Chapter 1: Introduction

Joanne J. Ho

Introduction

The Intermountain Adaptation Partnership (IAP) is a science-management partnership with a wide variety of participants across the U.S. Department of Agriculture Forest Service (USFS) Intermountain Region, which spans Nevada, Utah, southern Idaho, eastern California, and western Wyoming. This USFS region is the largest in the Nation, representing nearly 17 percent of all National Forest System lands. The partnership includes the USFS Intermountain Region and the USFS Pacific Northwest and Rocky Mountain Research Stations, National Park Service (NPS) Climate Change Response Program, U.S. Fish and Wildlife Service, North Central Climate Science Center, the Desert, Great Basin, Great Northern, and Southern Rockies Landscape Conservation Cooperatives, the University of Washington, Native American tribes, and dozens of other stakeholder organizations (fig. 1.1, box 1.1). Initiated in 2015, the IAP is a collaborative project with the goals of increasing climate change awareness, assessing vulnerability, and developing science-based adaptation options to reduce adverse effects of climate change and ease the transition to new climate states and conditions (see http://adaptationpartners.org/iap). Developed in response to proactive climate change strategies of the USFS (USDA FS 2008,

Box 1.1—Intermountain Adaptation Partnership Participating Organizations

Backcountry Hunters and Anglers
Boise State University
Bureau of Land Management (BLM)
Colorado State University
Cooperative Institute for Research in Environmental Sciences
Deseret News
Desert Landscape Conservation Cooperative
Eastern Idaho Public Health
EcoAdapt
Grand Canyon Trust
Great Basin Landscape Conservation Cooperative
Great Northern Landscape Conservation Cooperative
Henry's Fork Foundation
Idaho Army National Guard
Idaho Bureau of Homeland Security
Idaho Department of Fish and Game
Idaho National Guard
Idaho Power Company
Institute of Outdoor Recreation and Tourism
Inter-Tribal Council of Nevada
McGinnis and Associates
National Oceanic and Atmospheric Administration
National Park Service
National Weather Service
Natural Resources Conservation Service
Nevada Department of Wildlife
Nez Perce Tribe
North Central Climate Science Center
Northwest Watershed Research Center
Southern Rockies Landscape Conservation Cooperative
Trout Unlimited
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Forest Service Intermountain Region
U.S. Forest Service Pacific Northwest and Rocky Mountain Research Stations
University of Nevada, Reno
University of Utah
University of Washington
Utah Division of Forestry, Fire and State Lands
Utah State University
Utah's Hogle Zoo
Weber State University
Western Water Assessment
Wild Utah Project
Yerington Paiute Tribe
Yomba Shoshone Tribe

2010a,b), and building on previous efforts in national forests (Halofsky and Peterson 2017; Halofsky et al. 2011, 2018, in press; Littell et al. 2012; Raymond et al. 2013, 2014; Rice et al. 2012; Swanston et al. 2011, 2016), the partnership brings together resource managers, research scientists, and stakeholders to plan for climate change in the Intermountain Region.

This effort directly addressed goals identified in the USFS Intermountain Region Strategic Framework for FY 2017–2020 (USDA FS 2016) and the USFS Strategic Plan, FY 2015–2020 (USDA FS 2015). These main strategic goals are to: (1) sustain our Nation's forests and grasslands, (2) deliver benefits to the public, (3) apply knowledge globally, and (4) excel as a high-performing agency. These goals aim the USFS toward success in the agency's mission "to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." Finally, this assessment strives to provide options and solutions to a complex challenge in a way inspired by Gifford Pinchot, the first Chief of the USFS: for "the greatest good of the greatest number in the long run," (USDA FS 2007).

Climate Change Response in the Forest Service and National Park Service

Climate change is an agency-wide priority for the USFS, which has issued direction to administrative units for responding to climate change (USDA FS 2008) (table 1.1). In 2010, the USFS provided specific direction to the National Forest System in the form of the National Roadmap for Responding to Climate Change (USDA FS 2010a) and the Performance Scorecard for Implementing the USFS Climate Change Strategy (USDA FS 2010b). The goal of the USFS climate change strategy is to "ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources," (USDA FS 2010a, p. 2). To achieve this goal, starting in fiscal year (FY) 2011, each national forest and grassland began using a 10-point scorecard system to report accomplishments on 10 elements in 4 dimensions: (1) increasing organizational capacity, (2) partnerships, engagement, and education, (3) adaptation, and (4) mitigation and sustainable consumption. The scorecard elements can be found in box 1.2. From FY 2011 to FY 2016, progress toward accomplishing elements of the scorecard was required to be reported annually by each national forest and national grassland. All units were expected to accomplish 7 of 10 criteria, with at least one "yes" in each dimension, and in FY 2016, all units in the Intermountain Region were successful in this endeavor. As of FY 2017, the USFS is actively developing a new reporting model.

Similarly, the NPS Climate Change Response Strategy provides direction for addressing the impacts of climate change on NPS lands (NPS 2010) (table 1.2). The strategy has four components to guide NPS actions: science, adaptation, mitigation, and communication. The science component involves conducting and synthesizing research at various scales, monitoring trends and conditions, and delivering information to resource managers and partners. It also provides the scientific basis for adaptation, mitigation, and communication. Adaptation involves developing capacity within the agency to assess climate change scenarios and risks and implementing actions to better manage natural and cultural resources and infrastructure for a changing climate. Mitigation efforts focus on reducing the agency carbon footprint and enhancing carbon sequestration. Finally, the strategy requires the NPS to take advantage of agency capacity for education and interpretation to communicate the effects of climate change to NPS employees and to the public. Park rangers and other employees are encouraged to engage visitors about climate change because national parks are visible examples of how climate change can affect natural and cultural resources. The similarity of USFS and NPS climate response strategies facilitated coordination between the two agencies.

The IAP built on previous Adaptation Partners (www.adaptationpartners.org) efforts in ecosystem-based management and ecological restoration to address climate change and put these efforts in a broader regional context in the Intermountain Region. Starting in 2008, Halofsky et al. (2011) conducted a climate change assessment for Olympic National Forest and Olympic National Park (1.55 million acres), a science-management collaboration initiated to develop climate adaptation strategies. In 2010, the North Cascadia Adaptation Partnership (Raymond et al. 2014) began a similar effort with an expanded geographic scope of two national forests and two national parks. These organizations worked with stakeholders over 2 years to identify climate change issues relevant to resource management in the North Cascades to assist in the transition of diverse ecosystems of the region to a warmer climate. The North Cascadia Adaptation Partnership provided education, conducted a climate change vulnerability assessment, and developed adaptation options for the Federal agencies that manage nearly 6 million acres in north-central Washington. In 2013, the USFS Pacific Northwest Research Station, Pacific Northwest Region, and Malheur, Umatilla, and Wallowa-Whitman National Forests (5.29 million acres in Oregon and Washington) initiated the Blue Mountains Adaptation Partnership (Halofsky and Peterson 2017). Formed in 2015, the South Central Oregon Adaptation Partnership (Halofsky et al. in press) brought together the Deschutes National Forest, Fremont-Winema National Forest, Ochoco National Forest, Crooked River National Grassland, the USFS Pacific Northwest Region, USFS Pacific Northwest and Rocky Mountain Research Stations, Crater Lake National Park, and the University of Washington to conduct a similar climate change assessment, covering 5 million acres. In the largest effort to date in the western United States, the Northern Rockies Adaptation

Table 1.1—U.S. Forest Service policies related to climate change.

Policy	Description
Forest Service Strategic Framework for Responding to Climate Change (USDA FS 2008)	Developed in 2008, the Strategic Framework is based on seven strategic goals in three broad categories: foundational, structural, and action. The seven goals are science, education, policy, alliances, adaptation, mitigation, and sustainable operations. Like the challenges themselves, the goals are interconnected; actions that achieve one goal tend to help meet other goals. The key is to coordinate approaches to each goal as complementary parts of a coherent response to climate change. All seven goals are ultimately designed to achieve the same end (the USFS mission): to ensure that Americans continue to benefit from ecosystem services from national forests and grasslands.
USDA 2010-2015 Strategic Plan (USDA FS 2010c)	In June 2010, the U.S. Department of Agriculture released the Strategic Plan that guides its agencies toward achieving several goals including Strategic Goal 2—Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources. This goal has several objectives. Objective 2.2 is to lead efforts to mitigate and adapt to climate change. The performance measures under this objective seek to reduce greenhouse gas emissions by the U.S. agricultural sector, increase the amount of carbon sequestered on U.S. lands, and bring all national forests into compliance with a climate change adaptation and mitigation strategy. The USFS response to this goal includes the National Roadmap for Responding to Climate Change and Performance Scorecard (Roadmap).
National Roadmap for Responding to Climate Change (USDA FS 2010a)	Developed in 2011, the Roadmap integrates land management, outreach, and sustainable operations accounting. It focuses on three kinds of activities: assessing current risks, vulnerabilities, policies, and gaps in knowledge; engaging partners in seeking solutions and learning from as well as educating the public and employees on climate change issues; and managing for resilience in ecosystems and human communities through adaptation, mitigation, and sustainable consumption strategies.
Climate Change Performance Scorecard (USDA FS 2010b)	To implement the Roadmap, starting in 2011, each national forest and grassland began using a 10-point scorecard to report accomplishments and plans for improvement on 10 questions in four dimensions: organizational capacity, engagement, adaptation, and mitigation. By 2015, each is expected to answer "yes" to at least seven of the scorecard questions, with at least one "yes" in each dimension. The goal is to create a balanced approach to climate change that includes managing forests and grasslands to adapt to changing conditions, mitigating climate change, building partnerships across boundaries, and preparing employees to understand and apply emerging science.
2012 Planning Rule (USDA FS 2012)	The 2012 Planning Rule is based on a planning framework that will facilitate adaptation to changing conditions and improvement in management based on new information and monitoring. There are specific requirements for addressing climate change in each phase of the planning framework, including in the assessment and monitoring phases, and in developing, revising, or amending plans. The 2012 Planning Rule emphasizes restoring the function, structure, composition, and connectivity of ecosystems and watersheds to adapt to the effects of a changing climate and other ecosystem drivers and stressors, such as wildfire and insect outbreaks. A baseline assessment of carbon stocks required in assessment and monitoring will check for measureable changes in the plan area related to climate change and other stressors. Requirements of the Roadmap and Scorecard and requirements of the 2012 Planning Rule are mutually supportive and provide a framework for responding to changing conditions over time.

Box 1.2—The Forest Service Climate Change Performance Scorecard, 2011

1. **Employee Education.** Are all employees provided with training on the basics of climate change, impacts on forests and grasslands, and the Forest Service response? Are resource specialists made aware of the potential contribution of their own work to climate change response?
2. **Designated Climate Change Coordinators.** Is at least one employee assigned to coordinate climate change activities and be a resource for climate change questions and issues? Is this employee provided with the training, time, and resources to make his/her assignment successful?
3. **Program Guidance.** Does the Unit have written guidance for progressively integrating climate change considerations and activities into Unit-level operations?
4. **Science and Management Partnerships.** Does the Unit actively engage with scientists and scientific organizations to improve its ability to respond to climate change?
5. **Other Partnerships.** Have climate change related considerations and activities been incorporated into existing or new partnerships (other than science partnerships)?
6. **Assessing Vulnerability.** Has the Unit engaged in developing relevant information about the vulnerability of key resources, such as human communities and ecosystem elements, to the impacts of climate change?
7. **Adaptation Actions.** Does the Unit conduct management actions that reduce the vulnerability of resources and places to climate change?
8. **Monitoring.** Is monitoring being conducted to track climate change impacts and the effectiveness of adaptation activities?
9. **Carbon Assessment and Stewardship.** Does the Unit have a baseline assessment of carbon stocks and an assessment of the influence of disturbance and management activities on these stocks? Is the Unit integrating carbon stewardship with the management of other benefits being provided by the Unit?
10. **Sustainable Operations.** Is progress being made toward achieving sustainable operations requirements to reduce the environmental footprint and increase the resilience of agency operations and assets?

Partnership developed a vulnerability assessment and adaptation options for 15 national forests and 3 national parks in Montana, northern Idaho, North Dakota, and parts of South Dakota and Wyoming, covering a total of 183 million acres (Halofsky et al. 2018). The IAP continues these efforts to develop science-based adaptation strategies.

Other efforts have also demonstrated the success of science-management partnerships for increasing climate change awareness among resource managers and adaptation planning on Federal lands. In addition to the Adaptation Partners assessments described earlier, Tahoe National Forest, Inyo National Forest, and Devils Postpile National Monument worked with the USFS Pacific Southwest Research Station to develop climate change vulnerability assessments (Littell et al. 2012) and the Climate Project Screening Tool (Morelli et al. 2012) in order to incorporate adaptation into project planning. In response to requests from Shoshone National Forest in northern Wyoming, the Rocky Mountain Research Station synthesized information on past climate, future climate projections, and potential effects of climate change on the multiple ecosystems within the forest (Rice et al. 2012).

In the largest effort to date in the eastern United States, the USFS Northern Research Station, in collaboration with Chequamegon-Nicolet National Forest in northern Wisconsin and numerous other partners, conducted a vulnerability assessment for natural resources (Swanston et al. 2011) and developed adaptation options (Swanston et al. 2016). Another USFS science-management partnership assessed the vulnerability of watersheds to climate change (Furniss et al. 2013). These watershed vulnerability assessments, conducted on 11 national forests throughout the United States, were locally focused (at a national forest scale) and included water resource values, hydrological reaction to climate change, watershed condition, and landscape sensitivity. The assessments were intended to help national forest managers identify where limited resources could be best invested to increase watershed resilience to climate change. More recently, Butler et al. (2015) conducted a climate change vulnerability assessment and synthesis for forest ecosystems of the Central Appalachians region.

The processes, products, and techniques used for several studies and other climate change efforts on national forests have been compiled in a guidebook for developing adaptation options for national forests (Peterson et al. 2011). The guidebook outlines four key steps to facilitate adaptation in national forests: (1) Become aware of basic climate change science and integrate that understanding with knowledge of local conditions and issues (review), (2) evaluate sensitivity of natural resources to climate change (rank), (3) develop and implement options for adapting resources to climate change (resolve), and (4) monitor the effectiveness of

Table 1.2—National Park Service policies related to climate change.

Policy	Description
National Park Service Climate Change Response Strategy (NPS 2010)	Developed in 2010, the Climate Change Response Strategy is designed to guide management actions and collaboration, from the national to park levels, to address the effects of climate change. The Response Strategy is based on four components: science, mitigation, adaptation, and communication. These components provide a framework for consistent, legal, and appropriate management decisions. The Response Strategy calls for a scientific approach to updating interpretations of previous policy and mandates in order to uphold the mission of the NPS in the face of new conditions created by climate change.
A Call to Action: Preparing for a Second Century of Stewardship and Engagement (NPS 2011)	The Call to Action outlines themes and goals for the second century of stewardship and engagement of the NPS. The plan provides actions for the achievement of each goal before the NPS centennial in 2016. Under the theme of preserving America's special places, the plan sets the goal for management of resources to increase resilience to climate change stressors. Specific actions include revised management objectives, increases in sustainability, and changes in investments.
Green Parks Plan (NPS 2012b)	The Green Parks Plan (GPP) outlines how the NPS will achieve the commitment set in A Call to Action, to "Go Green." An overarching vision and strategy for sustainable management in the future, the GPP is based on nine strategic goals that focus on the effects of park operations on the environment and human welfare. The goals are to continually improve environmental performance; be climate friendly and climate ready; be energy smart; be water wise; develop a green NPS transportation system, buy green and reduce, reuse, and recycle; preserve outdoor values; adopt best practices; and foster sustainability beyond NPS boundaries.
Revisiting Leopold: Resource Stewardship in the National Parks (NPS 2012c)	In August 2012, the NPS released the Revisiting Leopold, intended as an updated interpretation of the guiding document, The Leopold Report (Leopold et al. 1963). Members of the current NPS Science Committee were tasked with revisiting three questions: (1) What should be the goals of resource management in the National Parks? (2) Which policies for resource management are necessary to achieve these goals? (3) Which actions are required to implement these policies? The interpretation presents general principles and guidance for the enlarged scope of all natural and cultural resources of the NPS. The committee stresses that the NPS needs to act quickly on structural changes and long-term investments in management in order to preserve resources through the uncertainties of environmental change.
Climate Change Action Plan 2012-2014 (NPS 2012a)	The 2012 Climate Change Action Plan builds on the 2010 NPS Climate Change Response Strategy to communicate how the NPS can respond to climate change at different geographic scales. The plan outlines parameters for introducing science, adaptation, mitigation, and communication actions to address climate change. The plan also identifies high-priority actions for addressing climate change in NPS operations, and describes how to anticipate and prepare for future changes.

on-the-ground management (observe) and adjust as needed. The IAP is focused on implementation of the principles and practices in the guidebook.

The Intermountain Adaptation Partnership Process

The IAP geographic area includes 12 national forests (table 1.3) and 22 NPS units across an ecologically and geographically complex area. The IAP process includes:

- A vulnerability assessment of the effects of climate change on water resources, fisheries, forest and nonforest vegetation, disturbance, wildlife, recreation, infrastructure, cultural resources, and ecosystem services. These resource sectors were selected based on their importance in the region and current management concerns and challenges.
- Development of adaptation options that will help to reduce negative effects of climate change and assist the transition of biological systems and management to a warmer climate.
- Development of an enduring science-management partnership to facilitate ongoing dialogue and activities related to climate change and to other natural resource management challenges and actions.
- Vulnerability assessments typically involve exposure, sensitivity, and adaptive capacity (Parry et al. 2007), where exposure is the degree to which the

Table 1.3—Area of U.S. Forest Service units in the Forest Service Intermountain Region (from USDA FS 2016). The national forests and grassland in the Intermountain Region are organized into 12 administrative units discussed throughout this assessment. The Forest Service Rocky Mountain Research Station manages the Desert Range Experimental Station. The "Other" category refers to areas located within National Forest System boundaries that are not Federally owned or administered by the Forest Service.

	Number of units	National Forest System	Other	Total
		Acres		
National forest	18	31,784,550	2,330,896	34,115,446
National grassland	1	47,544	27,240	74,784
Research and experimental area	1	55,510	0	55,510
Regional totals	20	31,887,604	2,358,136	34,245,740

system is exposed to changes in climate, sensitivity is an inherent quality of the system that indicates the degree to which it could be affected by climate change, and adaptive capacity is the ability of a system to respond and adjust to the exogenous influence of climate. Vulnerability assessments can be both qualitative and quantitative and focus on whole systems or individual species or resources (Glick et al. 2011). Several tools and databases are available for systematically assessing sensitivity of species (e.g., Case and Lawler 2016; Luce et al. 2014; Potter and Crane 2010).

We used scientific literature and expert knowledge to assess exposure, sensitivity, and adaptive capacity to identify key vulnerabilities for the selected resource areas. The assessment process took place over 2 years and involved monthly phone meetings for each of the resource-specific assessment teams. Each assessment team refined key questions that the assessment needed to address, chose values and key ecosystem attributes to assess, and determined which climate change effects models best informed the assessment. In some cases, assessment teams conducted spatial analyses or ran and interpreted models, selected criteria by which to evaluate model outputs, and developed maps of model output and resource sensitivities. To the greatest extent possible, teams focused on effects and projections specific to the region and used the finest scale projections that are scientifically valid.

By working collaboratively with scientists and resource managers and focusing on a specific region, the goal of IAP was to provide the scientific foundation for integrating climate change in planning, ecological restoration, and project management (Peterson et al. 2011; Raymond et al. 2013, 2014; Swanston et al. 2016). After identifying key vulnerabilities for each resource sector, scientists, land managers, and other stakeholders (box 1.1) convened five 2-day workshops in May and early June 2016 in Ogden, Utah (Uinta and Wasatch Front subregion), Boise, Idaho (Middle Rockies subregion), Salt Lake City, Utah (Plateaus subregion), Reno, Nevada (Great Basin region), and Idaho Falls, Idaho (Southern Greater Yellowstone subregion) to present and discuss the vulnerability assessment, and to elicit adaptation options from resource managers.

During these workshops, scientists and resource specialists presented information on climate change effects and current management practices for each of the resources. Facilitated dialogue was used to identify key sensitivities and adaptation options. Participants identified strategies (general approaches) and tactics (on-the-ground actions) for adapting resources and management practices to climate change, as well as opportunities for implementing these adaptation actions in projects, management plans, partnerships, and policies. Participants generally focused on adaptation options that can be implemented given our current scientific understanding of climate change effects, but they also identified research and monitoring that would benefit future efforts to assess vulnerability and guide management practices. Information from the assessment was also downscaled to identify the most significant vulnerabilities to climate change for priority resources in each subregion where appropriate. Facilitators captured information generated during the workshops with worksheets adapted from Swanston et al. (2016). Initial results from the workshops were augmented with continued dialogue with Federal agency resource specialists.

This publication contains a chapter on expected climatological changes in the IAP region, and one chapter for each of the resource sectors covered in the vulnerability assessment (water resources, fisheries, forest and nonforest vegetation, disturbance, wildlife, recreation, infrastructure, cultural resources, and ecosystem services). Each of the resource chapters includes a review of climate change effects, sensitivities, and current management practices. An additional chapter summarizes adaptation strategies and tactics that were compiled at the workshops (see Appendix 1 for author affiliations).

Resource managers and other decisionmakers can use this publication in several ways. First, the vulnerability assessment will provide information on climate change effects needed for national forest and national park planning,

projects, conservation strategies, restoration, monitoring, and environmental effects analyses. Second, climate change sensitivities and adaptation options developed at the broad scale provide the scientific foundation for finer scale assessments, adaptation planning, and resource monitoring. We expect that over time, and as needs and funding align, appropriate adaptation options will be incorporated into plans and programs of Federal management units. Third, we anticipate that resource specialists will apply this assessment to incorporate climate-smart resource management and planning in land management throughout the region.

Adaptation planning is an ongoing and iterative process. Implementation may occur at critical times in the planning process, such as when managers revise USFS land management plans and other planning documents, or after the occurrence of extreme events and ecological disturbances (e.g., wildfire). We focus on adaptation options for the USFS and NPS, but information in this publication can be used by other land management agencies as well. Just as the IAP process has been adapted from previous vulnerability assessments and adaptation planning, it can be further adapted by other national forests and organizations, thus propagating climate-smart management across larger landscapes.

Toward an All-Lands Approach to Climate Change Adaptation

The USFS and NPS climate change strategies identify the need to build partnerships and work across jurisdictional boundaries when planning for adaptation. This concept of responding to the challenge of climate change with an "all-lands" approach is frequently mentioned, but a process for doing so is rarely defined. In addition to representatives from the USFS and NPS, several other agencies and organizations participated in the resource sector workshops. This type of partnership enables a coordinated and complementary approach to adaptation that crosses jurisdictional boundaries. The IAP also provides a venue for agencies to learn from the practices of others so that the most effective adaptation strategies can be identified.

Risks and vulnerabilities resulting from climate change and gaps in scientific knowledge and policy need to be assessed on a continual basis. Adaptation is a prominent focus of the IAP, with emphasis on creating resilience in human and natural systems. Communicating climate change information and engaging employees, partners, and the public in productive discussions is also an integral part of successfully responding to climate change. The need for partnerships and collaborations on climate change issues was clearly identified in the IAP. Sharing climate change information, vulnerability assessments, and adaptation strategies across administrative boundaries will contribute to the success of climate change responses throughout the Intermountain West.

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Appendix 1—Author Affiliations

Chapter 1

Joanne J. Ho is a Research Environmental Economist with the University of Washington, College of the Environment, School of Environmental and Forest Sciences in Seattle, Washington.

Chapter 2

Hanna K. Olson is an undergraduate student at the University of Washington in Seattle, Washington.

Don W. Fallon is the Regional Resource Information and Monitoring Coordinator with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Chapter 3

Linda A. Joyce is a Research Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Human Dimensions Research Program in Fort Collins, Colorado.

Marian Talbert is a Biostatistician with the U.S. Department of the Interior, North Central Climate Science Center in Fort Collins, Colorado.

Chapter 4

Mark J. Muir is a Hydrologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Charles H. Luce is a Research Hydrologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.

Joseph T. Gurrieri is a Hydrogeologist with the U.S. Department of Agriculture, Forest Service, National Forest System in Golden, Colorado.

Marek Matyjasik is an Advisor in Applied Environmental Geosciences with Weber State University, College of Science in Ogden, Utah.

Jeffrey L. Bruggink is the Regional Soil Scientist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Stacey L. Weems is a Soil Scientist with the U.S. Department of Agriculture, Forest Service, Wasatch-Cache National Forest in South Jordan, Utah.

James C. Hurja is a Soil Scientist with the U.S. Department of Agriculture, Forest Service, Humboldt-Toiyabe National Forest and Spring Mountains National Recreation Area in Sparks, Nevada.

David B. Marr is a Forest Soil Scientist and Soil and Air Program Manager with the U.S. Department of Agriculture, Forest Service, Caribou-Targhee National Forest in Idaho Falls, Idaho.

Sarah D. Leahy is a Forest Soil Scientist with the U.S. Department of Agriculture, Forest Service, Ashley National Forest in Vernal, Utah.

Chapter 5

Daniel J. Isaak is a Research Fish Biologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.

Michael K. Young is a Research Fisheries Biologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Missoula, Montana.

Cynthia Tait is the Regional Aquatic Ecologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Daniel Duffield is a Fisheries Program Manager with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Dona L. Horan is a Fisheries Biologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.

David E. Nagel is a Geographic Information Systems (GIS) Analyst with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.

Matthew C. Groce is a GIS Analyst with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.

Chapter 6

Patrick N. Behrens is a Silviculturist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Robert E. Keane is a Research Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory in Missoula, Montana.

David L. Peterson was a Senior Research Biologist Scientist with the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station in Seattle, Washington.

Joanne J. Ho is a Research Environmental Economist with the University of Washington, College of the Environment, School of Environmental and Forest Sciences in Seattle, Washington.

Chapter 7

Wayne G. Padgett is a retired Ecologist, formerly with the U.S. Department of Agriculture, Forest Service, Washington Office in Washington, DC.

Matthew C. Reeves is a Research Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Missoula, Montana.

Stanley G. Kitchen is a Research Botanist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Provo, Utah.
David L. Tart is a Regional Ecologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Jeanne C. Chambers is a Research Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Reno, Nevada.
Cheri Howell is an Ecologist with the U.S. Department of Agriculture, Forest Service, Humboldt-Toiyabe National Forest in Sparks, Nevada.
Mary E. Manning is a Regional Vegetation Ecologist with the U.S. Department of Agriculture, Forest Service, Northern Region in Missoula, Montana.
John G. Proctor is a Regional Botanist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.

Chapter 8

Danielle M. Malesky is an Entomologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Barbara J. Bentz is a Research Entomologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Logan, Utah.
Gary R. Brown is a Regional Fire Specialist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Andrea R. Brunelle is a Professor with the University of Utah, Department of Geography in Salt Lake City, Utah.
John M. Buffington is a Research Geomorphologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.
Linda M. Chappell is a Fire Ecologist with the U.S. Department of Agriculture, Forest Service, Dixie and Fishlake National Forests in Richfield, Utah.
R. Justin DeRose is a Research Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Ogden, Utah.
John C. Guyon, II, is a Plant Pathologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Carl L. Jorgensen is an Entomologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Rachel A. Loehman is a Research Landscape Ecologist, U.S. Geological Survey, Alaska Science Center in Anchorage, Alaska.
Laura L. Lowrey is a Forest Entomologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Ann M. Lynch is a Research Entomologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Tucson, Arizona.
Marek Matyjasik is an Advisor in Applied Environmental Geosciences with Weber State University, College of Science in Ogden, Utah.
Joel D. McMillin is a Supervisory Entomologist with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Javier E. Mercado is an Entomologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Fort Collins, Colorado.
Jesse L. Morris is a Research Assistant Professor with the University of Utah, Department of Geography in Salt Lake City, Utah.
Jose F. Negrón is a Research Entomologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Fort Collins, Colorado.
Wayne G. Padgett is a retired Ecologist, formerly with the U.S. Department of Agriculture, Forest Service, Washington Office in Washington, DC.
Robert A. Progar is a Research Entomologist with the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station in La Grande, Oregon.
Carol B. Randall is a Forest Entomologist with the U.S. Department of Agriculture, Forest Service, Northern Region in Boise, Idaho.

Chapter 9

Megan M. Friggens is a Research Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Albuquerque, New Mexico.
Mary I. Williams is a Postdoctoral Researcher with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Boise, Idaho.
Karen E. Bagne is a Wildlife Biologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Albuquerque, New Mexico.
Tosha T. Wixom is a Regional Sustainability and Climate Intern with the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Samuel A. Cushman is a Research Landscape Ecologist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Flagstaff, Arizona.

Chapter 10

Michael S. Hand is a Research Economist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station in Missoula, Montana.
Jordan W. Smith is the Director of the Institute of Outdoor Recreation and Tourism and an Assistant Professor with Utah State University, College of Natural Resources, Department of Environment and Society in Logan, Utah.
David L. Peterson was a Senior Research Biologist Scientist with the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station in Seattle, Washington.

Nancy A. Brunswick is a Regional Landscape Architect with the U.S. Department of Agriculture, Intermountain Region in Ogden, Utah.
Carol P. Brown is the Forest Environmental Coordinator with the U.S. Department of Agriculture, Sawtooth National Forest in Twin Falls, Idaho.

Chapter 11

Michael J. Furniss is a retired Hydrologist, formerly with the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Redwood Sciences Lab in Arcata, California.
Natalie J. Little is the Regional Sustainability and Climate Coordinator with the U.S. Department of Agriculture, Intermountain Region in Ogden, Utah.
David L. Peterson was a Senior Research Biologist Scientist with the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station in Seattle, Washington.

Chapter 12

Tom H. Flanigan is an Archaeologist with the U.S. Department of Agriculture, Forest Service, Wasatch-Cache National Forest in South Jordan, Utah.
Charmaine Thompson is the Heritage Program Leader with the U.S. Department of Agriculture, Forest Service, Uinta National Forest in Provo, Utah.
William G. Reed is the Regional Heritage Program Leader with the U.S. Department of Agriculture, Intermountain Region in Ogden, Utah.

Chapter 13

Travis W. Warziniack is a Research Economist with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station Human Dimensions Research Program in Fort Collins, Colorado.
Matthew J. Elmer is a graduate student at Colorado State University in Fort Collins, Colorado, where he is currently working on his Ph.D. in economics.
Chris J. Miller is an Economist with the U.S. Department of Agriculture, Forest Service, Washington Office Ecosystem Management Coordination in Ogden, Utah.
S. Karen Dante-Wood is a Natural Resource Specialist with the U.S. Department of Agriculture, Forest Service, Office of Sustainability and Climate in Washington, DC.
Christopher W. Woodall is a Project Leader for the U.S. Department of Agriculture, Forest Service, Northern Research Station in Durham, New Hampshire.
Michael C. Nichols is a Computer Systems Analyst for the U.S. Department of Agriculture, Forest Service, Northern Research Station in Durham, New Hampshire.
Grant M. Domke is a Team Leader and Research Forester for the U.S. Department of Agriculture, Forest Service, Northern Research Station in St. Paul, Minnesota.
Keith D. Stockmann is an Economist with the U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center in Missoula, Montana.
John G. Proctor is the Regional Botanist for the U.S. Department of Agriculture, Forest Service, Intermountain Region in Ogden, Utah.
Allison M. Borchers is an Economist with the U.S. Department of Agriculture, Forest Service, Washington Office Enterprise Program, TEAMS in Washington, DC.

Chapter 14

Jessica E. Halofsky is a Research Ecologist with the University of Washington, College of the Environment, School of Environmental and Forest Sciences in Seattle, Washington.

Chapter 15

Joanne J. Ho is a Research Environmental Economist with the University of Washington, College of the Environment, School of Environmental and Forest Sciences in Seattle, Washington.
David L. Peterson was a Senior Research Biologist Scientist with the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station in Seattle, Washington.
Natalie J. Little is the Regional Sustainability and Climate Coordinator with the U.S. Department of Agriculture, Intermountain Region in Ogden, Utah.