Integrating traditional ecological knowledge (TEK) into natural resource management

Perspectives and projects in western U.S. national parks

By Moran Henn, David Ostergren, and Erik Nielsen

Editor's note: National Park Service policy for use of the best available science and the integration of traditional ecological knowledge in natural resource management are discussed in *NPS Management Policies 2006*, particularly at sections 4.1, 4.2.1, 5.1.1, and 5.2.

Abstract

A growing interest in traditional ecological knowledge (TEK) in the National Park Service (NPS) is emerging out of an understanding that the original peoples of the land and their unique knowledge have much to offer modern land management. While little information exists regarding the nature, location, and outcomes of TEK integrated projects, even less information exists regarding the perceptions of its integration among managers in the world's first protected area system, the U.S. National Park System. With many parks now managing lands that were inhabited for centuries by native tribes, understanding the nature of TEK-integrated projects is especially important. Using an online survey focusing on the Intermountain and Pacific West regions of the National Park System, we assessed the perspectives of NPS employees on TEK integration. We hope to shed light on the perceived benefits, obstacles, and attitudes toward TEK integration within the National Park Service, as well as to provide a preliminary map describing the location and nature of these projects.

Key words: traditional ecological knowledge, tribes, Native Americans, comanagement, public involvement, natural resource management

NOT LONG AGO IN A REMOTE GRASSLAND, A GROUP OF tribal elders, accompanied by a national park fire chief, botanist, and resource chief, gave a short prayer before setting fire to the meadow to help restore native vegetation and fight off invasive species. This fire was started and maintained with traditional methods, the same methods used by the tribe long before the designation of the park, or even the National Park Service. In another park unit more than 1,000 miles (1,609 km) away, selected park employees slog through a swamp, treading on Wapato (*Sagittaria latifolia*), a flowering plant also known as Indian potato that grows in shallow wetlands. To the uninformed spectator this act might seem ambiguous at best, but this activity is thousands of years old. Local tribal women shared the method with park employees to help propagate Wapato, now a threatened species in the park.

These two restoration projects are part of the National Park Service's attempts to integrate traditional ecological knowledge to improve natural resource management. This research investigates the status and perceptions of TEK, an emerging and, we believe, underused source of knowledge that can help managers maintain natural resources and engage in meaningful tribal partnerships, especially in park units with a long history of tribal affiliation.

Background

Though there is no single definition of TEK (Houde 2007), it is usually accepted as a "cumulative body of knowledge, practice, and belief, evolving by adaptive process, and handed down through generations by cultural transmission, about the relationship of living beings with one another and their environment" (Berkes 1993:8). It is knowledge based on long-term observation and interactions with the natural world associated with societies who have a strong connection to a geographic location and historical continuity in resource use and management practices (Berkes 1993).

After more than two centuries of Western science guiding natural resource management, many agencies are now realizing that Western science is sometimes limited and cannot solve resource issues alone (Bowers 2005). A growing number of park managers realize that resource-based peoples have tremendous insight and offer additional perspectives. Global examples of integrating TEK include (1) using TEK as baseline data of pre-European or pre-industrialized ecological conditions; (2) providing alternative perspectives, classification systems, and management methods; (3) providing information about past and current uses of resources; and (4) aiding in formulating research methods, questions, and hypotheses (Berkes et al. 2000). TEK also has the potential to facilitate reconciliation between indigenous peoples and governments (Cronin and Ostergren 2007).

While, in some cases, TEK integration has proven beneficial in improving resource management, some challenges have been identified, including a basic lack of trust, institutional barriers, mission conflicts, cultural differences, and the ambiguity of terms (Berkes et al. 2000). To successfully integrate TEK, these challenges must be understood and addressed (Cronin and Ostergren 2007).

With the exception of Alaska, relatively little information is available regarding such endeavors in the National Park System. This study sheds light on TEK projects in the western United States and describes perceptions and attitudes of a broad sample of NPS resource managers.

Methods

For the purpose of this study we focused on NPS projects that use TEK for conservation or management of a natural resource. Native American Graves Protection and Repatriation Act (NAGPRA) consultations and interpretive projects were excluded from this analysis. We selected the Pacific and Intermountain West regions because 75% of these parks are historically and culturally connected to tribes, and most park units are within 50 miles (80 km) of reservation lands. We collected data from a sample of NPS resource managers, scientists, and superintendents.

Interviews and survey

We employed a mixed-methods methodology with semistructured interviews and an online survey to explore perceptions and experiences with TEK, as well as the status of TEK that is integrated into natural resource projects.

In 2008 we began conducting exploratory semistructured interviews (Berg 2007) with relevant NPS employees (n = 6) using chain referrals (snowballing) to learn about the nature and outcomes of TEK integrated projects. We used qualitative coding to analyze the responses and develop key themes related to TEK. Based on thorough literature review and major themes that emerged during the exploratory interviews, we developed an online survey using Survey Gizmo (online survey software). The survey included open-ended, multiple-choice, and Likert scale questions addressing individual perceptions of TEK, involvement in TEK projects, and perceived outcomes, benefits, and challenges of TEK projects. We coded multiple-choice and Likert scale questions as discrete variables and used open coding, and later focused coding (as used in qualitative analysis), for open-ended questions (Lofland et al. 2006). In 2009 we sent the survey to a contact list of NPS resource managers and superintendents from park units in the Pacific and Intermountain West (n = 512). The contact list was generated through the Colorado Plateau Cooperative Ecosystem Studies Unit (CPCESU) at Northern Arizona University. Participants received an e-mail explaining the study and ensuring confidentiality and a link to the questionnaire. Following Dillman (2007), participants received two reminder e-mails. We then conducted six follow-up interviews selected from a pool of 23 survey respondents who agreed to participate. In addition we interviewed five tribal representatives or former tribal government employees selected through chain referrals. The interviews clarified our survey results and allowed us to either confirm conclusions or reject speculation.

A growing number of park managers realize that resource-based peoples have tremendous insight and offer additional perspectives [to Western science].

Results

Participant characteristics

We had a 34% response rate representing 69 different parks—65% of western parks with affiliated tribes. Some parks were represented by more than one respondent. Natural resource managers and supervisory-level scientists accounted for 35% of respondents, cultural resource managers and professionals accounted for 26%, superintendents and deputies accounted for 23%, and 16% identified themselves as both natural and cultural resource managers. Most respondents (70%) worked for the National Park Service for over 10 years. Self-reporting personal experience levels working with tribes ranged from no experience (6%), to little experience (14%), some experience (43%), much experience (23%), and extensive experience (14%).

Knowledge and perceptions of TEK

When asked about familiarity with the terminology and concept of TEK, 23.6% reported that they were very familiar with both the term and concept, 28.5% reported that they were somewhat familiar with the term and concept, 33.3% were familiar with the concept but *not* the term, and 14.6% were not familiar with the term and concept. More important, a majority of survey respondents indicated they believe TEK has a place in NPS management (see table 1, page 56).

TEK project involvement

Less than half (42.5%) of respondents said they are involved in TEK-related projects, and 43.7% know about TEK projects. From the 51 respondents who reported being involved or knowing about TEK-integrated projects, we identified 44 projects in 37 parks (fig. 1, page 56; table 2, pages 57–58). Three parks had more than one project, five projects were reported numerous times, and 11 projects did not provide the location or park unit name. We filtered the data to avoid counting the same project twice.

Table 1. Perceptions of incorporation of TEK in NPS management (n = 122)

Statement	Strongly Agree	Somewhat Agree	Neither	Somewhat Disagree	Strongly Disagree
It is important to incorporate TEK within the National Park Service.	43%	38%	12%	5%	2%
Incorporating TEK improves conservation/management of natural resources.	25%	35%	32.5%	6%	1.5%
The National Park Service must make it a top priority to incorporate TEK into its management objectives.	16%	32%	37%	10%	5%

TEK project information

Respondents were asked to provide information about goals, TEK use, benefits, and challenges to TEK integrated projects. The results are summarized in tables 3 and 4 (page 59).

In all, only 45% (n = 20) of projects dealt directly with conservation and restoration of natural resources. TEK was often used for adding knowledge diversity and historical context (44%; n = 15) or understanding resource uses (25%; n = 11), but not for direct natural resource management decisions. A biologist explained, "Incorporating TEK into natural resource issues is just low-priority, and that is why it is rarely used when making natural resource management decisions." Understanding current resource use, however, was emphasized by many respondents and was repeatedly expressed in the interviews. A superintendent stated, "We must know what is being collected and where."

Project challenges

Respondents identified "difficulties in obtaining TEK" as a major challenge (fig. 2, page 59). This refers to a lack of employee knowledge and training in the process of obtaining TEK, lack of collaboration with tribes, and a belief held by some participants that the knowledge is lost. A superintendent explained, "We were not always sure whom to speak with, how to approach the tribe, what is appropriate, whether our behavior is acceptable." A cultural resource manager added, "Since the tribes have been removed from the park for over 100 years, very little knowledge actually exists."

"Institutional barriers" included a lack of support and resource allocation for TEK projects as well as institutional inertia. A resource chief stated, "Getting enough financial support . . . this is an ongoing problem." However, two tribal interviewees regarded this issue not as a lack of resources but as a lack of prioritization. One stated, "There is no shortage of money or people . . . it is all about priorities . . . it just takes will from management."

Figure 1. The study identified 44 TEK integrated projects in 37 western U.S. park units (map displays 26 of the identified parks with TEK projects).

"Cultural differences" referred to personal differences in beliefs, attitudes, and actions, specifically differences in ideology, cosmology, and epistemology. A superintended explained, "My experience has been, as any time when people of different backgrounds and cultures try to jointly conduct a project, the groups bring their own distinct ideas to the process."

"Lack of trust" referred to instances where NPS employees felt a lack of trust from tribal representatives and governments. A resource chief explained, "They just don't trust us; why would they?"

Table 2. National park management projects using traditional ecological knowledge (TEK)

Park	Description	Type	How TEK Was Used
Anonymous (i.e., park name not provided/requested to remain anonymous)	American Indian students share TEK as seasonal interpreters	Interpretation	Knowledge diversity and historical context
Anonymous	Determine population status of a threatened plant species	Restoration and conservation	Knowledge diversity and historical context
Anonymous	Vegetation management and traditional use identification of plants	Restoration and conservation	Knowledge diversity and historical context
Anonymous	Obtain resource information for creation of a new park	Interpretation	Knowledge diversity and historical context
Anonymous	Collect native seed for reseeding disturbed areas	Restoration and conservation	Traditional management techniques
Anonymous		Interpretation	Resource use
Anonymous	Improve/develop relationships between tribes and park. Major emphasis on past, present, and future resources use	Relations	Resource use
Anonymous	Tribal involvement	Resource use	Resource use
Anonymous	Restoration of native forest	Restoration and conservation	Resource use
Anonymous	Update of fishing regulations	EIS consultation	
Anonymous	Watershed analysis	EIS consultation	
Bandelier NM	Fire management and ecological restoration	Restoration and conservation	Resource use
Bent's Old Fort NHS/Sand Creek Massacre NHS	Ethnobotanical survey	Restoration and conservation	Baseline data
Big Bend NP	Monitor plant species	Resource monitoring and research	
Big Hole NB	Camas citizen science monitoring program	Interpretation	Knowledge diversity and historical context
Canyon de Chelly NM	Gathering rights	Resource use	
Death Valley NP	Mesquite and pinyon monitoring	Resource monitoring and research	Traditional management techniques
Devils Tower NM	Develop a recreational management plan for a traditional cultural property	Sacred sites management	Knowledge diversity and historical context
Glen Canyon NRA	Provide emergency access to lake	EIS consultation	Knowledge diversity and historical context
Golden Gate NRA	Restoration of Crissy Field tidal mMarsh in the Presidio	Restoration and conservation	Baseline data
Golden Gate NRA	Redwood Creek restoration at Muir Beach (wetland and creek restoration)	Restoration and conservation	Baseline data
Grand Canyon NP	Colorado River management (both NPS plan and Bureau of Reclamation plan for operation of Glen Canyon Dam)	EIS consultation	Traditional management techniques
Great Sand Dunes NP&P	Prescribed fire	Restoration and conservation	Traditional management techniques
Great Sand Dunes NP&P	Identify traditional uses of plants	Resource use	
Joshua Tree NP	Install a traditional use demonstration garden	Interpretation	Knowledge diversity and historical context
Lake Mead NRA	Cultural landscapes, traditional tribal properties (compliance-related consultations)	EIS consultation	Knowledge diversity and historical context
Lake Mead NRA	Restoration of natural resources in a traditional cultural property	Restoration and conservation	Knowledge diversity and historical context
Lake Mead NRA	Eradicate invasive plant species within the park	Restoration and conservation	Baseline data and resource use
Lake Roosevelt NRA	Fire management	Restoration and conservation	Resource use
Lava Beds NM	Inventory cave cultural and natural resources	EIS consultation	Knowledge diversity and historical context

CONTINUES >>

Table 2 (continued)

Park	Description	Type	How TEK was used
Lewis and Clark NHP	Reintroduce Wapato (*sagittaria latifolia*), an indigenous food staple, to the ecosystem	Restoration and conservation	Traditional management techniques
Mount Rainier NP	Manage fisheries and tribal uses of plants and access to sacred sites	Resource use	Resource use
Mount Rainier NP	Information about tribal use of plant material	Resource use	Resource use
Nez Perce NHP	Restore camas lily to Weippe Prairie (camas citizen science monitoring program)	Restoration and conservation	Baseline data, knowledge diversity, and historical context
Olympic NP	Elwha River ecosystem restoration	Restoration and conservation	Baseline data
Olympic NP	Changes in fishing regulations	EIS consultation	
Redwood NP	Study the feasibility of reintroducing California condor to tribal and national park lands	Restoration and conservation	Knowledge diversity and historical context
Redwood NP	Management (protection and restoration) of bear grass on traditional use sites	Restoration and conservation	Resource use and traditional management techniques
Rocky Mountain NP	Senior Ranger Corps and Next Generation program	Interpretation	Knowledge diversity and historical context
Tuzigoot NM	Restore a marsh	Restoration and conservation	Resource use
Whiskeytown NRA	Develop trails within the park	EIS consultation	Value
Yellowstone NP	Conserve Yellowstone bison	Restoration and conservation	Knowledge diversity and historical context
Yosemite NP	Burn meadow for both cultural and natural resource values	Restoration and conservation	Traditional management techniques
Zion NP	Incorporate cultural harvesting of plants into resource management efforts	Resource use	Resource use

Abbreviations: NB = national battlefield, NHP = national historical park, NHS = national historic site, NM = national monument, NP = national park, NP&P = national park and preserve, NRA = national recreation area.

"Ambiguity with the term and the knowledge" referred to lack of a clear definition of TEK and conflicting or unclear information provided by tribes.

"NPS attitudes" referred to a spectrum of answers, ranging from perceived racism and prejudice to a lack of interest or desire to work with TEK or tribes. These attitudinal problems, however, did not emerge as challenges in our postsurvey interviews.

"TEK-NPS conflicts" referred to situations where NPS participants felt that TEK contradicts NPS values and mission. This was especially true for the collection and harvest of threatened or sensitive species. Although a request to collect an endangered species is a rare event, it is a worst-case scenario that elicits strong reactions in both groups.

"Unrelated challenges" referred to problems dealing with the resources or conditions themselves, including adverse weather conditions and broken machinery.

"Public opinion" referred to problems of perceived favoritism toward Native Americans in privileging their knowledge and input into resource management.

"TEK-science conflicts" referred to situations where NPS participants felt that the best available science contradicts TEK. In our postsurvey interviews, a tribal representative commented on this point and said that "in many cases it [TEK] strengthens Western science. But we need to understand it is also a science and should be evaluated as such."

Project benefits

Respondents identified "park-tribal relations" most frequently (39%) as a benefit of TEK integration (fig. 3). Tribal interviewees did not discuss relations as a TEK benefit but rather as a prerequisite. A former tribal resource manager explained, "For TEK projects to be successful the NPS must first create strong relationships with tribes and build trust."

Table 3. Distribution of TEK projects (n = 44) in western units of the National Park System

Project (categories based on goals)	(n = 44)	Details
Improving natural resource management	20 (45%)	Restoration and conservation
Environmental impact statement and consultation	9 (20%)	National Environmental Policy Act (NEPA), Endangered Species Act (ESA), cultural consultations
Resource use	6 (14.5%)	Monitoring, understanding, and regulating historic and current uses
Interpretation	6 (14.5%)	Educational displays, talks, trails
Resource monitoring and research	2 (4.5%)	Resource inventory
Sacred sites management	1 (2%)	Resolving sacred site issues

Table 4. Distribution of how TEK was used in identified projects (n = 44)

Uses	(n = 44)	Details
Knowledge diversity and historical context	15 (44%)	Cultural value given to specific resources and ethnographies
Resource use	11 (25%)	Current and historical harvest, collection, and hunting
No explanation	7 (16%)	Gave no explanation of how TEK was used
Traditional management techniques	6 (12%)	Executing alternative management and restoration actions based on traditional methods
Baseline data	5 (3%)	Information for restoring pre-European conditions to a site, such as vegetation pallets

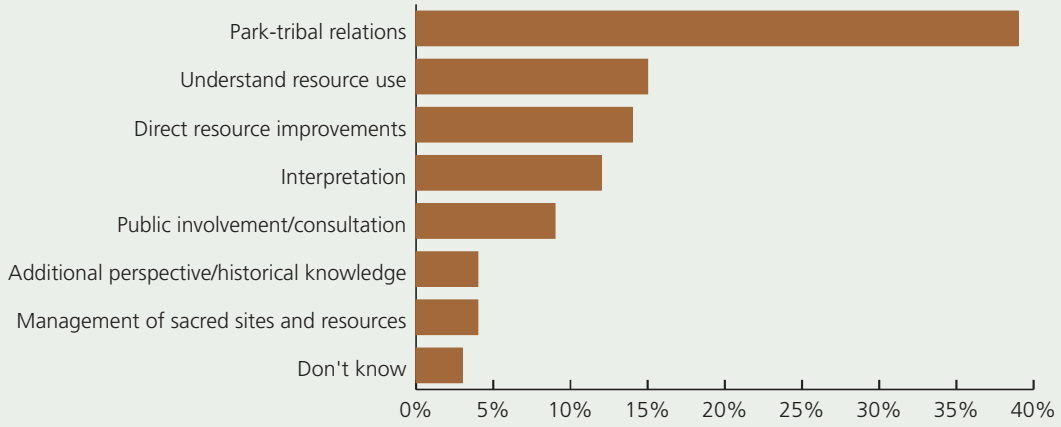

Figure 2. Distribution of perceived challenges (n = 77) of TEK integration into natural resource projects in western U.S. parks.

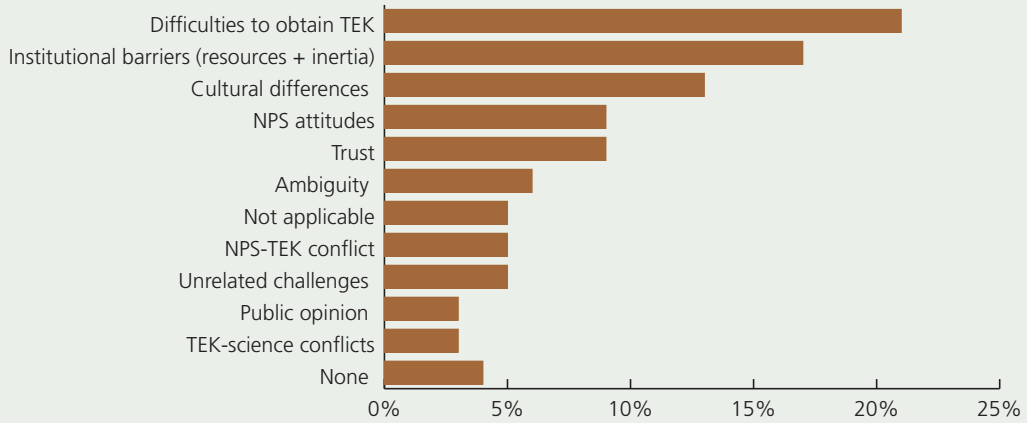

Figure 3. Distribution of positive outcomes and benefits (n = 46) from TEK integration to natural resource projects.

"Understanding resource use" (15%) referred to both historical and current harvesting, hunting, and collection of resources by Native Americans. An NPS resource manager stated, "It helps us better manage the resources if we know how they are being used and by whom."

"Direct resource improvements" referred to active management of natural resources, especially restoration, using methods guided by TEK. These include propagation of plants and burning methods. A biologist explained that "the greatest benefit from integrating TEK was preventing loss of a sensitive plant population."

"Interpretation" referred to interpretive displays, talks, and other educational programs. Even though we were not looking to capture TEK integration into interpretive projects, it was a common use and benefit mentioned by respondents.

"Public involvement and consultations" referred to the official NPS mandate of public involvement and consultations such as NEPA and NAGPRA.

"Additional perspective/historic knowledge" referred to general positive comments about TEK, or its value in adding knowledge diversity to a predominantly scientific knowledge base. A resource chief indicated that "while TEK might not have concrete benefits, using it adds a historical and cultural perspective."

"Management of Native American sacred sites and resources" referred to using TEK to improve management of these locations and resources.

Additional project details

The majority (73%) agreed that integrating TEK into natural resource management improved relations between tribes involved and the park unit and (70.1%) directly helped to conserve resources and improve natural resource management. However, just over half (60%) agreed that their park unit will continue to incorporate TEK for natural resource management.

Conclusion and implications

Incorporating TEK into resource management is not just the collection of specific information (or individual facts) about natural resources from tribal members. Rather, integrating TEK is a process of working in collaboration with tribes to assess the potential for using the TEK to manage culturally and ecologically important resources. Park staff can use participatory social science methods to elucidate and document this knowledge. Traditional ecological knowledge should be regarded as a body of information about ecosystems gleaned over generations that is as useful and informative as Western sources of knowledge. As such, it can contribute to informed decision making using the best available science and knowledge. If conflicts arise, then managers need to weigh the evidence and make the best decision they can with the available data—as in all management decisions. More likely the integration will provide complementary information to guide decisions (Huntington 2000; Ruppert 2003).

Throughout the world, managers are beginning to recognize the tremendous value of TEK, whereby tribes bring in their unique, long-term, local knowledge to complement Western science. In our study several respondents also reported that NPS TEK projects have improved natural resource conditions, and the majority of respondents reported that joint projects help build stronger relationships with tribes. The majority of respondents were familiar with TEK and felt that the National Park Service should use it more. That most of the respondents are in decision-making positions and have been in the National Park Service more than 10 years suggests a positive trend for future integration of knowledge and joint projects.

However, out of 69 parks in which 44 projects were identified, only 20 parks reported integrating TEK into natural resource management projects; 20% of respondents had little to no experience working with tribes; 14.6% were unfamiliar with TEK; the majority reported institutional inertia and cultural differences as barriers to TEK; and less than half (48%) reported that the National Park Service should prioritize TEK integration. These results raise the question, "Can the NPS culture embrace the use of TEK to improve natural resource management?" There will always be a place for the National Park Service to undertake projects to "strengthen relations with tribes" and "regulate resource use." But in order to work through institutional barriers and cultural differences to value and incorporate TEK into resource management decisions, the National Park Service will have to dedicate resources for training and implement policies that support and cultivate a culture of awareness and respect for TEK. As more park managers explore and evaluate the utility of TEK for specific resource management questions and then attempt to integrate it, the efficacy of these efforts will be the ultimate measure for broader applications. Future research should focus on documenting these applications and their outcomes for resource management and building partnerships with American Indian tribes.

Incorporating TEK into resource management is not just the collection of specific information (or individual facts) about natural resources from tribal members. Rather, integrating TEK is a process of working in collaboration with tribes to assess the potential for using the TEK to manage culturally and ecologically important resources.

Acknowledgments

This research was funded, in part, by the Colorado Plateau Cooperative Ecosystem Studies Unit through Grand Canyon-Parashant National Monument and was supported by Judy Bischoff and Jeff Bradybaugh of the National Park Service.

Literature cited

Berg, B. L. 2007. Qualitative research methods for the social sciences. University of Michigan Press, Ann Arbor, Michigan, USA.

Berkes, F. 1993. Traditional ecological knowledge in perspective. Pages 1–7 *in* J. T. Inglis, editor. Traditional ecological knowledge: Concepts and cases. Canadian Museum of Nature: International Program on Traditional Ecological Knowledge, International Development Research Centre, Ottawa, Ontario, Canada.

Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10:1251–1262.

Bowers, K. 2005. Learning from traditional ecological knowledge. Ecological Restoration 23:149.

Cronin, A., and D. M. Ostergren. 2007. Tribal watershed management. American Indian Quarterly 31:87–109.

Dillman, D. A. 2007. Mail and Internet surveys: The tailored design method. John Wiley and Sons, Hoboken, New Jersey, USA.

Houde, N. 2007. The six faces of traditional ecological knowledge: Challenges and opportunities for Canadian co-management arrangements. Ecology and Society 12:1–17.

Huntington, H. P. 2000. Using traditional ecological knowledge in science: Methods and applications. Ecological Applications 10(5):1270–1274.

Lofland, J., D. A. Snow, L. Anderson, and L. H. Lofland. 2006. Analyzing social settings: A guide to qualitative observation and analysis. Wadsworth Publishing, Florence, Kentucky, USA.

Ruppert, D. 2003. Building partnerships between American Indian tribes and the National Park Service. Ecological Restoration 21(4):261–263.

About the authors

Moran Henn *is a recent graduate of the Environmental Sciences and Policy Program, Northern Arizona University, and can be reached by e-mail at moranrh@gmail.com.* ***David M. Ostergren****, PhD, is the director of the Master of Arts Graduate Program in Environmental Education at Merry Lea Environmental Learning Center, Goshen College, Indiana, and can be reached at daveo@goshen.edu.* ***Erik Nielsen****, PhD, is an assistant professor in the School of Earth Sciences and Environmental Sustainability at Northern Arizona University, and can be reached at erik.nielsen@nau.edu.*