focusing on the above topics are relatively lacking in the wetland conservation field, this research intends to fill this gap by testing whether ecotourism involvement and different groups of perceived benefits can encourage tour operators' pro-environmental behaviors in Florida.

## Methodology

**Sampling and data collection**. A web-based survey was conducted to collect cross-sectional data from a total of 318 commercial tour operators, drawn from the VISITFLORIDA website.

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Dillman's (2007) modified Total Design Method (TDM) was employed in the survey, and one e-mail invitation and five e-mail reminders with a questionnaire link were sent to the non-respondents every 7–10 days after the previous reminder. During the period of seven weeks spanning November and December, 2010, a total of 97 responses were received. Based on the Response Rate 2 Calculator in the Standard Definitions of American Association for Public Opinion Research (AAPOR), a response rate of 31%.

**Questionnaire structure.** This study included six constructs which consisted of items comprehensively discussed in the past studies.

**Control variables.** There were three control variables—the size of the company, the frequency of wetland visits, and the environmental values of respondents.

**Independent variables:**

- *The factor of economic benefits.* This group of five 5-scale Likert-type items was utilized to ask potential respondents about their perception of general economic benefits brought by nature-based tourism such as marketing, stabilized revenues, local tax revenues, and development of related businesses (Stronz and Pêgas 2008; Wunder 2000; Zambrano et al. 2010).
- *The factor of conservational benefits.* The series of six 5-scale Likert-type items were used to assess the respondents' perceived conservational benefits of nature-based tourism according to the past literature (Orams 1995; Hill and Gale 2009).
- *The factor of socio-cultural benefits.* The survey incorporated eight 5-scale Likert-type items to evaluate respondents' perception of socio-cultural benefits heavily discussed by the previous researchers (Jamal, Marcos, and Stronza 2006; Stronza and Pegas 2008).
- *Ecotourism involvement.* The survey asked potential respondents to estimate their tour-related revenues derived from ecotourism.

**Dependent variable.** Conservation behaviors of planning and management approaches. There were eight 5-scale Likert-type items incorporating the shared concepts of participatory nature resource management in collaborative ecotourism and ecosystem management to investigate the activeness of potential respondents in wetland conservation activities (Brody 2008; Buckley 2009).

## Data analysis

Multiple Regression Linear (MRL) models were employed to examine the effects of independent variables on tour operators' active wetland conservation actions. The independent variables included tour operators' ecotourism involvement, perceived socio-cultural benefits, perceived conservation benefits, and perceived economic benefits. In addition, the models incorporated several control variables such as the size of the company, the frequency of wetland visits, and the business manager's environmental awareness considered associated with respondents' active conservation behaviors, based on past literature.

## Results

**Scale testing**. The reliability of the scales in economic benefits, socio-cultural benefits, conservational benefits, and conservation behaviors in the research indicated that those scales were ideal with the Crobach's alpha values of .92, .93, .90, and .90, respectively. In order to identify the factor structure underlying those observed variables, and increase the interpretability of the identified factor, exploratory factor analysis (EFA), using principal component analysis (PCA), was employed for all four scales. The Kaiser-Meyer-Olkin (KMO) test of sampling adequacy, and Bartlett's Test of Sphericity suggested that the data were appropriate for the factor analysis. The

| Factor (item) | Eigenvalues | % of variance | KMO | Bartlett's Test of Sphericity | Reliability (α) |
|---|---|---|---|---|---|
| Economic benefits (5 items) | 3.76 | 75.15% | 0.80 | p<0.001 | 0.92 |
| Socio-cultural benefits (8 items) | 5.40 | 67.52% | 0.90 | p<0.001 | 0.93 |
| Conservational benefits (6 items) | 3.99 | 66.57% | 0.86 | p<0.001 | 0.90 |
| Conservation behaviors (8 items) | 4.68 | 58.54% | 0.83 | p<0.001 | 0.90 |

**Table 1.** Factor analysis results and Crobach's alpha for four factors.

results of EFA showed that those items could be loaded on the four specific factors. Table 1 summarizes the information described above for the four scales used in the research.

**Descriptive statistics**. Based on the responses to the scales with the anchors "very well" = 5 and "not at all" = 1, the composite mean scores of economic benefits, socio-cultural benefits, and conservational benefits were 3.53, 3.33, and 3.59, respectively. First, the results showed that respondents perceived the conservational benefits of nature-based tourism activities greater than economic benefits and socio-cultural benefits. Second, of the economic benefits, "bringing economic opportunities to other businesses" had the highest mean score while providing "stable business revenues" was the item with the lowest score. Third, of the socio-cultural benefits, the array of items relevant to enhancing the sense of place was substantially perceived by respondents. Fourth, the mean scores of perceived conservation benefits reported by respondents ranged from 2.82 to 3.98. Among them, "wildlife protection" was rated as the greatest item while "long-term conservation efforts" was least identified. Table 2 illustrates the responses to all items of these three composite factors.

In the factor of wetland conservation behaviors, six management activities, including direct financial support, policy lobbying, land development, land use planning, water resource and recreation management, and natural resource inventories or monitoring relevant to wetland conservation, received considerably less respondent participations than the other two activities, including environmental education and physical conservation activities and events (Table 3).

**Regression analysis.** The results of MRL models (Model 1) indicated that the degree of ecotourism involvement was a significant predictor of respondents' wetland conservation actions. In addition, respondents' participation in active wetland planning and management activities was significantly associated with perceived economic, socio-cultural, and conservational benefits. The cross-model (Model 2, 3, and 4) comparison revealed that socio-cultural benefits had greater effects on wetland-related conservation actions than conservational benefits and economic benefits, holding ecotourism involvement, the size of the company, the frequency of wetland visits, and the environmental awareness variables constant. Table 4 shows the results of regression analyses.

## Discussion

The research found that the degree of ecotourism involvement would influence the activeness of tour operators' environmentally responsible behaviors in Florida. Strong engagement in ecotourism activities encouraged tour operators' conservation efforts, which would become an effective tool to significantly contribute to wetland management. The research suggests that continuously promoting the concepts and practices of sustainable tourism and ecotourism among the industry is critical through the collaborative efforts of agencies, departments, and organizations in order to ensure the favorable environmental outcomes.

| Items of three factors | Mean | SD. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| Economic benefits | | | | | | | |
| Opportunities to other businesses | 3.75 | 1.28 | 6.7% | 11.2% | 22.5% | 19.1% | 40.5% |
| Local tax revenues | 3.47 | 1.31 | 10.1% | 12.4% | 27.0% | 21.3% | 29.2% |
| Increasing business revenues | 3.60 | 1.26 | 8.2% | 11.8% | 21.2% | 29.4% | 29.4% |
| Stable business revenues | 3.35 | 1.30 | 11.8% | 14.1% | 23.5% | 28.2% | 22.4% |
| Business marketing | 3.48 | 1.26 | 9.4% | 14.1% | 18.8% | 34.1% | 23.5% |
| Socio-cultural benefits | | | | | | | |
| Preserving local cultures or heritages | 3.19 | 1.40 | 15.7% | 16.9% | 24.7% | 18.0% | 24.7% |
| Decision-making in the local tourism policies | 2.91 | 1.32 | 22.4% | 14.1% | 24.7% | 28.2% | 10.6% |
| Decision-making in the local environmental policies | 2.75 | 1.24 | 22.4% | 17.6% | 29.4% | 23.5% | 7.1% |
| Knowledge and training about natural resources | 3.26 | 1.27 | 12.9% | 12.9% | 28.2% | 27.2% | 18.8% |
| A greater sense of pride of the community | 4.11 | 1.13 | 5.9% | 3.5% | 12.9% | 29.4% | 48.3% |
| A stronger sense of belonging to the community | 3.80 | 1.29 | 7.1% | 11.8% | 16.5% | 23.5% | 41.1% |
| A greater appreciation of the community | 3.78 | 1.24 | 5.9% | 12.9% | 15.3% | 29.4% | 36.5% |
| Greater resident interaction | 3.55 | 1.26 | 8.2% | 12.9% | 22.5% | 28.2% | 28.2% |
| Conservational benefits | | | | | | | |
| Less pollution | 3.71 | 1.23 | 6.7% | 9.0% | 25.8% | 23.7% | 34.8% |
| Wildlife protection | 3.98 | 1.23 | 7.9% | 5.6% | 12.4% | 29.2% | 44.9% |
| Natural landscape or habitat protection | 3.90 | 1.23 | 9.0% | 4.5% | 12.4% | 35.9% | 38.2% |
| Increase of environmental awareness | 3.62 | 1.28 | 9.0% | 9.0% | 25.8% | 23.6% | 32.6% |
| Long-term conservation efforts | 3.53 | 1.20 | 7.9% | 10.1% | 28.1% | 29.2% | 24.7% |
| Enhanced dataset of natural resources | 2.82 | 1.22 | 20.2% | 12.9% | 30.4% | 25.8% | 6.7% |

**Table 2.** Responses to the items of 3 factors. Note: 1 represents "not at all" and 5 represents "very well" on the 1-to-5 rating scale.

| Items | Mean | SD. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| Cash donation | 2.52 | 1.25 | 27.4% | 21.4% | 31.0% | 11.9% | 8.3% |
| Conservation events or activities | 3.10 | 1.31 | 16.7% | 14.3% | 28.6% | 23.8% | 16.6% |
| NGO's government policy lobbying | 2.02 | 1.24 | 51.2% | 15.5% | 16.6% | 13.1% | 3.6% |
| Zoning or land development projects | 2.64 | 1.31 | 25.0% | 11.9% | 37.0% | 19.0% | 7.1% |
| Comments to land use planning officials | 2.71 | 1.24 | 26.1% | 19.0% | 31.0% | 17.9% | 6.0% |
| Comments to water use and recreation management officials | 2.58 | 1.22 | 35.8% | 22.6% | 19.0% | 11.9% | 10.7% |
| Environmental inventories or monitoring | 2.39 | 1.36 | 35.8% | 22.6% | 19.0% | 11.9% | 10.7% |
| School or community environmental education | 3.19 | 1.36 | 15.5% | 15.5% | 25.0% | 22.6% | 21.4% |

**Table 3.** Responses to the items of active conservation behaviors. Note: 1 represents "never," 2 represents "rarely," 3 represents "sometimes," 4 represents "very often," and 5 represents "always."

| | Model 1 (Beta) | Model 2 (Beta) | Model 3 (Beta) | Model 4 (Beta) |
|---|---|---|---|---|
| Ecotourism Involvement | 0.319*** | 0.276** | 0.250** | 0.235** |
| Economic Benefits | | 0.221** | | |
| Conservation Benefits | | | 0.307*** | |
| Socio-cultural Benefits | | | | 0.355*** |
| Company Size (log) | 0.186* | 0.151 | 0.200** | 0.149 |
| Environmental Values (log) | 0.154 | 0.140 | 0.150 | 0.092 |
| Visit Frequency (log) | 0.163 | 0.153 | 0.137 | 0.079 |
| (Constant: coeff.) | 1.708*** | 1.531*** | 1.316** | 0.854 |
| | N= 80<br>F(4,75)= 6.80<br>Prob.>F=0.000<br>Adj.$R^2$=0.227 | N= 80<br>F(5,74)= 6.68<br>Prob.>F=0.000<br>Adj.$R^2$=0.265 | N= 80<br>F(5,74)= 8.08<br>Prob.>F=0.000<br>Adj.$R^2$=0.309 | N= 80<br>F(5,74)= 8.36<br>Prob.>F=0.000<br>Adj.$R^2$=0.318 |

**Table 4.** Results of MRL models to predict wetland conservation behaviors (* <0.1 level, ** <0.05 level, and *** <0.01 level).

However, the results also indicated that the input of tour operators in the actions that could contribute to long-term positive environmental outcomes was relatively unenthusiastic in Florida. First, respondents were comparatively inactive in wetland relevant planning and management activities with the frequency of participation mostly lower than "sometimes." Second, the research found that the activities that were more knowledge-centered and required long-term commitments attracted, on average, less participation of tour operators. Those include NGOs' policy lobbying and environmental inventory and monitoring. The evidence suggests that land and nature resource management agencies or departments need to expand their partnerships with major stakeholders through sharing information, providing professional knowledge and skill training, and creating more ecological volunteer programs.

The study also revealed that tour operators in Florida would be significantly driven to participate in wetland relevant planning and management activities if they perceived greater socio-cultural benefits in nature-based tourism. The cross-model comparison showed that the incentive of conservational benefits, next to socio-cultural benefits, was greater than economic benefits to encourage tour operators' active conservation behaviors. Surprisingly, the socio-cultural benefits worked better than the economic benefits on galvanizing tour operators' actions to conserve wetlands. In conclusion, the comprehensive measurement of this study lends supports to the theory that the social-cultural-environmental paradigm illustrates humans' commitments and attitudes to the natural landscape that supports their social fabrics (Jamal, Marcos, and Stronza 2006). Management agencies or departments should enhance community-based conservation initiatives and improve disclosure and interpretation of scientific information in order to promote participatory ecological governance.

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# Going Global:
# IUCN's Global Program on Protected Areas

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***Trevor Sandwith*** **presented an overview of the IUCN Global Program on Protected** Areas, illustrating IUCN's global role as a convenor and influencer of global biodiversity policy and practice. IUCN, established in 1947, consists of a triple helix of a globally distributed secretariat, Commissions and Member organizations, epitomized in the composition of this panel. Members of IUCN include national governments as well as non-governmental organizations, making it a unique structure, with non-voting observer status and the right to speak at the United Nations General Assembly.

The year 2010 can be regarded as a pivotal year for biodiversity policy. The Global Biodiversity Outlook 3 painted a grim picture of ongoing global loss of biodiversity, against which backdrop the significant achievements of national governments and other conservation agencies in establishing protected area systems stands in bold contrast. Protected area systems around the world have grown in representivity and cover, although much remains to be done, particularly in the marine realm. In the intervening landscape and seascape, biodiversity continues to be threatened, by increasing pervasive threats, such as climate change and alien invasive species, that magnify the already serious impacts of habitat destruction and overuse.

Despite the apparent difficulties of achieving global consensus on a post 2012 climate regime and of ensuring that the mutuality of biodiversity and climate is taken into account in multilateral policy, 2010 saw some distinct progress. The tenth Conference of the Parties to the Convention

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on Biological Diversity (CBD) adopted a new strategic plan for biodiversity 2011-2020 that includes 20 important targets, including making linkages between biodiversity, ecosystem services and climate change. In the negotiations on climate change policy, there was the recognition that ecosystem-based approaches to climate change mitigation and adaptation were an essential part of the solution.

Against this background, an IUCN-commissioned Strategic Review of the IUCN Program on Protected Areas was concluded in 2010, making far-reaching recommendations for the revised objectives and functions of a new Global Program on Protected Areas (GPAP). These included the reinstatement of the position of a Director and the strengthening of the GPAP through prioritized budget support. It also sought a renewed relationship with the IUCN World Commission on Protected Areas (WCPA) and the World Protected Areas Leadership Forum.

Among other imperatives described in the recommendations, the GPAP's renewed focus should include the following:

- Coordinate the activities involving protected areas across IUCN's global thematic and regional programs, leading to funding and implementation of joint initiatives and projects.
- Lead to increased support and synergy with the IUCN WCPA and the World Protected Areas Leadership Forum.
- Support the strengthened implementation of the CBD's Program of Work on Protected Areas (PoWPA) through a strategic relationship with the CBD Secretariat and partner organizations.
- Integrate scientific discipline into the development of enhanced knowledge and institutional capacity to effectively manage systems of protected areas in all biomes.
- Mainstream protected areas into processes that maintain the integrity of ecosystems in the face of global challenges such as climate change and that underpin sustainable development.
- Advocate and communicate the essential role of protected areas through an enhanced communication program and through a strategic program for influencing global and national policy.
- Lead to a visible impact at the IUCN World Conservation Congress in 2012 and the sixth IUCN World Parks Congress in 2014.

The following are the currently identified priorities:

1. Enhance the capacity to *effectively manage* protected areas.
2. Mainstream protected areas as *natural solutions* to climate change.
3. Foster *equitable governance* of protected area systems.
4. Make the case for *sustainable financing* of protected area systems.
5. *Communicate and advocate* the value of protected area systems.

### Highlighted activities

Protected areas are established to achieve the "long-term conservation of nature with associated ecosystem services and cultural values". This requires the measurement of these outcomes, and the development of the means to achieve these outcomes. The CBD Strategic Plan sets a framework for national governments to set and achieve national targets, and IUCN and IUCN WCPA are requested to provide technical support, including the application of management effectiveness assessments and the development of guidance across a broad range of activities in support of these goals. The Strategic Review of the GPAP emphasizes the need for enhanced scientific underpinning of management effectiveness and for developing appropriate capacity development at national levels. Contemporary approaches to capacity development stress the importance of institutional and individual competence as outcomes of learning situated in practice. In addition, IUCN as a founder and promoter of a large component of this body of protected area policy must monitor and learn from the implementation of policy in practice and advocate enhancements at all levels. IUCN and WCPA have a rich heritage of involvement in guiding and enhancing best practices for the establishment and management of protected area systems, and many of IUCN's member organisations are the national parks and protected area management agencies of the world, including some of the largest and smallest agencies. The ability to develop and share lessons across these agencies is one of the key added values of the Union, epitomised in many ways by the decadal World Parks Congress, where peer to peer leadership across the globe is prominent, and independent of the limitations of political or multilateral processes.

Based on the conviction that resilient natural ecosystems are indispensable for sequestering and storing organic carbon for mitigation, and for maintaining the ecosystem services that are essential for societal adaptation to climate change, the conservation community has adopted wide ranging decisions in both the CBD and United Nations Framework Convention on Climate Change (UNFCCC) negotiations that recognize and employ ecosystem-based approaches. This has been the policy position of IUCN's thematic program on climate change that advocates nature-based solutions.

The existing, and increasingly important role of protected area systems in contributing to the cost-effective conservation of intact, connected, and therefore resilient ecosystems, has been supported by scientific and socio-economic analysis, including the Millennium Ecosystem Assessment and the recently released The Economics of Ecosystems and Biodiversity (TEEB) report. It has resonated with the parties to the CBD which has included direct references to ecosystem-based approaches to climate change adaptation and mitigation in the targets and goals of the Strategic Plan for Biodiversity 2011–2020, in the PoWPA, and in many associated programs of work (Inland Waters, Forests, Agriculture, Marine and Coastal).

It has also been recognised in the deliberations of the UNFCCC negotiations on long-term Cooperative Action for mitigation and for adaptation, where there has been agreement on the causal link between ecosystem resilience and societal resilience to climate change, and the need to develop ecosystem-based approaches.

Opportunities for responding to these developments include the following:

- Developing guidance on how to address the impact of climate change on protected area systems and their objectives, at the site and system level
- Promoting the contribution of protected areas within ecosystem-based approaches to climate change mitigation at national and sub-national levels, including the co-benefits for biodiversity of REDD+ schemes, and carbon storage in biomes other than forests
- Promoting the contribution of protected areas within ecosystem-based approaches to adaptation at national and sub-national levels, including for maintenance of water and food security, disaster risk reduction, human health and alternative livelihoods
- Ensuring the participation of communities of all types, including indigenous peoples, local communities, the private sector and co-management structures, in the management and governance of protected area systems across the landscape and seascape
- Reducing the impact of climate change response measures on protected areas and the ecosystems they protect
- Promoting the use of protected areas in ecosystem-based approaches to address effects on biodiversity-based livelihoods
- Accessing funding for maintaining protected areas in the face of climate change and for both mitigation and adaptation purposes

*Sue Stolton* and *Nigel Dudley* outlined the way in which the IUCN WCPA was responding to this opportunity. In terms of social and governance issues (element 2 of the PoWPA), the IUCN WCPA is moving forward though these efforts:

- Working with experts to develop a methodology and best practices on social assessment of protected areas
- Interacting with key stakeholder on the relationship with Sacred Natural Sites and protected area commitments
- Producing guidelines on application of protected area categories in: Indigenous and Community Conserved Areas; and private sector reserves

Understanding the values, costs and benefits of protected areas is becoming an increasingly important focus for all those working in protected area. The IUCN WCPA is planning to contribute to the understanding of these issues in this way:

- Providing guidance on identifying and managing protected area networks to provide the widest range of possible benefits without compromising biodiversity conservation
- Identifying cross-sectoral partnerships to work on protected area and ecosystem service strategies

Protected areas and climate change have become a priority issue on many levels in recent years. The IUCN WCPA is contributing to the understanding of the relationship between protected areas and climate change through these efforts:

- Publishing guidelines and case studies on managing protected areas under climate change
- Developing and implementing tools to identify benefits from protected areas to help mitigate and adapt to climate change
- Developing guidance for governments in incorporating protected areas into national climate change strategies and action plans
- Promoting the Natural Solutions: Protected areas helping people cope with climate change report which IUCN WCPA collaborated with The Nature Conservancy, United Nations Development Program, Wildlife Conservation Society, The World Bank and WWF to produce in 2010

Given the many pressures on protected areas, such as the impacts of climate change, issues related to connectivity and corridors have been identified as one of the newly important areas for the PoWPA. The IUCN WCPA is taking a lead in several parts of the world to facilitate the following:

- The establishment and management of large scale connectivity conservation areas
- Voluntary structures and systems for the international management and recording of connectivity conservation areas, such as the Alps the Atherton Corridor in Australia

The IUCN WCPA is planning the following to build capacity for protected areas:

- A global standard syllabus and training materials for protected area managers, protected area system managers and rangers
- An accreditation system for academic institutions providing protected area training
- A global scholarship fund for protected area professionals

The IUCN WCPA has led the development of a management effectiveness framework, and national and site implementation. This work will continue in these ways:

- Supporting worldwide assessments of protected area management effectiveness (to help countries reach the PoWPA target of 60% of areas assessed)
- Developing, testing, and refining management effectiveness assessment systems to include more social and climate change impact indicators

Marine areas are still dramatically under-protected worldwide. The IUCN WCPA will thus continue a major effort to secure a well planned and effectively managed marine protected area (MPA) network. Specific actions include the development of the following:

Additional guidance for implementing the IUCN categories in MPAs
Methodology development and implementation of management effectiveness assessments in MPAs

In many part of the world protected areas require restoration of habitats, along with effective management. The IUCN WCPA is developing a new effort on restoration which includes the following:

- Publishing best practice protected area guidelines for ecological restoration
- Conducting further awareness raising, capacity building, monitoring, research, and support of implementation of restoration activities

Finally, but clearly very importantly, the IUCN WCPA has a new task force working with the IUCN Species Survival Commission looking at biodiversity and protected areas. This task force has two key areas of work:

- Conducting a meta-analysis of relevant studies, and establishing a system to manage data on trends in species of conservation concern in and out of protected areas
- Facilitating a process to develop a common global standard for the identification and validation of such key biodiversity areas

The panel concluded with reactions from *Ernesto Enkerlin-Hoeflich*, *Alan Latourelle* and *Jon Jarvis*, who reinforced and enhanced the underlying needs and approaches, with examples from Mexico, Canada, and the USA. In particular, they argued for the incorporation of a variety of approaches, as opposed to the setting of global standards, and for much greater communication with the public and thought-leaders on the issues of conservation, and the intersection with sectoral development needs and directions. Enhancing public awareness is a preoccupation for the heads of parks agencies around the world. Increasing urbanization, immigration, and aging populations in the developed world present particular challenges for making protected areas relevant.

# No Ordinary Highway: A Thirty-Year Retrospective, Trans Canada Highway, Banff National Park of Canada

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## The setting

In the fall of 1883, three Canadian Pacific Railway construction workers stumbled across a cave containing hot springs, on the eastern slopes of Alberta's Rocky Mountains. From that humble beginning came Banff National Park, Canada's first national park, and the world's third. Spanning 6,641 sq km (2,564 sq mi) of valleys, mountains, glaciers, forests, meadows, and rivers, Banff National Park is one of the world's premier destination spots. Almost half of its area is alpine ecoregion, comprising rock and ice, and is inhospitable for wildlife, leaving only the valley floors between mountain ranges for their survival.

The Trans Canada Highway (TCH) is Canada's major pan-Canadian corridor, spanning from sea to sea. First conceived in the mid-1930s, it was initially a hodgepodge of roads of different standards. In the mid fifties, the Canadian government undertook a major redevelopment program to bring the highway to a modern and consistent standard across the country, culminating in its completion on September 3, 1962. It was at this time that the opportunity to relocate the highway outside of Banff National Park existed. Given the times, little attention was paid to wildlife, their habitat needs, and how the highway might alter ecosystem function. The route selected followed the historic route forged by early motorists, paralleling the railroad within the Bow River's low flat valley, cutting through the heart of Banff National Park. This same valley is home to much of the park's wildlife. The die was cast and the impact of this decision on park wildlife would be felt for decades.

## The situation

Banff National Park is administered by Parks Canada Agency, with a mandate to present and protect the park for present and future generation. As a length of the Trans Canada Highway is located within and on lands designated as national park, the responsibility for administration and management of this section of highway also falls to Parks Canada.

Banff National Park is also home to the richest diversity of large mammals remaining in North America. However, because its landscape is comprised to a large extent of rock and ice, the quality of habitat to support some species, such as grizzly bears and wolverines is extremely poor, resulting in large home ranges to seek out food. Animals like grizzlies are always hungry and on

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the move in search of their next meal or mate with the highway representing an obstacle that must be crossed. This environment also has a direct correlation to births. Grizzlies in Banff National Park have extremely low reproduction rates, and to maintain the population, the simple relationship exists that birth rate must equal the death rate. Highway-caused mortality represents a disruption to this delicate balance.

It is this need to maintain a reproduction/mortality ratio of one, and Parks Canada's mandate, that best explains the effort and costs that have been invested to reduce wildlife deaths caused by wildlife-vehicle collisions, and to create safe habitat connectivity and permeability across the Trans Canada Highway.

### The early years of twinning (liability)

In the late 1970s, traffic volumes and lengthy delays on the Trans Canada Highway between the park's east gate and Town of Banff, combined with increasing number of personal injury and property damage claims arising from wildlife-vehicle collisions, led to the demand by motorists for the twinning (converting a two lane highway into a divided four-lane highway, two lanes going in each direction) of the highway through Banff National Park. While human deaths were rare occurrences in these collisions, the increasing number of wildlife deaths, especially to elk, was disturbing to many, given the national park context. In response, the federal government put forward a proposal to twin the section of highway known as Phase I, which runs from Banff National Park east gate to the Town of Banff.

Countering this demand was a small, vocal group of local and national environmental organizations that argued that a major highway corridor had no place within a national park, and should be diverted to an alternate alignment outside of the park. Apart from wildlife deaths, concern was voiced with respect to the significant habitat loss from the expanded footprint caused by twinning the road. In addition, the possibility of habitat fragmentation and, as a consequence, potential habitat isolation leading to loss of genetic diversity within the species population, was also cited.

The divergence of opinion about the project led to the conclusion by the government in May 1978, that an Environmental Impact Statement be prepared, a formal review panel under the then Canadian environmental law should be convened to review the environmental impacts of the project, and public hearings should be conducted for this proposed first phase. Interveners in favour and opposed presented their perspectives, suggesting potential mitigation measures, and short and long term alternatives, as well as challenging the very need for the project. The debate was emotionally charged, but in the end, the panel concluded that the proposed project need was clearly demonstrated; no viable alternatives existed; that the environmental disturbances/impacts could be mitigated through the installation of fencing to eliminate ungulate mortality, along with construction of underpasses to permit safe wildlife movement across the highway; and that the overall environmental impact would not be significantly detrimental.

No sooner had this ruling been made and design commenced, than additional funding was received to pursue expanding an additional 14 km (Phase II) section of the highway, west of the Town of Banff. Given the lack of satisfaction and results of the first environmental assessment, interveners opposed to the project were able to successfully lobby that another formal review panel be convened to again review need and environmental impacts. Many of the same issues and concerns were raised, and in the end, the panel again concluded that the project could proceed, providing similar mitigations of underpasses and fencing to address elk, sheep, and moose mortality be adopted, and that their effectiveness be evaluated.

As a result of these conclusions and rulings, the Trans Canada Highway in Banff National Park embarked on becoming a world leader in mitigating the environmental impact of highways on flora and fauna, both at a local, and larger temporal level. Seven exclusive 16.5 m wide by 4 m high wildlife underpass structures were constructed in Phases I and II. Fifty four and a half km of 2.5 m high page-wire fence was erected, with one way gates to permit ungulates that inadvertently found themselves inside the fenced right-of-way to escape. Nine Texas gates (cattle guards) were installed on access roads, to permit vehicles unimpeded ingress and egress through fences

The cost of these environmental mitigations amounted to approximately 13% of total construction costs. The success of these mitigations was immediately evident, with the number of ungulate mortalities as a result of wildlife-vehicle collisions reduced by 95%. Use of the crossing structures by elk and other ungulates was monitored for a year, and indicated that they were being used. No further monitoring took place.

### The changing tide (transition)

Twinning of the Trans Canada Highway has proceeded in phases, as traffic volumes and accidents increased. It was not until the mid-1990s that the next phase (IIIa) of twinning was justified and funded; Phase IIIa ran between the end of Phase II and Castle Mountain Interchange, a distance of 18 km. Environmental concerns about the level of development in Banff, and the park's carrying capacity to accommodate more visitors without impairing it for future generations, were at the forefront of public concern. Opposing camps argued that parks were not intended to be nature preserves, but rather places for people to experience the park.

Trust in Parks Canada's management and administration, on the part of many external stakeholders, was at an all-time low. The successfulness of mitigations in earlier phases of twinning were questioned and challenged. Sheep that once used cliffs as escape terrain were prevented from using them by fences, with result that the population was decimated by predators. Wolves had re-colonized the park, and along with other carnivores, such as grizzlies, were now being killed within the highway right-of-way because the fence had been designed to prevent only large ungulates from accessing it. Monitoring the crossing structures had not continued beyond the first year after highway completion for any of the earlier project phases. Thus, no data existed to refute claims that no wildlife other than deer and elk had ever used them, which subsequently led to concerns about fragmentation and gene pool isolation.

With this as a background, the next phase of twinning environmental assessment took place and, building on past assessments and mitigation strategies, concluded that impacts could be mitigated through fencing and underpass structures. Public comment and concern centered on the lack of evidence that the previously constructed 16.5 m crossing structures and fencing actually worked for carnivores. With no data to refute these concerns, Parks Canada committed to building two 30 m wide underpass structures at known wildlife crossing locations, along with constructing seven smaller crossing structures at more frequent intervals than had been used during the previous phases (one every two km). A buried apron, in association with the fence, was proposed to prevent carnivores from gaining access by crawling or tunnelling beneath the fence.

Despite these commitments, there still remained critics of the underpasses that argued for overpass structures. During the detailed highway design process, the option of overpasses was more closely examined, and a simple arch overpass design was conceived that would be about two thirds the estimated cost of an underpass. Parks Canada, as project proponent, and in line with its mandate, chose to reinvest this difference by erring on the side of caution by building the overpasses 50 m wide, rather than the initial proposed 30 m width.

The cost of these mitigations amounted to approximately 25% of total construction costs. The success of these mitigations, other than reduced wildlife mortalities as a result of wildlife-vehicle collisions, was not immediately evident.

Having failed to follow up on monitoring mitigation effectiveness in past phases, Parks Canada embarked on a twelve year monitoring program to gauge the use of crossing structures by various species and genders. This long term monitoring provided evidence that there was an adaption period and learning curve associated with wildlife crossing structures, with ungulates using structures sooner than carnivores. It was observed that grizzly bears, moose, wolves, and other ungulates tended to prefer the larger overpass with good visibility, while cougars and, to some extent, black bears gravitated toward more confined, smaller underpasses that provided greater cover. Over this period, researchers recorded more than 185,000 wildlife passages through the 24 crossing structures between Banff East Gate and Castle Interchange.

### Metamorphosis (adaptive management)

Another decade passed before traffic volume and accidents justified funding the westward twinning of the Trans Canada Highway through the remainder of Banff National Park (Phase IIIb), a distance of 35 km. Based on the results from long term monitoring, the overall success of fencing and crossing structures as mitigation measures was no longer being challenged by external stakeholders. However, scepticism remained within environmental groups that Parks Canada would continue, or even improve, the level of investment in mitigation necessary to protect wildlife.

The environmental assessment for this phase of twinning was undertaken in 2004, and again concluded that any impacts from the project could be mitigated through fencing and wildlife crossing structures. The environmental assessment noted that this particular area of the park was home to grizzly bear and wolverine populations that were in a precarious balance between birth and death rates. Erring on the side of caution, and in keeping with its mandate, Parks Canada proposed to mitigate potential impacts by again fencing, plus improving permeability, by increasing the frequency of crossing opportunities to one every 1.5 km; increasing width of overpass structures from 50 m to 60 m; extending bridge structures well past the riparian zone at streams and rivers, so as to avoid fishery impacts and permit wildlife movement; and installing small 400 mm to 750 mm diameter culverts every 400 m to accommodate small mammal and amphibian movements across the highway.

The net result was a commitment to construct a total of four large 60 m overpass structures, one 60 m underpass structure, two 25 m underpass structures, two extra long bridge structures incorporating a 30 m or wider wildlife crossing opportunity, and nine 7 m wide underpass structures. In addition, where fish passage had been interrupted during original highway construction in the 1960s, Parks Canada committed to restoring this connectivity by installing culverts at the right grade and size to restore fish movement across the highway.

The cost of these mitigations amounted to approximately 36% of the total forecasted Canadian $315 million in construction costs.

A remarkable transformation occurred, as both opponents and proponents of the project came together to support the project, proceeding with agreement that the goal of improving highway safety and maintaining wildlife connectivity where not necessarily exclusive of each other, and should be given equal weight. Thus, when it came to funding and investment decisions, one goal could not be traded at the expense of the other, and that each kilometer of road twinned also had to have all mitigations built at the same time.

### Conclusion

Over the past 30 years, Parks Canada has focused its efforts on mitigating the effect of the TCH on wildlife mortality and habitat fragmentation in Banff National Park. A range of engineering mitigation measures, including fencing, underpasses, and overpasses have been incorporated and adapted, with each successive phase of TCH twinning. This has resulted in the first large-scale complex of highway mitigation measures of its kind in the world, and a natural laboratory for understanding the value of highway mitigation measures in conserving and protecting wildlife. Banff National Park's stature as a world-renowned national park has helped to further elevate the awareness of the value of these efforts, and their effectiveness.

Because of Parks Canada's pioneering of these wildlife-related mitigation measures, augmented by more than a dozen years of continuous monitoring, the use of wildlife fences and wildlife crossing structures has become increasingly common elsewhere in North America. This research and monitoring has resulted in the most complete body of scientifically sound information in the world on how wildlife respond to crossing mitigation. Parks Canada is now viewed as an international leader in highway mitigation performance and evaluation, design and connectivity studies.

Once referred to by some environmental groups as the "meat grinder" or the "Berlin Wall for wildlife," the Trans Canada Highway within Banff National Park has undergone a 30 year metamorphosis from environmental liability, to environmental leader in sustainable highway development.

# Beyond Consultation: Aboriginal Engagement for Effective Management of Legacy Contamination in an Arctic National Park

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## Introduction

**Stokes Point: a recent history.** Stokes Point is located on the Yukon North Slope coast in Ivvavik National Park of Canada (Figure 1). Over the past 50 years, this area has seen a wide variety of non-traditional uses. In the late 1950s, the United States Air Force built a short-lived Distant Early Warning (DEW) Line Station there known as BAR-B. Gulf-Beaudril operated a staging facility at Stokes Point in support of Beaufort Sea exploration during the 1980s oil boom. With the signing of The Western Arctic Claim, the Inuvialuit Final Agreement (Canada 1984), Stokes Point became part of Ivvavik, the first national park established in Canada through an aboriginal land claim agreement. Under the claim, Parks Canada manages the national park co-operatively with the Inuit People of the Western Arctic, the Inuvialuit. In the early 1990s, the BAR-B DEW Line buildings were removed and the Department of National Defence built an automated short-range radar facility that is still in operation. Over the years, cleanup of Stokes Point has been piecemeal, with no detailed investigation of contamination. In 2000, the community of Aklavik and the Inuvialuit Regional Corporation (the umbrella organization responsible for land claim implementation) raised concerns about possible pollution left behind at Stokes Point from past DEW Line and oil exploration activities. Inuvialuit from the region have strong ties to the land and water around Stokes Point, and still harvest animals and gather plants there for subsistence.

**The current project**. Starting in 2005, Parks Canada began a comprehensive five-year, $6 million investigation and cleanup of the site—the largest project of its type ever undertaken by the

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agency. The remoteness of the Arctic park presented great logistical challenges. Stokes Point is situated almost 200 kilometres northwest of the regional centre of Inuvik in the Northwest Territories; it has no infrastructure to support operations, and is only accessible by air and sea.

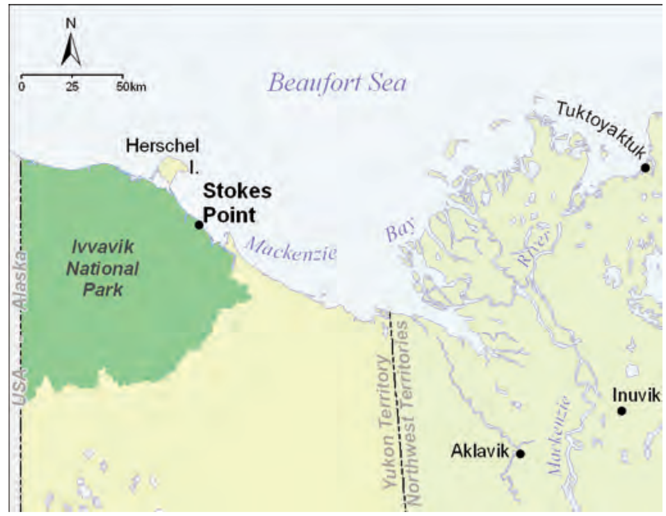


**Figure 1**. Location of Stokes Point in Ivvavik National Park of Canada, Yukon Territory.

A detailed site investigation was completed over the summers of 2006 and 2007. Lead, antimony, arsenic, PCBs, DDT, asbestos, fuel, and debris were identified at the site. Over the next two years (2007–09), human health and ecological risk assessments, and the site remediation plan were completed. The cleanup was finished in the summer of 2010. A total of 400 cubic meters of contaminated soil and debris were removed from Stokes Point, and disposed of in approved landfill facilities and treatment centres in the Northwest Territories, Alberta, and British Columbia.

**Moving beyond our duty to consult aboriginal peoples**. The Government of Canada has a legal duty to consult aboriginal peoples, where the government has real or constructive knowledge of aboriginal rights or title, and believes that its conduct might adversely affect such rights or title (Canada 2006). This duty for formal consultation arises from Canada's special relationship with aboriginal peoples as set out and defined by Section 35(1) of The Constitution Act (1982) and numerous case law decisions, various legal statutes including Section 12(1) of the Canada National Parks Act, contractual obligations under land claim agreements and treaties, and government policy. These reasons are also described in detail in various guidance documents produced by the Government of Canada (Canada 2006; Canada 2008).

This paper describes Parks Canada's efforts to go beyond the legal duty to consult by engaging, sharing leadership, and working together with the Inuvialuit to cleanup legacy contamination at Stokes Point within Ivvavik National Park. The co-operative management framework of the Inuvialuit land claim (Canada 1984) provided the foundation for moving beyond our duty. A corporate policy shift in the agency over recent years, that encourages broad engagement and shared leadership through active participation in the development and implementation of the Agency's future direction, also supported this, as Parks Canada moves from doing things for Canadians to doing things with and as defined by Canadians (Canada 2009). This paper will outline the key engagement challenges faced, and the approaches used to meet those challenges in moving beyond consultation to clean up Stokes Point. We will also describe the outcomes and show how a modest investment to engage, empower, and enable Inuvialuit has contributed to effective project management and yielded tremendous benefits for all involved.

### Inuvialuit engagement: challenges and approaches

We faced three main challenges to move beyond our legal duty to consult and meaningfully engage Inuvialuit on this project: mistrust of Parks Canada and fear of the site, local capacity, and community politics.

**Overcoming mistrust and fear**. Local mistrust of Parks Canada at the beginning of this project was the result of our past role in a Department of National Defence-led cleanup, in 1999, of the DEW Line station at Komakuk Beach, located within Ivvavik, just northwest of Stokes Point. Parks Canada insisted that materials be removed from existing landfills at Komakuk, and disposed of outside the park. Some materials were taken to an engineered landfill at the site of the former Shingle Point DEW Line station, located at the western edge of the Mackenzie Delta, near a seasonal whaling camp used by the Inuvialuit of Aklavik. Inuvialuit felt they were not adequately consulted on this decision and vowed it would not happen again in the Stokes Point cleanup.

In the early days of the current Stokes Point project we also had to consider heightened emotion and fear of the site among Aklavik residents. Over the years, Stokes Point was a camping site for Inuvialuit travelling along the North Slope coast. Inuvialuit hunt, fish, and gather in and around this site, and were concerned about the possible impact of legacy pollutants on their country foods. Some attributed cancer deaths in their community to these uses of the site.

In response to these challenges, Parks Canada listened to Inuvialuit concerns. The agency took steps to create a process that empowered Inuvialuit to share leadership, and sought involvement of trusted and credible team members from the community and external organizations. Parks Canada developed an engagement process for action built on some basic principles: shared leadership; respect for local knowledge; a process that is open, transparent and meaningful with real opportunities to influence decisions; a clear definition of what parties can and cannot do, laid out at the beginning of the project in a Terms of Reference.

We created a steering committee to act as a project advisory body that would share leadership in project decision-making through their recommendations, with appointed representatives from Inuvialuit organizations, co-operative management boards, the community of Aklavik, Royal Military College of Canada, and the Government of Canada (Figure 2). Inuvialuit Elders and others with history at the site were involved so that their local and traditional knowledge would complement the science for investigation design and development of the risk assessment model.

Finally, Parks Canada engaged the Environmental Sciences Group at the Royal Military College of Canada, a world leader in the assessment of Arctic military sites, to work on their behalf to conduct the Stokes Point site investigation and cleanup plan. Inuvialuit saw the Environmental Sciences Group as a credible, independent, arm's-length technical lead.

**Building Inuvialuit capacity for meaningful participation**. A number of approaches were taken to build capacity (knowledge and financial means) to enable Inuvialuit to meaningfully take

**Figure 2.** The Stokes Point Steering Committee and staff, with representatives from Inuvialuit and co-operative management organizations, Parks Canada, Department of National Defence and the Royal Military College of Canada (Photo Parks Canada).

part in the process, as it was difficult for Inuvialuit on the Steering Committee, and those from the community, to effectively participate when dealing with the highly technical subject of contaminated site management. This was compounded by local literacy issues, and the fact that English is often not the first language of many elders.

Parks Canada committed to build capacity of the Steering Committee throughout the project in four ways: dedicating a portion of each quarterly meeting to deliver relevant "Contaminants 101" training prior to making key recommendations; conducting site visits in all phases; committing to use plain language for all Committee business; and providing fair remuneration for professional services (e.g., travel, meeting preparation, and meeting days) of Inuvialuit representatives on the Committee as well as Elder knowledge-holders.

The Agency also committed to keep Inuvialuit people from Aklavik and other communities in the Settlement Region informed and involved. This was achieved through varied methods including: several rounds of community meetings; advertised quarterly Steering Committee meetings open to the public; site visits for elders and Inuvialuit leaders during project; regular leadership briefings of Inuvialuit organizations and co-operative management boards; realizing the potential of local workers hired and building their understanding of the project so they can act as project ambassadors in their home communities; a series of four plain-language newsletters distributed by mail drop to every household and business in the six regional Inuvialuit communities; magazine articles about the investigation and cleanup in the quarterly Inuvialuit current affairs publication distributed to every land claim beneficiary; and inclusion of a field-embedded media crew from the Inuvialuit Communications Society during the second year of the investigation. This embedded crew produced a 30-minute television documentary on the project.

**Navigating community politics surrounding local economic benefits**. Prior to the site cleanup, Parks Canada had to deal with some community politics regarding which Inuvialuit communities in the Settlement Region could benefit from the work. Aklavik, the community nearest to the national park and the Stokes site, sought to maximize local economic benefits from cleanup activities but lacked companies with the expertise and resources to lead a project of this nature. However, one of Canada's leading DEW Line cleanup companies, owned by Inuvialuit, was based in the region, in another nearby community.

Parks Canada worked closely with the Steering Committee, the Inuvialuit Regional Corporation, and Public Works and Government Services Canada to develop a solution. The Government of Canada subsequently delivered a competitive national tendering process that provided value for Canadian taxpayers, and met our obligations under the land claim to provide significant economic opportunities for Inuvialuit. Most of the economic benefits from the cleanup went to Inuvialuit companies and workers. The Inuvialuit-owned company based in another Settlement Region community was hired as the lead contractor. Subcontract and local hiring requirements in the tender package ensured that the lead contractor maximized benefits available to the Inuvialuit of Aklavik.

## Outcomes

Parks Canada's investment to move beyond our legal duty to consult and meaningfully engage Inuvialuit in the Stokes Point investigation and cleanup was modest (Table 1). However, the returns realized by all parties involved were tremendous. It is very likely that without such an investment, our case study may have been more of a cautionary tale of what not to do.

Generally, moving beyond consultation on this project resulted in better project management with all phases of work proceeding smoothly on schedule and budget. The Agency's mandate to restore and improve the health of the park was achieved. Principles of the Inuvialuit Final Agreement were also satisfied: the process allowed for meaningful involvement by Inuvialuit in project decision-making (i.e., empowered and enabled); the environment and cultural resources were

| | Year 1 Investigation | Year 2 Investigation | Year 3 Planning | Year 4 Planning | Year 5 Cleanup |
|---|---|---|---|---|---|
| Steering Committee | ✓ | ✓ | ✓ | ✓ | |
| Community meetings | ✓ | ✓ | | ✓ | |
| Local knowledge | ✓ | ✓ | | | |
| Site visits | ✓ | ✓ | | | ✓ |
| Newsletters ( ✓ ) & TV documentary ( [illegible] ) | ✓ | ✓ | | ✓ [illegible] | ✓ |
| Community feast | | | | | ✓ |
| TOTAL (CND$) | $43K | $140K | $22K | $19K | $25K |

* Percentage of the [illegible] project budget (Canadian Dollars) spent over 5 years on Inuvialuit engagement = [illegible] ($249K). Significant in-kind contribution of staff time not included.

**Table 1.** A summary of Inuvialuit engagement activities and investments over the five-year project (2005/06 through 2010/11).

protected; and Inuvialuit realized economic benefits from the project. Within the context of the three engagement challenges discussed in this paper, the outcomes were also notable.

**Overcoming the mistrust and fear**. By listening to Inuvialuit concerns, empowering them to share leadership in addressing concerns, and adding credible players to our team such as community elders and the Royal Military College of Canada, we were able to overcome mistrust and fear. The result of our collective effort is that Stokes Point is now safe for Inuvialuit, and the animals and plants they depend upon for subsistence. Inuvialuit were confident that our investigation was comprehensive, and cleanup approaches used to make the site safe were sound. Community support of the project was favourable—there was no bad press, no public outrage, and no angry letters were sent to the minister. Relationships were strengthened, and trust levels were bolstered among the Inuvialuit of Aklavik and the regional leadership. In fact, Inuvialuit leaders have pointed to this project as the model for future projects in the region.

**Building Inuvialuit capacity for meaningful participation**. Parks Canada engaged Inuvialuit to play a meaningful leadership role in the project through various approaches (*e.g.* Steering Committee; use of Elder and local knowledge; various public information and involvement approaches) that provided knowledge, opportunities for involvement to shape project decisions, and financial means to participate (Figure 3).

**Politics overcome**. We delivered a competitive national tendering process that provided value for taxpayers, as well as significant economic opportunities for Inuvialuit. The cleanup contracts awarded to Inuvialuit-owned companies accounted for 95 percent of the total project dollar value ($3.2 million), with 40 percent of contracts awarded to Aklavik companies. Approximately 85 percent of workers hired for the cleanup were Inuvialuit, with 66 percent from Aklavik.

### Conclusions

Parks Canada moved beyond our legal duty to consult, and worked with Inuvialuit to cleanup legacy contamination at Stokes Point in Ivvavik National Park. Payback on a modest investment was priceless, with tremendous tangible and intangible benefits. Our success working with the Inuvialuit was built on the basics, like having conversations with people, listening, fostering respect, and building relationships. Park managers must plan in advance for this level of engagement, and be ready to move from talk to action. It is critical to empower (by creating opportuni-

**Figure 3.** Inuvialuit were enabled to share leadership and influence project decisions through various engagement approaches that informed and involved, such as Elder site visits (Photo Z. Hoe, ICS).

ties to share leadership and influence decisions) and enable (by building capacity and providing means to participate) aboriginal peoples to take a leadership role in similar projects, or to have opportunities for meaningful involvement. Finally, to successfully move beyond the duty to consult, the government must be willing and able to share leadership.


## Acknowledgments

The success of the Stokes Point project was a result of collaboration among dedicated representatives of the Stokes Point Steering Committee from the community of Aklavik, various Inuvialuit land-claim bodies and co-operative management boards, Parks Canada, the Department of National Defence, and the Royal Military College of Canada. We would also like to thank Inuvialuit elders Bill and Lucy Cockney, Danny C. and Annie Gordon, Moses Kayotuk, Andrew Gordon Sr., Colin Gordon, and Nellie Arey for their significant assistance and contribution.

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# Continued Cultivation of Illegal Marijuana in U.S. Western National Parks

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### Abstract

SINCE 1998, AT LEAST 10 WESTERN NATIONAL PARKS WERE USED AS ILLEGAL MARIJUANA CULTIVATION sites by Mexican-national drug traffic organizations. This paper documents the continued use of national park lands as illegal cultivation sites through 2011. During the grow season of 2010, the Drug traffic organizations began scouting the hills of Whiskeytown in mid-winter. Supplies and personnel to manage the sites were in place as early as March. Rangers detected six grow sites within Whiskeytown National Recreation Area boundary, and several sites immediately adjacent to the park. Rangers eventually removed 26,028 plants, which had a street value of $78,840,000. Six foreign nationals were arrested, some with weapons, and all believed to be associated with the Mexican drug traffic organizations. Similar situations occur at Sequoia and Kings Canyon National Parks, Yosemite National Park, Golden Gate National Recreation Area, Pt. Reyes National Seashore, Santa Monica National Recreation Area, Lake Mead National Recreation Area, and North Cascades National Park. The drug trafficking organizations are operating year round within the parks. Added to this problem is the increasing number of quasi-legal medical marijuana

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grow sites operating on remote private land surrounding the parks, often within the same watersheds.

## Introduction

Rangers armed with long rifles, and fitted with battle fatigues and headset communications, are briefed to raid another marijuana cultivation site in the hills of Whiskeytown National Recreation Area (Whiskeytown). The rangers, a helicopter, contracted by Campaign Against Marijuana Planting, and highly trained sheriff's deputies are massed in a parking lot preparing to raid an illegal marijuana cultivation site at Whiskeytown.

This has been the scenario for the past 12 years at numerous western national parks and forests. What is playing out in the western national parks and national forests is a major threat to American conservation efforts, as public lands have become ground zero for illegal marijuana cultivation. National park and national forest lands offer isolated backcountry, clean water, and warm growing temperatures; the three necessary ingredients for growing marijuana.

**Scope of activities.** The following is a list of marijuana cultivation activities discovered during 2010 growing season on national park lands.

- Sequoia and Kings Canyon National Parks eradicated 41,414 plants; plants removed from a single complex comprised of 21 separate plots.
- Whiskeytown National Recreation Area eradicated 26,028 marijuana plants, 15 complexes investigated.
- Point Reyes National Seashore eradicated 13,316 plants.
- Yosemite National Park eradicated 3,657 plants, three complexes investigated, 2 confirmed active, 1 site not active.
- Santa Monica National Recreation Area eradicated 3,741 plants.
- Golden Gate National Recreation Area ran focused patrols in Marin and San Mateo park units.
- North Cascades National Park has investigation continuing from 2009 complex raid.
- Redwood National and State Parks arrested two people who were supplying a neighboring complex; established a long-term, focused patrol, which is believed to prevent new activity.
- Lake Mead National Recreation Area eradicated 3,300 plants and continued investigations.

## Background

Prior to the 1990s, a significant amount of America's marijuana product came from Mexico. In the late 1990s, Mexican drug traffic organizations began cultivating marijuana in Southern California. Following the terrorist attacks of September 11, 2001, America's borders became more secure, and drug traffic organizations realized growing and shipping the marijuana from within the United States was the new paradigm. Today, drug traffic organizations are increasing their range of network cultivation sites throughout the west. From coastal areas to well above 9,000 ft high in the eastern Sierra Nevada Mountains, law enforcement officials are discovering more and more marijuana complexes anywhere there are water, sunshine, and remote public lands with vehicle access. Driving this new level of drug cultivation is America's fondness for marijuana, and an extremely profitable business model. For every $10 invested, approximately $4,000 in revenue is generated from illegal marijuana cultivation sites on federal lands.

The drug trafficking organizations are running symmetrical, non-structured, insurgent-style operations that are extremely adaptable to changing situations and circumstances. Nearly all the men who are associated with marijuana cultivation in California come from the Mexican State of Michoacan, an area just west of Mexico City.

While the focus of this paper is to describe current drug cultivation activities occurring on western national park lands, the drug trafficking organizations are establishing cultivation sites on any and all public lands, and tracts of remote private lands, where favorable growing conditions and access needs are met. The vast majority of marijuana cultivation in California is occurring on U.S. Forest Service lands, which do not have the law enforcement staffing levels the National Park Service (NPS) has developed over recent years. To put this into perspective, Yosemite National Park eradicated 3,657 plants in 2010, while in neighboring Tuolumne County, the Stanislaus National Forest eradicated over 440,000 plants. Just west and south of Kings Canyon National Park is the Sierra National Forest, which destroyed 84,053 marijuana plants in 2010. The Shasta Trinity National Forests near Whiskeytown National Recreation Area eradicated 340,700 marijuana plants in 2010.

### Geographic distribution of cultivation sites within the parks

Beginning in 2005 the drug traffic organizations expanded their area of operation north of California, into Oregon, Washington, and along the Columbia River Basin. They also crossed over the Sierra Nevada Mountains to the White Mountain Range in Nevada, across the Basin and Range, to the Dixie National Forest in Utah, and the Wasatch Mountains. Drug traffic organization sites have been found in the Arapaho National Forests in the Rocky Mountains west of Denver, Colorado. They are also in the Appalachian Mountains in Blue Ridge Parkway and Great Smoky Mountains National Park, and as far north as the Upper Peninsula in Michigan.

The first marijuana cultivation site associated with the Mexican drug traffic organizations at Whiskeytown National Recreation Area was located in the Whiskey Creek drainage, at around 1,500 ft in elevation. The site has a dense cover of large manzanita shrubs, with a mixed conifer, oak-woodland overstory. The sites, like most cultivation sites found throughout Whiskeytown, are in steep, rugged country. Thick shrub cover, poison oak, and summer heat make moving through the area very difficult (Figures 1, 2). Small tributary streams high up in the drainages are tapped for irrigation. Thousands of feet of three-quarter-inch black plastic hose is laid to create a drip irrigation system, from plant to plant. The makeshift impoundments can be up to six feet deep and 20 feet across. The irrigation water is often heavily polluted by fertilizer. Within the park, irrigation hose has been found running over a half mile from the water source to the cultivation site. Usually, the irrigation hose is buried, to hide it from view.

Typically the native vegetation is pruned and trimmed back to allow filtered sunlight through to maximize plant production, but still partially camouflage the marijuana plants from aerial surveillance. Every cultivation site is constructed differently, but there are similarities among sites. For example, plants are usually set in the ground a few feet apart, similar to an orchard, so the plants are laid out in relatively straight lines to accommodate irrigation lines. Other times the rows of marijuana plants are laid out more like a vineyard, where rows are planted close together; the ground vegetation is cut at its base and laid in windrows. Such sites are easily visible from the air.

While some marijuana sites are like an orchard, covering a large opened area, most are made up of small, approximately one-quarter acre plots. Plots are connected by narrow trails through the brush. Law enforcement rangers will find a marijuana plot containing 25 to 800 or more plants, and may not discover the other plots growing in the same or neighboring drainages. Law enforcement rangers commonly find multiple sites peppering a hillside or drainage, which constitute a "complex," managed by the same growers.

Rangers at Sequoia and Kings Canyon National Parks report that drug trafficking organizations are planting at higher elevations than has been discovered in years past. Before 2008, culti-

**Figure 1.** An illegal marijuana encampment, Whiskeytown National Recreation Area.

vation sites were typically below 5,000 ft in elevation. Recent sites are between 5,000 and 6,000 ft, with growers accessing sites from higher elevations up to 7,200 ft.

### Resource damage and site rehabilitation

Pristine natural resource values are altered from their natural conditions when streams are diverted for irrigation, highly concentrated fertilizers and pesticides are introduced, and wildlife poaching occurs. In addition, encampments have no sanitation other than pits, large amounts of trash accumulate, attracting wildlife, and landscape manipulation, such as building terraces, water impoundment structures, and digging plant holes, alters natural landscape contours and conditions.

Park rangers at Sequoia and Kings Canyon National Parks believe the drug trafficking organizations are utilizing some of the park's more than 275 caves to hide and store supplies. Park management is concerned about the potential impacts such activities will have on extremely fragile cave resources (Figures 3, 4).

In Whiskeytown, law enforcement rangers have found three dead black bear carcasses in or adjacent to cultivation sites. Following a raid on a discovered marijuana cultivation site, rangers recovered a digital camera. In one photo several Mexican nationals are kneeling over a black bear that they had apparently just shot and killed. In 2009 at Whiskeytown, a historic mine shaft near

**Figure 2.** An illegal marijuana cultivation site at Whiskeytown National Recreation Area planted throughout a manzanita stand.

a marijuana site was discovered which contained 77 buried one-liter soda bottles, filled with fresh water.

Sequoia and Kings Canyon and Whiskeytown have been routinely conducting site reclamation (removal of garbage, irrigation hose, and hazardous waste) and, when possible, restoration (restoring natural contours, dismantling slash windrows, mitigating invasive plant introductions). However, these activities are very labor intensive and often require helicopter support, so are expensive to complete. Costs for reclamation and restoration of cultivation sites vary from $8,000 to $15,000 per acre, depending on the level of treatment.

### Increasing law enforcement investigations

The discovery of large-scale organized crime operations being run in parks caught the NPS by surprise, and required new funding to implement counteractive operations. Back in 2001, the NPS was not able to adequately respond to the marijuana threat, but did all it could to understand its extent, and destroyed those cultivation sites which were discovered. Several years later, due to special regional funding and specific base funding at individual parks, additional rangers were hired and specifically trained to counter the marijuana threat. In fiscal year 2009 (October 2008 to September 2009), some $3.3 million dollars were given to national park sites in the Pacific West Region that had marijuana cultivation threats. After 2001, the NPS strategy shifted to locat-

**Figure 3.** An image of an illegal marijuana encampment at Sequoia and Kings Canyon National Parks following law enforcement raid.

ing and eradicating marijuana cultivation sites. Rangers often discovered sites after harvest, or in many situations found sites and removed the marijuana plants, only to discover the next season that additional cultivation sites were linked to the raided sites, but were not detected. This meant that while law enforcement operations were destroying marijuana plants, millions of dollars worth of marijuana was still being successfully harvested from national park lands by the drug trafficking organizations.

Sequoia and Kings Canyon had numerous sites along the road to Mineral King on the south fork of the Kaweah River. The pressure by law enforcement operations on the Mineral King drainage forced the drug traffickers to move to new areas. Unfortunately they re-located to other areas in the park, at higher elevation.

### Societal trends

In 1996, the voters of California approved Proposition 215, entitled the "Compassionate Use Act of 1996." This proposition created a limited exception from state criminal liability for seriously ill persons who are in need of medical marijuana to use it for specified medical purposes.

In 2009, California cities and towns witnessed an explosion of medicinal marijuana collectives. Many of these store-front facilities have subsequently been closed down, but others are legally permitted establishments, operating under approved ordinances from cities and counties.

**Figure 4.** An image of the same illegal marijuana encampment at Sequoia and Kings Canyon National Parks following site restoration work by park work crews.

Elected officials in 2009 and 2010 struggled with developing rules and guidelines for legal medicinal marijuana dispensaries authorized by California Proposition 215. Medicinal marijuana is grown on private land, often grown in backyards of patient's private residences and for distribution at medicinal marijuana collectives. For example, at Whiskeytown, three known medicinal marijuana sites were established in 2010 that border the park, all within the park's watersheds that drain into Whiskeytown Lake. Often ranger staff conducting surveillance operations on drug traffic organizations were less than a mile away from entrepreneurs who are cultivating medicinal marijuana under the authority of California's Proposition 215.

While there are legitimate users of medicinal marijuana for serious medical ailments, almost anyone of age who desires to have a California 215 card can receive one for a fee through advertised doctors. Law enforcement investigators suggest links with some medicinal marijuana collectives having received marijuana from drug trafficking organizations. In November 2010, California's Proposition 19, to legalize the possession of marijuana for personal recreational use, did not pass, with 57% voting against it. While Proposition 19 failed in the polls, it raised the political discussion of whether or not to legalize marijuana for personal recreational use.

## Conclusion

While law enforcement rangers try to intercept and prevent establishment of marijuana cultivation on national park lands, drug trafficking organizations are expanding their cultivation sites throughout the west. NPS law enforcement is becoming more effective in locating preliminary activities that lead to establishment of cultivation sites, and removing detected cultivation operations within the parks. Confiscated plant counts continue to rise, as both federal land managing agencies and local county sheriff offices become more efficient in detecting criminal activities linked to marijuana cultivation.

Further complicating the situation is an expansion of medicinal cultivation sites on private lands that share watersheds with national land management agencies. Although California voters defeated Proposition 19's proposal to legalize marijuana for personal recreational use, the legalization initiative is gaining momentum.

Marijuana cultivation in national parks is creating serious problems for both law enforcement and resource managers as park watersheds, resources, and wildlife are being harmed. The presence of illegal cultivation in national parks or national forest backcountry is curtailing scientific studies and routine long-term monitoring programs. Such disruption to normal research operations is preventing the NPS and other agencies from accomplishing their mission. Marijuana cultivation in parks, facilitated by organized crime, is a nightmare scenario for the NPS. Many people believe recreational marijuana use may eventually be legalized in western states; however, marijuana cultivation has to be stopped in national parks to protect employees, visitors, and park resources.

The daunting reality is that after ten years of continued raids on marijuana cultivation sites, law enforcement continues to see an increasing amount of activity returning year after year, driven by demand and profit. Collaborative efforts between federal, state, and local law enforcement efforts has proven to be the most effective tool in reducing the ability of drug trafficking organizations to operate successful cultivation sites on public lands. Successfully curbing these illegal activities on American public lands is an uphill battle, that will require vigilance and determination, through cooperative collaboration at all levels of government.

# Managing the Historic Industrial Landscapes at the Quincy Mining Company National Historic Landmark

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From the early 1800s through the 1900s, Lake Superior natural resources and trade routes drew trappers, traders, miners, fishermen, mariners, and recreationalists to the area. The communities they created were typically built using local materials and expertise, reflecting the surrounding environment. Historical resources remaining in the region reflect responses to the extreme environmental conditions, and the unique situation of the Lake Superior region. This paper focuses on one example of a historic industrial landscape in the region, providing a brief historical background, an analysis of the cultural landscape resources, and a summary of landscape treatment recommendations subsequently developed for the Quincy Mining Company National Historic Landmark.

Keweenaw National Historical Park is home to an extensive industrial landscape, including impressive large-scale industrial buildings, and extensive associated landscape features. The 1,120-ac Quincy Unit is named after the Quincy Mining Company that transformed the northern wooded landscape from wilderness to an industrial site. The existing landscape includes extensive historic industrial resources related to copper mining, large expanses of native woodland, and threats from impending incompatible development.

For much of the nineteenth century, the majority of America's copper production came out of one of its remotest corners—the Copper Country of Michigan's Keweenaw Peninsula. During the 1850s, 1860s, and 1870s, Michigan produced more than 75% of the nation's copper, with that percentage peaking at 95% in 1869. Copper mining during that period was dominated by two companies: the Quincy Mining Company, and the Calumet and Hecla Mining Company.

The Quincy Mining Company, located north of Hancock, Michigan, ranked first nationally in copper production from 1862 to 1882. Founded in 1846, Quincy, like other mining companies, initially engaged in fissure mining, which yielded large, pure copper masses, but was expensive and time consuming. In 1856, Quincy switched to amygdaloid mining, which yielded lower grade, but more easily extracted and processed, copper. The Quincy Company successfully mined the rich Pewabic amygdaloid lode well into the twentieth century.

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Early explorers to the Copper Country found a forested wilderness, covered with dense vegetation, and only passable by narrow trails. While Native American cultures had worked surface copper deposits in the area for thousands of years, deeper deposits were hidden under the dense forest and thick ground cover. By the mid 1850s, the forest wilderness, which had originally covered the landscape, was extensively cleared to provide space, materials, and fuel for mining operations. Development of the Quincy site was originally concentrated on Quincy Hill, and included both the mining operations and worker housing. This early development included vernacular structures dedicated to the extraction of the mineral deposits, and arranged in the most efficient way possible to streamline the mining operation.

After the switch to amygdaloid mining, and the arrival of the copper mining boom in the 1850s and 1860s, the industrial and domestic settlement at Quincy became more formalized. The landscape was generally aligned along the axis of the Pewabic mineral lode below the surface, a geologic spine that ran from the southwest to the northeast. Mining operations were centered on the shaft houses that lined the lode (Figures 1, 2). Copper was brought up in the shaft houses, and then sorted and separated. "Poor rock" (rock with little or no copper) was discarded in piles nearby, while copper bearing rock was transported directly to the smelter via tramroads. Company buildings, including the mine office, were located nearby. Dirt roads and informal walking paths facilitated the transportation of goods and workers.

As the labor force grew, so did the demand for housing. In the early years, workers and officials lived either in irregularly placed houses located on Quincy Hill, or in private boarding houses in nearby Hancock. By the early 1860s, the company began building housing, and renting to workers. These were mainly single-family dwellings, built to attract families to the area. The company preferred to employ married men, as single men were considered less likely to stay committed to the company and more likely to engage in undesirable behavior. The first houses built were constructed of logs, the later models were wood frame structures. Many of the houses were one and one-half stories tall. The company often built houses in batches, resulting in streets with a row of matching houses. Early housing settlements were associated with immigrant groups who came to the area to fill specific mining positions. Near Quincy, community names included Hardscrabble, Limerick, Swedetown, and Shantytown.

**Figure 1.** View north from the No. 2 shaft-rockhouse ca. 1920s (above, source: Keweenaw National Historical Park Archives) and in 2007 (below, source: Quinn Evans Architects).


The Quincy Mining company continued to expand its operations in the following decades. The company acquired land and added support facilities to make their operations more profitable by consolidating more of the copper mining and processing operations in the immediate area. Technological developments increased production yields and created the need for new structures, like rock-crushing houses, and buildings to house equipment, such as compressors. Although the industrial character of the Quincy Mine continued

**Figure 2.** View from No. 6 shaft toward the No. 2 shaft-rockhouse, ca. 1920s (above, source: John F. Campbell collection, Keweenaw National Historical Park Archives) and in 2007 (below, source: Quinn Evans Architects).

to dominate the landscape, the influx of workers resulted in significant domestic development. The majority of the housing was modest, with spare, practical landscapes serving functional needs. Managers had larger homes that often included manicured lots instead of the livestock, privies, wood piles, and vegetable plots found in mine laborers' yards.

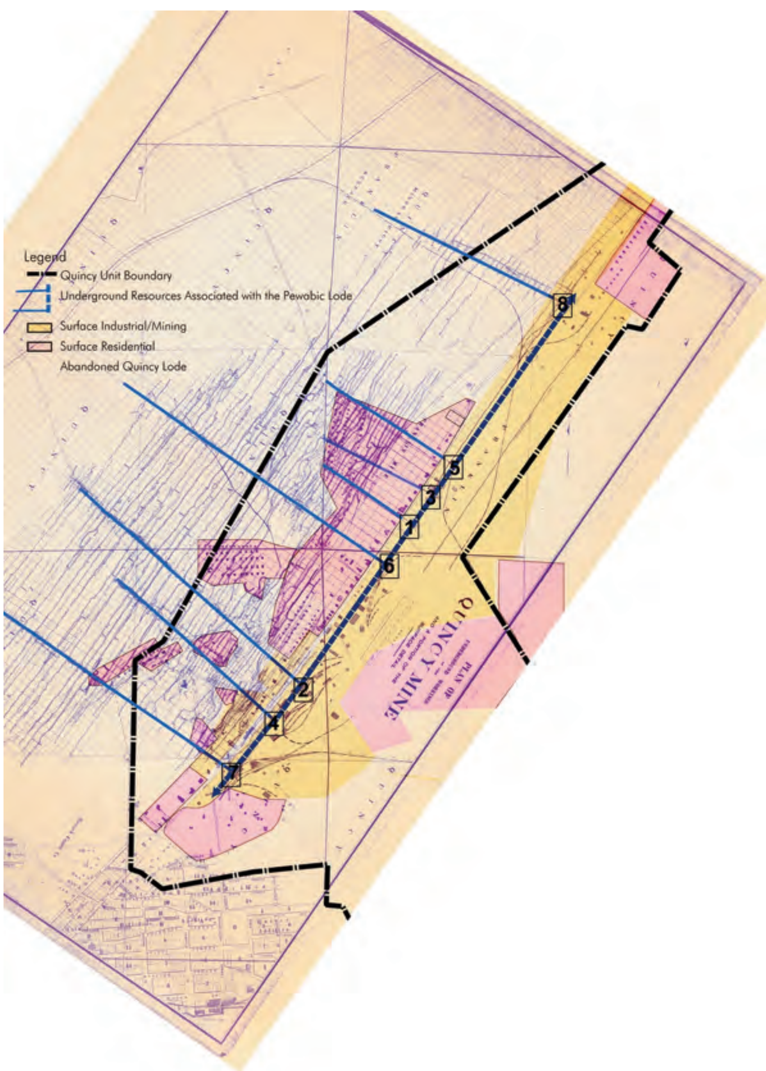
With the discovery of significant copper deposits in the western portion of the United States, Michigan's dominance of the copper industry was lost by the late nineteenth century. Nonetheless, operations continued to grow throughout the early decades of the twentieth century, as the Pewabic lode remained productive. Both Quincy and the neighboring Calumet and Hecla mines continued to dominate copper production on the Keweenaw Peninsula, managing to survive a major labor strike in 1913 and 1914. Increased demand for copper during World War I gave the company its last big boost. After 1920, copper mining on the Keweenaw Peninsula began a slow decline. By September of 1945, Quincy had closed all of its underground operations, although some reclamation operations continued through 1967.

The shutdown of the Quincy Mining Company operations had a significant impact on the industrial landscape. Equipment was sold for scrap, buildings were demolished, and land was sold off for redevelopment. Buildings remaining were left to the forces of weather, and vegetation began to reclaim the formerly industrial landscape. However, the mining legacy of the region was not forgotten. As early as 1958, the Quincy Mine Hoist Association was founded, originally to preserve the No. 2 Nordberg steam hoist—the world's largest steam driven engine when it was constructed, in 1918. The association eventually expanded their mission to preserve buildings, landscapes, and artifacts associated with the company, and they now offer tours of the steam hoist, hoist house, shaft rockhouse, and underground works. The No. 2 steam hoist was recognized as a National Historic Mechanical Engineering Landmark in 1984.

The late 1980s and early 1990s marked a renewed appreciation for the significance of the mining landscapes of the Keweenaw Peninsula. In 1989, the National Park Service (NPS) established two National Historic Landmark (NHL) districts, one centered on the former Quincy Mining Company property, and the other located at the site of the former Calumet and Hecla Mining Company in Calumet.

On the heels of those designations, the NPS established a new and unique national park in 1992. Keweenaw National Historical Park is unusual in several ways. First, it encompasses resources throughout the region with a main emphasis on two large non-contiguous sites: the Quincy Unit, and the Calumet Unit at the site of the former Calumet and Hecla Mining Company. Second, the ownership and management of the park does not follow the traditional NPS model of a federally-owned, self-contained property run by NPS staff. Instead, it is a "partnership park," where the NPS collaborates with local governments, individual landowners, and private and non-profit groups to create a more extensive area of protection than would be possible or politic under the traditional model of acquiring land, either through willing sellers or eminent domain. The shared responsibility for management, protection, and promotion of both (limited) park-owned lands and associated sites can include seeking federal funding, planning collaboratively, and developing cooperative educational opportunities.

**Figure 3.** Quincy Unit 1920 land use overlaid on "The Underground Workings of the Quincy Mine and a Portion of the Surface Detail," ca. 1900s (Quincy Unit Cultural Landscape Report, Chapter IV, page 13, by Quinn Evans Architects).




One of the most recent planning efforts engaged in by the NPS is the commissioning of cultural landscape reports for both the Quincy and Calumet Units. Cultural landscape reports are standard planning tools for the NPS, and require documentation and evaluation of historic landscapes to determine their integrity, and provide a plan for future use. The recently completed cultural landscape report for the Quincy Unit incorporated rigorous historical research (e.g., Figure 3), and in-depth environmental analysis into the planning process, leading to a rich understanding of the multiple layers of history that are represented in the current landscape. This knowledge will be utilized in the future to enhance site interpretation.

Assessing the historic landscape of Quincy was challenging. The landscape changed considerably since the height of the company's mining operations in the late nineteenth and early twentieth centuries. Passing time and a lack of maintenance reshaped the landscape since the mine was operational. All but one of the many shaft rock houses, once visible for miles on the horizon, have been scrapped—torn apart for their valuable steel. Capping mine shafts to improve public safety has left many mine shafts indistinguishable from the surrounding terrain. As the structural integrity of the extant smokestacks declines, they become expensive maintenance dilemmas and safety hazards. As a result, a number have been recently demolished. Weathered industrial buildings, crumbling masonry ruins, and rotting timber continue to erode beneath the immense weight of heavy annual snowfalls. Unsecured structures sometimes meet alternative fates, including fire and vandalism. Broken windows and decayed building shells are common sights in the district. Historic company housing complexes are often fragments of their former selves. Monumental poor rock piles once dominated the landscape; these have been diminished, as the rock is crushed for construction activities.

New development also threatens the integrity of the historic mine landscape. Former company homes are often modified to meet the changing needs of today's occupants. Modern ranch homes, signs, and billboards located along US Route 41 (itself widened and altered from its original character) now represent new commercial endeavors, while new roads bisect former housing locations. Quincy has been marked by modern industry as well, as communication towers blink into the night from strategic points on the hilltop. Volunteer vegetation now grows on once-barren mining lands, where it hides views, buildings, ruins, and landscape features.

While vegetation obscures the signs of industry, it also provides clues to settlement patterns and building locations. In some places, apple trees, lilacs, and lilies lead the eye toward ruins and small scale features, like fences and paths. Like tributaries, these features can be traced back to their source, often company-built roads and houses still in use. These subtle features offer glimpses of an earlier time, despite the layers of additions that have been made to the landscape and its structures. Although time and neglect have taken their toll, much of Quincy is still visible on the landscape today. What remains is the most complete mining company landscape on the Keweenaw Peninsula.

By comparing those elements still visible, to the extensive historic documentation gathered during the research phase of the cultural landscape report, it is possible to analyze the integrity of the landscape. Careful documentation of the existing conditions is compared against historic photographs, maps, diagrams, and written accounts. Landscapes are evaluated based on landscape characteristics, tangible and intangible aspects that collectively make up the historic character of a property. Some of the characteristics that were significant at the Quincy Mine site included land use, spatial organization of the landscape, the presence or absence of vegetation, topography, views into and out of the property, how people and vehicles circulated into and through the landscape, the variety of buildings and structures, and numerous small scale landscape features.

A few techniques were particularly useful in analyzing the landscape. Overlaying diagrams of the underground mine with plans of surface operations provided an uncommon opportunity to analyze the relationship between the mine shafts, drifts, and stopes, and the above-ground land use. This approach revealed that locations used for massive industrial operations were downhill from the shafts, close to the underground mineral lode, but not above the underground operations. Development above the lode itself was limited to lighter land use, including housing and commercial activities.

Survey records and aerial photographs were also useful in providing an understanding of large-scale changes to vegetation over time. According to an 1860s survey, the entire area was covered with "timberland, mostly sugar maple." During the historic period, the majority of the timber was removed to facilitate mining operations, as is clearly seen in historic photographs. Today, second-growth forest vegetation is reclaiming many formerly open areas of the landscape.

Addressing the preservation and rehabilitation of such a complex and significant landscape is a challenging task, not least because there is no single entity "in charge" of the whole landscape at this partnership park. Despite individual planning efforts, the stakeholders associated with the

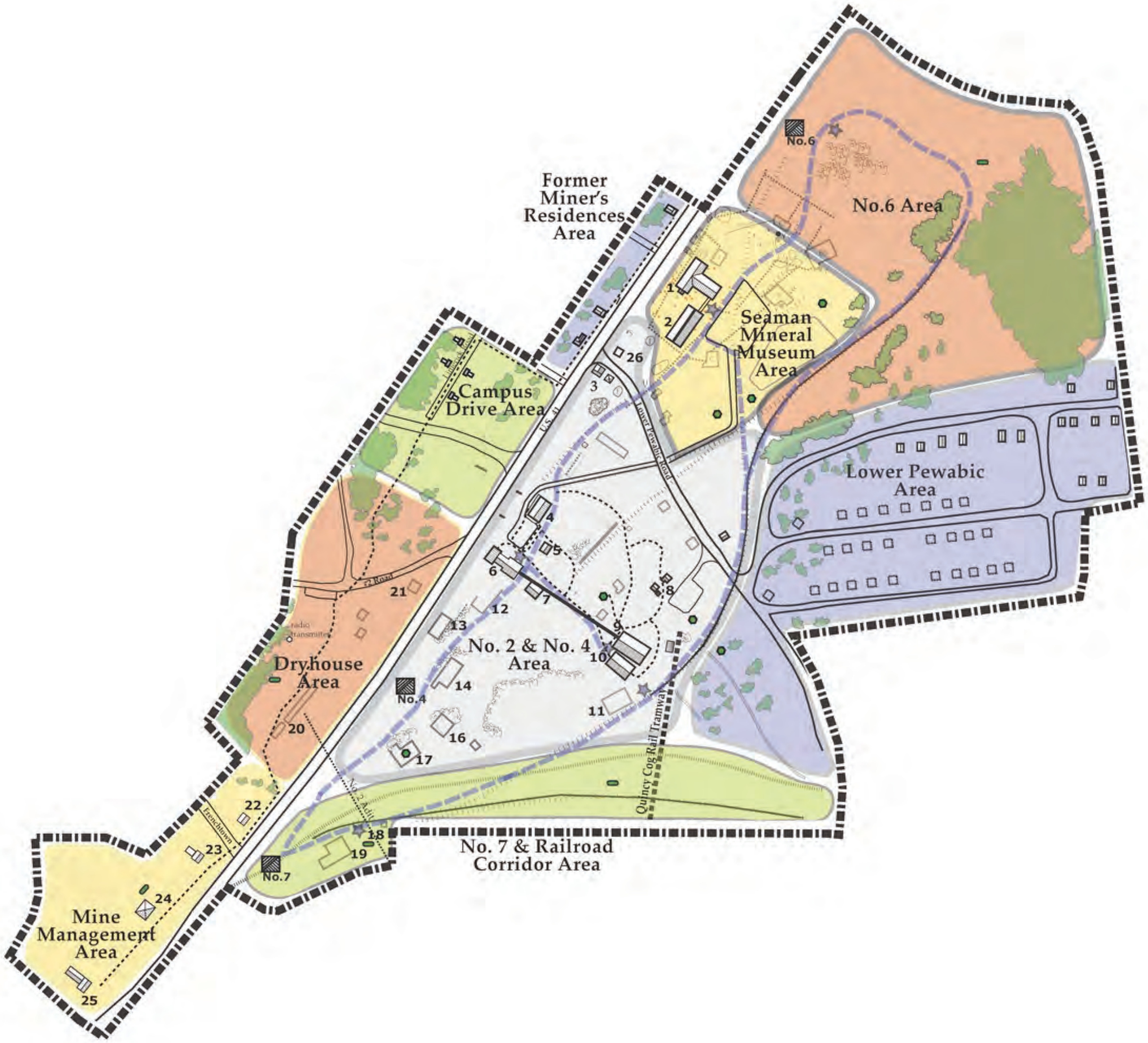



**Figure 4.** Quincy Unit historic core landscape treatment zones (prepared by Quinn Evans Architects, 2010).

Quincy property had not previously come together to discuss long-term management of the resources, or the desired visitor experiences at the site.

To formulate a treatment approach, the unit was divided into management zones (Figure 4). These corresponded to nine landscape character areas: the No. 6 (shaft) area, the visitor center area, the miners' residences, Campus Drive, the dryhouse area, the No. 7 (shaft) and railroad corridor, the mine management area, the No. 2 and No. 4 (shafts) area, and the lower Pewabic area. A plan for rehabilitation and management, based on integrity, intended use, and local conditions was developed for each management zone.

Overall recommendations for the site focused on providing a unified visitor experience in the landscape, and preserving and interpreting the historic industrial landscape. Specific recommendations include: rehabilitating the former Blacksmith Shop and Machine Shop into a joint visitor center and world-class mineral museum; utilizing historic rail routes to link key resources with an interpretive multi-use trail providing a visitor-oriented circulation system; rehabilitating the No. 2 Shaft-rockhouse to provide increased visitor access, interpretation, and an overlook; preserving and interpreting extant landscape features, including the ruins of industrial buildings and equipment; restoring selected landscape features that are critical to understanding and interpreting the site, such as portions of the railroad tracks and the pulley system; removing vegetation that impacts historic resources and obscures historic views; and preserving and interpreting the remaining poor rock piles, which were a key feature of the landscape during the historic period.

Although these once-dynamic industrial sites are now still and silent, their resources provide powerful reminders of the stories of miners and their families, and the industrial development of our country. The fact that many of these stories are painful, that the landscapes associated with them are not generally considered pleasant environments, and that their stories are not immediately clear to casual visitors, presents challenges to preserving the resources for future generations. The cultural landscape report provides a framework for future management of the property.

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# Assessment of Tropical Cyclone Induced Transgression of the Chandeleur Islands for Restoration and Wildlife Management

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THE CHANDELEUR ISLANDS ARE LOCATED SOUTH-SOUTHEAST OF ST. BERNARD PARISH, LOUISIANA. They began as a long island, that has since been segmented into several islets covering 80 km. The Chandeleurs were formed over 2,000 years ago and are uninhabited (Penland 1988). Dozens of hurricanes and other severe storms have fragmented these islands, resulting in severe erosion of the island chain's land mass over time. The islands serve as a migratory stop for birds, provide habitat for nesting bird species, and are part of the second oldest National Wildlife Refuge (NWR) in the United States, Breton NWR.

The Chandeleur Islands are a diverse landscape, composed of beaches, dunes, and marshes. The northern portion of the islands is dominated by beaches that have multiple bars and washover fans that are separated by dune fields. The dunes are vegetated by grasses and shrubs that grade into a high salt marsh, also populated by black mangroves. The southern portion of the islands is more narrow and lower in elevation than the northern portion, leading to shoals separated by tidal inlets and small island fragments.

To the west, over the St. Bernard Delta surface, the Chandeleur Islands are rapidly transgressing (transgressive barrier islands are long and narrow, and gradually migrate towards the main land body they parallel). The long-term Gulf shoreline erosion rates estimate a minimum 2 m/yr loss in the north-central portion and greater than 12 m/yr loss at the northern and southern ends of the islands (Kahn 1986). The deterioration of the islands is caused not only by the frequency of Gulf storms, but also by the subsidence of the St. Bernard Delta sediments, and the absence of a rejuvenating sediment supply. There have also been sea floor landslides, which may have caused stronger waves, and greater erosional impacts to the Chandeleur Islands (Hymel 2007).

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Over the past decade, tropical cyclones have decimated the Chandeleur Islands, destroying pre-existing vegetation, ruining habitats, and eroding the shoreline. In 2004, when Hurricane Ivan passed approximately 95 km east of the islands, it destroyed the restoration progress of the Chandeleur Islands. Almost all of the vegetation on the islands was lost, and the washover channels increased in number from 20 to over 100. The 2005 hurricane season further delayed any rebuilding progress that could have been made in the islands. Hurricanes Dennis, Katrina, Cindy, and Rita all occurred during the 2005 hurricane season, resulting in severe damage to the islands. In particular, Hurricanes Dennis and Katrina reduced and redistributed many terrestrial parts of the islands into sub-surface formations and shoals. Katrina also caused a severe amount of overwash, consequently all of the recent habitat restoration (planting) sites were converted to open water (Hymel 2007).

The 2008 hurricane season marked another disastrous year of hurricane impacts for the Chandeleur Islands, since they had not recovered from Hurricane Katrina by the time Tropical Storm Edouard passed the islands in August. Immediately following Edouard, two major hurricanes, Ike and Gustav, passed or made landfall near the Chandeleurs, further counteracting the small amount of land accretion (accumulation) that had occurred prior to Katrina.

**Data utilized.** For analysis of island land area change, vegetated area change, and island transgression, Earth observation and ancillary data were acquired from the following sources:

- Landsat 2-4 Multi-Spectral-Scanner (MSS) and Landsat 4 and 5 Thematic Mapper (TM) imagery were downloaded using the U.S. Geological Survey (USGS) Global Visualization Viewer (GloVis) at the Earth Resources Observation and Science Center at http://glovis.usgs.gov/. Images were acquired for path 21, row 39 (World Reference System). The images downloaded cover the Chandeleur Islands, were cloud-free, and were selected from time periods before and after 27 tropical cyclonic events that occurred between 1979 and 2009.
- Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) (onboard the Terra satellite platform) data were downloaded from the Land Processes Distributed Active Archive Center (LP DAAC) at https://lpdaac.usgs.gov/, using the NASA Warehouse Inventory Search Tool.
- Post-Hurricane Gustav aerial photography was downloaded from the National Oceanic and Atmospheric Administration's (NOAA) National Geodetic Survey Web site, http://ngs.woc.noaa.gov/gustav/.
- Moderate Resolution Imaging Spectroradiometer (MODIS) data (onboard both Terra and Aqua satellites) were obtained from the LP DAAC. Daily images were acquired from 2000 to 2008.
- A QuickBird image from August 22, 2007, was provided by the Pontchartrain Institute for Environmental Sciences, and was used as ground reference data to conduct an accuracy assessment on a 2007 land/water classified ASTER image.
- Hourly Global Surface Data were downloaded from the National Climatic Data Center (NCDC) Web site. Data from 1981 to 2009 were acquired from Buoy 42007. The MATLAB file wind_rose was downloaded from the file exchange on the MATLAB Central Web site (http://www.mathworks.com/matlabcentral/fileexchange/).

**Image processing.** Unsupervised ISODATA (Iterative Self-Organizing Data Analysis Technique Algorithm) classifications were conducted on Landsat and ASTER datasets using ERDAS IMAGINE on each of the subset images, using 150 classes, 150 iterations, and a convergence threshold of .995. The classified images were then manually aggregated into two classes: water and land. These land and water classifications were used to determine land area. Pixels classified as water were used to create a mask covering the water surrounding the islands for each date, to help ensure that Normalized Difference Vegetation Index (NDVI) calculations did not include surrounding water areas (Rodgers 2009).

MODIS images were processed using the Time Series Product Tool (TSPT), a program created at John C. Stennis Space Center for use in the "automated, rapid, large-scale regional surveillance" of vegetation, free of any atmospheric effects (McKellip 2008). TSPT, designed for use in MATLAB, provides a means to process MODIS data, and other satellite sensor products, by automatically correcting for cloud cover and by removing undesirable pixels. It uses a number of modules to create images that are cloud- and noise-free. The output of the TSPT includes single image displays of satellite imagery, time-series plots for specific locations, or videos that show single images over a specified time frame (Prados 2006).

For this project, TSPT was set to apply MODIS data from the Terra and Aqua platforms. Images collected daily from 2000 to 2008 were used. MOD 09 GQ and GA products were used to aid in tracking the transgression of the Chandeleur Islands over an eight-year period.

**Normalized difference vegetation index (NDVI)**. NDVI is used to measure vegetation health. This project calculated NDVI to assess vegetated area cover change on the islands. Landsat and ASTER data calculations were processed in the ERDAS IMAGINE spatial modeler. During image analysis, values ranging from 0.0 to 0.02 were classified as sand. In calculating vegetated areas, since most of the vegetation on the Chandeleur Islands is sparse grass and shrubs, pixels with NDVI values greater than 0.02 were assessed as vegetation. Measurements of vegetation in hectares were computed in ERDAS IMAGINE for each image.

**Land/shoreline change.** To display shoreline change for the Chandeleur Islands over the past 30 years, a series of maps was created in ESRI ArcMap. Then water masks from 1979, 1989, 1999, and 2009 were applied to Landsat images of the islands, converted into shapefiles, and compared to visualize land area changes.

**Transgression methods.** After MODIS data were processed using the TSPT, images were displayed in ENVI. For the analysis of island transgression, three transects were selected in the islands–north, central, and south. Horizontal profiles of the near infrared (NIR) value of each pixel in each transect were compared over time to show the transgression of the islands through movement of the maximum NIR value. The maximum NIR value in the first MODIS image was shown as a solid line in graphs; change in peak NIR value was extrapolated to analyze transgression.

**Classification accuracy assessment.** Accuracy assessments evaluate the quality of information derived from a particular dataset, and are an essential part of the research to determine how classification methods affect results. Accuracy assessments in remote sensing are performed by selecting a number of points in the classified image and checking them against reference data, such as field survey results or high resolution imagery (where the minimum mapping unit is usually less than 2 m) of the region (Jensen 2005). When adequate ground reference data or aerial photography are not available, visual interpretation of the original data by a skilled individual familiar with the land cover types and ground conditions may be the only reasonable option to conduct the necessary accuracy assessments (Sader 2002). For this study, thematic map accuracy assessment was based upon visual interpretation of Landsat MSS and TM data as ground reference data (Cohen 1998).

**Wind data.** NCDC hourly wind speed and wind direction data from 1981 to 2009 were input into MATLAB as the variables D and V, respectively. The command Wind-rose (90-D,V) was used to create a wind rose, which illustrates the wind profiles near the Chandeleur Islands. This process was repeated with seasonal data (April–September and October–March) from the same time period to create summer and winter wind roses.

**Land and vegetation change.** In 1979, the total area of the Chandeleur Islands was assessed at 2588.4 hectares. In 2009, the total area of the islands was 1663.29 hectares. This equates to a 35.7% loss of land area over the entire 30-year study period, with 16.0% lost between 1979 and 1998, and 19.7% lost between 1998 and 2009 (Figure 1).

In 1979, the total vegetated area of the Chandeleur Islands measured 412.92 hectares. In 2009, the total vegetated area of the islands measured 218.43 hectares. This equated to a 47.1% loss over the entire 30-year study period, with 89.7% gained from 1979 and 1998 and 136.8% lost from 1998 to 2009 (Figure 2).

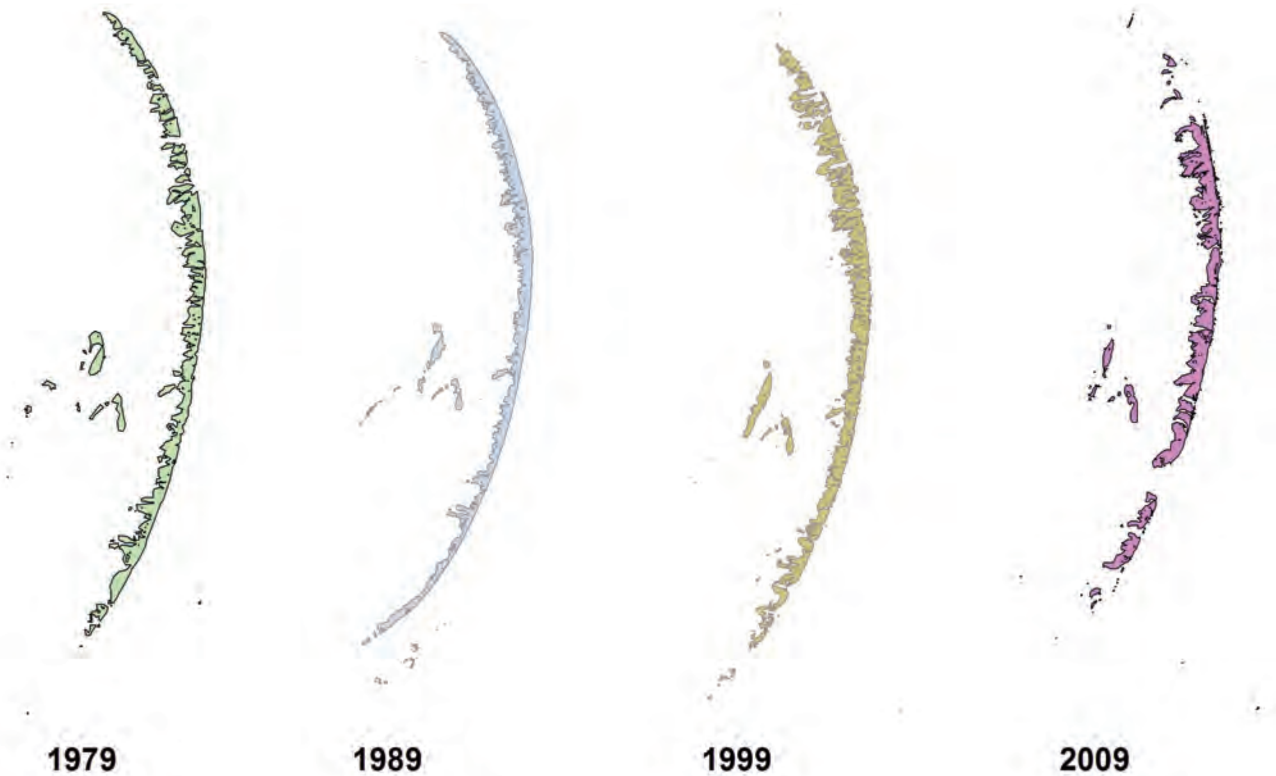


Figure 1. Chandeleur Island shoreline change, 1979–2009.

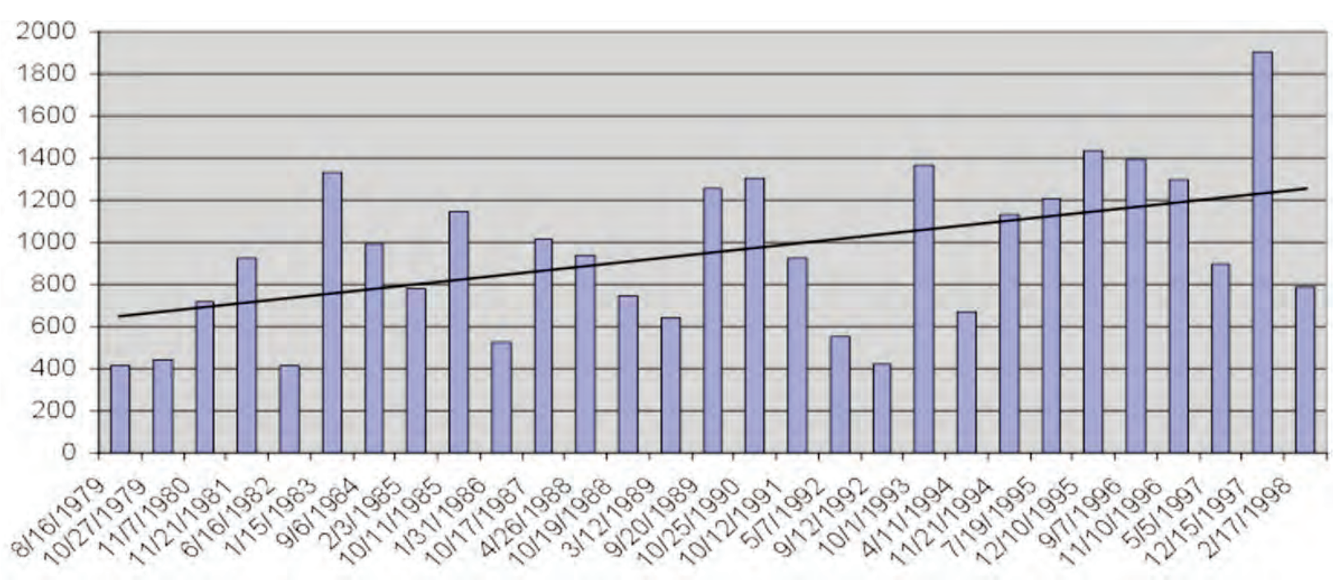


Figure 2. Vegetated area change in hectares, 1979–1998.

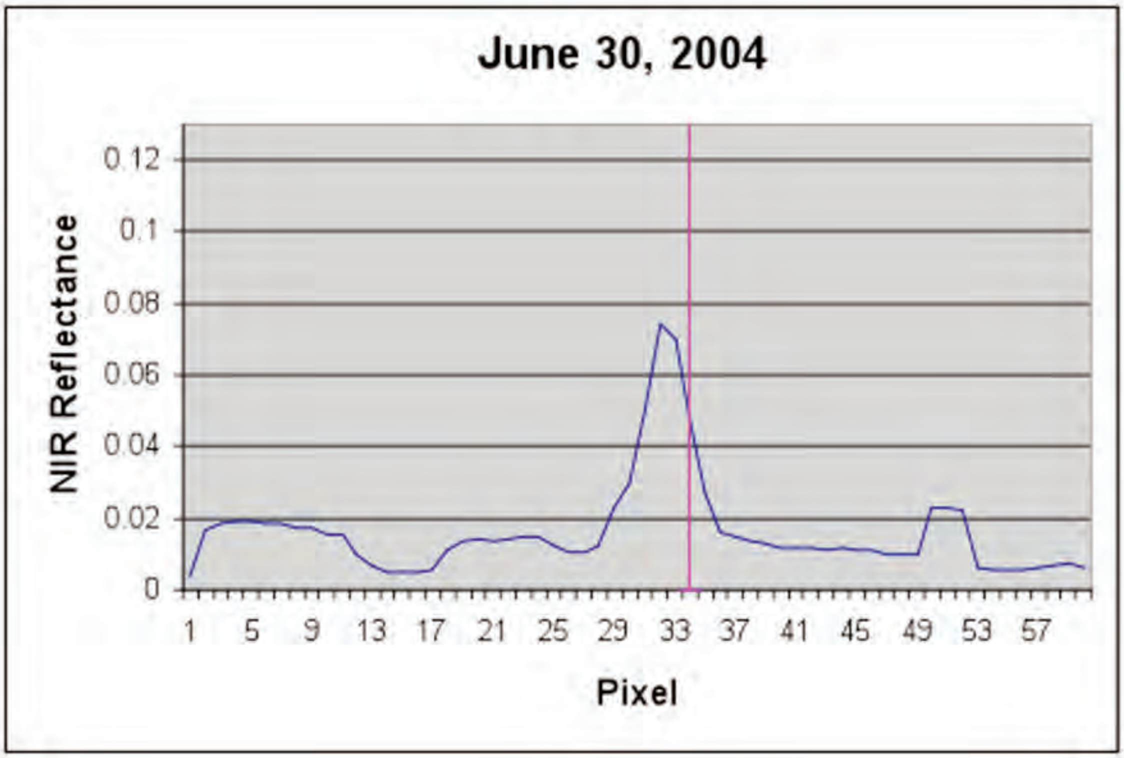


**Figure 3.** Southern Transect NIR Reflectance June 30, 2004.

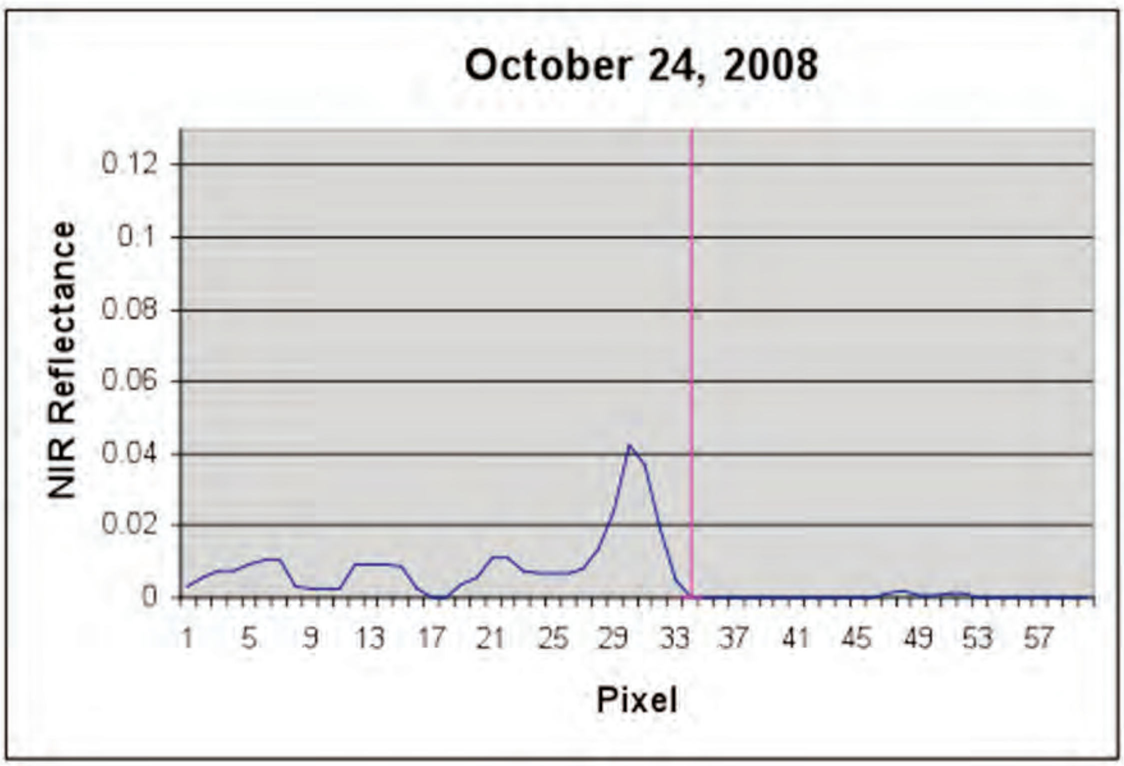


**Figure 4.** Southern Transect NIR Reflectance Oct. 24, 2008.

**Transgression.** The northern and middle portions of the islands remained mostly stationary throughout the MODIS study period, except for the time period directly following Hurricane Katrina in 2005. After Hurricane Katrina, the northern and middle portions of the island exhibited a slight transgressive movement. However, Figures 3 and 4 (at left) show that the southern portion of the islands steadily transgressed from 2000 to 2008. The transgression was accelerated by Hurricane Katrina in 2005.

**Tides.** Tides are an important factor to consider in the study of barrier islands. Tides control the water level, and the movement of water around barrier islands and through tidal inlets. Because of the bathymetry (topography of the ocean floor) and the shallow slope of the Chandeleur Islands, the tidal elevations at the islands are greatly influenced by wind. This process, called wind setup, can cause actual tides to be higher or lower than forecasted tides (Georgiou 2005). The ability to accurately measure tides on the Chandeleur Islands is limited. There are no tidal gauges on the islands, and the closest buoy is located about 9 miles NNE of the islands. The recorded tides at this buoy are not an accurate representation of the actual tides at the Chandeleur Islands. The buoy is located in open water, and is not affected by the same near-shore bathymetry as the islands. Estimated tidal ranges were acquired through the use of the Tides extension to NOAA's Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. The SLOSH Model provides historical predictions of tidal range by hour. Because of the shallow bathymetry near Chandeleur Island, relatively small changes in water level can cover or expose large areas of land, which complicates barrier island remote sensing.

**Winds.** Winds affect the erosion of the Chandeleur Islands because seasonal wind patterns greatly influence the wave climate along the Louisiana coast. The direction and speed of the winds can determine the erosive energy of the waves. There is a high correlation between wind direction, and direction of dominant wave approach (Georgiou 2005). Southeasterly winds produce waves with the greatest fetch because they can travel the farthest distance. Therefore, waves approaching from the southeast are often the most erosive. The wind profile reflects weather patterns. During the winter, because of cold front passage, the wind often comes from a north-northwesterly direction. This is significant because northwest winds cause waves that erode the back barrier beaches, which are more stable, and usually sheltered from erosive forces. Therefore, the Chandeleur Islands are susceptible to wind-driven erosion throughout the year.

## Conclusion

Over the past several centuries, the Chandeleur Islands have been slowly eroding, and moving toward the mainland. As transgressive barrier islands, this is their natural morphology. However, this project found that beginning around 1998, vegetated area and land area began dramatically decreasing. An increase in frequency and intensity of storms over the past decade has hindered regeneration of the islands, and has made them more susceptible to damage from natural phenomena, such as cold fronts, winds, and waves. Hurricane events, such as Hurricane Katrina in 2005, and Hurricane Gustav in 2008, have accelerated the transgression of the island. The northern and middle portions of the island remained mostly stationary throughout 2000-2008, except directly following Hurricane Katrina in 2005. The southern portion of the islands steadily transgressed landward throughout the entire period, but transgression was accelerated by Hurricane Katrina's impact in 2005. TSPT was instrumental in providing analysis, and quantifying transgression of the islands. Without restoration efforts, coastal Louisiana will likely lose these islands, its first line of defense from future tropical cyclonic events.

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# Improving Scientific Communication through the Use of U.S. Geological Survey Video Podcasts

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## Abstract

IT IS CRUCIAL THAT SCIENTISTS FIND INNOVATIVE WAYS OF EFFECTIVELY COMMUNICATING RESEARCH to resource managers, public officials, and the general public. New technologies, such as video podcasts, are being used as an outreach tool to communicate results from the U.S Geological Survey (USGS) National Water-Quality Assessment (NAWQA) program. The purpose of these podcasts is to summarize scientific research and methods from the NAWQA program. Video podcasts are audio podcasts that incorporate video clips to illustrate ideas presented in simple, concise language with brief 3 to 5-minute films. The process of creating concise podcast messages expands the potential audience for communicating research findings, but the production of video podcasts requires adequate allocation of time and resources. Audience responses to NAWQA podcasts thus far indicate that video is an effective means of sharing scientific information with a broader audience.

## Introduction

Public communication and engagement are recognized priorities for environmental scientists (Lubchenco 1998; Jordan et al. 2009). The challenge is transmitting scientific information in a manner that is comprehensible and engaging to non-scientific audiences (Groffman et al. 2010). Traditionally, scientists assumed the general public's lack of scientific understanding generally was a result of low scientific literacy. The belief has been that scientific communication can be improved through increasing scientific understanding of concepts and using this information to educate the public (Bauer et al. 2007). As a result, peer-reviewed journal articles and scientific reports are the primary tools scientists use for communicating scientific results. Although these

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products are excellent for communicating scientific research, the audience generally is limited to other scientists (Weingart et al. 2000).

To reach a broader audience, scientists must frame their results in a way that resonates with the general public by considering different methods for communicating scientific results. Challenges in communicating results to the general public include engaging general audiences, connecting scientific results to public values, and using new communication tools that can reach a broad range of audiences (Groffman et al. 2010). In order to accomplish this, scientists must reconsider how they will communicate their results by developing a clear communication strategy that tells the story, connects with the audience, and then provides the audience with practical information about how the associated results can be applied (Olson 2009). Generally, it is not effective to overwhelm an audience with statistics and complex details (Weingart et al. 2000). Communicating complex scientific concepts and processes involves determining the content that will apply to and resonate with an audience and then providing the information through a delivery method that will directly reach this audience (Olson 2009).

Short video podcasts, as used in the NAWQA program, are one such method of delivering a message to a non-scientific audience. Generally, film is not a good medium for providing detailed information; however, they can be effective at creating a single, deep impression (Olson 2009). By delivering one single piece of information, video podcasts can stimulate viewer interest in the scientific topic and results. Video podcasts are short film clips related to a specific theme, and they can be downloaded for viewing and delivered by an automated feed with computer software to subscribers. Once downloaded, video podcasts can be viewed anywhere on a computer, and they appeal to various learning styles (Herkenhoff 2006). If effectively deployed, video podcasts can improve scientific communication to general audiences by making information more accessible to auditory learners and improving engagement levels (Boulos et al. 2006).

Video podcasts are now part of the USGS CoreCast series. CoreCast video and audio podcasts focus on nationally relevant issues, including immediate breaking news about earthquakes and other natural disasters, recently released results of scientific studies, and other USGS topics that are relevant. Between August 2007 and March 2011, more than 20,000 users have accessed the USGS CoreCast series, and 100,000 downloads have been made. Currently, the USGS CoreCast has 3,350 subscribers who automatically receive new CoreCast video podcasts upon release at http://www.usgs.gov/corecast/. One NAWQA video in this series (Episode 127) communicates general results from a long-term study that focused on examining the effects of urbanization on stream ecosystems (EUSE). This video podcast can be downloaded at http://nc.water.usgs.gov/podcasts/. Recently, the EUSE video podcast has been used as a case study to determine (1) how video podcasts can be used to effectively communicate science, and (2) what the strengths and weaknesses of the EUSE podcast are in communicating science.

## Methods

Two methods were used in the research of the effectiveness of the EUSE video podcast. First, an evaluation form was distributed at the 2010 meeting of the American Geophysical Union (AGU) in San Francisco, CA, where the EUSE video podcast was presented. For this evaluation, Likert-scale responses were used to obtain feedback on what the audience considered important elements of the video podcast. Both closed and open-ended questions were included to evaluate the effectiveness of the podcast's substance and style for communicating scientific results. Descriptive statistics and general themes from responses to open-ended questions are presented in order to help synthesize results from the evaluations. Additionally, the EUSE video podcast was featured at the 2011 Aquatic Sciences Film Festival of the American Society of Limnology and Oceanography (ASLO). Here, the video podcast was evaluated by professional filmmakers, Randy Olson and Dorie Barton, who provided qualitative feedback on the effectiveness of the video podcast in communicating science http://www.aquaticsci.net/?cat=105.

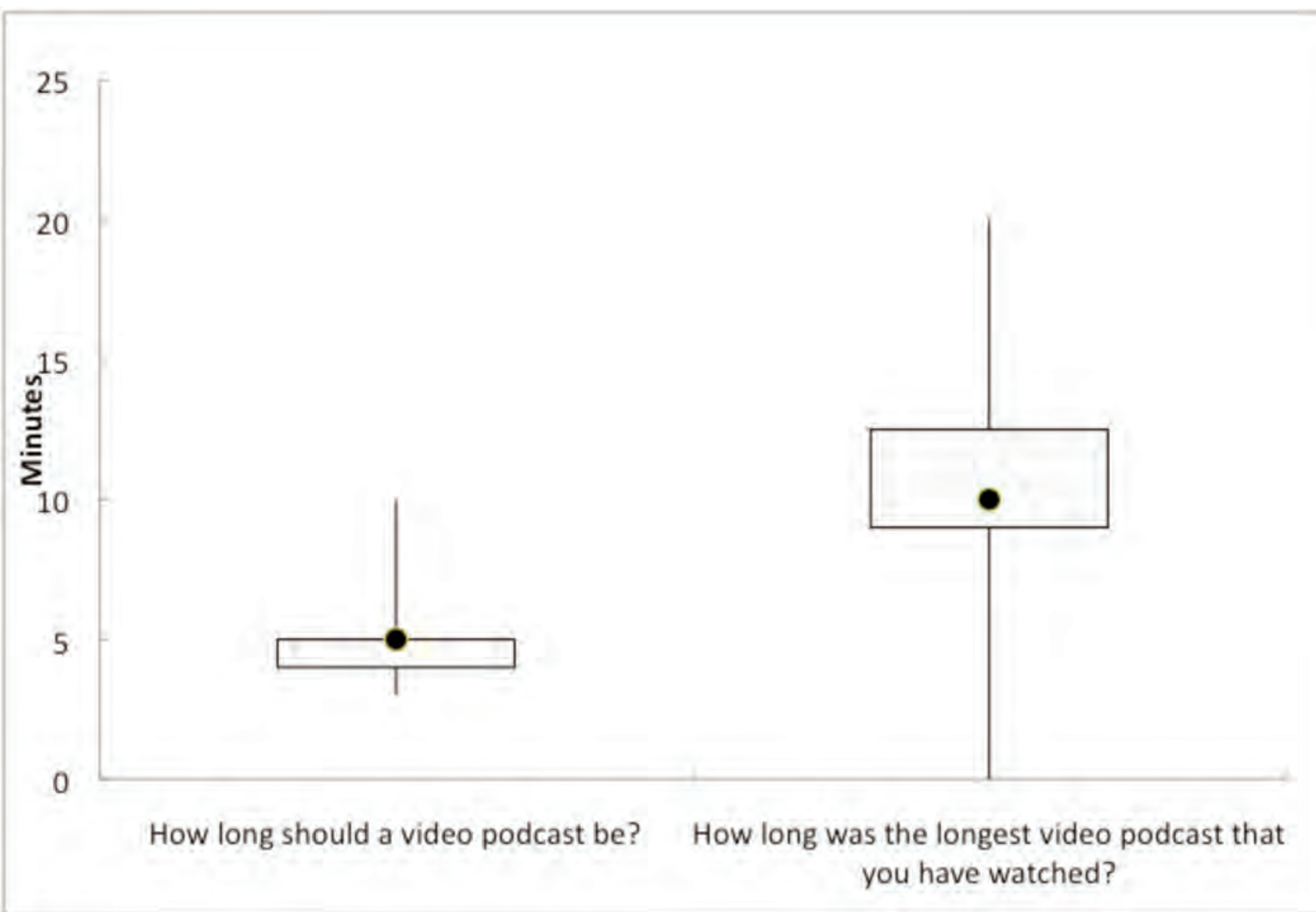
### Results

A total of 23 evaluations were received from session participants at the AGU meeting. Respondents' ages ranged from 25 to 66, and the median age was 41. Generally, respondents were highly educated. Every respondent had a college degree, 9 respondents had master's degrees, and 11 respondents had doctoral degrees. All respondents worked in the fields of science (n=12), education (n=9) and(or) communication (n=6).

On average, all respondents agreed that the podcasts should be 5 minutes or less. Responses were open ended and ranged from less than 3 minutes to a maximum of 10 minutes, but only two respondents suggested that podcasts should be more than 5 minutes. Despite this opinion, the majority of respondents had watched podcasts as long as 10-15 minutes in the past (Figure 1). The respondents previously viewed podcasts on YouTube (n=13), news or newspaper websites (n=13), or other science-agency websites (n=12). Fewer people viewed podcasts on Google viewer (n=6) or the USGS website (n=4). National Public Radio, Andrill.org, and Facebook were also listed as other venues for viewing podcasts. Four of the respondents had never before viewed a podcast.

As part of the survey, the audience was asked to rank the importance of various video podcast elements. The boxplots in Figure 2 highlight the median and range of audience responses. A rank of 1 represents elements ranked as least important, and 10 represents elements ranked as

**Figure 1.** Reviewers' responses to questions regarding the ideal length of video podcast (n=23). Median values are represented by the black circle.



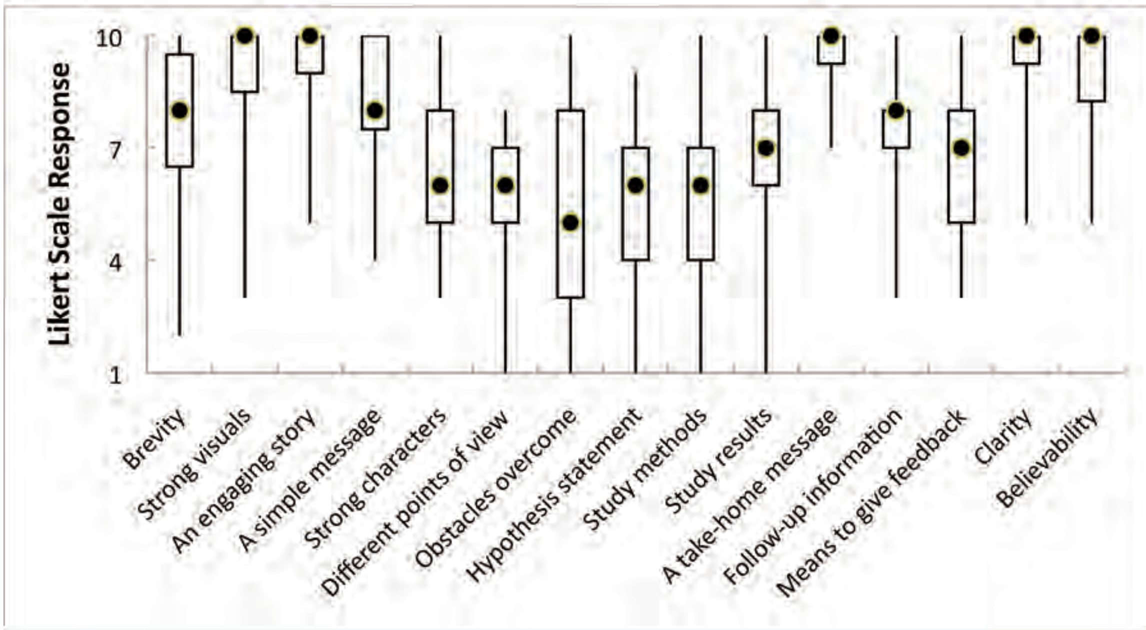



**Figure 2.** Reviewers ranked the importance of various elements in the EUSE video podcast from 1 to 10 using the Likert scale in which 1 represents elements the reviewers strongly agreed were least important and10 represents elements the reviewers strongly agreed were most important, with 5 being neutral. Median values are represented by the black circle.

most important (Figure 2). In all, 16 elements were ranked and then divided into two groups that represent the two parts of communication—style and substance. When it comes to style, short, sweet and complete were the preferred methods of communicating by video podcast. Respondents felt it was important to keep the audience engaged by having good visuals, a simple message, and an engaging story told within the brief time span of 5 minutes. With regard to substance, respondents felt the podcast needed to be clear, believable, and based on solid science, but they did not feel that it needed to include all of the details. Hence, the rankings were low for traditional elements, such as a hypothesis statement, study results, and study methods traditionally found in scientific reports. The respondents emphasized the importance of not overwhelming the audience with too much information.

Overall, respondents from the AGU meeting thought the EUSE video podcast was a good tool for communicating science, but they also provided some suggestions for improving the style and substance. One of the predominant themes in the survey responses was to keep the podcasts simple and easy to understand. This included having one straightforward take-home message, and eliminating jargon. Several respondents felt the EUSE video podcast included too much jargon. One respondent suggested that a non-scientist should review each script before filming. Respondents also emphasized that it was important for the scientist in the video to speak slowly and clearly. Finally, the respondents were curious about the marketing strategy, and emphasized the importance of getting video podcasts out to wider audiences. Between June 2010 and March 2011, the EUSE video had been automatically delivered to 3,500 subscribers. This number does not include individual downloads. Our respondents suggested linking the video podcast to various listservs, especially those that target educators.

Feedback from the two professional filmmakers at the ASLO film festival mirrored these responses. One of the filmmakers really liked the piece because it provides a clear take-home message: "I think this is a terrific piece. It's smart, effective, well produced, well-structured, and conveys its concept very simply and directly to the public." (Dorie Barton, ASLO) The other filmmaker suggested that the piece could have used a more engaging opening: "Let's begin by considering what this video is meant to be about — the impact of urban development on streams. Why not convey this in the opening images?" (Randy Olson, ASLO) He emphasized the importance of grabbing the audience from the very beginning so they will be interested in learning more about the message.

Finally, we were interested in learning if our viewers did get the take-home message, the ultimate goal of our podcast. The theme the video podcast intended to convey was urbanization does impact stream ecosystems, but the stream response is related to previous land use and regional differences. Generally, all respondents felt that the take-home message was related to the theme, "impacts of urbanization on stream ecosystems." Responses varied from "water quality was impacted by urbanization" (n=10) to "water quality was negatively impacted by urbanization" (n=3). A few respondents grasped the point that streams and stream responses varied by region (n=2).

### Discussion

Based on this feedback, we conclude that podcasts can be an effective medium for scientific communication if they are simple and easy to understand, with one straightforward take-home message. Video podcasts are most effective when they include good visuals and an engaging story. Too many details can overwhelm the audience. To ensure that a video podcast is brief and to the point, we suggest limiting the length of video podcasts to 5 minutes, as suggested by our reviewers. The goal of the video podcast is to engage and intrigue the audience, and leave them wanting to learn more. An engaging video can entice the audience to seek additional information by visiting the project website, or reading scientific reports and journal articles. The scientists must resist the temptation to include every facet of the study in the video podcast. Rather, video podcasts should be considered a scientific communication tool for general audiences, and an entry portal for those interested in obtaining more details about the research. In some cases, the video podcasts may be a viewer's first introduction to science. If the video podcast is engaging, the viewer may be inspired to learn more about the topic, or use the results of the science to inform decisions.

Once a video podcast has been created, it is important to consider how the product will be marketed. The most engaging video podcast will not effectively communicate science if it is not viewed. This point really came through in our respondents' evaluations. People wanted to know how we were marketing the podcasts. They wanted to know who our intended audience was and how we were reaching out to them. The CoreCast network is one tool for marketing the video podcast and automatically informs all subscribers of the podcast, but this currently is limited to a network of 3,500 people.

As a result, we are considering other audiences that may be interested in or affected by the results of our science. We can then use various marketing strategies to get the EUSE video podcast to them. Interested colleagues represent a sub-audience whom we target by e-mail. A suggestion made during our presentation at the 2011 George Wright Society meeting in New Orleans was to partner with parks to broaden the communication of our scientific message. As a result, our video podcast is now featured on the National Park Service's website at www.nps.gov/gate/naturescience/naturalfeaturesandecosystems.htm. We believe that working with the National Park Service to communicate USGS scientific results could be an excellent way to reach a broader audience, by combining the expertise of both organizations. Future marketing will include expanding our audience to other scientists who work in related disciplines, educators who could use the video podcast as an educational tool, and professionals, such as town councils, planners, and resource managers, who want to learn more about the effects of urbanization on stream ecosystems.

Engaging the public will be increasingly important in the future, as scientists are called upon to demonstrate the public value of scientific research (Lubchenco 1998; Jordan et al. 2009). Scientific research, results from programs such as NAWQA, and specialized studies such as EUSE, can help decision makers more wisely plan urban development and protect water resources. Strategic planning of communication messages, identifying new audiences and communication channels, and creating interesting, informative products, such as video podcasts, will be vital tools for relaying scientific results to the public and decision makers. Video podcasts require time, resources, and qualified staff, but the reviewers' responses indicated that video podcasts can be effective and well worth the investment.

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# DC's Island Sanctuary: Managing Nature and Culture on Theodore Roosevelt Island

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**Theodore Roosevelt Island National Memorial is a wooded island in the Potomac** River located between the thick mass of 12-story buildings that comprise Washington, DC, and the tall skyscrapers of Arlington, Virginia (Figure 1). The site is managed by the George Washington Memorial Parkway (GWMP), which spans approximately 40 miles between Great Falls, Virginia, and Mount Vernon. There is also a shorter section of the GWMP along the Maryland side of the Potomac.

There are volumes that could be written on events that took place on this landscape. This paper discusses the interesting history of the island in brief, which will help in the understanding of how modern resource management on the island is directly tied into island history. It will also discuss some of the management solutions and challenges on the site.

Archeological evidence shows that the island, known as Analostan, was in use by Native American tribes until the early eighteenth century. The island name Analostan possibly derives from Necostin or Anacostian Indians who lived in the area for hundreds of years before European settlement.

The Mason family of Virginia acquired the island in 1717. George Mason IV was the author of the Virginia Bill of Rights. In 1798 he established Mason's Ferry, which linked the island, via a ferry landing on its north side, to what was then Maryland, and what is now the Georgetown area of Washington, DC. The island became known as Mason's Island (Figure 2).

In order to get to the island from Virginia, people would hire private charter boats. This persisted from the time the ferry opened until 1807, when a temporary causeway was built from the Virginia shore to the northwest corner of Mason's Island. The ferry and subsequent causeway were a vital link between Virginia and the north. It changed the way people traveled around the area and the region. It was significant in national transportation history as it connected people to Washington and Maryland, as well as to the Ohio River Valley and beyond. It was not until 1809 that Long Bridge, the first bridge connecting Maryland and Virginia, was built, approximately one mile south of the island.

Mason IV's son John Mason built an estate plantation on the island, and called it Analostan. He and his family lived there from 1792 to 1833. He built a classical revival-style mansion and associated outbuildings. There were also slave quarters and associated buildings. Mason and his

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**Figure 1**. The wooded landscape of Theodore Roosevelt Island and the skyscrapers of Arlington Virginia as seen from the rooftop of the House of Sweden in Georgetown, D.C (Photo by Saylor Moss).

slaves tended pleasure, private, and kitchen gardens, an orchard, and a tree-lined alee that led from the ferry landing to his home, which was on a high point near the center of the island. There were lawns, agricultural fields, and pastures where Mason raised sheep and experimented with cotton, as did many gentlemen farmers of the day. It is said that Mason maintained a buffer of trees around the edge of the island, with a break for a view to the east. It is not known where that break was, and it is certain that whatever island dwellers saw during Mason's era is no longer visible in the vastly altered modern landscape. In 1928, one visitor described the island as "the most enchanting spot I ever beheld." After financial trouble and bank repossession, Mason left in 1833.

After Mason's departure there is mention of commercial cultivation on the island. Reports of peach trees, roses, and vegetables can be found. There was also a resort and a saloon on the island. People from the surrounding area would come to the island for recreation. There were company picnics, feasts, dances, and even a tale of jousting.

Cultivation and social use of the island ended in 1861 when the military occupied the island. Union troops were trained here, notably the black troops of the First US Colored Troops. Structures, including barracks, offices, and an infirmary, were constructed to house and care for the troops. It is likely that the Mason mansion and its outbuildings may have been used to house troops as well. The landscape at this time was untended and sparse.

Between 1864 and 1865 the Army buildings were used as a temporary refugee camp for blacks arriving in DC from the south. It was an overflow Freedmen's camp, where a lack of basic supplies and overcrowding led to death and disease. The federal government was unable resettle or take care of the men, women, and children who came north in search of jobs and a better life for themselves. The Association of Friends and other benevolent groups helped provide for the freedmen's physical, educational, and spiritual needs. The camp was disbanded in 1865.

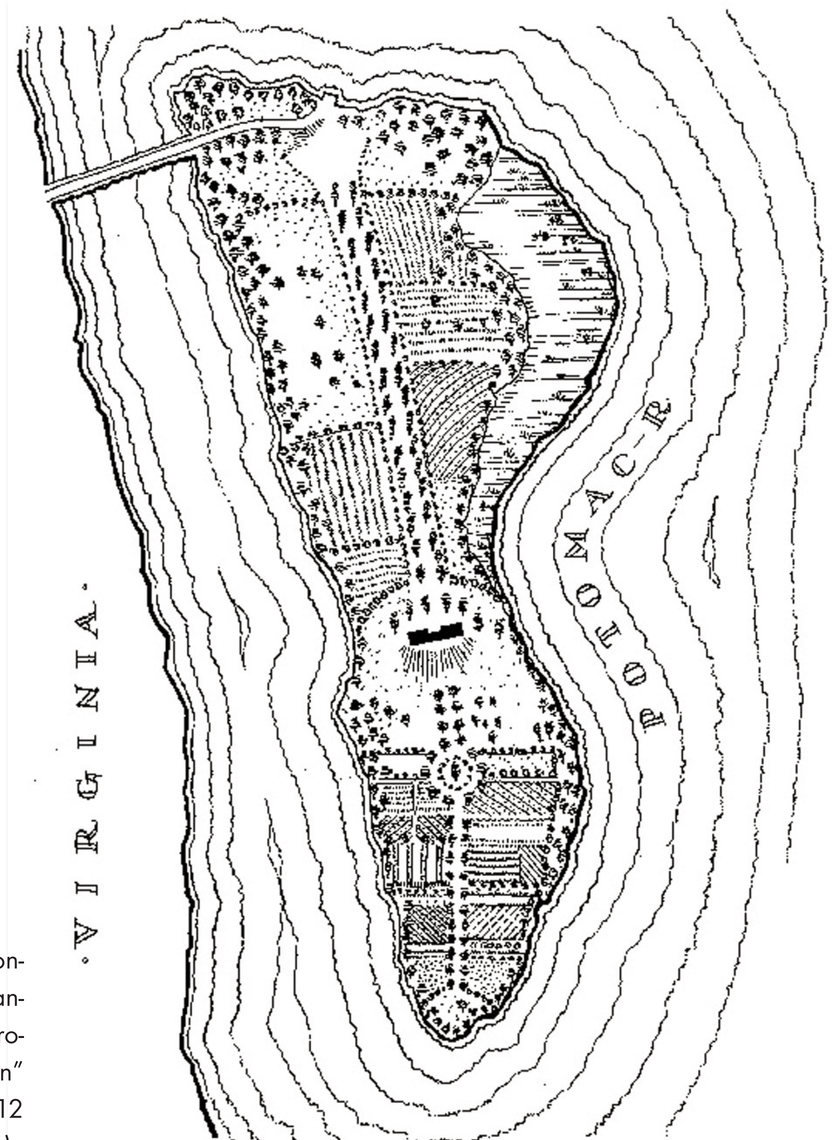



**Figure 2.** This 1818 map illustrates the Mason-era causeway, ferry landing, swamp land, mansion and associated landscape. (Image reproduced from "A Map of the City of Washington" by Robert King 1818: Source NPS HALS DC-12 2008 deliniated by Clemmens, Kidd, Mincey).

After the Civil War era, the island was once again used for short term recreation. It was used for ice storage; there was a boat house used by nearby boat clubs; a story exists about Alexander Graham Bell and a Smithsonian institution secretary, Professor Samuel Langley, conducting aerodynamics and aeronautics field tests in which they were unable to raise a large square kite-type rigging into the sky. The island also had a reputation for shady goings-on. At this point the island could only be reached by boat, and it was a good place to hide.

In 1902, a reporter for the *Washington Times* said, "The interior aspect of Analostan is desolate in the extreme." What was left of the Mason House was hidden in dense a growth of trees which had overrun the island. In 1913 the Washington Gas Light Company purchased the island for $77,000. No plants or facilities were ever built during their ownership. A caretaker and his wife lived in a clearing on the island. A carpet of honeysuckle covered much of the landscape. The swamp was a trickling creek surrounded by grass and cattails.

In 1931, the Roosevelt Memorial Association (RMA, established in 1919, and renamed the Theodore Roosevelt Association, or TRA, in 1953) purchased the island from the Washington Gas Light Company, just before the Justice Department condemned the property and added it to DC parkland. The RMA's goal was to establish a national memorial to Theodore Roosevelt that would rival those of Washington and Lincoln. The following year, the RMA gave the island to the federal government, but maintained planting and development rights.

Within two years of the purchase, the island was renamed Roosevelt Island, and later Theodore Roosevelt Island (TR Island) by President Herbert Hoover. The island was given to the United States, and was administered by the Office of Public Buildings and Public Parks of the National Capital. The RMA continued to retain the rights to create a planting plan, and to erect a monument to Roosevelt in the future.

In May 1932, the RMA hired architect John Russell Pope and the Olmsted Brothers firm to prepare plans for both projects. Pope served mainly as an advisor, and he died in 1937. Frederick Law Olmsted Jr. and his colleague Henry Hubbard are regularly associated with TR Island planting design. Olmsted was the son of the forefather of modern landscape architecture in America. At this point in his career he had served as adviser and designer, or both, on many prominent Washington landmarks, including the White House grounds, the Jefferson Memorial, Rock Creek Parkway, and the National Cathedral grounds. Over time, he became a major figure in comprehensive city planning, the concept of neighborhood-centered development, and designing to emphasize the importance of common open and recreational spaces. Some of the key language in the 1916 bill establishing the National Park Service (NPS) was Olmsted's. Henry Hubbard had been a student of Olmsted Jr.'s at Harvard, and was the first person to receive a degree in what was newly known as landscape architecture.

The landscape of the island was to be a nod to Roosevelt's conservation ethic. Olmsted utilized the methods that both his father and the NPS promoted. Those included the preservation and creation of natural or scenic beauty, and the use of native plants and rustic structures. Olmsted's goal for the site was to establish a native, climax forest, and to establish a feeling of sanctuary. He pictured a landscape accessed at a single point, with meandering paths, and without vehicular traffic, wherein an architectural memorial would serve as a unifying point on the island.

This was a unique concept in parks at the time. Olmsted would not be manipulating a preexisting landscape; he was basically reconstructing one, and leaving it to fend for itself. It was not typical of the NPS to create native woodlands and wetlands from scratch, and it would be difficult to sustain. It was not intended to be a professionally managed landscape like he and his father had created for George Vanderbilt in North Carolina at Biltmore, or a like the woods George Perkins Marsh and Frederick Billings managed in Vermont. TR Island would be of value to the country as a presidential memorial, and a respite from the urban surroundings, instead of a systematic attempt at forestry.

Olmsted wanted the ruins of Mason House removed so they would not be at odds with Olmsted's vision of ecological progression. The ruins were removed with permission of NPS (and despite the protests of architects and historians), and the artificial terraces were smoothed out. A historic American buildings survey (HABS) team was given a limited amount of time to document the ruins in 1936.

The Civilian Conservation Corps cleared most of the island vegetation, and planted and transplanted, according to Olmsted's specifications. Some of his plans were not realized, like a landing on the south end of the island, and a bridge leading to Little Island off of the southern tip of TR Island.

Along with a pallet of native plants, and a few non-natives thrown in for general interest, like the bald cypress that is still visible in the freshwater tidal marsh, Olmsted recommended keeping three species that are some of the most feared invasive exotics of modern times, English ivy (*Hedera helix*), periwinkle (*Vinca minor*), and Japanese honeysuckle (*Lonicera japonica*). There will be more about these plants later. Now a short timeline of events on the island during the second half of the twentieth century.

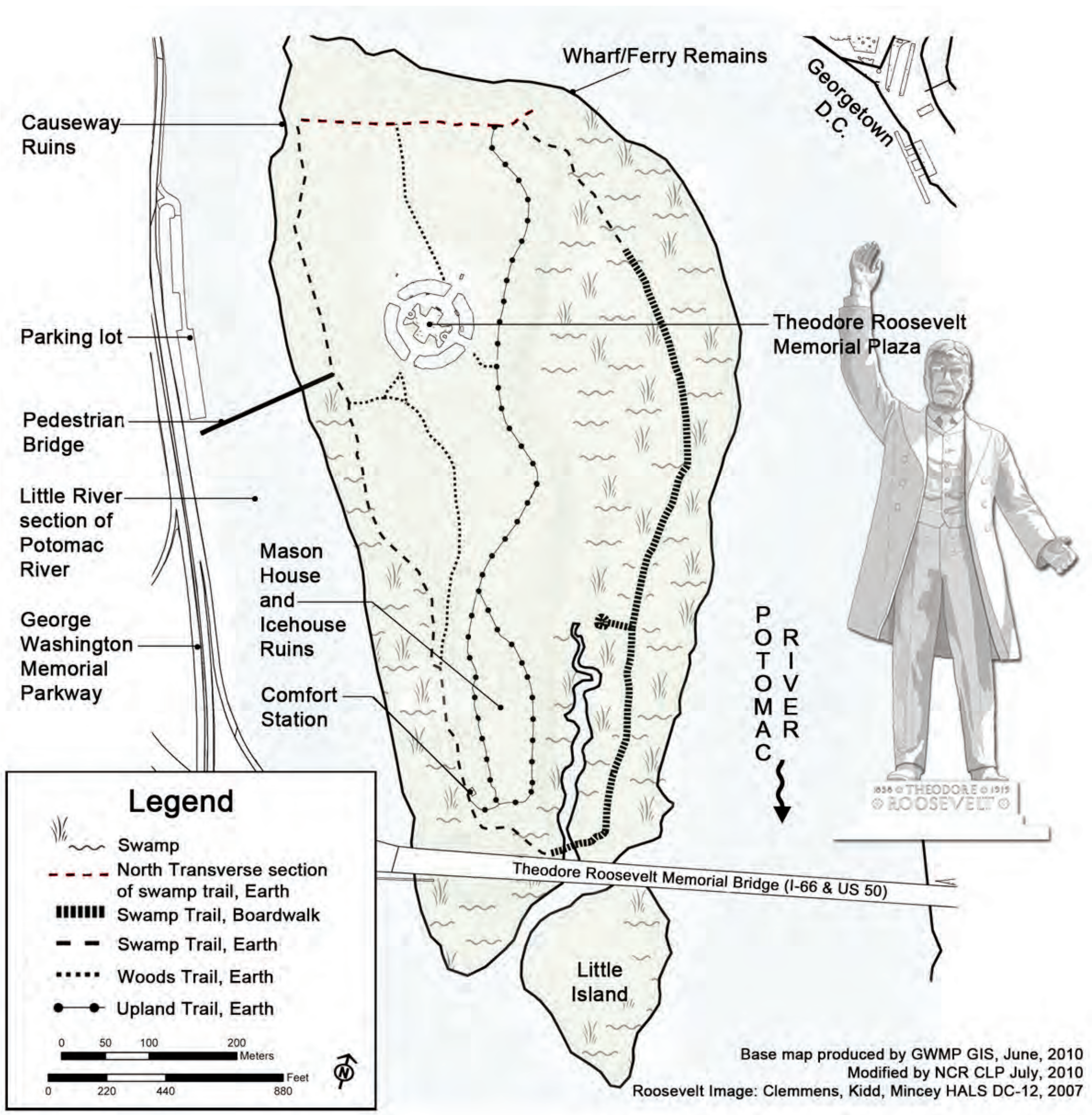
- 1953: An NPS ferry utilized the historic ferry landing, and started bringing visitors to the island by boat.
- 1954: Architect Eric Gugler (known for the White House's Executive West Wing) and Sculptor Paul Manship (known for the golden Prometheus sculpture at Rockefeller Center) were hired to prepare plans for the memorial. The end result of their work was a large plaza punctuated by the largest memorial in Washington, DC. At 21 feet, 6 inches, it is slightly taller than Jefferson and Lincoln's memorial statues, which are each 19 feet tall (Figure 3).

**Figure 3.** Paul Manship's Theodore Roosevelt Statue stands just over 21 feet tall. It is situated on the north end of an elliptical plaza with fountains, moats, benches and monoliths inscribed with Roosevelt quotations (NPS National Capital Region Cultural Landscape Program).

- 1964: Theodore Roosevelt Bridge was constructed. It was not part of Olmsted's original design, but deemed necessary to accommodate traffic flow between DC and Virginia. Its low profile and modest design were intentional, to blend in as well as a bridge can.
- 1967: The memorial was officially dedicated by President Lyndon B. Johnson.
- 1979: A pedestrian bridge was built between the island's west side and the Virginia shore. It provided the single access point that Olmsted imagined, and it was wide enough to accommodate service vehicles.
- 1996–1998: A boardwalk of recycled materials was built to allow visitors access to the island's swamp and marsh areas, without damaging sensitive ecological resources, or getting their feet wet. No significant changes to the island's hardscape have been made since that time (Figure 4).

**So what does all of this history have to do with resource management?** Aside from the formal plantings in the memorial area, which are primarily willow oaks and boxwood, today the

**Figure 4.** Theodore Roosevelt Island National Memorial existing conditions site plan (NPS National Capital Region Cultural Landscape Program).



island is a forest. To the untrained eye it looks perfectly natural—as if it could have been there for a thousand years. Resource managers know that limited work on the forest after planting, and limited resources, meant establishment and spread of plants we consider undesirable today.

So what do we do about this? We can do nothing and, like many, assume that a forest left alone will correct itself, or, we can continue to do the best we can with what resources we have. The concrete and marble may crack and become discolored, but it will probably last for a long time. The native vegetation, on the other hand, will decline or disappear altogether, without intervention. The proliferation of invasives and exotics is hindering growth and slowing succession of native vegetation. There is scientific speculation that vines thrive with increased carbon dioxide in the atmosphere, and many of the invasives on the island are vines. Without serious intervention, will the Olmsted forest be smothered by vines? With continued climate change, will more and different vines, like kudzu, move in and take over? Will the marshes and swamps be forever changed by non-native aquatic plants, like the beautiful but non-native yellow iris (*Iris pseudoacorus*) that expands the swamp, decreases marsh areas, and reduces the food supply for the native wood duck?

The GWMP is doing much more than simply letting the forest be. There are several in-depth studies on invasives, one in particular by a Duke University professor that talks about specifics on how honeysuckle thrives in the sun, and intercepts the light before it reaches the forest floor, and how ivy thrives in less sun, and intercepts light from the forest floor, and actively strangles trees. It study also talks about how vinca outcompetes native ground covers, and the specifics of the damage that yellow iris causes.

The park also engages in an early detection and rapid response program to identify and monitor invasives. The park actively uses volunteers and organizes funds for exotic vegetation removal. Understanding the historical significance of the property informs the methods selected for vegetation removal and treatment. For instance, the park identifies and treats English ivy, honeysuckle, and vinca using cut and paint techniques with approved herbicide, in a specific time of year. This method preserves archeological resources, both known and unknown, from being disturbed by hand-pulling vegetation which can cause soil removal, and exposure of underground resources.

Resource managers understand that the invasive ground cover fig buttercup (*Ficaria verna*) has a narrow herbicide treatment window, and it is hard to control without damaging nearby desirable plants. Knowing that the nearby plants are from Olmsted's plan motivates the park staff to avoid damaging non-target plants during non-native plant control efforts.

The island has a dense understory. Understory plants may not all be desirable, but in the mid-Atlantic region, the deer populations are so dense that a thick understory is rare. The fact that this landscape is an isolated island where deer do not exist is unusual, and may present another level of challenges for management.

TR Island is special. It is a wooded island in the middle of a large city. There are no vehicles there, and it is the largest presidential memorial in DC. The GWMP takes the layers of history into account when managing the unique resources of the site, in order to preserve the layers of the past, and honor the man who so revered the natural world.

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# The Role of Cultural Values in the Management and Conservation of Rwenzori and Lake Mburo National Parks in Uganda

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Protected areas cover 12 percent of the planet and play vital roles in conserving biodiversity. However, many are threatened by anthropogenic impacts. Their failure to deliver promised economic benefits to local communities, and erosion of values associated with the natural world generally, contribute to a lack of popular and political support for protected areas, resulting in inadequate protection in many developing countries. Yet protected areas need support, especially local support, to survive. Different approaches to build constituencies for conservation have attempted to address this challenge, most notably integrated conservation and development initiatives, and education and awareness raising programs. Nevertheless, the attitudes of local communities often remain ambivalent at best, hostile at worst.

This paper shares experiences of a cultural values approach to building support for protected areas. The Uganda Wildlife Authority (UWA) has piloted the integration of local cultural values into the design and management of two national parks to demonstrate how integrating values of local importance, rather than emphasizing economic and scientific values, can reduce conflicts and increase interest in and support for parks. By re-examining the ideas that underpin contemporary conservation approaches, the project has helped park managers recognize the importance of local values, and helped managers develop activities to integrate local values into protected areas, building local support, and improving management effectiveness.

## Introduction

The steady increase in the number and size of protected areas in Africa highlights the role they play in the conservation of biodiversity. But setting aside land to conserve biodiversity requires that other land-uses are sidelined, and other values excluded (Johannesen 2007). Conservation strategies are not fixed, however, and have respond to the growing pressures facing natural resources (Adams et al. 2004). The challenges of growing human populations, increasing habitat conversion, and declining biodiversity strengthened justifications for exclusive protected areas

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that separated people from nature (Adams 2004). This approach, however, has been only partially successful and conservationists, social scientists, policy makers, and the public continue to debate how demands for conservation, economic development, and human rights can be reconciled. How to reconcile scientific and economic perspectives on conservation with culturally determined connections with nature is a growing part of this discussion (UNESCO 2002).

Africa's protected areas have been strongly influenced by the so-called 'Yellowstone Model' of parks as wilderness areas (Adams and Hulme 2001). Though the model has proved effective in reducing species extinction (Hutton et al. 2005), local people living around protected areas have little interest in them, are negative towards them, and, on occasion, actively resist them (Infield 2001; Tumusiime 2006). This is not sustainable, and there is growing local opposition to protected areas (Hutton et al. 2005; Wells and McShane 2004).

Attempts to address this situation have resulted in approaches that emphasize the need to satisfy local economic needs, or at least provide material benefits (Hulme and Murphree 2001). Protected areas are increasingly managed to respond to the socio-economic goals of local communities. However, though community conservation approaches have received significant funding for decades, they have neither met communities' expectations nor adequately addressed questions about the relationships between people and nature. Despite numerous initiatives to integrate conservation and development, share benefits, give access to resources, provide education and awareness, and share decision making, parks continue to attract animosity from local communities.

These community approaches have failed to build local interest in protected areas because they emphasize 'absolute' scientific and economic values at the expense of locally meaningful values (Infield 2002). However, managing protected areas for their local cultural values will build local interest and support for them. Fauna and Flora International (FFI) in partnership with the UWA developed the Culture, Values and Conservation Project to integrate the cultural values of local communities into the management of two national parks (Figure 1).

### The Rwenzori Mountains—a sacred landscape

Rwenzori National Park and World Heritage site is rich in biodiversity and endemic species, and an area of great beauty. The mountains are home to the Bakonjo and Baamba peoples, who have occupied these foothills for centuries.

Cultural analysis revealed that the mountains are sacred to these peoples. Sacred sites receive their power from Kitathamba, the God of creation, who lives at the highest level amongst the snow and glaciers, and from his wives, who live in the moorland level below. Mountain ridge communities headed by Ridge Leaders are the basic level of social and ritual organization. The highest level is the King or Omusinga, who receives his authority directly from Kitathamba.

Prayers and sacrifices are made at the sacred sites to maintain harmony between people and the gods, guaranteeing good harvests, ensuring the forests are productive, and avoiding diseases and natural calamities (Stacey 1996).

Use of resources was controlled by Ridge Leaders, the King, and the gods. Violations of established norms would attract serious penalties, even death at the hands of the gods (Biira, Muumuza, and Mugisha 2009). For example, permission to collect medicinal barks in the high montane forest was required from Ridge Leaders, as these forests were within the domain of the gods, and respectful behavior was essential. The collector was required to approach the tree from a single direction, never walk around the tree, and retrace their steps exactly without looking back. Failure to observe these rules would mean treatment using the bark would fail. Other punishment by the gods might follow.

These sacred values and the institutions that mediated interactions between the people and the mountain landscape were not recognized by the park's policies and practices. The mountains


**Figure 1.** Project pilot sites, Rwenzori Mountains and Lake Mburo National Parks.

were represented as a water-catchment, a tourist destination, a place of rich biodiversity. Though important to conservationists or economists, these values were not meaningful to the resident peoples. The emphasis on economic benefits could not sustain local interest, as the financial incentives were small, and accessing them complex. Resentment of the park and its managers grew. Ironically, the Ridge Leaders, who could have helped manage these conflicts and values that resonated with the people, were undermined and weakened through exclusion.

### Lake Mburo: The beautiful land of 'beautiful cows'

Lake Mburo National Park is located in south western Uganda, within the traditional rangelands of the Bahima pastoralists. They call the land Karo Karungi, the Beautiful Land. The Bahima valued the landscape for raising long-horned Ankole cows, their own unique breed. Any other uses, especially farming, were prevented (Infield 2002). The Lake Mburo area was of particular significance as the King, the Omugabe, kept specially selected herds of Enyembwa, or 'beautiful cows,' there (Mugisha and Infield 2009). Bahima have bred Ankole cows for centuries to mirror the beauty of the cows bequeathed to them by their mythical god-like ancestors (Figure 2, Table 1). Owning Ankole cows, which are not highly productive, and breeding them for beauty, is central to Bahima identity (Figure 3).

With the creation of the park, grazing was outlawed, causing conflict between pastoralists and park officials. The landscape became a meaningless wasteland to the Bahima, reserved for hyenas, the ugliest of animals, instead of beautiful cows. Though expressed in terms of conflict over resource access, it was conflicting cultural values that were largely responsible for Bahima forcing their cows into the park, in an effort to reinvest the landscape with meaning (Infield 2002).

Social, economic, and land use changes that began when British imperialist agents demanded Bahima produce surplus milk and ghee to sell, and which speeded up when government poli-

**Figure 2.** Bahima select cows to retain the horn shape and color of the cows of their ancestors considered to be of great beauty.

| Type of characteristic | Frequency | Percentage |
|---|---|---|
| Appearance | 558 | 79.7 |
| Production | 106 | 15.1 |
| Behaviour | 6 | 0.9 |
| Other | 30 | 4.3 |
| Totals | 700 | 100.0 |

**Table 1.** Bahima selection of characteristics during selective breeding of Ankole cows (from Infield 2002).

**Figure 3.** A young Muhima boy plays with representations of beautiful cows, stripped twigs representing the long white horns and selected beans representing the favored color of beautiful cows.

cies encouraged settlement and intensive farming, have changed the landscape dramatically. Open rangeland now remains only within the park, and breeding cows for beauty has given way to breeding for economic production, and the beautiful cows have almost vanished.

### Evaluating project impacts

Following cultural analysis, the project selected key values that linked people to place and nature, and which were important in defining the identity of the different ethnic groups. In Rwenzori National Park sacred values were integrated into the day-to-day management of the park, and access to the sites for rituals and ceremonies agreed upon. In Lake Mburo National Park the project focused on the cultural values of the Ankole cow, and the conflict over the meaning of the landscape; a herd of 'beautiful cows' was formed and grazed within the park. In both cases the intention was to remove or reduce conflicts between local communities and the parks resulting from conflicting cultural values, and build interest, engagement, and support for the parks by integrating key cultural values into their day-to-day management.

After four years of implementation, people's knowledge, attitudes and practices towards the parks were investigated to assess project impacts. The review also examined changes in the perceptions, of the communities and their values, amongst park staff. The evaluation used guided discussions with key informants amongst the communities and park staff. Standard questions were generated from indicators designed to evaluate the project (Biira, Muhumuza, and Mugisha 2009).

Community members overwhelmingly reported that recognition of their values and institutions by the park authorities had increased their interest in and support for the parks. They believed that the interactions the communities and park staff now had, that recognized community values, were reducing conflicts and reducing illegal activities inside and outside the parks. Similarly, park managers thought that positive interactions with communities had increased, and were important in helping them understand communities' behavior, and address illegal activities.

Park staff demonstrated appreciation of local values and traditions, and were able to explain how they contributed to effective management of the parks. Staff at Rwenzori National Park believed that the cultural values approach was strengthening conservation efforts, and that mobilizing the community through Ridge Leaders was increasing support for the park. Interventions to open spiritual sites were improving relationships with communities, enhancing community interest in the park, and creating new tourism opportunities that would benefit both the park and the communities. Allowing access to cultural resources in an organized manner was also expected to increase reverence for the sites, leading to more sustainable resource use and strengthened protection.

Staff at Lake Mburo were more ambivalent about the contribution of the cultural values approach to conservation of the park. They recognized that Ankole cows were unique and important to conserve. They also recognized that Bahima attached great value to them, and that helping to conserve livestock would improve relations with the Bahima. However, they remained concerned about the implications of having livestock within a protected area. Despite these concerns,, it was recognized that, if well managed and marketed, the Ankole cow could become a flagship for the park, increasing local and tourism interest. Park guides revealed that the often-cited fear that Ankole cows in the park negatively affected tourism was not substantiated. The reaction of tourists was affected by information provided by the guides. Interestingly, local visitors were more likely to be concerned about the cows in the park, while international visitors are excited by the cows, and keen to take photos and learn about them. In the words of the head guide, "This project will be great for the park. It will give tourists an extra choice. Ankole cows will be another tourism product. Many tourists express interest in cultural tourism, but we do not implement it."

### Lessons learned

**People are excited by values they can relate to**. For example, talking about the beauty of Ankole cows to Bahima ignites interests which can be related to, and used to support nature conservation. A beautiful cow needs good pastures and waters; Ankole cows create a sense of peace, tranquility, and connection to the environment. Integrating beautiful cows into the park would create fundamental changes to the relationships between the park, the Bahima, and their values.

**Discussing cultural values promotes genuine two-way engagement**. The interest shown the project in their culture increased confidence amongst communities to discuss how their values can contribute towards conservation. In Rwenzori National Park, discussing sacred sites and their management empowered Ridge Leaders to support conservation goals. The positive attitudes created translate into pro-conservation behavior and practices.

**New ideas take time to become established**. People and institutions resist change when it counters established organizational norms and cultures. The proposal to integrate Ankole cows into Lake Mburo, for example, was not reviewed and discussed in terms of conservation outcomes, but in relation to UWA and park norms, history, and institutional culture. To side-step this problem, the project focused on the general idea of integrating cultural values rather than the particular idea of having cows in the park.

**Building capacity and awareness is a slow process**. Training workshops, study visits, mentoring, and exposure to examples and precedents to build understanding and capacity, and result in changes in thinking, take time, within both communities and institutions. Champions of innovation are important. Study tours were found to be most effective at developing new understandings and perspectives. A visit to a conservancy in neighboring Kenya to observe cattle being managed alongside large carnivores, for example, helped challenge the accepted wisdom that livestock and predators could not co-exist. Similarly, community leaders and park staff were inspired by their visit to community-managed sacred forests in Kenya.

**Investment is critical**. Implementing a cultural values approach is not easy, quick, or cheap. Significant resources and time must be invested to achieve success: it takes time to identify values that underpin people-environment relationships; it takes time to gain the confidence of local people, especially as communities may be highly guarded about cultural issues; it takes time to build understanding, interest, and capacity.

**Understanding local culture is important for effective conservation**. Not all local values are compatible with conservation. For example, chimpanzee body parts are used by the Bakonjo to cure fractures. Discussions with cultural leaders revealed this, but also revealed that members of one clan has healed fractures without chimpanzee medicine, while members of another clan are bound to protect chimpanzees, since chimpanzees are their totem. The cultural values approach identified ways to mitigate the impact of local values that conflict with conservation objectives through other cultural values.

## Conclusion

Both biological diversity and cultural diversity are essential to human well being, and their loss increases vulnerability to change, locally and globally. Both types of diversity face common threats, including globalization, homogenization, land use change, technological innovation, and the growing separation between people and nature. Efforts to conserve both culture and nature will be strengthened by integration.

Local values are understood and appreciated locally, while scientific, economic, and other foreign or imposed values are not so easily engaged with, especially amongst relatively isolated or traditional communities. Continuing to use the economic worth of nature and biodiversity as the primary justification for protected areas isolates them from values, institutions, and local perceptions of reality that continue to be important in how people define themselves and their relationships to the natural world. Integrating these local values into conservation initiatives helps build the local support and interest that is essential for sustainable conservation, and should be an integral part of the design, planning, and management of protected areas.

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# Using High Accuracy Geodesy to Assess Risk from Climate Change in Coastal National Parks

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## Abstract

The projected effects of global climate change threaten habitats, infrastructure and resources. In coastal ecosystems, sea level rise and an increase in storm frequency and intensity are two major impacts expected to result from climate change. In the northeastern United States, many coastal national parks are vulnerable to these impacts. To plan future land use and management activities, park managers require information about potential climate change-induced threats to coastal resources. Currently, inundation risk assessments are limited by the accuracy of the best available elevation data. We address this limitation by using geodetic-grade GPS technology to obtain accurate elevation data for "sentinel sites," areas of important natural, cultural, and infrastructural resources in the national parks. We assess the inundation risk to the parks' sentinel sites from coastal climate change impacts using global and local sea level rise predictions and modeled storm surge elevations.

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## Introduction

An increase in the rate of sea level rise is one of the most serious potential impacts of climate change (IPCC 2007). Globally, sea level rise has accelerated since the nineteenth century due to the expansion of warmer waters and melting glaciers. Around the world, sea level rise has not been uniform due to regional factors such as land subsidence and isostatic rebound (upward movement of land after being pressed down, e.g., when a glacier melts). In the Northeast, as much as 2.4 mm/yr of additional sea level rise is due to land subsidence (Kirshen et al. 2007). The Fourth Assessment of the Intergovernmental Panel on Climate Change projected 0.26 to 0.59 m of sea level rise by 2100 under the "business as usual" greenhouse gas emissions scenario (IPCC 2007). This represents a conservative estimate because it does not consider sea level rise caused by rapid increases in the melting of Greenland and Antarctic ice (Overpeck and Weiss 2009). A less conservative approach is the semi-empirical method proposed by Rahmstorf (2007) which links global sea-level variations to global mean temperature, on time scales of decades to centuries. Using the semi-empirical method to model sea level under the same IPCC "business as usual" scenario, Vermeer and Rahmstorf (2009) projected a global sea level rise of 1.13 to 1.79 m by 2100.

Another coastal impact to expect from climate change is an increase in the extent and frequency of severe coastal storms and flooding. Using an ensemble mean of 18 global climate models, the frequency of Saffir-Simpson Category 4 and 5 hurricanes is expected to double by the end of the twenty-first century (Bender et al. 2010). During intense storms, surge is produced when water is forced onto the shore by strong winds moving cyclonically around the storm. Storm surge can cause extreme flooding in coastal areas, especially when it coincides with a high tide. During Hurricane Katrina, surge levels reached 9 m (Fritz et al. 2007) and caused significant damage to the coastal infrastructure and ecosystems on the Louisiana and Mississippi coasts. In the coming century, storm surge will be exacerbated by sea level rise.

Coastal national parks in the northeastern United States are extremely vulnerable to sea level rise and storm events. They feature many low-lying areas susceptible to flooding. For example, every park in our study area, except two (Cape Cod National Seashore and Acadia National Park), are located entirely below the 15 m (NAVD88) contour interval (Figure 1). The purpose of our analysis is to determine inundation risk of park assets (ecological, cultural, infrastructure) from sea level rise and storm-induced flooding. To help focus the study, park managers have identified "sentinel sites," or locations of importance near the coast, where assessing risk is extremely important. Sentinel sites include natural resources (e.g., species of concern habitats), cultural resources (e.g., archaeological sites), and infrastructure (e.g., visitor centers). We are using the best available elevation data, and sea level rise and storm surge models to estimate the probability of inundation from sea level rise and storm surge at sentinel sites in coastal national parks in the northeast region of the United States.

## Digital elevation data

In order to initially evaluate resources at risk in coastal areas, we created detailed maps to determine which areas fall within elevations that would be inundated under various risk scenarios from sea level rise and storm surge. We found however, that the elevation data available for coastal parks are not accurate enough to conduct map-based assessments where critical elevations for inundation fall within the range of vertical accuracy of the digital elevation model (Figure 2). The United States Geological Survey (USGS) National Elevation Dataset for the entire country is accurate to within 2.4 m (Gesch 2009). A more recent source of elevation data is from LiDAR (light detection and ranging) acquired from a plane-mounted laser sensor that emits pulses of light energy at the ground, and is accurate to 0.15 to 1 m (Gao 2007).

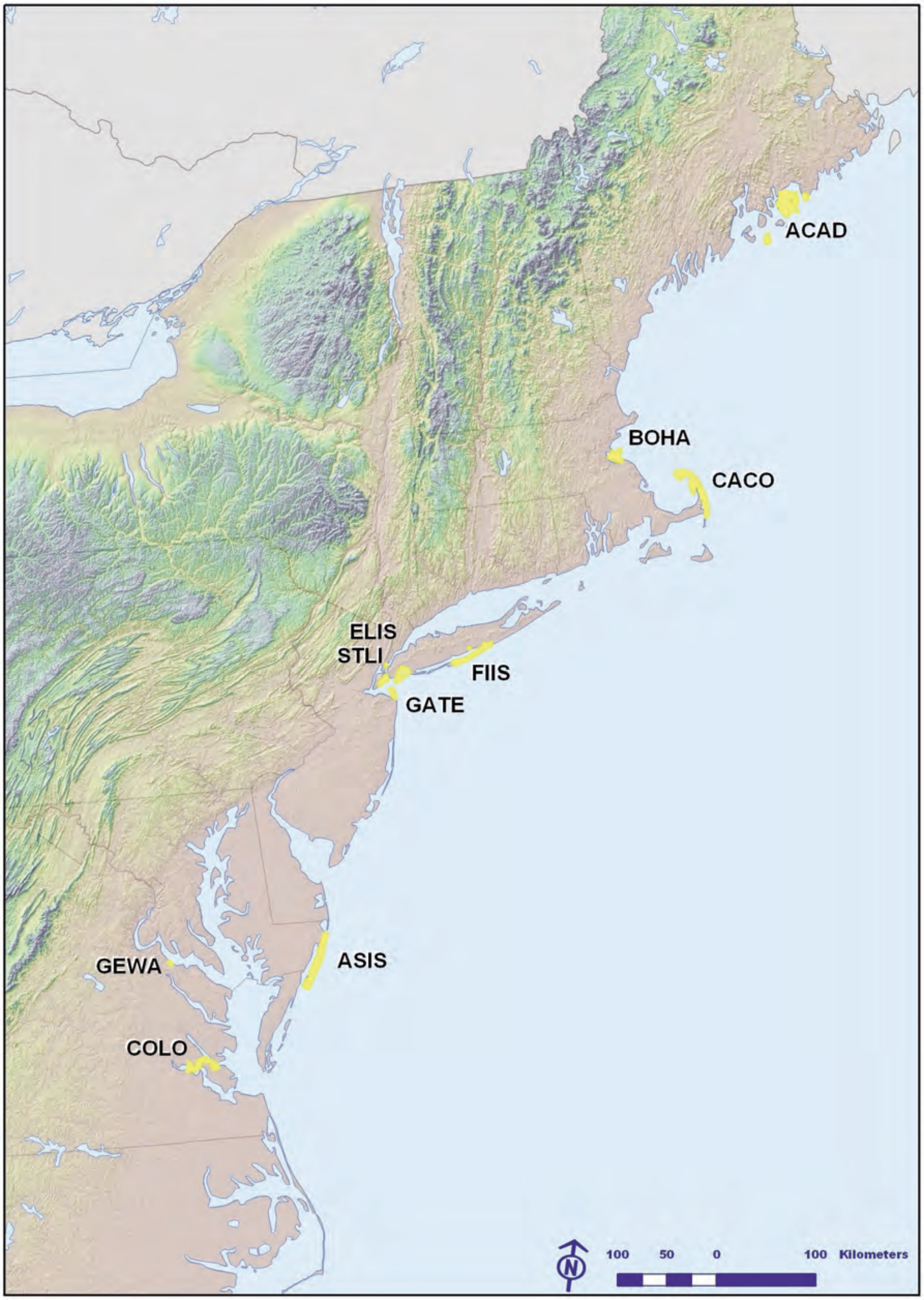



**Figure 1.** Study area. Acadia National Park in Maine, Boston Harbor Islands National Recreational Area in Massachusetts, Cape Cod National Seashore in Massachusetts, Ellis Island and Statue of Liberty National Monument in New York and New Jersey, Fire Island National Seashore in New York, Gateway National Recreational Area in New York and New Jersey, Assateague Island National Seashore in Maryland and Virginia, George Washington Birthplace National Monument in Virginia, and Colonial National Historical Park in Virginia.

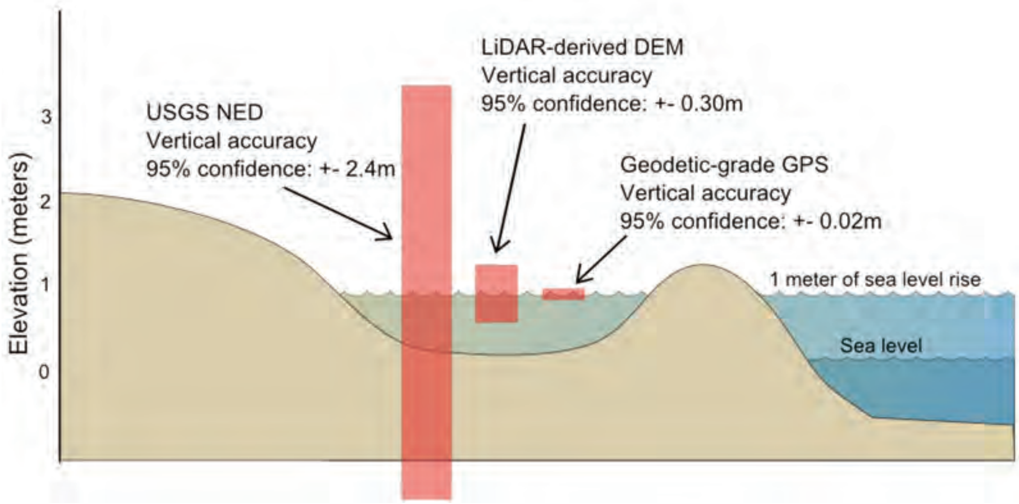



**Figure 2.** Mapping one meter of sea level rise on land. Digital elevation models with different vertical accuracies result in inundation zones with different ranges of uncertainty (adapted from Gesch 2009).

The most up-to-date elevation data for the coastal parks in the Northeast consists of LiDAR data, which are managed by the National Park Service Inventory and Monitoring Program. At present, there are LiDAR elevation data for every park in our study area, except Acadia. However, the coverage of these data is sometimes incomplete or in need of updating (Skidds 2011).

Given the inconsistencies and irregularities of park elevation data, an accurate measure of risk from sea level rise and storm surge inundation is problematic. Survey (geodetic) grade GPS devices are a promising tool in studying sea level rise and storm surge impacts. These devices are capable of measuring elevation at accuracies of up to 1 to 2 cm vertically, and have the ability to quickly calculate a reference position with highly accurate x, y, and z (longitude, latitude, and elevation) positional information (Trimble Engineering and Construction Group). When sea level rise and storm surge assessments are conducted using a network of many known, highly accurate reference positions (a geodetic control network), the ambiguity arising from error in the elevation data is reduced.

### Geodetic control network

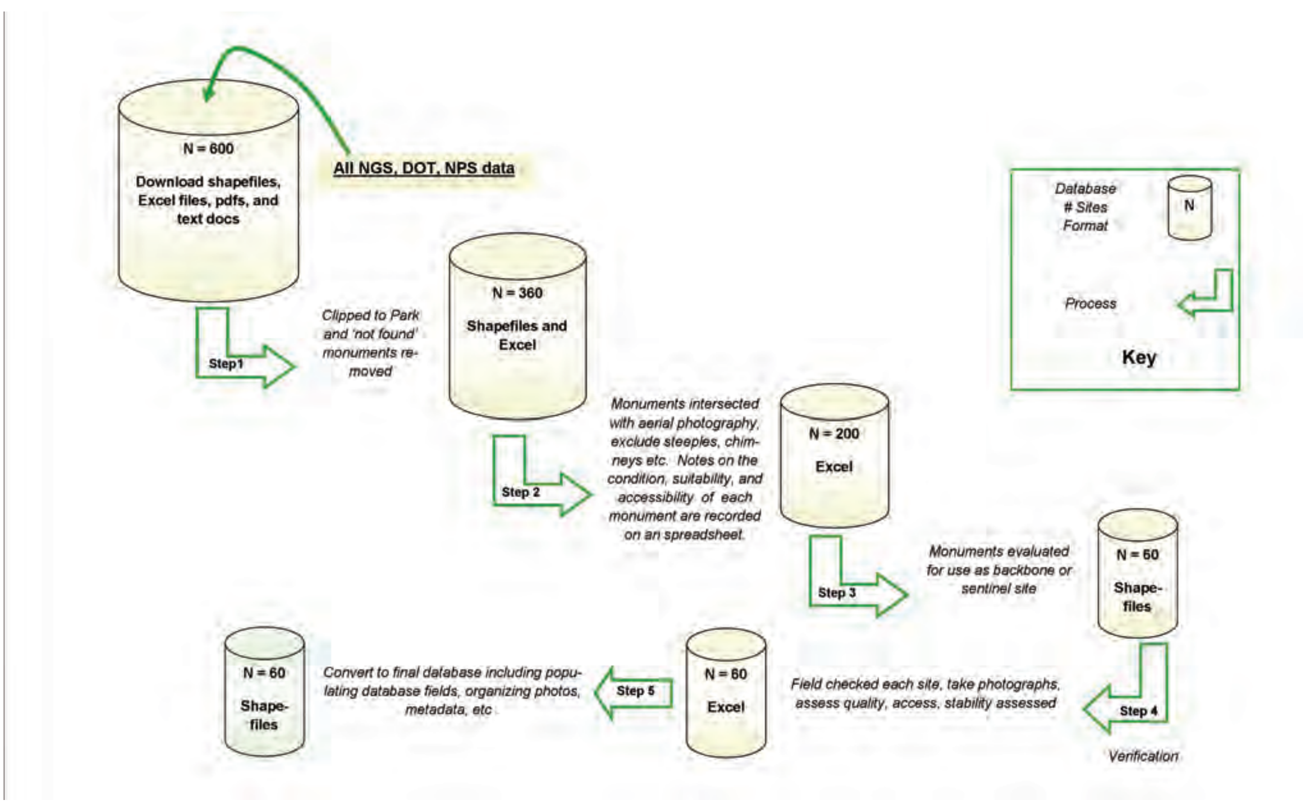
The coastal parks of the northeastern United States of America have had geodetic control monuments established inside the parks by various federal and state agencies. By "geodetic control monuments," we mean locations that are permanently marked with a brass disk, metal rod, cement or stone platform, or other permanent structure for which an accurate survey of location and elevation has been conducted (Smith 2007). Many of the monuments in national parks have been established by the National Oceanic and Atmospheric Administration's National Geodetic Survey (NGS). Additional geodetic control monuments have been added to the parks by the National Park Service (NPS) Denver Service Center for various projects over the decades. state department of transportation (DOT) offices have also been active in establishing geodetic control in and around coastal parks. Unfortunately, there is not a single database that identifies all geodetic control monuments in parks, and their current condition.

The initial phase of our project focused on taking an inventory of monumented geodetic control points in the parks. This included an extensive data mining exercise to download all readily available data from the NGS, NPS, and DOT offices. To be useful for our analysis, a control point must be accessible to park personnel and researchers (e.g., not on private property), be clearly marked and physically stable (e.g., marked with a steel rod driven to depth, or a brass disk mounted in bedrock), and accessible so GPS equipment can be used at the site. Inaccessible sites such as church steeples or water tanks were not used. Each potential control point's key information (e.g., date surveyed, location, monument ID, description of the site, navigation instructions) was encoded into a database and visited in the field. For each control point that we located, we photographed the site, ensured that the monument was intact and not damaged, prepared explicit descriptions of the monument, and developed instructions for navigating to the site. Any control point that was not found or which appeared to have been damaged or disturbed was so noted and indicated in the database. All of these points will be included in database of geodetic control monuments for each park (Figure 3).

Existing monuments that are highly stable and have long-term viability are eligible to be used as backbone monuments for a park. Backbone monuments are the network of monuments spaced at 10 km intervals that provide coverage of all coastal areas in a Park. The 10 km spacing among backbone sites represents the effective area for using geodetic-grade GPS systems that require an active GPS base station (Figure 4) established at a known location (backbone site), and a rover GPS that is used to measure elevations at sentinel sites. Using the database of existing monuments in the parks, as well as the spatial distribution of sentinel sites, we conducted a gap analysis to determine locations where existing monuments can be used, and where new backbone monuments must be installed. These backbone monuments will be surveyed following NGS protocols for benchmark establishment using survey (geodetic) grade GPS technology.

NPS managers provided us locations of sentinel sites near the coast where assessing inundation risk is critical. Currently, we are measuring elevations of sentinel sites using survey (geodetic) grade GPS equipment. It is imperative that sentinel sites be fully documented and monumented so they can be revisited in the future. Depending on the sentinel site, nearby geodetic control might suffice for recording accurate measurements of position and elevation for the location.

**Figure 3.** Monumented geodetic control evaluation process for Cape Cod National Seashore.



Where sites consist of hard infrastructure (buildings, roads), positions and elevations can be obtained from fixed features (building foundations, utility platforms). When sentinel sites do not have stable, permanent reference features to work from (e.g., shorebird nesting sites, salt marsh edges), we will install stable monumentation that will allow revisiting the location in the future.

**Figure 4.** Field site showing geodetic-grade GPS base station. (Photo credit: Cheryl Hapke, USGS).

### Inundation risk assessment

To assess vulnerability from severe storms, we use the NOAA Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model, a forecast model for hurricane-induced water levels (NOAA 2007). We obtained predicted elevations of storm surge for Saffir-Simpson Category 1 to 4 hurricanes in each northeastern U.S. storm basin. The SLOSH model predicts maximum potential storm surge elevation based on hurricane category, forward speed, landfall direction and landfall location for various locations around the USA. The maximum surge within each grid cell is defined as the maximum of the maximum envelope of water (MOMs) and represents the worst-case, localized surge that will occur for landfall in a given location. The results are location-specific, accounting for local water depths, proximity to bays and rivers, etc., and are accurate to within 20% of the calculated value (NOAA 2007).

For each park, we will compare the elevations from a LiDAR-derived digital elevation model to SLOSH surge elevations to create a generalized inundation risk map. The resulting map will show areas of the park which have a high likelihood of inundation. To supplement this, we will also compare the land elevations at sentinel sites (obtained from GPS) to the predicted surge elevations to give us a more accurate assessment of the vulnerability of sentinel sites during each storm event. Using these two methods we can make an informed assessment of probability of inundation risk at each site.

To assess vulnerability from accelerated sea level rise in coastal national parks, we use the Sea Level Affecting Marshes Model (SLAMM). The model simulates the dominant processes involved in wetland conversions and shoreline modifications during sea level rise (Clough et al. 2010). We will use the most recent LiDAR data and National Wetlands Inventory data as baseline inputs. We use historic relative sea level rise and projected eustatic sea level rise (i.e., global changes from changes in ocean, or net ocean basin, volume) rates to simulate processes that affect wetland fate during long-term sea level rise. The resulting maps show expected wetland conversions in each park. These results are used to assess risk to sentinel sites. For example, if a plover nesting beach is predicted to be converted to open water under a certain sea level rise scenario, then we assess that the habitat is at risk.

Storm surge and sea level rise models will be based on local tidal datums. To be conservative, we are using surge and sea level rises relative to mean higher high water (MHHW). MHHW is the average of the higher high water height of each tidal day observed over a national tidal datum epoch (i.e., 19-year measurement period adopted by the National Ocean Service, Hicks 1999). Standardizing surge and sea level heights relative to MHHW provides us the maximum extent of flooding during normal high tides.

### Conclusion

Modern sea level rise and storm surge models give us the ability to identify coastal areas at risk in the coming century. They allow national park managers to develop proactive adaptation and mitigation strategies. However, we must be aware that the delineated inundation zones predicted by these models are limited by the vertical accuracy of elevation data. The use of geodetic grade GPS technology is extremely valuable for assessing risk to national park resources from sea level rise and storm surge. The technology gives us the most accurate point elevation data for the parks' sentinel sites. These elevation data can also be used as inputs for storm surge risk assessments, and serve as reference points for accuracy assessments of digital elevation models. By including the point elevation data in a National Park Sentinel Site Database, they are available for future use as baseline data for monitoring and vulnerability assessment efforts. As the field of sea level and storm surge modeling matures, more sophisticated methods of predicting inundation will certainly be developed. As models become refined, the accurate elevations at sentinel sites will always permit better assessment of risk inundation.

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# Theoretical Concerns in Networks of Protected Areas: Symmetry and Asymmetry

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## Abstract

THE MIGRATORY BIRD TREATY OF 1916 EXHIBITS SYMMETRY IN THREE DIMENSIONS: A MIGRATORY species, land managers with shared goals, and stakeholders with shared goals that are largely consistent with manager goals. This is the basic model for a politically-successful network of protected areas. Changing any one of these three conditions may make a network politically infeasible. Interestingly, changing two of these conditions simultaneously may be conducive to successful management. This simple analytical framework can explain variation in successful and unsuccessful networks managing species such as migratory birds, bison, and wolves, as well as marine resources. This analysis makes policy recommendations conditional on both the type of the biological resource, and on key features of the political matrix within which networks exist.

## Introduction

Networks of protected areas play a key role in preserving natural processes. Though protected units and the corridors that connect them exist in a human matrix, biological approaches have tended to dominate discussions of political problems. The implicit baseline is something like the Algonquin-to-Adirondack or Yellowstone-to-Yukon (Y2Y) networks, linking populations in protected areas through corridors, or secondary habitat, at a regional or landscape level (Chester 2006; Klyza 2001).

This baseline rests on a number of political and biological assumptions. When those assumptions are made explicit, such networks do not seem all that typical. For example, in many settings some managers want more animals, while an adjacent manager may want fewer of the same species. Species such as bison, wolves, feral boars, burros, and goats provide examples of such differences in preferences over the same animal, even within a single agency.

This paper seeks to delineate key elements of the political problem for managing networks of connected protected areas. Asymmetry in agency goals, stakeholder interests, and/or natural resources poses easily-understood political challenges of varying difficulty.

When we consider those (a)symmetries, a better analytical baseline is the migratory bird case, where managers and stakeholders all want improved habitat and healthy populations, and

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where all habitats play a similar, seasonal role for each species. Departures from the migratory bird case in any of these three variables (agencies, stakeholders, and resources) pose significant political challenges. Confounding factors include non-migratory species, non-native species, "undesirable" species, such as wolves or prairie dogs, and differences in mandates across land managers. Anticipating these future management problems can help us better understand how to design networks to minimize management problems.

### Unconditional and conditional recommendations for networks of reserves

Writers on the challenges of protected areas often give surprisingly uniform recommendations. Many advocate "greater stakeholder involvement," others suggest that protected areas coordinate better if participants develop better personal relationships, trust, and goodwill, put more effort into developing a shared vision, improve communication, choose leaders with greater political will, or some combination thereof (e.g., Fall 2003; Wondolleck and Yaffee 2000, Chapter 3; Zbicz 2003).

Implicitly, such recommendations assume that protected area administrations are homogenous, without political differences of opinion or power struggles (*contra* Fall 2005, Chapter 6; Pahre 2011). Generally speaking, the only political opponents are certain kinds of stakeholders. Resource extraction industries, such as logging, grazing, petroleum, and hardrock mining, have interests opposed to the environmental goals of protected area land managers and preservationists, though recreationists may have more mixed interests.

While the public policy scholars worry about stakeholders, the natural scientists take their own, often homogenous approach to designing reserves and networks of reserves. They tend to identify desired biological resources, try to obtain those resources, and then change the goals of the managers (if necessary) in accordance with the overall design (e.g., Agardy 2000; Soulé and Terborgh 1999).

For example, Noss and Harris (1996) classically advocated networks based on multiple-use modules, designed around biologically key locations—old-growth forests, unique geological sites, ice-free bays, artesian springs, or mineral licks (Klyza ed. 2001). Networks of marine protected areas consider ecological processes, such as spawning, recruitment, and larval dispersal, while also allowing margins of error for the many species whose needs are poorly understood (Roberts et al. 2001; Sala et al. 2002).

Finally, some authors examine the interaction of human and natural considerations. For example, core preserved areas should protect species and ecosystems that cannot persist in the human sphere. Examples include large carnivores, species whose reproductive success is easily disrupted, and habitats and natural processes that conflict with human needs, such as wetlands, wildfire, and flooding (Klyza 2001).

I do not wish to take issue with the substance of any of those recommendations, which are individually and collectively sensible for a wide range of problems. However, we should note that the policy recommendations are *unconditional*. They do not recommend including biological hot spots under some political conditions but not others, or getting stakeholders involved under conditions Y but not Z. If all management problems are fundamentally similar, unconditional recommendations would be suitable.

This project assumes that management problems differ. It seeks to delineate differences in the political matrix and in the natural resource being managed, making management recommendations conditional on a parsimonious set of conditions that define the policy problem.

This approach can help us avoid a kind of selection bias that is found when the literature only looks at cases of *attempted* collaboration. In those cases, players often have shared interests—those interests bring them to the table—but stakeholders with conflicts of interest may not appear at the table. Unless we give attention to this selection issue, we may wrongly generalize about the factors that lead to success only for those players with shared interests. Applying those factors to groups with divergent interests will lead to faulty prescriptions.

Most generally, divergent (or "asymmetric") goals pose a particularly stark problem when we consider a political matrix that includes some form of sustainable harvest. Where surplus animals disperse from a core protected area into an adjacent area managed for harvest, political support for a network will be relatively easy among agencies and stakeholders. For a migratory species facing possible bottlenecks, the politics become more complicated (Roberts et al. 2001). This example highlights key variables of the analysis here: manager goals, stakeholder goals, and the nature of the resource (migratory or non-migratory).

### Symmetry, agencies, and wildlife

We can define a network of protected areas in terms of whether three variables are "symmetric"—land managers' goals, stakeholder interests, and the wildlife resource itself. I begin with the baseline case, in which managers and stakeholders share goals for a network containing a migratory species. In this case, a species leaves a winter habitat, managed by one agency, travels to a summer habitat, managed by another agency, and returns. If one agency fails to manage its resources well, the other agency will see a smaller returning population. That will result in a smaller population returning to the first manager's lands the next year. This simple biological logic gives both agencies an incentive to work together. With a supportive political matrix, there should be no opposition to actions that the agencies take to manage the protected areas for this species. All the variables are "symmetric" in that both agencies want more animals, stakeholder preferences match agency preferences, and the animals move back and forth between units.

The earliest network of protected areas fits this model exactly. Canada and the United States signed the Migratory Bird Treaty in 1916. The USA and Canada each implemented the treaty through legislative acts in the 1920s, and Mexico joined the treaty in 1936. These acts produced an extensive network of national wildlife refuges and other protected areas, providing key habitat for migratory birds (Dorsey 1998). Land managers all favored more birds. Stakeholders favored larger and more robust populations, either for reasons of preservation, or to provide opportunities for sustainable hunting. Key stakeholder groups, such as Ducks Unlimited, mobilized politically for duck stamp legislation that collects fees to pay for habitat acquisition.

With this baseline case established, we now turn to more complex cases. We start with cases that diverge from the baseline in only one variable, and then consider when two or more variables are asymmetric.

**Non-migratory species and symmetric interests**. A number of species along the US-Canadian border are listed in the USA but not in Canada: grizzly bears, lynx, wolverines, and wolves among them. Source populations in Canada can provide surplus animals for dispersal into the United States, helping recovery of these species in the Cascades, Selway-Bitterroot, and Glacier-Waterton regions. This strategy would work best collaboratively, with British Columbia and Alberta agreeing not to harvest these species within a certain distance of the border.

However, most Canadians live near the border, and prefer to hunt near where they live. As a result, wildlife populations at the border generally face greater hunting pressure than non-border populations. Despite the advantages of US-Canadian collaboration for US species recovery, a network of protected areas is politically challenging. Abstractly, the problem lies in a resource asymmetry, despite a symmetry in managers' preferences. Without symmetry in both, collaborative management does not occur.

**Migratory species with asymmetric manager goals**. Yellowstone's bison are essentially nomadic in biological terms, but their patterned annual movements outside the park in severe winters makes them migratory in political terms: they exit the park and then return. Montana state government and, for the most part, Gallatin National Forest want fewer bison on their lands in winter. Yellowstone National Park wants a healthy bison herd. These interests are compatible if the bison stay inside the park. Because they often do not, and because of the political salience of the herd, the NPS has been compelled to participate in hazing and culling operations around the park's boundaries (Franke 2005). The resource is symmetric but managers' and stakeholders' preferences are not, so collaborative management of adjacent protected areas is very difficult.

**Double deviations: non-migratory networks with harvest in the sinks**. The preceding two cases considered deviations from the migratory bird case in only one dimension at a time. Interestingly, two deviations may cancel each other out politically, facilitating a stable network. The best example is biological source-sink relationships, where surplus animals in the core disperse to an adjacent area, where they are subject to harvest. This issue has played an important role in the analysis of marine protected areas, where reserves have become an attractive alternative to traditional fisheries management (Agardy 2000). However, the politics of harvest has been left out of most analyses of terrestrial networks, though it remains part of many case studies of individual protected areas in developing countries (e.g., Robinson and Bennett 2000).

The double deviation works politically because the harvest in the sink does not affect the population in the source core. In contrast, if the species migrated, harvest in one unit would reduce the returning population in other units. The network would also not function if there was hunting in the core source habitat, since it would be unlikely to produce a surplus for dispersion into adjacent sinks. One important policy implication of this difference is that sustainable harvest of wolves, prairie dogs, and other controversial non-migratory species may play a role within a network that includes no-harvest source reserves.

## Conclusions

This paper has argued that relaxing any of three conditions from the migratory bird case will complicate the political problem of managing a network of preserved areas. The analysis implies that a diversity of protected areas and manager goals will be effective for managing some natural resources, particularly asymmetric ones. For symmetric problems such as migratory birds, shared visions will be more effective.

We have considered only the single-species problem. A network managing both carnivores and their prey, such as migratory caribou and non-migratory wolves, introduces complications for future theoretical work.

The analysis also implies that network designers should choose their stakeholders carefully, when choice is possible. When some stakeholder goals lie at odds with manager goals, designers can avoid future problems by removing the stakeholders, or redesigning the network to avoid stakeholder interests (see Sala et al. 2002). Removing difficult stakeholders, such as grazing leaseholders that conflict with bison in Montana, or the small set of leases that account for most of the wolf depredation in the GYA, would reduce the political controversies over bison and wolves.

In other cases, managers may want to include stakeholders whose interests are consistent with the goal of the network. Bringing in hunters, outfitters, and commercial fishermen could support a source-sink network with harvest in the sinks. In contrast, commercial harvest has proven challenging with migratory species such as tuna, since fleets can move to undepleted populations after overfishing an area.

Those complications among stakeholder groups also point to the need for richer theorization than provided in this brief introduction to the problem.

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# Veve Afa: The Loa's Trace

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> We are guided by our sense of identity, belonging, justice and equality. We defend not only our regional cultural values, but we are also engaged ethically and morally with Humanity to preserve our present for the future. (Taller Ennegro 2011)
>
> I was brought from Dahomey, not even the jungle, nor the sea, nor the whip could wrest me away from the god-filled drums. (Camilo Rivera Fis, Taller Ennegro 2011)

The members of Taller Ennegro are driven by a strong moral and social commitment that shapes their relationship with their community, their country, and with humanity as a whole. Their ethics, concerns, ideas, dreams, and their artistic, social, and environmental projects have been nurtured by the government's formal education, as well as their informal education received in their communities. But it is in the context of the informal education, in the intimacy of their homes and their community life, that they have received the spiritual foundation that guides, encourages, and strengthens their projects.

## Voodoo religion, humanistic foundation of Taller Ennegro

This organization was born the fourth of January of 1995, in the Hounfort (temple) of the Houngan (priest) Jhosvanis Milanés Carbonell in Palma Soriano, Santiago de Cuba. He took the initiative of convening a group of artists that were mostly descendant of Haitians that arrived in Cuba in different periods of time between the nineteenth and twentieth centuries. They got organized under his guidance and assumed the Voodoo (*Spirit*) religion and its cosmogony as an ethical and humanistic lifestyle. The mission of the organization that they founded is to value and preserve the preciousness, or the cultural legacy, of their ancestors, and to restore the urban and rural environment of the region of Palma Soriano. Since the foundation of the organization, their missions, their artistic and ecological projects, have been inspired and grounded in the moral principles of the voodoo religion: respect and service to the Loas, respect to the eldest and to their ancestors, rules of solidarity, cooperation, hospitality, conviviality, syncretism, and the animistic conviction that Earth, Nature, Cosmos is alive and sacred (Michel 2002; Cabrera 2000).

The group has always been very concerned about what they consider are the main problems of the region: deterioration of the cultural legacy, and degradation of the urban and rural environ-

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ment, including deforestation, water pollution, and soil erosion. To deal with these problems, they have developed artistic and ecological proposals and projects. Taller Ennegro has been working intensely on a creative, aesthetic proposal. Since they are multifaceted artists, they have been developing complex art works as "expo-performance." Through their art, they express the cosmogony of the Voodoo religion, and their concerns about their culture and the environment. They integrate in their expositions paintings, sculptures, music, literature, and several expresions of the traditional cultures of the region (Figures 1, 2).

The creative process of the art piece is in itself a religious ritual, and is the Loa, the one communicating the messages through the artists. The main design is always a *Vevé* (sacred design) that is first traced with white flour by the Houngan, who serves as a medium to communicate the messages of the Loa. The vevé's designs activate the communication between the material world and the supra-earthly space. Since the creative process is a ritual in itself, the Houngan and the artists are inspired by the Loas and, while in a state of grace, they create their expo-performances. The materials used for the creation of their works of art are diverse, and mostly collected from the natural environment: different kinds of pigments, leafs, branches, stones, seeds, wood, candles, bottles, metals, and others. One of the most successful expo-performance of Ennegro has been "*Mother Earth*." With this work they inspire the public to meditate about the ecological crisis of the planet, and urge them to be ethical toward the world in which we all live.

The most ambitious enterprise that the members of Taller Ennegro have conceived since the foundation of the group is the Eco Art project *Vevé Afá* (*Nature's Design*), sited near the basin of the Cauto River. The confluence of their religious principles, and artistic, cultural, social and environmental projects can be best perceived there, between the Cauto and the Yarabó rivers.

**Figure 1.**

**Figure 2.**

They plan to reforest 45 hectares of land, restore the soils, the river basin, and build facilities to host research and reinforce cultural and environmental education. The reforestation of this area is going to be made following a macro-territorial *Vevé*. This sacred macro design is going to be made with the sacralized elements of nature. The Vevé Afá is in fact a macro representation of the Voodoo Cosmogony. The Houngan, inspired by the message of Mahu, has been guiding the group in the process of identifying the chosen land, and serving the Loas to trace the *vevés*. The Vevé Afá is the tracing of the Loa, a sacred place where environmental and human restoration will take place.

The group Ennegro has always confronted all sorts of material limitations, nevertheless they are resilient, and persevere for what they are convinced is their highest purpose. Presently they are building the first structure of the *Vevé Afá*, at a location from which the sacred energy emanates.

> In the center is the Hounfour, the Loa's home, in the center of the hounfour the Califú (four roads) and the symbol of the Potón Mitán. The main entrance is oriented toward the east, in the center of the design is concentrated all the energy of the Loas. This is the place from which Mahú Lissa ascends and descends, is the place from which the terrestrial and supraterrestrial establish communication. From this place the words of human beings ascend to Mahú and the words of Mahú descend to human beings. (Taller Ennegro 2011)

*This work is based on and includes quote from interviews I made with several members of Taller Ennegro interviews in Palma Soriano, Cuba, during the years 2010–2011 . It is also based on documents provided by them, and personal experiences that I shared with the group and their community during that period of time. Carlos Enrique Isaac, "the man with his feet planted on the* *ground and his head in the sky," has collaborated in many ways for the preparation of this paper, nevertheless the conclusions of the work are the responsibility of the author.*

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# Assessment of Riparian Conditions at Chattahoochee River National Recreation Area

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## Abstract
THE CHATTAHOOCHEE RIVER NATIONAL RECREATION AREA (CRNRA) CONSISTS OF 15 DISCRETE park units along a 48-mile reach of the Chattahoochee River, in metropolitan Atlanta. The park completed a comprehensive inventory and assessment of wetlands and riparian areas in the summer of 2010. Each park unit was inventoried and mapped using existing data from 2009 aerial photos, existing geographic information system (GIS) data, 2006 U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps and the Natural Resource Conservation Service (NRCS) Web Soil Survey. Potential wetland areas were identified in the GIS, then located and field-verified using GPS. Wetlands were mapped and classified according to hydrology, hydric soils, and vegetation criteria. The total wetland acreage of 2486.80 represents an increase of 435.78 acres (or 21 percent) over the 2006 NWI inventory, with the largest increase in freshwater ponded wetlands. This baseline data provides resource managers the information needed to better manage water resources, including wetland integrity, ecological function, and wildlife habitat.

## Introduction
The CRNRA lies within one of the fastest growing metropolitan areas in the country. The growth of the metropolitan Atlanta, Georgia area along the Chattahoochee River corridor has contributed to significant increases in land clearing, impervious surfaces, stormwater runoff, erosion and sedimentation, and streambank failures in recent years. The Chattahoochee River is the park's primary resource, and the wetlands associated with the park serve a variety of important wildlife habitat, hydrologic, and water quality functions. They act as natural water purifiers, filtering sediment and absorbing pollutants in surface waters. Vegetation provides erosion control

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and helps prevent the downstream movement of sediment. Wetlands help maintain flow regimes, and provide flood control by storing excess water during rain events, reducing downstream flood damage. They also provide unique habitat for many fish, wildlife, and plant species, including many threatened and endangered species. Wetlands in the park are provided the special protection and conservation inherent in the National Park Service (NPS) mission, which requires the park to play an active role in wetlands management, restoration, and public awareness (Kunkle and Vana-Miller 2000). The purpose of this project is to inventory, assess, and map all wetlands areas at CRNRA. This baseline data provides essential information for management of the Chattahoochee watershed, and the river itself.

An overview study of wetlands in the park by L.G. Chafin (1990) concluded that the actual extent of wetlands in the park is greater than that depicted in the USFWS NWI maps. The study suggested that a detailed mapping of wetlands in the park should be conducted to provide a more accurate inventory. According to the 2006 USFWS NWI, the park contained 2,051.03 ac of wetlands. However, acres of wetlands exist within the park that were not documented by that 2006 inventory.

## Methods

During the summer of 2010, field inspections were conducted to inventory, assess, and map wetlands and riparian areas throughout the park, using 2009 aerial photos, CRNRA GIS data, 2006 USFWS NWI maps, and the NRCS Web Soil Survey. The project began at the southernmost units in May, 2010, and continued northward to the Bowman's Island unit, through July, 2010. Rainfall during the year before the study (2009) was over 19 inches greater than the 30-year average, inundating wetlands and other areas that had not seen water in many years, and allowing for field mapping under nearly ideal conditions for wetland identification.

Field personnel utilized maps generated from the science and resource management (SRM) GIS database that included the NWI maps and hydric soil layers from the Web Soil Survey, as well as current aerial photography. A comprehensive mapping protocol was established so the delineation would satisfy both the Clean Water Act wetland definition (Wetland Training Institute, Inc. 2009) and the NPS standard for identifying wetlands (Cowardin et al. 1979). The NWI data is based on the Cowardin system of wetland delineation. Problem or atypical situation areas, including transitional areas, were identified using the 1987 U.S. Army Corps of Engineers (USACE) manual procedures. These procedures fulfill responsibilities outlined in the NPS Procedural Manual on wetland protection (2008).

Each of the 15 park units was mapped and field-inspected for hydrology, hydric soil, and hydrophytic vegetation, and the resulting data were entered into USACE wetland determination data forms. Each wetland area was identified with a sequential numbering system, based on the unit abbreviation (e.g., 1PM for first area mapped at the Paces Mill unit) and given a rank according to site-specific parameters. Coordinates, ranking, Cowardin classification, and notes were recorded for each site and input into an Excel file; this Excel table was then merged into the attribute data for the wetlands GIS layer.

**Geographic information system**. This project utilized GIS technology for mapping wetland boundaries and also to produce maps used in navigating park units. A Garmin Oregon 550t GPS unit was used to collect coordinates, photos, and to map wetland boundaries. Paper and digital maps were created in ArcMap that incorporated the 2006 NWI wetlands and NRCS hydric soils contained within the park boundary. The hydric soils data were modified to create a shapefile for soils that were 100% hydric. Topographic relief was depicted using 10-foot contours, and maps used the NAD 1983 projection, and the UTM Zone 16N coordinate system. ArcGIS maps were saved as jpeg image files, imported as image overlays in Google Earth, and then saved as KMZ files to be added as background maps in the Garmin Oregon GPS units.

Waypoints were collected in the field via GPS, uploaded using DNRGarmin software (MDNR 2010), and saved in a shapefile format. The collected waypoints were compared with NWI wetlands boundaries and existing hydric soils, and modified after field verification, if necessary. A new wetland shapefile was created to include wetlands that were completely contained in the Chattahoochee River NRA boundaries. The attribute table was also modified to include the names of park units, and the sampling points assigned to each delineated wetland. The Excel file with the designated rankings and remarks was joined to the new wetland shapefile named "CHAT Wetlands 2010."

**Ranking**. NWI (Cowardin) classification was determined for each wetland. The CRNRA includes riverine, lacustrine, and palustrine wetlands systems. Within the palustrine system are the classes of freshwater forested/shrub, freshwater emergent, and freshwater pond. The NWI inventory included islands as freshwater forested wetlands or other, but the islands were not field-verified because of time restraints, and logistics of getting to every island in the park.

A wetland ranking system was developed and utilized to better differentiate among the wetlands, for management purposes. This system is a descriptive qualification that expands on the Cowardin classification by noting the plant indicator category, and the quantity of 1987 Corps manual parameters found in each ground-truthed area.

Each wetland was assigned a number (1–5) according to its hydrology, hydric soils, and hydrophytic vegetation qualities. A 1 indicates that the wetland was previously marked as an NWI wetland, but is not presently a wetland; or that the wetland is in transition, but is not presently a wetland. A 2 indicates that only facultative (FAC) plant species were present, and that wetland hydrology was present; hydric soils were not required to be present. A value of 3 indicates that hydrophytic vegetation and wetland hydrology were both present; hydric soils were not required to be present. A value of 4 indicates that hydrophytic vegetation was present and at least 2 obligate wetland (OBL) plant species were present; wetland hydrology was present, but hydric soils were not required to be present. Last, a value of 5 indicates that hydrophytic vegetation was present, and at least 3 OBL plant species were present; wetland hydrology and hydric soils were also present, and this last category of wetland meets the USACE parameter definition of a wetland. To qualify the rankings, each wetland was then assigned a letter representative of its hydrology when field verified: P if the wetland was ponded; S if the ground was saturated or muddy, but no surface water was present; D if the ground was dry; and W if the wetland appeared to be a system of interconnected streams.

An example: the second sampling point at the Paces Mill unit (2PM) has a ranking of 4S, indicating that the hydrophytic vegetation included at least 2 obligate wetland (OBL) plant species, wetland hydrology was present, but hydric soils were not necessarily present, and lastly that the ground was saturated or muddy, with no surface water. This site-specific information will help guide future management decisions in planning and compliance.

**Soils and disturbance**. The Chattahoochee River is a "red river" floodplain, dominated by ultisols, the highly-weathered, acidic, reddish-brown clayey loam, known locally as "Georgia red clay." This red parent material can be difficult to interpret. To further complicate soil morphologies along the Chattahoochee, the acceleration of erosion and sedimentation from historic farming practices and current regional growth has adversely affected the soils. Most of the land in the CRNRA has been highly disturbed, and getting an accurate soil core reading is difficult. In addition to human use, the recent flooding, in September and October 2009 along the Chattahoochee River, deposited a thick layer of sediment in the river corridor. The combination of all of these disturbances has made it difficult for anaerobic conditions to develop, a requirement for hydric soil development.

Due to these conflating factors, the NRCS soil survey maps were used to locate hydric soils during this survey effort, and were de-emphasized in the ranking system. The NRCS hydric soils data were also used to determine the presence of wetlands. Hydric soils that were not supporting hydrophytes because of a change in water regime were not considered wetlands in this project. The NRCS Web Soil Survey furnishes a valuable record of historic wetlands, as well as an indication of areas that may be suitable for wetland restoration.

Information gained during this delineation project will be compared against color infrared aerial photography of the park, scheduled to be collected by the Southeast Coast Inventory and Monitoring Network in 2011. We anticipate that this process will confirm the field verification.

### Results and discussion

A total of 2486.80 ac of wetlands were field-verified during the summer of 2010 (Table 1), representing an increase of 435.78 ac (21%) over the 2006 NWI maps. Of the total acreage, 458.27 were lacustrine, 510.94 were palustrine, and 1,453.34 were riverine. Riverine wetlands include the river and the larger streams. These account for approximately 58% of the total wetlands in the park. This is an increase of 180.13 ac over the 2006 data, likely due to a more accurate delineation of the river bed and streams, using current GIS data and high resolution aerial photography.

Palustrine wetlands account for 20% of wetland areas (Figure 1). They have been sub-divided into freshwater emergent (3%), freshwater forested/shrub wetland (13%), and freshwater ponded (4%). The best example of freshwater emergent and freshwater forested/shrub wetlands can be seen at Johnson Ferry South. This unit of the park was previously agricultural fields that were subsequently used as polo fields for many years. Upon acquisition by the park, the area was left to revert back to its natural state. With the constant human presence removed, beavers moved in and built dams that have created a large emergent wetland complex. Another recently created small, emergent wetland was found at the Paces Mill unit. This miniature wetland encompasses an area of approximately 300 sq ft. It has developed on top of a granite riprap substrate used during construction of a multi-use trail. The saturated soils have attracted obligate plant species, such as *Dicanthelium scoparius*, *Carex lurida*, *C. anectans*, and *Ludwigia alternifolia*.

The largest percentage increase in wetland type was freshwater ponded wetlands (Figure 1). The increase from 0% to 4% is due to the combination of a very wet winter and recent beaver activity in the park. An expanding beaver population has created numerous large wetlands and emergent and shrub/scrub complexes. Whitewater, Cochran Shoals, Johnson Ferry South, and Johnson Ferry North units had larger ponded areas than what was documented in the 2006 USFWS NWI maps.

Lacustrine wetland areas in the park increased by 34.41 ac, but total lacustrine wetland area percentage decreased by 3% from the 2006 survey. This is due to the increase in total wetland

**Table 1.** Wetland acreage, by type.

| Wetland Type | Acres 2006 | Acres 2010 |
|---|---|---|
| Palustrine - Freshwater Emergent | 63.52 | 85.73 |
| Palustrine - Freshwater Forested/Shrub | 222.82 | 314.82 |
| Palustrine - Freshwater Pond | 6.82 | 110.39 |
| Lacustrine | 423.86 | 458.27 |
| Riverine | 1273.21 | 1453.34 |
| Other | 60.79 | 64.25 |
| **Total** | **2051.02** | **2486.80** |

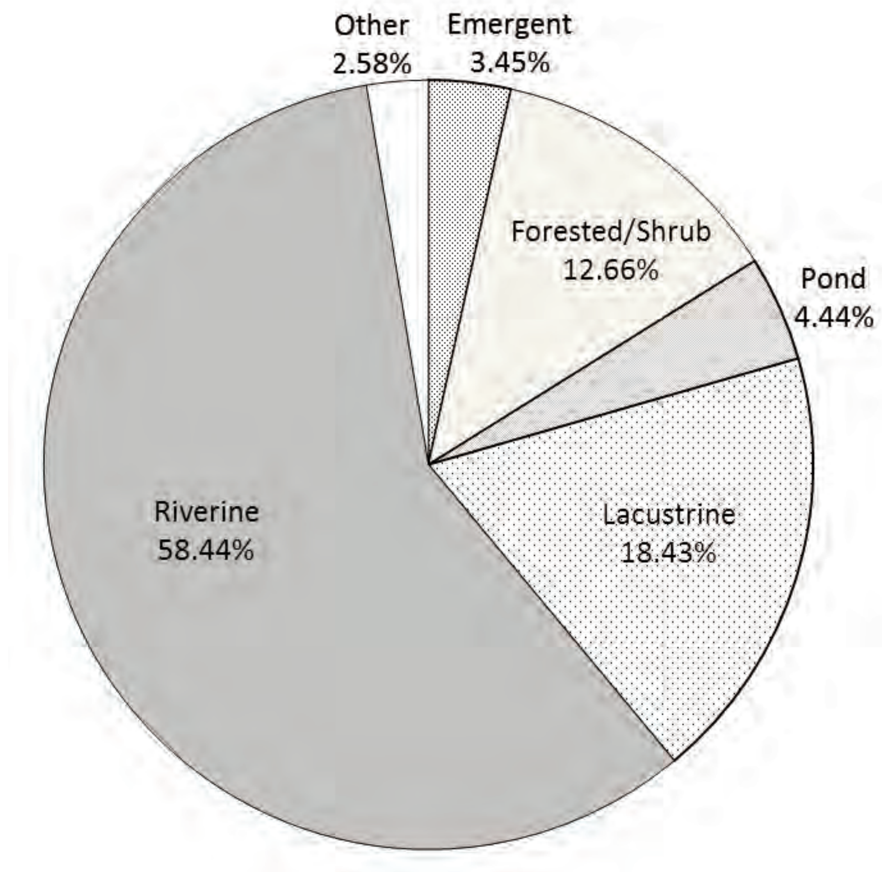


**Figure 1.** Percentage of wetland types at CRNRA.

acreage in the park. Bull Sluice Lake is the largest lacustrine wetland, and encompasses approximately 350 ac.

The islands in the river corridor were not field-verified. The NWI classification of each island was checked using current Google Earth aerial photography, and included in the appropriate wetland acreage. Most islands in the Chattahoochee River are heavily forested, and classified by USFWS as either freshwater forested/shrub, or "other." The 2011 color infrared aerial photography will be used to verify these classifications.

## Conclusion

As concluded by the 1990 Chafin overview study, CRNRA has more wetland acreage than is depicted in the USFWS NWI maps. The 2010 field-verified total wetland acreage of 2,486.80 is an increase of 435.78 ac over the 2006 NWI total acreage of 2051.02. The 21% increase in total wetland area is significant. The increase is due to several factors. The USFWS NWI maps did not include some large wetland complexes, and numerous emergent and shrub/scrub complexes have recently been created by beaver activity in the park. Beaver activity has increased throughout the park as their populations grow and expand. Additionally, small wetland areas have been discovered in remote areas of the park. One of the most useful tools for this wetland delineation was the hydric soil database in the NRCS Web Soil Survey, which greatly simplified the process of recognizing possible wetland areas from remote digital imagery.

The field-verified wetland inventory will be evaluated against the newly updated USFWS NWI maps, and the 2011 aerial photography. The rapid urbanization of the Atlanta metropolitan area requires that resource managers have current and accurate data to understand the impacts of the growth and dramatic changes occurring in the Chattahoochee River corridor. This baseline information will enable the park to better manage water resources including wetland integrity, ecological function, and wildlife habitat.

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# Developing a Wilderness Character Monitoring Protocol for the Otis Pike Fire Island High Dune Wilderness, a Federal Wilderness within Sixty Miles of New York City

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## Introduction

The Otis Pike Fire Island High Dune Wilderness lies completely within Fire Island National Seashore (FINS) on the south shore of Long Island, New York. It contains a variety of barrier island habitats, in relatively natural condition, within 60 miles of New York City. It is the only federally designated wilderness area in the State of New York, and is one of the smallest wilderness areas managed by the National Park Service (NPS), approximately 1,380 acres. To preserve and assess wilderness character in this relatively small and dynamic site from year to year, an interdisciplinary team at FINS developed a wilderness character monitoring protocol.

This article will discuss the development of this protocol for the Otis Pike Fire Island High Dune Wilderness. The framework is based on the four qualities of wilderness character: untrammeled, natural, undeveloped, and solitude or primitive and unconfined recreation. Several indicators and subsequent quantitative measures were chosen for each quality, based on the needs and conditions of this particular wilderness. Monitoring programs and databases already established by FINS staff were utilized as much as possible for measurements such as visitor use reports and data collected for natural resource monitoring programs. In addition, night sky was identified by the team as a new measure needed to properly assess an indicator within the solitude wilderness character quality. The entire process of developing a wilderness character protocol helped FINS staff view the Otis Pike Fire Island High Dune Wilderness holistically, and reflect on best management practices for preserving wilderness character, as mandated in the 1964 Wilderness Act. This protocol will provide other NPS units with an example of how FINS staff interpreted wilderness character for this particular wilderness and may, ultimately, expand our understanding of wilderness stewardship.

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The Wilderness Act of 1964 states the role of resource stewards is to manage wilderness in order to preserve wilderness character. However, how do we know whether we are following legal mandates and rightfully preserving it? An interagency team was created to address this question. A conceptual framework to monitor wilderness character was set forth in the team's publication, "Keeping it Wild" (Landres et al. 2008a). This publication defines wilderness character by its four qualities (as defined in the Wilderness Act of 1964), with each quality having relevant indicators and measures which can be quantitatively assessed. The four qualities of wilderness character are: *untrammeled*, where wilderness is essentially unhindered and free from modern human control or manipulation; *natural*, when wilderness ecological systems are substantially free from the effect of modern civilization; *undeveloped*, when wilderness is essentially without permanent improvements or modern human occupation; *outstanding opportunities for solitude or a primitive and unconfined type of recreation* exist, so wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration, and physical and mental challenge.

All wilderness areas, regardless of size, location, or any other feature, are unified by this statutory definition of wilderness. Given the practicable assessment tools in this protocol, NPS managers can now tailor this conceptual framework to evaluate short and long term trends in wilderness character. An interdisciplinary team at Fire Island National Seashore (FINS) used the "Keeping it Wild" framework to develop indicators and measures to produce a wilderness character monitoring protocol specific to the Otis Pike Fire Island High Dune Wilderness.

### Otis Pike Fire Island High Dune Wilderness

Congress established the Otis Pike Fire Island High Dune Wilderness within FINS on the south shore of Long Island, New York, in 1980. The northern boundary extends along the Great South Bay at mean high water, and is characterized by an extensive salt marsh. The southern boundary is located at the toe of the primary dune, which is ever-changing, due to the dynamic nature of the barrier island and the beach-dune system.

### Process of choosing indicators and measures

Our team consisted of two biologists, and one park ranger (visitor and resource protection). Choosing indicators and representative measures was the most challenging part of the entire process. It first involved a number of discussions between the primary team members, which spanned over a year. We then held a meeting with park management where we shared our ideas, and asked whether they felt the measures we chose adequately represented our wilderness. All comments and suggestions received during this meeting were considered, and agreed-upon measures were then incorporated into the final version of this protocol, to be signed by the park superintendent.

We first eliminated indicators and measures in Landres et al. (2008a) which were not applicable to our site. For example, there was an indicator for 'inholdings' within the undeveloped quality. This was removed from our protocol because there are currently no inholdings within the Otis Pike Fire Island High Dune Wilderness. We considered the remaining indicators, and discussed the example measures provided for each quality. We summarized and evaluated existing quantitative measures taken within the wilderness through routine monitoring and management actions, the sources of the information, and discussed whether we could utilize them for particular qualities within our framework. Finally, we went through each quality and identified data gaps, or areas for which a measure should be created.

The following are examples of existing measures being taken within our wilderness that we included in the framework. Park biologists annually collect data on the abundance and productivity of threatened and endangered species, most notably for the federally threatened piping plover (*Charadrius melodus*) and seabeach amaranth (*Amaranthus pumilus*). The abundance of these two species is a part of the measures included within the indicator, "Plant and Animal Communities" within the natural quality. The NPS Northeast Coastal Barrier Island Network's Inventory and Monitoring program identified salt marsh sediment elevation change as a vital sign for long-term monitoring (NPS 2011). Currently there are several sampling points within the wilderness. This change is measured by sediment erosion tables. This is one of two measures within the indicator, 'biophysical processes' within the natural quality (Table 1). Lastly, park rangers investigate and document unauthorized uses of motor vehicles, motorized equipment, or mechanical transport via case incident reports (form 10-343). This is one of three measures within this particular indicator for the undeveloped quality (Table 1).

Utilizing existing measures as much as possible was important in developing this tool because it is cost effective, and does not add too much to park staff workload. This increases the likelihood of managers using this tool into the future. However, new measures and baselines that we felt were important to our wilderness, such as night sky (i.e., something that would be diminished by light pollution) were also identified and developed. Many visitors experience our wilderness by primitive backcountry camping. On a barrier island the night sky is in full view, and considered an important part of the visitor's experience.

The overall strategy for measuring wilderness character at each site is to: choose a set of measures from those that are relevant, cost-effective, and tied to preserving wilderness character; periodically collect data to assess trends; and use these trends to assess and report on changes in wilderness character (Landres et al. 2008a). The framework allows flexibility for each agency and individual wilderness to monitor the specific measures most representative of their site. For our purposes, all four qualities are represented, and considered equally important.

### The final product

A wilderness character monitoring framework was developed which includes several indicators and measures for each quality (Table 1). It was decided by the team and park management that this framework holistically represented the Otis Pike Fire Island High Dune Wilderness, and will be used as a tool to assess wilderness character from year to year. The first year of monitoring will act as a baseline for wilderness character, and measures for the current year will always be compared to the previous year. This will be accomplished using the trend worksheet to assess whether wilderness character is improving (denoted by a +1 or an ascending arrow), degrading (–1 or a descending arrow), or is stable (0 or double arrow) overall, checking each measure, indicator, and quality. Trends can be determined by simply adding the rankings. All measures are equally weighted, allowing for an evaluation of change, but not the magnitude of that change.

### How will managers use this protocol?

Evaluating trends allows wilderness managers to see the impacts of management decisions on wilderness character. Managers can evaluate trends on a small scale or large scale, from an individual measure within one of the qualities, to overall wilderness character across all four qualities. Identifying which measures are "degrading," or a -1 trend, will highlight areas in which management decisions may need to be altered. The protocol is a tool, and should remain flexible so that it can be amended as changes occur, to more accurately reflect wilderness character of the site in the future.

Interestingly, management activities can have a degrading effect on wilderness character in the short term, but have a positive long-term effect. For example, the action of removing non-native invasive plants will have an initial degrading effect on the untrammeled quality. However, if the number of invasive plants decreases, along with the number of actions taken to remove them, wilderness character for both the untrammeled and natural qualities will improve.

| Quality | Indicator | Measures | Ranking |
|---|---|---|---|
| **Untrammeled-**<br><br>Wilderness is essentially unhindered and free from modern human control or manipulation | ▪ Actions authorized by the NPS-FIIS that manipulate the biophysical environment | 1) Number of actions to manage plants, animals, pathogens, soil, water or fire<br>2) Number of natural fire starts that receive a suppression response | ▪ ↑ in # of actions= ↓ in WC<br>▪ ↑ in # of actions= ↓ in WC |
| | ▪ Actions NOT authorized by the NPS-FIIS that manipulate the biophysical environment | 1. Number of unauthorized actions by other Federal or State agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water, or fire | a) ↑ in # of actions= ↓ in WC |
| **Natural-**<br><br>Wilderness ecological systems are substantially free from the effect of modern civilization | a) Plant and animal species and communities | a) Number of indigenous species that are listed as threatened and endangered, sensitive or of concern<br>b) Abundance of indigenous species that are listed as threatened and endangered, sensitive or of concern<br>c) Number of invasive non-indigenous species<br>d) Acreage of invasive non-indigenous species | a) ↑ in # = ↑ in WC<br>b) ↑ in abundance = ↑ in WC<br>c) ↑ in # = ↓ in WC<br>d) ↑ in acreage = ↓ in WC |
| | b) Physical resources | a) Ozone air pollution based on concentrations of N100 episodic and W126 chronic ozone exposure affecting sensitive plants<br>**b)** Extent and magnitude of change in water quality | a) ↑ in ozone = ↓ in WC<br>b) ↑ in WQ measurements = ↓ in WC |
| | c) Biophysical resources | 1. Forest Health<br>2. Salt Marsh Surface Elevation Tables (SETs) | a) ↑ in acreage = ↓ in WC<br>b) ↑ in elevation = ↓ in WC |
| **Undeveloped-**<br><br>Wilderness is essentially without permanent improvements or modern human occupation | ▪ Non-recreational structures, installations, and developments | 1) Number of authorized physical developments<br>2) Number of unauthorized (user-created) physical developments | ▪ ↑ in # = ↓ in WC<br>▪ ↑ in # = ↓ in WC |
| | ▪ Use of motor vehicles, motorized equipment, or mechanical transport | 1. Number of administrative and non-emergency use of motor vehicles, motorized equipment, or mechanical transport<br>2. Number of emergency use of motor vehicles, motorized equipment, or mechanical transport<br>3. Number of motor vehicle, motorized equipment, or mechanical transport use NOT authorized by NPS-FIIS | a) ↑ in # = ↓ in WC<br>b) ↑ in # = ↓ in WC<br>c) ↑ in # = ↓ in WC |
| | ▪ Removal of remnants which remain in the Wilderness from past occupation | a) Number of actions to remove remnants | a) ↑ in # = ↑ in WC |

**Table 1.** The final Wilderness Character Monitoring Framework developed for the Otis Pike Fire Island High Dune Wilderness. This framework was based on the concepts provided by Landres et al. (2008a and 2008b).

| | | | |
|---|---|---|---|
| **Solitude or Primitive and Unconfined Recreation-** Wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge | ▪ Remoteness from sights and sounds of people inside Wilderness | 1) Amount of visitor use<br>2) Number of areas negatively affected by camping<br>3) Number of actions taken that affect travel routes inside the Wilderness | ▪ ↑ in visitor use = ↓ in WC<br>▪ ↑ in # of actions = ↓ in WC<br>▪ ↑ in # of actions = ↓ in WC |
| | ▪ Remoteness from occupied and modified areas outside the Wilderness | 1. Area of wilderness affected by access or travel routes that are adjacent to the Wilderness<br>2. Night sky visibility averaged over the Wilderness | a) ↑ of people = ↓ in WC<br>b) ↑ in light pollution = ↓in WC |
| | ▪ Facilities that decrease self-reliant recreation | a) Number of agency-provided recreation facilities | a) ↑ in # = ↓ in WC |
| | ▪ User trail development | a) Number of actions taken to mitigate user trails | a) ↑ in # of actions = ↓ in WC |
| | ▪ Management restrictions on visitor behavior | a) Number of visitor-use restrictions | 1. ↑ in # of restrictions = ↓ in WC |

Table 1 (continued).

Degradation may also occur in unfortunate cases over which the park has no control. For example, a law enforcement or emergency incident requiring mechanical devices to rescue people may negatively affect wilderness qualities.

### Future suggestions for parks

We learned a great deal in developing this framework, and would like to share our challenges to help other managers develop wilderness character monitoring protocols of their own. Our site was able to develop these on our own, but the process proved to be lengthy, and took over two years to develop. Additional staff dedicated solely to this project could be of great use. This could be achieved by bringing on an intern for three months to help with finalizing the protocols, creating the baseline inventories, clearly identifying all data sources for each measure, assigning positions and divisions responsible for providing the specific measures (with a timeline), and creating a database to house and store all the collected wilderness character monitoring data. The database, with clearly spelled out standard operating plan, is an extremely helpful tool. This ensures that the wilderness character monitoring protocol can still be followed and continued into the future, in the face of staff turnover and budget constraints.

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# Mythic Narratives of the National Parks

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### Mythic narratives of the national parks

My brief reflections today focus on religion in the national parks in a time of change. I offer two proposals for your consideration. First, that studying parks as pilgrimage sites, by exploring park mythic narratives and rituals, is useful for better understanding the beliefs and values of American culture and the management decisions in parks that have resulted from these beliefs and values. Second, that the traditional narrative is changing in light of new developments in scientific understanding of the natural world, as well as the demographic makeup of the USA. However, change runs contrary to the very foundations of the national park idea, and at least until now, has been resisted, both in the park service and in the general culture, as we can see, for example in the reassertion of the traditional narrative in the Ken Burns film.

### National parks as pilgrimage sites

Traditionally, a pilgrimage site embodies the beliefs and values—that is, the religion—of the people who travel there to celebrate and reaffirm them and their shared community. The values and beliefs are articulated in a mythic narrative (often identified as the "national park idea") and enacted in ritual activities (like the famous campfire or being present for the eruption of Old Faithful). Sacred sites and the values and beliefs they embody are understood by the people who honor them to be timeless and unchanging, a refuge from the developing and imperfect world of everyday life. However, all sacred sites necessarily mirror the cultural context of their time, in which those beliefs and values are constantly being worked out and contested. No culture is static and no sacred site unchanging. Thus, we can learn a great deal about changes in American culture through studying how the mythic narrative of the national park idea has changed over time, particularly as related to the foundational understandings concerning the relationship between humans and the natural world. We can also better understand why parks have been managed the way they have, in terms of both natural and human resources.

Although traditional religious language about the parks is more common before the mid-twentieth century, at a recent conference I discovered that the language of "spiritual experience" and "transcendence" are becoming part of mission statements. A further example of what I would describe as "religion" comes from the 2009 Advancing the National Park Idea, the report of the National Parks Second Century Commission: "Americans have a *deep and enduring love* for the national parks, places we treasure because they embody our highest ideals and values. National parks tell our stories and speak of our identity as a people and a nation."[1]

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What are the ideals and values embodied in the parks? First, nature is the source of democracy and the parks are a demonstration of it. Myra Jehlen claims in *American Incarnation* that the establishment of democracy in the American "New World" was quite unlike Europe. "When the democratic Enlightenment became associated with the North American continent, something new did emerge … grounded, literally, in American soil, liberalism's hitherto arguable theses metamorphosed into nature's material necessities.… Americans saw themselves as building their civilization out of nature itself."[2] As the United States realized its Manifest Destiny across the continent, the national park lands became the places set apart from entrepreneurial development, where the power of the new world could be preserved, intact and unchanging. Here the sacred origins of America could be celebrated and Americans could be renewed. The parks not only contained the power of nature out of which democracy sprang, they also demonstrated the greatness of democracy in the United States. Unlike Europe where the great gardens were owned and enjoyed by the rich, in America the sublime places of nature belonged to all the people—and further, participation in the experience of the parks would make them better Americans.[3]

A second value embodied in the parks is the greatness of the American nation. Lacking the ancient history of Europe, nature became America's history—a history that seemed timeless. The big trees were America's ancient history. Horace Greeley said of sequoias in the Mariposa Grove: "That they were of very substantial size when David danced before the ark, when Solomon laid the foundations of the Temple, when Theseus ruled in Athens; when Aeneas fled from the burning wreck of vanished Troy, when Sesostris led his victorious Egyptians into the heart of Asia, I have no manner of doubt."[4] Yosemite Valley was called the nation's cathedral and the height of Yosemite Falls (2,425 ft.) was compared to St. Peter's in Rome—one sixth its height. As nineteenth century America was exploring its cultural identity, nature—closely coupled with democracy—was its rock solid foundation.

The parks provided not only the ancient history of the nation, but also its intimate connection with the primal unchanging garden of Eden. As Fitz Hugh Ludlow, a writer who traveled with Albert Bierstadt to Yosemite in 1863, said of the Valley, "If report was true, we were going to the original site of the Garden of Eden."[5] A contemporary example is from the Ken Burns documentary when Shelton Johnson, the rock star of the film, says of an experience in Yellowstone, in the midst of snow and bison: "I felt like this was the first day, and this morning was the first time the sun had ever come up."[6] The American Eden continues eternally in the parks.

These ideals and values have shaped the story of the park, told through interpretation, landscape architecture, and resource management. Even scientists evoke the mythic narrative.

Joseph Grinnell's 1916 "Animal Life as an Asset of National Parks" compared the parks to the primeval, unpeopled landscape, as it was "before the advent of the white man."[7] George Wright, in *Fauna of the National Parks,* 1932, begins, "The American people intrusted the NPS with the preservation of characteristic portions of our country as it was seen by Boone and LaSalle, by Coronado, and by Lewis and Clark. This was primitive America" that was to be kept intact in the parks.[8] The Leopold report of 1963 repeats similar themes as it called for the parks to be a "vignette of primitive America" and established the ideal natural moment to be the pristine new world that awaited European entry.[9]

The mythic narrative of the reconnection with primal, pristine America—perhaps especially as it is combined with science—has shaped both the management and the experience of the parks. At the heart of the narrative is the belief that the parks are lands set apart and preserved unimpaired. They do not change. They are our still point in a changing world. As the Ken Burns Film tells us over and over—you *can* go home again. Our parks are there waiting for us, as they have always been, so our children and grandchildren can have the same experience we did when we were children.

### Wilderness, naturalness, and beyond

But environmental historian William Cronon asserts that our devotion to our wilderness home leads us to neglect our everyday home environments. He says the way we conceive of "nature" reinforces the separation of human culture from the natural world and says "the trouble with wilderness" is that it emphasizes this dichotomy rather than offering a model of humans as part of the natural order.[10] Many indigenous traditions imagine the world in such a way, often not having a word designating "nature" as something separate from humans. Indeed, using our terms, civilization is sometimes defined as humans living in harmony with nature.

In a similar way David Cole, Laurie Yung, and Gregory Aplet speak of "the trouble with naturalness." And I'm quite sure they would add with "natural regulation." Like "wilderness," "naturalness" carries deep mythic meanings that are rooted in a nature that, without humans, is balanced, in equilibrium. They say that the old "beliefs about the stability of ecological systems, the insignificance of aboriginal humans as ecological agents, and our ability to mitigate the adverse effects of current and future human activity on park ecosystems have all been shaken by research in ecology … and related fields."[11] "Naturalness" clings to all of those earlier beliefs and the use of the term, they say, prevents attention to actual realities of ecosystems.

William Tweed, retired naturalist at Sequoia and Kings Canyon National Parks, has questioned the mythic narrative of the national parks, saying "deeply embedded" in the "legal mandate to conserve the parks in a way that leaves them 'unimpaired,' is the promise that things will not change." This narrative is no longer viable given climate change and new understandings of ecological systems. However, he says, "educating the public to accept change" is extremely difficult because the National Park Service (NPS) "has emphasized that its mission is to prevent change. The NPS must abandon this position and must begin talking about change as an inescapable part of the park world."[12] Tweed sees anthropogenic change as inescapable in our world, including in the parks. Others, like Daniel Botkin in *Discordant Harmonies,* go even further to say natural processes are "fundamentally stochastic to some degree." If this is so, he says, we need a shift in our myths, in our symbols and metaphors, as we reflect on the realities of humans and nature.[13] And I would add, what better place than our parks to development these new myths and metaphors?

This is not to say that a narrative that stressed dynamism, change, and uncertainty would be fundamentally "true" in a way that the story about preserving unimpaired is not. These are both mythic narratives, designed to offer large frameworks that anchor peoples' ideals and values, and provide ethical bearings to the decision-making processes that can never rely wholly on scientific information. If there is not a singular "natural" way, humans must make judgments on what they imagine to be the ideal state of nature and humans. Although the narrative of changelessness no doubt did a great deal for the parks in the past, today another story is needed that both takes account of scientific knowledge, and connects with the wisdom of contemporary culture on the relationship of humans to the natural world.

Some of the current realities the new narrative must take into account are, first, that parks are not islands. Boundaries are permeable, with external forces like air pollution crossing into the parks, and internal forces like bison and bears crossing in the other direction. The recognition of the Greater Yellowstone Ecosystem is one way of beginning to address these issues, and biosphere reserves are another. Second, change is inevitable. Parks were never museums, even though museum language was—or is—used. Climate change will bring dramatic alterations in the parks, and decisions will have to be made on how to manage it. Can a new mythic narrative emerge that can incorporate these new realities and help in these decisions? And if it cannot, will the national park idea survive? Mythic narratives cannot be created. They emerge out of the transformation of beliefs and values in light of natural and cultural realities. Looking at the Ken Burns film, I do not see the new story. But seeing what the NPS is doing on the ground leads me to think a new narrative is in the process of emerging. I expect this narrative will incorporate change as a meaningful part of the parks, which will be a dramatic change in the parks' mission. Two elements I think will be central to a new story are first, that parks are not wholly other from what lies outside of them. There is interaction and that must become part of the story. Second, humans are part of the ecosystem, affecting and being affected by the parks. They are not only gardeners or only guardians, but part of the dynamic, mysterious process; and all are involved in change. Such a narrative would not only be inclusive of ecosystem lands lying outside the parks and of humans and nature as part of this ecosystem, but would also better fit the diversity of visitors and the stories they bring to the parks, which would enable the national park narrative to be inclusive of more people and provide a canopy under which a variety of American stories can reside.

## Endnotes

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# Civic Engagement: What Does that Mean Again?

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Civic engagement is increasingly being seen within the National Park Service as a means to achieve greater relevancy, as well as a mechanism to increase resource stewardship, provide meaningful educational experiences, and diversify the agency's workforce. However, it is not generally recognized that civic engagement is utilized by a number of different parks, programs, and offices in meaningful ways. Nor is it realized that employees representing different areas—both geographically and discipline-wise—can work together and learn from one another on how best to engage with the public.

Our session attempted to provide some insight into what civic engagement is, and some of the ways that it is utilized in varying programs and offices in the NPS. To help achieve this we had panelists Barbara Little (Archeology Program), Dean Reeder (Office of Tourism), and Nora Mitchell (Conservation Study Institute) serve as representatives for their respective programs/offices. Each panelist explained why civic engagement is an important aspect of their office/program's work, as well as how it can inform all undertaken projects. Interpretive training manager David Larsen, who passed away earlier this year, was also supposed to serve on the panel. We would like to acknowledge David's expertise on this subject, and his numerous contributions to both civic engagement and the NPS. The session was dedicated to his memory.

Following our panelists' presentations, we asked the audience to participate in a discussion about perceived impediments that are making civically engaged projects a challenge. The purpose of this was two-fold. Firstly, it would provide a forum in which people could participate and know they were being listened to. Secondly, it gave our panel insight into challenges that many face when trying to implement highly collaborative projects so that current initiatives that have been launched at the WASO level take into account the feelings of those undertaking such work. In other words, it was a means by which we could begin to engage with those working outside of WASO.

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The following proceedings contain a general overview of each panelist's presentation. Following these overviews is a summary of the dialogue that occurred after the presentations. These comments will be presented in a manner that produces the greatest level of coherency, with some accompanying commentary to provide context.

### Civic engagement from a perspective of resource management and stewardship: Barbara J. Little

Resource managers, as well as other practitioners within NPS, work within a universe of standards, ethics, science and scholarship. Trends and influences in the professions in universities and in private practice impact our work. Archeology as a profession working with both local and descendant communities has increasingly found that civic engagement is a component of good practice.

Some changes in public archaeology came from within the field, but many of them came from external forces. We can trace the tearing open of archeology as a practice to the needs and desires of descendant communities, to decades of Native American activity resulting in the passage of NAGPRA 1990, and the discovery and none-too-elegant handling of the African Burial Ground discovery in 1991 in lower Manhattan.

It became clear to archeologists that stakeholder concerns could no longer be ignored. Stakeholders insisted on having some control. Professional sense of ethics changed in response. We have seen similar needs and similar trends across disciplines. There is a trend not only of public insistence on government accountability, but also an insistence on citizen involvement in government (widespread and involving not only land managing agencies but also, for example, public health).

Civic engagement and resource stewardship also intersect because people want to be part of research for many different reasons. Tribes, for example, may be very interested in being involved in designing the research that touches the remains of their ancestors; citizen scientists or students may want to learn and serve and even gain job skills.

In resource management, it seems as if civic engagement is less frequent than in some other NPS practices. Why should this be? Why does civic engagement happen less in resource management? Part of the reason may be that resource folks are trained as experts; sometimes that includes a sense of professional identity that instills in us the strange idea that we have all the answers—or the best answers—or the only answers that matter.

Kirsten M. Leong, John F. Forester, and Daniel J. Decker (2009) interviewed natural resource managers, planners, and practitioners with experience in public participation and identified roadblocks:

- Takes a lot of time
- Lack of support from management
- Fear of a lawsuit
- Fear of losing control of the outcome

One of their interviewees summarized it this way (2009, 27):

> Information must be three things: credible and accurate, salient to the issue at hand, and legitimate in the eyes of the public. To accomplish that, you need relationships that are transparent, open and accessible to everyone. All forms of knowledge have to be respectfully questioned and examined, both traditional and expert. This builds the legitimacy of expert knowledge. Otherwise, people will take the attitude, 'If you dismiss my local knowledge, I will dismiss your expert knowledge.'

In light of the importance of credible, accurate, salient, and legitimate information, it is useful to reframe the importance of civic engagement to scholarship: to consider that getting more perspectives, getting more input, gathering more data is what leads to sufficient quality and quantity of knowledge to make good decisions. We want good decisions, good and thorough understandings, and to avoid as much as possible short-sightedness and blind spots, recognizing that science is an imperfect practice.

To trust the process is a big leap. One of the lessons from archeology as a discipline comes from the aftermath of NAGPRA and the African Burial Ground. These were terrifying events for many archeologists. However, the truth of the aftermath is that archeology done in collaboration is better archaeology. It's not just more ethical, it's also better science.

### Recognizing the link between civic engagement and tourism: Dean Reeder

Tourism is connected to civic engagement in many ways, but most directly through three authorities. The first—the NPS mission itself—promotes sustainable visitation. Secondly, Director's Order no. 17 outlines a policy to promote and support sustainable, responsible, informed, and managed visitor use through collaboration and coordination with tourism partners, thus acknowledging a joint socio-economic interest with gateway communities. This Director's Order fosters positive relationships with park neighbors by promoting an understating of, and sensitivity toward, local cultures, customs, and concerns. Finally, the NPS National Tourism Strategic Plan outlines coordinated actions with gateway community partners to increase the communications capacity of parks and the park service. Many of these partnerships take the form of a cooperative marketing project designed to reach targeted audiences who may not otherwise visit park units.

As Jon Jarvis says, "Gateway communities and parks have an important relationship that needs to be grown through mutual respect and cooperation, particularly when tourism is an essential part of the economy."

It is through the direction of these authorities that parks and programs are encouraged to take a proactive approach and engage with gateway community partners. A common assumption is that these partners operate in close proximity to the park—occupying land that is contiguous to park boundaries. In reality, however, the term gateway community extends far beyond this general assumption. Consider these two different concepts of community: communities of place, and communities of interest. While communities of place refer to those in close proximity to a park unit, communities of interest are self-declared and therefore, self-defined. For example, a few years ago, the Western States Tourism Policy Council (travel directors from the thirteen Western states) co-produced a gateway community conference with the Department of the Interior. Through conference registrations, we learned that San Francisco considers itself a gateway to Yosemite, and Las Vegas considers itself a gateway to Grand Canyon. These cities, while not communities of place, have defined themselves as communities of interest in that they connected themselves to their respective park.

In the sustainable tourism model, such partners—whether they are communities of place or communities of interest—deploy patient capital. This means that they invest themselves with the expectation that they will experience greater financial benefits over a longer term. The values inherent in sustainable tourism emphasize local products, based on the host community's unique character, culture, and heritage—which are gained through civic engagement. Such emphasis, in turn, results in a higher quality visitor experience.

The emphasis of local products can be described as brand positioning. In simple terms, brand positioning conveys a promise as to what their NPS unit experience will be like. When consumers agree to accept our offer to visit, they look for clues in and around the destination that their expectations surrounding the brand promise will be kept. This is why a sustainable destination pays close attention to communicating a "sense of arrival." The park cannot create this sense alone. Together, we and the community partners are both being judged as providers of the destination experience. For example, the town of Springdale, Utah has worked in collaboration with Zion National Park on planning, underlying infrastructure, and a passenger transportation system. The level of collaboration is evident in architectural themes in Springdale, which preview and complement the historic architecture of facilities inside the park.

Civic engagement is also present in the "Crown of the Continent," a geotourism region that has been coordinated by the National Geographic Society. This geotourism region, in part, provides a holistic destination experience for those traveling to the "International Peace Park," which was created with the merger of Glacier NP and Waterton Lakes NP. As a cooperative marketing project, the parks, other federal and tribal land managers, and their gateway community partners formed a local stewardship council to sort and select the combination of natural and cultural experiences to be featured in the geotourism map guide. Conspicuously absent are park and political boundaries.

In closing, consider the following words from President Barack Obama: "Folks in communities around this park know they don't have to choose between economic and environmental concerns; the tourism that drives their local economy depends on good stewardship of their local environment."

### Civic engagement and social capital: Nora Mitchell

Civic engagement supports all four of the NPS current national priorities—relevancy, education, stewardship, and workforce. By making a commitment to have a "continuous, dynamic conversation" with communities and key stakeholders in a meaningful way, civic engagement builds the relationships and provides the knowledge and insights that are necessary for the NPS and our partners to achieve our shared conservation goals over the long term. This panel illustrated how programs across many disciplines—and every project team—can practice civic engagement for a more successful effort. Considering the breadth of this practice, civic engagement—conducted in a thoughtful, deliberate, sustained and inclusive manner—can play a transformative role for the NPS, our partners and also, importantly, for American civil society.

Civic engagement is of tremendous importance, in particular, to maintaining the relevance of the national park system and conservation stewardship into the next century. Numerous challenges exist as a result of certain current societal trends, including declining historical and cultural literacy, "nature deficit disorder" (a term to describe disconnection of youth from nature), concerns over obesity, a population that is more urbanized, and increasingly sophisticated technology. These are all challenges—but also opportunities—for the NPS and our partners to engage new communities, diversify visitation, and introduce more of the American population to all that the national park system has to offer.

Even so, reaching a broader part of the American public requires new approaches. Fortunately, in recent years, many national parks, NPS programs, and partners across the country have initiated innovative efforts to engage communities and to enhance their service and relevancy to all Americans. The emergence of successful programs provides an incredible opportunity to learn from and share knowledge among parks, programs, and partners across the national park system. This meeting at the George Wright Society Conference—and others like it—offer an important venue for sharing what we've learned and help all of us continue to hone our practice of civic engagement.

A particularly promising development that demonstrates the role of civic engagement in relevancy is the many recent innovative programs that engage youth from surrounding, diverse communities, building their connections to parks, and developing their sense of stewardship. Some of these initiatives also provide an avenue for considering career opportunities with the NPS. In order to learn from these programs, the NPS Conservation Study Institute initiated a research project with the University of Vermont to capture lessons learned and to better understand what constitutes good practice in engaging diverse communities and enhancing relevancy of national parks and programs. Working in cooperation with two national parks—Santa Monica Mountains and Boston Harbor Islands NRA—their partners, and the Northeast Regional Interpretation and Education Program, a team conducted research on the key ingredients for successfully engaging youth from diverse local communities.

This project coined a term "deep engagement" to describe the long-term, sustained engagement of community members that builds strong connections with NPS programs and parks so that the park becomes an integral and vital part of program participants' communities and an asset to their quality of life. Deep engagement complements other, more short-term experiences usually offered by national parks. The report on this project, *Beyond Outreach: Sharing Innovative Approaches for Engaging Youth from Diverse Communities* (Stanfield McCown et al. 2011) includes a "toolkit" for practitioners that can be used to guide the development of new programs and improve existing efforts to engage diverse communities (see also Tuxill, Mitchell, and Clark 2009; Jewiss, Laven, and Mitchell 2010; Tuxill and Mitchell 2010; and Duffin et al. 2009). By sharing these experiences, other managers and practitioners both within and outside of the NPS can, through adaptation of these good practices to their situations, enhance the effectiveness of their civic engagement with diverse communities.

### Audience comments

Following these presentations the audience was asked both for their questions, as well as to comment on any presentation or audience-member question that had been posed. Through this portion of the session we gained insight into many challenges that are encountered as people undertake civically engaged work. For example, a recurring comment was the need for a sustainable support-network that people can field questions and help troubleshoot challenges that have been faced. Audience members also suggested that overall organizational culture may inhibit civic engagement practices. Other comments referred to power struggles that at times interfere with collaborative work.

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# Redwood National Park Expansion, Woodstock, Earth Day, and the Kent State Massacre

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The campaign to establish Redwood National Park in 1968 has been documented in books, oral histories, and film. To an extent, the divisive story of correcting the ecological problems created by that park's enabling legislation, through the passage of the Redwoods Expansion Act of 1978, has been told as well. However, some who were part of that effort think the story is incomplete. This paper will illustrate how a community of local conservation leaders, a dedicated college professor, and a number of students and residents pushed back against the forces of local economics and national politics to force the "fixing" of that redwood problem.

This paper examines the untold story of a broad-based citizen effort to expand Redwood National Park by 48,000 acres, and the role played by informed citizens who were the product of a mélange of contemporary social activist issues, and the leadership of many people, including Humboldt State University Natural Resources professor, Rudi Becking. Finally, this paper will look for possible extrapolations to current conservation efforts.

## Background

A 1964 expedition chronicled by the National Geographic Society documented and publicized the discovery of the "Tallest Tree in the World" that grew on an alluvial flat on Redwood Creek, dubbed the "Tall Trees Grove."

The inclusion of the Tall Trees Grove, in the narrow boundary appendage along Redwood Creek in the 1968 congressional bill creating Redwood National Park, was recognized as a form of gerrymandering that flew in the face of local ecological, geological, and meteorological factors. The 1968 park legislation intended to spare Tall Trees Grove, but the trees would be doomed nonetheless (Figure 1).

## Humboldt State University students

Humboldt became known as the "environmental school" in the 1960s and 70s with the number

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**Figure 1.** Redwood National Park historic boundaries showing the original 1968 boundary and the narrow Redwood Creek "appendage" and later 1978 boundary including more of Redwood Creek Watershed (source: Redwood National Park, James O'Barr).

of graduates in Natural Resources rising from 2 in 1966 to 44 in 1970; more than a 200% increase while at the same time, forestry increased initially but experienced a slight decline late in the decade in spite of a dramatic 30% increase in overall enrollment (Figures 2 and 3).

This change from traditional forestry to education in broader environmental conservation and natural resource agency administration was reflected in the student population. In the early 1970s, students at Humboldt had dramatically changed from the traditional foresters of the 1950s and 60s to "ecologists," young people who had returned from Vietnam or had protested Vietnam. Humboldt students had seen their government take up arms against young people just like them, killing four and wounding nine more on campus at Kent State University. Students had seen colleagues taking up battles to clean up, and eventually stop ecological disasters, such as the oil spill in Santa Barbara in 1968. Students joined forces with Cezar Chavez and the United Grape Workers Union, and boycotted sales of grapes harvested by non-union labor. The bebop dance music and crooning of the 1950s and 1960s was drowned out by the heavy beat of Santana, Jimi Hendrix, and Janis Joplin, as well as the call-for-peace folk music of Joni Mitchell, Joan Baez, Bob Dylan, John Lennon, and Cat Stevens.

The United States struggled with the inequity of 18-year-olds who could be drafted into war and lose their lives, but who were not allowed to vote. On July 1, 1971, Congress adopted the twenty-sixth amendment to the U.S. Constitution, giving the right to vote to citizens 18 years and older, thus correcting what many considered a constitutional hypocrisy. As students returned to school in 1972, 6 of 10 candidates running for Arcata city council came from campus.

It was perhaps impossible to have predicted this new, energized generation would link with established conservation groups, local chapters of the Audubon Society, Sierra Club, as well as fishermen, mothers, fathers, and politicians to correct the Redwood Creek worm-shaped boundary problem, by expanding the park to include more of the watershed. Those connections among people of different generations and different backgrounds are the central point of this presentation.

### Emerald Creek Committee

The Emerald Creek watershed was named through the efforts of redwoods local Sierra Club photographer, Dave Van de Mark. Van de Mark documented the iconic sweep of the "Emerald Mile"

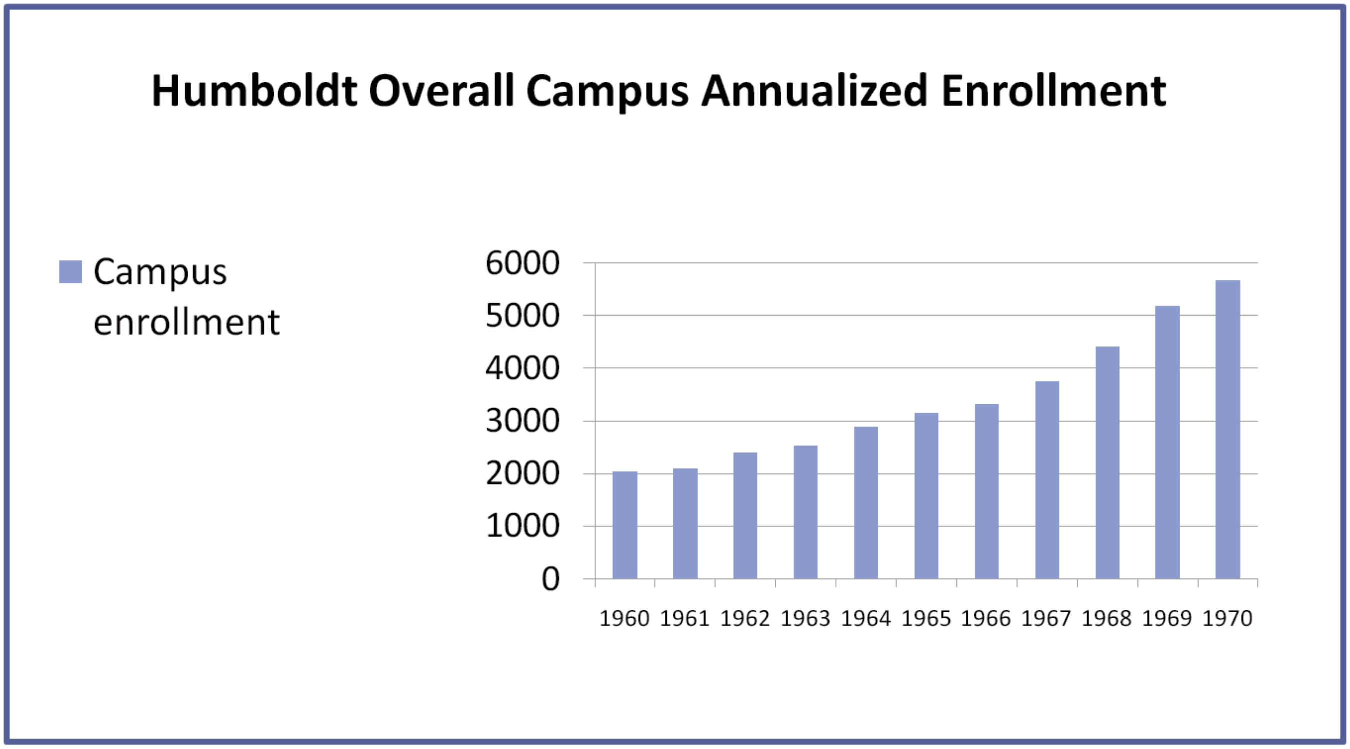


**Figure 2.** Annualized Humboldt enrollment from 1960–1970 showing increase in enrollment (source: www.calstate.edu/AS/abstract.shtml).

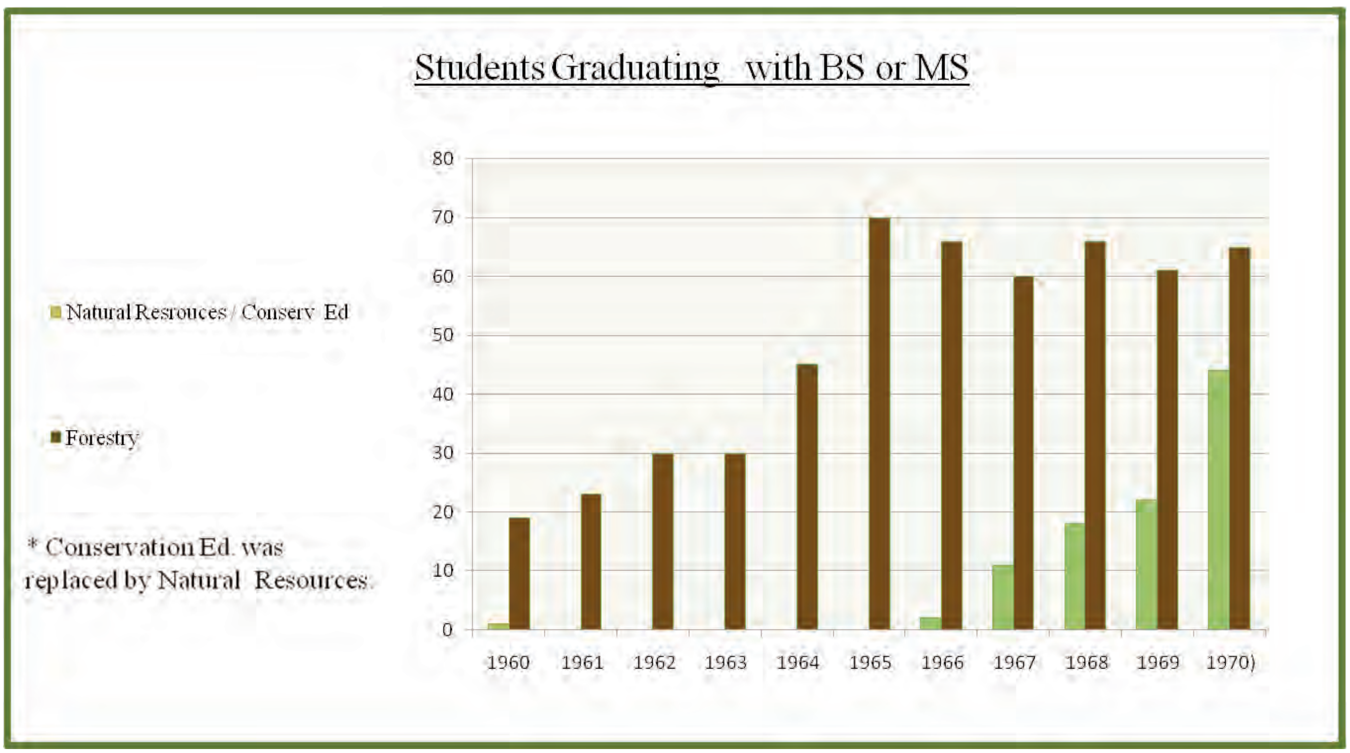


**Figure 3.** Comparison of graduates in Forestry vs. all other natural resource management programs from 1960–1970 (source: Ridenhour 2003).

redwood forest in the Redwood Creek Valley. In 1972, Humboldt Natural Resources professor Rudi Becking invited Howard King, a Save the Redwoods League photographer, to join him and students on a hike into Emerald Creek to see the trees and photograph them. This was the birth of the Emerald Creek Committee (ECC), whose purpose was to save the Tall Trees Grove, by including entire watersheds, such as Emerald Creek watershed.

Several organizations were active in protecting redwoods, but generally people were organized into loose systems of citizen-activist conservation work. Meanwhile, timber companies were emboldened and, perhaps, felt they had nothing to lose as they quickened their pace to clear-cut the few primeval forests left on steep, unstable slopes.

Documentation of the ecological destruction became an important task of local conservationists. This documentation became the story told to the general public nationwide through media contacts, as well as conservationists aligned with national organizations. Documentation required frequent hikes into the park and adjacent areas of private property where logging was progressing. Citizen activists defied trespass laws in order to give witness to the heavy loss and environmental destruction adjacent to the new park.

## Congressional hearings led by Congressman Phil Burton in Eureka

In 1977, Congressman Phil Burton held hearings on the new congressional bill to expand park boundaries. Hearings sparked unprecedented community tension. Several survey respondents commented on this event.

ECC member John Amodio: "It was perhaps the most graphic and most extreme illustration of the type of fear that turns to anger and hatred that we experienced in that whole process, and it stunned me because I knew it was building a lot of emotions and they were rallying trying to whip the community into frenzy. They spat on the mayor of Arcata who spoke for the park."

Sierra Club photographer, Dave Van de Mark: "When you have 5 goons standing around me with switchblades in their mouths and poking you in the chest saying, 'We know where you live.…'"

Local Sierra Club chapter president Lucille Vinyard who was subtly threatened with a knife recalled: "… it was the first time in my life I felt I was living in a near riot.… But we did our job."

Long work, careful study of ecological resources, lead by professors nearby at Humboldt State, photographic and personal testimony that documented ecological loss, finally combined with strong public support and political will to "fix" the problems created by the 1968 legislation.

On May 27, 1978, President Jimmy Carter signed into law the Redwoods Expansion Act adding, overnight, 48,000 acres, more than doubling the size of Redwood National Park. Some of the most significant of these acres included Redwood Creek, and the entire Emerald Creek watershed.

## Methods

**Initial surveys**. We targeted a group of current and former residents of Humboldt County, California, who were active in efforts to expand Redwood National Park during the years between the initial 1968 legislation that created Redwood National Park, and passage of the 1978 Redwood National Park Expansion Act. Surveys were sent via email to people who participated in the movement to Expand Redwood National Park who known by the authors through their actions and correspondence during the campaign to expand Redwood National Park. Surveys included requests to forward the survey to others who were involved in the activities to expand Redwood National Park in the 1970s. Respondents ranged from those who had limited involvement, to those who dedicated a majority of their time either for a few years or several decades. The initial survey generated 24 responses.

**Phone interviews**. We conducted four follow-up phone interviews with people who had been central to the effort. Two of these were active before 1968, and continued through 1978 and beyond. Two others came later, especially those worked with Emerald Creek Committee, and were active for a few years to a more than a decade.

## Findings

**Earth Day**. The First Earth Day in 1970 was an environmental "teach-in that promoted grass-roots events inspired by the oil spill that left over 4 million gallons of oil in the water and on the beaches of southern California killing over 3,500 birds and over 100 seals and sea lions" (survey respondent). The survey shows that over 93% of ECC members responding to the survey participated in Earth Day, 1970.

**Anti-war activities**. Another strong correlation was found between all respondents, who participated in anti-war movement at the time. The Anti-war movement was so pronounced in the survey respondents there was not a difference statistically in those who were members of ECC and the general respondents. The survey illustrated that almost all respondents were also involved in anti-war activities; twenty-one of twenty-four respondents indicated this type of activity.

**Participation in other social and civil rights issues**. Similarly, 87% of all respondents and 80% of ECC members were involved broadly in social movements of the time including feminist, civil rights, and gay rights.

**Youth music concerts**. Many students arriving at Humboldt in the early 1970s had participated in a wide variety of large youth-centered, music concerts that gained popularity after the phenomenon of Woodstock. This activism and spirit translated to positive ability in working to protect redwoods. However, this response was less significant, statistically. Only about 50% of all respondents attended large youth concerts, with a slightly larger proportion (60%) of the ECC members subset indicating they attended these concerts.

## What lessons can we learn?

1. Inspiration for social and anti-war peace issues, for example, can translate to environmental concern. Common narrative responses on survey forms included references to a variety of contemporary movements including, anti-war, American Indian Movement (AIM), no war taxes, native plant society, stopping the Gasque-Orleans Road through wilderness, feminist, union farm worker support, recycling, as well as founding the Northcoast Environmental Center, and formation of a new chapter for Friends of the Earth.
2. Movements can be fed by legacy work by elders or leaders, and fed by new energy—college universities have been a breeding ground (source) for that support. One survey respondent explained, "I think the outgrowth from ECC was merely our vision of that radical arm (of conservation.) Reaching out and grabbing onto something rather than what I felt as old guard which was OK sometimes with treading water. If they had not been there, before us, though, we would never have been there."
3. Citizen activism fed by a belief in right and wrong can withstand, and perhaps be strengthened by, threats. Participants in both written surveys and phone interviews indicated their anger was not directed toward the frontline loggers who had little ability to change logging plans. Participants instead blamed logging company corporate heads, stockholders and, to an extent, the National Park Service for the magnitude of the logging destruction. But participants were clear on their personal inspiration and dedication.
4. Political solutions must be fed by groundswell and personal experience. Personal testimony cannot be easily compromised by challenges motivated by political pragmatism, money

and political gain. Pragmatism is for the politicians and bureaucrats—effective conservation requires unapologetic activism. It is somewhat remarkable how some people withstood decades of scorn in small, sometimes tiny communities, where there is no way to hide, in order to promote the "better good." Local activists and national conservation leaders withstood personal threats in order to be heard.

5. Well positioned data, images, and testimony, fed by constant prodding, and even civil disobedience, can keep a spotlight on an otherwise transitory concern. Repeatedly, the surveys and interviews, as well as reference materials (e.g., Schrepfer 1983) spoke of the importance of the on-the-ground witness to, and documentation of, what was really going on behind what locals refer to as the "Redwood Curtain." Timber companies were willing to mischaracterize, or lie about, the impacts of their activities. Activists, including old guard conservationists, were willing to engage in civil disobedience to save what they considered to be an important ecological, and sometimes spiritual, resource. Van de Mar's photos, Janda's soil surveys, even National Geographic's articles, made it difficult, if not impossible, for the public and politicians to look the other way.
6. First-hand, personal experience provides strong nourishment for continued dedication to a long struggle. Local activists could readily see the destructive forces of logging near RNP. They could photograph it, pay witness to it, and take others to see it. Truth can be seen and cannot be denied by opportunists or liars.
7. It is important to recognize inspirational role models—not charismatic, but inspirational—for powering future conservation.
8. Rudi Becking was such a role model, but it is important to recognize the inherent human failures of any individual whether legislator, professor, activist or student.
9. Perhaps this current generation is ripe for that translation and spreading their firsthand experience through social media to fire up activism.

People today are not without interest in outdoor experiences. Visits to Redwood National and State Parks have grown from 34,000 in 1971 to 481,000 in 2010 and a high of 677,000 in 1988. Backcountry camping, on the other hand, service-wide, has dropped from 2,397,098 in 1979 to 1,763,541 in 2010 in spite of increased opportunities for that experience (NPS public statistics page, www.nature.nps.gov/stats/index.cfm).

How do we move beyond or incorporate the new networking technology to provide first-hand experience in testimony? We can look at a recent local example in Louisiana where cotemporary conservation activists might be thwarted in giving that testimony. The recent British Petroleum (BP) oil spill affected a large swath of the Gulf Coast. Unlike volunteer activist witnesses to redwood logging, employees paid by the responsible party (BP) for clean-up work may be contractually denied the ability to write or speak about what they witnessed while cleaning oiled beaches, birds and marine mammals. Similarly, news media indicated some researchers interested in using this once-in-a lifetime opportunity have been told by BP they must wait years before publishing their work. If Rudi Becking or Emerald Creek Committee had been paid for their work in return for silence, how could they have been successful?

An informed first-hand experience can translate to activism and commitment, however that commitment is best expressed.

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# New Horizons for Cooperative Management and Collaborative Partnerships: Redwood National and State Parks, California, 1994–2010

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The need for partnerships between national parks, state parks, other public lands agencies, and tribal governments is becoming increasingly important as federal and state agencies see reductions in funding, and increased complexity in preserving the ecological integrity of park resources. Frequently, local residents and businesses, tribal members, environmentalists, and federal and state agencies are key stakeholders within these partnerships. In 1994 Redwood National and State Parks (RNSP) initiated a cooperative management strategy to identify, develop and implement operational efficiencies that would result in improved visitor services and enhanced resource protection. The move toward cooperative management at Redwood National Park was necessary due to its unique setting: it is carved out of private property fitted around three majestic state parks, and is vulnerable to upstream land uses. Since 1994, RNSP has become an important model of agency to agency partnerships that provided a greater capacity to manage park resources and serve park visitors.

In 1923, 1925, and 1939, California established Prairie Creek Redwoods, Del Norte Coast Redwoods, and Jedidiah Smith Redwoods State Parks, respectively. In 1968, Congress established a relatively small Redwood National Park. In 1978, Congress significantly expanded Redwood National Park and included the three state parks within the national park boundary with the express idea that the state would transfer its parks to the NPS. This initiated almost two decades of resentment, stress, and turmoil between the NPS, and state parks managers, employees, and supporters.

In 1992, newly appointed Director for California State Parks Donald Murphy became involved in the issue as he sought means to deal with a major state budget problem, due to declining general fund revenues. The California Coordinating Committee on Operational Efficiencies was established by Director Murphy, and they and then NPS Western Regional Director Stanley Albright objectively evaluated the management of these parks, as well as parks in San Francisco Bay and Malibu coast areas. This committee recommended a cooperative management agreement be developed that maintained existing ownership and management responsibilities, but that

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“aligned respective staff energies to focus on common goals and agendas to maximize their effectiveness.” The committee’s report also contained several very specific recommendations including changing the name of the individual state parks and Redwood National Park to “Redwood National and State Parks.” An initial agreement for the cooperative management of the parks was signed in May, 1994, followed by renewals of the agreement in 1999, 2002, and 2007. Most, but not all, of the recommendations have been implemented.

The partnership is generally regarded as a success, but has not been and is not without its detractors and difficulties. The following are some of the successes:

- Co-location of NPS and California Department of Parks and Recreation (CDPR) senior management staff.
- Legislative expansion of NPS park boundaries to include newly acquired state park lands to allow for sharing of resources.
- Passage of legislation providing Congressional authority for the NPS to “…a cquire from and provide to the State of California, goods services …”and to allow the assignment of a Federal or State employee to “…work in any Federal or State of California lands….”
- Development, approval, and implementation of a jointly prepared and approved General Management Plan/General Plan for RNSP including completion of both state and federal environmental compliance requirements.
- Co-location of a joint of NPS & California Department of Parks & Recreation (CDPR) maintenance facility with jointly funded, built on state lands transferred to the NPS.
- Joint use of NPS GIS capabilities for mapping and data management purposes.
- Implementation of a joint agency recycling and solid waste programs.
- CDPR and NPS staff has jointly prepared a park Trail Plan that links National and State Park trail systems based on plans in the joint GMP/GP.
- A joint sign plan has been developed and implemented which provides for use of the RNSP logo for most signs.
- Implemented protocols for agency sources and contracts for procurement of materials and supplies which resulted in significant cost savings.
- Implemented a jointly developed, common lock and key system for all administrative and visitor use facilities.
- New RNSP entrance, developed area, and trail signs, jointly fabricated and installed by staff of both agencies.
- Procurement and installation of a common VOIP telephone system and computer network.
- Installation of a joint solid waste collection and disposal operation that saves about $20,000 per year.
- Trading and sharing of employees and services including NPS remodel of CDPR offices to accommodate NPS ranger staff, NPS carpentry and electrical work at CDPR Visitor Center, NPS remodeling work at CDPR historic Camp Lincoln residence. CDPR staff constructed a kitchen and comfort station and performed tree climbing, pruning and removal at NPS outdoor schools. Such work was accomplished under an agreement that produced significant savings since multiple contract change orders would have been necessary if a private contractor had been used.
- CDPR and NPS housing is used interchangeably by both required and non required occupancy employees of both agencies.
- Reduction by 40% of NPS propane gas costs at visitor and administrative facilities through use of a CDPR procurement contract.
- Sharing of CDPR and NPS storage facilities.

- All in-park training (i.e. chain saw operation, CPR/First Aid classes, etc.) is open to and frequently attended by both CDPR and NPS staff.

The character of and activities accomplished through the NPS/CDPR partnership have changed significantly from year to year. The initial phase was understandably devoted to developing support for the concept with agency staff. Over the last 16 years the parks have gone through a lot of trial and error, with a significant number of joint activities initiated and discontinued, or morphed into different arrangements, and subsequent efforts followed to form new joint operations. Personal relationships among the respective agency's management and supervisory staff plays a significant role in the level to which joint management actions are pursued and conducted. Consequently, transitions in the people filling these leadership positions have resulted in major changes in the character of the partnership over time.

In reviewing documents concerning the partnership, a list of "Lessons Learned" dating from a number of years ago was discovered, which seems just as relevant today as it was then.

### Lessons learned—keys to a successful partnership

- Developing a successful and productive partnership is a major commitment that takes significant time and energy. Partnerships require care, feeding, and continuous work.
- Don't force things. There seems to be an incubation period for acceptance.
- Buy-in from employees is critical. Building the partnership from the ground up pays off.
- Build an identity early on, and with all employees. Use all employee meetings as a vehicle to build and strengthen the partnership.
- Develop a joint vision early on. Having a previously established and agreed-upon purpose is useful during times of disagreement, challenge, or stress, and can help realign direction and priorities when necessary.
- View the partnership as a means toward jointly accomplishing bigger, longer-range objectives, not as a goal or an end to itself; common visions, missions, and objectives help assure this.
- Partners, regardless of their respective capabilities or contributions to the partnership, should be considered equal when it comes to resolving issues related to the partnership and its mission.
- Achieving equality and trust between or among partners often requires burying individual and organizational egos, and giving up "control."
- Co-locating the key partner staff enhances partnership effectiveness and success, primarily because of closer and more frequent communications and interactions.
- The evolution of partnerships in a positive direction depends heavily on the creativity and motivation of key staff.
- The administrative framework upon which the partnership is built must provide sufficient flexibility and discretion for staff to explore and pursue a wide variety of options to achieve "success." Rigid guidelines and sideboards can constrain creativity, experimentation, and adaptive management.
- Having similar or closely aligned missions between partners enhances the opportunity for success. Even with closely aligned missions, however, be alert for challenges that can come from different agency methods and cultures.
- An often unintentional but nonetheless real and unrelenting force will tend to push personnel from both partners toward conformance and consistency with agency practices and policies even when this damages the partnership. This is especially true as vacancies occur and new employees come into the partnership agencies. Constant attention, effort, and correction are necessary just to maintain the status quo.

- As staffing changes, recruit and hire those who thrive in organizations and partnerships that are doing things outside the traditional realm.
- Reward those who "get it." Joint projects developed by field staff indicate that the message is being received.
- Partners who start the relationship from scratch may have a stronger probability of success initially than partners who have coexisted for some time, and who bring a history that includes conflict or other baggage which takes time and effort to overcome.
- Partnerships ultimately succeed or fail because of the attitudes, energies, and relationships of the individuals involved, not the organizational relationships.

# Managing for Results: Parks Canada's Approach to Planning, Monitoring, and Reporting

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Parks Canada is the Canadian government's federal agency responsible for a network of protected heritage places, consisting of 42 national parks, 167 national historic sites, 4 national marine conservation areas, and a suite of other heritage-designated places. On behalf of the people of Canada, Parks Canada protects and presents nationally significant examples of Canada's natural and cultural heritage, and fosters public understanding, appreciation, and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations.

### Towards results-based management

Global trends in management include a shift towards results-based management,[1] where increasingly, programs are designed and expenditures justified by defining specific, measurable results to be achieved. Being able to attribute results to specific programs also enables a results-based approach to program manager performance evaluation, and enhances accountability for results delivered against expenditures made.[2]

The Canadian federal government has recently implemented legislation and policy designed to enhance accountability, and to shift towards results-based management. In particular, a federal Treasury Board policy[3] requires that every federal department and agency put in place specific frameworks to enable planning for, and reporting against, specific measurable results.

### Results-based management at Parks Canada

In accordance with federal policy, Parks Canada developed a program activity architecture, showing the suite of program areas in the agency and their relationship to each other, and to Parks Canada's strategic outcome, which is "Canadians have a strong sense of connection, through meaningful experiences, to their national parks, national historic sites and national marine conservation areas and these protected places are enjoyed in ways that leave them unimpaired for future generations." Broadly, these program areas represent distinct areas of policy and programming to which funding allocations are made, and against which investments are monitored. Parks Canada's program activities are Heritage Places Establishment, Heritage Resources Conserva-

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tion, Public Appreciation and Understanding, Visitor Experience, and Townsite and Throughway Infrastructure.

The policy also dictates that each government department or agency must develop a "performance management framework." The framework builds on the program activity architecture by outlining, for each program activity, expected outputs and results for which performance expectations are set. The expected results are defined as high-level outcomes related to each activity area, whereas performance expectations are specific, measurable targets with dates used to measure the extent to which results were achieved. Performance of the agency against these performance expectations is reported annually to the Canadian Parliament. Each report is subject to an independent audit in order to assess the fairness and reliability of the reported results.

**Primary outcomes.** The management of Parks Canada's protected areas is directed by several pieces of legislation and associated policies. In the "Canada National Parks Act,"[4] the maintenance or restoration of *ecological integrity* is the first priority of the minister, when considering all aspects of park management. National marine conservation areas are established under law[5] "for the purpose of protecting and conserving representative marine areas," and to provide for *ecologically sustainable use*. For national historic sites, the concept of *commemorative integrity* is the principle management objective. In all of the protected heritage places administered by Parks Canada, its mandate includes not only protection, but also providing opportunities for quality *visitor experiences*, and promoting *public appreciation and understanding*.

These concepts form the basis of monitoring programs in the agency, and are also the primary outcomes from which performance expectations are derived. For example, some of the expected results for Parks Canada's performance management framework are in Figure 1.

Some of these expected results are corporate in nature, and are delivered through the national policy function. Most, however, require results to be delivered in the field, that is, in each of the protected heritage places. Corporate-level results can only be achieved through a collective effort across the agency.

### The management planning cycle

Each protected heritage place is required by legislation to have a management plan in place within five years following its establishment, and every five years thereafter, to review the plan and

**Figure 1.** Expected results for Parks Canada's performance management framework.

**Expected Result of Program Activity: Management actions result in improvements to ecological integrity indicators in national parks, and the state of cultural resources in national historic sites is improved.**

| Performance Indicators: | Targets: |
|---|---|
| Percentage of national parks with at least one improved ecological integrity indicator | Outside of national parks in the far north with an already acceptable ecological integrity status, 80% of national parks have at least one improved ecological integrity indicator from March 2008 to March 2013 |
| Percentage of the condition of cultural resources and management practices elements of commemorative integrity rated as poor are improved | 70% of the condition of cultural resources and management practices elements of commemorative integrity rated as poor are improved within five years |

table in Parliament any required amendments. The mechanism driving results-based planning is the Parks Canada five-year management planning cycle.

In Figure 2, each element has a role to play in ensuring results-based management and planning.

**Monitoring.** Monitoring of the basic condition, or state, of each protected heritage place is an ongoing activity. Protocols have been developed to monitor and assess the condition of a suite of measures related to ecological integrity, commemorative integrity, visitor experience, and public appreciation and understanding. In addition to tracking these measures to understand the state of each place, Parks Canada tracks the effectiveness of management actions designed to improve different aspects of the state. It is this information that, through adaptive management, plays a key role in determining future management actions.

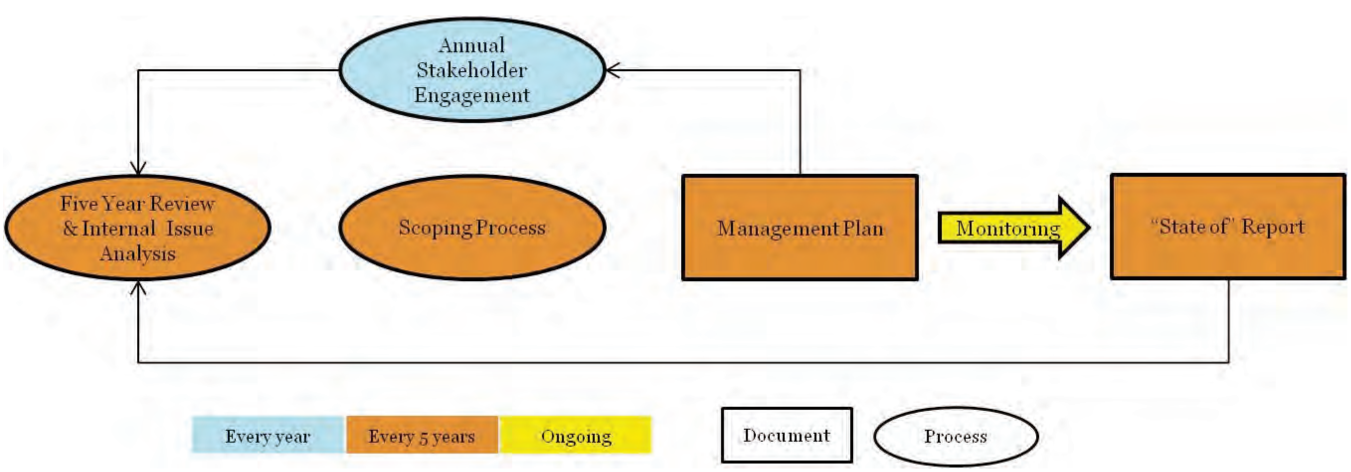
**"State of the Park/Site" reporting.** On a five-year cycle, each national park or national historic site must produce a report on the state of the protected place. The report summarizes the analysis of all monitoring data, and provides an evaluation of the condition of each aspect being monitored. Though some information is qualitative, criteria and thresholds are defined to indicate whether the state of various elements is "good," "fair," or "poor," and whether there are observable trends in condition, that is, "improving," "stable," or "declining" (Figure 3).

Based on this assessment of the condition of indicators, analysis leads to the identification of key issues facing the protected heritage place. The report also summarizes whether active management targets have been met. Examples of "State of the Park/Site" reports and the national report on the "State of Protected Heritage Areas" can be found at www.pc.gc.ca/eng/docs/bib-lib/index.aspx.

**Scoping process.** Prior to consulting the public on management plan development or review, Parks Canada officials have an internal dialogue about opportunities, issues, and challenges for the protected heritage place, and how the management planning process can be used to address them. Key intended results are identified, and the scope and scale of the planning process is agreed to. Important inputs to this discussion include the condition of the place, and the effectiveness of actions implemented in the previous management plan, as well as other factors that influence management planning, such as regional developments, and partners' expectations.

**Management plan.** The management plan is a strategic-level document that outlines a 15-year vision for the protected heritage place, and a series of strategies to achieve specific results. These are expressed as results-based objectives, which are defined along with 5-year measurable targets, and the large-scale actions that will be implemented in order to meet them. These targets

**Figure 2.** Elements of results-based management and planning.



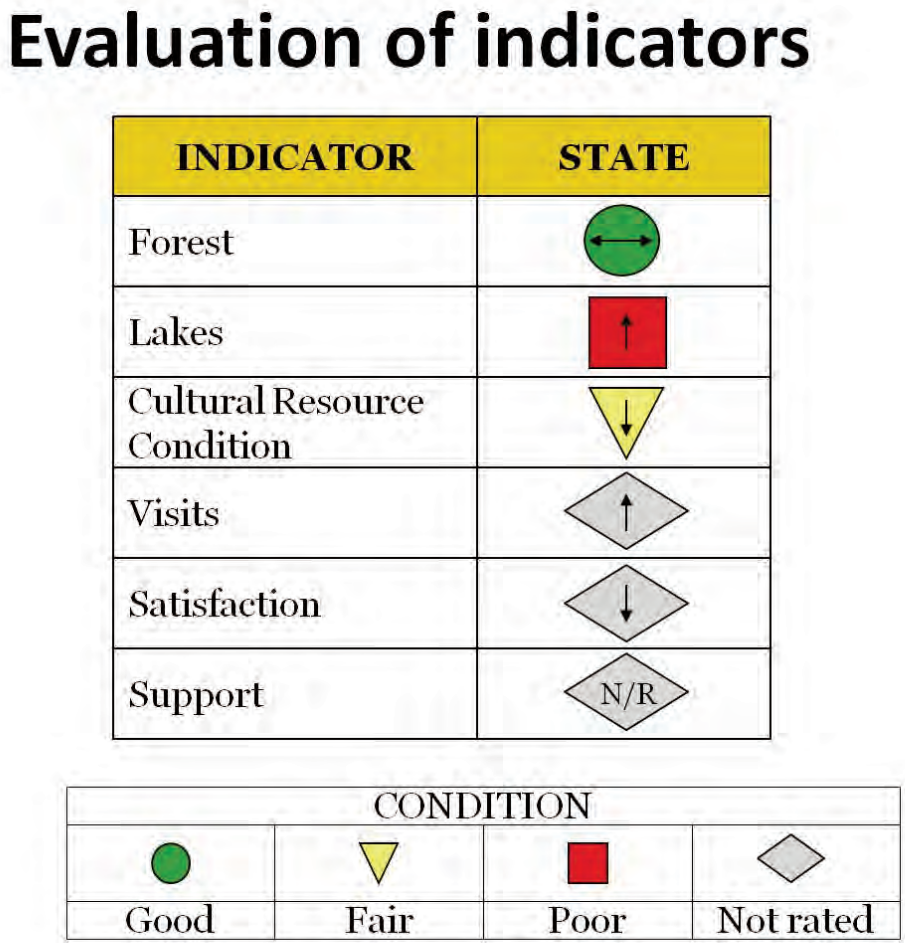



**Figure 3**. Evaluation of indicators.

in turn support adaptive management, as results are tracked on an ongoing basis and reported prior to the next plan review. Many targets will relate to improving condition, so success is measured through the ongoing long-term monitoring efforts.

### Progress to date

It is still early days for Parks Canada in terms of linking condition monitoring to planning and performance evaluation through its planning and reporting cycle. Each element of the Parks Canada mandate is at different stages of developing monitoring and assessment protocols and programs. "State of the Park/Site" information plays an important role in management plan scoping, but there is a lag in reporting the successes of previous management plans, since results-based targets are only included in the most recent generation of management plans. It will likely be another full five-year cycle before most national parks, national historic sites, and national marine conservation areas have monitoring programs that are fully implemented, and are generating monitoring data that can be meaningfully analyzed to determine changes in trends and conditions.

### Early challenges and lessons learned

As with the development of any new framework, there are challenges and lessons to be learned.

**Defining the information needs.** Ideally, at the outset of implementing such a framework,

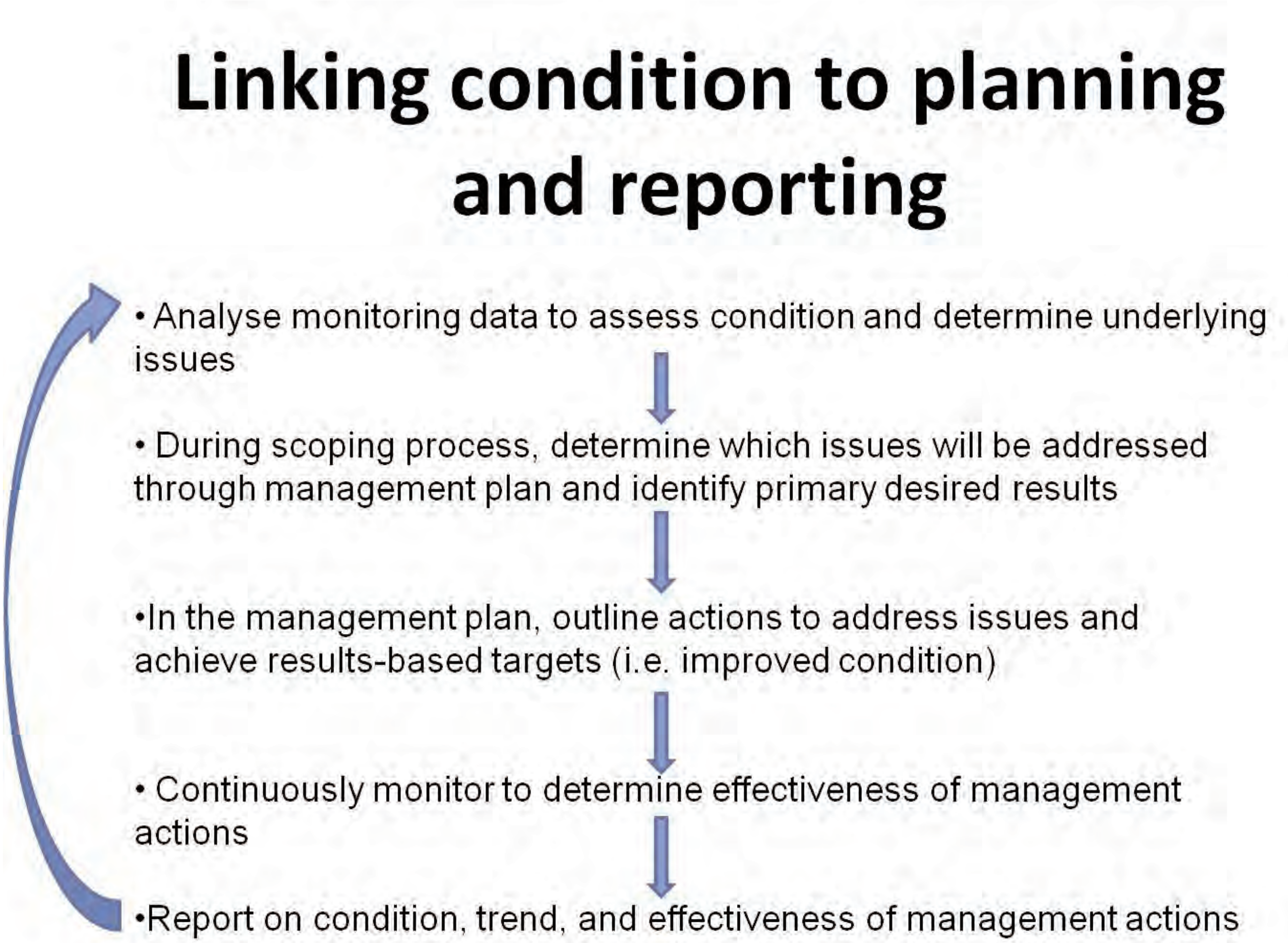



**Figure 4.** Linking condition to planning and reporting.

there would be a process to identify and clearly define key information required to answer the relevant management questions. For Parks Canada, there is a legal requirement to report on the "state" of its protected heritage places, in addition to reporting on performance. Parks Canada's efforts to report on state were fairly well established when the need to report on performance came into effect. As a result, some of the monitoring effort must be realigned, and some indicators re-examined, to identify the critical information required to support decision making, in addition to meeting "state of" reporting requirements.

**Setting appropriate performance targets.** If performance is to be tied to results, and desired results are based on the condition of a protected heritage place, then it is critical to ensure that performance expectations are clearly defined, readily measurable, and logistically, financially, and politically feasible. Many of the indicators in Parks Canada's monitoring programs can be influenced to a certain degree by concerted management actions, but are primarily determined by large-scale factors beyond the agency's control. For example, visitation levels can be influenced by concerted management action, but are affected by many other factors, such as the global economy, regional tourism trends, the strength of the Canadian dollar, the weather, etc. It is important to set targets that can be met through management actions and for which results can be attributed to those actions. Specificity and scale are important considerations.

While it is important to define longer term outcomes, it is also necessary to identify key outputs and intermediate outcomes that can be expected as a result of management actions. Parks

Canada's performance management framework is populated with results-based targets ranging from 1–5 years, but is just beginning to identify short term outputs that help to track progress on an annual basis.

**Distinguishing "state" from performance.** Parks Canada is obligated to report on the "state" of its places. Especially for ecological integrity of national parks and the ecological condition of our marine conservation areas, but also for other indicators, there will be measures that must be reported over which Parks Canada has little to no control. For example, measures of tundra ecosystem health, such as permafrost depth, are tied to global climatic change, and cannot reasonably be influenced through local management actions. Nonetheless, reporting on the health of the tundra ecosystem is important in order to be able to report to Parliament and Canadians on the overall state of our northern national parks.

It is important to clearly distinguish information related to state from that related to performance evaluation. Often performance will be related to certain aspects of state, but performance targets should be focused only on those specific aspects that can, and will be the focus of management actions, with a high probability of success. When is there no clear distinction made between performance and state, there is a danger of being wary of reporting "poor" condition ratings, based on the assumption that poor performance is somehow implied. Given the regional or global scale of the drivers and stressors acting on protected areas, there will only be certain aspects of their condition that can reasonably be maintained or improved through management actions. This is not, however, a reason to avoid objective, knowledge-based reporting on condition.

**Reconciling reporting timeframes with longer-term outcomes.** Managing complex systems is a challenge. Achieving outcomes such as improving aspects of ecological integrity, or increasing public awareness and understanding of Parks Canada's mandate, takes time. The timeframes associated with achieving meaningful results are not always compatible with reporting needs, and so results are difficult to demonstrate from one annual report to the next. The identification of intermediate outputs can help to bridge the gap.

**Seeking efficiencies in monitoring.** There are ever-increasing information needs in order to manage protected areas in a rapidly changing environment. For each area of management at every scale in Parks Canada, reliable information is required to inform decision-making. Yet resources are finite and increasingly scarce, and monitoring and reporting are only a few of the many demands on operational budgets. In designing performance targets, every effort should be made to use existing monitoring metrics to evaluate performance. There are challenges related to scale, where actions have local impact but condition is reported on a larger scale. Nonetheless, the results of management actions should be detectable through existing monitoring programs. If this is not the case, then a parallel monitoring effort needs to be made to measure the effectiveness of management actions, or else it is impossible to determine whether results have been achieved as a result of efforts undertaken. This latter scenario is problematic for evaluating success and demonstrating value for investments made.

Seeking efficiencies is also important in terms of cost-effectiveness. Long-term monitoring programs have been typically vulnerable to budget cuts, and so it is wise to design them to be able to withstand budget constrictions.

**Information management and availability.** Monitoring information has little or no value if it is not analyzed and made available to those who require it for decision making. Following the implementation of monitoring programs and integrating them into the management planning cycle, Parks Canada is now focused on ensuring that data gathered is regularly analyzed, entered into central databases, and made available to decision makers as useful information. Another area for improvement is to align monitoring and reporting protocols with the timing dictated by the five-year management plan cycles for each protected heritage place, in order to ensure that decision-making is informed by the most current information available.

## Conclusion

The move to a results-based management approach presents numerous challenges and opportunities.[6] Parks Canada, per the requirement for all Canada government departments and agencies, has identified a measurable strategic outcome that unites collective efforts towards a singular vision. As programs evolve, and a clearer understanding is gained of the state of the protected heritage places, and the effects of the efforts to achieve targeted outcomes, Parks Canada will be better positioned to serve Canadians through protecting, presenting, and providing opportunities to experience Canada's natural and cultural treasures in a manner that leaves them unimpaired for future generations.

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# Project Planning and Data Dictionary Design: Keys to Successful GPS Data Collection

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## Abstract

THE FIRST STEP TO SUCCESSFUL GPS DATA COLLECTION IN THE FIELD IS PROJECT PLANNING AND data dictionary design. Completion of these components allows surveyors to conduct a focused survey that returns the needed data and reduces costly field time. This discussion will cover aspects of planning and executing a successful GPS project. Project planning addresses the use of GPS as an additional tool to efficiently collect data in the field in order to populate a GIS. Topics include assessing the purpose and data needs of the project, data scale and accuracy, feature attributes, and data dictionary development, as well as best survey practices.

## Project planning

The first step, project planning and data dictionary design, allows surveyors to conduct a focused survey that returns the needed data and reduces costly field time. Also, the additional costs of post-processing and editing are minimized due to tailored data collection. The use of GPS as a tool to efficiently collect data in the field in order to populate a GIS is addressed in project planning. There are four steps that are key in planning a successful project; deciding on the purpose of the project, writing a project description, defining the level of accuracy needed, and determining data needs.

Projects can be broken down into three basic types; those meant to collect baseline data of resources, those designed as a specific application to answer questions about the resources, and projects that are a combination of the two. The baseline inventory project operates as an overview of resources. In this type of project, data reflects many types of features with more generalized and broad attributes about those features. Even though there may be no specific application for this type of database, it is often used as a base of context for more focused projects.

Projects designed for a specific application look at resources in a more focused way. These databases contain limited, targeted features with specific attributes. Often because of the lack of base data, a project must include components of an inventory-type project in order to be able to develop and apply the application project.

A project description explains the purpose of the project, any analysis to be completed, methodology to be used, data needs, deliverables, time and money budgeted, and the infrastruc-

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ture, staff, software, and hardware needed to complete the project. Any analysis required should be spelled out in detail in the project description. The analysis and deliverables will directly inform the data needs and scale.

The purpose of the project and the type of analysis being completed are the primary variables influencing the scale of the data, but they are not the only factors. Usually baseline inventory data is collected at a scale that is comparable to existing base maps. These will vary according to organizational standards and the size of the area involved. Collecting highly accurate data to be used with small-scale base data, such as 1:25,000 maps, would not be cost effective. Data at this level of accuracy may very well be available from numerous other sources. Analysis that is being completed on a regional level requires data at a smaller scale. But if the project area is compact, such as a site plan, or consists of unique features not normally publicly available data, then a site visit for larger-scale GPS data collection may be the most appropriate mans of collecting needed data.

Once the data needs are determined and specified in the project description, and the required accuracy is established, then data availability can be investigated. Geographic information is available from many sources; digital databases may already exist for your study area. Prime sources for publically available data are the United States Geological Survey, U.S. Census Bureau and ESRI ArcGIS Online. Collecting GPS data is costly, both in time and money. Not only do you have field time to consider, but also the added burden of post-processing the data. Using GPS to populate the GIS database should be considered only if the data is not already available at the accuracy and specificity needed.

If it is determined that GPS data collection is necessary, then a project-specific data dictionary should be developed. A data dictionary is a list of features to map, and the attributes of those features that will be recorded. It serves as a guide to the surveyor in the field. Capturing too much data can result in complex maps which are hard to read and analyze, and can incur unnecessary expenses. Conversely collecting too little GPS data can lead to incomplete maps and faulty analysis.

### Data dictionary design and development

There are numerous ways to build a data dictionary: you can build it in the GPS-specific software, such as Trimble Pathfinder Office; it can be replicated in a ESRI GeoDatabase structure; a GeoDatabase can be built in the GPS Analyst extension in ArcGIS and convert it into a data dictionary; you can use GPS Analyst to convert a data dictionary into a GeoDatabase; other software packages, such as CartoPac, etc., can be used and custom forms for phone and tablet applications can be utilized.

There are three steps in developing and building a data dictionary: identify the features to observed and mapped, determine the attributes to be recorded for each feature, and test the data dictionary. When looking at the features to map, the features should be divided into two categories, target features and reference features. The attributes collected for each will differ. Target features are those that are specific to the application, and the feature attributes collected need to be project specific. Reference features provide context and quality control, so the attributes can be more generalized. For example the location of artifacts collected in an archeological survey would be the target features. But roads, trails, and fence lines added to that map would help archeologists re-locate the artifacts, providing a context for the location of the artifacts. Reference features, such as hills and streams would allow analysis of the artifacts in a landscape context.

All features must be a line, point, or polygon. The decision of what option to select is dependent upon the intended use of the data, and the scale at which it will be displayed. All features have an area, but due to accuracy and scale issues, it is not always efficient to map polygons (the only option that has an area) for all features, when a point or line would do. It would be use-less to record buildings as polygons for a small-scale, region-wide project, but if you are mapping for facilities management, using a point to represent a parking lot may not work out if the maintenance department needs to calculate the cost of repaving.

Once you have identified the features needed to meet the project objectives, you then need to specify which attributes are project oriented. You should only use attributes that are recognizable in the field, are observable and readily understood. You should limit target feature attributes to those that address the project, be sure attribute values are objective, avoid over-reliance on vague assessments (e.g., "good," "fair," "poor"), and make sure values are distinct from each other. Always have a unique identifier for all of the target features. And most importantly, when developing a data dictionary, make sure that the field surveyors are familiar with the resources being mapped. If you are recording architectural details on structures, do not send a herpetologist.

Attribute values can be recorded in numerous formats; menus, pick lists, radio buttons, image icons, numeric, text, and auto-generated formats like dates and times. In addition, certain functions, such as auto incrementing, can be programmed into the data dictionary. With formats such as menus, pick lists, radio buttons, you can standardize choices, reduce input errors, and make the data easier to query. But these formats are less flexible, although this can be mitigated by allowing multiple choices, and must be well thought out. If the surveyor runs into something unexpected in the field, then they are out of luck. On the other hand, text and numeric boxes are very flexible and responsive to the unexpected and unanticipated conditions. They can be hard to query due to spelling and case errors. Often the best data dictionaries are a combination of both of these formats, contain values such as 'other' or 'unknown,' and contain a text box for comments.

I look at a data dictionary as iterative. I often expect to revise them, by adding and subtracting features, attributes and attribute values, and refine them, by going from the extraneous to the essential, the subjective to the objective, and the vague to specific.

This is an era of shrinking budgets, manpower shortages, and ever tightening controls on travel expenditures. Following these simple guidelines for project planning and data dictionary design will help stretch project budgets by maximizing the efficiency of time spent in the field, and limiting the amount of data that needs post-processing and editing.

# The Misbehaving Spring: Studying Unique Underground River Flow Patterns with Advanced Middle School Science Students

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## Abstract

Scientists have long known that the spring for one of Mammoth Cave's primary underground rivers will sometimes "misbehave." This "misbehavior" takes the form of a stable reverse flow pattern that brings surface water into the cave instead of taking cave water out to the surface. Although interesting, little research has been conducted on this phenomenon, or its possible impacts to the cave ecosystem. In 2009, the Mammoth Cave International Center for Science and Learning and a local middle school science class embarked on a research project that monitors the unique flow pattern of this underground river and its spring. This paper presents a case study of that project and includes information about developing the project with the students, the students' surprising discoveries, and things we learned along the way. We also offer suggestions, based on our experiences, for others interested in working with students to conduct research.

## Introduction

Mammoth Cave is the world's longest cave and is the center of one of the world's most highly studied karst regions. However, even with the intense scientific research that has occurred there, Mammoth Cave still holds many mysteries. The River Styx, one of the cave's major underground rivers, is one example of those mysteries.

Under normal circumstances, the River Styx flows underground to the River Styx Spring, through the River Styx Spring, and to the surface, where it joins the Green River (Figure 1, a). Herein is the mystery—sometimes the River Styx will flow backwards. When this happens, surface water from the Green River enters the spring and flows into the River Styx causing it to flow backwards and jump the drainage divide between it and Echo River, another underground river. The water then flows out Echo River Spring, and back into the Green River (Figure 1, b). This reverse flow pattern is a stable one, and appears to be tied to the level of the Green River. Scien-

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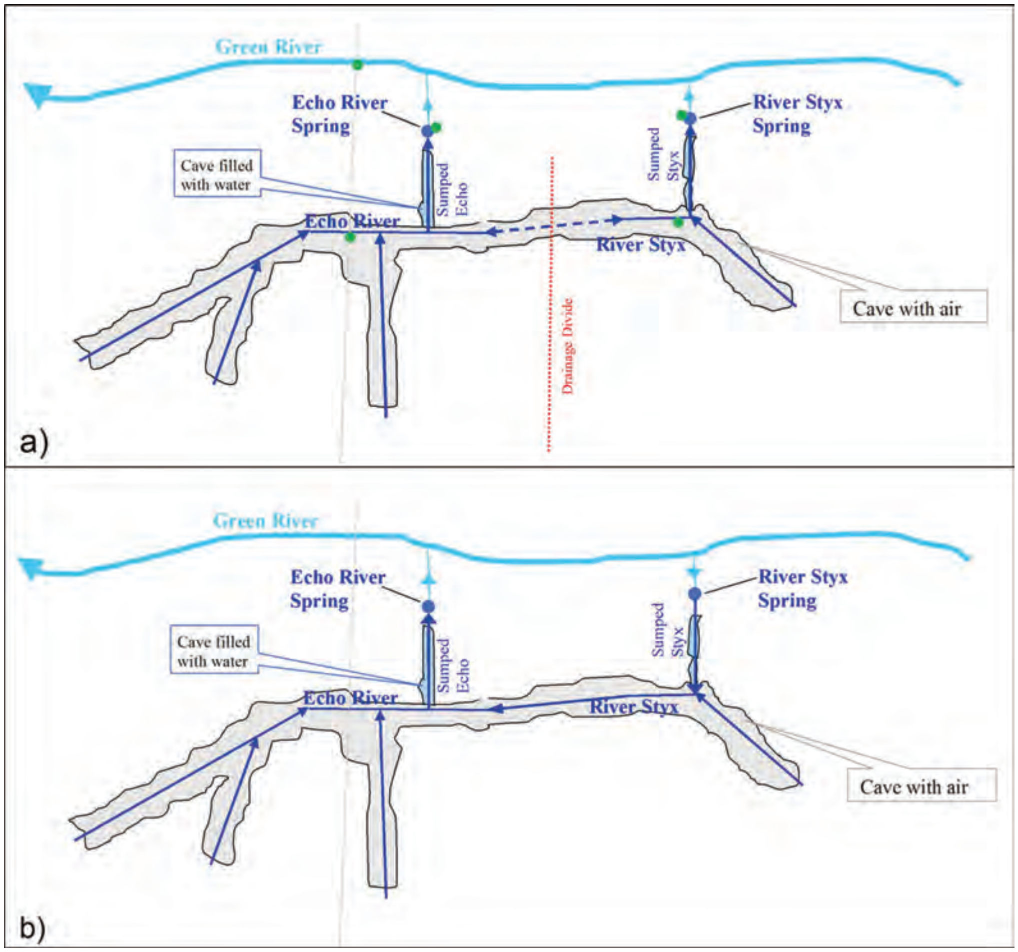


**Figure 1.** The River Styx flowing in its normal direction (a) and in its reverse flow pattern (b). The green dots in Figure 1a show the locations of the data loggers associated with this project. The drawings are diagrammatic only and are not made to scale.

tists have known about this phenomenon for decades, but have conducted very little research on it.

In the summer of 2009, Ms. Kim Weber, TK Stone Middle School's seventh grade science teacher, contacted the Mammoth Cave International Center for Science and Learning (MCICSL). She was interested in opportunities for her students to conduct research at Mammoth Cave National Park. MCICSL staff suggested the River Styx's reverse flow pattern as a potential study subject. A full understanding of the mysteries behind the River Styx's reverse flow pattern will likely encompass complex geological and hydrological studies. However, even basic information, such as the minimum and maximum water temperatures for the River Styx, or the frequency and duration of the reverse flow pattern, is unknown.

Because most of Mammoth Cave, including its underground rivers, remains a relatively constant temperature year-round, the students could easily begin gathering data on the frequency and duration of the reverse flow patterns by monitoring the water temperature in the River Styx. Under normal flow conditions, the River Styx's water temperature, like the air temperature in the cave, should remain relatively stable throughout the year. However, when the River Styx is in its reverse flow pattern, the Green River brings warm surface water into the cave during the summer, or cold surface water into the cave during the winter. Water temperature, therefore, could serve as a proxy during most of the year for determining which direction the River Styx was flowing. Also, since the students would be monitoring water temperature to determine flow direction, they could easily use that data to determine the minimum and maximum water temperatures during their study period.

Although this basic information is only a small piece of the puzzle, it is a piece that the students could tackle, and one that could provide a valuable starting point for future, more complex studies. Ms. Weber and MCICSL staff were especially excited about this research topic because it meant that the students would be conducting real scientific research, and would be at the forefront of research on the topic. Resource managers, scientists, and educators would all be learning about the reverse flow pattern alongside the students. The students' work has generated a considerable amount of excitement among people interested in Mammoth Cave, and the hydrology of the Mammoth Cave drainage basins.

### Materials and methods

In late summer 2009, Ms. Weber, Ms. Trimboli, Education Program Specialist at MCICSL, and Dr. Toomey, Research Director at MCICSL, applied for and received a research permit from Mammoth Cave National Park. This is an ongoing research project and is currently in its second year. The students have been involved in all aspects of the research, including data collection in the field, analyzing the data in the classroom, and presenting their results.

When school began in the fall of 2009, Ms. Weber and Ms. Susan Ryan, TK Stone's Coordinator for Gifted Education, identified the incoming seventh grade students who were considered either gifted or high achieving in science. MCICSL staff went to TK Stone to meet the students and introduce them to the project. The students were divided into two groups, and each group was scheduled to visit the park to work on the project. A similar process was repeated in the fall of 2010 when the next set of incoming seventh grade students arrived.

The field research began in October 2009 when the students arrived to install five sets of HOBO waterproof data loggers. One set of data loggers was installed at each of the following locations: the River Styx (in cave), River Styx Spring (surface), Echo River (in cave), Echo River Spring (surface), and the Green River (surface) (Figure 1, a). Each set of data loggers consisted of two identical data loggers that served as backups for each other. Before being deployed, the data loggers were programmed to record water temperature once every two hours.

Each year the students visit Mammoth Cave two to four times to download data from the data loggers. MCICSL staff accompany the students, assist them with any necessary maintenance to the data loggers, and convert the data into an Excel spreadsheet after returning from the cave. MCICSL staff then visit TK Stone Middle School to teach the students how to use Excel for data management, graphing the data, and visually analyzing the data (Figure 2). Later the students analyze the data, draw conclusions from their results, and present their findings to classmates, students at other schools, community members, and professional audiences.

### Results

Data analysis is ongoing, and all results are considered preliminary. However, the students' research has resulted in some surprising findings. Echo River (in cave) remains a relatively constant 13.5 to 14.5°C year-round, while the water temperature in River Styx (in cave) varies greatly. The students have recorded temperatures in River Styx as low as 3.6°C and as high as 20°C. These are much greater temperature extremes than resource managers and scientists would have predicted. The River Styx also appears to go into its stable reverse flow pattern more frequently than previously suspected.

### Conclusions

Everyone involved with this project believes it is highly beneficial from both scientific and educa-

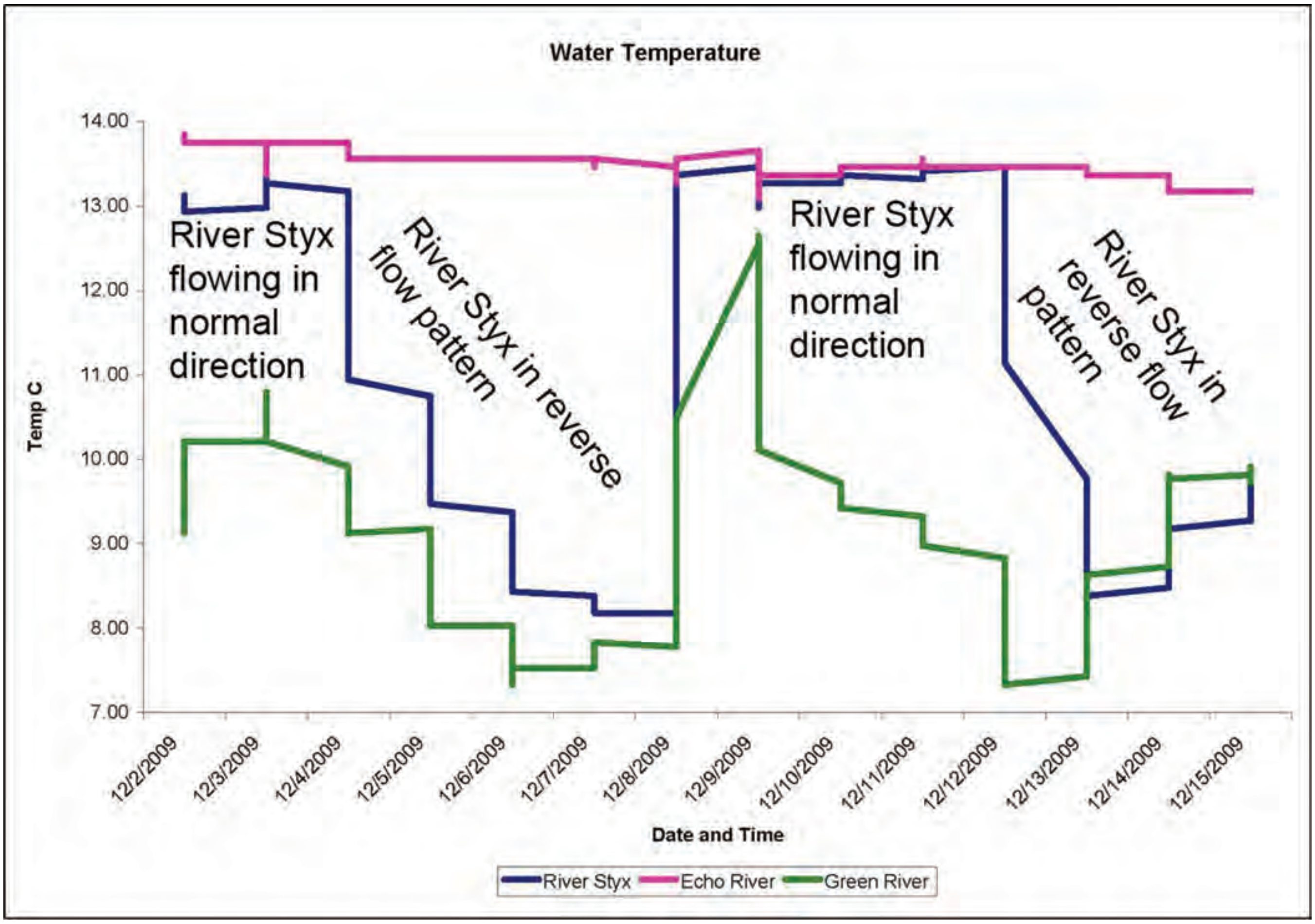


**Figure 2.** Graph of River Styx (in cave; blue line), Echo River (in cave; pink line), and Green River (surface; green line) water temperatures during a two week period in December 2009. Annotations are provided on the graph to show how the students visually interpret the data by comparing the River Styx water temperature to that of the Green River and Echo River.

tional viewpoints. Scientifically, the project is important because the changes in water temperature associated with the River Styx's reverse flow pattern could impact geological, archeological, and biological resources found within the surrounding cave passages. Also, as precipitation patterns are altered due to climate change, the frequency and duration of the reverse flow patterns will likely change. The students' data provide resource managers and scientists a baseline against which future changes can be compared.

Educationally, the project is important because the students involved don't just learn about science, they become scientists. Through this project, they learn to think and act like researchers. They learn that in real research, things don't always work out as planned. Through their research the students learn valuable critical thinking, technology, public speaking, and leadership skills.

We look forward to continuing this project; however, no project is without its challenges. Below is a discussion of some of the challenges we have run into, lessons we have learned along the way, and suggestions we would make to others considering starting a research project that includes students.

## Challenges

**Limited time.** The students can only come to the park a few times a year, and only for a few hours at a time. We have to work around school schedules, testing dates, snow days, etc. They also have limited time for data analysis in their classrooms. Of course, we always want more time and think about how much more we could do if we only had it. However, much can be done in a limited amount of time so the lack of more time shouldn't be used as an excuse for not doing a project.

**Fieldwork logistics**. The students are conducting real scientific research and collecting real data, and thus have to deal with the challenges that come with fieldwork. This can be a new experience for them. Each spring, the students have hiked two miles into the cave to find that Echo River was flooded, and they were not going to be able to download the data. Instead, MCICSL staff would have to come back later and gather the data for the students. Major floods have washed away data loggers and summer droughts have left the data loggers hanging in midair instead of in the water. It can be tempting to try and "fix things" for the students, but learning that fieldwork is not always easy, that it comes with unique challenges, and that scientists have to learn how to deal with those challenges, are important lessons. It also ensures that the project remains a real research project, instead of becoming more of a controlled science experience.

**Lack of funding.** Initially, Ms. Weber obtained a grant from Dow Corning to purchase five data loggers. Mammoth Cave National Park loaned the project five additional data loggers, so that each site could have a pair of data loggers. We are currently seeking additional funding to replace some of the original data loggers, and potentially expand the project.

### Lessons learned

**Always allow extra time.** Everything takes more time than expected. As we walk to our field sites, we encourage the students to observe their surroundings and ask questions. The students love the fact that we will stop and talk about the things in which they are interested, and they always have lots of questions. It is common for us to take over two hours to hike two miles, and then make the return trip in 45 minutes. It is evident that the students remember what we talked about, because students that come later in the year eagerly ask about things that earlier groups of students saw on their trips. This shows us that the extra time we spend with the students is time well invested.

**Expect a lot from the students; they'll live up to your expectations.** We give the students ownership of the research project, and involve them in all steps of the scientific process. If they arrive at Mammoth Cave in "field trip mode," we simply remind them that they are there as scientists and researchers, not students, and there is an immediate change in behavior and attitude. When they return to the classroom, they become the leaders as they share their experiences and research with the rest of the seventh grade science students. In addition to the science, math, and leadership skills that they gain through this project, the students also gain technology and public speaking skills through virtual presentations to students at other schools, and through attending and presenting at professional conferences.

**Maintaining good communication is important.** This point is true for any project, but becomes even more important for conducting research with students. It is important to make sure that park and school administration knows what the students are doing, what they are finding, and even the "just cool, fun stuff" associated with the project. Also, since MCICSL staff are at Mammoth Cave more often than the students, MCICSL staff pass information along to the teachers (and thus to the students) about interesting observations made when the students aren't able to be there to make the observations themselves. The teachers have also set up an online discussion site for the students. Using a Moodle interface (similar to the Blackboard interface used by many universities), the students are able to read comments and discussions from previous students, discuss the research and other interesting things they encountered during the field work, and share pictures. The teachers have also posted related articles and videos for the students to read and watch.

**Drop the jargon, sometimes.** We are working primarily with gifted students who often enjoy learning new vocabulary. However, like anyone else, they can become bored if we use too many technical terms or use them too often. We try to create a balance between challenging them with technical terminology (like "hydrology") and using less technical words or phrases that convey the same meaning (like "how the water flows"). Sometimes even substituting words like "mysteries" or "puzzles" for words like "scientific investigations" and "research" can make the project more appealing and "fun-sounding" for the students. This lesson is probably more important for students who may not be as interested in new vocabulary words.

**Have fun!** Probably the most important lesson of all is to simply have fun! If you are having fun, then the students will too. Allowing the students to discover that they can have fun while learning and conducting research is probably the most important lesson they can learn.

# Transit in the Parks: The Role of Foundations and the Private Sector

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## Introduction

ADDRESSING TRANSPORTATION ISSUES CONTINUES TO BE A MAJOR CONCERN AT MANY NATIONAL parks. Congested roads, overcrowded parking lots, exhaust fumes, and vehicles blocking scenic vistas all detract from the park experience. Working with local and state partners, the National Park Service (NPS) has implemented new shuttle bus services and other improvements to address these issues and to enhance visitor experiences. Foundations and the private sector are playing key roles in planning, funding, and promoting these new transit services.

This paper examines the support that foundations and the private sector are providing in planning, implementing, and operating the bus services at Acadia National Park, Zion National Park, and Colonial National Historical Park. Common themes are highlighted and applications to other parks are described. This paper is partially based on a report prepared by the author on a National Cooperative Highway Research Program project.[1]

The remainder of this paper is divided into three sections. The case studies are presented next, focusing on the roles of foundations and the private sector in supporting transit services at the three national parks. The common themes emerging from the case studies are highlighted in the third section. The paper concludes with a discussion of areas for additional research.

## Case studies

**Acadia National Park.** Acadia National Park comprises some 40,000 acres along the coast of Maine, including Mount Desert Island and other islands. Concerns arose in the 1980s about the ability of the carriage roads, small parking lots, and other facilities to accommodate the ever-increasing number of visitors and vehicles. The potential for an area-wide bus system was assessed as part of the park's general master planning process. A transit system concept was defined, but not pursued, until the local communities expressed interest in the concept as a way to address growing traffic and parking congestion in the area.

Initiated in 1999, the Island Explorer bus service represents the coordinated efforts of Acadia National Park, the Maine Department of Transportation (MaineDOT), the Mount Desert Island League of Towns, Friends of Acadia, Downeast Transportation, local businesses, the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). L.L.

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Bean became the single corporate sponsor in 2002, providing significant financial resources for the system. The Island Explorer has expanded over time, serving both visitors and residents, and the partners continue to work together on additional improvements, including Acadia Gateway Center in Trenton, Maine.

Planning for the Island Explorer built upon the experience with a campground shuttle bus operated in the mid-1990s. A two dollar fare was charged for the campground shuttle, which was operated by Downeast Transportation. In response to survey results indicating more people would ride the campground shuttle if it was free, Friends of Acadia provided funding to subsidize the service, allowing for free service in 1997. Ridership on the campground shuttle increased by 600 percent during the first year of free service.

Park staff took the lead in the planning process, working with other partners. Acadia National Park continues to play a key role in funding the service, and working with other partners on improvements. MaineDOT assisted with planning the Island Explorer service, facilitated federal funding for the system, and provided state funding. MaineDOT continues to provide ongoing operation support through the allocation of FTA 5311 funding. MaineDOT is the lead agency in planning and developing the Acadia Gateway Center in Trenton.

The four towns on Mount Desert Island—Bar Harbor, Southwest Harbor, Mount Desert, and Tremont—and the surrounding communities of Trenton, Lamoine, and Cranberry Island collaborate as the Mount Desert Island League of Towns. The League implemented the Island Explorer service. In addition, the local communities support ongoing funding for operating the service. The communities have also participated in locating transit centers, stops, and other system elements. Tremont is a key partner in the development of the Acadia Gateway Center.

Downeast Transportation is a non-profit transit provider based in Ellsworth, Maine. Downeast Transportation operates the Island Explorer. Downeast Transportation is responsible for all aspects of operating and maintaining the Island Explorer bus system. In addition, it provides commuter, shopping, and shuttle services in the region.

Founded in 1986 as a 501(c)(3) non-profit charitable organization, Friends of Acadia has played an instrumental role in the development and ongoing operation of the Island Explorer bus system. Representatives of Friends of Acadia were actively involved in planning and implementing the system. The organization, which has approximately 3,500 members, has provided $1.6 million in ongoing financial support for the Island Explorer through donations and other methods.[2]

Friends of Acadia played a key role in securing private funding for the service. It facilitated the initial $1 million donation from L.L. Bean in 2002 to support the Island Explorer, and to establish the L.L. Bean Research Fellowship, and Kids in Acadia programs. Friends of Acadia also facilitated additional contributions from L.L. Bean, which now total $2.25 million. In 2004, the organization secured a three-year option to purchase 369 acres at Crippens Creek in Trenton for the Acadia Gateway Center. Friends of Acadia acted on its option in 2007 and acquired the property. Since Acadia National Park cannot purchase land outside the established park boundaries, the action of Friends of Acadia was critical to develop the Gateway Center.

L.L. Bean is an outdoor apparel and equipment company based in Freeport, Maine. Founded in 1912, L.L. Bean has grown from a one-man operation to a global business, with annual sales of $1.5 billion. With close to 3 million annual visitors to its store in Freeport, L.L. Bean and Acadia share honors as the most popular destinations in the state. Initially announced as its 90th anniversary gift to the state, the sponsorship of the Island Explorer and other programs reflects the company's values to promote recreation and sound stewardship of the nation's natural resources, and their corporate consciousness to help address local issues.

L.L. Bean became the sole corporate sponsor of the Island Explorer in 2002, and reaffirmed this commitment in 2005. The company's contributions have reached $2.25 million for the

Island Explorer, Research Fellowship, and Kids in Acadia program. Island Explorer buses display the L.L. Bean logo, and L.L. Bean promotes its support of the bus system on its webpage, catalogues, and other marketing materials. The funding from L.L. Bean has been used to extend service later in the fall, to introduce a bicycle express service, and to match federal funds.

Implemented in the summer of 1999, with eight propane buses operating on six routes, the Island Explorer links hotels and businesses with key destinations in the park. A seventh route was added in 2000, and nine additional buses were purchased. With funding from L.L. Bean, the operating season was extended from Labor Day to mid-October in 2003. An eighth route serving the Schoodic Peninsula was introduced in 2004. The Bicycle Express was added in 2005, providing service between Bar Harbor Village Green and Eagle Lake, using a 12-passenger van and a bicycle trailer.

Ridership on the Island Explorer has grown from 142,000 passengers in 1999, to approximately 405,000 riders in 2008. By 2009, 3 million riders had used the service.[3] The system averages some 4,980 passengers per day during the peak season, with the highest one-day total of 8,440 riders. In addition, the bicycle express transports over 12,000 bicycles during the summer.

Acadia National Park and its partners in the Island Explorer continue to consider service improvements, and opportunities to enhance the overall operation of the system. The Acadia Gateway Center in Trenton, which is under construction, will include the Acadia National Park transportation information center and an intermodal hub.

**Colonial National Historical Park.** Colonial National Historical Park occupies a peninsula between the James and York Rivers in Virginia. The three colonial settlements of Williamsburg, Jamestown, and Yorktown, which provide visitors with an understanding of the British colonial experience, represent major sites in the park. The 23-mile Colonial Parkway links these three sites, known as the Historical Triangle.

In the late 1990s and early 2000s, traffic congestion during peak visitor times, and limited parking at many sites, focused attention on possible transit alternatives in the park. Construction of the new Jamestown Visitor Center, which removed 150 parking spaces from a 300-space lot and resulted in visitors parking in undesignated areas, increased the need for transit service in the park. The 400th anniversary celebration of the settlements in 2007, and the expected high-volume of tourists, further supported consideration of transit alternatives.

A pilot seasonal shuttle bus system, the Historic Triangle Shuttle, was implemented in 2004. The Colonial Williamsburg Foundation operates the service, which is provided on two routes that originate at the Colonial Williamsburg Visitor Center and use the Colonial Parkway. One route provides service to Jamestown and the other route serves Yorktown. Both routes connect to local shuttle bus systems in Jamestown and Yorktown.

The Historic Triangle Shuttle represents a partnership among the Colonial National Historical Park, the Colonial Williamsburg Foundation, the Williamsburg Area Transit Authority, and Preservation Virginia. Other partners include York County, the Jamestown-Yorktown Foundation, and the FTA.

Colonial National Historical Park took the lead in the planning process for the shuttle service with assistance from other partners. The park conducted a feasibility study, developed a plan, and completed an environmental assessment. It also led the effort to develop and submit the request for the new Jamestown Visitor Center, which included funding for the purchase of the shuttle buses and operation of the service until 2010.

The Colonial Williamsburg Foundation operates Colonial Williamsburg, a 300-acre historic area with restored, reconstructed, and historically furnished buildings. The Colonial Williamsburg Foundation operates and maintains the Historic Triangle Shuttle through an annual cooperative agreement with the park. The Foundation also provided the 20 percent local match for the FTA funds.

The Williamsburg Area Transit Authority (WATA) operates the Williamsburg Trolley and other bus routes within its service area. Representatives from WATA were involved in the planning process for the Historical Triangle Shuttle. The WATA purchased the Historic Triangle Shuttle buses with FTA funding. It owns the buses and leases them to the Colonial Williamsburg Foundation.

Ridership on the shuttle has increased since the pilot was initiated in 2004. Approximately 67,520 passengers rode the shuttle in 2006. In 2007, which marked the 400th anniversary for the historic sites, ridership on the shuttle was approximately 172,200. In 2008, ridership declined to approximately 101,520 passengers.[4]

**Zion National Park.** Zion National Park encompasses 229 square miles of cliff-and-canyon landscape in southwestern Utah. Springdale is the gateway community for the park. Traffic congestion on the six-mile dead-end road in the main canyon, and a lack of parking led to the consideration of transit options in the 1990s.

A free shuttle bus system has been the only means of transportation for summer visitors to Zion Canyon since 2000. Buses traverse the roadway from 6:30 a.m. to 9:30 p.m., providing access to hiking trails, scenic view points, and Zion Lodge. Overnight guests at Zion Lodge are the only visitors allowed to drive private vehicles on the roadway.

A second shuttle bus route serves the gateway community of Springdale. The two routes connect at the Zion Canyon visitor center allowing passengers to transfer between the two loops. Additional parking spaces were constructed at the center as part of the shuttle bus system. Frequent service, averaging every six minutes or less during peak times, is provided on both loops, using propane-powered buses and trailers.

Ridership on the shuttles has increased since 2000. In 2001, some 2.13 million trips were made on the shuttles. In 2008, 3 million trips were taken on the shuttle buses. It is estimated that visitors on the Canyon Loop average three to four trips a day on the shuttle.[5]

Planning, funding, and implementing the shuttle system in the park and Springdale represent the coordinated efforts of Zion National Park, the National Park Service's Denver Service Center, Springdale, the Utah Department of Transportation (UDOT), FHWA, Zion National History Association (ZNHA), local businesses, and other groups. Zion National Park purchased the shuttle buses with McDonald Transit Associates, Inc. to operate the service. Springdale obtained federal Transportation Enhancement program funds through UDOT for the bus shuttle stops and related streetscape improvements, which were matched by city and ZNHA funds.

Established in 1929, the ZNHA is a non-profit organization supporting education, research, publication, and other programs for the benefit of Zion National Park, Cedar Breaks National Monument, and Pipe Spring National Monument. ZNHA supported the shuttle project and contributed to the local match for the federal enhancement funds. The ZNHA provides information about the shuttle on its website, along with energy-saving transportation tips.

Zion Canyon Theater, which is located adjacent to the park, was an early partner in the planning process. The ultimate project used private funds to construct the town shuttle loop northern terminal, a camper store and restaurant, and tour bus parking area. These improvements directly connect to the park visitor center, providing a park and gateway community link. Other local businesses participated in the planning process, and continue to be actively involved in supporting the shuttle system and the Springdale Loop.

### Common themes

A number of common themes emerge from the three case studies. First, the case studies highlight the importance of partnerships. These partnerships involve the parks, federal, state, and local governments, and local foundations, organizations, businesses, and corporations. It takes time to establish trust and build strong working relationships among these diverse groups. This time is well spent, however, and is critical to the ongoing success of transit services in the parks.

Second, the case studies illustrate the important role foundations play in supporting transit services in the parks. These organizations can undertake and facilitate many activities that parks and other government agencies cannot. Foundations can also help in fund raising, managing funding from other sources, and purchasing property. Third, although not all parks have an L.L. Bean in their backyard, involving the business community is important to obtaining support, and possibly funding, for transit projects.

Finally, the case studies highlight the importance of leveraging resources and expertise. Given budget constraints at all levels of government and the sluggish economy, innovative financing and maximizing funding from multiple sources is critical. Leveraging staff resources and expertise among agencies and groups is also important.

### Additional research

The three case studies presented in this paper also highlight areas for further research. First, examining the experience with transit systems in other national parks and federal lands would be beneficial to further explore the role of foundations and the private sector.

Second, examining additional roles for foundations and the private sector would be of use. This analysis could include identifying additional techniques for leveraging resources and maximizing funding from multiple sources.

### Endnotes

1. Texas Transportation Institute and Cambridge Systematics, Inc., Innovative Transportation Planning Partnerships to Enhance National Parks and Gateway Communities, National Cooperative Highway Research Program Project 8-36, Task 83 (Washington, DC, October, 2009).
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4. National Park Service, Colonial National Historical Park, Public Transportation, www.nps.gov/colo/planyourvisit/publictransportation.htm.
5. National Park Service, Zion National Park, Zion Canyon Shuttle System, www.nps.gov/zion/planyourvisit/zion-canyon-shuttle-system.htm.

# Dead Wood Relative to Slope Severity in Mesic Loess Bluff Hardwood Forests

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### Abstract
To aid in identification of land within Vicksburg National Military Park that was subjected to forest restoration during the 1930s, I evaluated the hypothesized relationships between maximum live tree diameter or dead wood (standing and down) and severity of slope. Disproportionate mortality among early-successional, pioneer tree species suggested maturation of pioneer upland hardwood forests. As such, input and decomposition of dead wood have likely approached equilibrium. Thus, I did not detect a useful predictive relationship between dead wood (standing or down) or maximum diameter of live trees and severity of slope. Lack of relationships between slope and large diameter trees or volume of dead wood resulted in an inability to evaluate former land use based on these parameters.

### Introduction
The Mississippi Valley Loess Plains physiographic region extends about 750 km along the eastern edge of the Mississippi Valley (Figure 1; Omernik 1987). This region is distinguished by deep (15–60 m) fertile soils comprised of silt-sized sediments, likely of eolian origin. The loess bluffs along the western edge of this region (Figure 1) are well-drained but prone to severe erosion, such that locally abundant rainfall has produced a severely dissected, rugged topography of great relief on a diminutive scale (Caplenor 1968).

Although historically vegetated by mesic hardwood forests, the primeval climax forests have been largely lost (Delcourt and Delcourt 1974). Post-European settlement, nearly all areas have been subjected to timber harvest, many of which were subsequently converted to agriculture. The extant hardwood forest continues to be impacted by erosion, exurban encroachment, conversion to pine forest, and invasion of exotic plants. Even so, some pockets of 'old-growth' forest remain, particularly in areas with steep-sided gullies that are not suitable for cultivation, and where timber harvest is difficult (Davis 2003). Throughout this loess plain, some areas converted to agriculture have been abandoned, often spurred by severity of erosion, and subsequently returned to hardwood forest (Taylor 2010). Within Vicksburg National Military Park, at the western fringe of the loess bluffs (Figure 2), active forest restoration via tree planting was undertaken by the Civilian Conservation Corps during the 1930s to combat excessive erosion (NPS 2009). Although

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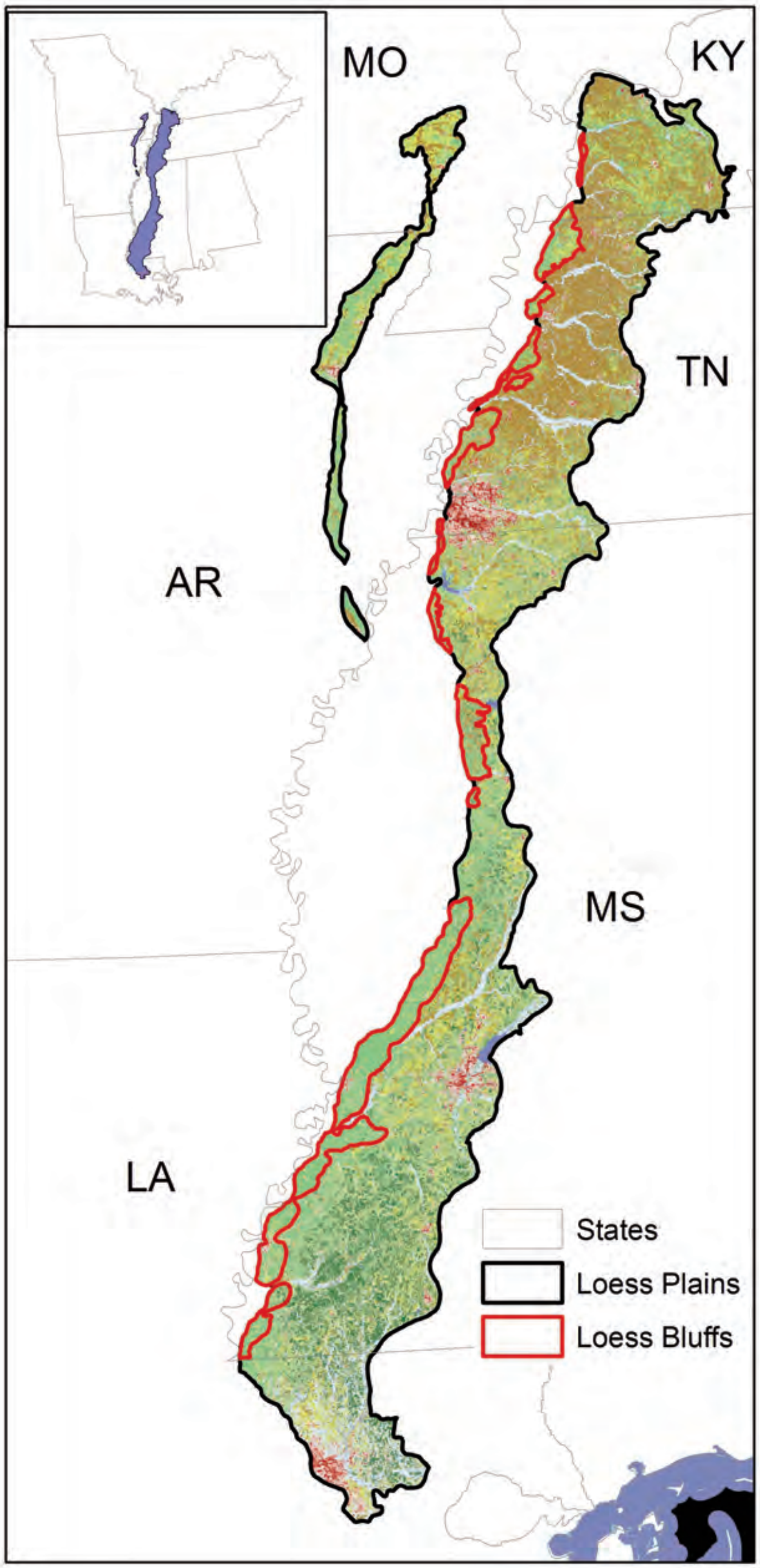


**Figure 1.** Mississippi Valley Loess Plain ecological region (Level III; Omerik 1987) and Loess Bluffs (Level IV) along the western edge of the eco-region.

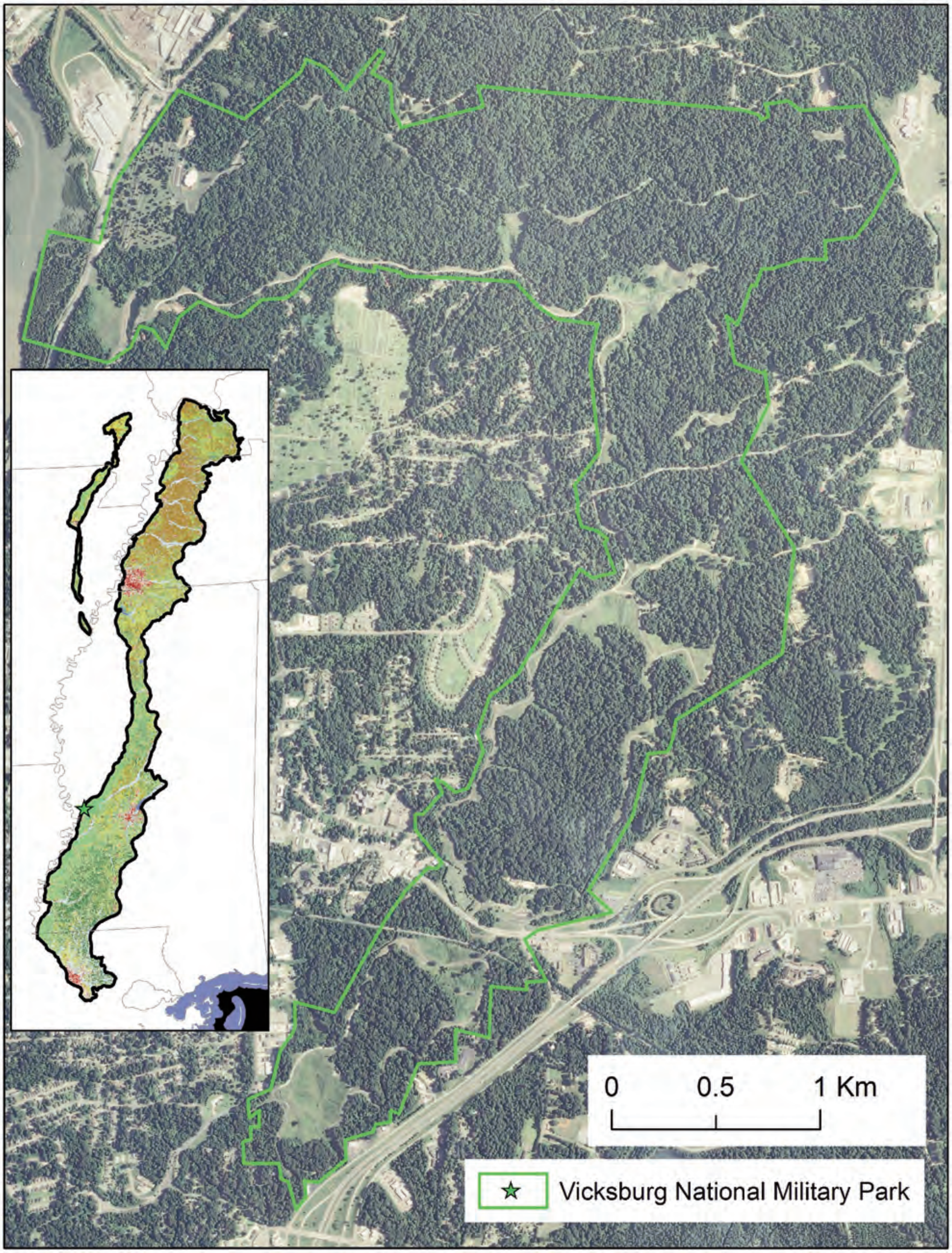


**Figure 2.** Forest and non-forest land cover within Vicksburg National Military Park depicted on 2010 U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP) aerial photograph.

historical records are sparse, these forest restorations were not undertaken to restore antebellum forest compositions, and likely introduced selected species disproportionate to their natural occurrence.

The primary management objective of Vicksburg National Military Park is to preserve and commemorate the historic Civil War battlefield. As such, despite ubiquitous pre-settlement forest vegetation, transformation of forest land cover to open land cover, as was present during Civil War military campaigns, is being undertaken to maintain the park's cultural landscape (NPS 2009). However, the entire battlefield is not slated for landscape transformation, but rather specific locales that enhance interpretation of battlefield conditions, and that provide visitors with suitable viewscapes that portray historic campaigns. Thus, one of the key recommendations of the park's Cultural Landscape Report was to remove woodland so as to approximate historic patterns of open landcover within areas of key military engagement (NPS 2009). Identification of these areas would benefit from knowledge of the history of Civilian Conservation Corps (CCC) tree planting so as to determine the exact locations of forest restoration projects and their scope. As such, identification of site plans, photographs, or written descriptions confirming the nature, location, and extent of plantings would be valuable (NPS 2009).

Unfortunately, historical records that document forest restoration within this park are incomplete. Therefore, I sought to exploit a hypothesized linkage between severity of slope and propensity to retain forest cover (Davis 2003) to evaluate the usefulness of the ecological record for identifying areas that historically were denuded of forest cover. For example, Sturtevant et al. (1997) found that coarse woody debris in boreal forests accumulated asymptotically until decomposition rates began to equal input rates, at circa 80 years post disturbance. This 80-year time horizon roughly corresponds with the time elapsed since the aforementioned 1930s tree planting by the CCC.

To characterize the historical distribution of forest clearing within Vicksburg National Military Park, I evaluated the relationship between steepness of slope and maximum diameter of live trees, density and volume of standing dead trees (a.k.a., snags), volume of down dead wood (DDW), and total volume of dead wood (down or standing). My hypotheses were that areas with steeper slopes would not have been deforested, and would therefore have larger diameter trees and a greater volume of dead wood than areas with more moderate slopes. Secondarily, I hypothesized that snag density would be less on steeper slopes due to greater soil erosion at these sites, which destabilizes root systems of standing dead trees.

## Study area

Vicksburg National Military Park is about 7,300 hectares nearly entirely within the Mississippi Valley Loess Plains (Figure 2). Forest land cover comprised about 80% of the area: non-forest cover was maintained through periodic mowing or burning (Figure 2; Somershoe et al. 2006). Forest cover was predominately mixed mesophytic hardwoods. Sweetgum (*Liquidambar sytraci - flua*), water oak (*Quercus nigra*), elms (*Ulmus* spp.) and sugarberry (*Celtis laevigata*) were common canopy species, but composition and survival of naturally colonizing species generally reflected topography. For example, large tulip poplar (*Liriodendron tulipifera*) were present in moist ravines, whereas dominant cherrybark oak (*Q. pagoda*) and chinquapin oak (*Q. muehlenbergii*) were common on slopes and ridges (Table 1).

## Methods

At 150 random locations in Vicksburg National Military Park, during 2008 through 2010, I assessed species, diameter at breast height (dbh), basal area (BA), and height (m) of live woody vegetation and snags (≥10 cm dbh) using 1-$m^2$ Basal Area Factor (BAF) prism plots (Avery and Burkhart 2002). Similarly, species (if discernable), mid-point diameter, and length (m) of dead down wood (≥6 cm mid-point diameter) were assessed within 1-$m^2$ BAF plots (Bebber and Thomas 2003). Volume of dead down wood was calculated as the product of basal area (BA) and length (Harmon and Sexton 1996). Snag volume was the product of BA and height, adjusted for tree taper, using a form factor of 0.91 (Hilt 1980). Within superimposed 10 m radius fixed area plots, I quantified snag density and maximum diameter of live trees. I used an inclinometer to determine slope (degrees) in each cardinal direction, from plot center to 10 m (plot edge): maximum slope was the greatest absolute (+) slope, whereas mean slope was the average absolute slope among the 4 quadrants. Rarely, dramatic topographic relief within 10 m was not identified by inclination from plot center to 10 m radii. I used linear regressions to examine relationships between measured forest variables and severity of slope.

### Results

I censured data from 30 plots that were primarily non-forested, because mowing or burning restricted accumulation of down dead wood. On the other 120 plots where forest predominated, density of snags per hectare (ha) was 38.5 ± 4.4 (SE; range = 0–255), volume ($m^3$/ha) of dead down wood was 43.1 ± 3.2 (range = 0–242), and total volume of deadwood (DDW + snags) was 63.1 ± 3.7 (range = 0–249). Maximum diameter (cm) of live trees within 10 m was 61.2 ± 2.3 (range = 17–132). Mean slope was 10.4 ± 0.6 degrees (range = 1–41), with maximum slope of 18.6 ± 0.9 degrees (range = 2–56).

Linear regressions failed to detect any significant relationship between severity (mean or maximum steepness) of slope and maximum tree diameter ($F \leq 1.58$, $p \geq 0.21$, $R^2_{adj} \leq 0.01$), volume of down dead wood ($F \leq 2.96$, $p \geq 0.088$, $R^2_{adj} \leq 0.02$), density of snags ($F \leq 2.83$, $p \geq 0.095$, $R^2_{adj} \leq 0.02$) or volume of snags ($F \leq 1.98$, $p \geq 0.162$, $R^2_{adj} \leq 0.01$). Total volume of dead wood (DDW + snags) was positively related to mean slope ($F = 4.36$, $p = 0.04$), but the relationship was poor ($R^2_{adj} = 0.03$; Figure 3). Quadratic regression for volume of dead wood improved model fit ($F = 5.43$, $p < 0.01$), but the relationship to mean slope remained poor ($R^2_{adj} = 0.07$).

### Discussion

Within the mesic hardwood forests of Vicksburg National Military Park, severity of slope appears to be a poor predictor of deadwood volume. Thus use of deadwood volume to predict areas of forest restoration is not justified. I suspect that the approximately 80 years since forest restoration was undertaken has provided sufficient time for establishment of equilibrium in rates of deadwood input and decomposition within newly established forests. Therefore, forests in areas that were not cleared have similar accumulation of deadwood as forest areas that were historically cleared. Alternatively, deforestation during the Civil War era may have been so widespread that most of what is now Vicksburg National Military Park was open land. If so, our sampling regime may have been insufficient to capture those few areas of relictual native forest.

The 52 species of trees greater than or equal to 10 cm dbh identified within surveyed plots confirmed the mixed mesophytic nature of forests within this park (Table 1). Although diverse in species composition, succession and maturation of restored forests within Vicksburg National Military Park was evidenced by the high proportion of standing dead trees that were 'pioneer' tree species, such as *Juniperus virginiana*, *Robinia pseudo-acacia*, *Gleditsia triacanthos*, *Sassafras albidum*, and *Salix nigra* (Table 1). Conversely, the paucity of *Magnolia grandiflora* (n = 6), *Fagus grandifolia* (n = 2), *Ilex opaca* (n = 0), and *Q. alba* (n = 2) within sample plots suggests these forests are not representative of primeval loess bluff forest as described by Delcourt and Delcourt (1974). Thus, the current forests within Vicksburg National Military Park should likely be characterized as an old pioneer forest, because although the forest is relatively young, the pioneer species therein are relatively old (Runkle 1996).

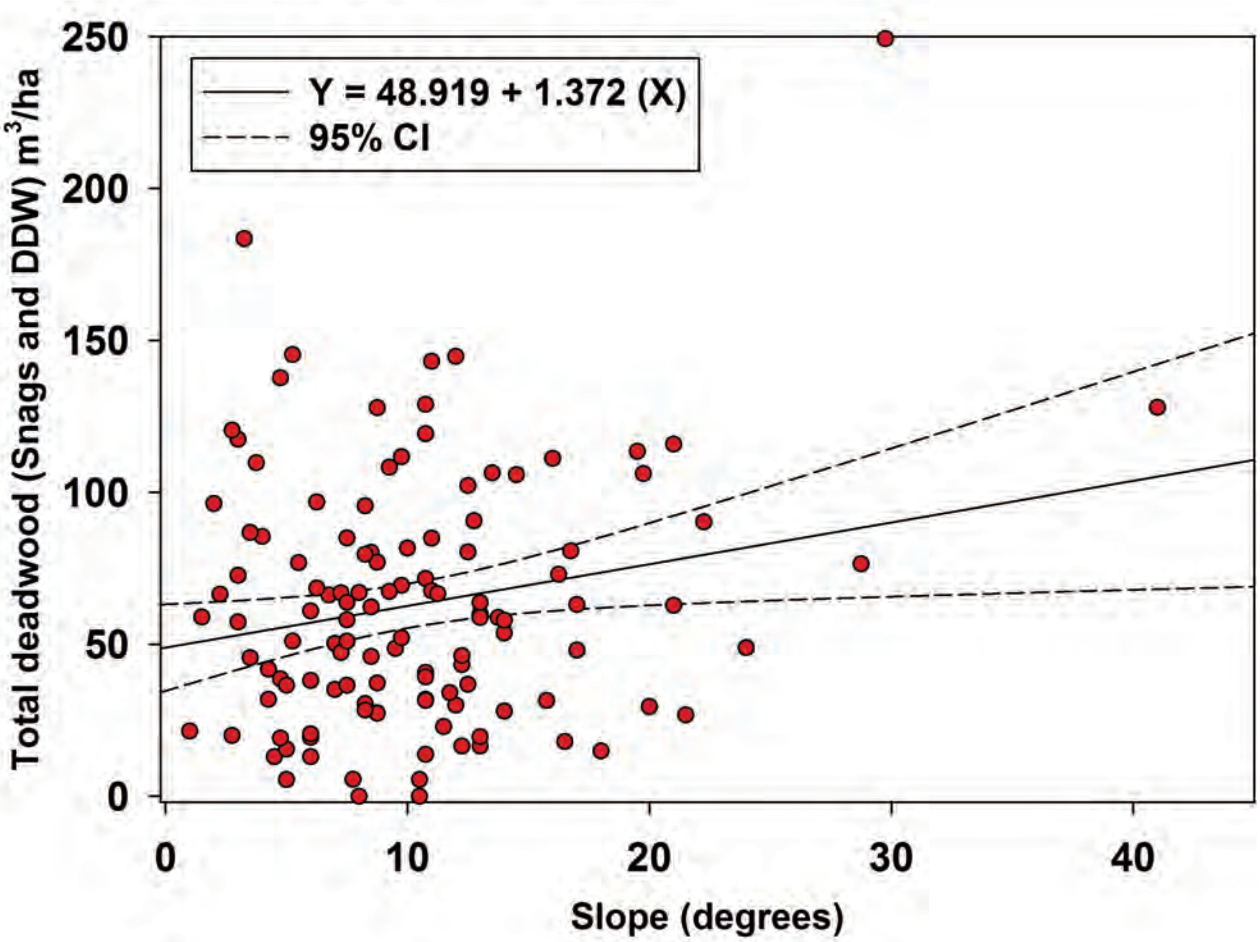


**Figure 3.** Poor ($R^2_{adj}$ = 0.03) relationship of total volume of dead wood (standing and down) and severity of slope assessed at 120 random forested locations within Vicksburg National Military Park, 2008 to 2010.

Desired forest conditions for priority wildlife species within bottomland hardwood forests are describes as having coarse woody debris (>25 cm diameter) volume that exceeds 14 $m^3$/ha, and standing dead or stressed trees >25 cm dbh should exceed 15 stems/ha, or >0.9 $m^2$ BA/ha (Wilson et al. 2007). Although these desired forest conditions were proposed for bottomland forests, evaluation of data from the mesic bluff forests within Vicksburg National Military Park suggests that standing and down dead wood exceed recommended conditions. That is, after limiting to snags and DDW >25 cm diameter, density (15.6 ± 2.4 snags/ha) and basal area (1.5 ± 0.1 $m^2$/ha) of snags exceed recommended forest conditions. Similarly, the 22.8 ± 2.2 $m^3$/ha volume of coarse woody debris >25 cm diameter exceeded desired forest conditions.

## Conclusions

Disproportionate mortality among early-successional tree species suggests maturation and senescence of pioneer upland hardwood forests within Vicksburg National Military Park. As such, input and decomposition of dead wood are likely approaching equilibrium. Forest maturation and equilibrium of dead wood generation and decomposition likely contributed to my inability to detect a relationship between dead wood and severity of slope. Lack of relationships between slope and large diameter trees or volume of dead wood, resulted in an inability to evaluate former land use based on these parameters.

**Table 1**. Species, percent basal area of identified[a] trees >10 cm diameter at breast height (%_all), and percent basal area of each species comprised of dead trees (%_species_dead) based on live (n = 3047) and standing dead (n = 237) trees surveyed on 120 forested, 1-$m^2$ basal area factor prism plots within Vicksburg National Military Park, Mississippi, 2008–2010.

| Species[b] | %_all | %_species_dead |
|---|---|---|
| *Liquidambar styraciflua* | 15.31 | 3.73 |
| *Quercus nigra* | 14.14 | 6.79 |
| *Acer negundo* | 10.53 | 6.55 |
| *Ulmus americana* | 8.52 | 7.39 |
| *Celtis laevigata* | 8.25 | 2.18 |
| *Liriodendron tulipifera* | 4.98 | 2.41 |
| *Quercus pagoda* | 4.83 | 3.73 |
| *Robinia pseudo-acacia* | 4.11 | 30.66 |
| *Carya illinoinensis* | 3.15 | 7.62 |
| *Quercus muehlenbergii* | 3.12 | 2.88 |
| *Platanus occidentalis* | 2.07 | 7.25 |
| *Morus rubra* | 1.83 | 3.28 |
| *Ostrya virginiana* | 1.71 | 7.02 |
| *Prunus serotina* | 1.50 | 10.00 |
| *Sassafras albidum* | 1.38 | 23.91 |
| *Juniperus virginiana* | 1.20 | 55.00 |
| *Ulmus alata* | 1.14 | 13.16 |
| *Carya cordiformis* | 1.11 | 5.41 |
| *Prunus caroliniana* | 0.99 | 0.00 |
| *Fraxinus americana* | 0.84 | 10.71 |
| *Quercus velutina* | 0.69 | 0.00 |
| *Gleditsia triacanthos* | 0.66 | 22.73 |
| *Tilia caroliniana* | 0.66 | 4.55 |
| *Cercis canadensis* | 0.57 | 0.00 |
| *Ligustrum sinense* | 0.54 | 0.00 |
| *Populus deltoides* | 0.36 | 8.33 |
| *Broussonetia papyrifera* | 0.36 | 0.00 |
| *Pinus taeda* | 0.36 | 0.00 |
| *Acer barbatum* | 0.33 | 0.00 |
| *Juglans nigra* | 0.30 | 0.00 |
| *Salix nigra* | 0.27 | 44.44 |

[a] Species of 46 snags could not be identified and are not included in percentages.

[b] 20 additional species accounted for <5% of total basal area within surveyed plots.

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# Geology of National Parks Modules for the Spreadsheets Across the Curriculum Library

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## Introduction

The National Park Service (NPS) Natural Resource Challenge provides an opportunity to promote the teaching of quantitative literacy (QL) in the undergraduate curriculum. At the same time, it provides an opportunity to illustrate for students that geology in the parks comprises not only captivating interpretive stories behind the parks' informative rocks and magnificent scenery, but also a body of knowledge useful to parkland stewardship. With those thoughts in mind, our Geology of National Parks Collection for the online Spreadsheets Across the Curriculum (SSAC) Library aims to add environmental geology to the traditional Geology of National Parks course and infuse it with student exercises to do foundational math in context. We make use of NPS inventory and monitoring data where we can, and we are kept on course by collaborators and advisors from the NPS network of research learning centers.

## Background

*Mathematics and Democracy: The Case for Quantitative Literacy* (Steen 2001) is an argument for an educational focus on the kind of concepts and skills required for us to function in "a world awash in numbers" (p. 1). Also known as numeracy (Madison and Steen 2008) and characterized as a habit of mind, QL is the opposite of math avoidance. In concept, QL is one of the dimensions in which students can improve by taking general education (non-major) science courses in college. To achieve QL in these courses, students must do math in them—what mathematics educators call doing "math in context." Geology of national parks is one such general education science course; nationally, it is a particularly popular one, because it is about our national parks. In short, Geology of National Parks, the course, provides the opportunity for students to do math in the context of *America's Best Idea* (Duncan and Burns 2009).

The SSAC Library was initiated with a National Science Foundation (NSF) Division of Undergraduate Education (DUE) grant (NSF DUE 0442629) to develop and populate an online repository of "spreadsheet modules" to support undergraduate college courses at the intersection

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of mathematics and context—i.e., for mathematics educators wishing to bring context to their math classes, and for non-mathematics educators wishing to bring mathematics to their courses. "Spreadsheet modules," very briefly, are elaborate word problems, short PowerPoint presentations (15–20 slides) that students work through to answer one or more questions posed in context. In working through the module, students are introduced to the context, they consider what math is relevant, and then build or expand a spreadsheet to carry out the plan, which can be one or more calculations, or one or more graphs. Thus the students climb aboard three mutually-reinforcing learning curves: the context of the word problem, a little math that solves it, and some spreadsheet work that does the math. The result of the initial grant was a collection of 55 modules touching 26 different Library of Congress categories. The modules were created by 40 authors from 21 institutions in 11 states. For more information about the collection, the modules, and the project, see Table 1 and Vacher and Lardner (2010).

### The Geology of National Parks Collection and course

The 55 modules of the initial SSAC project are housed in the General Collection of the SSAC Library. The SSAC Library now contains two additional collections: the Physical Volcanology collection (9 modules), developed for an advanced undergraduate course of that title at the University of South Florida (USF) and Pennsylvania State University (Penn State), and the Geology of National Parks Collection being developed in the current project, "Geology of national parks: spreadsheets, quantitative literacy, and natural resources" (NSF DUE-0836566).

The Geology of National Parks Collection consists, so far, of 22 park-oriented modules (Figure 1) and two tutorials. Figure 2 lists the titles of the 24 completed modules, 17 of which are online. The other seven completed modules are in final review and editing stages (April 2011), and three more are being written as part of the present project. Eighteen modules were prepared from learning experiences at eight research learning centers:

- Old Growth Bottomland Forest Research and Education Center (Congaree National Park)
- Great Lakes Research and Education Center (Indiana Dunes National Lakeshore)
- Appalachian Highlands Science Learning Center (Great Smoky Mountains National Park)
- Greater Yellowstone Science and Learning Center (Yellowstone National Park)
- Crown of the Continent Research Learning Center (Glacier National Park)
- Pacific Coast Science and Learning Center (Point Reyes National Seashore)
- Mammoth Cave International Center of Science and Learning (Mammoth Cave National Park)
- Urban Ecology Research and Learning Alliance (Washington DC).

The modules of the Geology of National Parks Collection are designed for the online Geology of National Parks (GNP) course taught by Judy McIlrath at USF. GNP is included in the list of approved physical science core courses that students may choose to satisfy their requirements in the Foundations of Knowledge and Learning Core Curriculum, which itself is under the purview of USF's General Education Council. To qualify for approval, the course must engage the students in learning activities, in addition to the usual information transfer. Over the years, GNP has augmented the study of the text *Parks and Plates* (Lillie 2005) with 10 to 12 writing exercises and virtual field trips as the additional learning activities.

With the development of the spreadsheet modules for the course, GNP has been trading out as many as six of the old activities for new modules. The six that are being used in the course for the spring 2011 semester are the following:

| | |
|---|---|
| Spreadsheets Across the Curriculum | |
| http://serc.carleton.edu/sp/ssac_home/index.html | Home page for the project |
| http://serc.carleton.edu/sp/ssac/index.html | The pedagogy |
| http://serc.carleton.edu/sp/ssac_home/design.html | Module design |
| http://serc.carleton.edu/sp/ssac_home/general/examples.html | Access to General Collection |
| Geology of National Parks Collection | |
| http://serc.carleton.edu/sp/ssac/national_parks/index.html | Home page for collection |
| http://serc.carleton.edu/sp/ssac/national_parks/GNP_modules.html | Access to collection |

**Table 1.** Links to more information.

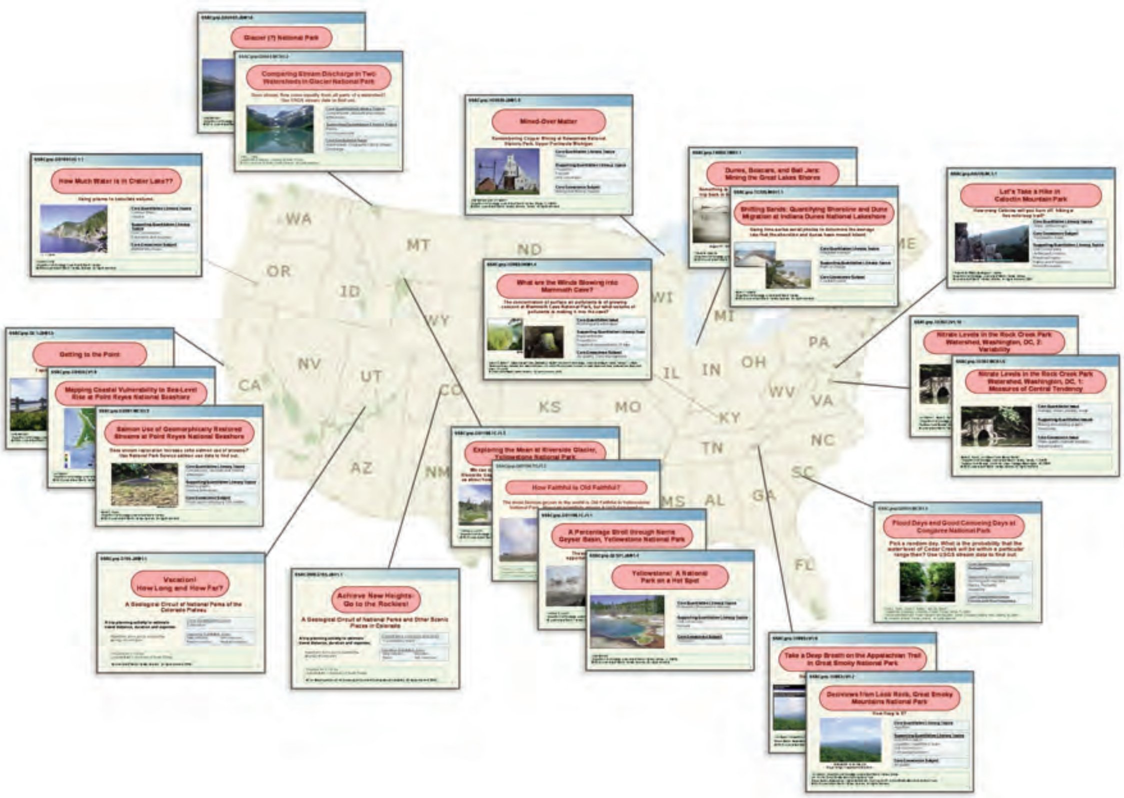


**Figure 1**. Title pages of modules completed as of the George Wright Society Conference, March 2011.

✓ Live Online! • In final editing stages

**Beginner**

- ✓ Spreadsheet Warm Up for Geology of National Parks Modules
- ✓ Spreadsheet Warm Up for SSAC Geology of National Parks Modules, 2: Elementary Spreadsheet Manipulation and Graphing Tasks
- ✓ Achieve New Heights: Go to the Rockies!
- ✓ Mined-Over Matter: Remembering Copper Mining at Keweenaw National Historic Park, Upper Peninsula Michigan
- ✓ Yellowstone! A National Park on a Hot Spot
- ✓ A Percentage Stroll through Norris Geyser Basin, Yellowstone National Park
- ✓ Vacation! How Long and How Far? A Geological Circuit of National Parks in the Colorado Plateau

**Elementary**

- ✓ Getting to the Point at Point Reyes National Seashore
- ✓ Dunes, Boxcars, and Ball Jars: Mining the Great Lakes Shores
- ✓ Salmon Use of Geomorphically Restored Streams at Point Reyes National Seashore
- ✓ Comparing Stream Discharge in Two Watersheds in Glacier National Park
- ✓ Shifting Sands: Quantifying Shoreline and Dune Migration at Indiana Dunes National Lakeshore
- ✓ Mapping Coastal Vulnerability to Sea-Level Rise at Point Reyes National Seashore
- ✓ Glacier (?) National Park
- ✓ Let's Take a Hike in Catoctin Mountain Park
- • Just How 'Faithful' is Old Faithful? Finding Order in Random Behavior
- • What are the Winds Blowing into Mammoth Cave?
- • Exploring the Mean at Riverside Geyser, Yellowstone National Park

**Moderate**

- ✓ How Much Water Is In Crater Lake?
- ✓ Flood Days and Good Canoeing Days at Congaree National Park
- • Deciviews from Look Rock, Great Smoky Mountains National Park: How Hazy is it?
- • Take a Deep Breath on the Appalachian Trail in Great Smoky Mountain National Park: How Many Ozone Molecules Do You Inhale?
- • Nitrate Levels in the Rock Creek Park Watershed, Washington DC, 1: Measures of Central Tendency
- • Nitrate Levels in the Rock Creek Park Watershed, Washington DC, 2: Variability

**Figure 2.** Status and Excel level of the modules at the time of the George Wright Society Conference, March 2011.

- Achieve new heights: Go to the Rockies!
- Yellowstone: A national park on a hot spot
- Mined-over matter: Remembering copper mining at Keweenaw National Historical Park
- Getting to the point: Exploring the tectonic motion of Point Reyes National Seashore, California
- Shifting sands: Quantifying shoreline and dune migration at Indiana Dunes National Lakeshore
- Glacier (?) National Park

Pre- and post-implementation assessment data are being gathered as part of the project to examine whether this change in the course has the desired effect of improving these general education students' QL skills, attitudes, or both. The skills exercised in these modules are standard fare for QL (e.g., Vacher and Lardner 2011): ratios, unit conversions, percentage increase, probability, graph interpretation. The attitudes are familiar too: "I don't do math," or not. Enrollment fluctuates between about 70 and 200 students.

### Other courses

One of the features of SSAC modules is that each module is easily adapted to serve courses other than the one that the module author had in mind. Changes are easily made to modules by, for example, adding or trading out slides in the PowerPoint presentations, making alterations within the slides, combining parts of different modules, and changing the Excel spreadsheets embedded within the slides. Although the modules are copyrighted, instructors are encouraged to adapt the modules to their use, and simply note on the new version the source of the original. Our own experience illustrates the adaptability of the modules, as does the fact that they can be used in a variety of courses. We have used modules from the Geology of National Parks Collection in the three courses described in the next three paragraphs.

**Hazards of the Earth's Surface (Juster)**, like the Geology of National Parks course, is an approved introductory-level physical science course in the Foundations of Knowledge and Learning Core Curriculum. The course is designed to introduce students to both catastrophic hazards, such as earthquakes and volcanoes, and slow-moving hazards, such as ground subsidence. Students must complete five spreadsheet activities that they select from a menu of eleven—three from the Geology of National Parks Collection, and the others from a set made specifically for the course and a potential new geohazards collection for the SSAC Library. The modules in the Geology of National Parks Collection used in the course are these:

- Yellowstone! A national park on a hot spot
- A percentage stroll through Norris Basin, Yellowstone National Park
- Flood days and good canoeing days at Congaree National Park

The three modules were adapted by the addition or alteration of a few slides (including end-of-module assignments) to give more focus to the hazard concepts and phenomena. Typical enrollment is 40 students, and it is expected to grow with the addition of an online section.

**Fluid Earth 2: Hydrogeology (Rains)** is an upper-division, lecture and lab course required for the geology major. The purpose of the course is to introduce principles affecting groundwater occurrence and flow, fundamental tools used by hydrogeologists, and concepts pertaining to groundwater management and water law. As part of the lab, the students do a total of six to eight modules, including three to four modules from the Geology of National Parks Collection and others made by the instructor, colleagues, and teaching assistants specifically for the course. The modules from the Geology of National Parks Collection follow:

- Flood days and good canoeing days at Congaree National Park.
- Comparing stream discharge in two watersheds in Glacier National Park.
- Nitrate levels in the Rock Creek watershed, Washington DC, 1: Measures of central tendency.
- Nitrate levels in the Rock Creek watershed, Washington DC, 2: Variability.

Typical enrollment is around 20 students, about half from geology, and half from environmental science and interdisciplinary science.

**Environmental Geology in the National Parks (Vacher)** was an upper-division geology elective offered once as part of the Geology of National Parks project. The purpose of the course was two-fold: (1) to experiment with a lecture course to introduce students to applied environmental earth science using the NPS and its Natural Resource Challenge as an example, and (2) to test-drive the modules. Specifically, the students were assigned the task of reviewing all the modules that were in draft form (spring semester 2010) and give written feedback to the module authors. Most of the modules were coordinated with the book that was used as the main textbook in the course, Geological Monitoring (Young and Norby 2009), which was produced by the Geologic Resources Division of the NPS. To increase breadth of coverage in the course, students were also assigned sections from Management Policies 2006 (NPS 2006). Table 2 shows how modules were coordinated to these text resources. Twelve students from seven different majors took the course.

## Concluding remarks

The guiding purpose of the Spreadsheets Across the Curriculum Library is to provide a resource to promote the teaching of QL, and a guiding purpose of the Geology of National Parks Collection is to help get out the message about resource management in the national parks. Introducing national park information into math classes would broaden the exposure of NPS stewardship to the public. It is thus appropriate to step back and look at how these modules might be assembled into a sequenced set of activities to support a QL-specific course. Selecting subject headings from prior lists of topics (e.g., Sons 1996, Steen 2001, Vacher and Lardner 2011), we see the following as one possibility:

*Number sense: Estimation, ratio and proportion, unit conversions, magnitude:*

- Vacation! How long and how far? A geologic circuit of national parks in the Colorado Plateau
- Getting to the point: Exploring the tectonic motion of Point Reyes National Seashore, California
- Mined-over matter: Remembering copper mining at Keweenaw National Historic Park.
- Dunes, boxcars, and bells jars: Mining the Great Lakes shores
- Take a deep breath on the Appalachian Trail in Great Smoky Mountains National Park

*Making quantitative comparisons:*

- Mapping coastal vulnerability to sea-level rise at Point Reyes National Seashore
- Comparing stream discharge in two watersheds in Glacier National Park
- Salmon use of geomorphically restored streams at Point Reyes National Park
- Percentage stroll through Norris Geyser Basin, Yellowstone National Park
- Deciviews from Look Rock, Great Smoky Mountains National Park: How hazy is it?

*Reading graphs and maps:*

- Let's take a hike in Catoctin Mountain Park
- Glacier(?) National Park
- Shifting sands: Quantifying shoreline and dune migration at Indiana Dunes National Lakeshore
- How much water is in Crater Lake?

*Probability and elementary descriptive statistics:*

- Flood days and good canoeing days at Congaree National Park
- Yellowstone! A national park on a hot spot
- Just how faithful is Old Faithful?
- Exploring the mean at Riverside Geyser, Yellowstone National Park

Coordinated with *Geological Monitoring* (Young and Norby 2009)

- Chapter 12. Volcano monitoring
  - Yellowstone! A national park on a hot spot.
  - How much water is in Crater Lake?
- Chapter 5. Geothermal systems and monitoring hydrothermal features
  - A percentage stroll through Norris Geyser Basin, Yellowstone National Park.
  - Just how faithful is Old Faithful?
  - Exploring the mean at Riverside Glacier, Yellowstone National Park.
- Chapter 4. Fluvial geomorphology: Monitoring stream systems in response to a changing environment
  - Comparing stream discharge in two watersheds in Glacier National Park.
  - Salmon use of geomorphically restored streams at Point Reyes National Seashore.
- Chapter 2. Geological monitoring of caves and associated landscapes
  - What are the winds blowing into Mammoth Cave?
- Chapter 3. Coastal features and processes
  - Shifting sands: Quantifying shoreline and dune migration at Indiana Dunes National Lakeshore.
  - Mapping coastal vulnerability to sea-level rise at Point Reyes National Seashore.
- Chapter 1. Aeolian features and processes
  - Dunes, boxcars, and Bell jars: Mining the Great Lakes shores.
- Chapter 6. Glacier monitoring techniques
  - Glacier(?) National Park.
- Chapter 10. Seismic monitoring
  - Getting to the point: Exploring the tectonic motion of Point Reyes National Seashore, California.

**Table 2.** Modules used in the course "Environmental Geology in the National Parks."

| |
|---|
| Coordinated with *Management Policies 2006* (NPS 2006) |
| Chapter 4, Natural Resource Management. Section 4.6.3 Water Quality |
| Nitrate levels in the Rock Creek Park watershed, 1: Measures of central tendency. |
| Nitrate levels in the Rock Creek Park watershed, 2: Variability. |
| Chapter 4, Natural Resource Management. Section 4.7.1, Air Quality |
| Deciviews from Look Rock, Great Smoky Mountains National Park. |
| Take a deep breath on the Appalachian Trail in Great Smoky Mountains National Park. |

Table 2 (continued).

- Nitrate levels at Rock Creek Park watershed, Washington DC, 1: Variability
- Nitrate levels at Rock Creek Park watershed, Washington DC, 2: Measures of central tendency

The list of subject headings also helps define what we mean by QL. Obviously our project has only scratched the surface of possible connections between the national park context and QL content.


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# The Economic Impact of Canada's National, Provincial and Territorial Parks (2009)

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## Introduction

SINCE THE CREATION OF NATIONAL, STATE, PROVINCIAL, AND TERRITORIAL PARK SYSTEMS ACROSS North America over the last 125 years, we have benefited in many different ways as a society, community, family and individually. Parks provide opportunities for families to be together, to learn about nature and to enjoy healthful outdoor recreation. Parks contribute to our sense of identity and place, and we consider them an important legacy to pass on to future generations.

They provide a board range of ecological services. They produce clean water and air, protect critical habitat for species-at-risk and maintain healthy, diverse and resilient ecosystems upon which our own health depends. Parks also generate economic activity, supporting tourism, providing sustainable jobs, generating tax revenue to governments and diversifying the economy, particularly in rural and remote areas.

The purposes of this paper are the following:

1. Provide an overview of the economic benefits framework used by the Canadian Parks Council.
2. Describe the input-output model used by the Council and data required to calculate the economic impact of park and visitor expenditures.
3. Report on the results and significance of total park agencies and visitor spending on the national, provincial and territorial economies of Canada in 2009.

## The economic benefits framework

In 1998 the Canadian Parks Council, made up of federal, provincial, and territorial park agencies directors, identified the need to develop a common framework for measuring the economic value of parks. The purpose of the framework was to develop standard measures, and ultimately methodologies, that could be used by member agencies to assess the wide array of economic benefits provided by parks. Summarized in Table 1, the framework included not only traditional economic measures of *commercial benefits*, such as Gross Domestic Product, employment, wages and tax revenue, but also *personal benefits*, such as direct use and non-use/passive values, and *societal benefits*, such as ecological services (clean water and air, carbon capture, etc).

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| | Personal | Commercial | Societal |
|---|---|---|---|
| **Definition** | benefits accrued to individual users & non-users | benefits derived from the re-distribution of commercial activity from one area to another | benefits accrued to society as a whole which exhibit a "public or common good " |
| **Components** | use values<br>-direct use<br>-indirect use<br><br>non-use/passive values<br>-option value<br>-existence value<br>-bequest value | impacts from agency & visitor expenditures for the development, operation and use of parks | ecological services<br>resource integrity<br>health effects<br>quality of life<br>scientific<br>educational<br>community |
| **Measures/Examples** | contingent valuation<br>willingness to pay<br>visitor satisfaction<br>use levels | gross domestic product<br>employment<br>labor income<br>tax revenue | substitute value for clean water & air<br>carbon credits<br>re-forestation |

**Table 1.** Total economic benefits of parks framework.

### Economic impact model for Canadian parks

In 2007 the Parks Council started a multi-year project to estimate the commerical benefits or economic impacts in 2009 of Canada's parks. The Outspan Group, an Ontario consulting firm, developed the Economic Impact Model for Parks (EIMP) which was used to undertake the 2009 analysis. The model is an on-line analytical tool (http://174.143.205.154/miep-eimpa/) that can be used to evaluate the economic impacts of Canadian park agencies and visitor expenditures at various scales. This includes entire agency operations (national, provincial, or territorial park systems), individual parks (existing or proposed), major capital investment (interpretive centres, campgrounds, trails, etc.) as well as specific activities (performances, events, and festivals). Economic impacts are calculated within and outside the province or territory in which the park or capital investment is located, or where the event took place. The model uses 2006 coefficients and multipliers created by the Statistics Canada Inter-provincial Input-Output Model. The Statistics Canada Inter-provincial Input-Output Model was chosen because it takes into account the trade flows of goods and services among the provinces and territories, and it provides comparable coefficients for each province and territory.

This input-output model shows in tables: the production of goods and services by each sector of the economy in each province and territory, the utilization of goods and services by each sector of the economy in each province and territory, and the flows of goods and services between provinces and territories. From these tables a series of input-output coefficients are created that relate production in a given industry/sector to the industries/sectors providing it with the required inputs. Multipliers are then calculated to trace the effects of an increase in the demand for a specified commodity through the provincial and territorial economies. These effects are measured in terms of *labour income*, *gross domestic product*, *level of employment*, and *tax revenues*. The model calculates the *direct*, *indirect*, *induced impacts,* and total effects for each unit of impact measurement, for each contributing organization and for each visitor market segment.

The EIMP uses a standardized set of expenditure categories associated with a site or an event that reflects spending by parks agencies and visitors in order to perform economic impact calculations. The economic impacts are calculated on the basis of the following expenditures: agency purchases of goods and services, agency expenditures for infrastructure, agency payment of wages and salaries and the spending of visitors attributable to a park, facility, or an event.

**Required data for the model**

Whether assessing the economic impact of an existing park, an event that has already taken place, or a project that is planned for the future, expenditure data are required from either administrative records, surveys and/or estimates, as well as from all private sector, public sector and not-for-profit partners. Data required for park *operations* includes public utilities, printing and publications, supplies, professional services, business services, and travel and transportation. Data required for agencies' capital expenditures includes repairs/renovations, staff housing, non-residential buildings, access roads, major equipment purchases, other construction and professional services. Agencies also supply *salary and wages*, benefits, honorarium and training cost data.

Most park agency accounting systems can readily identify or build up the expenditure data required for operations. The user's guide for the model provides clear definitions of what expenditures are included (or not) in each of the categories; and, as such, provides reasonably accurate data. However, the identification of visitor expenditures is more complex; and, typically requires the collection of a wider variety of data to build an overall estimate. Administrative data such as visitor counts, survey data, or approximate estimates (with clear assumptions and rationale) are used to generate visitor expenditures. In gathering visitor spending data, only spending related to the targeted park or event is considered relevant. Therefore, only spending within the jurisdiction (province or territory) in which the park is located or in which the event takes place was used in this study. The model can also apportion a percentage of visitor expenditures depending on the level of motivation attributable to park or event (i.e., a destination visit to the park versus a variety of other reasons for being in the area).

The amount spent by visitors on goods and services is broken down by the following categories ideally for each visitor segment (i.e., day use, overnight, front country, etc): transportation(vehicle, rental, air), food and beverages(restaurants, store bought), accommodations, recreation and entertainment.

**The economic impacts of Canada's national, provincial and territorial parks**

Park agency and visitor expenditure data for 2009 are summarized on Tables 2 and 3. In total, Canada's parks agencies spent over $772 million in 2009 on operations, capital investment, and salaries and wages. These direct expenditures are significant to local communities in terms of employment and income. This is particularly true in remote locations where employment opportunities can be scarce. While overall federal and provincial/territorial agency spending is virtually the same, the split between operating costs and capital investment is significantly different. Provinces and territories spent a third less in operations, but three times more in capital investment. Wages and salaries paid were similar between the provinces/territories and federal categories.

Total visits to Canada's parks in 2009 were calculated to be some 70 million. Those visitors spent an estimated $4.4 billion on transportation, food and beverages, accommodation and other items. These expenditures are directly injected into Canada's tourism and service sectors. Visitor expenditures are significantly higher than those of the park agencies. Overall for every dollar of agency funding spent on parks, $5.70 is returned to the Canadian economy through visitor expenditures. This agency to visitor spending ratio varies from the lowest in relatively remote, expensiveto operate and visit locations such as the Yukon ($1:$1.5) to easy to access, destination areas such as Alberta ($1:$7.80).

| Jurisdiction | Operations | Capital | Wages & Salaries | Total |
|---|---|---|---|---|
| Provinces/Territories | $111,672.30 | $107,675.70 | $164,631.60 | $383,979.70 |
| Federal | $168,660.30 | $32,471.80 | $186,978.10 | $388,110.20 |
| Total | $280,332.60 | $140,147.50 | $351,609.70 | $772,089.90 |

**Table 2.** Park agency expenditures, 2009 ($1000).

| Jurisdiction | Transport. | Accommo. | Food/Bev | Other | Total |
|---|---|---|---|---|---|
| Provinces/Territories | $471.00 | $282.20 | $602.10 | $598.70 | $1,953.70 |
| Federal | $644.10 | $495.20 | $705.10 | $607.00 | $2,451.40 |
| Total | $1,115.10 | $777.40 | $1,307.20 | $1,205.70 | $4,405.10 |

**Table 3.** Visitor expenditures, 2009 ($1,000,000).

In turn, these park agency and visitor expenditures create substantial and recurring impacts on the Canadian economy, creating jobs, generating income for local business and producing tax revenue for governments (Table 4). The combined $5.2 billion in agency and visitor spending added $4.6 billion to Canada's Gross Domestic Product (GDP). This amount of GDP had a labor income component of $2.9 billion and created an equivalent of 64,000 full-time jobs. The impact assessment also showed that $337 million was returned in taxes to the three levels of government (federal, provincial/territorial, and local). As would be expected, Table 4 shows that the higher visitor spending had a significantly greater impact by four times on GDP compared to park agency expenditures.

Each level of government receives a comparable amount of tax revenue (municipal governments: $119.1 million, provincial/territorial $121.4 million and federal $96 million) totaling $337 million. However municipal governments are the real beneficiaries as these are net revenues not reduced by operating expenses which are incurred at the national, provincial, or territorial levels.

The leveraging effect of agency expenditures is further increased when tax revenues are added to visitor expenditures. The ratio grows from 1:5.7 to 1:6.15, or approximately an additional 10%. Not included in this ratio are the park fees collected which for some jurisdictions are significant. The fee revenue to operation cost ratio varies widely between agencies depending on visitation, fee structures and payment compliance levels. In smaller, remote northern jurisdictions such as the Yukon, revenues collected cover only 20% of operating costs while in larger, southern jurisdictions such as Ontario operational cost recovery is a high as 80%.

### Challenges related to economic impact analysis

**Counting visitors.** Accurately counting visitors can be expensive and time consuming. In many cases, groups of visitors such as day users are not included because an effective and efficient means to count them does not exist.

**Understanding visitors.** Knowing who the visitors are, what motivates them to visit parks, what they do and for how long, and what they spend when visiting a park requires expensive and time consuming visitor surveys.

**Apportioning visitor expenditures.** Accurately apportioning expenditures to the park visited can be difficult. This is straightforward if the visitor confirms that the sole purpose for the visit was the park. But, if visiting friends or family or other places, then determining the split is more difficult.

**Keeping input-output models current.** Maintaining the input-output models current with relatively up to date coefficients can be costly, especially if the model is purpose-designed, such as for parks.

| Economic Impact | Federal | Provinces/Territories | Total |
|---|---|---|---|
| GDP | $2,541.7 | $2,031.4 | $4,573.1 |
| Labor income | $1,606.4 | $1,276.7 | $2,883.1 |
| Tax revenue | $171.8 | $165.2 | $337.0 |
| Employment (FTE) | 34,989 | 28,989 | 63,978 |
| | | | |
| GDP Impacts by: | Federal | Provinces/Territories | Total |
| Visitors | $2,068.4 | $1,571.7 | $3,640.1 |
| Park Agency | $473.3 | $459.7 | $933.0 |

**Table 4.** Economic impacts of Canada's parks, 2009 ($1,000,000).

**Common data collection.** A multi-jurisdictional analysis faces the challenge of standardized data collection. Park agency expenditure accounting systems vary significantly. As well, how visits are counted between jurisdictions differ.

**Comparing study results.** Comparing study findings to other park or other industry studies, such as forestry or mining, must be done cautiously, if at all. For instance, the impacts calculated by EIMP are derived from "value added" measures, and are considered relatively conservative. This approach eliminates multiple counting of the value of goods and services involved in the production chain, and then the final sale which is a measure of "gross output." "Gross output" and/or use of "total sales" measure the sum of all transactions leading to the final sale of goods and services, and accordingly will be considerably larger than using the "value added" measure.

## Conclusions

**Parks are important economic generators.** The economic impacts (direct, indirect and induced, GDP/value added, income, jobs, and taxes) are significant and re-occurring at all levels: local, provincial/territorial, and nationally. Local economic impacts related to job creation and wage earnings are particularly significant in smaller, more remote communities where unemployment rates can be high.

**Parks are a good investment.** The leveraging effect of park agencies' expenditures in generating visitor expenditures in the tourism and service sectors is significant, with average ratios varying from 1:1.5 to 1:8, averaging 1:6 nationally. This leveraging effect is further enhanced when the tax revenues and park fees are included as additional offsets to the agencies' annual operating expenditures.

# Place Meanings among Resource and Recreation Managers of the Great Barrier Reef Marine Park, Australia

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## Introduction

"Place meanings" and related concepts that reference human attachment to parks, protected areas, and cultural sites have received considerable attention (Farnum et al. 2005). This line of research offers a promising approach to better understand the meanings that visitors ascribe to places and, therefore, what is or is not important (Kyle et al. 2004). This information offers a guide for managers to oversee resource and recreation conditions in ways consistent with those meanings. A variety of techniques have been employed to capture in-depth understandings of place meanings (Davenport and Anderson 2005), generalize to larger populations using survey scale items (Williams and Vaske 2003), and map areas of significance using geographic information system (GIS) applications (Brown 2005). These approaches have helped managers address on-going challenges to incorporate subjective interpretations of place into decision-making (Cheng, Kruger, and Daniels 2003), identify effective strategies for engaging and collaborating with stakeholders (Brandenburg and Carroll 1995), clarify conflicts in the meaning of resources (Yung, Freimund, and Belsky 2003), and address human responses to changing environmental conditions (Kyle et al. 2004).

Previous investigations have explored how visitors and residents feel connected to spatial settings; however, the perspectives of managers have generally been absent from these investigations (Hutson, Montgomery, and Caneday 2010). This is problematic, because managers are entrust-

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ed through public consent to protect environmental conditions while providing opportunities for use and enjoyment of natural resources. It is also important to clarify how managers' views align with an agency's mission. We build on this gap in the literature with insight on the meanings that Australian managers associate with places at the Great Barrier Reef Marine Park (GBRMP). Our discussion is organized in terms of four dimensions—functional, natural, experiential, and interpersonal—to illustrate the diversity in attachment that forms between managers and places under their jurisdiction. We hope this information will help managers draw on their personal relationships with places to more effectively negotiate meanings that their public constituents associate with protected area landscapes.

## Methods

**Study context**. The GBMRP encompasses approximately 345,000 square miles, and extends 1,500 miles along the northeastern coast of Australia in the state of Queensland. This area hosts one of the most biologically diverse ecosystems in the world, including an expansive network of coral reefs, continental islands, coral cays, and an abundance of marine life (GBRMPA 2009). Interconnected within these habitats are other communities, such as mangroves, seagrass beds, and sponge gardens that contribute to an extraordinarily productive ecosystem. The GBRMP is an iconic destination that fosters a range of values and meanings among user groups (Wynveen, Kyle, and Sutton 2010), and serves as a driving force for the economy of Queensland (e.g., tourism industry, fishing) and, in part, for all of Australia (Day 2002). Federal, state, and local organizations cooperate to address key environmental threats (e.g., climate change, coastal development, water quality), engage local communities, and accommodate multiple interests such as shipping, commercial charters, scientific research, and recreational activities such as fishing and diving, and indigenous hunting (GBRMPA 2009).

**Research approach.** We drew on grounded theory to examine the meanings that managers, from three agencies charged to oversee the GBRMP, ascribed to places (Glasser and Strauss 1976). Semi-structured interviews were conducted both in-person and by telephone from June through September, 2010 (n = 35; Table 1). Informants were selected using a purposive "snowball" sampling frame, which involved identifying key figures in the management network, and building a sample based on recommendations from study informants. The interview guide consisted of 25 questions designed to query place meanings and management decision-making. Following Schroeder (1996), we elicited responses by asking informants to describe a place of importance and explain why it was of value. Over 33 hours of formal interview time were tape recorded, transcribed verbatim, and analyzed using open coding in ATLAS.ti version 4.2.

## Study findings

Results illustrated strong attachment formed between managers and places within the GBRMP. To organize our informants' narratives, we drew on four place dimensions that have been previously supported in past research (e.g., Davenport and Anderson 2005; Williams & Vaske 2003) (Figure 1). Excerpts from the interviews are presented below to illustrate how these four dimensions converged around the idea of place meaning. Our discussion offers a perspective on how managers' personal connections can influence decision-making.

**Natural.** Our first place dimension, titled "natural," illustrated managers' appreciation for biological and physical forces that existed independent of human presence. Ecosystem function and resilience were of concern, as well as the pristine nature of environmental conditions: "There's a very strong sense of place, which I have constructed for, you know, Magnetic Island. And that sense of place is built around its natural values, its landscape, it still has some sense of the island as a national park. Even more than that, it's still understood natural bushland." Biodiversity, in terms of marine life and vegetation, characterized values that were ascribed to set-

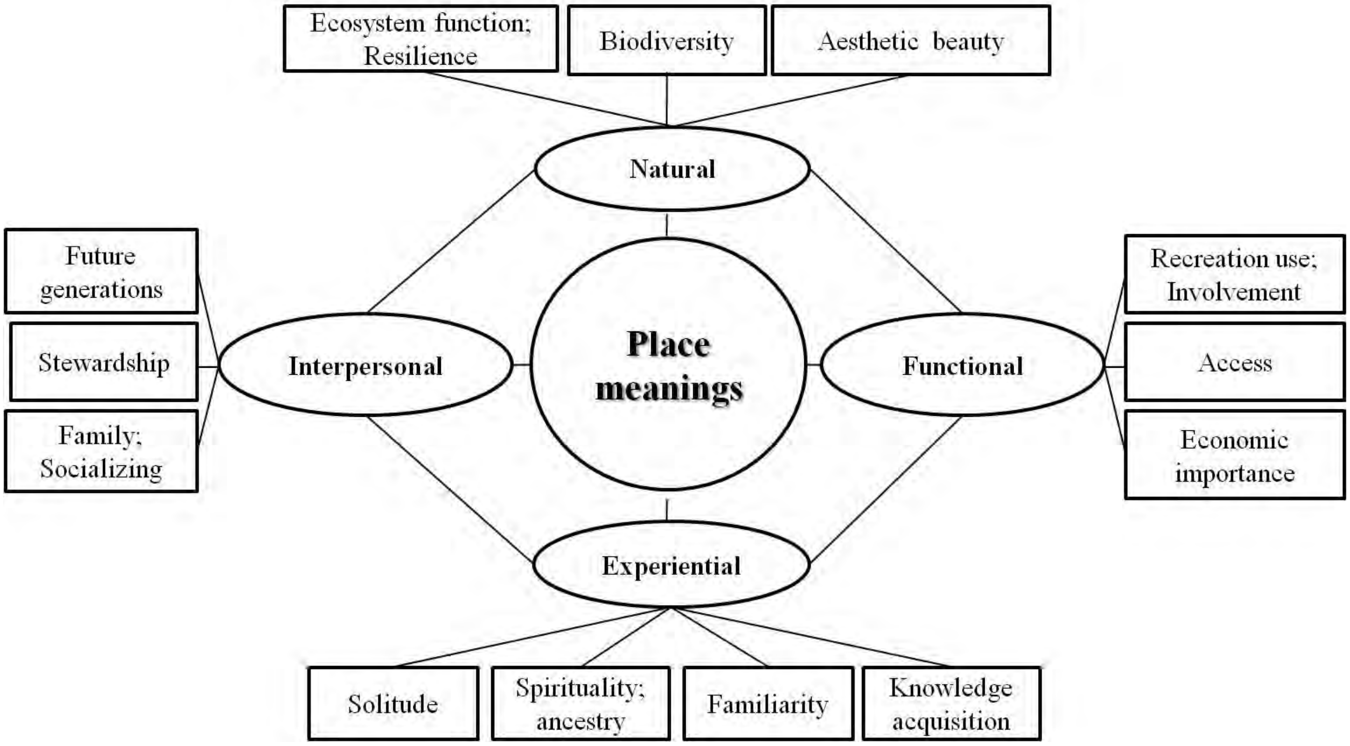


**Figure 1.** Four dimensions of managers' place meanings.

| Variable | | Frequency |
|---|---|---|
| Gender (n=35) | Male | 23 |
| | Female | 12 |
| Age (n=35) | Average | 44 |
| Ethnicity (n=32) | Aboriginal or Torres Strait Islander | 1 |
| | Not Aboriginal or Torres Strait Islander | 31 |
| Race (n=33) | Primary school | 0 |
| Education (n=35) | Secondary school | 1 |
| | Tertiary degree | 3 |
| | C.A.E. degree | 1 |
| | Graduate degree | 30 |
| Annual Household Income (n=31) | \$50,000–\$99,999 | 3 |
| | \$100,000–\$149,999 | 9 |
| | \$150,000–\$199,999 | 14 |
| | \$200,000–\$249,999 | 3 |
| | \$250,000–\$299,999 | 2 |
| Years in Management | Ranges from 1.5 to 31 years | |
| Years in Agency | Ranges from 2.5 to 31 years | |
| Years in Current Position | Ranges from 4 weeks to 12 years | |

**Table 1.** Socio-demographic characteristics among managers of the Great Barrier Reef Marine Park.

tings. One informant referred to aesthetic experiences, explaining that geographic locales became meaningful when linked to species conservation: "One thing that's important I think, too, is that when we talk about place, is probably a lot of us are concerned with species more than locations. And good examples of that would be things like turtle and dugongs … the location becomes important if you've got an island, like this place called Raine Island in the north, which is the most important green turtle nesting site in the world.… It's not a very pretty place. It's all been churned over by green turtles all the time when they're nesting. But it's a vital place for the turtle." This passage also pointed the functional meaning of places.

**Functional**. We labeled the second dimension of managers' place meanings "functional," and it represented utilitarian-oriented values, the importance of economic support stemming from the fisheries industry and other consumptive practices that drew on natural properties of the park, and indigenous use. Fishing, snorkeling, diving, and swimming were activities often referenced. When asked why places were important, one informant referenced Hinchinbrook Island National Park: "It's where I, uhm, prefer to do some of those recreational activities." Others derived benefits from places through outdoor activities: "catching a really good fish and eating it," "trail running on the weekend," and "recreational activities and fishing values." One informant explained that these benefits were motivational on personal and professional levels: "I only became a fisheries scientist, fisheries manager, because I love fishing." The functional dimension of place was reflected in a multiple use philosophy that resonated with many informants: "I'm very pleased that some areas are protected. I'm very pleased that some areas you can use.… I don't believe in locking things up.… I actually believe that the more people that see something and appreciate it, the more support you will have.… Places become special because you can use them."

**Experiential**. The third dimension of managers' place meanings was "experiential" and it referenced individually-oriented experiences that facilitated connections between managers and their environments. Familiarity was central to meaning creation: "Isles is also a very special place to me 'cause I've. I'm very familiar with it." Another informant explained, "people that are particularly familiar with the local environment have strong sense of place about it." Spirituality and ancestry were also linked to the experiential dimension, in that Aboriginal populations or "traditional owners" were understood to have "quite strong linkages to sites and place... they still have a strong sense of place, of belonging back to here through their ancestral roots." Places were intrinsically valued for the purposes of intellectual stimulation and curiosity to understand what objectively existed at the GBRMP: "A big part of it is knowledge. Just seeing what's out there and the beauty of it." Another informant noted, "The most important place for me in the Marine Park is Lizard Island … and I think one of the things that makes it so valuable to me is... the research station there." Others spoke of places becoming meaningful through rejuvenation, a sense of humility and the importance of solitary experiences: "the remoteness or the feelings of being, of moving away from civilization and not being part of, you know, the sort of ant hills of human population."

**Interpersonal**. We titled the fourth dimension "interpersonal" and it was rooted in social aspects of place meaning. Managers, as custodians of the GBRMP, expressed a strong desire to provide for future generations, and maintain professional responsibility and stewardship: "I mean that's why I came onboard to this position. I felt I could contribute to the, you know, conservation of the Great Barrier Reef. But at the same time, I was also very linked with all the users, the fishermen out there as well." When asked whether recreation activities were pursued with other people, one informant responded, "Yeah, and that's the purpose. They definitely have a social component." One individual reiterated the importance of shared experiences: "Queensland is my home state and while I've lived for many years away from Queensland, it has a, you know, a powerful sense for me because of family and history and all those things that bind people to an area."

## Discussion

Our discussion of managers' place meanings extended to the interrelationship between personal views of the environment and decision-making processes. Managers may find it useful to consider how their perspectives shape interpretations of place and allow them to better understand the sentiments of their public constituents. Human-place bonds were beneficial for managers to understand local issues: "When it comes time to review the management plan for a place like Hinchinbrook Island, having that personal experience there, understanding the way in which that place can move people will give me, I think, greater insight into how we can structure a management plan to protect those very values." However, this informant went on to caution, "There is a risk and an opportunity there that those personal experiences will bias that decision, but ultimately we have to make a call about how these lands and waters are used... I guess that connection to place for me is a valuable addition into that decision-making process." Managers exercised their understanding of places to construct management plans and more effectively engage their public constituents.

In some cases, attachment to places provided common ground shared by managers and members of the local community. One informant explained, "Most of the people in [the agency] are from North Queensland … most of us were into things like recreational fishing and that sort of thing, and I think that the people felt a lot better.… I think the fear people have is that decisions will be made about their lives by someone who doesn't understand." Practical and personal experiences helped alleviate the fear that management decisions were made in ignorance without considering or understanding public viewpoints. Others referenced "street credit" and "trust capital" when asked how place meanings contributed to decision-making. This point is illustrated well by the boat ramp test: "If you're trying to talk to people about an issue. If the guys out at the boat ramp on Saturday morning don't understand it, you've got no chance." In this sense, decision-making partially relied on managers' personal connections to places and depended on clearly articulating management issues of interest.

## Conclusions

This study examined place meanings among managers of the Great Barrier Reef Marine Park. Our study informants reported multifaceted and diverse attachment manifested in the meanings they ascribed to the GBRMP. We organized their expressed meanings into four dimensions: natural, functional, experiential, and interpersonal. First, naturalistic values were reflected in elements such as ecosystem function and resilience, biodiversity, and aesthetic beauty (Davenport and Anderson 2005; Manning, Valliere, and Minteer 1999). Second, recreation use and involvement in outdoor activities, access to resources and economic benefits were central tenets to the functional dimension of place. Third, the experiential dimension referenced managers' desires for solitude, spirituality and ancestry, familiarity, and knowledge acquisition. Finally, providing for future generations, environmental stewardship, and socializing contributed to interpersonal relations that made places meaningful for resource and recreation managers.

Our investigation is aimed at helping incorporate a range of values and meanings within planning and management of parks and protected areas (Cheng, Kruger, and Daniels 2003; Farnum, Hall, and Kruger 2005; Wynveen, Kyle, and Sutton 2010). We examined managers' perspectives to shift focus from individuals and groups to those that are empowered by the will of the people to oversee conditions in ways consistent with public expectations (Hutson, Montgomery, and Caneday 2010). Understanding personal connections to place enables managers to better respond to their public constituents and participate in a process of negotiating meaning and use of natural resources. We anticipate that this information will guide management decisions to consider diverse value systems and initiate discourse of how place meanings materialize in decision-making processes.

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# Integrated Science and Interdisciplinary Research for Parks and Protected Areas

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THIS PAPER SUMMARIZES PRESENTATIONS AND DISCUSSION THAT FOCUSED ON INTEGRATED SCIENCE and the use of interdisciplinary research during a panel session held at the George Wright Society Meeting in New Orleans, March 14, 2011. The panel brought together nationally recognized members from the social and biological scientific communities, along with decision-makers and managers of parks and protected areas (Figure 1).

The goal of the panel was to spark a discussion among panel members and the audience on the benefits and challenges of utilizing interdisciplinary research and integrated science to answer complex questions at the international, national, regional, and local park levels. The key focus points for the panel presentations and subsequent discussion revolved around the following five questions: How do we define interdisciplinary research and integrated science? What are the benefits, drawbacks, and challenges of interdisciplinary research and integrated science? When should this type of science be used? What are the barriers to employing interdisciplinary research and integrated science, and how can those perceived barriers be overcome? What are some examples of situations where this type of science has worked for you? We will break this paper down into seven sections, each summarizing the results of the panel presentations and subsequent audience discussion:

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**Figure 1**. Integrated science panel members at the 2011 George Wright Society biennial conference. From left to right: Charles van Riper III, Gary Machlis, Jan van Wagtendonk, Bob Powell, Russell Galipeau, and Carena van Riper (recorder Eick von Ruschkowski not shown). Photograph courtesy of Gary E. Davis.

1. How do we define integrated science and interdisciplinary research?
2. The need for integrated science.
3. The challenges of integrated science and interdisciplinary research.
4. The benefits of integrated science and interdisciplinary research.
5. Integrated science in protected area management.
6. Communicating integrated science.
7. Key components to improve scientific outcomes.

### How do we define integrated science and interdisciplinary research?

Integrated science is defined as a *cumulative* approach of scientific study that synthesizes the perspectives of the individual disciplines, and integrates them during all phases of the approach to a question or problem, with the results having an influence on policy and management decisions (Gallagher et. al. 2008). Integrated science is interdisciplinary. We define interdisciplinary research as the use of a wide spectrum of scientific disciplines that are brought together to solve complex problems. Thus, integrated science not only involves personnel with diverse expertise, but also aims at collaborative efforts to examine the linkages among single-disciplinary perspectives, during which new methods, concepts, and approaches are often developed. Interdisciplinary research and integrated science brought to bear on complex management questions are cumulative, synthesizing perspectives of individual disciplines, and integrating them during all phases of work to solve scientific and resource management problems.

### The need for integrated science

With the increasing complexity of natural and social issues facing parks and protected areas throughout the world, it is important for managers to recognize the benefits of utilizing and employing interdisciplinary and integrated scientific approaches to solving resource management-related problems. Over the past several decades, the need for interdisciplinary research and integrated science has become more apparent. The reasons for this are varied, but several key factors can be identified; there is a rising need to solve some of the "wicked" (Rittel and Webber 1973) societal problems that are complex in nature. Examples of these "wicked" problems might be "How can the National Park Service best adapt to global climate change" or, "How can the National Park Service maintain species diversity throughout all parks in the system?" The needs for addressing such complex questions and problems are not confined to a single management unit or to a single scientific discipline, and require approaches that transcend disciplinary boundaries and political borders. Also, the advancement of today's new technologies, such as geographic information systems (GIS), enhanced computer memory, agent-based modeling, and adaptive management frameworks provides new capabilities for integrating information that has not previously existed (CFIR 2004).

### The challenges of integrated science and interdisciplinary research

In general, the increasing complexity of scientific problems leads to challenging management decisions regarding protected areas. Given this complexity, it has become quite clear that management requires not only scientific knowledge about natural resources, but also social processes, and often a combination of both. Even with this knowledge, the challenges for park managers grow constantly. It needs to be recognized that interdisciplinary research and integrated science can lead to lengthy research processes that typically involve people from different scientific backgrounds. With the initiation of such a project, difficulties immediately exist because of different technical information associated with each discipline, and their associated jargon (e.g., a biologist will need some time to understand a social scientist vocabulary and vice versa). Trust must be built among disciplines and all participants must recognize that this is necessary for integrated research to be successful. As different disciplines also use different 'currencies' to communicate their results, defining a common currency, such as probability (e.g., likelihood for a specific scenario to occur), or in what journal to publish the results, will provide a common ground and working platform. These terms are best agreed upon at the early stages of research efforts. In some cases, social science actually proves to be the harder discipline to integrate, as variables such as subject "attitudes" and "perceptions" are difficult to measure, yet vital to understanding complex problems.

Interdisciplinary and integrated approaches usually reach across institutional and organizational boundaries, which can cause additional difficulties, especially when it comes to the money flow for projects involving more than one funding institution. For social and natural scientists, putting the focus on "interdisciplinarity" may also potentially lead to personal disadvantages, such as publication timeliness. Interdisciplinary competence should always be based on a strong disciplinary background in order to avoid the jack-of-all-trades versus master-of-none dilemma (see also von Ruschkowski 2003). With this disciplinary expertise, scientists can then acquire fluency in other disciplines, thus being able to communicate their work to other scientists, which eventually leads to successful interdisciplinary efforts. This education and learning process will always take more time than becoming a single discipline-trained, "traditional" scientist. However, in the extremely competitive world of today's scientific community, selecting the longer and harder path may initially be regarded as a disadvantage, but an interdisciplinary foundation will potentially become an advantage and lay the groundwork for future productivity and long-term success.

Because of the complexity of interdisciplinary research processes, this requirement for a higher personal (and personnel) resource investment not only applies during initial training, but also during the management of interdisciplinary research projects.

Becoming an interdisciplinary scientist requires a high degree of intrinsic motivation and endurance in order to overcome these perceived hindrances. An especially noteworthy mechanism that discourages interdisciplinary science is inherent within the scientific review system. Working within interdisciplinary scientific environments always bears the danger of initially being less productive (usually measured in the form of publication numbers), and longer-than-expected time frames for products, from the beginning to the output of a research project. However, it must be remembered that interdisciplinary research and integrated science products have the potential to be robust and have great impact on management decisions and scientific communities. Thus, at least from a career perspective, embarking on interdisciplinary and integrated science projects can be challenging, but ultimately rewarding.

### The benefits of integrated science and interdisciplinary research

In spite of the potential disadvantages outlined above, interdisciplinary research is worthwhile and rewarding. Not only do interdisciplinary projects have potential to better balance different interests and needs, because of their ability to address complex questions, they also seem to have a higher potential for a successful transfer into politics and decision-making processes, hence the close connections between interdisciplinary research and integrated science. If we are to move beyond simply conducting interdisciplinary work to accomplishing integrated science, we must think across disciplinary boundaries, and offer implications for decision-makers and politicians. In summary, most of today's local and global park challenges are issues that have to rely on interdisciplinary scientific research in order to answer the complex issues facing our natural and cultural resources, and to ensure human well-being.

### Integrated science in protected area management

Parks and protected areas provide a prime setting for integrating science, as they can be regarded as coupled human-natural systems (Figure 2). Today, many societal challenges arise outside park boundaries, thus parks can serve as control sites from which to measure change. Also, most current threats to natural areas are human-based and societal in nature. Park managers need to view their actions as closely related to a larger context, both in terms of social and ecological processes, and that these connections should be reflected in management guidelines (e.g., Dudley 2008).

Two of today's largest challenges in parks and protected areas—fighting global climate change and stopping the loss of biodiversity—can only be addressed with interdisciplinary research that is integrated into management decision-making. Integrated science also lends itself well to the inventorying and monitoring of natural and, more recently, societal processes, which is now a core activity for the National Park Service (NPS) science programs. By utilizing integrated science, park managers will be better able to fulfill the NPS mission. We recommend that integrated science decision-making be based on three criteria: use of the best available sound science, accurate fidelity to the law, and long-term public interest. Balancing these criteria requires integrated approaches in science.

### Communicating integrated science

Interdisciplinary approaches to integrated science seems—at least in U.S. parks and protected areas—to be challenged by several major obstacles. One of the greatest challenges is associated with the communication of scientific results to park managers and the public. The distrust of science among politicians, and sometimes the general public, is a unique development seen throughout the world, and especially in North America over recent years. Climate change and its science is a prime example of this situation. The gap between academia (i.e., the ivory tower) and the rest of society is derived largely from the level of uncertainty associated with predictions of complex issues. Despite knowledge of complex issues, uncertainty is inevitably an accompanying factor. As a precautionary principle for all scientists, this uncertainty needs to be addressed and

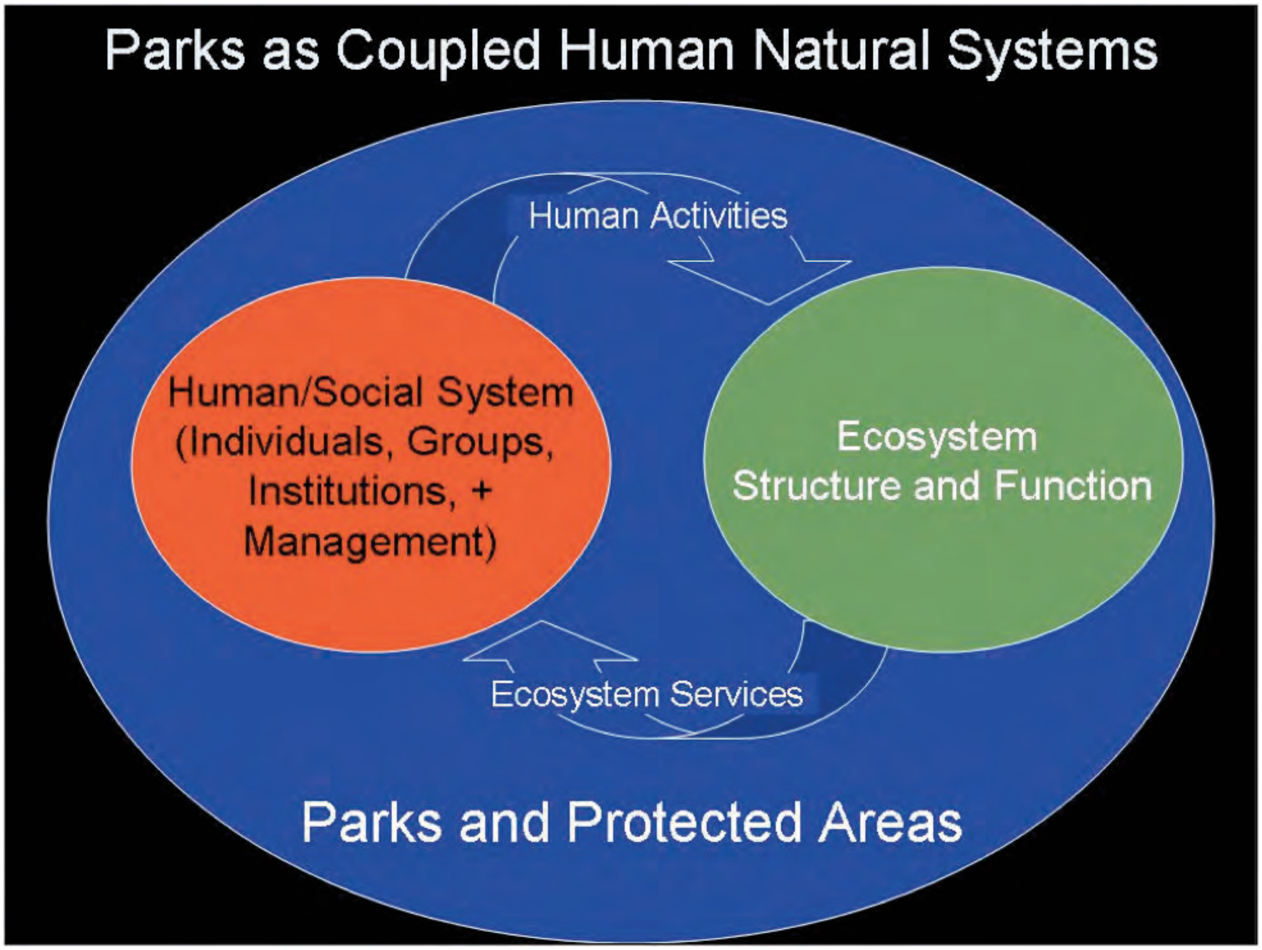


**Figure 2.** Interrelationships between social and natural components in parks and protected areas (adapted from www.resilience.org and NSF 2010).

labeled in a more systematic way to bridge the gap between long-term scientific processes and short-term decision-making.

In many cases, the science behind certain decisions remains unclear. One reason for this is the lack of public access to research. A second reason is the absence of knowledge transfer from the scientific community to society. Scientists need to work toward clearly communicating with non-technical audiences. What better place to transfer the knowledge than at the park itself? In recent years, institutions have begun to address this task, but again, non-scientific communication and publications are not always rewarded in academia. Park managers are in a perfect position to mediate and translate scientific results into publically digestible information.

### Key components to improve scientific outcomes

In summary, integrated science has tremendous potential to help solve complex challenges on both large (global) and small (park) scales. We presently face a tremendous challenge of overcoming the gap between fast-paced demands and timely predictions, and the time needed for high quality research. The combination of interdisciplinary research, and the integration of that research into science, will lead to better-informed decisions. In order to make this happen, science needs faster communication channels and opportunities to brief the public. While doing this, the art of concision becomes a key factor in communicating with non-scientific audiences. This becomes extremely important in crisis situations that demand urgency. Disasters such as the 2010 Deepwater Horizon accident, or the 2011 Japan earthquake and tsunami, are examples of how the scientific community is being encouraged to develop nimble systems of communication and information transfer (often gathered from long-existing inventorying and monitoring processes) that make information available in a timely manner.

From a scientific standpoint, data should never be delivered with a false sense of accuracy. In some cases, providing a realistic range of findings rather than numbers can be helpful. In other situations, assigning and accepting some systematic level of uncertainty may be the key to successful communication. Additionally, managers should let their decisions play out, but always keep in mind predetermined reversal points whereby decisions can be rescinded.

The integration of interdisciplinary research into scientific outcomes needs to be supported and valued by managers. Within the scientific community, conferences like the George Wright Society meeting play a key role in providing a starting point for interdisciplinary and integrated conversations. Changes can already be seen. Natural and social scientists are quickly moving toward multi- and inter-disciplinary efforts. Academic institutions are now implementing programs for training the future generation of managers and scientists in interdisciplinary research and integrated practices. This movement gives hope for more holistic approaches that will benefit the precious resources protected by parks and protected areas throughout the world.

### Audience contributors to the panel discussion

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# Fires in Previously Burned Areas: Fire Severity and Vegetation Interactions in Yosemite National Park

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## Abstract

In 2009, four fires occurred in Yosemite National Park in extensive areas that had burned in the 1990s. In some high severity areas resulting from these fires, a vegetation type conversion from lower and upper montane pine and fir forests to montane chaparral communities occurred. Questions arose from resource managers and the public regarding whether the park should reintroduce fire into those areas. This analysis evaluates the effect that the 1990s fires had on vegetation and the severity of the 2009 fires. In particular, areas that resulted in high severity in the first fires shaped vegetation and, therefore, the severity distribution of the subsequent fires. With external factors such as climate change, population growth, and air quality concerns affecting how Yosemite implements federal fire policy, the park can use this information to evaluate and manage fires in a more effective manner.

## Introduction

Yosemite National Park covers 747,955 ac of the central Sierra Nevada in California, and varies from 2,000 ft in the west to 13,000 ft along the crest of the range. The elevation profile from west to east produces distinct vegetation communities. Lower montane forests occur between 2,000 and 6,000 ft, upper montane forests from 6,000 to 8,000 ft, and subalpine forests from 8,000 ft to tree line at 11,000 ft.

The Mediterranean climate of Yosemite is characterized by warm, dry summers and cool, wet winters with precipitation primarily occurring between November and April. However, a monsoonal flow from the southeast, south, and southwest creates numerous thunderstorms, and is responsible for lightning and rain in the summer. At the lower elevations, where burnable vegetation is abundant, lightning is less frequent. The converse is true for the higher elevations: abundant lightning, sparse vegetation. In Yosemite and the Sierra Nevada, lightning ignited fires will burn fire-adapted and dependant vegetation every year (van Wagtendonk et al. 2002, van Wagtendonk and Fites-Kaufman 2006, van Wagtendonk and Cayan 2008).

Fires that have not burned since the start of park's fire history dataset, dating back to 1930, or burn areas that have missed more than three return intervals, are considered first entry. Subsequent, or second entry, fires that burn within the initial fire footprints interact based on fire

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severity and vegetation. The first entry burns can influence the vegetation and subsequent severity of future fires. Severity is defined by the amount of environmental changed caused by fire, or how the vegetation responds to fire.

## Methods

**Severity data.** Satellite imagery compiled by Thode (2005) and Miller and Thode (2007) was used to determine fire severity for all fires between 1974 and 2003. They used Landsat Multitemporal Spectral Scanner (Landsat MSS) imagery to map the severity of all fires greater than 100 ac in the Sierra Nevada between 1974 and 1983, using the normalized difference vegetation index (NDVI). They used Landsat Thematic Mapper (Landsat TM) imagery to map fires from 1984 through 2003, using the differenced normalized burn ratio (dNBR). To account for heterogeneity of pre-fire vegetation among fires, relative measures of fire severity were used: the Relative differenced NBR (RdNBR) for fires mapped with Landsat TM, and the Relative NDVI (RNDVI) for fires mapped with Landsat MSS (Thode 2005, Miller and Thode 2007). Since 2004, for fires greater than 100 ac, the park used the USGS Monitoring Trends in Burn Severity (MTBS) program (Eidenshink et al. 2007). The severity thresholds determined by Thode (2005) between severity levels in the RdNBR data were used to distinguish unchanged, low, moderate, and high severity areas.

**Vegetation data**. The vegetation in Yosemite was mapped in the 1930s and 1990s. Field surveys for the first map were conducted between 1932 and 1936, as part of an effort to map areas of continuous forest cover throughout California (Wieslander 1935). The second map was completed in 1997, using plot data and aerial photography (Keeler-Wolf et al. 2011). Both maps indicated dominant overstory and understory species, and were entered into a geographic information system (GIS) by the park (van Wagtendonk et al. 2002).

**Data analysis.** The severities of first entry burns were initially clipped, using ArcGIS (Environmental Systems Research Institute, Redlands, CA), to the extent of the second entry fire, to provide an analysis with the reburned areas for each subsequent fire. The severity of the first fire was compared to the severity of the second fire to determine how the initial fire influenced the subsequent fire. The vegetation that burned in the second fire was also compared to that fire's severity to determine which vegetation types resulted in any given severity category.

## Results

The A-Rock and Steamboat fires of 1990, and the 1996 Ackerson fire were three of the largest fires in park history (Figure 1). August thunderstorms ignited these unprecedented fires in the western part of Yosemite. Large areas of ponderosa pine, white fir, and red fir were burned in crown- or canopy-fires, which converted the habitat to chaparral, dominated by species of ceanothus and manzanita.

In 2009, fires reburned parts of all three of these large burned areas (Figure 1). The Cotton - wood and Harden fires reburned entirely within the footprint of the Ackerson fire, the Grouse fire reburned a portion of the Steamboat fire extent, and the Big Meadow fire reburned part of the area the A-Rock fire burned. The Big Meadow fire also burned part of the 1988 Walker fire burned area, and a prescribed burn completed the reburn of the Walker fire extent in 1980. A 1979 prescribed burn was almost completely reburned by the A-Rock fire, except for a small area that was then reburned by the Big Meadow fire. Additionally, there were areas that the Big Meadow fire burned that had not burned in over 100 years.

All acres reported here were generated from the GIS analysis. Figure 2 breaks down each fire in terms of severity, by the initial fire and the subsequent fire. The "total" row for each analysis is the number of acres in each severity category for the first fire, each "total" column relates to the acres in each severity class for the 2009 fire year. The "unburned" column lists the acres that

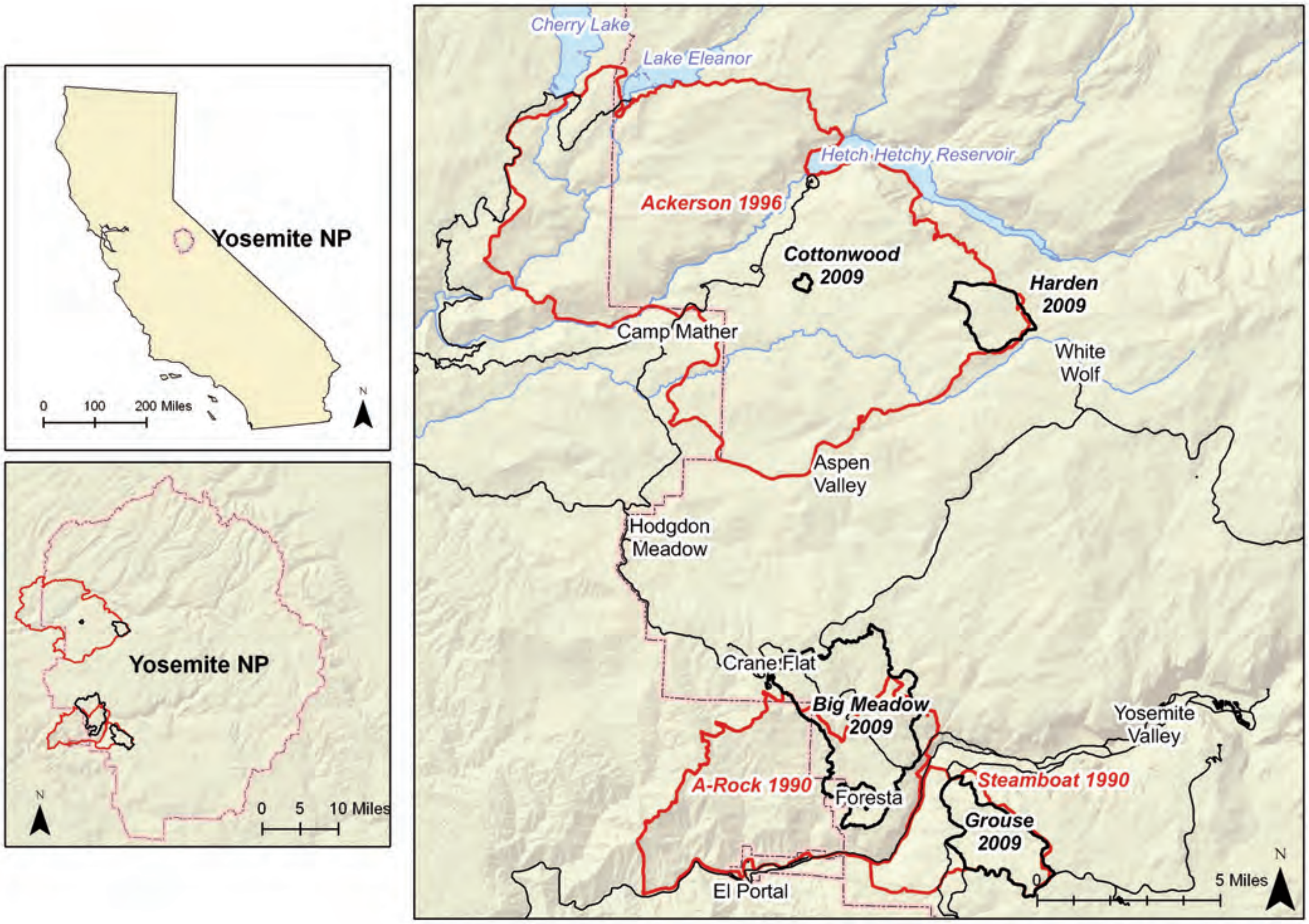


**Figure 1.** Vicinity map showing California, Yosemite, and fires. A-Rock and Steamboat fires burned over 13,000 ac of the park in 1990 and Ackerson burned nearly 47,000 park ac in 1996. The fires of 2009 burned a total of 12,200 ac.

burned in the subsequent fire, but not in the initial fire. The rest of the data report how many acres of each category in the first fire relate to how many acres resulted in each class of the second fire. For example, in the Cottonwood fire, 2 ac that resulted in low in the Ackerson fire resulted in unchanged in Cottonwood fire. Figures 3 and 4 show the severity of the initial Ackerson fire and the severity of the subsequent Harden fire.

**Cottonwood, Grouse, and Harden fires**. The 2009 Cottonwood fire reburned 94 ac of the Ackerson fire from May 18th to 25th. While the Ackerson fire had 44 ac that resulted in high severity, the Cottonwood fire only had 3 ac. The majority of Cottonwood resulted in low severity (Figure 2). The majority of the vegetation burned was ponderosa pine (45 ac) and chaparral (39 ac). Ponderosa pine resulted in the 3 ac of high severity.

The 2009 Grouse fire was ignited on May 30th, but did not grow in size until the last week of June when weather conditions were conducive to fire growth. By July 11th, the Grouse fire had grown to 3,067 ac, reburning 3,026 ac of the 1990 Steamboat fire. Even though the severity distribution was similar between the two fires, there was a shift in severity from unchanged to low and from low to moderate from the Steamboat fire to the Grouse fire. It is worth noting, though, that the majority of high for the Grouse fire came from the high from the Steamboat fire (Figure 2). The two widely burned vegetation types in the Grouse fire were red fir (908 ac) and white fir (820 ac). However, the chaparral resulted in the largest amount of high severity: 184 out of 396 ac (46%). This represented 62.5% of all high severity acres.

| 2009 fire | 2009 severity | 1980 - 1996 severity (acres) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Unch | Low | Mod | High | Unbrnd | Total |
| Cottonwood/Ackerson | Unchanged | 0 | 2 | 1 | 3 | 0 | **6** |
| | Low | 0 | 20 | 12 | 29 | 0 | **61** |
| | Moderate | 0 | 3 | 10 | 11 | 0 | **24** |
| | High | 0 | 1 | 1 | 1 | 0 | **3** |
| | **Total** | **0** | **26** | **24** | **44** | **0** | **94** |
| Grouse/Steamboat | Unchanged | 159 | 157 | 54 | 5 | 13 | **388** |
| | Low | 390 | 704 | 152 | 15 | 18 | **1,279** |
| | Moderate | 164 | 510 | 304 | 119 | 9 | **1,106** |
| | High | 10 | 48 | 58 | 177 | 1 | **294** |
| | **Total** | **723** | **1,419** | **568** | **316** | **41** | **3,067** |
| Harden/Ackerson | Unchanged | 43 | 159 | 54 | 9 | 9 | **274** |
| | Low | 23 | 304 | 117 | 16 | 17 | **477** |
| | Moderate | 3 | 129 | 200 | 77 | 10 | **419** |
| | High | 1 | 14 | 146 | 251 | 0 | **412** |
| | **Total** | **70** | **606** | **517** | **353** | **36** | **1,582** |
| Big Meadow/ A-Rock and Walker | Unchanged | 18 | 31 | 71 | 114 | 0 | **234** |
| | Low | 59 | 217 | 168 | 236 | 0 | **680** |
| | Moderate | 95 | 318 | 514 | 906 | 0 | **1,833** |
| | High | 28 | 70 | 282 | 1,195 | 0 | **1,575** |
| | **Total** | **200** | **636** | **1,035** | **2,451** | **0** | **4,322** |
| Big Meadow/1979 & 1980 Rx | Unchanged | 9 | 28 | 16 | 0 | 14 | **67** |
| | Low | 110 | 358 | 281 | 0 | 13 | **762** |
| | Moderate | 127 | 483 | 621 | 0 | 0 | **1,231** |
| | High | 29 | 77 | 220 | 0 | 0 | **326** |
| | **Total** | **275** | **946** | **1,138** | **0** | **27** | **2,386** |
| Big Meadow/previously unburned | Unchanged | | | | | 11 | **11** |
| | Low | | | | | 211 | **211** |
| | Moderate | | | | | 350 | **350** |
| | High | | | | | 268 | **268** |
| | **Total** | | | | | **840** | **840** |
| Big Meadow total | Unchanged | 27 | 59 | 87 | 114 | 25 | **312** |
| | Low | 169 | 575 | 449 | 236 | 224 | **1,653** |
| | Moderate | 222 | 801 | 1,135 | 906 | 350 | **3,414** |
| | High | 57 | 147 | 502 | 1,195 | 268 | **2,169** |
| | **Total** | **475** | **1,582** | **2,173** | **2,451** | **867** | **7,548** |

**Figure 2.** Number of acres resulting in severity classes. The columns report the resultant acres of severity for the initial fires, and the rows report the resultant acres of severity for the subsequent fires. The unburned column shows acres that burned in the subsequent fire but not in the initial fire. The total column reports the total acres the severity for the initial fires, and the column row reports the total acres for severity of the subsequent fires.

The 2009 Harden fire, ignited on June 8th, remained small until the end of June, and was declared out on July 11th. Both the Grouse and the Harden fires were managed with fire personnel herding the fire to predetermined and established boundaries. The Harden fire reburned of 1,546 ac of the Ackerson fire, as well as 36 previously unburned acres. There was much less unchanged vegetation in the Ackerson fire than in the Harden fire. The severity distribution of

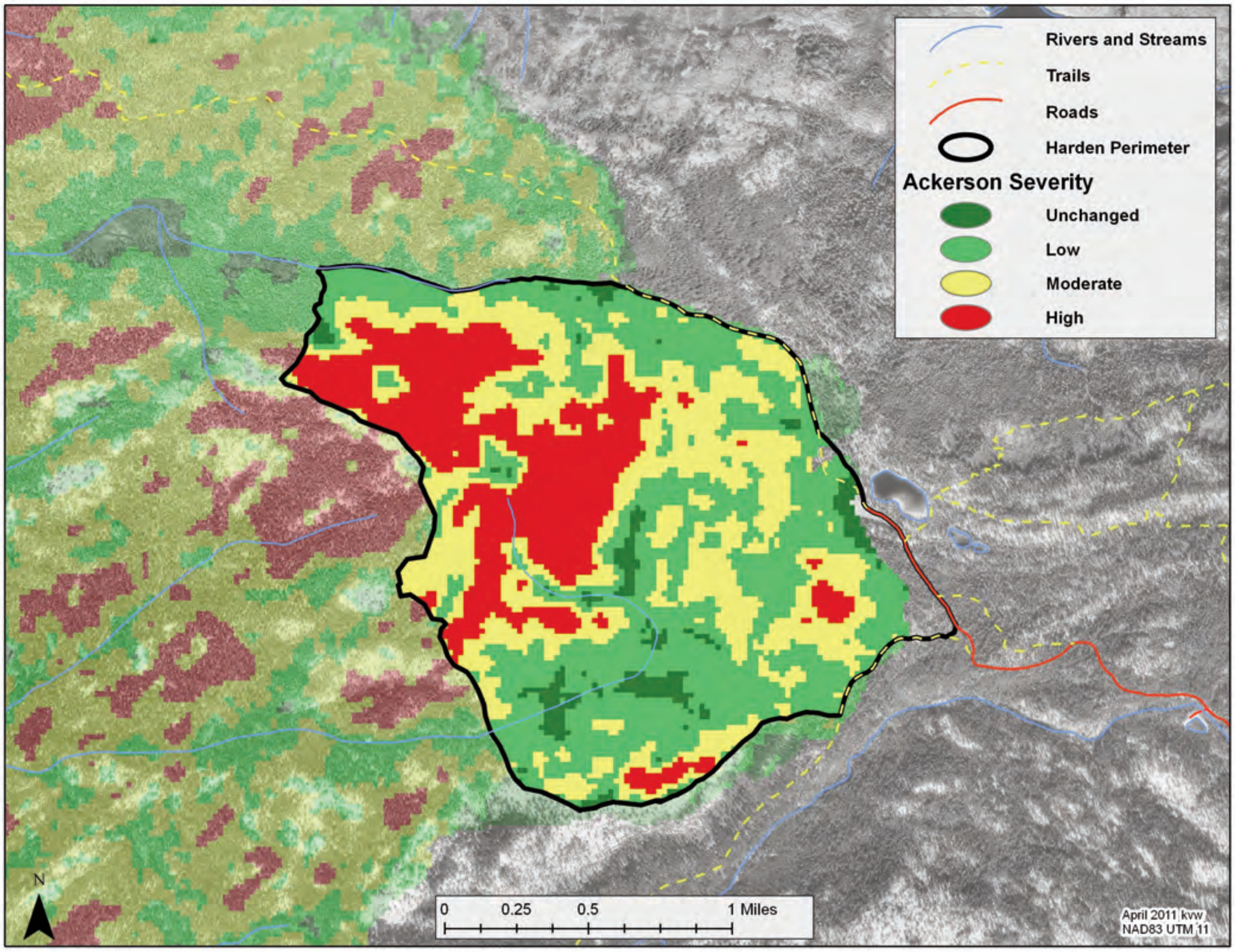


**Figure 3.** Map of the 1996 Ackerson fire severity. The dark green areas represent unchanged severity, light green low severity, yellow moderate severity, and the red symbolizes areas that resulted in high severity. The 2009 Harden fire perimeter is shown for reference.

the other classes is similar. However, it is interesting to note that the majority of high severity in the Harden fire came from areas of moderate and high severity from the Ackerson fire (Figure 2). Red fir (1,035 ac) and chaparral (434 ac) are the dominate vegetation types within the Harden footprint. The resulting high severities were 105 ac and 300 ac respectively. For red fir, this was 10% and for chaparral 69% of the area of each of those vegetation types. In terms of percentage of high severity acres, red fir accounted for 25% with chaparral making up 73%.

**Big Meadow fire.** The 2009 Big Meadow was a management-ignited prescribed burn conducted on August 26th. The intent of the burn was to treat 91 ac of Big Meadow. However, the fire escaped control lines, and by September 4th, it had burned 7,548 ac (Figure 2). Of those acres, 2,386 had burned in a 1980 prescribed burn, 361 in the 1988 Walker fire, and 3,961 in the 1990 A-Rock fire. Eight hundred forty acres burned in the Big Meadow had not previously burned. There was an additional prescribed burn completed in 1979; the A-Rock fire reburned all but 27 ac of that earlier burn. The reburn analyses of A-Rock fire and this prescribed burn were completed, but not included because it did not influence the behavior, intensity or resultant severity of A-Rock fire. Most of the area of the 1979 prescribed burn, regardless of initial severity (mostly unchanged and low), resulted in high severity when reburned by the A-Rock. The

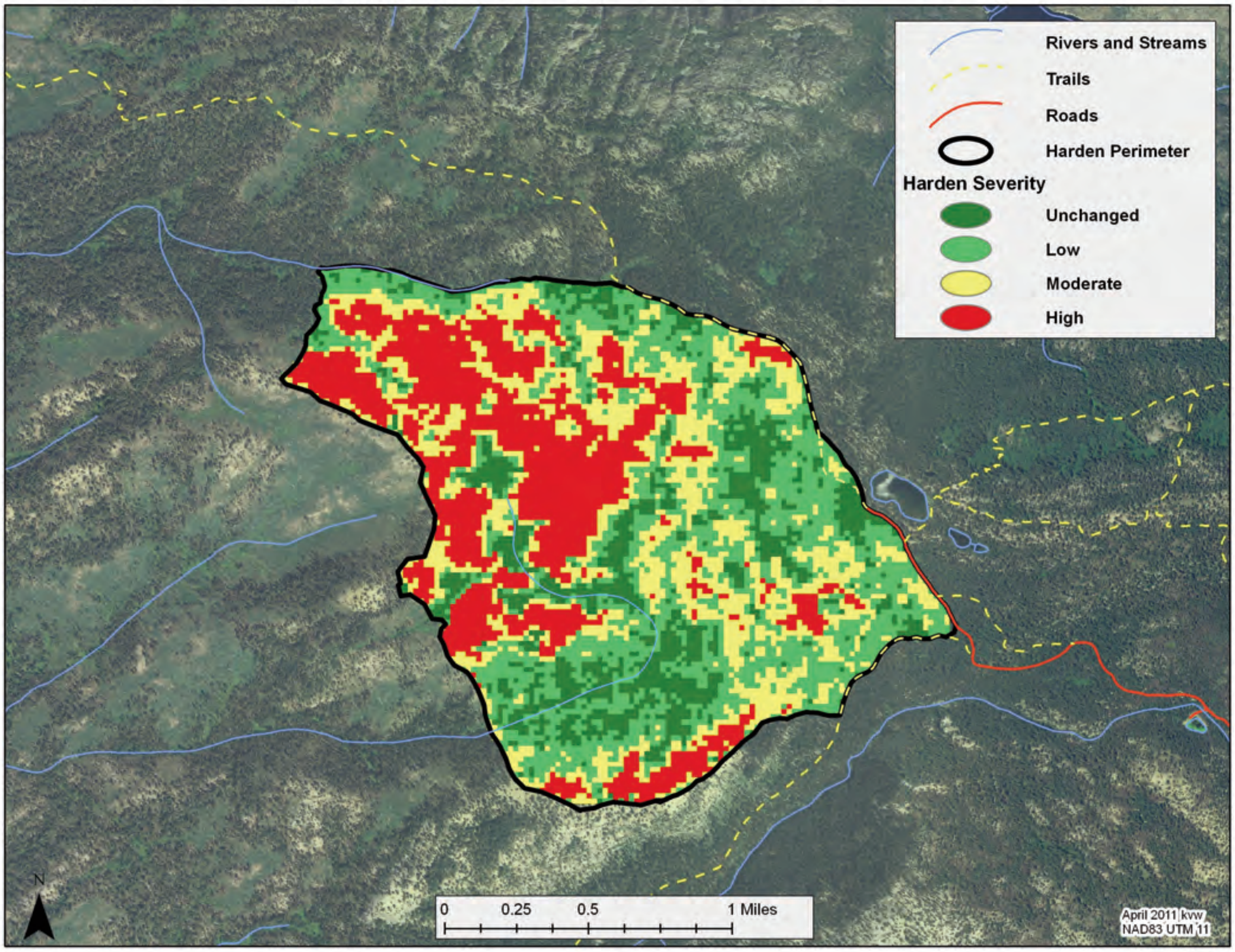


**Figure 4.** Map of the 2009 Harden fire severity. The dark green areas represent unchanged severity, light green low severity, yellow moderate severity, and the red symbolizes areas that resulted in high severity.

severity of the Big Meadow fire was skewed toward moderate and high severity. This was true in the areas that were burned by the Walker and A-Rock fires, as well as in the previously unburned areas, and to some extent in the area previously burned by the prescribed fire (Figure 2).

The two dominate vegetation types that burned in the Big Meadow were white fir and chaparral with 1,891 and 1,760 ac respectively. Other species of note are ponderosa pine, red fir, and live and black oak. Chaparral had the most acres resulting in a high severity burn, with 967 ac, or 55% of that vegetation type. This accounted for 44.5% of all high severity acres. White fir had the second largest amount of acres resulting in high severity with 376, or 20% of that vegetation type. This represented 17% of all high severity acres. Live oak had the second largest percentage resulting in high severity within its vegetation type with 177 out of 454 ac (39%), making up 8% of all high severity acres.

### Discussion

In areas of high severity that are now chaparral, early season burns could be used to reduce the large amount of coarse woody debris that remain, either standing or fallen, from the first entry fire. The Cottonwood fire is a good example of how areas of high severity in the initial fire converted ponderosa pine to chaparral, but then when reburned; it did not result in high severity.

The in-season burns, however, show that areas of high severity in the first entry burn subsequently reburned with high severity. For example, a patch of forest that had burned with high severity might be replaced with shrubs that will subsequently burn with a high severity stand replacing crown fire (Collins and Stephens 2010). As a result, the high severity patch is perpetuated by the change in vegetation.

In the footprint of the Big Meadow fire, the previous wildfires of 1988 and 1990 also converted extensive areas of pine and fir to chaparral in those areas that resulted in high severity. These areas resulted in high severity when reburned by the Big Meadow fire. Additionally, in the areas that had not previously burned, resulting moderate and high severity acres made up the majority of area burned by the Big Meadow fire. Conversely, subsequent high severity was lower in areas that had previously been prescribe burned, because and the fire did not burn into the canopy. Therefore, prescribed burn areas were, in subsequent burns, had only a small acreage of high severity burn.

Frequent resultant high severity in these type converted landscapes could lead to a permanent shift from pine and fir to chaparral. This is especially true if the climate changes allowing fires to start earlier, last longer, and grow large (Westerling et al. 2006). However, early season burns can allow for the large coarse woody debris to be consumed and, in Yosemite, typically burn with unchanged or low severity. Wildfires, which usually do not burn under prescribed conditions, burn with moderate and high severity (van Wagtendonk and Lutz 2007). Using prescribed fire or natural lightning ignitions to burn under prescribed conditions can effectively reduce fuels and the probability of large, unprecedented fires that may lead to a change in vegetation types.

A transitory fire fuel type was created after the large fires of the 1990s, as a result of high severity. The type conversion from lower and upper mixed conifer that has occurred over the past 15 to 20 years has resulted in homogeneous patches of tall and compact ceanothus and manzanita, growing among the standing snags and fallen logs created by the initial fire. Yosemite has thousands of acres of this fuel type as a result of the high severity of fires in the past 40 years. Since 1972, the park has attempted to restore fire as a landscape level ecosystem process that was excluded for decades (van Wagtendonk 2007). The goal had been, and continues to be, to avoid the large, unprecedented fires that lead to type conversions from timber to chaparral, as seen by the A-Rock, Steamboat, and Ackerson fires. The park now has severity data for first entry burns, vegetation data from 1997, and severity data for second entry burns. New lightning ignited fires that occur in areas that resulted in high severity in previous years can be assessed by park managers when deciding a course of action for fire management.

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# Lightning Fire Ignition Patterns in Yosemite National Park

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## Abstract

FIRES IN YOSEMITE NATIONAL PARK BURN ACROSS THE LANDSCAPE IN MANY VEGETATION TYPES and elevation zones. Fire records dating from 1930 to 2010 have been used to determine the spatial distribution of lightning fire ignitions in the park. This investigation involved conducting a density analysis of all lightning ignited fires in the park to evaluate potential patterns within the landscape. When lightning does ignite fires, park managers use fire management units to prioritize which fires to manage or to suppress. However, the park is investigating removing the fire management unit boundary which dictates management action to bring decision making into congruence with current federal wildland fire policy. Assessing large landscape areas to determine whether or not to allow lightning ignited fires to burn will be paramount in this process. The following analysis will provide park managers with a means to prioritize management of ignitions based on the historic distribution of starts, the time since an area last burned, the time of year of the ignition, and where the ignition is located.

## Introduction

Yosemite National Park covers 747,955 acres of the central Sierra Nevada in California, and its elevation varies from 2,000 feet in the west to 13,000 ft along the crest of the range. Along the elevation profile while travelling west to east, distinct vegetation types can be seen. Lower montane forests occur between 2,000 and 6,000 ft, upper montane forests from 6,000 to 8,000 ft, and subalpine forests from 8,000 ft to tree line, at 11,000 ft.

The Mediterranean climate of Yosemite is characterized by warm, dry summers and cool, wet winters, with precipitation primarily occurring between November and April. However, a monsoonal flow from the southeast, south, and southwest creates numerous thunderstorms and is responsible for lightning and rain in the summer. At the lower elevations, where burnable vegetation is abundant, lightning is less frequent. The converse is true for the higher elevations: abundant lightning, sparse vegetation (van Wagtendonk and Cayan 2008).

Because the Sierra Nevada has an extensive history of lightning strikes and subsequent fires (van Wagtendonk et al. 2002, van Wagtendonk and Fites-Kaufman 2006, van Wagtendonk and Cayan 2008), managers must consider factors, in addition to ecology, when deciding whether to

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suppress a fire. In 1972, a prescribed natural fire program was established in Yosemite, establishing the opportunity to manage lightning ignited fires, allowing them to burn under prescribed conditions (van Wagtendonk 2007). Yosemite National Park's extensive fire records (1930 to the present) have facilitated studies of the spatial distribution of lightning fire ignitions (van Wagtendonk 1994, van Wagtendonk and Davis 2010). This analysis builds on this research by addressing spatial density patterns of lightning ignitions.

In Yosemite, lightning ignitions occur along the western boundary of the park, in the lower mixed conifer forest. The majority of this area, however, falls in the Suppression Unit of the park, which is also in the most altered condition class (fire regime condition class, FRCC) or highest fire return interval departure (FRID) class. If a lightning ignition occurs in this management unit, Yosemite is bound by its fire management plan (FMP) to suppress the fire. In order to return fire to the landscape, and thereby reduce fuel build up within the Suppression Unit, the park is obligated to use prescribed fire. It becomes increasingly difficult to conduct large, landscape-level prescribed burns, and park managers have begun to evaluate its FMP to decide whether the Suppression Unit boundary (except around communities and infrastructure) should be removed. Yosemite would still evaluate each ignition based on fire history, time of year, availability of fire management resources, location, and amount of quality planning that has been accomplished.

## Methods

**Ignition distribution.** Fire data from Yosemite National Park's GIS database were used to assess when and where fire ignitions occurred. These data are updated annually at the completion of the fire season, and are added to the database, which dates back to 1930. Actual ignition point location data have been collected by fire personnel using GPS for a number of years in Yosemite. However, for historic fires without accurate location data, the center of each fire perimeter was calculated in GIS. The lightning ignited point database was used for the spatial analysis of lightning fire ignition patterns. Additionally, this ignition point database was used to determine which fires were suppressed, and which were managed. Within the database, fire size was queried to determine how many acres were burned under each of two varying management strategies. The dataset was split into two groups, 1930 to 1971, and 1972 to 2010, because a change in fire management policies allowed park managers to allow lightning caused fires to burn, beginning in 1972, if the ignition occurred under prescribed conditions. The data were analyzed within these two groups as well as in totality.

**Density analysis.** The ignition point dataset was processed in a density analysis application. For each ignition, the analysis determined how many other ignitions were within 2 km. The resultant density was calculated, and displayed in ignitions per square kilometer.

## Results

**Ignition distribution**. Between 1930 and 2010, a total of 3,199 lightning fires ignited, and they burned 197,027 ac within Yosemite National Park (Table 1; Figure 1). The result was an average fire size of 61.6 ac. However, before 1972, 1,340 fires burned 7,689 ac. This represents 42% of all ignitions, but only 4% of the total acres burned. The average fire size during this 42-year period decreases to 5.7 ac. All fires were suppressed per the management policies of the time.

Between 1972 and 2010, an additional 1,859 fires were detected, and they burned 189,338 ac. Therefore, in the past 39 fire seasons, the lightning ignitions, comprising just 58% of the total from 1930–2010, burned 96% of the total acres burned sine 1930. The average fire size in the last 39 seasons increased to 101.8 ac. Of these fires, 1,151 were suppressed either due to location, time of year, or availability of fire resources. This represents 36% of all fires, and 62% of fires between 1972 and 2010. These suppressed fires burned 83,280 ac (42% of the total acres burned, and 44% of acres burned since 1972) resulting in an average size of 72.4 acres. Seven-

| Fire management period | Number of fires | Percent 1972-2010 | Percent 1930-2010 | Area burned (ac) | Percent 1972-2010 | Percent 1930-2010 | Ave size (ac) |
|---|---|---|---|---|---|---|---|
| 1930-1971 | 1,340 | | 42 | 7,689 | | 4 | 5.7 |
| 1972-2010 | | | | | | | |
| Suppressed | 1,151 | 62 | 36 | 83,280 | 44 | 42 | 72.4 |
| Managed | 708 | 38 | 22 | 106,058 | 56 | 54 | 149.8 |
| Sub total | 1,859 | 100 | 58 | 189,338 | 100 | 96 | 101.8 |
| Total | 3,199 | | 100 | 197,027 | | 100 | 61.6 |

**Table 1.** Number, percent, and area burned by lightning fire ignitions for the period before and after the management policy change.

hundred-eight fires were managed for resources objectives between 1972 and 2010, and burned 106,058 ac. These managed fires represent 22% of all fires and 38% of fires between 1972 and 2010. They burned 54% of all acres and 56% of the acres since 1972. The average fire size of these managed fires grew to 149.8 ac.

**Density analysis.** Areas with a high density of lightning ignitions are apparent in Figure 2. Ridge tops with burnable vegetation in the western portion of the park are locations where multiple lightning ignitions have occurred. These areas are relatively higher on the landscape, and did not burn in the past 81 years. The surrounding fuels of the lower montane vegetation zone have become abundant due to fire exclusion, and are receptive to lightning-caused fires under the right conditions (van Wagtendonk and Fites-Kaufman 2006). Other areas of interest are vegetated, unglaciated ridges in the north-central part of the park. Areas of low density are equally visible in Figure 2. Deep, glaciated, granite valleys show few, if any, lightning ignitions.

There are, however, two areas that have low densities, despite being surrounded by areas of higher density. These areas are located near the middle of the park, and not near the crest (where ignitions are rare), nor are these areas deep valleys, where lightning is less likely to strike, much less ignite, a fire. Factors such as slope, elevation, vegetation type, and density were all assessed to determine why these areas have a low incidence of lightning ignitions. However, one factor, snow duration, seemed to influence the low ignition density result.

**Discussion**. Yosemite manages fire according to its 2004 fire management plan/environmental impact statement (FMP). Specifically, the park has two management units: Suppression and Managed Fire (NPS 2004). If lightning ignites a fire within the Suppression Unit, the park will immediately suppress it, using the appropriate management response strategy (NPS 2004). In the Managed Fire Unit, lightning-ignited fire would be the primary tool used to meet ecological target conditions (NPS 2004). Therefore, in order to treat fuels in the Suppression Unit, the park is mandated to use prescribed fire to achieve that objective because other mechanical methods to remove fuels are not permitted in the wilderness portions of the unit.

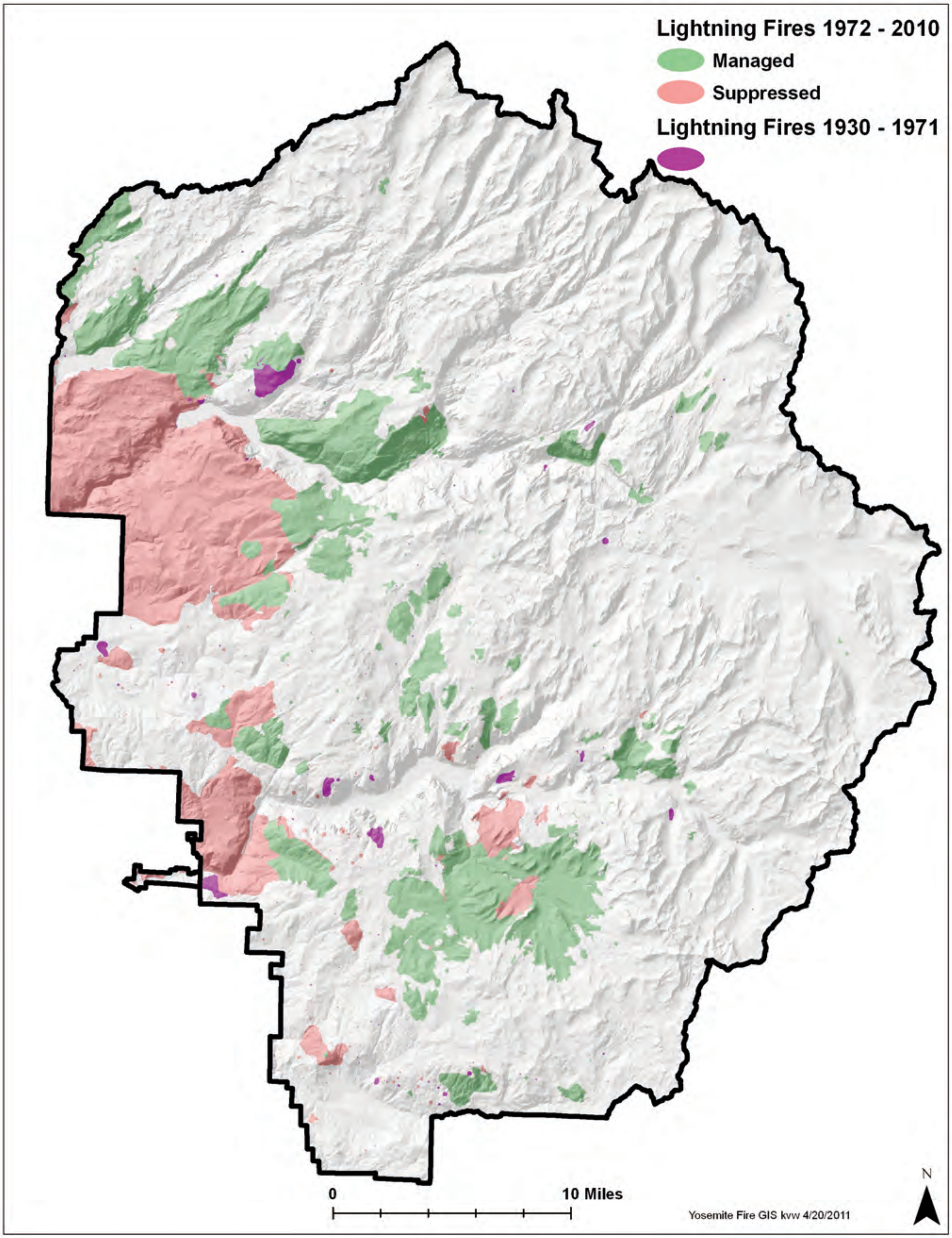


**Figure 1.** Lightning fire history for Yosemite National Park. The purple areas show the 7,689 acres that burned from 1930 to 1971. The pink areas represent the 83,280 acres that were suppressed and the green areas symbolize the 106,058 acres that were managed from 1972 to 2010.

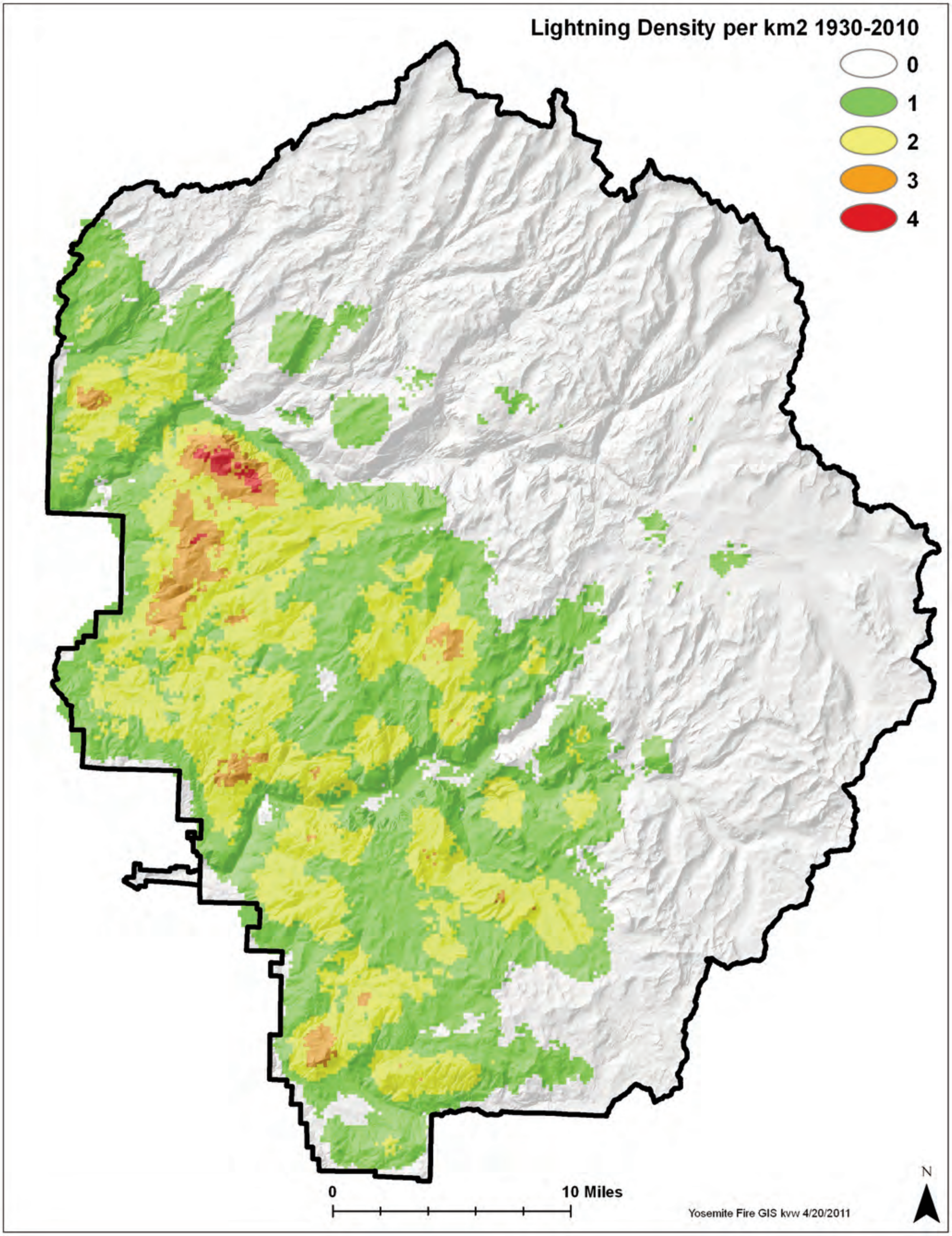


**Figure 2.** Lightning fire ignition density. The green areas represent low ignition density, and the red symbolizes areas of high density. Density is categorized as number of lightning fire ignitions per square kilometer.

As shown by the ignition and density data, the Suppression Unit receives significant lightning. Given that in this unit, the park would manage lightning fires for the single objective of putting them out, it would follow that the park should use prescribed fire to treat fuels and return fire to the Yosemite landscape. However, when looking at the prescribed fire history in Figure 3, this simply has not been happening on the scale needed to treat large areas. The park is suppressing lightning fires and is also not prescribe burning. Had the park allowed some of the lightning fires to burn, fuels could have been reduced (van Wagtendonk and Davis 2010). Additionally, each time the park suppresses a fire, there is an impact to the landscape, and a missed opportunity to break up the continuity of fuel loading and complex forest structure. Had a few of these fires been allowed to burn under prescribed conditions, future fires may have burned into the fire scars, and required fewer fire fighters and equipment, less risk, and environmental impacts from suppression. This strategy is how the park does manage fires outside of the Suppression Unit and there are numerous examples of where previous fire history influenced fire spread, intensity, and area burned.

Indeed, could Yosemite remove its Suppression Unit altogether? The park would still evaluate all fires, and employ suppression tactics near the communities of Wawona, Foresta, Yosemite Valley, El Portal, and the infrastructure at Hetch Hetchy, but outside of these identified wildland urban interface (WUI) areas, lightning would be used as the primary tool to restore fire to its natural ecological roll in the fire-adapted ecosystem of the Sierra Nevada. Yosemite, though, could suppress any fire, depending upon weather, fuels, topography, national and state preparedness levels, and time of year. But, by removing the Suppression Unit, the park would be able to manage landscape level fires through lightning, and reach targeted treatment acres as directed by the FMP. Additionally, given that the fuels projects outside of the WUI will only receive 10% of potential funding, leaving lighting as the only option to manage fires outside of WUI, this would be a way to treat fuels naturally. For example, the park conducted a 210 ac burn in 2010, and is funded for another 200 ac in 2011. While these projects are designed to protect the WUI areas, they do not meet the broader ecological objectives that landscape-wide prescribed or lightning ignited fire would achieve.

There are thousands of acres of the park that have missed more than 3 fire return intervals; however, the data and analyses show that these areas do indeed get lightning. The park, therefore, could utilize lightning ignitions to restore landscape complexity that would allow fires to "self organize," as we've seen in the Illlilouette basin. If multiple starts occurred, these previously unburned areas within the old Suppression Unit could be prioritized over previously-burned higher elevation areas. This would require a tremendous amount of planning to ensure the completion of a successful project. If the park were to move away from prescribed burn units, and utilize watersheds as planning units, the park could identify areas in the lower mixed conifer that receive frequent lightning, and use existing roads, trails, ridges, drainages, and previous fires as control points, but not boundaries. In 2009 the park managed the Grouse lightning ignited fire in such a way that used existing fire handline, the Wawona and Glacier Point roads to manage a lightning fire. Once the boundaries were established, the park was able to burn over 3,000 ac.

Inter-agency collaboration with the Forest Service would be essential if Yosemite were to move forward with this idea of using watershed boundaries as planning units. The western boundary between Yosemite and the Stanislaus and Sierra National Forests is made up of straight lines, and is not ecologically meaningful, nor is it realistic to manage fire along it. Other stakeholders, such as gateway communities, and local and regional air quality control districts, would have to agree to such a proposal before the park could go ahead with it. Agreement from all interested parties is the way to move forward, and is essential as the park strives for transparency in how it manages fires on its landscape.

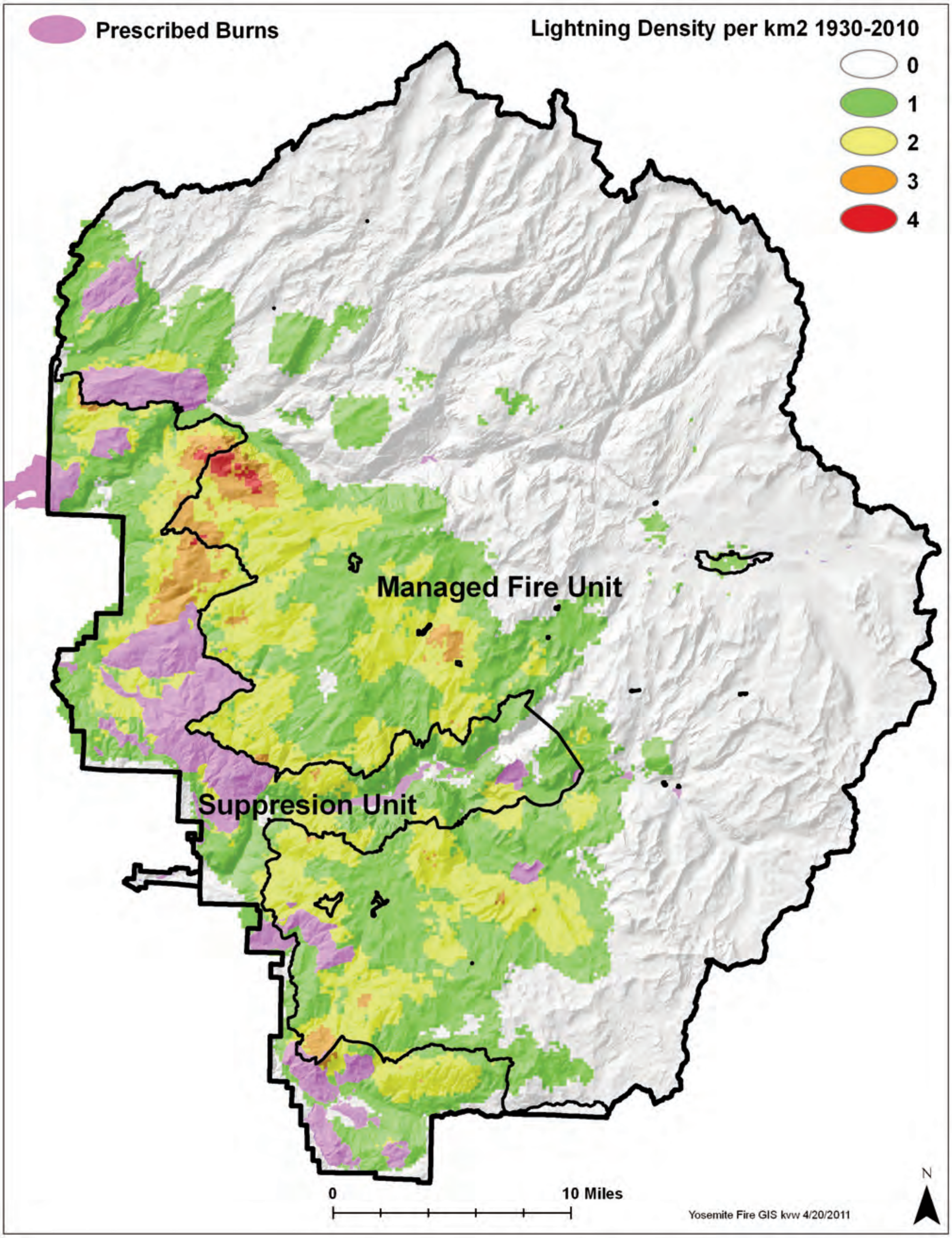


**Figure 3.** Lightning fire ignition density and prescribed fire history. Despite the benefit of large prescribed burns, many large burns were completed prior to 2006. In many years when the park is unable to conduct landscape-level burns, the more vulnerable the ecosystem becomes to large, undesired fires.

In these lower elevation areas, the planning efforts would pay off. The park has to be realistic about its able to manage fire in these highly altered landscapes that have a tremendous amount of fuel. Conditions would have to be just right in order to allow fire to burn here. Again, existing infrastructure and previous burn perimeters would need to be identified, to ensure these fires could be managed safely. Under prescriptive parameters for these vegetation types and fuel models, Yosemite could usher in a new era of fire management on both sides of the border.


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# An Interactive Workshop: Identifying Ways to Improve Park Break

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## Introduction

An interactive workshop, intended to identify ways to improve Park Break, was conducted during the week of March 14–18, 2011, during *Rethinking Protected Areas in a Changing World,* the biennial George Wright Society Conference on Parks, Protected Areas, and Cultural Sites, held in New Orleans, Louisiana. The goals of the workshop were to examine recent Park Break evaluation results, review past Park Break participants' suggestions for improvement, engage workshop attendees in a discussion of these suggestions, and create a list of recommended actions to present to Park Break organizers.

## Background

Park Break is a national park-based, weeklong field seminar for graduate students interested in a career involving park-related research, education, or management. The Park Break concept was developed in 2007 as a collaborative program by members of the George Wright Society (GWS), National Park Service (NPS), U.S. Geological Survey (USGS), Texas A&M University, Colorado State University, Geological Society of America, and the Student Conservation Association. Park Break offers graduate students in academic fields related to parks, i.e., natural resource management, ecotourism, civic engagement, conservation, social science, and cultural heritage, an opportunity to spend a week in a national park. Students attend both field and classroom activities led by park scientists, managers, administrators, members of partner organizations, researchers, and scholars. An additional goal of the Park Break program is to provide increased opportunities for minority students to facilitating their careers in the field of park and protected area research and management.

Graduate students have primarily been recruited for Park Break through the GWS web site, with participants selected, and fellowships awarded, through a competitive application process. Sponsored by the USGS, NPS, and USFS, and with support from the other founding organiza-

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tions, four Park Break sessions were held in 2008, three in 2009, and one in 2010. There is currently an additional session scheduled in the fall of 2011 at Delaware Water Gap National Recreation Area, the only NPS unit to have hosted a Park Break Session every year since the program's inception.

Parks and themes in 2008 included the following:

- Acadia National Park/Civic Engagement
- Delaware Water Gap National Recreation Area/Conservation Policy
- Gateway National Recreation Area/Global Climate Change
- Indiana Dunes National Lakeshore/Wildland Urban Interface

In 2009 the parks and themes were these:

- Delaware Water Gap National Recreation Area/Conservation Policy
- Great Sand Dunes National Park/Climate Change & Sustainability
- Mt. Rainier National Park/Natural Hazards

In 2010 the park site utilized, and its consistent theme, was Delaware Water Gap National Recreation Area/Conservation Policy.

### Workshop results

During the Park Break workshop, attendees reviewed the preliminary results of a 2010 evaluation of Park Break (Susan L. Vezeau, Carla Mora-Trejos, Robert B. Powell, and John Donahue, in preparation), which included participants' suggestions for improving the program. These suggestions were the foundation for further discussion, resulting in a list of proposed action items for future Park Break organizers. Workshop attendees believed the program to be a worthwhile endeavor, and suggest that in order for Park Break to grow and prosper, the following items need to be addressed:

- A sound structure of support needs to be established, including the identification of sustainable funding sources
- The creation of standards of learning, goals, or expected outcomes
- The selection of an individual to undertake the primary leadership of Park Break
- The development of a skeletal structure around which all future Park Break sessions could be organized
- Standardization of Park Break forms, general information, expectations, rules of conduct, etc. (i.e., a Park Break Handbook, or a welcome pack of information), to be made readily available for host parks, with only minimal modification needed
- The organization of a volunteer database containing information on interested individuals willing and able to support Park Break (i.e., Park Break alumni, speakers, sponsors, hosts, etc.)
- Marketing through a variety of venues, using an array of modalities, with the intent of recruiting a diverse group of applicants (i.e., through minority universities, indigenous communities, or national historic places that signify important events to specific segments of the population)
- Create and maintain a Park Break web site where future applicants, past participants, potential hosts, or instructors can go for information and inspiration
- Promote and encourage the inclusion of Park Break alumni for future Park Break sessions

- Simplify travel arrangements and minimize costs by utilizing a reimbursement method of payment
- Emphasize the importance of parks and the benefits of play, by bringing participants in a day early, and having them stay a day late, in order to explore the park for recreational as well as educational purposes.
- Continue to strive for excellence in all aspects of Park Break, but especially substantive areas such as speakers, experiential activities, and providing opportunities for engagement

### Suggestions for improvement from Park Break participants

Preliminary results the 2010 Park Break evaluation were discussed with workshop attendees. For the evaluation, researchers utilized a survey instrument to acquire both qualitative and quantitative data from Park Break participants on several topics of interest. Qualitative answers, grouped by topic, included numerous comments and suggestions for improvement.

**Relevancy.** "It is incredibly relevant, some of the things I learned there I am still trying to understand and incorporate in my own research. There were great examples of things that happen there, that are happening in so many other places."

- Care should be made in the selection of Park Break themes (they should not be too overarching).
- Once a theme has been announced it should not be changed.
- Topics of discussion, itineraries, and speakers should be relevant to the Park Break theme.

**Speaker selection.**

- Speakers should be knowledgeable, professional, enthusiastic, and inspiring.
- Try to provide input from local stakeholders.
- International speakers would be beneficial if possible and appropriate.
- Provide a balance between natural and cultural resource experts.
- Allow adequate time for discussion after a speaker's presentation.
- Provide opportunities for speakers to spend casual time with participants.
- Maintain a strict presentation schedule; allow a reasonable length of time for presentations, and include time for discussion.
- Schedule frequent breaks between speakers.
- Schedule field trips to pertinent locations (speakers during travel time).

**Implementation of a speaker evaluation form.**

- Evaluations would be helpful. They would provide organizers guidance regarding which speakers to invite to future sessions, and would allow presenters to get feedback as well.
- Make sure that the evaluation forms are anonymous.
- Provide enough time at the end of the for evaluation forms to be completed.
- Include questions on relevancy.
- Encourage consistent use of the same form for all Park Break sessions.
- Develop and implement an overall Park Break session evaluation (perhaps a version of the survey under discussion) for in-depth and long-term monitoring of Park Break to track performance, allowing for current standards to be maintained or improved.

**Provide opportunities for student presentations.**

- Presentations should be requested, and content should be research-related.
- If participants elect to present, presentations should be short (i.e., 15 minutes), and should be scheduled on the first day (afternoon session) of Park Break.

- This would help to connect participants with speakers and mentors who have similar interests.
- Require each participant to provide a short autobiography with personal and research interests (can be distributed prior to, or immediately upon arrival), to facilitate social interaction, networking and future research.

**Communication.**
- Need for a central communication contact both before and after the Park Break session.
- Develop a welcome packet or website with information on logistics, schedule, packing lists, flights, as well as assigned pre-trip readings that could complement the discussions during Park Break.
- Facebook should be clearly defined as an unofficial communication medium run by participants for social networking only (not everyone has, or wants, a Facebook account).
- Communicate clear expectations for student assignments, projects, papers, or other deliverables, and follow through with necessary support.

**Preparatory materials and assignments.** "It was great reading professional scientific research papers about a park… and then actually meeting and learning from the authors of the papers. It made science 'come alive' this way—'Hey, these are real people doing this research!'"

- Have a few, very relevant readings assigned for each Park Break session.
- Preparatory materials should also include a detailed itinerary.
- Communicate clear expectations for student assignments, give examples if possible.

**Travel arrangements.**
- Have a dedicated contact for logistics.
- Ask participants about transportation preferences and cost saving suggestions.
- Provide a timeline for the reimbursement process.
- Have an emergency contact number to carry during travel.

**Accommodations.** "Accommodations were incredible, it really felt like we were appreciated and taken good care of." "Accommodations were above and beyond what I expected."

- Maintain high standards in accommodations.
- If shared rooms are a necessity, make sure the room size is appropriate.
- Limit travel time to meeting facilities.
- If possible, provide transportation in the park to allow greater access.

**Meal arrangements.**
- Maintain current high standards, including the availability of snacks, and vegetarian options.
- If possible, alcohol should be allowed with dinner and during evening social time.
- Try to schedule some free time before dinner or other evening activities.

**Meeting facilities.** "I think having the meeting at Grey Towers was an amazing opportunity—really once in a lifetime." "Grey Towers is incredibly beautiful and comfortable. This historic icon in conservation history was the cherry on top."

- Meeting facilities should be sized appropriately and have the necessary equipment for presentations.
- Room temperatures need to be maintained at comfortable levels.
- Limit drive times to meeting facilities.
- Try to schedule some outdoor meeting time within the park if weather permits.

**Extracurricular activities.** "Students had a chance to shadow park staff doing night-time owl surveys—excellent! Maybe one or two nights of activities would be good, but not every night."

- Provide unstructured, free time within the schedule.
- Introduce participants to appropriate park staff (i.e. entry level, scientists, HR, etc.).
- Arrange venues for casual social interactions between participants, organizers, park staff and speakers.
- Allow time, or schedule time, for participants to explore the park.
- Coordinate one or two night time activities (maybe make participation optional).

### Other issues: GWS presentations or papers

"The task at the end of the Park Break program, to write a publishable journal article, was in my opinion, not really feasible given the context of the experience. Given that the paper topics were so variable and disconnected from our own areas of expertise and academic study, the low success rate of the manuscripts was not surprising. In spite of all of the comments listed above, I had a fantastic experience and met some very kind and knowledgeable individuals associated with the NPS and USGS. I have recommended Park Break to others and will continue to do so as long as the program exists."

- Communicate clear expectations for student assignments, projects, papers or other deliverables.
- Follow through with necessary support (i.e., co-authorship or guidance on or review of a GWS poster, paper, or panel discussion proposal).
- Provide examples of what past participants have produced for deliverables.

### Overall satisfaction

"Great experience, invaluable at combining 'textbook'/school with real world problems and those trying to manage our public natural resources!" "So satisfied that I came back the following year as a mentor!" "I think park break is a great program and hope it continues." "I found it very useful to get a perspective on the American conservation paradigms. I would even want to go to another Park Break session, if it is organized in a different area, just so that I can familiarize with other Parks in the USA."

### Conclusion

"Park Break is not just about a week in a park—it's intended to create an ongoing community of motivated young professionals" (discussion participant, George Wright Society Biennial Conference, March 2011). Park Break alumni have proven to be passionate about this program. Several past participants have been hired by the NPS, USFS, and USGS as of the time of this report and others have clearly stated the role this program played in solidifying their goals to pursue a career related to park and protected area research, education, or management. The program also seems to be successful in attracting a diverse range of applicants; survey respondents reported the following demographics for race or ethnic group: 62.6% white (not of Hispanic descent), 14.3% Hispanic, 9.9% Asian, 4.4% African American, 4.4% Hawaiian or other Pacific Islander; and 4.4% other.

The Park Break workshop was organized and run by previous Park Break participants in the spirit of reciprocity, a desire to give back to something they felt had benefited them profoundly. It was also done with the intent of helping to make the same experience, or an even better one, available to future graduate students for the benefit of the individuals, and also the parks and protected areas that they may someday become the stewards of. It is our hope that the results of this workshop, along with the suggestions from past participants will be applied to the betterment of Park Break. In lieu of a closing statement, the following are additional quotes that Park Break alumni wanted to share with the program organizers.

- "Really enjoyed it and wish I could do it again!"
- "Park break was a great opportunity to see how things were done, and how development affects protected areas that are so close to such a big city like NY."
- "Keep it going, but have clear expectations for participants!"
- "I truly enjoyed the entire experience, the relationships created because of Park Break. I hope that more students are able to take advantage of such an enlightening experience. I also hope the organizers of Park Break take steps to create a more diverse cadre of participants. MANRRS (Minorities in Ag, Natural Resources, and Related Sciences) is a organization comprised of undergraduate and grad students, many of which with interests which fall into the goals of Park Break."
- "I really hope that Park Break continues so that other graduate students can experience what I have."
- "Great program! I was thrilled to have the experience, and connect with some very accomplished people. Great way to spend spring break!"
- "Got me to where I am now … would love to help it succeed into the future."
- "Appreciate all the work done by the staff of Park Break."
- "Thanks so much for the Park Break program!"

# Informed User Capacity Management Decision Making: Linking Visitor Use Levels to Visitor Experience

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## Abstract

In 2009, as part of general management planning efforts in Devils Postpile National Monument (Devils Postpile), staff within the Visitor Use and Social Science branch of the Resources Management and Science division, at Yosemite National Park, initiated a process for addressing user capacity and long term monitoring, to establish indicators and suggest standards for experiential and resource-related metrics (Pettebone, Newman, and Lawson 2010). In 2010, they took the experiential and social indicators one step further by implementing evaluative measurements, including visitor perceptions and preferences. Studies were developed for both Devils Postpile National Monument, and Crystal Cave at Sequoia and Kings Canyon National Park. While both reports are currently in progress, the Crystal Cave study is highlighted for this discussion.

The research results presented in this report provides a quantitative understanding of how visitor use levels, such as Crystal Cave tour group size, affects various park management concerns and visitor experience. These results, and future results of this type, can be used to inform, and potentially guide, management decisions about visitor use.

## Introduction

Visitor carrying capacity is "the type and level of visitor use that can be accommodated while sustaining the desired resource and visitor experience conditions in the park" (NPS 2006). The National Park Service (NPS) is required by the National Parks and Recreation Act (1978) to include visitor carrying capacity as a part of any park unit's general management plan. Recent court decisions have required the NPS to address capacity issues by describing the kinds and amounts of visitor uses that are acceptable; monitoring alone is not an adequate manner to address capacity (*Friends of Yosemite Valley v. Kempthorne* 2008).

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Understanding visitor use patterns and trends is crucial for effective visitor management planning, as it allows for the development of justifiable decisions if management action is deemed necessary. Knowing when and where visitor use tends to occur can help park managers determine if management objectives are being met, and allocate resources if deficient conditions are found.

**Visitor Use Studies.** The onset of general management planning efforts in Devils Postpile in 2009 initiated the process of addressing user capacity and long term monitoring to establish indicators and suggest standards for experiential and resource-related metrics (Pettebone, Newman, and Lawson 2010). Natural resource and biological indicators included informal trails in meadows and along the river, water quality, and riverbank erosion. Experiential and social indicators included descriptive metrics, people at one time (PAOT) counts at attraction sites, and daily visitation on trails.

In 2010, we took the experiential and social indicators one step further by implementing evaluative measurements, including visitor perceptions and preferences. Studies were developed for both Devils Postpile and Crystal Cave. While both reports are currently in progress, the Crystal Cave study will serve as our example for this discussion.

## Background

Sequoia National Park is located in the Sierra Nevada Mountains, adjacent to and administered with Kings Canyon National Park. Crystal Cave is one of the park's primary visitor attractions, only accessible tickets purchased for guided tours run by the Sequoia Natural History Association. The cave has a constant temperature of 48°F, yet is only open May through October due to limited winter accessibility via the Crystal Cave Road. The Crystal Cave Road provides the sole access to the cave, other than a single, one-half mile trail which originates in the Crystal Cave parking area.

## Methods

Visitor use data, including evaluative and descriptive data, was collected at Crystal Cave during the summer of 2010, using several concurrent approaches.

**Descriptive data.** Descriptive data included estimating visitor and vehicle use. People-at-one-time (PAOT) counts were documented in two sections of the staging zone for Crystal Cave tours, the "queue," and an informal picnic area in the middle of the parking lot (Figure 1). Observers documented PAOT every 20 minutes from 11am to 5pm on eight separate days (4 weekend and 4 week days) in June and July. Tour group attendance was collected through ticket sales reported by the concessionaire. Vehicle traffic data was collected through the use of an automated vehicle traffic counter deployed along the entrance road to the Crystal Cave parking lot (Figure 1); counters record volume, speed, and vehicle class 24 hours a day, 7 days a week. Vehicles-at-one-time (VAOT) counts were conducted in the Crystal Cave parking lot, and along the roadside (Figure 1); park managers had been concerned about parking availability, and the use of informal roadside parking. Observers documented VAOT every 20 minutes from 11am to 5pm on the same eight days that PAOT counts were collected.

**Evaluative data.** Evaluative data was collected through visitor surveys which were distributed at the entrance of the cave (Figure 1) to a random sample of park visitors at the completion of their Crystal Cave tour. Surveys were collected during ten days in June and July, six weekdays and four weekend days, including the fourth of July holiday. A total of 296 surveys were completed with questions on demographics, visitor experience, and perceptions of crowding. A series of survey questions pertaining to visitors' perceptions of crowding utilized photos, with visitors asked to rate the photos on a scale of –4 "Very Unacceptable" to 4 "Very Acceptable." Photo one contained 5 people, photo 2 had 15, photo 3 had 30, photo 4 had 45, and photo 5 illustrated a

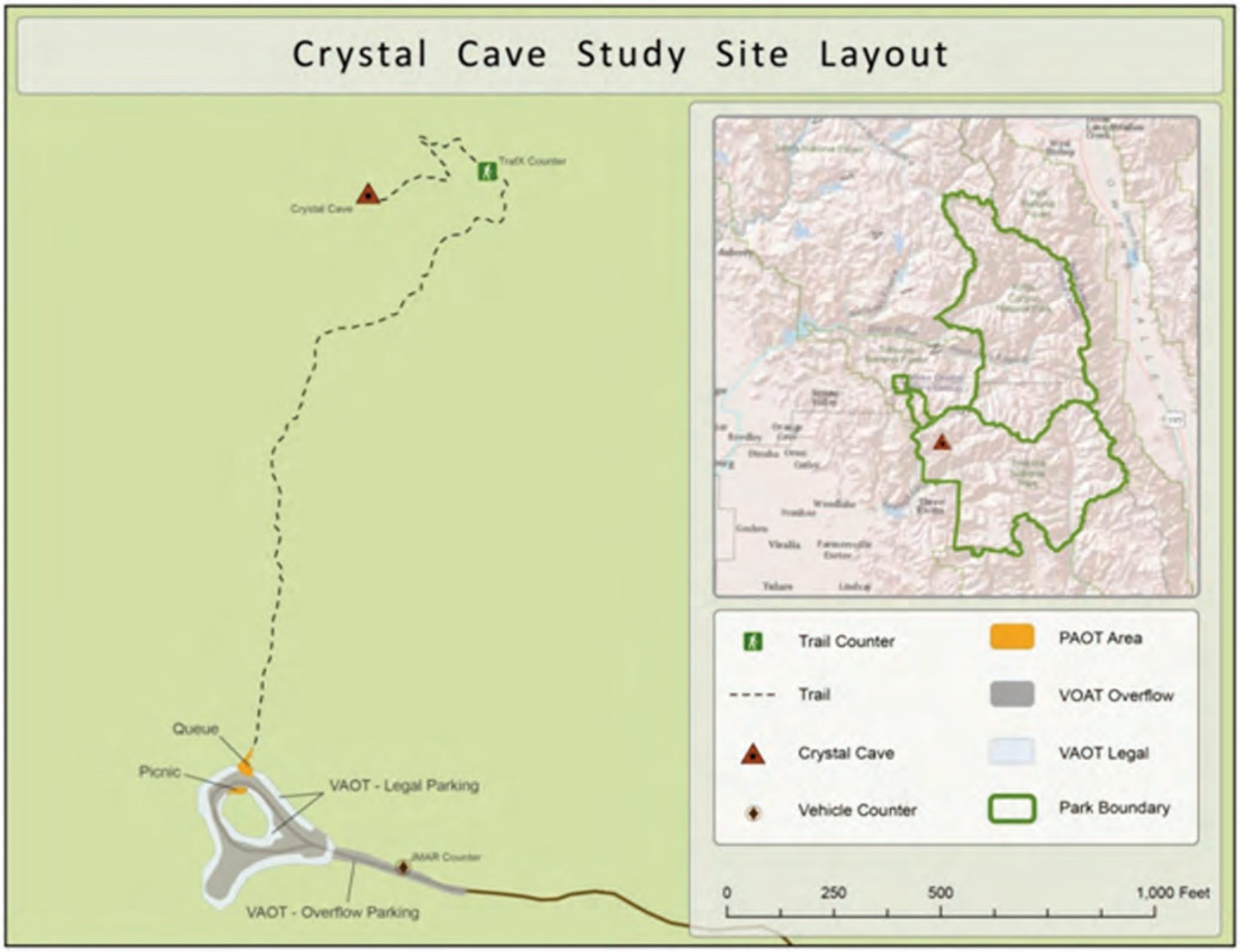


**Figure 1.** Crystal Cave study site.

Crystal Cave tour group size of 60 people (Figure 2). Currently, the cave is managed so that only one tour group, of up to 70 people, is allowed in the cave at a time.

### Results

**Survey results**. Demographic results were relatively typical of national parks. Eighty six percent of the respondents reported their race as "white," and 93% were residents of the United States, most from California. Answers to visitor experience questions were informative:

- 50% of the respondents were on their first visit to Sequoia National Park.
- 5% had been there more than ten times.
- 65% reported being fairly unfamiliar with the park.
- 81% had a personal interaction with their tour guide.
- 76% reported being 20 feet away or less from their guide during the tour.
- 68% of visitors were able to hear their Crystal Cave tour guide "well" to "very well."

Results from the perception of crowding questions were interesting. While actual group tour attendance ranged from 6 to 55 people, with a mean of 39 people per group, visitors' perceptions of their tour group size were rarely accurate (their perceived mean was 35). Other responses to perception of crowding questions included the following:


**Figure 2.** Crystal Cave survey scenario Photo 5 with 60 people.

- 61% of survey respondents reported being from "only slightly crowded" to "not crowded at all" on their tour.
- 35% reported that group size had no effect on their enjoyment, 31% that it added to their enjoyment, and 34% that it reduced their enjoyment.
- 36 was the maximum acceptable number of people in Crystal Cave at one time.
- 29 was the maximum number of people that respondents felt the NPS should allow in Crystal Cave at any one time.
- 20 was the number of people that they would prefer to see.
- 53 was the number that would cause them to never return.

**Effects of tour group size.** Tour group size is one of the tools used to manage Crystal Cave, and results pertaining to these analyses should prove to be the most informative for future park-planning efforts. To better understand how tour group size affected visitors' experience at Crystal Cave, linear regression analyses were conducted using responses averaged by tour group. The strongest relationships provided evidence that 34% of the variance, or variability of answers, in response to the question "How crowded did you feel on your tour," was related to tour group size, and 55% of the variance in answers to the question "Which photograph best represents the number of visitors you saw on your tour today," was related to group tour size.

One of the most interesting aspects of these study results is that visitors seem to perceive tour group size as larger than reality when groups are small, 5–20 people; are able to accurately judge group size for groups of approximately 25 people; and then tend to underestimate group size when groups are relatively large, 30–55 people (Figure 3). Possible reasons why visitors percep-

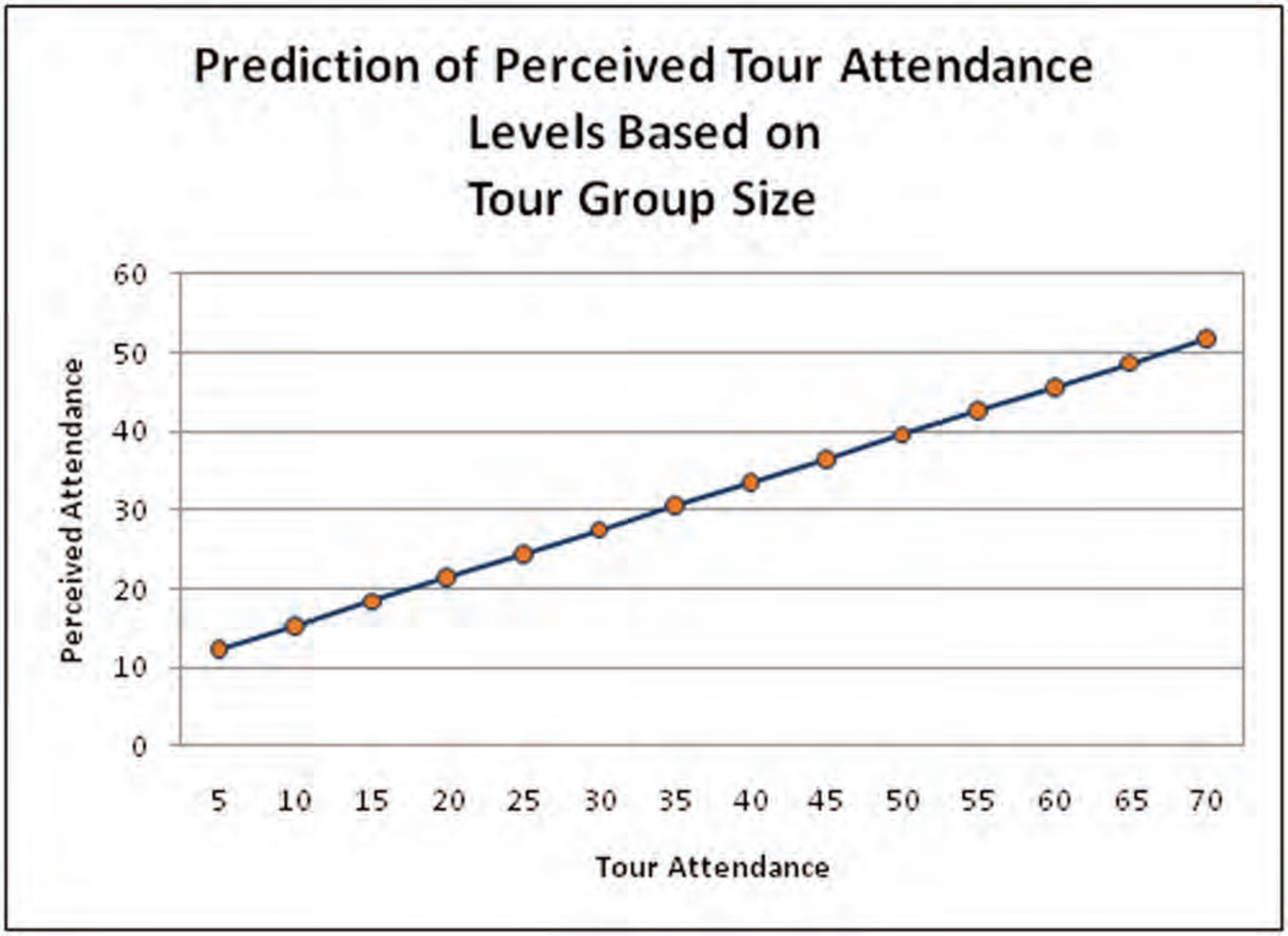


**Figure 3.** Crystal Cave visitors' perceptions of tour attendance predicted by tour group size.

tions of group size are inconsistent with actual group size may include the fact that two dimensional photographic representations are different than actual experiences, the dark environment of the cave, the linear trail or route taken by the group (which would limit clustering), group size effects on sound (such as echoing) in a cave environment, or people may be concentrating more on the tour guide, or the cave environment, than on other members of the group.

Based on the finding that visitors inaccurately evaluated actual tour group size, we tested to see if evaluations of crowding could be explained by perceived tour group size. The subjective response to the question: "Which photograph best represents the number of visitors you saw on your tour today," turned out to be the sole significant predictor of how crowded people felt on their tour; the actual tour group size, an objective variable, was non-significant.

In order to inform park managers about the effect of tour group size on visitors perceptions of crowding we developed a conceptual model which illustrates that perceived tour group size can be explained by actual tour group size, and subsequently, crowding explained by perceived tour group size (Figure 4). This relationship suggests that visitors are more tolerant of crowding at higher levels of use because they perceive fewer people than there actually are. The model provides a basis for park managers to consider the effects of tour group size on visitor experience such as perceptions of crowding.

**PAOT results.** PAOT results included counts taken for the "Queue" which had a mean of 15, and the "Picnic Area" with a mean of 4; both of which were combined for total PAOT with a mean of 19.5. Total mean PAOT was significantly different for weekdays and weekends, ranging


**Figure 4.** Conceptual model showing tour group size influencing perceived tour group size influencing perceptions of crowding.

from 13.5 on weekdays to 26 on weekends, and reaching a high of 37 for the mean total PAOT on July 4.

Tour group size explained 57% of the variance for total PAOT counts ($p < .001$). In other words, roughly half of the people on a tour (depending on group size) were found in the staging area before a tour, the remainder may have been awaiting the tour along the trail, or at the cave entrance one-half mile away.

**VAOT results.** VAOT results included both parking in the Crystal Cave parking lot (with a capacity of 86 spaces), and informal overflow parking along the roadway. The total hourly mean VAOT was 48, 47 for parking in the lot (which is 55% of capacity), and less than 1 for overflow parking along the road. Total hourly mean VAOT ranged from 39 on weekdays to 61 on weekends, with the forth of July reaching 66, still well below capacity. The total hourly count of VAOT was in the range of 36–45 vehicles in the Crystal Cave parking lot 35% of the time.

Tour group size explained 66% of the variance for total VAOT counts ($p < .001$), and results show that as long as group tour size is limited to 2010 use-levels or lower, there should be adequate parking in the Crystal Cave parking area.

**Vehicle traffic volume results.** Automatic vehicle counters (pneumatic tube counters) collected information on vehicle volume, speed, and class. Results showed that 72% of all vehicle traffic utilizing the Crystal Cave Road was personal vehicles, including cars, trucks, and RVs. On average, 148 vehicles per day accessed the road (June had a mean of 135; July a mean of 160). Inbound traffic peaked at 11 a.m. and outbound at 3 p.m., with parking lot accumulation peaking at 1 p.m. Daily mean traffic ranged from 130 vehicles on weekdays, to 188 vehicles on weekends. Strong relationships to vehicle traffic volume were found in this study:

- Inbound vehicle traffic volume explained 47% of the variance for total VAOT taken one hour later ($p < .001$).
- Inbound vehicle traffic volume explained 43% of total PAOT counts taken one hour after the vehicles had arrived ($p < .001$).
- Tour group size explained 54% of the variance for inbound vehicle traffic volume collected one hour before tour times ($p < .001$).

### Recommendations for future research

The following work is recommended for future research at Sequoia's Crystal Cave:

- Determine the impacts and implications of current use levels on natural resources and visitor experience.
- Ongoing systematic surveys (i.e. every 5–10 years) to monitor visitor perceptions of crowding.
- Regularly monitor vehicle traffic volume along Crystal Caves road to determine any changes from current conditions
- Additional research to more fully understand why people inconsistently evaluate levels of use (i.e. group size).

## Conclusion

The research presented in this report provides a quantitative understanding of how visitor use levels, such as Crystal Cave tour group size, affects various park management concerns and visitor experience. These results can be used to inform, and potentially guide, management decisions about visitor use in Crystal caves. For example, the 2010 data suggests that visitors are largely tolerant of crowding related to current levels of use; however, park managers may choose to manage for smaller tour group sizes, family group tours, or adult only tours, in order to provide a less crowded, more intimate, and potentially higher-quality visitor experience ,which might also prove to have less impact on the resource.

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# Wetlands Mapping in the Vicinity of the Mineral King Valley Cabins and Corral, Sequoia and Kings Canyon National Parks

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## Purpose and need

There are 64 permitted cabins in the Mineral King area of Sequoia and Kings Canyon National Parks (SKCNP). These cabins and their associated human waste systems are the personal property of the cabin owners, but the land belongs to the federal government. SKCNP is now preparing a management plan for the Mineral King area, and is gathering the information necessary to prepare that plan.

## Wetland definitions, policies, and regulatory authorities

National Park Service (NPS) policies require parks to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance their natural and beneficial values, wherever practicable (NPS 2006, Section 4.6.5). If activities conducted or authorized by the NPS have the potential to have adverse impacts on wetlands, the NPS must comply with wetland protection procedures found in NPS Procedural Manual #77-1 (NPS 2011). Included in these procedures is a requirement (Section 5.6) to inventory existing structures and facilities that are located in or otherwise may be adversely impacting wetlands, and decisions regarding their retention, removal, or management must be recorded and justified in an NPS planning document. An early step in compliance with this requirement is to determine the locations of existing facilities, such as the cabins and corral at Mineral King, in relation to wetland boundaries.

Park managers must also comply with wetland protection requirements of the federal Clean Water Act (Act). Under Section 404 of the Act, the U.S. Army Corps of Engineers (Corps) regulates the placement of fill in wetlands and other waters of the U.S. through the 404 permit program. Implementation of other parts of the Act is delegated to the state of California.

For Section 404 permitting purposes, the Corps defines wetlands as areas that exhibit three parameters: hydric (wetland) soils, hydrophytic (wetland) vegetation, and wetland hydrology.

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The Corps' 1987 Wetland Delineation Manual (Environmental Laboratories 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual (ACOE 2010) provide procedures for delineating wetlands that meet the Corps definition. The Department of the Interior (including the NPS) defines wetlands slightly differently than the Corps, using the U.S. Fish and Wildlife Service's (USFWS) Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979) as its wetland standard. The Cowardin wetland definition includes the three-parameter Corps wetlands described above, but incorporates some additional areas that, though lacking vegetation and/or soils, are still saturated or shallow inundated environments that support aquatic life (e.g., unvegetated shallow streams).

The NPS procedural manual (2011) provides techniques to ensure that wetland delineation and mapping projects on NPS lands will satisfy both the Act's wetland definition and the NPS standard for identifying wetlands. The manual states that for sites with vegetation and soils, wetland delineators should use the most recent version (and any approved regional supplements) of the 1987 Corps manual. For delineating any other naturally unvegetated or non-soil aquatic sites, such as many stream channels or active shorelines, delineators should use the "limits" of these systems as described in Cowardin et al. (1979).

Nearly all the wetlands we mapped at Mineral King were vegetated and had soils, so we followed Corps wetland delineation procedures for those sites. The East Fork of the Kaweah River and a small intermittent channel at the corral location were additional unvegetated areas that are classified as wetlands under the Cowardin system.

### Landscape setting, geology, and geomorphology

The study area is situated in the western portion of the upper Mineral King Valley along the East Fork of the Kaweah River. The valley floor elevation is 7,500 feet and the peaks surrounding the valley are generally between 11,000 and 12,500 feet. The mountains and valleys in this region were glaciated and are underlain by marble, slate, schist and granitic rocks.

On the basis of geomorphology, the study area can be divided into three distinct subareas (see Figure 1):

1. Corral subarea a: toe and foot slopes of recent debris slides with a narrow floodplain adjacent to the East Fork of the Kaweah River. Parent material is colluvium derived from marble, slate and schist.
2. North of creek subarea b: toe and foot slopes of an active alluvial/debris fan that has many active, semi-active and abandoned channels, with a narrow floodplain adjacent to the East Fork of the Kaweah River. Parent materials are alluvium and reworked colluvium derived from granitic rocks, marble, slate and schist.
3. South of creek subarea c: foot slope of lower mountain slope and possibly the remains of a lateral moraine, with a narrow floodplain adjacent to the East Fork of the Kaweah River. Parent materials are reworked colluvium and till and scattered alluvium derived from granitic rocks, marble, slate and schist.

### Hydrology of the surveyed area

Precipitation in the region follows a very strong seasonal pattern of a wet season (October to May) and a dry season (June to September). The average annual precipitation recorded at NOAA's Ash Mountain, California weather station (CA040343) is 26.6 inches, with 95% falling in the wet season and only 5% (approximately 1.3 inches) falling during the summer dry season. The hydrology of the three study areas shown in Figure 1 is predominantly driven by groundwater that is recharged annually by wet season precipitation and spring snowmelt. Groundwater discharges near the land surface in these foot slope and toe slope locations, and wetlands exist where water

**Figure 1.** Mineral King Valley and wetland study areas.

tables are close enough to the land surface to create sustained saturated conditions in the upper parts of the soil profiles.

Presence or absence of wetland hydrology is one of the three parameters used by the 1987 Corps manual (along with hydrophytic vegetation and hydric soils) to delineate wetland boundaries. Wetland hydrology exists at a site when it is flooded, ponded, or has a water table within 12 inches of the ground surface for 14 or more consecutive days during the growing season in at least 5 out of 10 years. Wetland hydrology is the most seasonal and transitory of the three parameters. Therefore, the Corps manual describes primary and secondary wetland hydrology "indicators" that allow delineators to evaluate hydrology throughout the growing season, even late in the dry season when saturation in the upper part of the soil may no longer be present.

### Vegetation of the surveyed area

Predominance of "hydrophytic" (wetland) vegetation is one of the three parameters used to identify wetlands. According to Corps of Engineers wetland delineation procedures, calls regarding presence or absence of hydrophytic vegetation are based on the "wetland indicator status" of each dominant species in the plant community being evaluated. Reed (1988) classifies plant species into indicator status categories ranked from wettest to driest as follows: obligate (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), and upland (not listed). Plant communities are considered to be hydrophytic (wetland vegetation) if greater than 50% of the dominant species are ranked as OBL, FACW, or FAC. Prevalence indexes were calculated and used for hydrophytic vegetation determinations in cases where OBL, FACW, or FAC species comprised exactly 50% of the dominant species (ACOE 2010, 27-32).

### Soils of the surveyed area

Soil survey data are not currently available for Sequoia and King Canyons National Parks. In general, soils at the study sites are Aquolls and Cryolls formed in colluvial or alluvial sediments derived from primarily granitic rocks with minor amounts of marble, slate and schist. Soil surface textures were dominantly loams and sandy loams. Subsurface textures were primarily gravelly sandy loams, very gravelly sandy loams to extremely cobbly loamy sands. All soil profiles described have thick, dark, humus-rich surface horizons 15 to 30 inches thick.

Hydric soils are one of the three parameters used to delineate wetland habitats. Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (SCS 1994). Most hydric soils exhibit characteristic, identifiable morphologies that result from these anaerobic conditions and persist in the soil during both saturated (reduced) and dry (oxidized) conditions. Examples include a mottled color pattern resulting from reduction and re-oxidation of iron or manganese, and accumulation of organic matter due to increased production and slow decomposition rates in saturated environments. The National Technical Committee for Hydric Soils has developed "field indicators of hydric soils" based on these characteristic morphologies (NRCS 2010). These have been incorporated into the Corps wetland delineation manual supplement for this region as a means of confirming the presence or absence of hydric soils.

Of the 23 plots we examined, none exhibited hydric soil field indicators. There are a number of possible explanations for the lack of hydric soil indicators related to oxidation and reduction of iron and/or manganese, including the following:

1. Organic matter (humus) rich mineral soils can mask these indicators.
2. Water has significant dissolved oxygen (soils do not develop redoximorphic features related to iron and manganese until oxygen is depleted).
3. Water and soil temperature may be too low for microbial populations to effectively function to create anaerobic conditions.

This lack of hydric soil indicators, even in sites that clearly met the wetland hydrology and hydrophytic (wetland) vegetation parameters, led us to use the procedures found in the "problematic hydric soils" section of the supplemental Corps manual.

To assist in hydric soil determinations, Indicator of Reduction in Soil (IRIS) tubes were installed at 16 locations (for a total of 20 tubes) along potential wetland boundaries in the study area from June 23 to 25, 2010. The IRIS tubes were removed and read from July 8 to 10, 2010. At each location, IRIS tubes were installed to a depth of 30 cm.

IRIS tubes are coated with an iron (Fe) compound, which will partially or completely dissolve in saturated soil conditions, where microbial populations are active. Removal of the Fe coating provides a visual indicator that hydric soil conditions exist. In well-drained, oxygenated, non-saturated soils, the Fe coating will not be removed. A strong relationship exists between the removal of the Fe coating and the degree of soil saturation and reduction. If 20% or more of the Fe coating is removed within a 4 inch section of tubing over a period of three weeks, there is a high level of confidence (greater than 87% probability) that the soil is reduced and is a hydric soil (Castenson and Rabenhorst 2006).

Hydric soils form under conditions of saturation, flooding, or ponding for long enough during the growing season to develop anaerobic conditions in the upper part. For the Mineral King

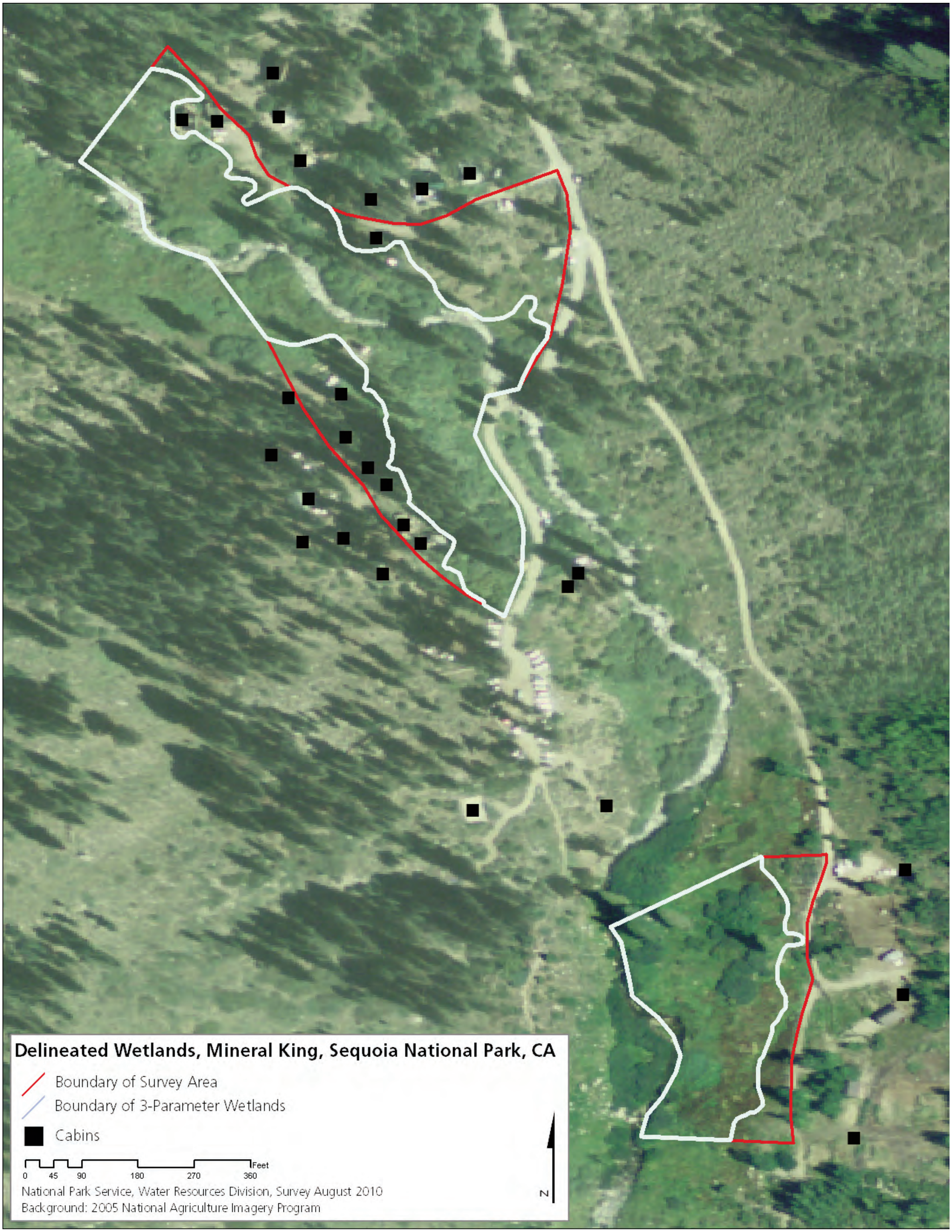


**Figure 2.** Overview of wetland boundaries delineated at Mineral King.

| Site | Location | Hydric soil | Hydric soil indicator | IRIS | IRIS tube response | Technical standard | Surface water | Water table (inches) | Saturation (inches) | Wetland hydrology | Indicator | Vegetation group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Corral Area; north of road | no | Na | #1 | <20% Fe removed | No | no | no | no | no | na | sedge-grass-forb |
| 2 | Corral Area; north of road | no | Na | no | na | na | no | no | no | no | na | corn lily-sedges |
| 3 | Corral Area; south of road, 30 ft | yes | F1 | #2 | >20% Fe removed | Yes | no | 8.25 | 4.7 | yes | A2, A3 | corn lily |
| 4 | Corral Area; south of road, 130 ft | yes | A9, F1 | no | na | na | no | 10.6 | 0 | yes | A2, A3 | sedges-grasses |
| 5 | Corral Area; south of road, floodplain | yes | A9, F1 | no | na | na | no | 9.5 | 0 | yes | A2, A3 | sedges-grasses |
| 6 | Corral Area; swale near road | yes | None | no | na | na | no | 13 | 9.1 | yes | A3 | corn lily |
| 7 | North of creek; side yard of cabin | no | None | #3 | No Fe removed | No | no | 16.9 | 13 | no | na | corn lily |
| 8 | North of creek; north side of road, sw of cabin | no | Na | no | na | na | no | no | no | no | na | corn lily |
| 9 | North of creek; north side of road, nw of cabin | no | None | #4,5 | <20% Fe removed | No | no | no | 13 | no | na | sedges/margin corn lily |
| 10 | North of creek; north side of road, channel near cabin | no | Na | #6 | <20% Fe removed | No | no | no | no | no | na | corn lily |
| 11 | North of creek, 60 ft from creek, margin of depression | yes | F1 | #7 | >20% bottom 4" Fe removed | Yes | no | 11 | 1.2 | yes | A2, A3 | sedges/margin corn lily |
| 12 | North of creek, 60 ft from creek, 20 ne from site #11 | yes | None | #8,9 | #8 No, #9 yes >20% Fe rem. | Yes | no | 16.9 | 11.4 | yes | A3 | sedges-grass-PICO |
| 13 | South of creek, 15 ft from cabin, break in slope | no | Na | no | na | | no | no | 13 | no | na | sedges/margin corn lily |
| 14 | South of creek, end of road, near trail | no | Na | #10,11 | <20% Fe removed | | no | no | 19.3 | no | na | sedge-grass/margin willow |
| 15 | South of creek, end of road, 20 ft north of #14 | ?? | None | #12,13 | #12 yes >20%; #13 No <20% | Yes? | no | 16.9 | 11.4 | yes | A3 | sedge-grass/margin willow |
| 16 | South of creek, end of road, 20 ft north of #15 | yes | F1 | #14,15 | Fe removed >20% | Yes | no | 9.1 | 11.4 | yes | A2, A3 | corn lily |

**Table 1.** Results of IRIS tube study. (IRIS tube locations are shown in Figures 2 and 3.)

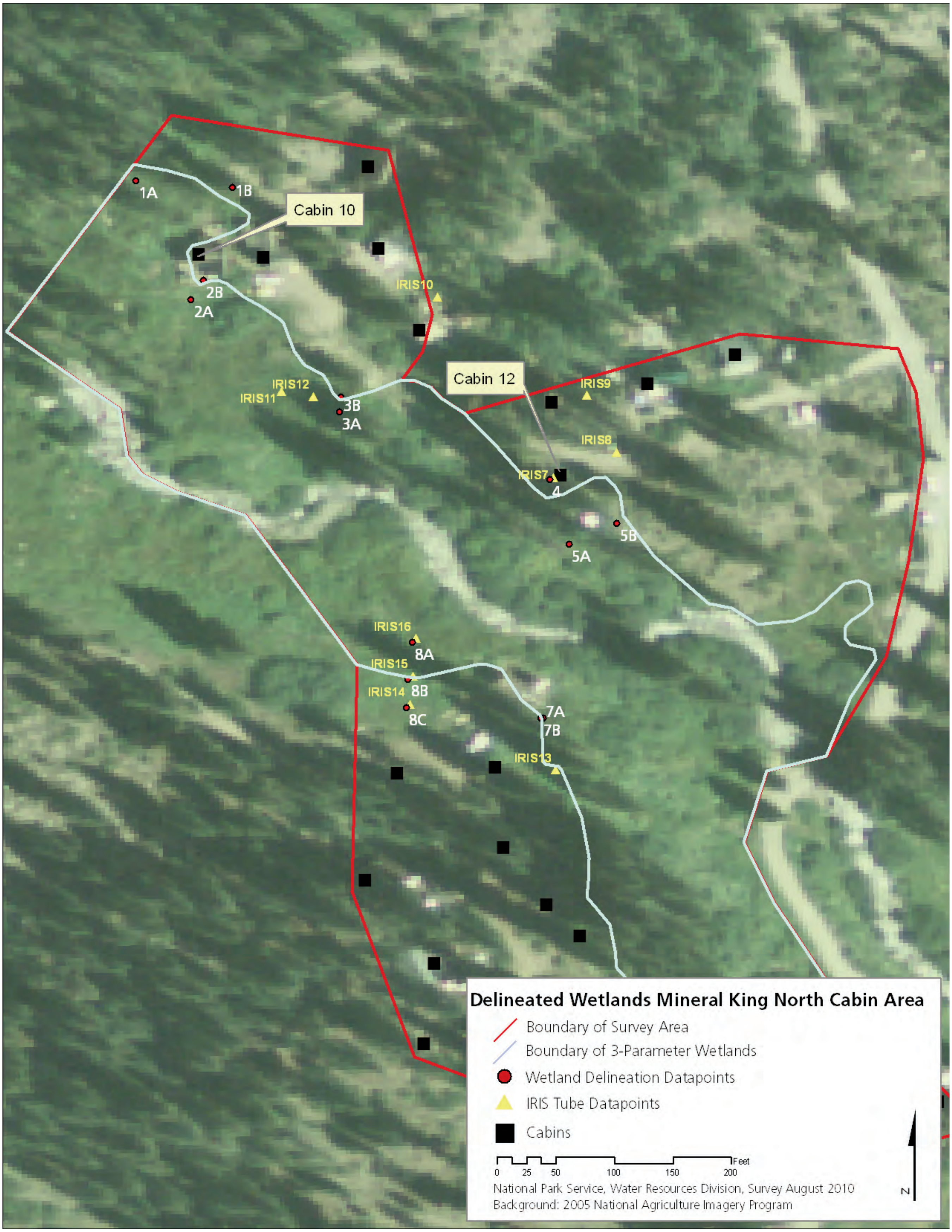


**Figure 3.** Wetland boundaries, data point locations, and IRIS tube locations for the Mineral King cabin area (northern section).

Basin project area, the growing season is estimated to be June 15 to August 30, or approximately 75 days. In addition, the development of anaerobic conditions in the upper part of the soil is dependent on soil texture. In sandy soils the upper part is the upper 6 inches of soils, and for loamy and clayey soils, the upper part is the upper 12 inches. The installation of IRIS tubes early in the growing season allowed for correlation between seasonally high water tables, soil saturation and reducing conditions, and development of redoximorphic features.

The results of the IRIS tubes corresponded well with water table and soil saturation depth measurements and plant communities found during this study (see Table 1). Of the 23 plots that were set up by the wetland team during the August visit, seven corresponded with IRIS tubes plots that were set up in June. At three of the seven plots, more than 20% of the iron coating was removed from the IRIS tubes, and these were classified as hydric soils. The other four locations where less than 20 percent of the iron coating was removed were classified as non-hydric soils. IRIS tube results were incorporated into the soil sections of the delineation data sheets to support problematic hydric soil calls.

### Wetlands within the surveyed area

Within the survey areas (Figure 2; above), a total of 4.8 acres of wetlands were delineated according to Corps of Engineers and NPS procedures. The northernmost wetland polygon in Figure 2 (cabin area) covers 3.29 acres and the wetlands in the corral area total 1.51 acres. Figure 3 (above) is a photo enlargement of a delineated area. The wetland delineation data points shown in these figures correspond to the wetland determination data forms. IRIS tube locations shown in Figures 2 and 3 correspond to the results shown in Table 1 (above).

The vegetated wetlands within these polygons meet the regulatory wetland definitions used by both the Corps and the NPS. According to the Cowardin classification system, the vegetated wetland areas with willow overstory are classified as "palustrine scrub-shrub" wetlands, and areas with herbaceous wetland plant cover (no overstory) are classified as "palustrine emergent" wetlands. Water regimes for these two wetland types range from "semi-permanently flooded" (surface water persists throughout the growing season in most years) in the wettest areas to "saturated" (saturated to the surface for extended periods during the growing season, but surface water may not be present) at sites near the upland boundaries.

We also identified predominantly unvegetated stream channels within the surveyed areas, which are classified as riverine wetlands under the Cowardin et al. (1979) definition. The Kaweah River channel visible in the northernmost polygon in Figure 2 is classified as "riverine, upper perennial," and the tributary channel above and below the corral (Figures 2 and 3) is classified as "riverine, intermittent." These channels are considered wetlands under NPS wetland protection policies and procedures. The Corps does not consider these unvegetated channels to be wetlands, but treats them as other "waters of the U.S." that may still be regulated under sections 401 and 404 of the Act.

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# Using Scenarios to Prepare for Climate Change in Alaska National Park System Areas

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## Introduction

Changing climatic conditions are rapidly impacting environmental, social, and economic conditions in and around national park system areas in Alaska. With over 50 million acres of parklands to administer, Alaska park managers need to better understand possible climate change trends to better manage arctic, subarctic, and coastal ecosystems, and human uses of these areas. National Park Service (NPS) managers have been exploring scenario planning as an alternative approach for science-based decision-making in the face of an uncertain future. Climate change scenarios will help prepare Alaska park managers for impending changes, so they can make informed decisions with the fewest regrets about future outcomes.

NPS and the University of Alaska, Fairbanks, Scenarios Network for Alaska Planning (UAF-SNAP) are collaborating on a three-year project to help Alaska NPS managers, adjacent landowners, and key stakeholders to develop plausible climate change scenarios for all NPS areas in Alaska. Final products will include climate change scenario planning exercises and reports for all the NPS units in Alaska, with efforts organized around each of four inventory and monitoring (I&M) networks.

Stage one in this project was a climate change scenarios training workshop with NPS contractor Global Business Network (GBN). Participants learned how to develop scenarios based on nested frameworks of critical uncertainties, and then fleshed out the beginnings of climate change scenarios for two pilot parks. Webinars were held to orient trainees to the scenario-building process, climate drivers, and climate effects. The training workshop was facilitated by Jonathan Star of GBN, and included key personnel with NPS parks and I&M networks in Alaska, NPS Climate Change Response Program staff, major adjacent area landowners, UAF-SNAP, and a few climate scientists.

The first climate scenarios workshop took place in Anchorage, Alaska, in late February, 2011, and addressed park areas in the South-West Alaska Network (SWAN), which includes Kenai Fjords National Park, Katmai National Park and Preserve, Lake Clark National Park and

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Preserve, Aniakchak National Monument and Preserve, and Alagnak Wild River. Members of a core team completed at least one GBN scenarios training course before leading the workshop. Participants included representatives from SWAN parks, NPS Anchorage office staff, UAF-SNAP personnel, plus key individuals from other agencies, businesses, and communities with a stake in this region. Thirty-four individuals contributed a wide range of perspectives and expertise to the inputs and outcomes of the workshop.

### Workshop preparations

To orient participants, suggested reading included two books and a talking points paper: *Beyond Naturalness* (Cole and Yung 2010), *The Art of the Long View* (Schwartz 1996), and *Understanding the Science of Climate Change: Talking Points—Impacts to Alaska Maritime and Transitional Zones* (Jezierski, Loehman, and Schramm 2010). The NPS Alaska Regional Office made a small library of books available, which addressing climate change, scenarios processes, and climate change education and interpretation. Before the workshop in Anchorage, participants took part in three webinars. The webinars covered introduction to scenario planning, Southwest Alaska climate drivers, and Southwest Alaska climate change effects.

Workshop webinars, workshop results, and supporting documents are online (www.snap.uaf.edu/webshared/Nancy Fresco/NPS/). Other available online files included the following: an August 2010 training workshop summary; NPS maritime and transitional climate talking points paper; SNAP regional maps showing projected changes in temperature, precipitation, thaw date, freeze date, and season length; climate driver and effects tables; SNAP climate briefs for Katmai, Kenai Fjords, and Lake Clark; participant lists; workshop presentations.

### Workshop summary

The workshop began with a plenary session on the fundamentals of scenario planning. Scenarios are defined as hypotheses about the future, rather than predictions. Scenarios are intended to be stories of divergent, yet plausible, relevant, and challenging futures that stretch thinking, and provide a tool to navigate change. Scenario development involves five steps: orient, explore, synthesize, act, and monitor (Figure 1).

In step one, *orient*, participants considered strategic issues or decisions that we wish to address: "How can NPS managers best preserve the natural and cultural resources and values within their jurisdiction in the face of climate change?" and, "How will climate change affect the landscapes within which management units are placed, over the next 50 to 100 years?"

In step two, *explore*, participants discussed critical forces that could affect the future of our issue. Critical forces, climate drivers in this case, have unusually high impact and unusually high uncertainty. In other words, what changes in climate are most important, most uncertain, and most likely to drive major change in park conditions and NPS management? Participants divided into two focus groups, coastal and riverine, to select critical climate drivers and develop scenarios. The groups used those drivers to develop potential scenario matrices (Figure 2; Table 1). From these matrices each group selected one matrix to develop further and build narratives for the future. In the next stage of the workshop, each group nested their original matrix within a higher level socio-political matrix representing varying degrees of public concern and varying degrees of institutional involvement with climate change (Figure 3).

In step three, *synthesize*, participants created narratives from bullet-point scenarios. With sixteen (or more) choices available, each group selected 3 -4 nested scenarios to turn into narratives and planning tools. They focused on scenarios that were *relevant, divergent, plausible, and challenging*. From each scenario they identified implications or "effects," which were pulled from existing effects tables and talking points papers. Each group outlined future actions appropriate

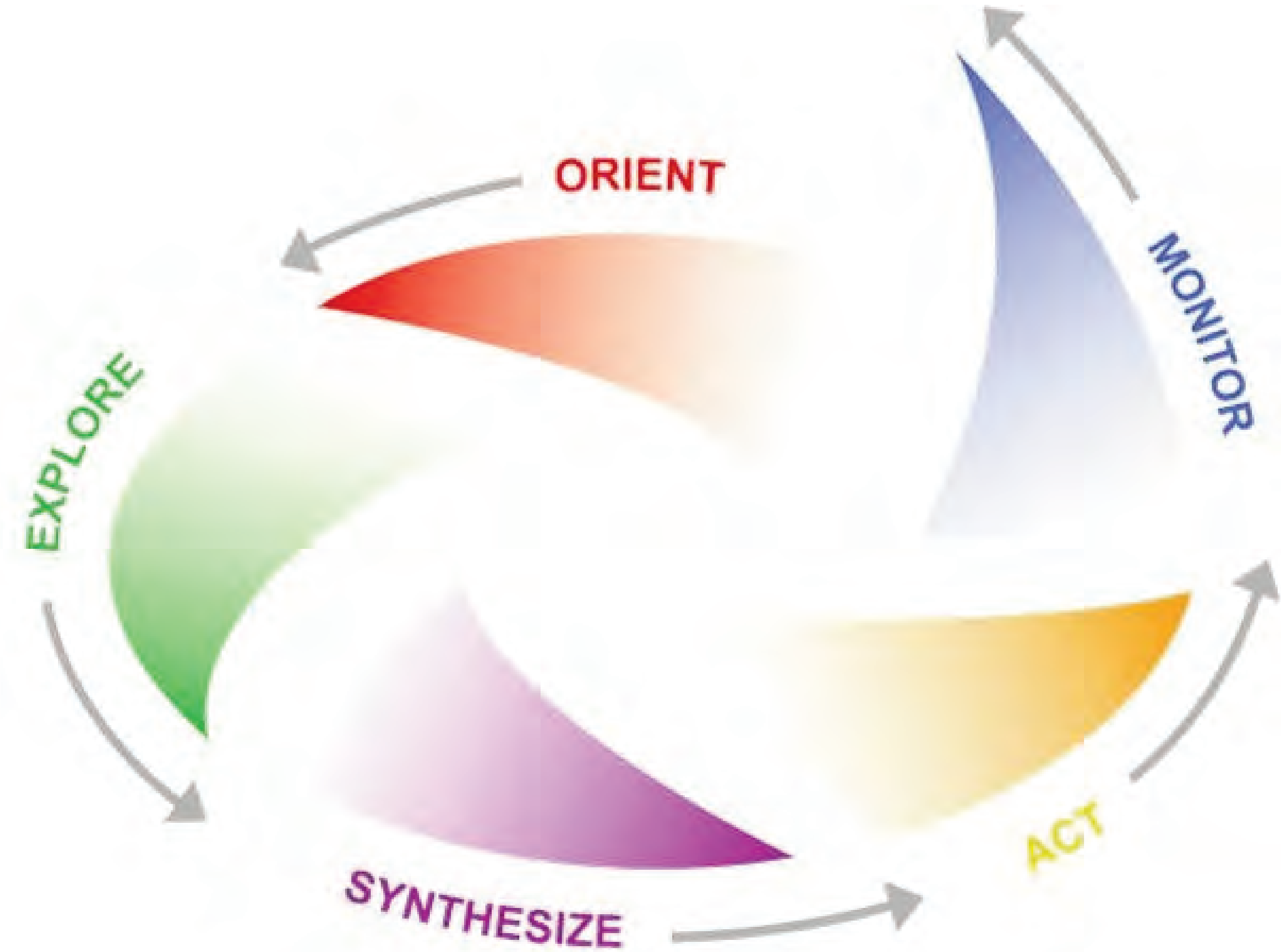


**Figure 1.** This diagram, provided by GBN, shows the stages in the scenarios building process.

to the selected scenarios as the first part in step four, *act*. The final step in the process is to *monitor* effects of actions over time, and then reorient.

This process is summarized for the riverine group, which was a focus of the associated George Wright Society presenation. The group explored "climate drivers" for the bioregion and added other critical drivers such as volcanic eruptions (local acidification), Pacific Decadal Oscillation (PDO)/Arctic Oscillation (AO)/jetstream changes, and variable stream flows. They selected from four climate drivers, precipitation (variability), temperature (variability), thaw days (more or fewer), and PDO (warm/cold phase shifts). They decided to use thaw days (more or fewer) and precipitation (low/high variation). PDO was included with thaw days, looking at the cold-phase PDO with fewer thaw days, and the warm phase PDO with more thaw days, to push extreme possibilities.

1. "Smokey" is the climate scenario from the upper left quadrant of Figure 2, and would result in the following environmental conditions: drought stressed vegetation; increase in disease/pests; longer growing season; maximum shrub expansion (less overland access); long-term reduction in stream flows; initially higher stream flows from seasonal glacial melt; reduction and loss of glaciers; increased fire on the landscape; 40% reduction in salmon fry due to smaller fry; less water access with warming, and less precipitation, so barge transport on Naknek Lake and Lake Clark is reduced; fewer biting insects; decreased waterfowl; exposure of cultural resources;

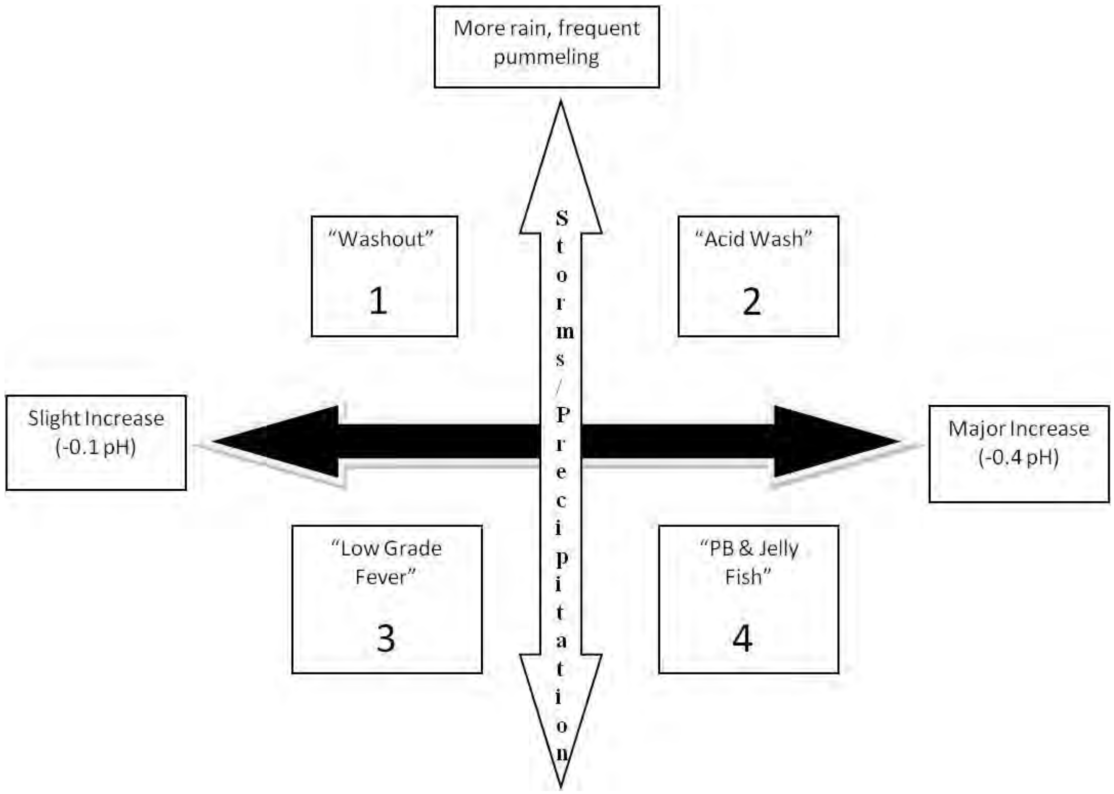


**Figure 2.** An example climate driver matrix produced by the riverine group.

| Climate Drivers (or "Scenario Drivers Based on Climate") | UC | HC | Important |
|---|---|---|---|
| Temperature | X | | X |
| Precipitation | X | | X |
| Freeze-up | | X | |
| Length of growing season | | X | |
| Sea level | X | | |
| Water availability | X | | |
| Relative humidity | X | | |
| Wind speed (separate from Aleutian Low) | X (duration) | X (increase) | |
| Pacific Decadal Oscillation (PDO) | X | | |
| Extreme events (temperature) | | X | |
| Extreme events (precipitation) | X | X | |
| Extreme events (storms) | | X | X |

**Table 1.** Climate drivers rated for certainty and importance by the riverine group.

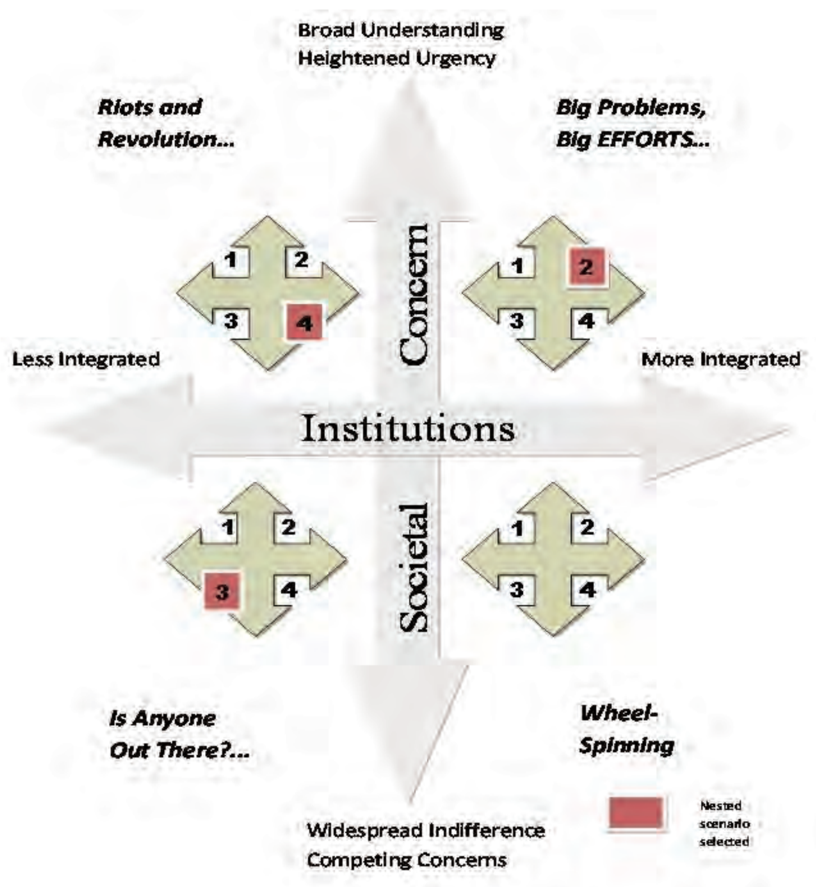


**Figure 3**. Matrix showing riverine climate scenarios nested in a social/institutional framework. Each quadrant yields four linked scenarios; three are selected in red. The details of these three are described in the text.

lowering of groundwater tables; more fugitive dust at Pebble Mine; increased competition for water; decreased subsistence travel over water and snow.

2. "Juneau /Helly Hansen" is the climate scenario from the upper right quadrant of Figure 2, and would result in the following environmental conditions: increased rain on snow events (increased flooding); thicker vegetation; increased erosion; increased lightning; increased evaporation (soil drying); more berries (good habitat for bear, moose, caribou); decreased area of alpine tundra; arrival of black bear; increased in waterfowl; increased impacts to park infrastructure; decreased backcountry use (due to rain and reduced flying days); increased hurricanes; decreased salmon production due to flooding; increased contamination due to runoff events; increased avalanches.

3. "Freeze-Dried" is the climate scenario from the lower left quadrant of Figure 2 and would result in the following environmental changes: permafrost persists; decreased productivity (plants and berries) impacts wildlife; overland access continues; competition for water resources intensifies between communities and mining; facilities and infrastructure are stable; slow retreat of tundra ponds; Dall sheep range extends; lichen ranges are stable and support caribou; high wind potential develops; and brown bear populations decrease.

4. "Tiny Ice Age" is the climate scenario from the lower right quadrant of Figure 2 and would result in the following environmental conditions: glaciers stabilize or enlarge; winter travel access remains viable; pests and diseases moderate; extreme weather events may impact salmon.

### Nested scenarios

Each of the four climate scenarios described above were nested within a larger social/institutional framework (Figure 3). This framework explores how each story might play out in a world with greater or lesser degrees of societal concern and institutional commitment. We altered this framework slightly from that presented by GBN, where the horizontal axis is defined as "institutional" rather than "governmental" and would take place at a national, state, and local scales, rather than at national and international scales. Because sixteen scenarios present far too many possible futures for anyone to fully consider, the riverine group selected three scenarios highlighted in red, one of which is described below as an example. This example scenario includes future implications, important management actions, research and information needs, and a descriptive narrative to illustrate how the scenario could affect people and managers.

Nested scenario 3, "Freeze-Dried," is in a social context of riots and revolution. Future implications under this scenario resulted in numerous changes to natural, cultural, and subsistence resources, socioeconomics, and facilities. This scenario diverges from the others in that salmon resources could be severely decreased, vegetative growth would be limited, and significant economic and cost of living issues would occur.

Natural resource condition changes would result in less water in a cool dry temperature regime producing poor conditions for salmon reproduction, less snow, and large shifts in wildlife distributions and populations. Historical and archeological resources would not be seriously affected, but conflicts would result between subsistence, sport, and commercial user groups regarding access, seasons, and allocations for increasingly limited resources. Over-snow and river access would be reduced, making access for local area residents limited and difficult. Fewer locals would retain commercial fishing permits, and a higher cost of living, with increased fuel costs and governmental deficits, inflation, and less funding for land management, would impact rural communities. Coupled with the reduction in fish and wildlife resources for subsistence, local rural residents would move to urban and regional population hubs. Local cultures would suffer a loss of traditional ecological knowledge. The dry conditions would increase the risk and occurrence of wildland fires, but most facilities would not be severely damaged.

Important management actions would include intensive management of fish and wildlife resources. Federal harvest preference for local rural residents would be triggered. Current and future critical habitats for fish and wildlife would be protected, including migration routes, breeding grounds, and ecosystem services. A more flexible process would be devised to adjust resource harvest to reflect rapidly changing conditions. Federal local-hire authority would be greatly enhanced. Long-term funding for managing invasive species would be secured. Future climate change scenario workshops would need to make a greater effort to include important stakeholders.

Research and information needs would include an intensified science outreach and education effort to multiple audiences. A higher understanding of Alaska protected areas in the global context would be presented. Funding for interdisciplinary studies would be acquired, and social scientists for the Landscape Conservation Cooperatives and climate science center in Alaska would be hired to balance the biologists. An ethnography program would be enhanced to capture cultural information before it is lost forever. Communication between the Alaska Landscape Conservation Cooperatives (LCC) would be enhanced, and the Bristol Bay area and its fisheries would be addressed under one LCC. Climate change models would be validated with I&M data.

As one example, the following narrative was created to synthesize this climate change scenario. An open letter to Senator Will Goforth, from the Alaska Peninsula Mayors Council, was envisioned, to be published by the Alaska Daily News, in July, 2030.

> Dear Senator Goforth,
>
> We the undersigned appreciate your many years of wise public service and support for Alaska's coastal communities. We are writing today to ask your help again in dealing with a crisis for which government agencies seem unable or unwilling to help our communities. You are well aware of the importance of community, place, and subsistence to rural Alaskans.
>
> While most people in our communities still live a subsistence lifestyle, it has become harder to subsist, and harder to maintain a viable community. After more than a decade of diminishing stream flows and sharply declining salmon returns, many local fishermen

have been forced to sell their salmon permits, their livelihood, and their family legacy to out-of-state businesses. After our fish processing plant closed, more people left to seek wage work elsewhere. We were devastated when school enrollments dropped below the minimums. Because schools have closed, there will soon be few younger people and families left in the community. With the prohibitively higher costs of fuel and electricity, we are thankful that some residents still have good paying jobs in government and community services. But the number of such positions has also declined with falling tax revenues. A few residents found jobs with new construction, wind farms, and mining operations on nearby state and corporation lands, but most good jobs seem to be filled by Outsiders.

Federal and state agencies have compounded the challenges faced by our communities. For example, with the loss of salmon, we have increasingly looked to hunters to provide for our aging residents. The decades-long drought, coupled with a history of water resources mismanagement, deforestation by wildland fires and mining impacts, and steadily increasing federal predator protection, has made it increasingly necessary for hunters to travel long distances to find harvestable wildlife. Agency regulators don't appreciate that the changed landscape and unrealistic hunting seasons make access by boat, foot, and snow machine unreliable. Now, those same agencies are working against our hunters, by denying use of ORVs for access to game on government lands. Senator, we need the agencies to work with our public, not against us, and we desperately need more good jobs in our rural communities before our young families all move away to hub communities and urban areas.

Today, we ask for your sponsorship of the "Salmon for our Children" bill, a program to fund construction and operation of an expanded network of government-funded community salmon hatcheries. We also ask for your support of a local-hire mandate, provisions for securing any necessary water rights from adjacent federal lands, and reasonable community access to federal lands by ORV in this bill.

Respectfully,
The Members of the Peninsula Mayors Council

In summary, park managers, park neighbors, and stakeholders can learn from the future by using the best available scientific information and climate projections to create plausible, divergent, relevant, and challenging future scenarios to prepare for uncertain future conditions in the face of climate change.

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# Extrapolating Climate Change Data for Cultural Landscapes

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## Climate change

Climate change, for the purposes of this paper, refers to a "significant change in the measures of climate lasting for an extended period (decades or longer) … measured by indicators such as temperature, precipitation, wind, etc." (EPA 2010, 1). Scientific evidence indicates that climate change is a natural ongoing process. However, recent scholarship indicates that climate change is not always slow and systematic, but can also be abrupt leaving little time for civilization(s) to react. Paleo-climate study, benefiting from technological advancement, shows that climate change has occurred within a ten-year period, with global effects persisting over centuries (NAS 2002).

Adaptation to climate change is evident through the archeological record, and through paleo-environmental research where links between abrupt climate change and distinct cultural transitions or periods have been identified. The Paleo-Indian, Archaic, and Woodland periods and period subdivisions are defined by "technology, settlement patterns, and artistic traditions" and "change of material culture" (Munoz, Gajewski, and Peros 2010, 22009). These transitions have been found to correspond to a "major transition in the climate and vegetation of the region" (ibid.). The relationship between climate change and cultural transitions has been interpreted as native populations adapting to shifts in ecosystems resulting in cultural changes in areas such as "resource procurement strategy, technology, and/or population size" (ibid.). Essentially, "the ecosystems from which prehistoric humans subsisted changed periodically in response to new climatic regimes, and as a result humans adjusted their toolkits accordingly by developing or adopting new or existing technologies" (ibid., 22011).

This poster is not to debate climate change—natural or human-induced/accelerated. This display simply acknowledges that changes in climatic patterns have been and continue to be observed and explores how to utilize climate change science in a transitive way that would allow for better understanding of the effects of climate change on cultural landscapes. Identifying the potential range of climate change effects on cultural landscapes provides valuable information for "what if" scenario planning models that ultimately assist resource managers with adaptive treatment strategies that preserve cultural landscape resources for the "enjoyment, education, and inspiration of this and future generations" (www.nps.gov/aboutus/mission.htm).

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### Cultural landscapes

"A cultural landscape is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibit other cultural or aesthetic values. There are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes" (Page, Gilbert, and Dolan 1998, 12). A landscape listed on the National Register of Historic Places meets National Register criteria, and has significance and historic integrity. Characteristics and features that convey evidence of human manipulation and adaptation to an environment define cultural landscape integrity.

A landscape has historic integrity to an identified period of significance if it has most or all of the seven aspects that define integrity—location, design, setting, materials, workmanship, feeling, and association. There are several recognized characteristics and features of cultural landscapes as outlined in the *Cultural Landscapes Inventory Professional Procedures Guide* (Page 2009). These characteristics and features were adapted from several National Register Bulletins, including *Bulletin 30, Guidelines for Evaluating and Documenting Rural Historic Landscapes*. Several features are resource types in and of themselves, while others are combinations of human made and natural features:

- Archeological sites
- Buildings and structures
- Circulation
- Cluster arrangement
- Constructed water features
- Cultural traditions
- Land use
- Natural systems and features
- Small-scale features
- Spatial organization
- Topography
- Vegetation
- Views and vistas

While all of these characteristics and features can be affected by changes in climate, some may be more vulnerable affecting the integrity of the landscape as a resource. "The relationships between landscape characteristics and the seven aspects of integrity are complex. Patterns of spatial organization, circulation networks, and clusters directly relate to integrity of design and strongly influence the cohesiveness of a landscape. Boundary demarcations, small-scale elements, vegetation, and the evidence of responses to natural systems and features all add to location and setting. Continuing or compatible land uses and activities enhance integrity of feeling and association. Buildings and structures, vegetation, small-scale features, and land uses all reflect materials, workmanship, and design. Archeological sites may strengthen integrity by providing physical evidence of activities no longer practiced" (Page 2009, 7-2). The best way to preserve a cultural landscape as a resource is to protect the relationship of the components that convey integrity.

The issue with a manipulated environment is deterioration, aging, and/or weathering begins from the moment they are built or installed. Even under the most controlled conditions, nothing has proven to last forever. In respect to historic sites, the accepted pattern of deterioration and maintenance can become a challenge in terms of timing as well as availability and suitability of in-kind materials. With so many cultural landscape characteristics and features overlapping with natural resources, one of the most detrimental effects of changes in climate to cultural landscapes

| Indicator/Trend | Climate Change Science Observations | Potential Changes to Cultural Landscapes |
|---|---|---|
| **Temperature & Heat Waves –** increasing & more frequent | Vegetation & growing season<br>Evaporation rates<br>Precipitation/snowfall<br>Drought<br>Water Temperature<br>Water Level<br>Animal Behavior | **Vegetation** – Species stress & mortality from excess heat, moisture, disease, & pests<br>**Constructed water features –** Water shortage or excess<br>**Buildings/structures** – Material deterioration; stressed structural & mechanical systems<br>**Cultural Traditions** - Practices and events may shift seasons or cease<br>**Land Use** – Changes due to drought, excess precipitation, & altered growing season<br>**Natural Systems/features** –Unbalanced ecological systems impact human response<br>**Archeological Sites** – Above ground accelerated deterioration, subsurface shifting |
| **Precipitation & Heavy Precipitation Storms –** increasing & more frequent | Vegetation/growing season<br>Water Erosion<br>Water Level/flooding<br>Water Quality<br>Animal Behavior<br>Snowfall | **Vegetation** -Species stress & mortality from moisture, disease, pests, storm damage<br>**Constructed water features –** Excess water<br>**Buildings/structures** -Material deterioration, damage; structural & mechanical system stress<br>**Cultural Traditions** -Practices and events may shift seasons or cease<br>**Land Use** - Changes due to drought, excess precipitation, & altered growing season<br>**Natural Systems/features** -Unbalanced ecological systems impact human response<br>**Topography** – Erosion, landslide, slumping<br>**Circulation** – Patterns may change due to flooding, perpetual wet areas<br>**Archeological Sites** – Above ground accelerated deterioration, subsurface shifting, exposure |
| **Ocean Heat & Sea Surface Temperature -** Increasing | Evaporation<br>Ecosystems<br>Water Erosion<br>Water Level/flooding<br>Animal Behavior<br>Snowfall<br>Weather patterns<br>Ocean Currents | **Vegetation** - Species stress & mortality from temperature changes and weather patterns<br>**Buildings/structures** -Material deterioration, damage; structural & mechanical system stress<br>**Cultural Traditions**-Changes due to temperature, altered seasonal activity & animal behavior<br>**Land Use** - Changes due to drought, excess precipitation, & altered growing season<br>**Natural Systems/features** -Unbalanced ecological systems impact human response<br>**Topography** – Change in relative Sea Level, land mass sink/rise<br>**Archeological Sites –** Above ground accelerated deterioration, subsurface shifting, exposure |
| **Sea Level –** Increasing | Ecosystems<br>Water Erosion<br>Flooding<br>Animal Behavior<br>Topography | **Vegetation** - Species stress & mortality excess water, tidal erosion, water salinity<br>**Buildings/structures** –Material damage; structural & mechanical system stress/failure<br>**Cluster/Spatial Patterns** - Relationships of infrastructure change<br>**Cultural Traditions** -Changes due to temperature, altered seasonal activity & animal behavior<br>**Land Use** – Decreased land for infrastructure, land composition and elevation levels shift<br>**Natural Systems/features** -Unbalanced ecological systems impact human response<br>**Topography** - Change in relative sea Level, land mass sink/rise<br>**Archeological Sites** – Above ground feature inundation |
| **Arctic Sea Ice & Lake Ice -** Decreasing | Temperatures<br>Sea Level<br>Currents<br>Storm Exposure<br>Ecosystems<br>Animal Behavior<br>Climate Stability | **Vegetation** - Species stress & mortality due to temperature and composition changes<br>**Buildings/structures** -Material damage; structural & mechanical system stress/failure<br>**Cluster/Spatial Patterns** - Relationships of infrastructure change<br>**Cultural Traditions**-Changes due to temperature, altered seasonal activity & animal behavior<br>**Land Use** –Infrastructure instability, land composition and elevation levels shift<br>**Natural Systems/features** -Unbalanced ecological systems impact human response<br>**Topography** -Change in relative sea Level, land mass sink/rise<br>**Archeological Sites** - Above ground inundation, subsurface shifting, exposure |
| **Plant Hardiness –** Zones Shifting North | Vegetation/growing season<br>Animal Behavior<br>Human Behavior<br>Ecosystems | **Vegetation** - Species stress & mortality due to increased composition changes<br>**Cultural Traditions** -Changes due to plant availability, altered seasonal or ceased activity<br>**Land Use –** Changes in growing season, crop yields and responses to tradition methods<br>**Natural Systems/features** – Ecological shifts in relationships of systems<br>Archeological Sites – Cover vegetation species may not grow or too much in specific areas |
| **Length of Growing Season & Leaf & Bloom Dates** – Longer & Earlier | Vegetation/growing season<br>Animal Behavior<br>Human Behavior<br>Ecosystems | **Vegetation**- Species stress & mortality due to increased composition changes<br>**Cultural Traditions** -Changes due to plant availability, altered seasonal or ceased activity<br>**Land Use** – Changes in growing season, crop yields and responses to tradition methods<br>**Natural Systems/features** – Ecological shifts in relationships of systems<br>**Archeological Sites** - Cover vegetation species may not grow or too much in specific areas |
| **Animal Behavior –** Shifting Northward and Inland | Habitat selection<br>Mortality<br>Migration<br>Breeding<br>Symbiotic relationships | **Vegetation** - Species stress & mortality due to increased animal demand for food, habitat<br>**Buildings/structures** – Pest and nuisance animal behavior towards infrastructure<br>**Cultural Traditions** -Changes due to animal availability, altered seasonal or ceased activity<br>**Land Use** – Changes in hunting seasons and typical human animal relationships<br>**Natural Systems/features** – Ecological shifts in relationships of systems<br>**Archeological Sites** – Exposure/shifts due to animal behaviors such as digging & burrowing |

**Table 1.** Climate change indicator/trend in relationship to climate change science observations which, through extrapolation, will result in potential changes to cultural landscapes.

could be a shift in environmental context and the difficulties in perpetuating it in a way that preserves integrity.

### Climate change indicators

Understanding that climatic patterns change naturally and abruptly with persistent and, at times, global effects, presents an opportunity for society to be proactive in indentifying vulnerabilities and adaptation strategies that will save time, money, and resources. In their report, *Climate Change Indicators in the United States*, the Environmental Protection Agency outlines 24 out of a set of 110 potential climate change indicators. While all indicators are related in the overall affect on climate, some have more direct effects than others on cultural landscapes. Of the 24 in the report, this display looks at a smaller subset (Table 1, above) that in general have the potential to directly impact cultural landscapes in the United States.

### Extrapolating and planning

Climate change science currently focuses primarily on natural resources. Cultural landscapes contain characteristics and features both natural and human-made that react to changes in climate which in turn affects historic integrity. Climate change trends and data can be extrapolated to identify potential vulnerabilities to cultural landscape characteristics and features. With vulnerabilities identified, adaptation strategies can be developed to provide the tools managers need to plan for plausible climate scenarios that may present themselves incrementally or abruptly in the future. Understanding the impacts of climate change on cultural landscapes not only forces a shift of preservation philosophy, but also technique which may include several possibilities and options including innovation, managed retreat, and/or documentation and release.

### Conclusion

Cultural landscapes convey human adaptation to an environment. Extrapolating data and using scenario-planning methods from the NPS Climate Change Response Program will help identify vulnerabilities and adaptation strategies. This approach reaches beyond preservation, restoration, and rehabilitation towards a balanced resource management model. A balanced approach will assist managers in mitigating impacts and adapting to change while honoring the National Park Service mission.

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# Knowledge All Around You: Cultural Landscapes Management from a Landscapes Point of View (Session Introduction)

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## Introduction

CULTURAL LANDSCAPES ARE EVIDENCE OF CONTINUING AND CHANGING RELATIONSHIPS BETWEEN particular landscapes and the inhabitants of those landscapes. Within an ethnographic approach to cultural landscapes management, landscape use can inform personal and cultural identity. In large part, we get our identity from place, from the landscape. Think about the landscapes in which you live—where do you feel you belong? What elements in your environment give you cues as to who you are, where you fit, and to what community you belong? By asking these kinds of questions, we can develop an understanding of how people derive their identity through interaction with landscape. Race, ethnicity, class, and gender can also influence personal and cultural identity. As relationships between people and places grow and change, cultural landscapes provide information about race, class, and gender (Vivien Rose, pers. comm.).

In this session, we explored how individuals and communities have derived, and continue to derive, their identities from places in which they live, the landscapes they revere. The issue of landscape and identity has important ramifications for inter-community negotiations around race and gender, for international politics, and for the preservation of parks and protected areas. In addition to looking at how we relate to landscapes and the associations we give to landscapes, we considered how the landscape itself—as a living being, as a character in a story—can communicate with us and influence our concept of who we are.

This session included papers from Elizabeth Goetsch, Park Ranger at Stones River National Battlefield in Tennessee, Laura Schuster, Chief of the Cultural Resource Division at Hawaii Volcanoes National Park, and Jill Cowley, Historical Landscape Architect at the National Park Service Intermountain Region Office in Santa Fe, New Mexico (this volume). Thanks go to Vivien Rose, Historian at Women's Rights National Historical Park, for initiating and contributing to this session.

## Conclusion

All three papers addressed how landscapes can influence personal and cultural identity. Elizabeth

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showed how a community retains ties to their home landscape after it has been established as a battlefield park, and how using the landscape as a character in the story also helps maintain objectivity in relating the story. Laura described how the key to managing an active volcano is ongoing consultation and an increased understanding of how Pele, the goddess of fire, is considered by Native Hawaiians to be the living landscape of Hawaii. And my visitor study explored how gendering landscape can influence creative responses to that landscape.

After the presentations, the audience discussion ranged between the broad and the specific, and a number of questions and comments were addressed. One question asked what federal preservation mechanisms are available to ensure the protection of ethnographic landscapes. In response, the National Register of Historic Places traditional cultural places category was discussed. Tribal perspectives, including the need to consult with associated tribes, were discussed. And, the question was raised: How might a belief that the landscape is a living being, able to communicate with us, influence land management? One objective of the papers and discussion session was to explore how an understanding of the landscape as a living being can help land managers appreciate tribal perspectives.

# An Integrant Part: Using Cultural Landscapes in Interpretation of Difficult History

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In her 1886 novel, *Where the Battle was Fought,* Mary Noilles Murfree, writing under the pseudonym Charles Egbert, described a dark and dreary scene of a former battlefield landscape, resting years after the battle devastated the land. She wrote, "A great brick house, dismantled and desolate, rises starkly above the dismantled desolation of the plain. Despite the tragic aspect of this building, it offers a certain grotesque suggestion.... There is no embowering shrubbery about it, no inclosing [sic] fence. It is an integrant part of the surrounding ruin..." (Egbert 1886, 2). She further detailed the place as a former home site, difficult to distinguish from the surrounding natural growth. Murfree's description could be a metaphor for the history and the landscape. The stories contained within the landscape amalgamate with the landscape itself. To tell only a piece of the story without also understanding the significance of the place would be like only seeing a part of the Murfree's house without seeing its connection to the devastated landscape, or understanding the stories contained within. Each of these stories and their relationship to the landscape remain "integrant parts" of the whole history connected to a place.

Maintaining the landscape as a character when interpreting the history of a place allows the site an opportunity to engage visitors with the "layers" of history. In order to demonstrate this idea, the following examination of the histories contained within Stones River National Battlefield, land now managed by the National Park Service (NPS), will serve as a case study for a cultural landscape approach in interpretation. In addition to being the site of a major Civil War battle, the place provided the land for an African American community to reside for decades after the Civil War ended, as well as a landscape that hosts several markers and monuments, reflecting the Civil War veterans' commemoration activities nationwide in the years following the Civil War. Previous scholars who have written about the ideas of Civil War "memory" on the land, and ideas about cultural landscape, include David Blight, Paul Shackel, J.B. Jackson, Paul Groth, Denis Cosgrove, Robert Melnick, and Arnold Alanen.

## A brief history

Approximately 81,000 soldiers met and fought at the Battle of Stones River between December 31, 1862, and January 2, 1863. The Union victory secured Middle Tennessee for the Union army,

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bolstered Union morale, and gave weight to President Abraham Lincoln's Emancipation Proclamation that took effect on January 1, 1863. At the end of the war, the War Department established Stones River National Cemetery on a small portion of the over 4,000 acres on which the battle had been fought. Members of the 111th regiment of the United States Colored Troops (USCT) built the cemetery. A community developed on the battlefield land over the next few years, as the soldiers gathered Union bodies from the surrounding area to reinter them at the national cemetery. At the height of this community, in 1880, over 2,000 individuals lived on about 1,000 acres of land. The community, called Cemetery, existed on the former battlefield land until 1927, when Congress authorized a little over 350 acres for Stones River National Military Park as a site to interpret the Battle of Stones River. The War Department paid landowners for their property, and removed several members of Cemetery in order to establish the military park. This property included several small tracts owned by African Americans (Figure 1) and two churches. The combination of removing houses of worship and residents damaged what could be considered the heart of the community.

### Significance in the landscape

The landscape's significance in Cemetery's story becomes evident after an examination of the connection between the landscape and the history of the land. The community's origins rest in the national cemetery in the same way the national cemetery's location is related to the battle fought on those grounds. As the 111th USCT gathered the Union dead from as far as ninety miles away for reburial at the national cemetery, families of the soldiers began to settle around the area and claim the land as their own. The national cemetery served as a flag stop on the Nashville, Chattanooga, and St. Louis Railroad, initially to aid the soldiers in their reinterment efforts, and to allow for travelers along the railroad to visit the national cemetery. This evolved into a train station in the later part of the nineteenth century that would have provided community members access to the larger cities of Murfreesboro and Nashville.

**Figure 1.** This photograph from the 1890s shows members of the Cemetery community on the former battlefield land in Murfreesboro. (Albert Kern, photographer). From the Albert Kern Collection at Dayton History.

The physical nature of the land suggests another reason why the members of Cemetery would have an easier time acquiring land here than in other places. Limestone abounds throughout middle Tennessee, and makes a significant appearance on the battlefield landscape. The area where members of Cemetery settled did not contain much value as agriculture land, and was probably easier for the African American individuals to purchase. The African Americans who did acquire land did not have anybody trying to reclaim that land because of its low value. How the community members acquired the land remains unknown; this is one of many aspects of the community's history that requires further research.

Another reason for the undesirability of the land, beyond the poor soil, comes from the idea that soldiers waged war on this land. After the battle devastated the area, the battle remnants would have included unexploded artillery pieces, broken wagons and carriages, and destroyed forests. A colonel visited Murfreesboro in April, commenting "There is a fearful stench in many places near here, arising from decaying horses and mules, which have not been buried at all … the country for miles around is strewn with dead animals, and the warm weather is beginning to tell on them" (Beatty 1946, 184). The mess would have been difficult, unpleasant, and potentially dangerous to clean up. The members of the 111th USCT, and their families, who stayed on the land because of proximity to the national cemetery, would have had to deal with cleaning the site. For some, that would have been a small price to pay for living as free blacks.

The ideological associations of the battlefield held by locals also provided reasons for the African American community to stay. The Union army occupied Murfreesboro for two years after their victory at the Battle of Stones River. During the occupation period, a large number of contrabands, former slaves who had freed themselves and were seeking asylum, migrated to the area. Local citizens viewed the battlefield as a representation of Confederate loss. Murfreesboro citizens did not express much interest in commemorating or preserving the space in the years following the war. The fact that Stones River National Cemetery, or what some would refer to as "that Yankee graveyard," existed on the battlefield land would further discourage Murfreesboro citizens from visiting the site. Their lack of interest would have also provided a buffer for Cemetery. The African American community would have been able to function with little interference from the Murfreesboro citizens.

The physical location of the battlefield, as well as the population of Cemetery, also presented forms of safety for the community. The battlefield rested almost three miles north of the city of Murfreesboro. This granted a haven for the African Americans in the community to start their lives anew by way of isolation. The distance from the concentration of Rutherford County's white population in Murfreesboro provided some safety for the residents of Cemetery. Cemetery's population of nearly 2,000 individuals amounted to another form of protection for the community.

While the community remained mostly isolated, it did not remain untouched. Over the six decades of the community's existence on the battlefield, veterans made a few efforts to commemorate the battle by way of monuments. The first monument established on the battlefield preceded the national cemetery; the men of Hazen's Brigade built a monument in 1863 dedicated to their efforts and the fallen soldiers of their brigade. In 1886, the United States Regular Troops built a monument in the national cemetery, dedicated to their brothers in arms who were buried in the national cemetery. And in 1906, the Nashville, Chattanooga, and St. Louis Railroad built an obelisk on the site where the Union artillery line blasted into the charging Confederates on the last day of battle, ending the battle in the Union victory. The Artillery Monument could originally be accessed by both railroad and road, and stood within the confines of the Cemetery community.

The community found a "homeplace" within the boundaries of the former battlefield. They settled on the land and called it their own. After the War Department removed a sizeable portion of the community in 1927, with the establishment of Stones River National Military Park, the land physically remained the same, with some alterations to the human material resting on the landscape. The human understandings of the site's significance shifted with the change. "Honor," "respect," and "commemorate" replaced the word "home" in relation to the place. The War Department managed the place as memorial of the events that took place from December 31, 1862, to January 2, 1862. When the NPS began managing the site in 1933, their focus remained on the battle, less on the Civil War, and not at all on the Cemetery community, or the effects of the war in that place. Not until the 1990s, through initiatives driven by contemporary historical scholarship, did management begin to contextualize the story of the battle.

### Current interpretation

Though the current museum briefly mentions the efforts of the 111th USCT, as well as the social and cultural effects of the war, it does not tell the story of Cemetery. Few remnants on the landscape show the lives that followed the Civil War. Among the physical remains of the community include decaying wood boards, rusty barbed wire, and various types of rubbish throughout the wooded areas of the battlefield, covered in moss, waiting for discovery. The remaining house sites of Cemetery are hardly accessible by the public; the natural growth interferes with inquiry, while protecting the sites for future archeological investigations.

Currently, the park has found some effective ways of telling the stories of Cemetery, and continues to seek methods to tell this history more holistically in relation to the battle and the Civil War. The park maintains a relationship with Middle Tennessee State University (MTSU) History Department and Public History program. Researchers from the school have provided, and continue to provide, information about the community. The university has developed an online database of Cemetery information. Interpreters from the park have used that research to expand formal interpretive programs. Interpreters also use the research to engage the public in informal conversations about the broader meanings of the Civil War. In recent years, the park erected a wayside exhibit about William Holland, a member of Cemetery, by his headstone, near the Hazen Brigade Monument. In 2009, students collaborated with the park to develop a traveling exhibit that focused on the layers of history contained within the battlefield landscape. The exhibit utilized quotes about the place and pictures of the land as a way to keep the landscape as a character throughout the exhibit.

Allowing the landscape to inform interpretation, the park looks at its future interpretive projects contextually. Within the next few years, the park has plans to develop and implement a long-range interpretive plan that reflects current scholarship. Specifically, several planned projects will enlighten visitors about the African American community and its role on the land after the war. A cultural resources management class from MTSU is designing a wayside exhibit portraying life within the community. The inherent nature of a historic wayside site provides the viewer a chance to experience his or her surroundings while learning about what took place at that location. The park has also discussed using digital media to provide user-friendly access to some of the more complex community stories. Through its relationship with MTSU, the park may interpret the site through a public interface which houses park research data.

### Landscape as integrant part

Understanding how a landscape reveals itself as an "integrant part" of the history of a place helps historians approach the story more holistically. Using a cultural landscape approach to tell the stories of a place brings many benefits. When looking at the landscape as a character in the story, interpreters can contextualize stories and show how they relate to each other. Cemetery's story is not complete without the battle story in the same way that the battle's story is not complete without looking at its effects. As a character in the story, the landscape serves as a way to seamlessly share these stories.

Using the landscape as a character in the story also helps maintain objectivity in relating the story. Interpreters can contextualize difficult histories by utilizing the cultural landscape approach. By keeping the landscape a character in the "telling" of a difficult history, interpreters can remove blame and victimization. By removing these subjective themes, interpreters make it easier for visitors to engage in the story, and can give visitors a basis for understanding contested history. Visitors have an easier time accepting that there were no "good guys" or "bad guys," and can seek the broader story when they experience the place, and consider the events that played out there.

Finally, visitors will make a better connection to the place and to the story when interpreters use the landscape as a character in their story. People "experience" the history when they visit these historic places. Visitors have a more informed encounter when interpretive materials and programs integrate the stories of history with the significance of the place. Learning a site's stories while in that place gives visitors a chance to "experience" history. When the landscape becomes a part of the story, visitors can also understand their own history in the making by being in that place. By visiting, they have contributed to one of many layers of history at that site. The NPS can better interpret their resources when they think of the landscape as a character in their interpretations of a place.

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# Pelehonuamea: Managing an Active Lava Landscape

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**Hawai'i Volcanoes National Park is the home of two active volcanoes,** Kīlauea and Mauna Loa. The summits of both volcanoes lie within park boundaries, and for some Hawaiians the summit areas of these two volcanoes are considered sacred. This park includes around 333,000 acres of land (Figure 1) which is considered to be the physical body of the deity Pelehonuamea. Mauna Loa is the most massive volcano, rising to 13,681 feet above sea level, and 9,600 cubic miles in volume. It makes up half of the island of Hawai'i. Kīlauea rises to 4,000 feet above sea level, and is between 6,000 to 8,500 cubic miles in volume (not all of either volcano falls within the park boundary). The frequent volcanic activity and the access to lava flows from these two volcanoes is the very reason the park was established. Ongoing lava activity is creating new land within the park. Past activity is described by over 400 years of oral traditions that are celebrated and told through *mo'olelo* (stories), *mele* (song, chant or poem) and *hula* (dance) that relate to Pelehonuamea, and the geologic history of the Hawaiian Island Archipelago.

When Hawaii National Park was established in 1916, there was little consideration of the cultural significance of Kīlauea and Mauna Loa (Moniz-Nakamura 2007). The prime goal of park development and planning was, and is, to get people to the active lava flows—the red active lava. Consequently, park planning efforts are designed to take advantage of the natural topography that allows visitors to drive through Kīlauea Caldera and up to the very edge of Halema'uma'u—the pit crater considered to be the residence of Pelehonuamea. Although light on the land, the roads cross through the very sacred land associated with Pelehonuamea. In addition, a 300-car parking area was developed at the edge, Halema'uama'u. The sacred summit of Uwēkahuna became the location for a museum and other park buildings. The summit is considered to be the most sacred of locations to the Hawaiians, and now houses the Hawaiian Volcano Observatory and Jaggar Museum. The site remains important to Hawaiians, visitors and scientists, who visit and work in the park. Similar plans to construct a road to the summit of Mauna Loa have resulted in paved access to the 6,000 foot elevation, and a truck trail to the summit that dates to 1915.

Since the park is currently moving forward with a General Management Plan (GMP), which is a document to guide the park for the next 20 years, it is imperative that we consider what we know today of the cultural significance of our parklands. Consultation, with Native Hawaiian

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**Figure 1.** Map of Hawaii Volcanoes National Park and the land of Pelehonuamea.

Organizations and individuals, is used to address the issue of the significance of Pele as it affects future planning within the park.

Hawai'i National Park (today called Hawai'i Volcanoes National Park) was the thirteenth national park established within the National Park system. It is a World Heritage Site, and is included in the Hawaiian Islands Man and the Biosphere Reserve. These designations were based on the natural resource values, and not specifically the cultural resource values of parklands. Hawaii is the most geographically isolated chain of islands in the world, and the rate of endemism in flowering plants is 90% within park lands. The Hawaiian cultural connections remain vibrant and thrive. The forest and all things natural for Hawaiians are not separate from humans; they are all part of the same culture.

The Kīlauea Crater is a listed property on the National Register of Historic Places, and it is significant for its "… frequent, almost continual, centering of volcanic activity … in prehistoric and historic times [it] has affected human life, cultures, religions and undertakings and in historic times has attracted local and worldwide governmental, tourist and scientific interests. Kīlauea Crater has been, and is, both worshipped and studied" (Apple 1973). This volcanic feature is one of the major visitor attractions in the park. It is ringed by Crater Rim Drive, and is a National-Register-eligible property, based on initial National Park Service master planning effort in the 1930s. It has high integrity, and after many eruptive events, the bulk of the original historic infrastructure remains.

Hawai'i Volcanoes National Park is a dynamic landscape, with Kīlauea likely being the most active volcano in the world, with 61 eruptions since the late eighteenth century, and nearly continuously active through the nineteenth century. Our current situation is a flank, or rift zone, eruption that has been ongoing for 27 years. A summit eruption within Kīlauea Crater at Halema'uma'u started in March of 2008, and continues. With all of this activity, it is not uncommon that lava and Kīlauea play a big role in the Hawaiian culture.

Hawai'i was colonized by people from Polynesia, several times, between AD 800 and AD 1400. Voyaging double-hulled canoes carried people, food, and plants; all the baggage needed for life on new lands. Volcanic activity on the island of Hawai'i would have been visible for great distances at sea. One of the three active volcanoes—Hualālai, Manua Loa or Kīlauea—may have been the beacon that brought the first wave of visitors to this island.

The story of Pele and Hi'iaka, as told by Nathaniel Emerson (1993), was published in 1915. Based on oral tradition, it tells the story of two sisters, Pelehonuamea and Hi'iaka (Figure 2). The story is an account of the geologic history of the islands, and how Kīlauea (which means spewing rock) was formed, when it was formed, and how it was formed. The Pele Family, or Pele Mā, arrived in the Islands sometime around the fifteenth century. Pele traveled through Hawai'I, starting on the Island of Kaua'i in the northwest, and then journeyed to the Island of Hawaii in the southeast, where she made her home at Kīlauea. Her journey across the archipelago is in keeping with the geologic sequence of formation of the Hawaiian chain, which begins with Kaua'i and progresses to the youngest addition, Lō'ihi, just off Hawai'i Island, still a mile below the ocean's surface.

Pele lives at Halema'uma'u in Kilauea Caldera. Kalua o Pele (Pele's pit, as it is often referred to locally) is where her jilted lover Kamapua'a built a *hale' ama'u* or house of ferns, to keep her from escaping. Kīlauea, Pele's home, is considered by some to be *Ka Piko O Ka Honua* (the navel of the earth), the center of the world for Hawaiians.

Today, traditional accounts, or 'ō*lelo no'eau* (proverbs), share with us truths of the past. Prior to Pele's arrival, the area of Puna, a land division that is half of the park, is said to have been a rich and fertile land. Today much of Puna within the park and adjacent to the park is a barren lava landscape. To people living in Puna this landscape is home—they understand that it is Pele's land and they are living on it only temporarily until she claims it again.

From 1987 through 2003, the Kalapana area within the District of Puna has been the focus of intensive archeological surveys and salvage excavations. The eruptive event of Pu'u 'Ō'ō (when lava started flowing into the park in 1987) continues to transform the landscape from once forested areas to expanses of new lava. This landscape was home for many Native Hawaiians, and provided nourishment from taro, sweet potatoes, and fish, with trails across and within land divisions that linked the house sites, religious structures, and agricultural and animal husbandry activities. The diversity of site features is typical of a landscape that was in constant use, both seasonally, and for the long term. It is a seemingly marginal landscape, as there are no visible water resources, and no extensive soil deposits, and little seems to grow on the expansive lava fields. However to the people of Puna, this area was full of traditions and opportunities that reflected a very rich cultural heritage and agricultural region. In a recent description of the park landscapes, Myra Tomonari-Tuggle (2011) describes the context of the archeological record as it relates to Pele, "all of the sites of the Hawaiian past have to be seen as places where homage and offering were made to Pele and her family … the story is more than the archeological remains it is the story of the world view of those of old who lived and worked on the land that was Pele."

Much of the southeastern corner of the park has been covered with lava from the Pu'u 'Ō'ō eruption. The losses include a visitor center, campground, and thousands of archeological features. A new site for the interpretation of traditions of this area is currently being developed in consultation with the adjacent Hawaiian community members of Kalapana. The story is theirs to tell.

**Figure 2.** Pelehonuamea at Halemaumau with the summit of Mauna Loa in the background (artwork by Herb Kane).

Pelehonuamea, or Pele, is so much a part of why Hawai'i Volcanoes National Park was established. A recent effort to focus on the park as a traditional cultural property, specifically related to the Pele traditions, has brought us to consider the boundaries of such a designation. On one hand the boundaries could include the entire 2,000 plus miles of the Hawai'i Island Archipelago, or a smaller focus could be just on the specific lands that we manage. Current research has given us a deeper understanding of the Hawaiian world view. The acceptance of the idea that Pele has been in residence at Kīlauea since the fifteenth century is based on the traditional "unwritten" literature or existing oral tradition, combined with hard science. Together these two areas have provided an enlightened view of the geologic history of Kīlauea.

In the following quote Don Swanson (2008), former Director of the Hawaiian Volcano Observatory, describes an "aha moment" regarding his profession: "… volcanologists were led astray by not paying close attention to the Hawaiian oral traditions. Had we looked for geologic evidence to test the traditions, rather than ignoring them, we probably would have realized much sooner that the formation of Kīlauea caldera happened much earlier than 1790 … but it is difficult to interpret anecdotal comments, particularly those cloaked in thick poetic metaphor. We are used to thinking scientifically, not metaphorically, when we tackle volcanic problems... Oral traditions dealing with volcanoes in Hawai'i implicitly ask and overtly answer the why questions in terms of Pele. If we volcanologists take the traditions seriously, we stand a good chance of learning about the what, when and where questions and answering those first three questions is often very helpful in addressing the more important how."

Consider the site known as Steam Vents, where 2.5 million visitors annually climb out of buses and cars to have a firsthand look into a steam vent, and feel the thermal heated vapors. This is also a place known as Wahine Kapu, used traditionally by Hawaiian women for physical and spiritual cleansing. Traditional users have found a way to avoid the visitors in the park, however. The issues of appropriate use, access, and development need to be revisited in the GMP process as it relates to the larger Pelehonuamea traditional cultural property. Any planning for the future must incorporate consideration of this cultural icon. Pele's story is retold at every eruption, it is told through the landscape of expansive lava. It is shared through the sulfur steam of earth cracks or steam vents; Pele is manifested in the place names found within Hawai'i Volcanoes National Park.

Pele is an implicit part of our universe at Hawai'i Volcanoes National Park. The challenge remains to incorporate current understanding of the significance of the elements of Pelehonuamea into current, and likely future, decision making. If there is an eruption and a visitor center burns and is covered by lava, do we rebuild in the same location? Would we build a hotel at the edge of an active volcano? Do we rebuild a hotel on the sacred lands of Pele where traditionally no one lived? Do we remove the roads that allow visitors and Hawaiians alike easy access to and across the *Ka Piko O Ka Honua* (the navel of the earth), the center of the world for Hawaiians?

What would be the boundaries for a traditional cultural property (TCP) that tells the story of Pelehonaumea? If the entire park qualifies as a TCP, how precedent setting would that be for the National Park Service?

When our roads and infrastructure are impacted by eruptive events, they are re-opened and we continue to provide visitor access to active lava flows. This is in keeping with the parks legislation "as a public park or pleasure ground for the benefit and enjoyment of the people of the United States." Waha'ula, the first sacrificial temple constructed in Hawai'i, is currently buried beneath 75 to 100 feet of lava. It may not be visible any longer but the location remains important to Hawaiians. Should we re-establish access to the site?

We continue to learn from the 400-year oral history that relates to Pele, and from the work done daily in the management of the park lands. Through consultation and careful listening we can incorporate the oral traditions, stories, songs, and dance for those that follow. The elders from the adjacent community understand Pele very well—she is Hawai'i, and although we are all here for the short term, the land belongs to her; if she wants it she will take it.

Although lava flows may seem barren, they are Pele's realm and it is Pele who provides a clean canvas for new life, and for the pioneering plants that in turn bring the water that nourishes the land that is Hawai'i (Figure 3). Hawai'i Volcanoes National Park provides an opportunity to combine indigenous and scientific knowledge.

Hawaiians consider the human world and the natural world to be one, with the origin of all living things beginning with Pele. The life cycle revolves around Pele and she is the connection between all things. This is a key idea to managing a traditional cultural property located on an

**Figure 3.** New land in the Puna District of Hawaii Volcanoes National Park (photo by USGS-HVO)

active volcano. The practice of consultation with traditionally associated groups or individuals will provide direction to an issue such as building a road to access the center of the Hawaiian's world. Consistent responses and constant consideration of our actions, with continued consultation, will help to educate and protect Pele's domain.

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# Visitors' Creative Responses to Protected Landscapes

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Understanding park and protected area visitors can be thought of as another kind of ethnography, that is, finding out about their point of view. In comparison with the Schuster's and Goetsch's papers (this volume), I discuss the perspective of visitors who develop personal connections—both intellectual and emotional connections—with park landscapes, rather than the perspective of members of traditional communities who made connections with park landscapes before they were designated as a park.

Visitors' creative responses to protected landscapes can help them, and land managers, understand the resource and their relationship with the resource. Creative responses can include painting, drawing, writing, singing, and dancing. Park visitors, in all their variety and diversity, have various relationships with protected landscapes. They can have strong ties, associations, emotional bonds, and strong responses that can influence how they respond to land management decisions, for example, whether they support or disagree with proposed management actions. One type of visitor response is painting.

Landscape painting has a strong relationship with parks and protected areas, and can influence personal and community identity. For example, landscape painting influenced the perception and establishment of large western national parks (Belanger 1999; Gussow 1971), and some park units have been established specifically to commemorate and preserve specific artist's work and influence (e.g., Weir Farm National Historic Site). Painting can be used as a vehicle to communicate resource values. For example, between 1937 and 1943, Bandelier National Monument hired Santa Clara Pueblo artist Pablita Velarde to produce over seventy paintings of contemporary pueblo life (Ruch 2000). These paintings, which visitors have viewed over the years, support the major interpretive message that Puebloan occupants didn't "disappear" from Bandelier, but relocated, and that their descendants, who live in neighboring pueblo communities, still consider the park landscape important to the continuity of their culture. Velarde's paintings illustrate the relationship between Puebloan people and their landscapes, and this relationship influences their sense of community identity. These paintings also communicate to monument visitors that the Bandelier landscape plays a role in Puebloan identity, and that this association is an important value of the monument's landscape resource.

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Visitors' paintings can also illustrate relationships, communicate resource values, and influence the painter's and others' sense of identity. My case study of how visitors' responses can reflect their understanding of, and relationship with, a protected landscape, and in turn influence their sense of identity, is a two-day workshop I held at the Ghost Ranch Conference Center in northern New Mexico (Figure 1). During this workshop, a group of ten participants created images that reflected and expressed their relationship with the Ghost Ranch landscape.

Ghost Ranch is closely associated with the life and work of nationally-significant artist Georgia O'Keeffe, and the workshop used O'Keeffe's relationship with this landscape as a reference and for comparison. Ghost Ranch is a privately owned landscape, protected as a conference center and venue for public workshops. The high desert landscape contains multi-colored hills and cliffs, riparian areas, and building complexes. The O'Keeffe house is on the property but is not open to the public.

I developed the workshop as part of my dissertation that focused on Georgia O'Keeffe's relationship with the Ghost Ranch landscape (Cowley 2006). I used concepts from ecofeminist theory to help explore that relationship. The workshop was held over a weekend in May, 2005. I led the ten participants (eight women and two men) through a series of "experience cycles"—cycles of presentation, outdoor creative activity, and group discussion. Workshop activities were both contemplative and interactive. My goal was to facilitate participants' opportunities to explore their relationship with the landscape, using O'Keeffe as a case study. The key question was, "Does gendering the landscape, and our relationship with it, influence our creative responses to that landscape?"

By "gendering the landscape" I mean assigning a gender (feminine, masculine, androgynous) to a landscape, or to a specific landscape feature. For example, using the term "Mother Earth," or characterizing the overall landscape as feminine, is a long-standing, almost subconscious gender-

**Figure 1**. Ghost Ranch Conference Center landscape (photo by J. Cowley, 2005).

ing of the landscape prevalent within many cultures. Compare this with thinking of the landscape as masculine. This might be unfamiliar and even seem odd. Sometimes, individual landscape features are gendered as masculine. For example, some Puebloan people experience mountains as masculine, and valleys and villages as feminine (Swentzell 1998).

By "gendering our relationship with a landscape," I mean experiencing our interactions with the landscape as gendered, that is, having qualities we associate with feminine, masculine, or androgynous. For example, if we relate to a landscape through our senses more than through cognition—if we feel the landscape more than think about it—and if we associate relating through our senses as feminine, then we might characterize our relationship with that landscape as feminine.

Ecofeminism studies the connection between the degradation of nature and discrimination against women (Warren 1997). Within ecofeminist fiction, landscapes are often portrayed as living beings, as characters in the story, along with humans and animals. Relationships between people and the landscape involve communication between equals (LeGuin 1987; Silko 1977). Within these stories, human characters experience the landscape, and specific places within the landscape, as living entities with whom they can directly communicate. To characterize and describe relationships with the Ghost Ranch landscape, I used three relationship aspects that I derived from ecofeminist thought:

1. The landscape is a living being with voice and volition, so two-way communication with the landscape is possible.
2. We can come to know the landscape, and communicate with the landscape, through our senses.
3. We can develop an intimacy with the landscape, that is, we can identify with and feel close to the landscape, as we can with a person.

Due to their association with ecofeminism, I consider these three aspects of relating with landscape as feminine. This does not mean than men don't and can't experience these ways of relating with landscape; it just means that to me, these aspects are part of a feminine relationship with landscape. A sense of identity can be highly subjective.

During the workshop, I introduced the idea of gendering the landscape and the three relationship aspects, and participants took these ideas with them during the painting exercises. Responding to the idea of gendering the landscape, one workshop participant portrayed the cliffs as a family, i.e. both feminine and masculine. Another participant experimented with separate paintings for masculine, feminine, and androgynous landscapes (Figures 2 and 3). Some participants did not gender the landscape at all; their experience of intimacy with landscape did not involve or depend on an awareness of gender but depended more on an awareness of the landscape being alive (Figure 4). Some felt that thinking about gender got in the way of experiencing the landscape.

When focusing on communicating with the landscape, some participants gendered their relationships, and some did not. For some, communicating with a landscape involved color and touch rather than language. Overall, a gendered approach made their experience more personal and intimate. Most thought in terms of stereotypical gender associations (e.g. enclosed landscape as feminine, vast open landscape as masculine) than experimenting with different associations. And for many, a sense of two-way communication with the landscape needed to include them giving back to the landscape in some way, for example, through some conservation activity. Whether or not they found gendering useful, all participants developed a more intimate relationship with the Ghost Ranch landscape, and for some, this involved allowing the landscape to influence how they thought of themselves, that is, their personal identity. As one participant expressed, "The

**Figure 2.** Masculine landscape (by S. Otter, 2005).

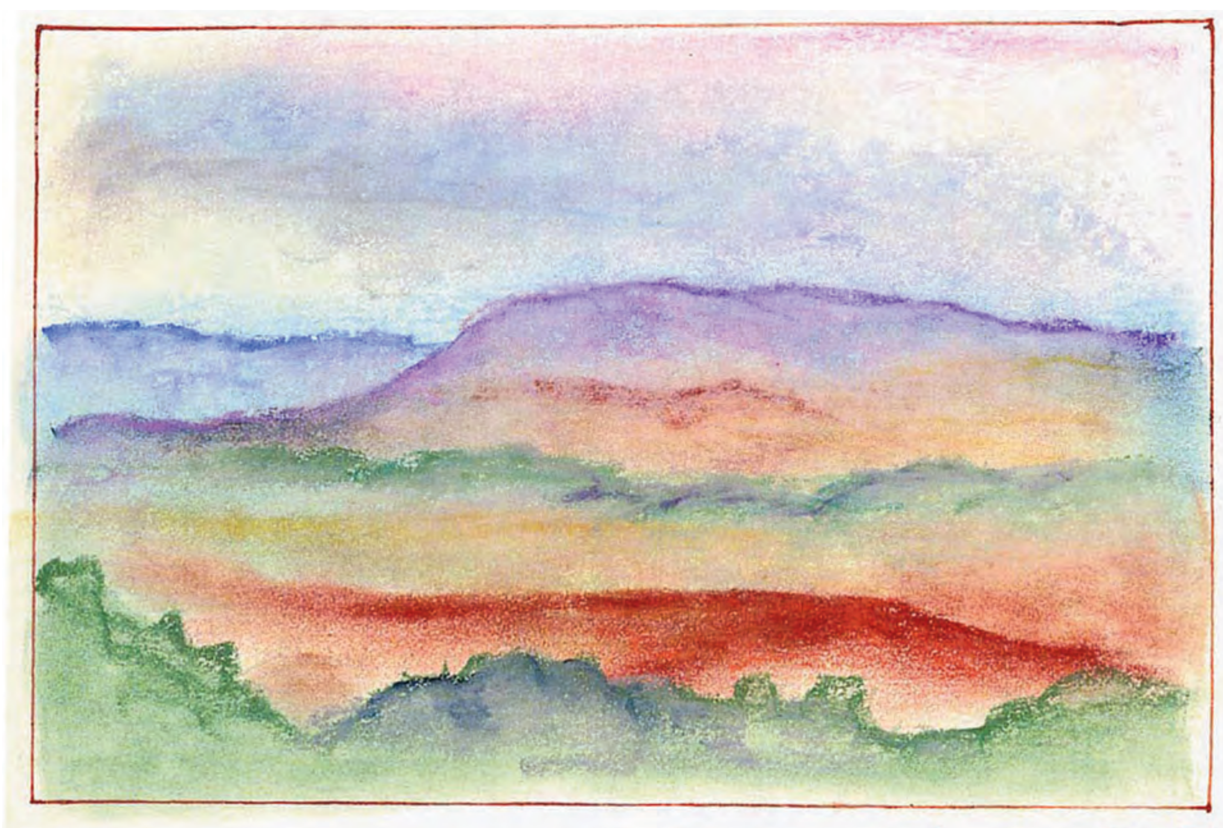

**Figure 3.** Feminine landscape (by S. Otter, 2005).

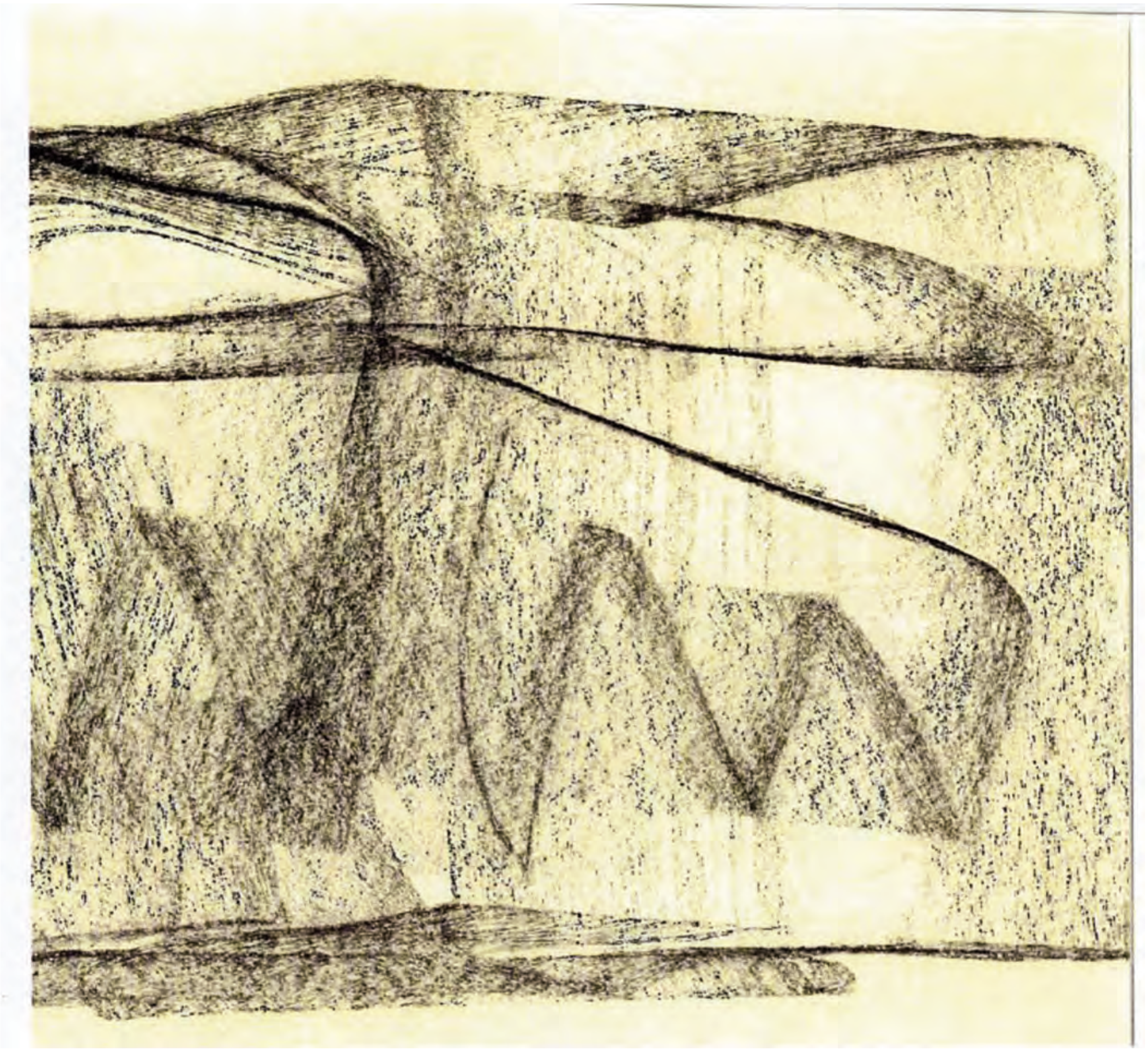

**Figure 4.** Landscape, not gendered (by M. Munguia Wellman, 2005).

relationship with the landscape captured an essence unattainable with human relationships" (Cowley 2006).

This type of visitor study has several applications to the management of parks and protected areas. Understanding visitors' creative responses to a landscape and to specific places can help managers understand why visitors interpret the landscape in different ways, and what interpretive themes might be of interest. Understanding visitors' ways of relating with landscape can help determine how to design (or not design) interpretive or experience settings. This kind of study can help us understand visitors' community identifications, for example, whether and why they identify as a member of the community of O'Keeffe aficionados, or identify primarily as a member of a community of painters. And, as land managers, we can reflect an understanding of visitors back on ourselves. For example, we can ask ourselves, how might our own personal relationship with a landscape (gendered or not) influence our management decisions?

*This previously published material represents my dissertation research, and does not represent the policies or views of the National Park Service.*

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