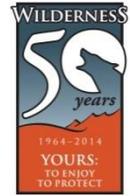


# Aldo Leopold Wilderness Research Institute

Providing scientific leadership to sustain the enduring values and benefits of wilderness



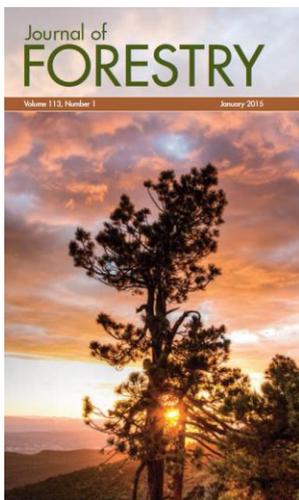
USDA - Forest Service and USDI - Bureau of Land Management, Fish and Wildlife Service, Geological Survey, and National Park Service

## RECENT ACCOMPLISHMENTS, 2013-2015



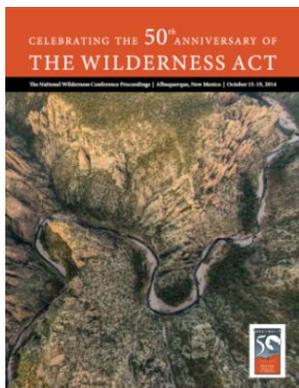
### National Wilderness Manager Survey

In 2014, at the request of the Interagency Wilderness Steering Committee, the Leopold Institute partnered with the USFS Southern Research Station and academia conducted a national survey of NWPS managers to support interagency wilderness strategic planning. The focus was on major challenges, perceived needs for science and training, and accomplishments of 1995 Strategic Plan objectives. The survey revealed priority rankings for perceived threats and needs for science-based information, and directly contributed to the interagency 2020 Vision strategy for the NWPS. [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr336.pdf](http://www.fs.fed.us/rm/pubs/rmrs_gtr336.pdf)



### Journal of Forestry

Following the National Wilderness Conference in 2014, the Leopold Institute worked with the SAF in the development of a special issue on Wilderness Science, to be published by the Journal of Forestry in May 2016. The authors include scientists and managers from federal agencies, academia, and wilderness organizations. This issue is comprised of 14 peer-reviewed articles (e.g., social science, recreation ecology, economic values of wilderness, fire science, wildlife and wilderness, soundscapes, ecological representation, shifting social values of wilderness), case studies, and pictures of the past by 55 authors. <http://www.ingentaconnect.com/content/saf/jof/pre-prints>



### Proceedings of the National Wilderness Conference

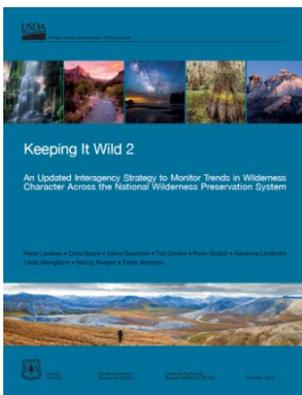
The Leopold Institute directed and guided the publication of the National Wilderness Conference Proceedings, in cooperation with the four federal land management agencies that administer designated Wilderness along with several participating partners of the National Wilderness Conference and Wilderness50. We chaired three sessions at this Conference and contributed summary papers and abstracts to these Proceedings. We also served on the general conference organizing committee and on the committee that selected keynote speakers.

[http://www.wilderness.net/toolboxes/documents/50th/National\\_Wilderness\\_Conference\\_Proceedings\\_2014.pdf](http://www.wilderness.net/toolboxes/documents/50th/National_Wilderness_Conference_Proceedings_2014.pdf)



### Evaluation Framework for Proposed Ecological Interventions in Wilderness

Every year the four wilderness managing agencies (BLM, FS, FWS, NPS) receive hundreds of proposals to implement ecological restoration actions within the NWPS. The combination of climate change with other landscape stressors is driving ecological restoration to be one of the single most important, challenging, and potentially litigious wilderness stewardship issues because decisions need to incorporate diverse legal, scientific and ethical considerations. In response to this challenge, the Leopold Institute has been collaborating with NWPS managers to develop an *Evaluation Framework for Proposed Ecological Interventions in Wilderness*. (Photo is before and after the removal of the Elwha River dam in the National Park Service’s Olympic Wilderness, Washington.)



### Keeping It Wild 2

The Leopold Institute led Keeping It Wild 2, an interagency strategy to monitor trends in selected attributes of wilderness character based on lessons learned from 15 years of developing and implementing wilderness character monitoring across the National Wilderness Preservation System. This document updates and replaces Keeping It Wild, the original interagency strategy published in 2008, and provides a foundation for agencies to develop a nationally consistent approach to implement this monitoring. This monitoring strategy addresses two questions: How do stewardship activities affect attributes of wilderness character? How are attributes selected as integral to wilderness character changing over time within a wilderness, within an agency, and across the National Wilderness Preservation System?

[http://www.fs.fed.us/rm/pubs/rmrs\\_gtr340.pdf](http://www.fs.fed.us/rm/pubs/rmrs_gtr340.pdf)



### Wilderness Fellows

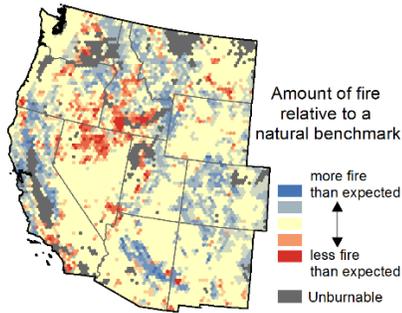
The Leopold Institute initiated and co-led the Interagency Wilderness Fellows Program. From 2010 to 2015, nearly 50 recent college graduates and graduate students were hired for 6-month Fellowships through a partnership with American Conservation Experience. Fellows lived on-site and worked closely with local agency staff to identify measures and the data to create baselines for monitoring trend in wilderness character. The Wilderness

Fellows Program has been a primary vehicle for developing baseline assessments of wilderness character that are consistent across all the agencies. The Wilderness Fellows Program has been an important way for the agencies to engage youth and build wilderness capacity during a time of declining budgets and staff resources.



### The Significance of Public Lands and Wilderness to Renewable Fresh Water Supply

Water supply volume and area was estimated across the contiguous 48 states for the period 1981-2010, including the contribution of forests and public lands, with special attention to wilderness areas. Looking at the West alone, where most of the national forest and wilderness lands are found, wilderness occupies 20% of the land and provides 29% of the contribution to water supply. These estimates highlight the importance of providing renewable water not only to onsite users, but also to users downstream of forests and wilderness, whether they rural or urban residents, farmers or industrial water users.



### Managing Fire in Wilderness

Wilderness managers need to understand the options for restoring fire as a natural process and when intervention may be necessary. Research by the Leopold Institute and collaborators has shed light on 1) the degree to which natural fire regimes have been altered by fire suppression and other human activities; 2) the ability of past wildfires to act as fuel-breaks that limit the occurrence, size, and severity of future fires; 3) where and when fires starting in wilderness are unlikely to escape a wilderness boundary; and 4) how fire regimes will change in a future climate. Research findings are informing strategies for restoring and managing fire in wilderness and can

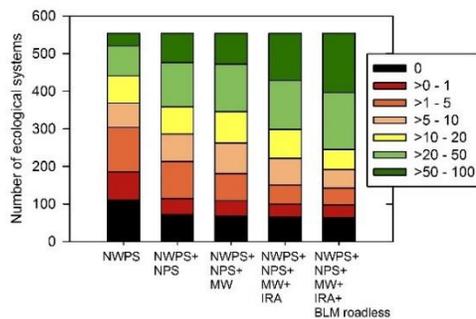
be applied to the management of other lands. <http://nrfirescience.org/event/ability-wildfire-act-fuel-treatment>



### Visitor Use Management Plan for BLM's Grand Staircase-Escalante

In 1996, the Grand Staircase-Escalante National Monument was established to protect the area's rugged and remote landscapes, its historic and scientific resources. The management plan for the Monument established two basic management objectives: (1) to protect "its primitive, frontier state," by safeguarding its "remote and undeveloped character;" and (2) to "provide opportunities for the study of scientific and historic resources." Opportunities for recreation use are to be provided as long as they do not impair the Monument's scientific and historic resources and are consistent with the remote and undeveloped character of the

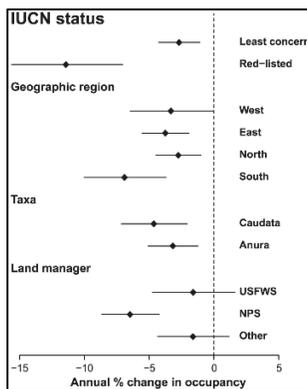
Monument. Management problems have surfaced and our scientists compiled, analyzed and displayed existing visitor use related monitoring data. We organized and facilitated a visitor use management planning workshop to review existing policy and management direction, as well as available data and initiated the process of developing the additional management direction needed to guide visitor use management decisions.



### Ecosystem Representation

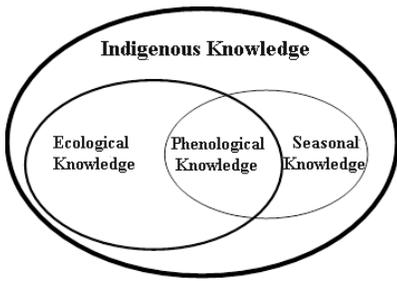
The NWPS is the world's largest wilderness protection network, yet within the contiguous United States (CONUS) it does not encompass the diversity nor is it fully representative of ecological systems on federal lands. To potentially increase NWPS diversity and representation, we simulated adding potentially eligible lands within CONUS to assess changes in ecological systems. The addition of several categories would increase the NWPS area from 12.8 to 48.3% of federal lands, increase diversity by adding 46 ecological systems, and nearly triple the number of ecological systems on federal lands

with >20% representation. Our analysis identifies opportunities to increase diversity and representation of ecological systems within the NWPS.



### Amphibian and Aquatic Ecology

Research conducted by USGS scientists at the Leopold Institute has concentrated primarily on amphibian declines and other issues related to aquatic ecosystems. Along with several collaborators, this research is focused in areas ranging from designated wilderness in national parks and the Canadian subarctic, to highly fragmented systems such as energy development in the Northern Plains and arid lands along the USA-Mexico border. Projects include the Amphibian Research & Monitoring Initiative, a DOI initiative in response to global amphibian declines; studies exploring the effects of wildfire and climate change; and investigations of diseases, invasive species, and other stressors. (Figure shows change in wetland occupancy by amphibians for geographic regions and land management agencies.)



### Using Traditional Phenological Knowledge to Support Adaptive Management

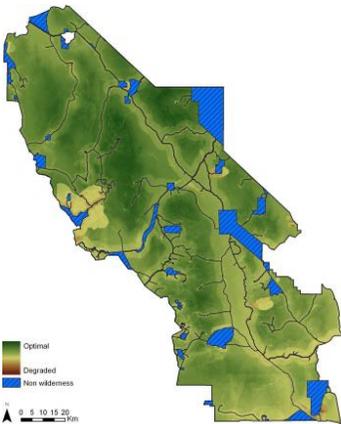
Indigenous peoples have a wealth of place-based traditional phenological knowledge (TPK) that is based on empirical observations gathered over hundreds to thousands of years. This knowledge has been invaluable to indigenous communities living with and adapting to natural variation in ecological disturbances and climate. Today, humanity must adapt to a world in which social-ecological systems are threatened by accelerating changes in

the environment. We are working to better integrate the bodies of science and knowledge pertaining to adaptive management and TPK is likely to suggest innovative policies and practices to improve the resilience and adaptive capacity of social-ecological systems to human-caused changes in the environment.



### Data Archiving and Cataloging of Historical Files

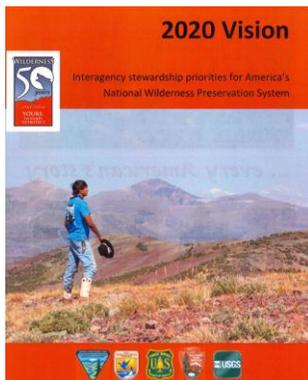
We have done research for more than 50 years of research. There are many datasets that have been collected over those 5 decades. The primary goal of data archiving is to conserve and protect the data with information that explains why and how it was collected. The secondary goal is to make data available to other scientists and managers so that they can use it for future study and inquiry. We have archived all 50 years of data collected by our scientists. Also, we have many historical files associated with the research we have done. We have cataloged these data so they will be protected, organized, and easily searchable.



### Mapping Threats to Wilderness Character

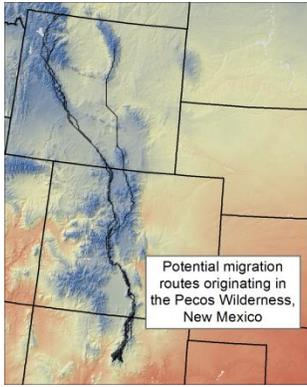
Our scientists developed a set of standardized methods to map threats to wilderness character for designated wilderness and other areas that are not designated but they are managed to preserve their wilderness character. These maps provide a measurement baseline from which future monitoring can show spatial trends and changes in wilderness character over time, and allow the four agencies managing wilderness to analyze the potential impacts of different management actions on wilderness character. Wilderness character maps can also improve wilderness planning and have supplemented the development of new wilderness stewardship plans for various wilderness areas in the NWPS. *(Figure shows a map of the cumulative threats to wilderness character in Death Valley Wilderness, CA.)*

## PROJECTS UNDERWAY IN 2016



### Developing a Comprehensive Science Plan for Wilderness in America

We are working with key wilderness science partners in federal agencies, universities, and wilderness organizations to develop a science plan for all wilderness lands. This new plan will be a part of the strategic and implementation planning process for the National Wilderness Preservation System. In addition to identifying long term priority needs, it will address specific research needs for 2016 to 2020, a timeframe consistent with the implementation of the *2020 Vision: Interagency Stewardship Priorities for America's National Wilderness Preservation System*.



### Climate Change Exposure

Leopold scientists are using innovative and novel approaches to quantify climate change exposure for North America. This project extends the theoretical and practical framework of climate change exposure assessments by 1) better identifying biologically relevant migration routes between current and future climate domains, and 2) quantifying exposure to dissimilar climates along these routes. These previously unexplored facets of climate change exposure will better enable managers to facilitate climate-induced species migrations by, for example, providing adequate connectivity between climate domains. Our analysis will result in spatially explicit maps of climate change exposure for North America. These maps will be overlaid with designated wilderness to identify which areas are most vulnerable to climate change.

*(Climate domains, areas of similar temperature and precipitation, are generally expected to move upslope and northward in response to a changing climate. This figure depicts hypothetical migration routes for species originating in the Pecos Wilderness as climate domains move northward.)*



### Online Wilderness Character Monitoring Database

Beginning in 2014, the Leopold Institute initiated the design and implementation of an interagency, online wilderness character monitoring database. The purpose of this database is to provide a consistent framework and a single place for all four wilderness managing agencies to enter and store their data from monitoring wilderness character, and to provide consistent reporting on trends. This database has undergone

thorough testing and is currently undergoing significant revisions to improve its functionality and ease of use. The database will be ready for use by early summer of 2016.



### Evaluating the Societal Demand for Water-based Ecosystem Services

Water-based ecosystem services depend on the complex spatial and temporal interactions between climate, ecological conditions of terrestrial, riparian and aquatic ecosystems, land and water management and policy, and social preferences. Most current climate assessments focus on biological and physical vulnerability of ecosystems, without explicitly evaluating and integrating societal demand for the ecosystem services. We are developing this tool to show the flow of water-based ecosystem services to diverse

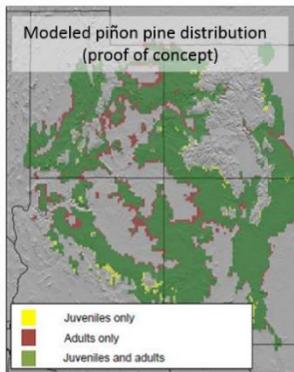
stakeholder groups of the Wind/Bighorn Basin, WY. This landscape will serve as a case study to refine our methods and to demonstrate utility for all federal public lands, including designated wilderness.



### Wilderness Recreation: Visitor Use Trends and Predictions

Our scientists have developed a time-series database that tracks wilderness hiking permit data over multiple decades and more than 20 US Forest Service wilderness areas, combined with census and ecosystem data. This database now contains: 1) several hundred thousand wilderness permits; 2) 48 million observations between every zip code in the US and the specific trail head locations as recorded in the permit data; 3) demographic characteristics and cohorts associated with each trip (including zero trips); and 4) ecosystem classifications for each trip. This project is continuing to collect, analyze, and

archive wilderness permit data collected by the four wilderness management agencies, which will be used to forecast how factors such as changing demographics and climate will affect future wilderness recreation.



### Understanding fire as a natural process

In collaboration with Canadian partners, Leopold scientists are studying how and to what degree wilderness fire regimes have been altered by human activities across North America. For the western US, we are quantifying relationships between fire and climate that are derived from wilderness areas to predict and map expected fire frequency and severity under future climates. Results will help land managers anticipate, adapt to, and mitigate expected changes in fire regimes. For the dry forests of the Southwest and California, where a warmer climate is limiting tree regeneration and where historic fire and land management activities have resulted in conditions conducive to stand-replacing fire, we are studying the risk of fire-facilitated conversions from forest to non-forest. Research results will identify areas

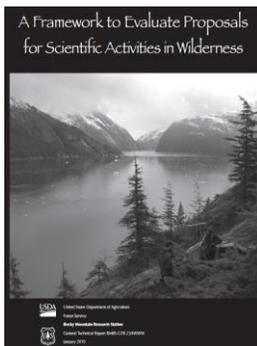
most vulnerable to ecosystem transformation and elucidate treatment options that decrease this vulnerability. Finally, detailed fire atlases from five large wilderness area complexes are being used to study how previous fires affect the spread rate of subsequent fires and the overall likelihood of reburning. This research will help land managers evaluate longer-term benefits of wildland fire and better understand how to maintain and restore landscape resilience. *(Picture shows modeled piñon pine distribution. Areas in red indicate where climatic conditions are not favorable for regeneration, and consequently, may be at a higher risk of fire-facilitated transition to non-forest.)*



### Evaluating Management Effectiveness in Wilderness Stewardship

The International Union for the Conservation of Nature developed a comprehensive framework for evaluating the management effectiveness of protected areas. This framework has been applied extensively worldwide, but surprisingly, has not yet been applied in the United States. We are developing an interagency framework for evaluating the effectiveness of the full range wilderness stewardship (context, planning, inputs, outputs, and outcomes) across the NWPS. This framework will

help local unit field managers improve on-the-ground stewardship, and help regional and national program managers evaluate program effectiveness and needs. The framework will improve stewardship, accountability, and integration among the wilderness managing agencies.



### Revising the Framework for Evaluating Proposed Scientific Activities in Wilderness

The Leopold Institute will be implementing a thorough revision of this interagency framework that was originally published in 2010 to incorporate lessons learned over the past five years of use, and to make it much more streamlined. In addition, Institute scientists will be working closely with on-the-ground staff as well as staff from the Arthur Carhart National Wilderness Training Center to pilot test the revised framework and ensure that it is easy to understand and use. When completed, the revised framework will be published and updated on the wilderness.net website and in other training and education materials.



### Describing the Values and Benefits of Wilderness

The Wilderness Economics Working Group was established in 2015 to facilitate research collaboration among federal agencies on the economic and social dimensions of wilderness, and to improve communication with the American public and land managers. Participants include economists and social scientists from the USFS, USFWS, NPS, BLM, and USGS, as well as academia and non-governmental organizations. Research teams are addressing diverse topics: 1) Ecosystem services and nonmarket values; 2) Economic impacts; 3) Visitation and visitor use; and, 4) Societal relevance. In FY15, two research projects were completed: a synthesis of the literature on the economic values and benefits of wilderness (Holmes et al. 2015); and a national analysis of the economic contribution of wilderness to jobs and income in gateway communities (Hjerpe et al., in press).

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