

Wilderness Science

A Historical Perspective

BY DAVID N. COLE

Wilderness is a relatively new and powerful idea that is still finding its footing in the world of science. Although the intellectual history of wilderness can be traced farther back in time (Nash 2001), as a land classification wilderness is less than a century old, and it was just 50 years ago that wilderness was codified in legislation in the United States. While much of the attention over the past 50 years has been given to the growth and development of the National Wilderness Preservation System and the issue of how much and which lands should be protected as wilderness, it is clear that wilderness must be managed and that sound management should be built on a foundation of wilderness science. Without stewardship and management, wilderness designation will not necessarily result in wilderness protection. And without science, management is little more than trial and error, varying with the worldviews and beliefs of whoever happens to have management responsibility at any point in time. Therefore, wilderness science is critical to the success of the wilderness idea. The importance of science to the protection of wilderness values will only increase with time, as the contrast between wilderness and developed lands widens, as the diversity of wilderness values expands, and as the threats to those values intensify.

Antecedents of Wilderness Science

Although systematic wilderness science is only about as old as the Wilderness Act, there were some important antecedents to wilderness research. In the biological sciences, there has long been a tradition of research into the ecology of natural systems and landscapes, often using study sites that were eventually designated as wilderness. In fact, at the same time The Wilderness Society was working to establish, define, and promote the concept of wilderness, largely for its primitive recreational values, a committee within the Ecological Society of America was working to establish a system of natural areas,

representative of all major ecosystem types that would be preserved for study (Sutter 2002). Also in this vein, in the late 1920s, the National Park Service instituted a number of studies of wildlife relationships in the national parks, either broad faunal surveys (Wright et al. 1933) or studies of individual species, such as the wolves of

what is now Denali National Park (Murie 1944). Although the focus of this research was primarily on developing a basic understanding of natural systems, it provided a foundation for more applied work on mitigating threats to the wilderness values of such systems. Basic and applied ecological studies continue to be conducted in wilderness by both federal scientists and academics; however, the focus is typically management of the plants, animals, and ecosystems being studied – not management of wilderness.

One of the threats to wilderness values that has been widely studied for many years is fire and its management. Although research originally focused largely on damage caused by fire and how to improve fire suppression techniques, there were also early challenges to the notion that all fires are bad (Harper 1913). By the 1960s, research had shown that in many forests, frequent low-intensity fires were critical to ecosystem function (Kilgore 1987).

The advent of recreation research in the 1960s contributed significantly to the development of wilderness science. Early development was largely spurred by recognition within the Forest Service that burgeoning recreational use of public lands needed to be managed scientifically and that to do so, a discipline of recreation science needed to be developed and stimulated. To do this, Forest Service Research created a recreation research



David Cole: Photo by Liese Dean.

program, starting in 1958, which included placing recreation scientists at five universities, where they could develop curricula, conduct recreation research, and teach and advise students to become recreation scientists (Camp 1983). By 1962, there were 20 scientists working full-time in forest recreation research, probably five to six times as many as remain working today. These scientists and others that followed conducted much of the seminal early work in recreation, with international repercussions.

Toward Systematic Wilderness Science

To a substantial degree the catalyst for systematic wilderness science came from within Forest Service recreation research. In the late 1950s, the Lake States Forest Experiment Station cosponsored research in the Boundary Water Canoe Area, Minnesota – the first study of wilderness visitors and their experiences (Taves et al. 1960). At the same time, Bob Lucas, a graduate student in geography at the University of Minnesota, began his dissertation work on visitors, their perceptions of wilderness, and the carrying capacity of the Boundary Waters Canoe Area. The Lake States Station subsequently hired Lucas in 1960 to lead their recreation research program. Several of the earliest publications from that program came from Lucas's dissertation work (Lucas 1964a, b). Although the mission of that program was broad, much of the research was focused on the Boundary Waters Canoe Area, not because the Boundary Waters was wilderness but because it was among the most unique and valued recreation resources in the forests of the north-central United States.

With passage of the Wilderness Act in 1964, however, interest

in studying wilderness – because it was wilderness – increased. Again, leadership came from Forest Service Research, which decided to charter, in 1967, a Wilderness Management Research Unit. The unit was located in Missoula, Montana, as a field office of the Intermountain Forest and Range Experiment Station, with Bob Lucas as project leader. As noted above, there were a few other studies conducted in or about wilderness at this time, but this work was neither systematic nor cumulative. With the creation of the Wilderness Management Research Unit, for the first time scientists were able to devote a career to wilderness science. Forest Service wilderness scientists could pick research projects strategically, replicate studies in different places to test the generalizability of findings, and establish long-term longitudinal studies. They could devise research programs from which knowledge could build cumulatively, collaborate with other scientists, and sponsor the work of other scientists, who thereby were encouraged to do long-term, cumulative research. Of particular importance, they could synthesize results; advance concepts, principles, and frameworks; and apply these to improved wilderness management.

One myth about Forest Service wilderness research – and about wilderness management generally – is that it has been focused exclusively on recreation issues. This is not true. Bob Lucas's initial staffing at the Lake States included Dr. Miron Heinselman, who conducted pioneering wilderness fire ecology work in the Boundary Waters (Heinselman 1973), as well as ecological scientists who studied the native vegetation of the Boundary Waters (Ohmann and Ream 1971). In developing the research agenda

for the new Wilderness Management Unit, Lucas continued to support fire ecology research, research on wilderness vegetation, and wildlife and wilderness economics. However, since economists, fire, vegetation, and wildlife scientists were plentiful both within Forest Service research and academia, and recreation science was sparse, Lucas's initial hire was another geographer, George Stankey, a social scientist who could work on recreation issues. The initial agenda for in-house work included studies designed to (1) better measure wilderness use; (2) understand wilderness visitors, their experiences, their attitudes, and their preferences; and (3) explore ways to manage wilderness within its carrying capacity.

Early Wilderness Visitor Science

The three most prominent themes of early wilderness science involved research on wilderness visitors, recreational impacts on the environment, and fire ecology. Prior to establishment of the Wilderness Management Research Unit, as noted earlier, several studies of visitors to the Boundary Waters Canoe Area had been conducted. In addition, in 1960, visitor surveys were conducted, under the auspices of the Outdoor Recreation Resources Review Commission, in seven "wildernesses": Mount Marcy in the Adirondacks, Great Smoky Mountains, Boundary Waters Canoe Area, Yellowstone-Teton, Bob Marshall, Gila, and High Sierra (Outdoor Recreation Resources Review Commission 1962). The other studies conducted in the early 1960s were a 1962 study of social characteristics of camping groups in the Three Sisters (Burch 1966; Burch and Wenger 1967); a 1964 study of visitors to the Bob Marshall,

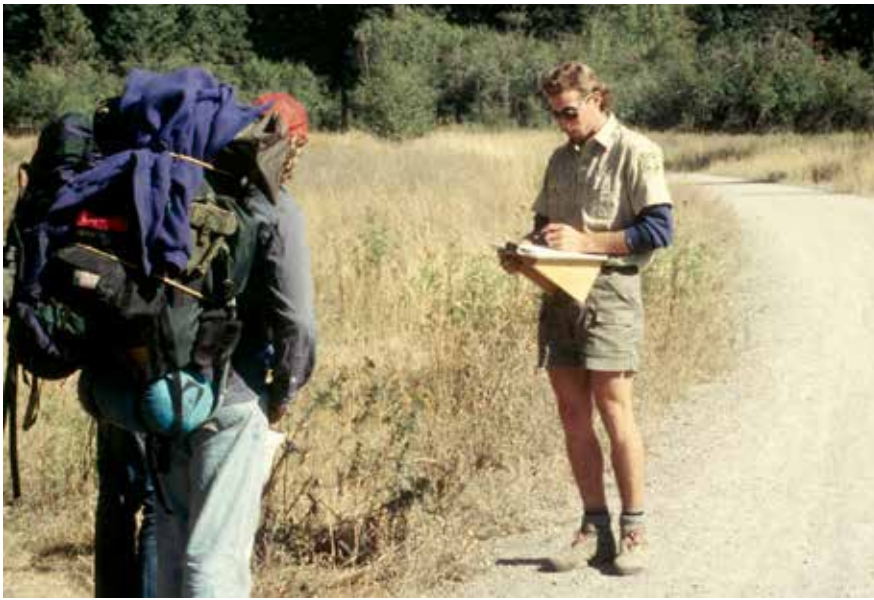


Figure 1 – A Forest Service interviewer collects information from visitors as they head into the Rattlesnake Wilderness, Montana. Photo by Alan Watson.

Mission Mountains, and Glacier Park (Merriam and Ammons 1967); and a 1965 study of visitors to the Three Sisters, Eagle Cap, and Glacier Peak wildernesses (Hendee et al. 1968).

One of the earliest contributions of wilderness visitor science was the ability to more accurately measure amount of visitor use. This involved improved sampling and statistical techniques (e.g., questions about how to efficiently distribute sampling effort), as well as technological development (e.g., better automatic data collectors [Lucas and Oltman 1971]). Much of this work laid the foundation for the vastly improved measurement techniques of today.

As with most sciences, the first step toward improved knowledge is largely descriptive. Building on earlier work, Lucas (1980) studied visitors to nine different wilderness and roadless areas. This work provided foundational information about who wilderness visitors were, as well as the type, timing, and areal distribution of use; how visitors use wilderness; their motivations for visiting; and so on (see Figure 1).

By sponsoring and inspiring similar research elsewhere, it was possible to draw insightful conclusions about wilderness visitors and visits, many of which were broadly applicable and some of which varied substantially among wildernesses (Roggenbuck and Lucas 1985).

A third body of work was referred to as carrying capacity research because it was motivated by early work on recreational capacity and a belief that limiting recreation use was key to maintaining quality wilderness experiences. In his seminal work on wilderness capacity, Stankey (1973) explored relationships between amount of use, visitor experiences, and perceptions of quality, but in fact advanced science more by showing how other use attributes – such as the type, timing, and location of use – were even more important determinants of visitor quality than amount of use. This work, bolstered by subsequent studies undertaken elsewhere, was highly influential in developing the diverse toolbox of techniques available to wilderness managers today.

Early Wilderness Recreation Ecology

Early studies of recreation impacts on the environment include Meinecke's (1928) study of the effects of tourist traffic in redwood parks and Wagar's (1964) early use of trampling experiments. Some of the first rigorous recreation ecology studies were conducted in the Boundary Waters Canoe Area, sponsored by Bob Lucas's Forest Service research project. Frissell (1963) quantified impacts on campsites that received different levels of use. Although Frissell did not recognize their significance, these data were the first used by Cole (1981) to advance one of the most important recreation ecology principles. For attributes as fragile as groundcover vegetation, the relationship between amount of use and impact is curvilinear. Relatively infrequent use can cause near-maximum levels of impact; therefore, concentrating use is usually more effective in minimizing impact than dispersing use (see Figure 2). Frissell (1963) did note that, since impact is inevitable with even low levels of use, the manager's job is to keep impacts to acceptable levels, the genesis of what became the Limits of Acceptable Change framework (Stankey et al. 1985).

In 1978, I (David Cole) joined the Wilderness Management Research Unit, as the first scientist with a career devoted to recreation ecology in relatively undeveloped environments such as wilderness. As with wilderness visitor science, long-term and cumulative research was begun. Disparate studies were synthesized and applied directly to the stewardship of wilderness. This work contributed to the development of wilderness monitoring techniques (Cole 1989a) and the development of Leave No Trace principles (Cole 1989b). Ecological research, parallel

to the visitor capacity research being conducted, identified the factors that influence amount of impact, such as amount and type of use and environmental durability, providing further insight into the effectiveness of wilderness management techniques (Cole et al. 1987).

Early Wilderness Fire Ecology

Although progress in wilderness fire science was as critical to the mission of the Wilderness Management Research Unit as progress in recreation research, this work was conducted by fire scientists elsewhere – within Forest Service research, other federal agencies – particularly the National Park Service – and academia. Perhaps the most profound outcome of early research was the conclusion that most wilderness ecosystems are dependent on recurrent fire. Fire controls plant community composition and structure; regulates ecological processes; and impacts wildlife, insects, and disease and the productivity, diversity, and stability of the ecosystem (Kilgore 1987). Consequently, actions to suppress fires or otherwise intervene in the natural role of fire in wilderness conflict with the fundamental wilderness goal of preserving wilderness in its “natural condition.”

Given that fire suppression and management were adversely affecting wilderness values, considerable research attention turned to understanding natural fire regimes and exploring means of reintroducing fire in wilderness ecosystems. The work of Heinselman (1973) in the Boundary Waters Canoe Area is an important early example of fire history work. He developed stand origin and fire year maps for the 1-million-acre (404,685 ha) wilderness, assessed fire history since 1595 and developed the concept

of the “natural fire rotation.” Kilgore (1987) summarizes the considerable knowledge that has developed about fire effects, organized by fire regimes that vary in the frequency and intensity of fires, along with whether fires were stand replacing or surface fires. This early research has had a dramatic impact on fire management both in and outside wilderness. Lightning fires are often allowed to burn in wilderness, and human ignitions are sometimes used, even in wilderness, to reduce high fuel loads that have accumulated after years of fire suppression and to more closely mimic natural fire regimes.

More Recent Themes in Wilderness Science

In the 50 years of systematic wilderness science, the diversity of research themes has increased. In the 1990s, the Wilderness Management Research Unit was transformed into the Aldo Leopold Wilderness Research Institute and spread its resources across a much wider range of topics. Early wilderness science was focused on threats to wilderness values, particularly those posed by recreation use and fire management.

More recently, studies have explored such threats as air pollution (Tonnessen 2000), invasive species (Randall 2000), grazing of domestic livestock (McClaran 2000), wildlife management (Kammer 2013), and climate change (Stephenson and Millar 2012). Attention has also turned to monitoring these threats and their effects on wilderness values. Recently, there has been considerable excitement about what has been called wilderness character monitoring (Landres et al. 2008). This involves monitoring a number of indicators of the attributes we care about in wilderness, aggregating them, and then assuming that the overall trend in these aggregated measures is correlated with trends in wilderness character – the holistic, perceptual essence of what wilderness preservation is all about. While some critics argue that this approach does not adequately capture wilderness character (e.g., Watson 2004), it is an extension of earlier wilderness monitoring science and has the positive benefit of advancing wilderness monitoring generally.

In addition to studying threats to wilderness as a basis for more



Figure 2 – Measuring the response of vegetation to restoration treatments on highly impacted campsites in the Eagle Cap Wilderness, Oregon. Photo by Dave Spildie.

effective wilderness stewardship, science has also explored the values associated with wilderness (Cordell et al. 2005). At the last wilderness science conference (held in Missoula, Montana, in 1999), one of the themes was Wilderness for Science: a Place for Scientific Inquiry, in recognition that science has much to learn by studying both wilderness ecosystems and how people interact with wilderness (McCool et al. 2000a). Another theme was Science for Understanding Wilderness in the Context of Larger Systems. Research papers explored the connections between wilderness and surrounding lands – linkages to social and ecological systems at regional, national, and international scales (McCool et al. 2000b). As the wilderness idea has spread around the globe, it has evolved. For example, in many countries, preservation of biodiversity is a higher priority than it is in the United States, while concerns about solitude, lack of permanent habitation, and untrammelled ecosystems are less important. The International Journal of Wilderness provides an important forum for papers that explore wilderness internationally.

The State of Wilderness Science at the 50th Anniversary

So what is the state of wilderness science on the eve of the Wilderness Act's anniversary? We can celebrate the significant contributions that science has made to improved wilderness stewardship, particularly in the realms of recreation and fire management. Some of this work has impacted stewardship of wilderness around the world and even of nonwilderness lands. Wilderness science has increased in breadth, examining diverse threats to wilderness values, as well as understanding those values

and the place of wilderness in society and the world. As wilderness science has expanded it has also lost, perhaps necessarily, some of the focus and collaborative spirit that existed in its first couple decades. Even those few scientific disciplines that considered wilderness to be an important category of research, primarily recreation and fire, no longer do so. This suggests the need to reinvigorate wilderness as an organizing subject of study as we move forward after the 50th.

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Continued from TAKE A SCIENTIST TO THE SAUNA!, page 3

research in the United States and other countries.

This issue could not include a complete review of all wilderness research. The executive editors – and the readers – of *IJW*, however, would welcome additional reviews of relevant research on wilderness issues at this, an important watershed moment in wilderness history: the 50th anniversary of the U.S. Wilderness Act. The history, debate, and future of wilderness restoration pur-

pose and methods could be reviewed; the role of wildlife in wilderness is an important topic; the role of wilderness in off-site water benefits; and how the public has responded to both management-ignited fire in wilderness and restoration of natural fire are all important topics not covered as well as they could be in these short, applied articles. We hope the readership will like the summaries provided and be inspired to contribute further to current efforts to strategically plan

the direction for the next 50 years of wilderness science and stewardship.

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