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In This Issue

- Grand Canyon
- Ecosystem Services
- Rocky Mountain National Park
- Human Waste Management

APRIL 2013 VOLUME 19, NUMBER 1

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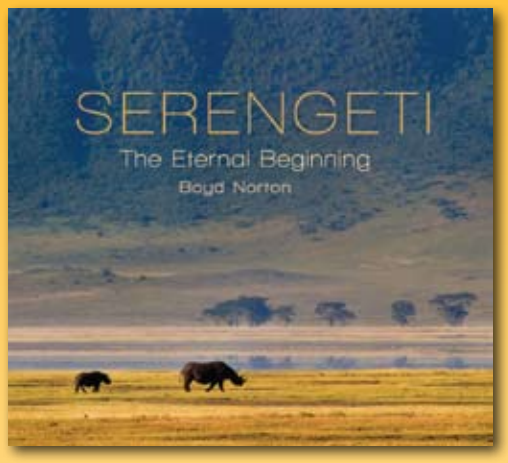

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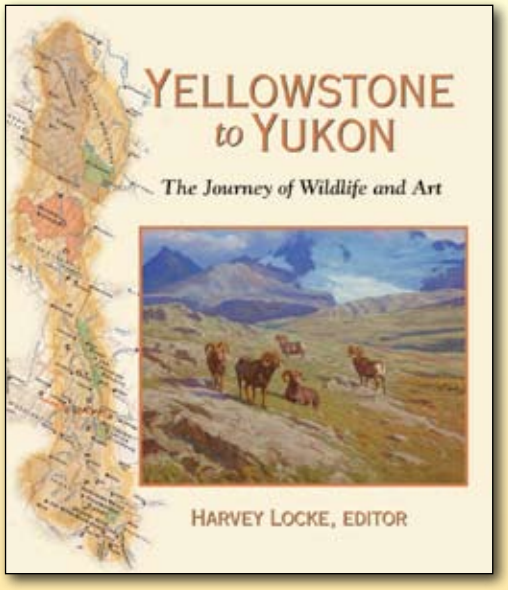

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On the Cover

The legendary Nahanni River — one of Canada's most famous "wilderness rivers" — wends its way through the remarkable karst geology of the Nahanni National Park Reserve and the land of the DehCho First Nations in Northwest Territories. The river bed and shores abound in marine fossils from the time when it was an ancient seabed, here held in the hands of the pioneering geologist for that region, Dr. Derek Ford. Photos © courtesy of Vance G. Martin, The WILD Foundation.

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

International Journal of Wilderness

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EDITORIAL PERSPECTIVES

Wilderness Visitor Experiences

BY CHAD P. DAWSON

As the 50th anniversary of the 1964 Wilderness Act approaches, many managers, rangers, scientists, visitors, educators, and wilderness advocates will reflect back on the progress and challenges of stewarding and maintaining the wilderness resource and managing visitor experiences. One such group of 21 managers and scientists convened for four days in April 2011 under the direction of David Cole at the Lubrecht Experimental Forest near Missoula, Montana. The purpose was to reflect on and document both the progress over 50 years in research and management toward providing quality visitor experiences and the influence of visitor experiences on wilderness stewardship in the National Wilderness Preservation System (NWPS).

That workshop consisted of both presentations and directed discussion on a wide variety of topics related to visitor experiences in wilderness. The results were published by the U.S. Forest Service in a proceedings compiled into three sections: (1) 12 papers that reviewed literature or described empirical research about wilderness visitor experiences, (2) three papers on management frameworks and the perspectives of planners and managers, and (3) five papers on wilderness experiences and the future (Cole 2012). The proceedings represent a comprehensive overview of both where the scientists and managers have been working and practicing and a roadmap for future work that needs to be conducted to further the science and management of visitor experiences in wilderness.

The workshop process was, for some participants, also a "passing of the torch" from retiring professionals who were documenting and commenting on their work to younger professionals and a conscious attempt to foster another generation of wilderness scientists and managers. It is hoped that other such groups will convene or be part of 50th anniversary workshops, conferences, and seminars to produce parallel reflections on the science and stewardship of all biophysical, social, cultural, and inspirational aspects of wilderness that comprise the NWPS. If the NWPS is to be an enduring resource, then we must foster successional stages of stewards and scientists to carry that torch.

In this issue of *IJW*, another two articles continue the wilderness ecosystem services theme of the December 2012 issue of *IJW*: Laura López-Hoffman and colleagues discuss how migratory species add ecosystem service value to wilderness, and Linda Moon Stumpff relates how linking cultural knowledge, ecosystem services, and wilderness provides insights into how traditional wisdom views the water in wilderness. David Pettebone discusses wilderness over the last 35 years in Rocky Mountain National Park. Joel C. Barnes summarizes the debate about and need for Wild and Scenic Rivers designation for the Colorado River within the Grand Canyon National Park. Hill and Henry make the case for minimizing the cost of human waste management in wilderness.

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SOUL OF THE WILDERNESS

Protecting Wild Waters in the Grand Canyon

BY JOEL C. BARNES

For those who directly experience the Grand Canyon, the river and its tributaries come to represent the heart and soul of the place. These waterways are largely responsible for carving the Canyon's magnificent landscape over millions of years, and these riparian corridors have evolved into a textbook example of a keystone habitat in that they support an unusually high percentage of the canyon's biological diversity (Barnes 2005a; Stevens and Perla 2008). With estimates of Arizona's remaining healthy riparian habitat being low (Omart and Anderson 1986), Grand Canyon's waterways represent an extensive and relatively intact system of aridland riparian habitat. We also know that these waters have had a formative influence on the cultures that have explored the canyon, from prehistoric hunter-gatherers to hikers and boaters of the new millennium. A living vestige of our southwest natural and cultural heritage, they are prime candidates for Wild and Scenic River (WSR) designation, which represents the gold standard for river conservation throughout the nation and provides long-term protection for those waterways under its wing.

Joel C. Barnes. Photo by Jason Arbetter.

That the Colorado River and its tributaries in and around the Grand Canyon have yet to be honored with WSR designation comes as a surprise to many – even those actively involved in river conservation. One could easily assume that the spectacular Colorado River and its tributaries in Grand Canyon are the southwestern gems of the National Wild and Scenic River System. In fact, WSR designation has eluded a number of our most notable wildland river systems here in the arid Southwest, including the San Pedro, Agua Fria, Hassayampa, and the Grand Canyon's share of the Colorado River system (see Figure 1).

Figure 1 – The Nankoweap Creek Granaries. The Colorado River and its tributaries in Grand Canyon have yet to be honored with Wild and Scenic River designation. Photo by Joel C. Barnes.

Studies show that more than 90% of Arizona's riparian areas are in poor and/or degrading condition due to a century of overgrazing, urban development, groundwater withdrawals, and more (Omart and Anderson 1986; Zaimes et al. 2007). In contrast to this bleak piece of news about the state of Arizona, Grand Canyon's river, streams, seeps, and springs have been largely exempt from these nearly ubiquitous impacts. These waterways and canyons represent the largest intact system of nearly pristine riparian areas left in the American Southwest – a living vestige of our bioregional heritage. The Grand Canyon's riparian areas account for only 0.5% of the park's total landscape, yet they provide critical habitat to more than 35% of the plant and bird species and 80% of wildlife species overall (Stevens et al. 1999;

Hubbard 1977). These corridors and patches not only function as habitat for biodiversity, they are also central regulators of the flow of energy and matter through the region's landscapes and ecosystems. Compared to wetter environs, ecosystem processes in arid landscapes such as those of Grand Canyon are more closely tied to the temporal rhythms and spatial patterns of hydrologic cycles (Sowell 2001). Hydrologic cycles exert an ecological ripple effect on the surrounding landscape that is disproportionate to the scarcity of water. As such, these riparian areas function like a keystone species but at the habitat and ecosystem levels (Barnes 2005a; Stevens and Perla 2008). Grand Canyon's riparian areas provide a compelling case for applying the keystone concept at the habitat and ecosystem levels to help guide park policy, and this holds merit even considering the views of Mills et al. (1993) that the concept of a keystone species has been applied too simplistically in resource management and conservation. In fact, Mills et al. (1993) suggest that conservation planning and policy would benefit from shifting its focus on single species to emphasize the complexity of natural systems at the habitat, ecosystem, and landscape levels. Indeed, in aridland parks such as Grand Canyon, riparian systems play a central role in maintaining the ecological integrity of the overall landscape. Unfortunately, even Grand Canyon's springs, seeps, and streams are now threatened, and WSR designation can help save them.

Suitability for Wild and Scenic River Designation

Managers and conservationists alike cite the fact that the Colorado River and its tributaries, seeps, and springs are already protected by Grand Canyon National Park (GCNP) status as reasonable cause for not pursuing WSR designation. But increasing pressures on our national parks from beyond their political boundaries are very real, as evidenced by the latest resuscitation of a large-scale tourism project in the town of Tusayan – the infamous Canyon Forest Village proposal from the late 1990s (Barnes 1999). If the water required for this development depends on groundwater (which is likely), it will have to be pumped up from the Redwall-Muav aquifer. This aquifer underlies the town of Tusayan *and* the eastern portion of GCNP. Most important, it feeds some of the tributaries, seeps, and springs of eastern Grand Canyon (Barnes 1999). This is where the importance of WSR designation plays into the stewardship of these resources.

The Wild and Scenic River Act (WSRA) provides the most comprehensive legal protection available for the instream flows of river systems. The WSR designation guarantees that enough water stays in a stream to support the values for which it was designated. The WSRA is potentially as significant to the water resources of parks as the Wilderness Act is to our land resources. Wild and scenic river designation would maintain and enhance long-term protection for the Colorado River in Grand Canyon, including its tributaries, seeps, and springs – some of which are clearly threatened by activities beyond the park's boundaries.

"In a world of increasing threats – including short-sighted pumping of groundwater that's essential for the park's springs – and especially in light of increasing aridity due to climate disruption, Grand Canyon needs all the tools available to avoid impairment of America's greatest national park," says Kim Crumbo, conservation director with the Grand Canyon Wildlands Council and board member of Arizona Wilderness Coalition. "Wild and Scenic River designation for Grand Canyon's Colorado River and its tributaries makes solid ecological sense, and would magnificently complement the Canyon's national park and World Heritage Site status" (Crumbo, personal communication, July 28, 2012). Crumbo served for almost 20 years at GCNP as wilderness manager and river ranger.

A comprehensive WSR Study Report was conducted in GCNP that helps set the stage for WSR designation (Barnes 2005b). This study identifies the outstanding riverine attributes along 577 river miles (929 km) of 50 river and stream segments in and adjacent to Grand Canyon, and compiles this information into a GCNP WSR narrative catalog and database with GIS maps and digital photographs. These 50 segments are identified as eligible for WSR designation through regional comparisons that highlight the cumulative and synergistic qualities of a broad spectrum of Grand Canyon's resource values. The study also illustrates how Grand Canyon's wild, free-flowing waters play a central role in the geophysical, biocultural, and sociopolitical realms of this remarkable landscape, which reveals how riparian areas function as a keystone habitat. Viewing Grand Canyon's riparian systems as a keystone habitat helps not only to better understand how these arid landscapes function ecologically but also to develop effective strategies for conservation. Finally, the WSR Study Report identifies issues pertaining to WSR suitability, with the intention of helping GCNP conduct a complete suitability study as part of its planning process (see Figure 2).

During the past three decades, southwestern riparian systems have been identified time and again as an endangered ecosystem of North America

Figure 2 – Saddle Creek Falls. Grand Canyon's wild, free-flowing waters are central to the ecological integrity of this remarkable landscape. Photo by Joel C. Barnes.

(Omart and Anderson 1986; Noss 1997). These southwestern riparian ecosystems have continually suffered as demands on water resources increase. This situation calls for a regional and systems approach to water resource conservation – one that recognizes the interconnections between aridland river systems and their surrounding watersheds. Thus, a successful conservation strategy for the waterways of GCNP should embrace a regional river system and watershed-based approach to WSR designation, as opposed to the segment-by-segment approach adopted in most WSR proposals. The segment-by-segment approach has proved to be a painfully slow political process, and overlooks the ecological importance of riparian areas as a keystone habitat in aridland ecosystems such as those in Grand Canyon. A GCNP WSR omnibus bill could be patterned after WSR bills already passed into law in Michigan, Oregon, and Alaska (Raffensperger 1993). WSR legislation for Grand Canyon's river and tributaries would protect a contiguous portion of the Colorado River system, would dramatically increase protection of the region's biodiversity, and could place these aridland waters at the heart of a regional conservation strategy.

The WSR Study Process

Before Congress legislates a WSR designation, a WSR study process is conducted by the lead federal land agency managing those lands, and it involves three steps: (1) eligibility, (2) classification, and (3) suitability. For a waterway to be eligible for WSR designation, it must be free flowing and exhibit one or more "outstandingly remarkable values" (ORVs) as described in the Wild and Scenic River Act of 1968 (U.S. Public Law 90-542). Once a river or stream segment is determined to be eligible, it is then given a tentative classification of either "wild," "scenic," or "recreational." These categories reflect levels of development and natural conditions along a river segment. Finally, the suitability step evaluates the consequences of designation and the manageability of the river if it is designated, which would consider biological, political, and economic factors. After the WSR study process is complete and depending on its recommendations, Congress is then prompted to act with legislation, which can take years and even decades to occur (Crumbo 1996).

What Would WSR Designation Do for the Ecoregion?

WSR designation in GCNP would mandate protection for the exceptional natural and cultural values of the Colorado River main stem and tribu-

taries, particularly those "outstandingly remarkable values" identified in the eligibility and suitability steps of the WSR study process. Moreover, identifying in the WSR study process the unique wilderness values that enhance river recreation on the Colorado River through Grand Canyon would establish important legislative and management connections between the park's (currently proposed) wilderness and its wild and scenic rivers. The WSRA also recognizes preexisting types and levels of river recreation where they do not conflict with the existing goals of river management. However, the WSRA does not freeze the status quo in a river corridor when it is designated. Rather, the WSRA codifies a "nondegradation and enhancement policy" for all designated river areas, regardless of classification. These details are mentioned here to elucidate important differences and similarities between the Colorado River main stem and tributaries in regard to how WSR designation could affect their ecology and management. For example, by identifying ORVs along the tributaries that are directly dependent on existing base flows (e.g., riparian vegetation, wildlife, and fish), the WSR study process could help set a legal stage for protecting future instream flows of the seeps, springs, and tributaries in and around Grand Canyon. Because the act acknowledges existing river management goals, designation would not impose any significant influence on the scheduled flows (essentially Glen Canyon Dam releases) of the Colorado River.

The upstream existence of Glen Canyon Dam would not violate the "free-flowing" criterion of the WSRA as evidenced by other such situations where river segments were designated below existing dams. More important, in regard to the Colorado River main stem, designation would finally put to rest any of the dams that are proposed from time to time in Congress. The WSRA provides the highest level of legal protection available to ensure that no dam projects from Congress would be authorized for the Grand Canyon (see Figure 3).

Figure 3 – Granite Falls Rapid. WSR designation would help protect the unique wilderness values that enhance river recreation on the Colorado River through Grand Canyon. Photo by Joel C. Barnes.

The WSRA's allowance for preexisting types and levels of river recreation, where they do not conflict with the existing goals of the river's management, could be interpreted to support the controversial status quo of commercial use on the river (including large motorized trips). Moreover, popular interpretation of the WSRA states that WSRs are managed primarily for the values for which they were designated (IWSRCC 1999). Additionally, the WSRA codifies a nondegradation and enhancement policy for designated rivers and directs administering agencies to improve conditions in river corridors where necessary.

Conclusion

The Grand Canyon's share of the Colorado River system represents the largest intact system of nearly pristine riparian areas left in the American Southwest – a living vestige of our natural heritage. Activities outside GCNP – especially the pumping of groundwater that feeds tributaries, seeps, and springs inside the park – pose imminent threats to the park's surface waters and associated riparian areas (Barnes 1999). A Grand Canyon Wild and Scenic River omnibus bill would be good public policy and resource stewardship, adding a critical layer of protection focused specifically on this keystone habitat.

Grand Canyon National Park is currently in the process of revising its Backcountry Management Plan (BCMP), which represents the best opportunity for gaining WSR status for the Colorado River and its tributaries (visit parkplanning.nps.gov/grca).

Unfortunately, in the initial phase of the BCMP public scoping (held in fall 2011), WSRs were identified as an issue beyond the scope of the plan (NPS 2011). This is particularly puzzling in light of the fact that, in early 2000s when the Colorado River Management Plan was being revised, the park took this same "beyond the scope of the plan" position and assured stakeholders that WSRs would be

included in future plans or processes, most likely in the next BCMP revision (NPS 2002). If the park passes up this chance to designate WSRs, the future possibility of WSRs in Grand Canyon would be uncertain at best. In light of the fact that the park's original 1980 wilderness recommendation has yet to be forwarded to Congress, we could find ourselves "waiting for Godot" in regard to both wilderness *and* WSR designation in GCNP (Crumbo 1996).

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The Grand Canyon's share of the Colorado River system represents the largest intact system of nearly pristine riparian areas left in the American Southwest.

Note: A similar version of this article appeared in the Winter 2012–2013 issue of the *Boatman's Quarterly Journal*.

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Rocky Mountain National Park

Wilderness after 35 Years

BY DAVID PETTEBONE

David Pettebone.

Introduction

Rocky Mountain National Park Wilderness (RMNP) encompasses some of the most scenic landscapes in the southern Rocky Mountains (see Figure 1). More than one-third of the park is above tree line, with 60 peaks above 12,000 feet (3,658 m) and panoramic views of the Continental Divide that draw visitors from all over the world. The park also protects a variety of natural habitats such as montane and subalpine biomes as well as the best representation of tundra ecosystems in the southern Rockies. For well over a century people have come to this area to experience these natural wonders, which has led to a long history of protection efforts.

Like many large western national parks, the story of RMNP describes our country's evolving relationship with wild land. Since the late 19th century, the United States has set aside large tracts of land for the public's benefit. In terms of RMNP this legacy began in 1905 when President Theodore Roosevelt extended Wyoming's Medicine Bow Forest Reserve into northern Colorado and included the land in today's RMNP. Ten years later, the establishment of RMNP redefined how people interacted with and managed these mountains to emphasize preservation over resource extraction. RMNP's inclusion in the Wilderness Preservation System in 2009 ensures the highest level of land protection afforded by the United States.

RMNP's wilderness designation presents a variety of opportunities and challenges for park managers because the land protected within the park's wilderness has historically accommodated a variety of human uses, including recreation, farming and ranching, hunting, and mining. Emerging issues such as increasing levels of day-use recreation, elk and vegetation management, and insect infestations pose difficult choices for park managers entrusted to be wilderness

Figure 1 – Alpine summits and panoramic views are some of the scenic landscapes of Rocky Mountain National Park. Photo courtesy NPS.

stewards. These choices require philosophical as well as practical and ecologically based considerations to balance utilitarian and preservation ideals. The tension between these ideals is a recurrent theme throughout RMNP's history and inherent in many issues that confront the park today. This article provides a short historical background about RMNP's legislative path toward wilderness designation followed by brief overviews of a few current issues in the park in order to illustrate some of the challenges in managing wilderness in a popular national park.

Legislative Path to Wilderness

Since the late 1800s, RMNP has been associated with resorts, recreation, tourism, and development around the gateway communities of Estes Park and Grand Lake. Nationally, the conservation movement began taking shape during the 1890s, and, in 1891, Congress passed a law that provided the president authority to set aside land reserves. President Benjamin Harrison exercised this authority by establishing the Yellowstone Forest Reserve on March 30, 1891, followed by the establishment of four forest reserves in Colorado. The idea of a forest reserve in the Estes Park area was put forth as early as 1892 in order to protect watersheds that supported agricultural practices east of the Rocky Mountains (Buckholtz 1983), and, as mentioned earlier, in 1905, President Theodore Roosevelt expanded the Medicine Bow Forest Reserve in Wyoming to include the area now known as RMNP (United States Forest Service 2012).

Soon after the designation as a forest reserve, many local residents began calling for the creation of a national park. Among local constituents advocating for a national park was a mountain guide named Enos Mills. Mills was particularly outspoken regarding the establishment of a national park because he believed that forest reserves emphasized utilitarian purposes such as timber extraction and cattle grazing rather than protection of scenic beauty and natural resources (Buckholtz 1983).

Mills envisioned a 1,000 square mile (2,590 sq. km) park with the town of Estes Park at its center. The United States Forest Service (USFS) took exception to the creation of a national park and suggested instead that a game reserve be established to protect wildlife for recreation purposes (Buckholtz 1983). In 1915, the national park idea in the southern Rocky Mountains was realized; however, Mills's dream of a 1,000 square mile park did not come to pass. Resolutions and compromises among competing interests resulted in a bill that established a 358.5 square mile (929 sq. km) national park; nonetheless, the establishment of RMNP created the foundation for natural and cultural resource protection that benefits us today.

The creation of RMNP was a milestone for the region that fueled development in and around the park in order to accommodate greater demands for tourism. RMNP's history after 1915 closely parallels the broader history and goals of the National Park Service (NPS) to promote parks, increase access for automobiles by constructing roads, and develop infrastructure (e.g., campgrounds, trails, administrative buildings, ranger patrol cabins). These efforts were clearly successful, as visitation in RMNP grew dramatically from 31,000 visitors in 1915 to nearly 275,000 people in 1929 to more than 600,000 visitors annually in the late 1930s (NPS 2012).

Infrastructural development in national parks sparked concerns from some people about the goals of preservation. In 1922, Horace Albright, the assistant park service director, responded to these concerns by clarifying that "certain wild sections of every park should be forever reserved from any development except by trails, first because the National Parks are destined to soon be the only sections of wilderness left in America, and second because wildlife thrives best in untouched wilderness" (Buckholtz 1983, p. 161). However, Albright also strongly believed that parks were established for all people and not just adventurous and hearty individuals with the ability to penetrate remote wilderness. Roads such as Trail Ridge Road provided access for those with physical limitations who were not otherwise able to enjoy rugged and remote areas of the park.

Interest in RMNP continued to increase throughout the years. After World War II, in 1948, park visitation increased dramatically and exceeded 1 million visitors (NPS 2012). By 1950, facilities throughout the national park system, including RMNP, were outdated and inadequate to accommodate the growing demand of increased visitation, and in 1956, the NPS launched the Mission 66 program to upgrade facilities. Projects to renovate facilities such as bathrooms, roads, and visitor centers were well underway by the late 1950s and sparked public debate over whether the NPS was catering too much to its mandate to provide recreation opportunities at the expense of natural resource preservation.

Mission 66 provided momentum for the growing wilderness movement that wanted to emphasize preservation of nature over development for recreation (Sellers 1992). In 1964, the Wilderness Act was passed, and throughout the United States land agencies were tasked with developing recommendations for

public lands to be included in the Wilderness Preservation System. In 1974, under the Nixon administration, approximately 240,000 acres (97,166 ha) within RMNP were first recommended for wilderness protection.

Although RMNP was recommended for wilderness protection in 1974, it was not until 1994 that the first legislation to designate the park as wilderness was introduced to Congress. This first attempt did not succeed, and between 1996 and 2006, 11 more bills were introduced to Congress to designate RMNP as wilderness, none of which passed.

During this time, a number of other wilderness laws were passed that affected land surrounding RMNP. In 1978, The Indian Peaks Wilderness, the Arapaho National Recreation Area, and the Oregon Islands Wilderness Area Act established the Indian Peaks Wilderness to the south of RMNP. The Colorado Wilderness Act of 1980 created the Never Summer Wilderness, Cache La Poudre Wilderness, Comanche Peak Wilderness, and Neota Wilderness areas that border RMNP and changed the boundaries of the NPS and USFS to the "natural" north and south ridgeline. Lands transferred from the USFS remained in the National Wilderness Preservation System, and lands transferred from the NPS to the USFS were incorporated into the Indian Peaks Wilderness. As a result, RMNP was charged with managing the northernmost 2,960 acres (1,198 ha) of the Indian Peaks Wilderness.

Finally, the Omnibus Public Land Management Act of 2009 (P.L. 111-11) was signed into law on March 31, 2009. This law established 14 new wilderness areas in the United States, including 249,126 acres (100,861 ha) in RMNP. RMNP's inclusion into the Wilderness Preservation System marks the culmination of 35 years of effort to gain wilderness protection and ensures that natural and cultural resources within the park are protected in their natural state, free from the influence of society.

Managing RMNP as wilderness is both a privilege and a challenge.

RMNP's inclusion into the Wilderness Preservation System is the latest evolution in our relationship with these public lands and reaffirms a long-standing effort to balance recreation use and resource protection. As such, there are a number of challenges regarding the preservation of wilderness character that confront RMNP managers. For example, high levels of day use during the summer months affect visitors' ability to find intimate wilderness experiences, extirpation of predators such as wolves has allowed the park's elk population to grow to unsustainable numbers, and epidemic levels of insect infestations associated with warming due to climate change has affected wilderness campsites. A brief overview of these issues is discussed in the following sections.

Visitor Use

Rocky Mountain National Park's wilderness is an exceptionally accessible and popular natural area. The park is adjacent to Estes Park, which is only a one-hour drive from the cities of Boulder and Fort Collins, and less than two hours from Denver. Approximately 4 million people live along the neighboring Front Range Urban Corridor, and in 2011, the National Park Service estimated the park's annual visitation at 3.5 million people (NPS 2012). Because recreation is a stated purpose in the Wilderness Act and accessibility enhances recreational value, this is both a unique value and a challenge for park managers trying to maintain the park's wilderness character. However, the Wilderness Act directs agencies to simultaneously provide outstanding opportunities for solitude or primitive and unconfined experiences. Clearly, high levels of visitor use can diminish opportunities for solitude, but are park managers required to provide for these qualities all the time, everywhere, and at any expense? Because of the popularity of RMNP, a variety of opportunities are provided for various types of users who visit.

During the summer months, popular trailheads such as Bear Lake, Wild Basin, and Long's Peak accommodate high levels of day-use visitors; however, there are many less-used trailheads where visitors can escape from crowds and find solitude just minutes up the trail. The park also manages overnight use through a permitting system to ensure a variety of experiences are available throughout the park. Overnight campers can choose a variety of recreation opportunities in the park's wilderness during the summer, including camping in designated sites, cross-country zones, and bivvy zones (for technical rock climbs). To promote solitude, designated campsites are located out of sight from trails and other campsites, and only a limited number of campsites are offered within each drainage. For example, the Glacier Gorge drainage teams with day users, but there is only one overnight campsite available, thus outstanding opportunities for an intimate and personal experience in this often-busy area is available for overnight campers. Cross-country camping zones without designated campsites

provide opportunities for visitors who seek more primitive and self-reliant wilderness experiences. Similarly, overnight users during the winter months are not required to camp in designated sites and are free to choose their campsite within designated zones.

Elk and Vegetation Management

The elk population that winters on the eastern side of RMNP has grown to levels that are severely impacting aspen and willow communities. Elk are native to the area in and around RMNP and lived in the vicinity for thousands of years until they were eliminated in the 1870s due to extensive unregulated hunting. Elk were reintroduced in 1913–1914 before the park was established in 1915, and after gray wolves (their only natural predator) were extirpated around 1900. Because hunting was not allowed within RMNP or Estes Park and because they had no natural predators, elk populations increased dramatically, and as early as the 1930s RMNP managers expressed concern about impacts to vegetative communities browsed by elk.

Culling operations began in 1944 by park rangers, and for the next 25 years the RMNP elk population was maintained at between 350–800 animals. In 1969, park staff reconsidered active management of the elk population and discontinued interventions to control its size. It was believed that hunting in areas adjacent to the park would act as a control on the size of the population. However, studies from the mid- to late 1990s concluded that about 1,000 elk wintered in low-elevation areas of RMNP, and another 2,000 wintered within Estes Park, private land, and USFS lands (Lubow et al. 2002). Moreover, the elk population had become less migratory and more concentrated than would be expected under natural conditions, resulting in declining biodiversity within aspen and willow communities.

In 2006, RMNP developed the Elk and Vegetation Management Plan (USDI 2007) to consider various actions to address these concerns. Renewed culling operations as well as fencing to limit browsing around affected aspen and willow communities were approved to restore overbrowsed vegetation. Some of these actions take place within the park's wilderness and clearly affect the natural, undeveloped, and primitive character of the area. However, the choice to pursue these actions illustrates the difficult trade-offs park managers must consider in a wilderness area that is heavily influenced by its history and surrounding nonwilderness areas.

Insect Infestations

Over the last decade, RMNP has been experiencing a large infestation of bark beetles in its forests. The mountain pine beetle (MPB) is species native to the park whose populations have grown to epidemic levels in the last 10 years (see Figure 2). MPB tend to affect pine trees that are larger than 4 inches (10 cm) diameter. Beetles bore tunnels into the phloem layer of the tree and leave behind a blue stain fungus carried on their wings. The fungus clogs tree cells responsible for nutrient and water exchange, which ultimately kills the tree.

Historically, MPB populations were regulated by cold winters, with large numbers dying off due to temperatures dropping below –13°F for consecutive days (Amman and Cole 1983). More recently, temperatures during winter months rarely persist below 0° long enough to reduce beetle populations. The change in temperature dynamics along with lower levels of annual precipitation has caused epidemic levels of beetle populations that have affected and killed the majority of lodgepole pine trees within the park. Limber pines and fir trees are also being affected by MPB, and large numbers of spruce trees are declining due to the spread of spruce beetles throughout the park.

Although Section 4d of the Wilderness Act gives agencies authority to control insects within wilderness areas, RMNP managers have largely chosen to let this natural process run its course within the park's wilderness. However, safety in overnight campsites is a concern because of potential hazard trees that surround tent pads where visitors sleep. The park has taken an adaptive management approach to address visitor safety that includes regular monitoring within sites and prescribed actions such as selective cutting of hazard trees within striking distance of tent pads when tree removal is less than 30% of trees within striking distance around a campsite. The threshold of 30% was identified as a standard because standing trees are more likely to fall due to wind throw when this standard is exceeded. Campsites that have had 30% of trees within striking distance of a campsite removed are closed and relocations considered if safer and sustainable sites can be located. Similarly, creation of dispersed camping zones is considered to replace closed backcountry campsites where appropriate.

Summary

RMNP has a long history and relationship with its surrounding communities. Tourism, hunting, and ranching were important early activities during the United States's westward expansion, and early local settlers recognized the potential for tourism as an industry and vehicle to protect the mountains adored

by so many residents. This led to strong public support for federal land protection of the mountains surrounding local communities, and through the years much has been learned about balancing use and preservation in RMNP. At times it seems development and recreation took priority over preservation, but this process has ultimately culminated in RMNP's recent designation as part of the Wilderness Preservation System.

Managing RMNP as wilderness is both a privilege and a challenge. Throughout the park's history, a variety of uses incompatible with the National Wilderness Preservation System have been allowed. Currently, RMNP is engaging in a number of activities to enhance its natural character and to provide recreation opportunities to visitors. These actions are evaluated using the Wilderness Act's mandate to consider Minimum Requirements to administer an area. Often these choices have no clear answer and reveal the limits of a completely hands-off approach. The example of excessive elk populations was provided as an illustration of a difficult choice, but RMNP is currently grappling with a myriad of issues, including proliferation of invasive species, habitat loss due to climate change (e.g., American pika), nitrogen deposition across the landscape, and changing wildfire regimes. Ideally, as vegetation communities within RMNP recover, some actions, such as elk fencing, can be reduced. However, other issues, such as warming due to climate change, will continue to affect the natural resources within RMNP, and park managers will be faced with difficult philosophical decisions about how to respond to changing conditions. It is possible that accelerated environmental change will become the "natural condition" and that a minimal-intervention management approach will become more appropriate. Once again, there are few clear solutions.

Figure 2 – Infestations by bark beetles in Rocky Mountain National Park challenge wilderness managers. Photo by Debbie Mann.

Similarly, the MPB epidemic illustrates the paradox of public land management that requires balance of use and preservation. In some ways, established campsites reduce primitive conditions as well as an individual's self-reliance. The current overnight system used in RMNP was developed about 40 years ago in response to natural resource impacts – such as excessive vegetation trampling, soil compaction, and increased erosion potential – which resulted from high levels of unregulated overnight use. Vegetation recovery is very slow in areas with high use levels over successive years, and park managers chose to establish a limited number of campsites in order to concentrate use and limit impacts (Cole 1987). Monitoring and maintaining these sites ensures that overnight use in the park's wilderness does not unnecessarily degrade natural resources. Moreover, the permit system requires that visitors speak with a park ranger and agree to use Leave No Trace behaviors while camping in the park. Clearly there are trade-offs related to wilderness character associated with the approaches presented in this article, but it is clear that the choice to not manage these issues has consequences as well.

Despite the challenges presented in this paper, RMNP's designation as wilderness is cause for celebration for all who cherish this precious resource. Wilderness protection ensures that the majority of RMNP will not be subject to developmental or extractive pressures and that this wilderness resource is protected for future generations.

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How Do Migratory Species Add Ecosystem Service Value to Wilderness?

Calculating the Spatial Subsidies Provided by Protected Areas

BY LAURA LÓPEZ-HOFFMAN, DARIUS SEMMENS, and JAY DIFFENDORFER

Abstract: Species that migrate through protected and wilderness areas and utilize their resources, deliver ecosystem services to people in faraway locations. The mismatch between the areas that most support a species and those areas where the species provides most benefits to society can lead to underestimation of the true value of protected areas such as wilderness. We present a method to communicate the "off-site" value of wilderness and protected areas in providing habitat to migratory species that, in turn, provide benefits to people in distant locations. Using northern pintail ducks (*Anas acuta*) as an example, the article provides a method to estimate the amount of subsidy – the value of the ecosystem services provided by a migratory species in one area versus the cost to support the species and its habitat elsewhere.

Introduction

Wilderness and protected areas generate benefits well beyond their boundaries – many species that migrate through wilderness areas and utilize their resources, deliver ecosystem services to people in faraway locations (Semmens et al. 2011; López-Hoffman et al. 2010). Migratory species – animals such as birds, mammals, fish, and insects that regularly migrate between two or more different areas – provide ecosystem services to people, such as controlling crop pests, pollinating food plants, or supporting recreational hunting, fishing, and bird-watching. For example, the migratory Mexican free-tailed bat (*Tadarida brasiliensis mexicana*) helps control cotton crop pests in the southwestern United States and northern Mexico. Female bats migrate annually from central Mexico to the U.S.-Mexico borderlands where they feed on corn earworm/cotton bollworm, providing an estimated $700,000 worth of pest control annually in one region of Texas (Cleveland et al. 2006). Throughout the yearly cycle of migration, bats and many other migratory species depend on wilderness areas for food, shelter, and breeding habitat (see Figure 1).

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This mismatch between the areas that most support a species and those where the species provides most benefits to society can lead to underestimation of the true value of protected areas such as wilderness. People, and most critically decision makers, may not realize that locally used ecosystem services may be linked to (supported by) distant protected areas. In the United States, in an era of concern about visitation rates to national parks and wilderness areas (Pergams

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Figure 1 – Mexican free-tailed bats near Bracken Cave near San Antonio, Texas. Photo by A. Russell.

and Zaradic 2008; Cordell et al. 2008), it is important to be able to understand, calculate, and communicate the full value of wilderness (Watson and Venn 2012), including the "on-site" benefits provided within or near protected areas and the "off-site" benefits provided to people far beyond area boundaries (Loomis and Richardson 2001). The purpose of this article is to present a method to communicate the "off-site" value of wilderness areas in providing habitat to migratory species that, in turn, provide benefits to people in distant locations.

What is the full ecosystem service value of protected areas? How do protected areas support the delivery of ecosystem services in distant locations by providing habitat for migratory species? Using northern pintail ducks (*Anas acuta*) as an example, we (1) outline a method to estimate the amount of subsidy – the value of the ecosystem services provided by pintails in one area versus the cost to support the species and its habitat elsewhere, (2) describe how the approach can be applied to account for individual wilderness areas, and (3) suggest how such an approach could be used to communicate the value of protected areas to people and decision makers in distant locales.

Calculating the Spatial Subsidy Provided by a Wilderness Area

Consider a wildlife refuge on a migratory flyway that is widely judged a "critical" stopover site for birds. Scientists trying to ascertain the ecosystem service "value" of this refuge would traditionally consider the number of visitors, how much the average visitor spends, and any other goods or services extracted from or provided by the refuge. If they were to consider the birds, however, they would recognize the refuge plays an important role in supporting bird migration and thus the overall ability of the species to provide ecosystem services in other locations – a service that was previously unaccounted for in the valuation of the refuge. This "migration support" is a type of supporting service (*sensu* Millennium Ecosystem Assessment 2003) provided by ecosystems. By understanding the nature of migration support as an ecosystem service, it is possible to quantify spatial subsidies one location provides to, or receives, from others.

All locations regularly used by a migratory species can both provide and receive benefits via migration support. Locations *provide* benefits by contributing to the overall viability of migratory species that in turn provide services to humans elsewhere in their range. Locations *receive* benefits in the form of services provided locally by migratory populations that are dependent on distant areas. Therefore, the net ecosystem service subsidy either provided or received by an area is a balance between the services received from a species dependent on other locations and the support the area provides to the species. The following description of how the subsidy can be calculated is excerpted from Semmens et al. (2011), which can be referenced for additional details.

For a single species, the gross migration support provided (out) by location A to all other locations, M_{Ao}, is simply the value of migratory services provided at all other locations multiplied by the species' proportional dependence on location A:

$$M_{Ao} = (V_S - V_{SA}) \times D_{SA} \quad (1)$$

Where V_S is the total value of services provided by a species S throughout its range, V_{SA} is the value of services provided at location A, and D_{SA} is the proportional dependence of the species' population on location A. Locations can be defined in any manner and number, provided they encompass the full migratory range of a species. Values for D_S must satisfy the following two requirements:

$$0 \le D_{SL} \le 1$$

$$\sum_{L=1}^{m} D_{SL} = 1$$

where D_{SL} represents the proportional dependence at any given location, and L encompasses all m

locations used by a species. The latter requirement assumes migratory species are dependent on the persistence of favorable conditions across their entire range; they cannot be more or less than 100% dependent on their environment.

The gross migration support received (in) by a location from all other locations, M_{Ai}, is the product of a species' dependence on all other locations and the value of services provided locally:

$$M_{Ai} = V_{SA}(1 - D_{SA}) \quad (2)$$

The migration support values calculated in Equations 1 and 2 are based on the annual monetary value of services provided by the migratory species (see Semmens et al. 2011 for a discussion of how nonmonetary values could be incorporated into this approach).

The net difference between outgoing and incoming migration support is the spatial subsidy for location *A* (Y_A):

$$Y_A = M_{Ao} - M_{Ai} \quad (3)$$

Positive values indicate location *A* is subsidizing other areas. Negative values indicate location *A* is being subsidized by other areas. When applied to all locations, *L*, throughout a species' range, Equation 3 satisfies the requirement that the sum of all subsidies is zero, or

$$\sum_{L=1}^{m} Y_L = 0 \quad (4)$$

For a given location, the total annual value resulting from its use by a migratory species is the sum of the spatial subsidy and value of services provided locally:

$$V_A = Y_A + V_{SA} \quad (5)$$

Equations 3 and 5 can be rewritten to accommodate multiple species by simply summing across all *n* species of interest.

$$Y_A = \sum_{S=1}^{n} (V_S D_{SA} - V_{SA}) \quad (6)$$

$$V_A = Y_A + \sum_{S=1}^{n} V_{SA} \quad (7)$$

The migratory ranges of each species need not overlap completely. Equation 6 still satisfies the requirement of Equation 4, provided that the combined spatial extent of all ranges is considered.

Despite the conceptual framework, estimating real values for V_S and D_S presents a substantial challenge. Estimates of V_S must be location specific, yet measured across all locations. This creates considerable hurdles both in the required ecological understanding of a species and its valuation at each location. Estimates of D_S must allow comparisons of different sites in terms of their contribution to overall population growth or viability. The most difficult aspect of estimating D_S and V_S lies in developing demographic and economic data across all sites – very few studies approach migratory species from a population level, or systematically address their functional interactions with humans. As a result, data limitations will hamper the application of our approach in the short term and permit analyses for only those charismatic, endangered, or economically important species that are the best studied and monitored. In the long term, the approach demands substantial investment in, and coordination of, new data collection, monitoring, and database development to systematically address migratory species. To date, there are no published examples of spatial subsidy calculations. However, a U.S. Geological Survey Powell Center for Analysis and Synthesis working group led by the authors is attempting to calculate spatial subsidies for three species: northern pintail ducks, monarch butterflies (*Danaus plexippus*) and Mexican free-tailed bats.

Global Importance of Wilderness for Migratory Species

Around the world, many wilderness and protected areas support migratory species, often by design. For instance, the Monarch Butterfly Biosphere Reserve in Mexico supports overwintering congregations of eastern North American monarchs, and the Maasai Mara/Serengeti National Parks in Africa support massive migrations of wildebeests and other ungulates. In the United States, the U.S. Fish and Wildlife Service refuge system and other managed lands in the Prairie Pothole Region account for only 2% of the breeding habitat for all waterfowl, yet contribute to 23% of the overall waterfowl production (USFWS 2007), indicating that these managed lands play an important role in waterfowl demography. Many other reserve systems around the world support migratory birds, such as Keoladeo National Park in India, Radipole Lake nature reserve in the UK, the nature reserve system in Israel (an important geographic location for bird migration between Africa, Europe, and western Asia), and numerous World Heritage sites. Within countries or regions, reserve systems also support smaller-scale altitudinal migration, such as the migration of resplendent quetzals and other tropical forest birds in Costa Rica, and ungulates in Wyoming, United States.

Example of Northern Pintail Ducks

Northern pintail ducks are a popular species for hunting and wildlife viewing. Pintails generally overwinter in the southern United States and

Mexico and fly north each spring to breed in the northern United States and Canada (the majority of the pintail population occurs in the western part of the continent, despite a broad distribution across North America). Through their migration, pintail ducks create ecological and economic links between distant locations. The potential for a large ecosystem service subsidy exists because the vast majority of the harvested birds (80–90%, Miller and Duncan 1999) are taken in the United States, yet breeding habitats in Canada play a large role in overall pintail population dynamics. Indeed, the leading hypothesis for historic pintail declines is the intensification of agriculture in the prairie pothole region of western Canada (Miller and Duncan 1999; Podruzny et al. 2002; Miller et al. 2003) (see Figure 2).

How can we estimate the spatial subsidies in ecosystem services (harvest of pintails) between locations where birds are harvested versus places that support the pintail population? A promising approach is to combine harvest value information with a demographic model of pintails via the method described earlier. Mattson et al. (2012) developed a demographic model for pintails in North America. The model included three breeding populations (Alaska, northern Canada, and the Prairie Potholes), and two nonbreeding populations (California and the Gulf Coast). It modeled both fall and spring migratory dynamics and was parameterized using a wide array of data from nest studies, aerial waterfowl surveys, and harvest records. The model can be used to estimate *Ds* for each of the five regions, while harvest data can be used to estimate *Vs*. At this broad geographic scale of North America, the subsidy calculations can inform policy between the United States and Canada for pintail management.

Figure 2 – Northern pintail ducks in Kolkata, West Bengal, India. Photo by J. M. Garg. License held by Creative Commons.

To assess the subsidy provided by an individual protected area, we suggest adapting Mattson et al. (2012) to understand how pintail demographic processes vary across the modeled regions. The maps of protected area boundaries could be compared to maps of how the landscape contributes to a species' demography to estimate the subsidy provided by particular protected areas. For pintails in the Prairie Potholes, this is nearly possible. Podruzny et al. (2002) analyzed data from 72 transects spanning an area about 600 x 400 miles (1000 x 600 km) in the Canadian Prairie Potholes. This area represents about 60% of the Prairie Pothole breeding population in Mattson et al. (2012). The analysis determined geographic features that influenced where pintails "settled" or chose to breed after their spring migration to the prairie. The analysis also generated detailed maps of the density of breeding pintails across the region and developed an understanding of how particular vegetation types, agricultural practices, and pond density affected breeding bird density. Using these maps it would be straightforward to quantitatively partition regional subsidy or proportional dependence values among subareas, such as a wildlife refuge. These types of geographic analyses are becoming commonplace given the increasing use of species distribution modeling (Scott et al. 2002) and provide a potentially powerful method for overcoming the scale discrepancy between the regional population models with which proportional dependence is estimated and the more local scale at which subsidy values are needed.

Applications

Migratory Species and Spatial Subsidies as a Communication Tool

In a large and diverse country such as the United States, communicating the value of a given protected area can be challenging. For example, managers of parks and wilderness areas west of the Rocky Mountains need to demonstrate their value to decision makers located in the nation's capital, Washington, D.C. – more than 2,000 miles away – and to stakeholders from around the country. Previous work by natural resource economists has suggested that the value of wilderness be communicated in terms of on-site and

off-site values (Loomis and Richardson 2001). On-site values are the benefits received or enjoyed locally, such as recreation, protection of fish and wildlife habitat, and increased revenues to local communities from visitor expenditures. The primary metrics of off-site values, to date, are improved downstream water quality and passive-use existence values to people who many never visit the area but derive satisfaction from knowing the area exists and is protected (e.g., Pate and Loomis 1997; Chichilnisky and Heal 1998; Bateman et al. 2006).

Downstream water-quality improvements are an effective way of demonstrating the *regional* benefits of protected areas – that is, benefits to downstream users – but may not communicate why more distant stakeholders should care about protecting wilderness. On the other hand, existence values do capture how distant stakeholders value wilderness but may be viewed by some as less convincing (Defries and Pagiola 2005). Our method of expressing the value of protected areas to distant people through *migration support* can communicate the value of protected areas, and it does so in a way that is quantitative and easily understandable. As such, it provides a valuable addition to the portfolio of tools used by managers and conservation advocates to articulate the value of wilderness.

Migratory Species and Spatial Subsidies as a Framework for Conservation Funding

As described earlier, protected areas can *subsidize* the delivery of ecosystem services in other locations. In an ideal world of abundant resources for conservation, this situation may be tenable. However, with the current reality of shrinking budgets for conservation, park managers and decision makers may want to convince the people who receive benefits from a migratory species to share in the cost of protecting the species' critical habitats in distant protected areas. Our method provides a way of identifying who is receiving benefits from migration support, quantifying the "value" of those benefits, and connecting them back to source areas via an equitable subsidy calculation. Resource managers could use the calculated subsidy values to guide how much people in a receiving location might pay to support conservation efforts in the protected area(s) supplying the subsidy.

This approach provides a quantitative means to assess the need for increased conservation for migratory species and the wilderness and protected areas that support them.

Payments to support conservation and land management efforts and protect ecosystem services have been termed "payments for ecosystem services," or PES. A wide and growing literature describes PES programs, the opportunities they present, the challenges of implementing them, and possible negative consequences of doing so (Engel et al. 2008; *The Economist* 2009; Norgaard 2010). These important issues must be addressed when considering PES. Most of these issues, however, are beyond the scope of this short communication – but we do address one particular concern that might arise in the United States when considering developing PES programs for protected areas that provide migration support services.

In the United States, wilderness and other protected areas are public lands – lands that are owned and set aside by local, state, or federal governments – and receive government funds for their management and protection. The issue of paying a management agency for protecting land that they are already charged with protecting arose in the Forest to Faucets Initiative where the Denver, Colorado, water utility is paying the U.S. Forest Service for erosion control and wildfire prevention activities in agency-owned forests above the city's water-supply reservoirs. Both the Forest Service and the city have argued that the funds are for *additional* actions specifically designed to protect and enhance the ecosystem service in question (Denver Water 2011).

Conclusion

In an era of concern over the numbers of visitors to wilderness and protected areas, park managers and other conservation advocates in the United States are examining new ways to express the value of protected areas and wilderness to decision makers and stakeholders. Here we present a new approach for accounting for the value of protected areas through migration support – the provision of habitat and resources to migratory species that in turn supply benefits to people in distant locations. We believe this approach provides an effective tool for communicating the value of protected areas, in particular to people and decision makers located far from the areas in question. In addition, this method could be used by decision makers to communicate the value of a migratory species and why protecting the species' critical habitats in distant wilderness and protected areas is important. Through a U.S. Geological Survey

Powell Center working group, the authors and colleagues are implementing this approach for three North American migratory species, as we refine and make the techniques more accessible. This approach provides a quantitative means to assess the need for increased conservation for migratory species and the wilderness and protected areas that support them.

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Living Waters

Linking Cultural Knowledge, Ecosystem Services, and Wilderness

BY LINDA MOON STUMPFF

Abstract: American Indian tribes value pristine water sources that often originate in wilderness areas to support provisioning and cultural benefits. Based on interviews with four traditional leaders, this article focuses on the concept of living waters in ways that connect ecosystem service benefits to wilderness. Cultural knowledge connects indigenous water stewardship and protection of living waters throughout watersheds as threats increase due to climate change and development.

Cycle of Life

Water energizes the cycle of life at the intersection between culture, ecology, and spirituality. Pristine, cool water can be thought of as the most important asset held by the environment over long periods of time. It encompasses weather, mists, underground springs, precipitation, drainages, and watersheds in a system of human cooperation and stewardship. In recent literature these assets held within the environment are referred to as ecosystem services (Daily et al. 2009). Water is more than a resource, it is *living water* to native people.

Weidner (2011) suggested that ecologists, economists, modelers, and geographers would have to work together to help build spatial tools that support ecosystem services assessments. Traditional ecological knowledge will also enhance this work. This article employs a simple definition of traditional ecological knowledge and adaptive ecological knowledge developed through intimate reciprocal relationships between groups of people in a particular place over time (Ecological Society of America 2012).

The Speakers and the Method

This article brings together knowledge from four in-depth interviews with native wisdom keepers, chosen for their knowledge of the cultural, spiritual, and ecological values of water. Each articulated knowledge within their cultures, and they all enjoy the role of elder wisdom keepers within their cultures and play recognized leadership roles locally, nationally, and internationally outside their internal roles. They were all asked to answer 10 open-ended questions in an ethnographic-style interview. All four have grown up in traditional culture and are cognizant of the fact that watersheds transcend land-use boundaries. They come from four different tribes, three from the northwest and one from the southwest United States. The first three take a regional focus. Billie Frank Jr., of the Nisqually Tribe, speaks of living waters connected to Mount Rainier and its wilderness. Delbert Miller, a spiritual leader of the Skokomish Tribe, shares origin narrative associated with wilderness and adjacent areas in Olympic National Forest and Olympic National Park. Calleen Sisk-Franco is the traditional leader of the Winneman Wintu Tribe in California. She speaks of alpine wilderness areas on Mount Shasta as a source of living waters. Lomayumtewa Ishii, chair of Native Studies at Northern Arizona University and a Hopi priest, gives the final southwestern interview, focusing on the relationships between living water and wilderness areas on the San Francisco Peaks. All spoke of spiritual and cultural uses of water and the need to prevent disruption of the natural systems that produce clean, clear water.

Linda Moon Stumpff.

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Living Water as an Ecosystem Service

It was clear in all interviews that moisture, as it arrives in the form of snow high in the alpine peaks, is critical. The peaks are the true homelands because they are the homes of the spirits and the origins of the people, of water, and of all life. Snow, ice, and rain at these high elevations represent the purest, coldest, and most valuable form. Cultural narratives recount origins in these alpine areas where spiritual beings make contact with humans and recharge the systems of life. The quality and quantity of these headwaters predict the water supply below and the sustainability of human occupation. Speaking for the water, Billy Frank Jr., an international leader on fisheries from the Nisqually and chair of the Northwest Indian Fish Commission, holds an intimate connection to the watersheds and springs related to Mount Rainier and the Nisqually River (see Figure 1). He gives us a description of the reverence and respect for these living waters:

> The creator gave us all the gift of water; we respect it. It is for Indian people and it is for all people. It is what life is all about. Cool, clear water. Water is key to the culture and way of life, the spiritual and the cultural. We are gatherers and harvesters. Both quantity and quality of water are important. The salmon and the shellfish need it. … Indians still go to the springs at the foot of our mountain Tahoma and get water to take home. Spring water. It is beautiful there. Blue water. Beautiful blue water. You can drink it right out of your hand. It generates from under the earth. I'll take you there sometime. (Frank 2011)

These high elevations are holy places. To commodify these resources for economic markets is the greatest of "takings," for it denies people's origins. The willingness of tribes to use enormous amounts of their resources to fight for the protection of sacred peaks evidences the respect with which they are held. They communicate the indigenous understanding of their importance as the origin point of services that sustain their culture and their existence.

For the Winnemem Wintu Tribe in northern California, the icy water high on Mount Shasta (see Figure 2) is the home of their benefactor, the McCloud salmon. Their cultural existence is threatened without the icy water and the salmon (Sisk-Franco 2011). Access to clean river water is essential for the young women's ceremony: young women swim across the river in the ceremony in the process of becoming a woman of the tribe. For the Hopi and the Navajo and other Arizona tribes, the San Francisco Peaks (see Figure 3) represent a homeland for which they bear a responsibility to protect as a source of spiritual and life-giving benefits. The threat to their cultural existence includes the loss of their wisdom, their respectful relationships, and their understandings and practices related to the support of ecosystem services through the protection of the waterscape. The cultural existence of indigenous people who have lived on the land for thousands of years is in itself an ecosystem service because their residence records an interaction with the environment that supports a rich

Figure 1 – Mount Rainier. Photo by Dave Graber.

Figure 2 – Middle Falls on the McCloud River. Photo courtesy of the U.S. Forest Service.

Figure 3 – San Francisco Peaks. Photo by John Batchelder.

cultural and religious life. This is the only long-term record of human interaction with the ecosystem that comes from a direct, original source.

Indigenous scientists with parallel Western scientific training recognize the significance of origin stories that function as primary sources of connectedness and continuity. The same understanding is transmitted by Western scientists who have deep and long-term dedication to understanding indigenous knowledge. Physicist David Peat (2005), for example, writes: "That to deny a people's origins is to cut them off not simply from the land they physically occupy but also internally – from the very sense of their own bodies." In Arizona, tribes worked to establish the Kachina Wilderness as a way of protecting such values. But today, the city of Flagstaff, Arizona, sells treated sewage water to be piped to the top of the San Francisco Peaks next to the Kachina Wilderness to make artificial snow. Evaporation and displacement disrupt the cleansing return to the aquifer. With a focus on the market price of water alone, the city failed to understand the interconnectedness signaled by Hopi elders. Ishii describes the connectedness of living water as it flows, rises, and transcends land management boundaries:

> It is better for the water to return to communities through natural systems to carry out daily life projects … it is all part of a system. … Fir boughs are used by the Kachinas because the firs live higher and they need water: clouds live on the boughs of these trees. By using fir boughs in ceremonies, prayers will return to the Kachinas on the peaks. They return to us as rain. (Ishii 2011)

Commodified water piped out of the watershed and sprayed in the air misses the natural cleansing process of seeping deeply into the earth to be purified, balancing out its human use with its pristine, icy origins atop the peaks. Snowmaking machines lack the ecosystem functions of the natural seasonal flows that support the peaks' rare alpine meadows, plant willows, the herbaceous plants used for medicines, and life-forms in all seven life zones. Thirteen tribes in Arizona, recognizing the critical functions that the peaks and the associated precipitation provide, continue to fight to protect them on native religious grounds. But the federal courts, unable to recognize the broad meanings drawn from indig-

enous epistemology that connect the belief system with ecosystem services beyond land management boundaries, fall silent. The very nature of water is to move, flow, permeate, evaporate, and precipitate in ways that cannot be contained. Nor can the impacts to the associated spiritual beliefs be contained: "Certain deities, such as Kachina (Hopi) or Ga'an (Apache), dwell on the peaks, and that snowmaking (irrespective of the source of water) will negatively impact the deities, potentially causing drought or other suffering" (Ishii 2011).

Echoing the southwestern example, the life-producing wild waterscape that was threatened in the Northwest impacted the culture of the Skokomish Tribe. Their culture is so water dependent and so closely connected with fish that they recognize the salmon as their ancestor. Delbert Miller relates the emergence of the people from the second branch of the Skokomish creation story that mirrors the deep sense of connectedness with the salmon and its continuous celebration in the origin of the Water Ceremony: "They climbed out of water, now turning into humans. You could still tell they were half salmon, the first ones. The Father came and said, 'I will return and you prepare for me.' They prepared the blessing of the Water Ceremony. They began to do that as instructed" (Miller 2011).

Clear, cold, pristine water is needed for the Skokomish Water Ceremony held at high elevations. Ceremonial bathing in icy water at high elevations ties spiritual beliefs to indigenous life activities through origin stories:

> The Changer wept and said: "These are my beloved people … wherever they go wild roses will grow." This is the beauty of the gift. … It was so sacred that everything was frozen and went into a fast. … People swim in those tears: it is the kind of water they drink and set aside for cooking. The water is called "sweet water." It waters the sacredness within us: it waters our internal sacredness and spirituality. (Miller 2011)

The ecosystem functions of living water are poetically described in Delbert Miller's narrative:

> There are a few basic rhythms of life: fish swimming back and forth, wind coming down to the valley, streams coming from mountains to the valleys, butterflies flying, leaves falling. It's a living dance. Do not change the dance of the stream. Every year the stream moves, creating different places. You return and it's different because it's alive and dancing. They dress themselves by logjams, by flowers and trees, and they give refuge for the ones they are to protect. They know they are home to fish and things that live there. They give retreat for things that need a place. (Miller 2011)

Water and Ecosystem Services under Conditions of Climate Change

The contribution of clean, cold waters for fish habitat is integral to the indigenous diet, but this is being impacted by climate change. Salmon represent one of the most efficient systems in nature. They leave the streams of their birth as tiny fingerlings and go to the ocean where they absorb the nutrients and resources of the sea. They return to the icy streams of their birth with pounds of rich, healthy flesh for the diets of wildlife and humans. Almost no other ecosystem service is as efficient, as bountiful, or as healthy as the production of salmon from cool stream habitats. Northwest cultures make direct linkages between water and food that are impacted by climate change. The right to have salmon as food is founded in the responsibility to care for the water. Indigenous adaptation is the constant practice of the responsibility to keep the water clean, founded in spiritual practice and connected with the right to take salmon:

> The salmon need clean water. We pray for blessing of the water, no refuse to be in the water. … Some beings became the Tree People whose leaves fall and hit the ground and they called to the Salmon People. The leaves hit each other on the way down and called to the Salmon People to come home, telling them that the people have kept the water clean. The Father of the salmon comes; he is the first for the Salmon Ceremony. In the Salmon Ceremony, his remains are put into the water and he would swim back to his home and tell the salmon that people have done the ceremony and the leaves have fallen, so it's time to return home to the people. (Miller 2011)

When a species such as salmon is critical to healthy diet, water issues, and cultural uses, a careful assessment is needed as climate change proceeds. We are reminded that life-forms are vulnerable and require certain qualities of water to be sustained. Billy Frank Jr. talks of the critical free-flowing clean, cold water habitat required for salmon, and he identifies the direct impacts to ecosystem services from climate change:

> In the past, glaciers melted slowly during the summer months and helped contribute cool, clean water to the rivers where salmon begin and end their lives. But today our rivers are getting warmer and our glaciers are disappearing, harming salmon at every stage of their life cycle. Salmon and Indian people

> evolved together over centuries, but climate change is happening in the blink of an eye. It's happening too quickly for salmon – and us – to keep up. (Frank 2011)

Embedded in the Skokomish origin stories are descriptions of climate change and adaptation to changing ecosystem services that narrate the people's move from forest to coast, from deer and elk to salmon. The reproductive capacity of salmon is recorded in the portion of the narrative that marks the increasing abundance of offspring. The connection with cedar is also embedded in the cultural narratives of the Skokomish people: "Grandmother Cedar taught generosity. … For thousands of years it stands … the Plant People are cheering, applauding the salmon coming home … see them standing together " (Miller 2011).

Medicinal plants and herbs produced by the forest's interaction with healthy watersheds define a provisioning service that requires sufficient amounts of pristine water for growth that may be affected by climate change. Tribal members have specific gathering areas for medicinal plants. Traditional ecological knowledge describes their potency as dependent on certain gathering sites, sacredness, and human interaction with these sites.

> The mountain is like a pharmacy. Plants are adapted to a water system that provides pure water at specific times and quantities. Religious uses of plants are important like gathering of (certain plants) for the kiva, the need for pure and unpolluted sources of material. Impure water can have a bearing on spiritual practice … you cannot assume the threat is the same to all tribes, since they have different practices. (Ishii 2011)

Prehistoric and historic reactions to major shifts in climate often combined with human conflict over water. Fagan (2011) agrees that migrations and dispersal were often the result of changes in climate, and he suggests that cultural landscapes can be redefined as homelands under adaptive management. Even so, without the preservation of cultures, migrations may result in significant impacts and loss of the wisdom that supports living sustainably within the watershed, and the sustainability of ecosystem services is intimately connected to culture and the recognition of connectedness.

Living Waters and the Weather Cycle

The respondents agreed all types of water provide important cultural and provisioning benefits: the liquid, flowing water, the gas vapor in the clouds and mists, the dew on the boughs of spruce, the solid ice and snow, and various types of precipitation. They are understood as part of a system that moves precipitation to seepage into groundwater, from running streams to gurgling springs. Weather patterns take place over long periods of time and may be little understood by newcomers who take them to be static and absolute (Logan 2008), so memories of indigenous people are important in discerning shifting patterns. The intersection of special forms of water with the shifting cycle of weather patterns is specific to a given region. These are understood and shared through a ritual calendar that recognizes the role of weather in sustaining ecosystem services and in stories and prophesies that record cataclysmic events. For example, the montane meadows that produce the medicinal herbaceous plants for the Hopi and Navajo are dependent on snowmelt. Alpine and subalpine plants are particularly sensitive to pollution, so clean, natural snow provides the moisture that is needed. Cultural symbols mark these relationships and underline the need for good heart, for collaboration, and for good behavior as part of indigenous stewardship.

Like the Skokomish oral traditions, Hopi understandings bridge the long history of prehistoric agriculture and what happens when humans disrupt the natural and ceremonial cycles to upset critical ecosystem services. Ishii warns of unknown and uncontrolled effects as he indicates the predictive capacity of indigenous knowledge. Traditional stories hold markers that may indicate when the range of variability experienced and recorded in traditional knowledge is exceeded:

> What interferes with these cycles when unknown effects occur? We have the stories of drought from Chaco Canyon. What happened there? What got out of balance when the water and animals went away? A spiritual disconnection of some kind occurred. This approach is guided by an indigenous way of thinking, acting, and the ceremonial cycles. We look at things through time: versus the now thing. How people were in cycle in the past and how they will be in the future are tied. What will happen … not what happens. The world we used to know. (Ishii 2011)

Protecting Living Waters, Cultural Knowledge, and Wilderness

Traditional ecological knowledge as expressed through the concept of living waters and indigenous water stewardship strengthens cultural/community-based institutions, preserves long-term traditional ecological knowledge, and points to the need to conserve connected watersheds.

Cosmologies that articulate the balance between Father Sky and Mother Earth connect precipitation and weather cycles with water systems on earth. This is a source of long-term knowledge about weather and water sources: "A good number of American Indians and Alaska Natives have maintained thousand- and hundred-years-old relationships with specific landscapes and seascapes. The knowledge embodied in these deep spatial relationships to homelands have served indigenous peoples well." (Wildcat 2009, p. 3)

Indigenous markers identified through traditional ecological knowledge operationalize the traditional values of indigenous stewardship into knowledge and practice. They point to important strategies and alternatives when the earth-sky balance reaches a tipping point. This deserves consideration in wilderness management along with strategies to protect watersheds adjacent to wilderness areas. Failure to ensure provisioning and cultural benefits basic to indigenous cultures results in the disappearance of bodies of knowledge, practices, and technologies that emerged from a long evolution of interaction with wild places. Without enhanced protection, climate change may result in forced migrations and dietary changes. The seriousness of this loss should not be underestimated. If the fish are gone from their icy homes, if the practice of indigenous fishing and agriculture stop, the interconnected practical knowledge of the species and their place in the cycles of living water will be lost. It isn't possible to assess the tipping point for ecosystem services unless the whole can be described. Traditional ecological knowledge is embedded in the land and living waters for each indigenous nation that has participated, observed, and recorded information for thousands of years (Stumpff 2006; Turner and Clifton 2009). It is virtually irreplaceable and deserves consideration. New strategies are needed to protect these water-based ecosystem services connected to wilderness. This reaffirms protection of traditional ecological knowledge and the cultures that carry it. The idea of living waters engages deep discussions beyond land management boundaries. It paints an ongoing mural so we can see ancient scenarios, their contemporary evolution, and the future of living water.

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The Application and Performance of Urine Diversion to Minimize Waste Management Costs Associated with Remote Wilderness Toilets

BY GEOFF HILL and GREG HENRY

Abstract: The diversion of urine away from fecal matter, prior to contact, has the potential to improve a wide variety of public toilet systems managed at remote wilderness sites. In order to evaluate the reduction in mass, cost, and impact associated with human waste management at the Kain Hut, Bugaboo Provincial Park, British Columbia, Canada, we designed and tested three alternative waste treatment systems, all of which involved the diversion of urine with urinals and urine-diversion seats. By quantifying the mass of excreta deposited per toilet use, we were able to compare the baseline excreta mass collected per use in an unmodified barrel fly-out toilet system with that collected in a barrel toilet modified with urine diversion (urinals and urine diversion seats), urine diversion with solar dehydration, and urine diversion with 110V evaporation.

Introduction

Parks Canada is aiming to increase annual wilderness visitation to 22.4 million visits in 2015 from 20.7 million visits in 2008 (Parks Canada 2011). Total waste volume and waste management costs increase directly with increased visitation. In wilderness areas experiencing low usage, human waste may be adequately managed by pack out, cat holing (in areas with adequate soil structure; Cilimburg et al. 2000), or desiccation by smearing (dry/hot; Ells and Monz 2011). Under ideal conditions of low use as well as suitable environmental conditions, these standard methods of disposal should have little risk of ground or surface water pollution, pathogen transmission, or negative visitor experience (Cilimburg et al. 2000). However, should any of these criteria not exist, the risks associated with human waste outlined by Temple et al. (1982), Cilimburg et al. (2000), Moore et al. (2010), and Banerjee (2011) should stimulate the implementation of waste management plans.

Geoff Hill conducting research in Assiniboine Provincial Park, British Columbia, Canada.

Human waste management in wilderness, and especially alpine wilderness, is very challenging. Remote sites frequently lack standard municipal infrastructure, including road access, sewerage, electricity, and water supply. Without these basic services the removal or treatment of human waste can become an expensive, intensive, offensive, and dangerous task. Additional challenges at alpine sites include short summers, large diurnal fluctuations, frequent freeze-thaw events, extreme weather, shallow and weak soils, limited vegetation, and challenging terrain (Weissenbacher et al. 2008).

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Nonetheless, the proper management of human waste is essential in order to prevent environmental contamination, ensure adequate user sanitation, and meet legal requirements.

There are two approaches to waste management programs in parks and wilderness areas: pack out or provision of toilets. Pack out involves the collection of fecal matter in bags, transport throughout the wilderness visit, and disposal at an approved septic waste disposal facility. Toilet provision involves the construction, maintenance, collection, and either on-site treatment and on-site disposal of end products or transport for off-site treatment.

Effective pack-out programs have a specific set of criteria (Robinson 2010 and White 2010). In all other wilderness areas, where annual visitation or intensity exceeds the loading rate manageable by open defecation and cat holing, toilets are generally provided. There are a variety of toilet systems used in North American remote wilderness areas, including pit toilets, barrel collection toilets (barrel fly-out), composting toilets, and dehydrating toilets. There is a wider selection of waste treatment technologies available in Europe, as wilderness travel in Europe is supported and serviced by large networks of popular and high-use huts, but many of theses require running water or power (Becker et al. 2007).

Human excrement is composed of urine and feces, the majority of which is urine. Urine, containing the majority of nutrients and much lower pathogen content than feces, could conceivably be treated on-site with minimal impacts by natural soil processes, assuming leachate to groundwater was not allowed. Feces, having high organic matter and pathogen content, is much more difficult to treat on-site, and in most cases – except where collected in pits – is removed for off-site treatment. The diversion of urine away from feces is commonly practiced in Scandinavian countries, primarily in order to capture and reuse uncontaminated nutrients in urine (Jönsson and Vinnerås 2007). However, there are a number of other beneficial uses of urine diversion, especially when applied to remote site waste management toilet systems.

The majority of urine can be diverted from fecal matter in barrel fly-out toilets, resulting in considerable operation and maintenance cost reduction.

Pit toilets are one of the least expensive toilet systems to build and operate, as they function both as collection and on-site treatment by relying on natural soil to attenuate pathogens and nutrients (Gunn and Odell 1995). Despite research indicating that >20 m (65.6 ft.) unsaturated soil must exist below a pit toilet in order to effectively remove viral pathogens from water 50 m (160 ft.) horizontally away (Moore et al. 2010), common practices frequently either place the pit into groundwater (McCrumb, pers. comm. 2012) or require only 1–2 m (3.3–6.6 ft.) of vertical separation from seasonal-high groundwater (Gunn and Odell 1995). Horizontal separation to surface water is reported by Gunn and Odell (1995) to be 10–20 m (32.8–65.6 ft.), depending on soil type, but with more recent concerns over enteric virus survival and transport, these distances may be as high as 1,000–3,000 m (3,280–9,842 ft.), depending on soil type and depth of unsaturated soil below the pit. Moore et al. (2010) provide an in-depth summary and calculation templates for separation distances and risk tolerance. In light of the likely impacts of pit toilets on water quality, they may no longer be a reasonable choice except where proof of vertical and horizontal separation from groundwater and surface/well water is suitable for soil type and seasonal flux in water table. It may be possible to eliminate the pollution risk associated with pit toilets if urine is diverted away from the pit, and the pit sealed with an impermeable liner.

North American mixed latrine-style composting toilets propose to employ aerobic bacteria and microorganisms to decompose excrement to the point at which end products are "safe" for on-site discharge, making them an attractive alternative for pit-toilet sites. However, the body of literature on mixed latrine-style composting toilets, especially from field studies, indicates that they are unreliable in the production of compost suitable for discharge into a public park environment (Matthews 2000; Redlinger et al. 2001; Holmqvist and Stenstrom 2002; Guardabassi et al. 2003; Jenkins 2005; Jönsson and Vinnerås 2007; Tonner-Klank et al. 2007; Jensen et al. 2009; Hill and Baldwin 2012; Hill et al. 2013). Moreover, this style of composting toilet is expensive and hazardous to maintain as material must be removed annually (Hill and Baldwin 2012). With the diversion of urine away from feces, the feces become a viable feedstock for invertebrate-driven decomposition (vermicomposting) and the source of odor is eliminated (ammonia from urea), making them far superior in performance and hazard reduction (Hill and Baldwin 2012). However, there are currently no commercially available public-utility urine-diversion systems available in

North America. Urine-diversion seats and urinals, commonly used in residential Scandinavia, require testing in a public environment to prove their worth.

In rare circumstances, dehydrating toilets and incinerating toilets can be found, but there is limited data on these systems in North American wilderness environments, and their ability needs to be evaluated prior to greater market uptake.

Alpine sites, generally not suitable for pit toilets (lack of soil) or composting toilets (too cold), are frequently serviced with barrel fly-out collection toilets in Canada. Barrels are transported annually by helicopter for off-site treatment. However, the expense and intrusion of helicopters to regularly remove barrels from wilderness destinations is large and can cost thousands of dollars per year at high-use sites (Hanson, pers. comm. 2011). By diverting urine, which constitutes 75% of daily excreta mass per capita, away from the collection barrel into a shallow septic field or wetland, considerable expense, intrusion, and risk associated with helicopter removal of excreta could be minimized. The remaining fecal matter, high in moisture, could be further minimized through desiccation.

The performance of urine diversion by urine-diversion seat and urinal would be most effectively evaluated at a barrel fly-out toilet site because of the simplicity in quantifying excrement collected in easily managed drums. In order to evaluate and enumerate the reduction in excreta associated with each mass reduction treatment, we established each treatment at a high-use backcountry wilderness site and periodically measured the change in mass collected per average toilet use under each toilet treatment system. Based on the reduction in mass, potential cost savings were estimated using available financial data.

Methods

We chose the Conrad Kain Hut, Bugaboo Provincial Park, British Columbia, elevation 2,100 m (6,890

Figure 1 – Alternative toilet waste management treatments at Kain Hut, Bugaboo Park, BC Canada. (A) Urine diversion toilet seat. (B) Urinal with 1-inch braided drain pipe to collection barrel. (C) Lower toilets with UD12V solar hot-air panel (i) above a 5W PV panel (ii). (D) Upper Kain Hut toilet insulated basement, 110V heater, and 110CFM exhaust fan positioned around a 200 L plastic barrel with double garbage bags to collect solids.

ft) above sea level, as a site to test three alternative waste treatment technologies. The hut sits 5 km (3.1 miles) from and 700 m (2,297 ft) above the trailhead, 45 km (28 miles) west of Brisco, British Columbia. Accommodating 40 overnight occupants, it is used principally in the summer by hikers, climbers, and guides. It is one of the more popular destinations in the Canadian alpine and is serviced with propane for cooking and lighting. Water from above the hut is piped directly to plumbing in the hut for cooking and drinking. Gray water is gravity fed to a solids-separating tank or direct to disposal field in a natural sedge meadow overlying solid granitic parent material 30 m (98 ft.) below the hut. There are three outdoor toilets: one close to the hut and two down a short flight of stairs. Prior to our experimental manipulations, the toilet close to the hut was used as a urine-only toilet; a mesh grate just below the toilet surface dissuaded fecal matter additions. Urine from the urine-only toilet was diverted into the gray-water disposal pipe. The hut and toilets sit on a small bedrock knoll with unobstructed solar exposure until mid-afternoon when Snowpatch Spire interrupts direct incoming solar radiation. This site was chosen for research as it was representative of other moderate to high-use alpine sites, was guaranteed to have adequate visitation to accumulate necessary excrement for measurement, and provided attractive sanitation amenities, including running water for hand washing and bathing – important for researchers and assistants conducting this biohazardous research.

We designed and assessed three alternative toilet waste management systems that could be retrofitted into any standard barrel fly-out toilet (BFO). The simplest system was urine diversion (UD), which included both a men's urinal and urine-diverting seat from EcoVita (Bedford, MA) (see Figures 1A and 1B). The second involved the urine-diversion system plus solar dehydration (UD12V). This system transfers incoming solar radiation to sensible heat inside a thin, flat, transparent panel; the hot air is then driven through ducting by a fan and 12V photovoltaic panel to the surface of the excrement pile. The $0.5m^2$ solar hot-air panel, 100-cubic-feet-minute (CFM) fan, and 5W photovoltaic panel were purchased from Clear Dome Solar (San Diego, CA). We designed our own solar dehydrating toilet system based on Arnold's (2010) design (see Figure 1C). The third system combined urine diversion with a 110V 800W heater and a 110V 110 CFM blower and exhaust fan inside an insulated chamber (UD110V) (see Figure 1D). The toilet closest to the Kain Hut was chosen for UD110V due to its proximity to 110V outlets. The basement chamber at this toilet was insulated with 4-cm (1.6 in.) thick Styrofoam boards. Data were collected during two sample periods in August and September, during which time access to the other toilets was restricted so as to account for all toilet uses. BFO, UD, and UD12V treatment systems were established at the lower two toilets for three-to-six-day periods, according to following schedule: BFO/BFO, August 14–18; BFO/UD12V, August 18–20; UD/UD12V, September 4–10; BFO/UD, September 14–19. During these sample periods, access to the UD110V upper toilet was restricted as much as possible without creating lines so as to maximize the use in the lower toilets and ensure no preference or bias was occurring in toilet selection (e.g., upper toilet for urination, lower toilets for defecation). In addition, hut visitors were instructed to use all available toilets equally during their stay so as to ensure an even and unbiased distribution of toilet use (e.g., potential preference for left vs. right).

In order to determine mass reduction performance with respect to the standard BFO, we recorded the number of door counts at 6 to 24 hour intervals over the course of the 3-to-6-day sample periods. The interval and period length depended on the intensity of hut visitation; we increased sampling intensity with increased visitation. We targeted 10–30 toilet uses per interval in order to maximize the number of intervals, while minimizing differentiable mass change at the collection barrel below each toilet. Change in barrel mass was determined by weighing the collection barrel with a veterinary pet scale before and after each sampling. Door counters were EPC-MAG1 model made by Inter-Dimensional Technologies, Inc. (Hop Bottom, PA). A 10-second delay function was employed in order to eliminate erroneous readings caused by wind or door-closing errors. We subtracted the unit's final count from its initial and divided the difference by two in order to obtain the total toilet uses. Dividing the change in barrel mass by toilet use eliminated the effect of variable sampling interval length and established a robust quantifiable baseline in the assessment of remote site waste treatment performance. A simple mass balance equation was used to quantify performance. Temperature and humidity sensors connected to data loggers (HOBO U12, Onset Computer Corp.) were used to collect ambient and treatment system air temperature and relative humidity data. Wind speed at the outlet of the ducting above the barrel was measured with a Kestrel 4500 (Nielsen Kellerman).

All three alternative treatment systems were tested twice. BFO was tested

three times. Combined, there were nine treatment runs conducted between August and September 2010. Each run was divided into three to six sample periods. Measurements with fewer than five toilet uses per sampling period were not used in order to reduce variability.

JMP 9 (SAS Institute) was used to analyze our data. For all statistical tests, the alpha value was set at 0.05. One outlier was removed from the BFO treatment dataset after it was discovered that a dysfunctional door latch caused an overestimation of toilet use. No other alterations or transformations were made or required for the data analysis.

Results

The installation of the urine-diversion seat and urinal required one hour (see Figures 1A and 1B). The solar hot-air system was tested prior to installation on August 16 on an exposed meadow adjacent to the Kain Hut. The sky was cloudless and winds were calm over the course of the day. The solar hot-air panel consistently raised the air temperature and reduced the relative humidity for eight and a half hours by an average of +10°C and –14%, respectively, with a maximum heating of +15°C and drying of –19%. Wind speeds at the outlet of the vent varied from 0–3 m/second (0-9.8 ft/ second). The solar hot-air system required eight hours to plan and install at the lower toilet site (see Figure 1C). Over the course of two sample periods spanning four days, the treatment consistently raised the air temperature and reduced the relative humidity for 6.8 hours per day. The hot-air panel produced a maximum of 3 m/second (9.8 ft/ second) air flow, heating of +7°C, and drying of –18%.

UD110V system assembly and testing required 15 days. During a representative 20-hour sample interval, the system increased the average basement temperature and reduced the relative humidity by an average of +24.7°C and –44%, respectively, up to a maximum of +30.5°C and –63%. The system averaged an actual temperature of 31°C and 17% relative humidity.

Change in barrel mass per toilet use data were compared between sampling periods within treatment type with robust, rank sum, nonparametric Wilcoxon Kruskal-Wallis tests; none of the treatment runs was significantly different. Therefore, in order to increase sample sizes, we grouped treatment runs into treatment types (see Figure 2). The relationship between mean change in excreta mass per toilet use by treatment type was significant ($p<0.0001$), with largest mass associated with BFO toilets (median = 0.27 kg/use; 0.60 lb./use), followed by UD (median = 0.11 kg/use; 0.24 lb./use), UD12V (median = 0.086 kg/use; 0.19 lb./use), and UD110V (median = 0.009 kg/use; 0.02 lb./use).

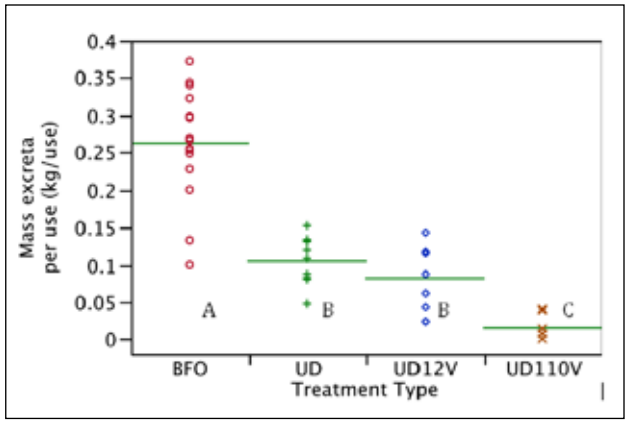

Figure 2 – Mass of excreta mass per toilet use by treatment type (kg/use) (wet solids). Data are measurements from each 24-hour interval over the summer. Significantly different treatments denoted with different letters (A, B, C) as determined by pair-wise comparisons using the Wilcoxon method (a=0.05).

Discussion

The median values of urine mass/toilet use (feces mass/toilet use subtracted from excreta mass/event), feces mass/toilet use (UD mass/use), and excreta mass/toilet use (BFO mass/use) were found comparable to values from other locations (see Table 1). Urine volume reported here was slightly lower than for other studies, but this could be explained by the remote location. All site visitors are required to ascend >1000 m (3,280 ft.) in elevation to access the facility, and the main activities include hiking and mountaineering, both of which are likely to induce dehydration. Fecal mass reported here is on par with fecal mass of the average European/ North American (see Table 1). The fecal mass we reported might also be slightly elevated due to the assumption that all matter collected in the UD treatment was fecal matter; it is likely that a small fraction of urine bypassed the urine-diverting seat and urinal. If the efficiency of urine diversion was 90%, the fecal mass/toilet use would drop to 99 g/use (3.5 ounces/use) and the urine mass/use would increase 176 g/use (6.2 ounces/use), bringing our values closer into the middle range of these studies.

Our results indicate that with the addition of a urine-diversion seat and urinal, up to 0.16 kg (0.35 lb.) can be eliminated from the barrel fly-out system. This equates to a 60% reduction in barrel fly-out mass. Equipped with urine-diversion equipment, each barrel will hold 2.5 times as many excrement deposits as compared with standard all-in-one barrel collection systems, greatly reducing the total numbers of barrels filled at each site.

A urine-diversion seat and plastic urinal costs less than $200CDN and is simple and quick to install. The urinal was easier to maintain than the urine-diversion seat, which occasionally became clogged with toilet paper. After such events the toilet was inoperable and posed a health hazard for other toilet users and required cleaning, which was done by the on-site hut custodian. More research and development are needed to develop low maintenance public-utility urine-diversion systems (Shiskowski 2009). There are two commercial urine diversion products that are likely to require less regular maintenance: an inclined foot-operated treadmill (Ecosphere Technologies, France) and the adhesion and gutter systems (NatSol Ltd., Wales), but neither is available commercially in North America. The first author has filled the need for public-utility urine-diversion technology in North America by designing two system: the TTS-Basic and the TTS-Mechanical (Toilet Tech Solutions, Squamish, BC), but testing is required to verify long-term performance.

Urine could be diverted into pre-existing gray-water systems for dilution and to reduce the chance of struvite precipitation and potential flow constriction. Sites without a preexisting gray-water treatment system would need to design and construct a leach field according to local septic field codes to ensure sufficient soil surface area to attenuate nutrients and low levels of pathogens given estimate flows of urine (Steinfeld 2007). For sites that generate more than three barrels of excrement per year (the max load of a Bell 407), installing a UD system could reduce the total cost of barrel removal by 60%.

With nonsignificant differences between UD and UD12V, we are unable to conclude whether solar dehydration is a viable waste reduction treatment. Given labor and capital costs to set up and take down the dehydrating equipment and variable weather conditions that would reduce the efficacy of the dehydrating system, we do not think dehydration through this type of retrofit is likely to be a reliable solution for these alpine areas. More effective commercial toilet systems maximize the surface area of fecal matter and the time it is exposed to a desiccating environment; the best example of this is the cloth bagging carousel systems developed by Ecosphere Technologies where a urine-diverting treadmill moves fecal matter onto the surface of a rotating carousel (where cloth bags hang), ensuring subsequent fecal deposits do not cover up the most recent additions, and even those buried can desiccate through the cloth fabric.

The UD110V treatment had the lowest mean excreta mass per toilet use but is the most inappropriate system for most wilderness toilets due to its reliance on electrical power and constant maintenance. This toilet also had the greatest degree of sampling error, being closest to the hut and likely used most frequently for quick urination trips at night and the lowest number of sample intervals. These factors lead us to place low confidence in the data from this treatment and the practicality of this waste management system. Instead, we suggest further research should be conducted on commercially available dehydrating toilet systems, which reportedly can dry material with only solar energy, to the point at which it can be burned on-site (Neau, pers. comm. 2012).

Fecal matter must have <15% moisture content before it is easily burnable (Pretzsch, pers. comm. 2010); applying this to the average wet fecal deposit measure here of 110 g/toilet use (3.9 ounce/use), the estimated desiccated end product would need to be <16.5 g/toilet use (0.58 ounce/use), which is slightly higher than the result obtained in the UD110V of 8.6 g/toilet use (0.3 ounce/use). However, we attempted to burn the end product of the UD110V treatment on-site with a portable SmartAsh cyclonic incinerator by Elastec (Carmi, IL) without success,

Table 1—Range/Median Urine, Feces, and Excreta Mass Per Toilet Use. Modified from Schouw et al. (2002)

Location	Urine range (g/toilet use)	Feces range (g/toilet use)	Excreta range (g/toilet use)	References
Vietnam	164–240	87–93	198–267	Polprasert et al. (1981) in Schouw et al. (2002)
Developing nations	240	87–347	290–310	Feachem et al. (1983) in Schouw et al. (2002)
Europe/ North America	240	67–133	270	Feachem et al. (1983) in Schouw et al. (2002)
Thailand	120–240	80–267	188–306	Schouw et al. (2002)
Canada backcountry	160*	110*	270	This study

*Assumes UD efficiency was 100%.

Table 1 – Range/median urine, feces, and excreta mass per toilet use. Modified from Schouw et al. (2002) by dividing reported generation rate of urine, feces, and excreta per person per day by the average number of urination events per person per day (5), average number of fecal deposits per day (1.5), and estimated average number of excreta events per day (5).

casting doubt on the ability to burn desiccated fecal matter. More research is needed to verify the claims that this material can be incinerated on-site. If validated, this treatment would result in the lowest mass/toilet use, management exposure, and off-site transport cost.

Diverting urine away from the collections barrel resulted in a much thicker residual material, which did not slosh when dragged out from under the toilet. This is an important aspect of waste management, as park visitors are required to exchange full barrels for empty ones at many wilderness sites managed by the Alpine Club of Canada. Full barrels of conventional excrement are predominantly urine and are difficult and hazardous to handle but easier for the septic truck to evacuate. The evacuation of the urine-diverted barrel took four times as long (20 minutes as opposed to a standard 5 minutes) and required an equal volume of added water to waste. The success of this step was critical in proving the benefits of urine diversion in this context. Septic truck costs ($225CDN/hr.) are much lower than helicopter costs ($2,000CDN/hr). Many septic trucks carry water tanks. Nevertheless, until a reliable urine-diversion system becomes available, urine should be diverted only from urinals to prevent toilet-seat clogging issues.

Discharged urine will have a plant fertilization effect favoring grasses, sedges, and deciduous shrubs and is not likely to enhance invasive species (Bowman et al. 1995; Wang et al. 2010; Ells and Monz 2011). Competition for nutrients found in urine – by both microbes and plants – is strong, and risk of leaching nitrogen into water bodies is low if unsaturated soil is discharged into, even in alpine and Arctic soils (Brooks et al. 1996; Jones and Murphy 2007). Nitrogen loading rates should be kept below 430 kg/ha (384 lbs./acre) in grassland soils to ensure ammonia does not build up in the soil, thereby inhibiting microbial processes as occurs with high concentrations of cattle urine (Orwin et al. 2010). These findings come from experimental studies simulating the effects of climate change, snow-cover change, or land-use change. To the best of our knowledge, no studies on the impacts of human urine diversion have been conducted, and more research on this topic is necessary before urine diversion becomes common practice.

Many wilderness destinations in the Canadian Rocky Mountains are used for winter travel. Fortunately, nutrient uptake even occurs in winter in both alpine and Arctic tundra under snowpacks (Bilbrough and Welker 2000; Schimel et al. 2004). There is some concern with frozen urine causing blockages in pipes or at the discharge point, but pilot projects have demonstrated this concern is limited when plumbing runs are short, piping is of appropriate diameter, and discharge occurs under snow (insulating) (Neau, pers. comm. 2012).

Conclusion

The majority of urine can be diverted from fecal matter in barrel fly-out toilets, resulting in considerable operation and maintenance cost reduction. Further reduction in moisture content by dehydration was not efficient, but further research on commercial dehydration systems may prove otherwise. Urine diversion can also benefit the other common toilet systems. If pit toilets were modified to isolate fecal matter from groundwater and urine were diverted and discharged to surface aerobic soil, the risk of pathogen transmission to groundwater would be eliminated without much increase in operation and maintenance costs. Urine diversion can also render feces into a suitable feedstock for vermicomposting (Yadav et al. 2010) and presumably other forms of invertebrate decomposition. Vermicomposting is a low-temperature process that requires very little management, making it suitable for treatment of fecal matter at wilderness locations, reducing total mass, volume, pathogen content, and handling risk (Yadav et al. 2010; Hill and Baldwin 2012). However, urine-diversion seats proved unreliable as a public utility.

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Motivations to Visit Designated Wilderness at Cumberland Island National Seashore

BY MATTHEW T. J. BROWNLEE and JEFFREY C. HALLO

Abstract: Evaluating wilderness visitors' motivations to use a specific area is important because effective management requires understanding visitors' opinions and behavioral drivers. However, most wilderness managers do not possess fundamental information about the characteristics of their visiting population, including their motivations for use. In 2010, researchers conducted a study of visitors (n = 329) to Cumberland Island National Seashore (CUIS) wilderness to explore their motivations to visit. Results indicate people use CUIS wilderness for five distinct reasons and that these motivations relate to visitors' characteristics, elements of the visitor experience, and perceived crowding. The authors discuss two implications stemming from this study: (1) using motivations to visit as one method to inform site-specific recreational zoning, and (2) using motivations to assess visitors' potential responses to site changes and management action.

In 2010, researchers conducted a study of visitors to Cumberland Island National Seashore (CUIS) designated wilderness area to explore motivations to visit and whether these motivations related to visitors' residence proximity to CUIS, repeat visitation level, trip length, and perceived crowding. Evaluating motivations to visit an area is important because effective management of outdoor recreation, in areas such as designated wilderness, requires understanding visitors' opinions and behavioral drivers (Hendee and Dawson 2002; Manning 2011). However, wilderness visitors are diverse, and one example of diversity is represented in the types and degrees of motivations to visit (Cole 2012). According to Cole (2012), many motivations to visit exist, but some are more notable than others. Some people visit for spiritual experiences (Heintzman 2010, 2012) or personal growth (Priest and Gass 2005), to experience adventure and risk (Brown and Haas 1980), to socialize with friends (Anderson et al. 2008), or because of accessibility or cost (Ewert 1998).

Matthew T. J. Brownlee. Photo by Matthew Brownlee.

Jeffrey C. Hallo at Denali National Park, Alaska. Photo by Martha Manning.

Regardless of the diversity of motivations, some variables are common (although to different degrees) among all wilderness visitors, such as residence proximity to the area, repeat visitation to the area, and trip length. These elements are often recorded on wilderness permits and are readily available to managers. Understanding how these elements relate to motivations is one way managers can identify

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potential support for management actions in response to environmental and experiential conditions. For example, Andereck and Knopf (2007) found that outdoor recreationists seeking social experiences in wilderness settings perceived impacts to water, soil, and experiential conditions (e.g., crowding) differently from those motivated to visit for natural or educational reasons.

Although the connections between visitor and trip attributes (such as residence proximity, repeat visitation, trip length, perceptions of crowding) and motivations have management implications, these relationships are not fully understood. For example, Hall, Seekamp, and Cole (2010) indicate that although some studies identify motivations to visit, most do not examine the connections between motivations and other variables (such as perceptions of crowding). Other researchers contend the relationships between motivations to visit, repeat visitation, and residence proximity should be further investigated (Anderson et al. 2008). Cole and Wright 2004 report only 24% of wilderness managers possess fundamental information about the characteristics of their users, including motivations to visit.

Therefore, this study addresses two needs. First, it provides CUIS managers with information about wilderness visitors, including their different motivations to visit. Second, it helps address the gap in the literature regarding the relationships among motivations to visit, residence proximity, repeat visitation, trip length, and perceptions of crowding.

Motivations to Visit Wilderness

Motivations can be segmented into experiential, external, interpersonal, and intrapersonal categories. The experiential category includes motivations such as a desire to experience nature, adventure, risk, exploration and discovery, and to receive inspiration (Dawson et al. 1998; Ewert 1998). Others indicate that challenge and closeness to nature are important experiential factors in wilderness experiences (Anderson et al. 2008; Patterson et al. 1998).

External factors such as visitors' residence proximity to designated wilderness or trip costs may motivate use of a specific area. Ewert (1998) found that accessibility and low cost were identified as strong motivators for visitors. Also, residence proximity to a wilderness area or natural park is influential when making decisions to visit (Fesenmaier 1998; Perdue 1986).

Interpersonal factors, such as spending time with family or friends, are salient motivators for engaging in activities in natural environments (Russell 2009). Although, experiencing solitude is a hallmark of wilderness experiences (Hendee & Dawson 2002; Nash 2001), social interaction has been found more important for some nature-based recreationists (Anderson et al. 2008). Also social interaction can be related to resident proximity, with individuals who live closer to the outdoor recreation area reporting social interaction as significantly more important (Fesenmaier 1988; Perdue 1986).

A substantial amount of literature indicates that people may be motivated to visit wilderness to facilitate intrapersonal benefits, such as spiritual growth, personal reflection, and restoration of self. Fredrickson and Anderson (1999) found that individuals in a structured trip experienced empowerment, feelings of hopefulness, and spiritual inspiration. Ewert (1998) indicates that some reported a spiritual experience as a motivating factor for visiting wilderness. Others assert that wilderness experiences can enhance self-identity (Williams, Haggard, and Schreyer 1989) and provide opportunities for spiritual outcomes (Heintzman 2012).

Research Questions

Based on gaps in the literature and managers' need to understand motivations to visit CUIS, the researchers investigated three primary questions:

R1: Do visitors possess different motivations to use designated wilderness at CUIS? If so, what are the differences in their types and levels of motivations?

R2: What are the relationships between motivations to visit and residence proximity, repeat visitation, and trip length?

R3: Do different categories of motivations (e.g., interpersonal, external) relate to visitors' perceptions of crowding?

Description of the Study Area

CUIS is Georgia's largest barrier island. Access to the island is by boat only, and most visitors reach CUIS via a National Park Service (NPS) concessionaire ferry service. The island is approximately 17 miles (27.4 km) long, and 3 miles (4.8 km) wide, with more than 50 miles (80.6 km) of hiking trails traversing sand dunes, maritime forests, salt marshes, and freshwater swamps (see Figure 1). The wilderness area on Cumberland Island was designated in 1982 and encompasses 9,886 acres (4,002 ha), which is managed by the NPS (CUIS 2010). Backpacking is the main visitor activity, and the area houses numerous established campsites.

Methods

Researchers mailed a paper questionnaire to past CUIS wilderness visitors (2008–2009) using a three-stage

Figure 1 – Photo by J. Adam Beeco.

multiple mailing procedure (Dillman 2007). Postal addresses were obtained from backcountry permits, and the questionnaire contained multiple inquiries about perceptions of crowding and a matrix of 18 items that measured motivations to visit. These 18 items have been used in previous studies with wilderness visitors (e.g., Ewert 1998), and the current researchers suspected the items represented multiple motivation categories. Also, these items represented a diverse, well-accepted understanding of existing wilderness motivations. Respondents rated each motivation item using a four-point scale anchored with "did not influence (1)" and "strongly influenced (4)." The researchers used a four-point scale without a neutral category in order to influence respondents to provide a directional response.

During data analysis, the researchers first performed an Exploratory Factor Analysis (EFA) to assess how well the 18 motivation items represented different categories of motivations found in the literature (e.g., experiential, interpersonal, intrapersonal, external). The research team followed standard procedures (e.g., Fabrigar et al. 1999; Tabachnick and Fidell 2007; Vaske 2008) to evaluate the measurement properties of (1) each item (e.g., factor loadings and variance), (2) the entire scale (e.g., reliability coefficients, percent of variance explained), and (3) each item's relationship with other items (e.g., cross loadings and convergent validity). Next, each respondent was assigned an individual score (i.e., a factor score) for each motivation category by summing an individual's response to each item and dividing by the number of items. As a result, each respondent received his/her own score representing the importance of each motivation category. This is a conceptual description of computing factor scores. Factor scoring also uses the differences in loadings to help account for unequal contributions from each item (i.e., weighted sum scores; DiStefano, Zhu, and Mindrila 2009).

During the final step, the researchers used a series of multiple regressions to assess the relationships among motivation categories, residence proximity, repeat visitation, trip length, and perceptions of crowding. The geographic center of respondent zip codes was used to calculate residence proximity (as a function of driving distance to the ferryboat departure). Repeat visitation was measured using a dichotomous variable, which identified respondents who visited more than once in the last five years (i.e., frequent and infrequent visitors). A five-year frame was used because it helped distinguish a recent recurring visitor in an objective and comparable manner. Following practices in other studies (e.g., Manning 2007), visitors' perceived crowding at CUIS was measured using a nine-point Likert scale (1 = not crowded at all; 9 = extremely crowded).

Results

As a result of the mailing procedure, 329 of the 489 eligible participants returned a completed questionnaire, yielding a response rate of 67.3%. The EFA results indicate that visitors potentially consider five categories that are divided conceptually and statistically when reporting motivations. Although diverse motivations exist beyond what is presented here, the five categories identified in this study align well with the motivation categories in the wilderness literature (experiential, external, interpersonal, and intrapersonal). Specifically, people are motivated to visit CUIS to (1) experience nature (experiential), (2) realize personal benefits (intrapersonal), (3) participate in social relationships (interpersonal), (4) seek adventure (experiential), and (5) capitalize on convenience (external). The importance of each motivation category is significantly different among visitors

Table 1 – Exploratory Factor Analysis results with the means and standard deviations of motivations to visit.

	λ*	*M* (SD)[b]	RHO[a]	% of variance (Eigen)
Nature (experiential)	—	3.69 (0.40)[b]	0.81	11.49% (2.30)
View scenery	0.60	3.79 (0.43)	—	—
Close to nature	0.66	3.79 (0.44)	—	—
Pristine, clean area	0.60	3.71 (0.54)	—	—
Absence of human-made objects	0.51	3.56 (0.72)	—	—
Wildlife watching	0.67	3.52 (0.73)	—	—
Personal benefits (intrapersonal)	—	3.12 (0.70)[b]	0.78	8.22% (1.65)
Solitude	0.63	3.70 (0.65)	—	—
Escape routine	0.66	3.33 (0.83)	—	—
Slow my mind down	0.83	3.00 (1.02)	—	—
Spiritual experience	0.56	2.47 (1.18)	—	—
Social (interpersonal)	—	2.94 (1.02)[b]	0.77	6.32% (1.26)
Do something with others	0.84	2.98 (1.20)	—	—
Recreate with family and friends	0.80	2.93 (1.20)	—	—
Adventure (experiential)	—	2.80 (0.79)[b]	0.83	26.65% (5.33)
Adventure	0.57	3.60 (0.70)	—	—
Risk and challenge	0.77	2.92 (1.05)	—	—
Personal achievement	0.80	2.70 (1.13)	—	—
Preparation for future trip	0.72	2.20 (1.15)	—	—
Convenience (external)	—	2.12 (0.86)[b]	0.84	6.70% (1.34)
Low cost	0.71	2.73 (1.07)	—	—
Easy to get to	0.83	1.91 (1.06	—	—
Short drive	0.79	1.77 (1.01)	—	—

Note: λ = standardized factor loadings derived using a Maximum Likelihood Extraction with an Oblique Promax Rotation; rotated solution displayed.
[a]Reliability coefficient RHO is an adjusted Cronbach's Alpha to account for unequal contributions from the items. The RHO for the entire scale was 0.91.
[b]All composite means for wilderness use motivation categories differ significantly from each other at $p < 0.01$.

(see Table 1; all composite means for motivation categories differ significantly from each other at $p < 0.01$). Visiting for experiential reasons (e.g., nature: to view scenery, be away from human-made objects, watch wildlife) was reported as the highest motivation ($M = 3.69$) and visiting for external motivations (e.g., convenience: low cost, short drive) was least important ($M = 2.12$). Interpersonal motivations (e.g., social: do something with others, recreate with family and friends) had the largest standard deviation (1.02), indicating that large differences about the importance of this category exist among visitors.

The mean residence distance from CUIS was 354 driving miles, and 50% of the respondents reported living within 268 miles of CUIS. Only the motivation categories of adventure and convenience were significantly related to residence proximity. The closer a visitor lives to CUIS (higher residence proximity), the more influential using the area for adventure is reported as being in deciding to visit ($\beta = 0.14$, $p < 0.05$). Visitors with higher residence proximity to CUIS reported convenience as more influential in their decision to visit ($\beta = 0.20$, $p < 0.01$).

The majority of respondents (60.5%) reported visiting more than once in the last five years (i.e., frequent visitors). Using CUIS wilderness for personal benefits seems more important for frequent visitors than infrequent users ($\beta = 0.12$, $p < 0.05$). The same appears true for the categories of nature and adventure, which are more important for frequent visitors $\beta = 0.15$, $p < 0.05$; $\beta = 0.12$, $p < 0.05$, respectively).

Visitors reported spending one to eight days in CUIS wilderness, with an average trip length of 3.23 days ($SD = 1.26$). Visitors with shorter trip lengths reported social motivations as more important ($\beta = -0.16$, $p < 0.05$). No other motivation categories were significantly related to trip length.

Wilderness at CUIS is managed to provide opportunities for solitude, and therefore visitors' perceptions of crowding is important evaluative feedback regarding desired management goals. Visitors reported experiencing limited crowding during their experience ($M = 2.96$ out of 9; SD = 2.86). However, visitors who expressed

Table 2 – Relationships between residence proximity, repeat visitation, trip length, and wilderness use motivations.

	Residence proximity β *(t)*	Repeat visitation β *(t)*	Trip length β *(t)*
Nature	—	0.15* *(2.46)*	—
Personal benefits	—	0.12* *(1.97)*	—
Social	—	—	— 0.16** *(–2.58)*
Adventure	0.14* *(2.36)*	0.12* *(1.96)*	—
Convenience	0.20** ***(3.01)***	—	—
R^2	0.19	0.24	0.21

Note: β = standardized regression coefficients; *t* = t-values; obtained from a series of multiple regressions. *$p < 0.05$; **$p < 0.01$

experiencing nature as important to their visit reported a higher perception of crowding at CUIS (β = 0.24, $p < 0.05$). Visitors reporting personal benefits and adventure as important motivations reported higher perceived crowding (β = 0.14, $p < 0.05$; β = 0.16, $p < 0.05$, respectively). Residence proximity and trip length were not significantly related to visitors' perception of crowding ($p > 0.05$).

Table 3 – Relationships among wilderness use motivations, residence proximity, trip length, and perceived crowding.

	Perceived crowding β *(t)*
Nature	0.24* *(3.13)*
Personal benefits	0.14* *(1.87)*
Social	—
Adventure	0.16* *(2.13)*
Convenience	—
Residence proximity	—
Trip length	—
R^2	0.19

Note: β = standardized regression coefficients; *t* = t-values; obtained from a multiple regression; perceived crowding was measured using a nine-point Likert scale (1 = not crowded at all; 9 = extremely crowded). *$p < 0.05$.

Discussion

The results identified in this study align with the motivation categories in the previous literature regarding wilderness experiences (experiential, external, interpersonal, and intrapersonal). This study also found that people are motivated to visit CUIS wilderness to (1) experience nature (experiential), (2) realize personal benefits (intrapersonal), (3) participate in social relationships (interpersonal), (4) seek adventure (experiential), and (5) capitalize on convenience (external).

Visitors who live close to CUIS reported adventure and convenience as significant motivators to visit. The relationship between the importance of adventure and residence proximity could be a function of the recreation focus and metropolitan development in the region. The coastal region where CUIS is located possesses an abundance of outdoor recreation opportunities, such as fishing, sailing, and kayaking. Also near CUIS are large urban areas such as Atlanta, Georgia, and Jacksonville, Florida. Visitors residing close to CUIS may visit to continue their nature-based adventure aspirations (e.g., kayaking and sailing) and also escape these metropolitan areas.

Frequent visitors were more likely than infrequent visitors to report the categories of nature, adventure, and personal benefits as important factors influencing their decision to visit CUIS. Perhaps individuals with more frequent visits to CUIS wilderness have realized the experiential and intrapersonal benefits of wilderness experiences and are therefore motivated by these factors to return. Visitors with short trip lengths reported that recreating with family and friends or doing something with others influenced their decision to visit. This may indicate visitors with short wilderness trips may focus more on the intragroup processes and social outcomes than on resource conditions or the physical components of the activity.

Crowding at high-use wilderness areas is often cited as a primary management concern (Cole and Hall 2007) and in this study, visitors who expressed nature, personal benefits, and adventure as important motivations to visit reported experiencing more crowding. This suggests that wilderness visitors with these specific motivations may be more sensitive to crowding. Additionally, residence proximity and trip length did not relate to perceived crowding in this study. This suggests that managers and researchers may need to evaluate visitors' motivations to fully understand perceptions of crowding.

Although this study revealed different categories of motivations and correlations with visitor and trip characteristics, limitations do exist. First, the study is cross-sectional, representing a set of responses regarding one experience. It is likely that some motivation categories may vary in importance during different visits by the same individual (e.g., backpacking as a family in the spring season vs. backpacking solo in the fall season). Second, respondents received the questionnaire at home after their visit, and this delay in time and distance from CUIS may influence recollections and perceptions. Third, the motivation items investigated here were adopted from a previous study and do not represent the full breadth of motivation categories. Finally, potentially important visitor and trip characteristics were not included in this study (e.g., age, education, miles hiked, days spent annually in wilderness areas), which may have relationships with motivation categories.

Implications for Management

Management of designated wilderness is bound by numerous legal and fiscal considerations (Hendee and Dawson 2002), and it is not always feasible or appropriate to incorporate visitor motivations or preferences into all management decisions. However, this study provides two major implications

for managers and researchers of wilderness to consider: (1) using motivations to visit as one method to inform recreation zoning, and (2) using motivations to assess visitors' potential responses to management actions.

Wilderness use motivations to inform recreation zoning: Wilderness visitors' motivations to recreate at CUIS varied, which may require intrasite zoning to accommodate different motivation categories. For example, the categories of nature, adventure, and personal benefits were positively related to repeat visitation and perceived crowding (see Figure 2). This suggests that frequent visitors may desire settings that allow for connections with nature, opportunities for challenge and adventure, and the realization of personal benefits. Therefore, managers may need to purposefully zone areas to provide longer and more challenging trails and remote camping locations, with limited crowding, to accommodate these desires.

The social category was related to shorter trip lengths, and convenience was related to residence proximity, which may indicate that some visitors may desire shorter trip lengths to more accessible wilderness locations where the social element of wilderness experiences can be the focus. Creating and zoning areas where camping locations are close to access points (e.g., trailheads), and shorter (e.g., two-day) circular routes could potentially accommodate these visitors' motivations. Managers at CUIS could potentially identify existing zones that accommodate combinations of all five motivation categories. This prescriptive and intentional zoning informed by knowledge of visitors' motivations may increase the enjoyment of the visitor experience, which is a primary management goal and a component of the Wilderness Act of 1964.

Motivations and potential responses to management action: Knowledge of visitors' motivations can help managers identify groups who may be sensitive to specific management actions or changes occurring in or near a wilderness area. For example, opposition to increased fees for backcountry permits may exist for visitors motivated because of convenience (low cost is one component of convenience). If visitors are motivated to visit to experience nature, they may be more sensitive to crowding resulting from increased backcountry use or encroaching development. Also, visitors who are motivated by experiential (e.g., being close to nature) and intrapersonal categories (e.g., spiritual experiences) may be more sensitive to NPS vehicles patrolling the beach area in or near wilderness. Therefore, managers could use knowledge of visitors' motivations to identify and respond to groups sensitive to inter- and intrasite influences, which could help predict and prevent conflict between managers and visitors.

Conclusion

Wilderness visitors have diverse motivations to use a specific area, and these motivations relate to residence proximity, repeat visitation, trip length, and perceived crowding. As Cole and Wright (2004) reported, approximately three-quarters (76%) of wilderness managers do not have basic information about their visitors, including their motivations to visit. Additionally, changing desires of contemporary wilderness visitors (Hallo and Manning 2010) suggests a further need to comprehensively understand the visiting population. Assessing motivations to visit wilderness has the capacity to inform management decisions regarding recreational zoning, crowding-related issues, and intra- and intersite changes. Therefore, a better and more thorough understanding of wilderness visitors' motivations, throughout the National Wilderness Preservation System, may assist managers as they continue to provide high quality visitor experiences while protecting the resource.

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Understanding of wilderness visitors' motivations ... may assist managers as they continue to provide high quality visitor experiences while protecting the resource.

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Wilderness Managers, Wilderness Scientists, and Universities

A Partnership to Protect Wilderness Experiences in the Boundary Waters Canoe Area Wilderness

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The Boundary Waters Canoe Area Wilderness (BWCAW) in northern Minnesota has a rich history of advocacy for protection as wilderness. In the 1950s, Sigurd Olsen best described the song of the wilderness in Minnesota's north country: "I have heard the singing in many places, but I seem to hear it best in the wilderness lake country of the Quetico-Superior, where travel is still by pack and canoe over the ancient trails of the Indians and the voyageurs" (Olson 1956, p. 6).

Perception of this place as wilderness extends back to well before the passage of the Wilderness Act. Of all wildernesses in the United States, the BWCAW has probably been under the eye of the public, Congress, and the Forest Service more than many others. Not everyone agreed with the restrictions on motorboats, snowmobiles, logging, and mining that wilderness designation eventually brought with it, and there have been many contested policy decisions, ranging from group size limits to permit quota systems and restrictions on glass containers and designated camping sites. The BWCAW also has a rich history of policy adjustments, legislative oversight, and scientific understanding of the threats to the wilderness character of this special place.

The BWCAW, at 1,086,953 acres (440,062 ha), is the largest designated wilderness in the two eastern regions of the Forest Service. Located on the Superior National Forest, the BWCAW was officially designated as part of the Wilderness Act of 1964, and then enlarged in 1978 by the BWCAW Act and many incompatible uses were restricted. Researchers from the Forest Service and academic partners had been collaborating with managers in conducting research on use, distribution of use, and impacts of use well before it was officially designated wilderness (e.g., Lucas 1964).

In 1969, Stankey conducted a broad baseline visitor study at the BWCAW for his dissertation at Michigan State University, which was completed in 1971 (Stankey 1971), and later as part of a Forest Service Research Publication in 1973 (Stankey 1973), which combined results from several wilderness visitor studies. Based on research by Peterson and Gilbert (1971), a travel simulation model was established and later updated to establish launch point quotas based on maximum campsite occupancy level predictions within zones of the wilderness.

In 1991, during an era when adjustments to quotas were evaluated, group size limits were proposed to be reduced, and many proactive regulations and education efforts were implemented to protect this unique resource from increasing use, Forest Service scientists – collaborative

with scientists at the University of Minnesota – again provided an update to trends in use and users and their perceptions of wilderness conditions (Cole et al. 1995) as well as examination of likely impacts of proposed management changes (Watson 1995).

In 2007, a team consisting of Superior National Forest managers, Forest Service scientists, and academic partners realized the need and the opportunity to update information on trends in use and users and their perceptions of wilderness conditions as well as explore many new challenges facing managers at the BWCAW. For instance, the overnight recreation user fees that had been implemented, changes in the permit distribution process, and the impact of large-scale disturbances (fire and blowdowns) were explored to provide baseline information on these newer issues managers faced.

In Dvorak et al. (2012), a detailed analysis of these changes since studies in 1969 and 1991 was provided to help managers, the public, academia, and other interested parties understand some of the major changes in use and users and their perceptions of wilderness conditions at the BWCAW. BWCAW overnight visitors remain predominantly white, male, and well educated, but the proportion of full- or part-time students has decreased dramatically. The average age of adult visitors increased throughout the years of these investigations (25 years in 1969, 35 years in 1991, and 45 years in 2007). Visitors have a great deal of wilderness trip experience in the BWCAW now and in other wilderness areas as well, with relatively few being first-time visitors to the area. Visitors report seeing significantly more groups while on their trips now compared to previous years and visits (an average daily encounter rate of almost nine groups per day is double even that reported in 1991). Although these intergroup encounter rates are mostly within the expectations visitors have for the area (more than half in 2007 said these higher encounter rates were about at the level they expected), only 38% felt conditions were not overcrowded, compared to 72% in 1969 and 44% in 1991.

The USDA Forest Service Chief's 2012 Award for Excellence in Wilderness Stewardship Research went to the team of managers (Ann Schwaller), Forest Service scientists (Alan Watson), and academic cooperators (Bob Dvorak, Neal Christensen, and Bill Borrie) that are again trying to make the best science available to managers making decisions at the BWCAW. This award recognizes the continued efforts of these managers, Forest Service scientists. and academic partners to "help the Forest Service be more effective in addressing wilderness stewardship and meeting the intent of the Wilderness Act, the 10-Year Wilderness Stewardship Challenge, and forest plan standards."

Collaboration continues at the BWCAW to further examine the effects of changes in users, their travel patterns, and management strategies. There are many other wildernesses that have benefited from the rich exchange of ideas and knowledge among our managers, our federal scientists, and our academic partners. In times of reduced budgets, shifting demographics, increasing presence of new technologies, and increasingly important benefits from protection of wilderness resources (Watson 2011), renewed emphasis on building relationships between managers, federal agency scientists, and academic partners has never been more important.

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Announcements

COMPILED BY GREG KROLL

Bolivian Oscar Loayza Receives Kenton Miller Award

Oscar Loayza of the Wildlife Conservation Society's Madidi program in Bolivia was presented with the Kenton Miller Award for Innovation in Protected Areas Management (*IJW* Digest, April 2012) at the International Union for the Conservation of Nature's (IUCN) World Conservation Congress in South Korea in September 2012. A US$5,000 stipend accompanies the award.

Loayza, who works with the Greater Madidi-Tambopata Landscape Conservation Program, was chosen by an international jury for his development of initiatives that strengthened indigenous participation in the management of protected areas, leading to improved governance in a region challenged by large infrastructure projects, roads, dams, oil exploration, and small-scale mining.

Loayza's efforts in Madidi National Park, one of the world's most biodiverse protected areas, promoted alliances between the Bolivian Park Service, conservationists, and indigenous peoples, building on Bolivian government policies to consolidate indigenous territorial and representation rights. IUCN's World Commission on Protected Areas chair Nik Lopoukhine said, "[Loayza's] innovative approach to governance of protected areas has ensured that not only do indigenous people participate in the process, but they are empowered and become an integral part of it." (Source: International News Service, September 13, 2012)

U.S. Forest Service Announces 2012 National Wilderness Award Recipients

Nine awards honoring individuals and groups for excellence in wilderness stewardship, and recognizing outstanding endeavors toward meeting the 10-Year Wilderness Stewardship Challenge, were recently bestowed by the U.S. Forest Service (USFS):

- **Bob Marshall Award, External Champion of Wilderness Stewardship** was presented to Dave Cantrell for being the key architect of the National Wilderness Stewardship Alliance, the first ever national nonprofit organization to create and support wilderness volunteer groups across America.
- **Bob Marshall Award, Internal Champion of Wilderness Stewardship** was conferred upon Adam Barnett, wilderness manager on the Stanislaus National Forest, California, who as chair of the USFS Wilderness Advisory Group secured US$1.5 million in additional funds to support the Wilderness Stewardship Challenge.
- **Bob Marshall Award for Group Champion of Wilderness Stewardship** went to the Santa Fe/Carson Wilderness Stewardship Task Force, New Mexico, for working across both forests to manage the combined seven wildernesses, focusing on campsite inventory, invasive plants, and encounter monitoring.
- **Bob Marshall Award for Partnership Champion in Wilderness Stewardship** recognized Rob Mason and the Selway-Bitterroot and Frank Church Foundation for completing critical trail work, providing more than 28,000 volunteer hours.
- **Traditional Skills and Minimum Tool Leadership Award** honored Wayne Chevalier, Willamette National Forest, Oregon, for demonstrating an unparalleled commitment to using traditional tools in wilderness for more than 22 years. Under his leadership, his trail crew has never used a motorized tool in his district's wilderness.
- **Wilderness Education Leadership Award** was presented to Harry Tullis, Don MacDougal, Dori Brogliano, Deven Hafey, John Neary, Chad Rice, Carl Koch, and Jane Pascoeare of Admiralty National Monument, Tongass National Forest, Alaska, for educating visitors about Admiralty's brown bears and the unique wilderness settings in which they are found.
- **Excellence in Wilderness Stewardship Research Award** went to Ann Schwaller, Robert G. Dvorak, Alan Watson, Neal Christensen, and William T. Borrie for their collaborative research paper identifying trends in use and user characteristics in the Boundary Waters Canoe Area Wilderness.

Submit announcements and short news articles to GREG KROLL, *IJW* Wildernss Digest editor. E-mail: wildernessamigo@yahoo.com

- **Excellence in Research Application Award** recognized the team of Trent Procter, Mike McCorison, Suraj Ahuja, Ricardo Cisneros, Don Schweizer, Andrea Nick, and Glen Shaw of the Pacific Southwest Region Air Quality Program for their hard work regarding air quality monitoring in 61 wildernesses.
- **Excellence in Line Officer Wilderness Leadership** honored Lee Benson, Tongass National Forest, Alaska, for leadership he exhibited in working with his district and forest wilderness managers to advance the Wilderness Stewardship Challenge. (Source: U.S. Forest Service, Washington Office)

The Wilderness Society Defends Green Mountain Lookout

When U.S. District judge John Coughenour ordered the U.S. Forest Service to remove its reconstructed lookout from Green Mountain in the Glacier Peak Wilderness of Washington's Mount Baker-Snoqualmie National Forest, he ruled that the presence of the structure "detrimentally impacts on the wilderness character" of the locale (*IJW* Digest, August 2012). The judge's decision resulted from Wilderness Watch's 2010 lawsuit.

In December 2012, a bill to protect the lookout was introduced by U.S. senators Patty Murray and Maria Cantwell, and Congressman Rick Larsen. In response, The Wilderness Society issued the following statement from Doug Walker, governing council chair, and Peter Dykstra, Pacific Northwest regional director:

"The Wilderness Society thanks Senators Maria Caldwell and Patty Murray for taking important steps to protect the Green Mountain Lookout. … The lookout is a historic icon visited by many who hike up a popular trail to the summit of Green Mountain. It is an important piece of Washington state's heritage and one of the few surviving lookouts in Washington state.

"We believe the Green Mountain Lookout provides outstanding benefits to the preservation of Glacier Peak Wilderness and the education of wilderness visitors and does not detract from the qualities we seek in wilderness. The lookout was erected for fire spotting in 1933 by the Civilian Conservation Corps, prior to the designation of Glacier Peak Wilderness. The Forest Service still uses the lookout during the fire season today.

"We applaud the efforts of the senators and Congressman Larsen to save this unique structure so that future generations my enjoy its vistas and historical relevance like so many have before them." (Source: www.wilderness.org, December 19, 2012 press release)

European Transboundary Wilderness Is Established

"Nature knows no borders," according to a recent announcement by Europe's PAN Parks organization. In what is the first successful creation of a transboundary wilderness area between Oulanka National Park, Finland, and Paanajärvi National Park, Russia, the largest protected area entity within the European Wilderness Preservation System was established. Both parks were previously certified as PAN Parks, but they were artificially divided by international boundaries. The two parks cover more than 325,000 acres (132,000 ha), of which 255,000 acres (103,000 ha) are managed as wilderness, where there is no extractive use, including hunting, logging, or grazing with domestic animals. It is hoped that this transboundary cooperation will preclude the opening of a newly planned gold mine close to Oulanka National Park. (Source: www.panparks.org/newsroom, August 13, 2012)

Oyster Farm Saga Continues

In what has become a nearly interminable issue, Interior Secretary Ken Salazar, citing the value of wilderness and congressional intent, ruled on November 29, 2012, that an oyster farm at Drakes Estero, in Point Reyes National Seashore, California, must terminate its operations. The following day, National Park Service (NPS) director Jon Jarvis declared the estero part of the Philip Burton Wilderness at the Seashore, effective December 4. That decision, said oyster company owner Kevin Lunny, was a "devastating" one.

Congress had directed that when the Drakes Bay Oyster Company's lease ran out, the estero should become fully designated wilderness once all nonconforming uses were terminated. The 1976 legislation that set aside 25,370 acres (10,300 ha) of the national seashore as wilderness required that another 8,003 acres (3,200 ha) encompassing the estero be "essentially managed as wilderness, to the extent possible, with efforts to steadily continue to remove all obstacles to the eventual conversion of these lands and waters to wilderness status."

The oyster company, which employs 31 workers who produce between 450,000–500,000 pounds (200,000–230,000 kg) of Pacific oyster meat a year for Bay Area outlets, has been embroiled in controversy for years, with powerful U.S. senator Dianne Feinstein defending the company and its workforce, while environmentalists pressed to see the estero granted full wilderness designation, as Congress intended.

Although Mr. Lunny admitted he always knew there was a possibility

that the farm's permit wouldn't be renewed, he held out hope that it would be. Secretary Salazar gave the oyster company 90 days to remove its personal property, including shellfish and racks, and said no commercial activities at the farm would be allowed following his decision. He also directed NPS Director Jarvis to "use all existing legal authorizations at your disposal to help … workers who might be affected by this decision, including assistance with relocation, employment opportunities, and training."

Following the secretary's decision, the oyster company went to court, arguing that the interior secretary acted rashly and without cause to deny an extension of the lease. The lawsuit, filed on Lunny's behalf by Cause of Action, a law firm that works to hold government accountable, largely is built on the contention that the secretary's decision violated the National Environmental Policy Act, in part because the NPS failed to prepare a thorough environmental impact study on the oyster farm's operations at Drakes Estero. Salazar, however, contends that he was acting on a directive from Congress issued in 2009 that he personally consider renewing the farm's lease for another decade, and when he announced his decision, he specifically referred to that directive, noting that it "does not require me (or the NPS) to prepare a DEIS or an FEIS or otherwise comply with the National Environmental Policy Act of 1969 or any other law."

Next, attorneys for the Drakes Bay Oyster Company sought a temporary restraining order (TRO) to prevent the Interior Department from closing down the oyster farm. The lawyers argued that implementing the secretary's order "will cause the immediate and irreparable loss of 2.5 million oyster spat (approximately 20–25% of its 2014 crop) and the corresponding immediate layoff of one-third of its employees over the Holiday season, and it will cause the utter destruction of Plaintiffs' business, harm to the public, and irreparable environmental damage to Drakes Estero in the next 90 days. Furthermore, it is impossible for Plaintiffs to comply with the Secretary's decision because it would take much longer than 90 days for Plaintiffs to comply."

Mr. Lunny claims it could take nearly two years to fully remove the oyster growing operations from the estero's waters.

On February 4, 2013, U.S. District Court judge Yvonne Gonzalez Rogers declined to issue a TRO, stating that she had no jurisdiction to rule on the secretary's decision, and that Mr. Lunny did not prove that Secretary Salazar abused his discretion. Three days later, the California Coastal Commission issued a cease-and-desist order based on Lunny's now-unpermitted operations in Drakes Bay, land alterations, debris from the farming operations, violations of previous cease-and-desist orders, and company boats operating in waters that were supposed to be closed to traffic due to harbor seal pupping.

Finally, on Feburary 25, the 9th U.S. Circuit Court of Appeals blocked the NPS from forcing the oyster farm to close down, stating that there are serious legal questions and the balance of hardships tips heavily in the appellants' favor. The court has scheduled a hearing on the dispute for May. (Source: National Parks Traveler, November 29 and December 5, 12, and 18, 2012 and February 12 and 25, 2013)

FAA Raises Minimum Ceiling over Blue Lake Wilderness

In an unusual move, the Federal Aviation Administration (FAA) has expanded the minimum allowable airspace altitude over New Mexico's Blue Lake Wilderness from 2,000 feet (600 m) to 3,000 feet (900 m). At the same time, it raised the minimum altitude over the nearby Taos Pueblo, a World Heritage Site, from 2,000 feet to 5,000 feet (1,500 m). For more than 20 years, Taos Pueblo officials have been fighting to protect the sites from potential flyovers that could compromise ancient buildings and the sacred wilderness area. The FAA's decision accompanied its plans to award $1.05 million to the Taos Regional Airport's crosswind runway project. At the meeting in which the FAA's decision was announced, pueblo governor Laureano Romero said, "I'm very happy to sit here now. And I certainly appreciate the FAA and all those concerned who have been very cooperative. This year, I found out we are very good neighbors."

Blue Lake is central to the pueblo's religion, which requires privacy. Blue Lake had been taken from the pueblo by order of President Theodore Roosevelt in 1906, and pueblo members and sympathizers spent the next six decades fighting for its return. In 1970 President Richard Nixon signed HR 471 into law, returning the 48,000 acres (19,500 ha) surrounding the lake to Taos Pueblo. At the time, Congress specified that the land must be managed according to the Wilderness Act of 1964. Blue Lake, closed to nonmembers of Taos Pueblo, is now managed as wilderness by pueblo rangers and the war chief's staff. War Chief Secretary Scott Fields said it is an arduous climb to the area, and tribal members continue to go to Blue Lake with a sense of reverence, recognizing that it is a special place. (Source: *The Taos News*, September 18–19, 2010, and October 7, 2012)

Blue Ribbon Coalition Challenges Wilderness Study Area Restrictions

The Blue Ribbon Coalition and the Idaho Snowmobile Association have sued the Clearwater National Forest, Idaho, over its travel plan banning motorcycles, ATVs, snowmobiles, and mountain bikes in a Wilderness Study Area (WSA). Although motorized and mechanized use is prohibited in wilderness areas designated by Congress under the Wilderness Act of 1964, the U.S. Forest Service (USFS) has traditionally allowed motorized use in WSAs, which are not yet designated by Congress but qualify for designation according to agency managers. Wilderness advocates have long criticized the agency's unwillingness to restrict motorized users in WSAs as a failure to protect their wilderness character.

After 40 years of motorized use in many WSAs, plans to restrict use in the Great Burn has motorized recreationists questioning the agency's authority. "Only Congress can designate wilderness," said Sandra Mitchell, public lands director of the Idaho State Snowmobile Association. "We cannot stand idly by and watch them change the long-established system for managing these treasured lands."

However, Brad Brooks, The Wilderness Society's deputy regional director in Boise, Idaho, said the lawsuit questions the ability of the USFS to protect wilderness character at all. "I see this as a full frontal assault on wilderness," he stated. "They are making essentially the argument that the Forest Service doesn't have the power to protect wilderness character as a multiple use of public lands."

Brian Hawthorne, public lands policy director of the Blue Ribbon Coalition, claims that the "[USFS's] Northern Region guidance to its national forests contradicts not only the law but the reality of modern-day wilderness." "Any wilderness designation today will necessarily be a creative balance that allows a variety of uses that would be prohibited under a pure reading of the 1964 Wilderness Act," he said. Recent wilderness bills have not been as "pure" as earlier ones, according to Hawthorne. (Source: *Idaho Statesman*, September 3, 2012)

Peru Creates Three New Amazon Protected Areas

Peru has created three new protected areas in the northern Amazon territory of Loreto, covering an area of nearly 1,485,000 acres (600,958 ha). The new areas of protected Amazon rain forest harbor one of the highest biological and cultural diversities worldwide and are made up of the Huimeki Communal Reserve, the Airo Pai Communal Reserve, and the Güeppi-Sekime National Park along the border of Ecuador and Colombia.

This recent development consolidates the Putumayo Trinational Conservation Corridor, a joint effort by the governments of Peru, Ecuador, and Colombia. It is an example of transboundary cooperation and a joint effort with indigenous communities (Kichwa, Huitoto, Secoya) in natural protected areas management. According to the World Wildlife Fund, its potential for replication throughout the region would significantly accelerate the conservation of the Amazon. (Source: wwf.panda.org/wwf_news/?206543/Peru-creates-three-new-Amazon-protected-areas)

Great Old Broads for Wilderness Threatened in Utah

Great Old Broads for Wilderness is an organization primarily composed of "old and gray" people, mostly women, whose mission is to advocate and educate on behalf of the environment. The organization holds twice-yearly campouts in various locales, called Broadwalks, which feature educational hikes and speakers who discuss environmental issues and advocacy campaigns in the area. During the last weekend of September 2012, about 50 members gathered in southeast Utah's canyon country near the Needles District of Canyonlands National Park.

The Broads were camping on private property, The Nature Conservancy's Dugout Ranch, which is surrounded by Bureau of Land Management (BLM) lands. The first evening, the group's banner, attached to the Conservancy's gate, was slashed and spray painted. The Broads took it in stride, joking about San Juan County residents picking on a bunch of grandmothers and "little old ladies." Next morning, however, they found the gate padlocked shut and an old hag Halloween mask, doused in fake blood, hung in effigy on a fencepost nearby. The words "Stay out of San Juan County. No last chance" were scrawled below the mask.

This was not the first time residents of San Juan County threatened the Broads. In 2006, Great Old Broads for Wilderness monitored the impacts of an illegally constructed trail in Recapture Wash. The trail, which included a bridge, culverts, and rock cribbing, allowed motorized access into archaeological sites. The following year, the BLM closed the route because of vandalism to the sites. Such vandalism triggers automatic closures to motorized vehicles under the Archaeological Protection Act, but locals blamed the Broads.

Although the Broads subsequently worked with a group of stakeholders, including motorized users, to address the future of the trail, numerous signs appeared in the area that read: "Wanted

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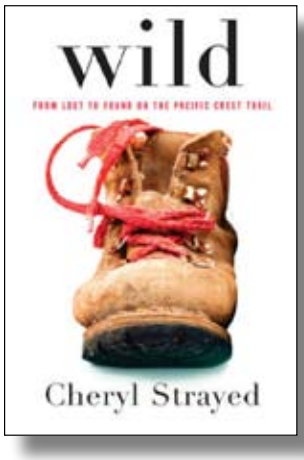
Book Reviews



Wild: From Lost to Found on the Pacific Crest Trail

By Cheryl Strayed. 2012. Alfred A. Knopf, New York. 336 pp. $25.95 (hc).

The Spirit of the Appalachian Trail: Community, Environment, and Belief on a Long-Distance Hiking Path

By Susan P. Bratton. 2012. University of Tennessee Press, Knoxville. 304 pp. $49.95 (hc).

A great deal of wilderness literature by writers such as John Muir, Bob Marshall, and Sigurd Olsen discuss the emotional and psychological impacts of long distance wilderness travels. These writers were changed from these experiences, and their writings often examined how and why the wilderness changed them. Through their writing, they encouraged other people to attempt similar wilderness trips. Both books reviewed in this issue of the *IJW* provide a more contemporary exploration of the impact of long distance hiking on the lives of these particularly committed participants.

Susan Bratton's *The Spirit of the Appalachian Trail* (AT) provides an interesting mélange of writing styles, mainly academic but also attempting to be more accessible to a wider audience, including AT users and volunteers. It is also somewhat unusual for a book as it provides the results of a mixed-methods study primarily assessing the spiritual/religious benefits of long distance hiking on the AT. Five data sources were used: interviews with volunteers, a survey of long distance hikers, hikers' logs and postings, published diaries and memoirs, and personal observation and informal discussions with hikers and volunteers. However, little information on the research design or sampling approach is provided. Other academic sources are used, but they are not incorporated throughout the work as they would be in a typical empirical study.

The survey results, which seem to be based on 205 respondents in 2007–2008, suggest that 11% explicitly noted a spiritual or religious motivation for their long distance trip, compared to 21% for self-exploration or reflection, 23% a life transition, 25% for "taking a break," 27% noting it was their life's dream, and 37% by a sense of adventure and challenge. Hikers seemed to be most impacted in terms of personal experiences by the trail environment and the social network of other users and volunteers found along the trail; for the latter impact, Bratton notes, "The trail provided a shared focus, making it easy to start a conversation and to find a common platform for relating to others" (p. 148). These experiences, together with the time spent on the trail, allowed them time to think about their personal problems or concerns and provided relief from daily stresses.

About 62% of long distance hikers stated they had a spiritual or religious experience while on the trip, with about 25% specifically identifying the AT trip as a spiritual or religious experience. Bratton suggests that personal growth or change was generated from "physical exercise, simple lifestyle, peer feedback and support offered by other hikers," with "the most widely shared outcomes of the AT hike … the physical and social environment of the AT itself, including making new friends, experiencing natural beauty, and acclimating to physical stresses of the trail" (p. 195). She suggests a seven-phase experience (entry, accommodation, community formation, functional network, commitment, celebration, and reintegration) in the long distance AT hiker experience, although it is unclear what data was used to generate this list. Bratton also suggests a "Canterbury Tales effect" exists: "People sharing long distance journeys with strangers form beneficial new

relationships and contemplate the quality of their interactions with others. The 'secular' long distance journey on foot can provide some of the benefits traditionally associated with religious pilgrimage, particularly assistance with life transitions, time for reflection, improved self-control, and the ability to live in a simple or austere environmental conditions" (p. 197).

Cheryl Strayed's *Wild* echoes many of these themes of self-discovery but provides a much more personal and powerful story. In this memoir – an Oprah's Book Club choice and best seller – she describes how the death of her mother and the disintegration of her family made her spiral into an empty, broken existence: "*I had to change* was the thought that drove me in those months of planning [the hiking trip]. Not into a different person, but back to the person I used to be – strong and responsible, clear-eyed and driven, ethical and good" (p. 57). Despite never having backpacked before, she decided to hike as much of the Pacific Crest Trail as she could in 100 days. She had "set out to hike the trail so that I could reflect upon my life, to think about everything that had broken me and make myself whole again"; but she found that on the trail, as she was so inexperienced, she was mainly "consumed only with my most immediate and physical suffering" (p. 84).

She also notes, like Bratton, that the social environment of the trail, the deep camaraderie between the long distance hikers and the support they provided, supplied a powerful solace and sense of community. This social component of the experience seems to at least have equaled the environmental aspect of the trip, although she does note that "perhaps being amidst the undesecrated beauty of the wilderness meant that I too could be undesecrated. … Of all the things I had been skeptical about, I didn't feel skeptical about this: the wilderness had a clarity that included me" (p. 143).

Wild provides a powerful and perhaps extreme example of how an extended wilderness experience can profoundly change and heal a troubled person. For Cheryl Strayed, it wasn't so much that she had more time to think about her life; more important, the daily deprivations, decisions, and simplicity of wilderness life provided a respite from focusing on her "old" life. The sense of profound achievement from her trek also helped her regain her true self.

Together, these two books provide a reminder of the emotional and psychological benefits of extended wilderness trips, examine the complexity of the spiritual nature of wilderness recreation, and highlight the key nature of the social component of wilderness use in long distance hiking trails.

Reviewed by John Shultis, *IJW* book editor, email: john.shultis@unbc.ca.

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dead or alive: Members of Great Old Broads for Wilderness are not allowed in San Juan County Utah." Even the *Blue Mountain Panorama*, the county's main newspaper, ran a two-page article letting readers know exactly where the Broads were planning to camp, concluding with the suggestion that "maybe we should keep an eye on them while they're here." (Source: *High Country News*, October 8, 2012)

Volunteers Remove Remaining Fencing at Sheldon National Wildlife Refuge

Volunteers have clipped, rolled, and packed out the last four miles (6.5 km) of barbed wire fencing at Sheldon National Wildlife Refuge (NWR), Nevada. Since 2009, volunteers and staff with Friends of Nevada Wilderness have hauled out 150 miles (240 km) of fencing. The old range fence was deemed unnecessary by the U.S. Fish and Wildlife Service and interfered with pronghorn migratory paths and water access as pronghorns shimmy under rather than leap over fencing. The refuge is also home to sage grouse whose low-flying habits entangle them in barbed wire.

At a celebration honoring the volunteers, former refuge manager Barry Reiswig said he was amazed by the progress. "I can hardly believe you folks removed so much fence in such a short period of time," he said. "To picture that big refuge without endless cross-fencing is a dream come true! You guys are the best." Reiswig was instrumental in removing grazing from the Hart-Sheldon Refuge Complex in 1994.

The Sheldon NWR was founded in 1931 to protect the pronghorn, the fastest land animal in North America, which can reach speeds of 60 miles per hour (100 km/hr). The Sheldon Refuge encompasses more than 900 square miles (233,000 ha) of sagebrush-steppe ecosystem that provides habitat for bighorn sheep, mule deer, pygmy rabbits, hawks and falcons, and 75 species of butterflies. (Source: www.nevadawilderness.org)

For the young conservationists in your family

John Muir • Rachael Carson • Henry David Thoreau

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Thomas Locker and Robert C. Baron

Rachel Carson
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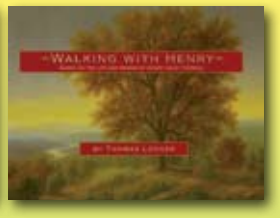

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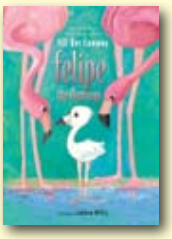

Felipe the Flamingo
Jill Ker Conway,Illustrated by Lokken Millis

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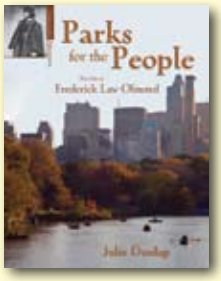

Parks for the People
The Life of Frederick Law Olmsted
Julie Dunlap

Growing up on a Connecticut farm in the 1800s, Frederick Olmsted loved roaming the outdoors. A contest to design the nation's first city park opened new doors for Olmsted when his winning design became New York's Central Park, just one of Olmsted's ideas that changed our nation's cities. Award-winning author Julie Dunlap brings Olmsted to life in this memorable biography, featuring resource and activity sections, a time line, and a bibliography, as well as black-and-white historical photographs.
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