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USDA Forest Service Perspectives on Forest Management in a Changing Climate

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USDA FOREST SERVICE PERSPECTIVES ON FOREST MANAGEMENT IN

A CHANGING CLIMATE

by

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ABSTRACT

USDA Forest Service Perspectives on Forest Management

in a Changing Climate

by

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The Forest Service faces significant climate change-related management
challenges. Understanding employee perspectives on climate change will inform
potential strategies to address these challenges. By analyzing data from key informant
interviews and an internet survey of Forest Service employees in the Intermountain West,
this study examined how Forest Service employees view and approach climate change,
assessed how they perceive barriers to and opportunities for climate change adaptation
within the National Forest System, and compared their perspectives across the
organizational hierarchy, from district level to national policy making. The results show
that although forest managers consider climate change a concern for the agency in
general, they do not necessarily see how it affects the work they do personally. Although
they tend to agree that climate change should be a high priority for the agency, their own
ability to incorporate adaptive practices into managing a National Forest is limited by
various constraints, including a lack of time, funding, and personnel, a lack of direction

for on-the-ground management, and a communication gap, which has inhibited climate

change-related knowledge transfer within the agency. Thus, more effective

communication is needed to help forest managers see how climate change affects various

aspects of forest ecosystem health in their own National Forests or districts, how climate

change poses challenges to forest resilience, and what can be done to incorporate climate

change considerations into their own work. The agency needs to focus on building trust,

especially across its hierarchical structure, and on encouraging both vertical and

horizontal information flow among employees to facilitate scientific knowledge sharing

and to enhance formal and informal social networking for increased collaboration. The

agency also needs to create more opportunities for district-level employees to provide

feedback and get involved in climate change-related policy making, as they are a crucial

source of local knowledge and experience and can be invaluable in problem-solving

within the National Forest System. The insights from this study not only contribute to the

Forest Service's continuous efforts to adapt to climate change but also shed light on

strategies that can be tailored by other natural resource agencies to address various

management challenges within the context of global environmental change.

(99 pages)

PUBLIC ABSTRACT

USDA Forest Service Perspectives on Forest Management

in a Changing Climate

Jamie E. Laatsch

As climate change becomes more problematic for the Forest Service (FS) and other federal land management agencies in the U.S., it has become increasingly important to understand how their employees view climate change and related challenges. This study examined how FS employees in the Intermountain West view forest management in the face of climate change, what barriers and opportunities they see in terms of dealing with climate change, and how different levels of agency management view climate change-related issues differently. This study found that many FS employees believe climate change is an important issue; however, they have not done much to deal with climate change due to a lack of time, funding, and personnel. This study also identified a communication gap regarding climate change information sharing between higher-level decision makers and on-the-ground forest managers. To improve its ability to deal with climate change, the FS needs to encourage knowledge sharing among employees across different levels, and to help forest managers see how climate change affects their work and what they can do locally to tackle climate change-related issues. It also needs to create more opportunities for forest managers to provide feedback and get involved in higher-level climate change-related policy making so their knowledge and expertise can be used to help generate solutions to solve forest management problems locally.

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Jamie E. Laatsch

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CHAPTER 1

INTRODUCTION

The USDA Forest Service is currently facing significant challenges due to climate change and has responded with a suite of new policies and plans to attempt to address climate change impacts (USDA Forest Service, 2008; 2011a; 2011b; ICCATF, 2011). The potential impacts from climate change in the United States have been documented in the literature to include drought, rising sea levels, and extreme weather events (ICCATF, 2011). In the National Forests, the Forest Service has documented increased severity and size of wildfires and bark beetle infestations, and shifting water regimes, which they believe to be, at least in part, driven by a changing climate (USDA Forest Service, 2008). Additionally, key forest species, such as quaking aspen, are projected to experience significant range contractions (Rehfeldt et al., 2009).

The geographic area of interest for this study is the Intermountain West, an elevated region defined by a semi-arid climate, situated between the eastern Rocky Mountains to the east and Cascade and Sierra Mountains on the west (Stewart et al., 2002). For the purposes of this research, the Intermountain West is comprised of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, which, when considering Forest Service Regions, includes parts of Regions 1, 2, 3 and 4. In terms of climate change impacts, the West has faced increased temperatures in winter and spring, which has affected plant life as well as the hydrology of the region (Mote et al., 2005). Also, spring snowmelt timing has shifted to occur earlier in the year (Stewart et

al., 2005; Mote et al., 2005) and the West is experiencing decreasing mountain snowpack (Mote et al., 2005). The past few decades have also seen forest fires of increased size and severity due to human activity and changes in climate (Marlon et al., 2012), as well as increases in the size and severity of bark beetle outbreaks (Bentz et al., 2010).

The Forest Service has established that it prioritizes addressing these climate change impacts (USDA Forest Service, 2008), however, barriers do exist to implementation of climate change adaptation plans. The literature suggests these might include budget constraints, multiple or conflicting natural resource values, and uncertainty in the information that is available regarding future climatic conditions, to name a few (Koontz & Bodine, 2008; Archie et al., 2012; Ellenwood et al., 2012; Bierbaum et al., 2013). It is difficult to implement new plans or policy on the ground (Butler & Koontz, 2005) and federal land management agencies, including the Forest Service, still struggle with implementation of their climate change adaptation plans (Jantarasami et al., 2010; Berrang-Ford et al., 2011; Ellenwood et al., 2012; Archie et al., 2012).

Another possible setback to the successful implementation of climate change adaptation plans and policies is the Forest Service's inability to effectively transfer knowledge and direction throughout the agency, which we will argue has manifested itself in the form of a communication gap. The process of policy implementation or implementation of new plans relies so heavily on the District Rangers (Kaufman, 1960), and presumably the employees who take direction from the District Rangers, that these lower-level employees are the ones left to translate policy into action (Kaufman, 1960). Implementation essentially falls on their shoulders, which is why communication of

information and direction from the upper levels of management to the lower levels of the agency is so critical and why it will be a primary focus of this analysis.

What is of interest for this study is not only the challenges the Forest Service might face in its efforts to address climate change, but also how it attempts to overcome those challenges. This research aims to understand, both from a theoretical and practical standpoint, how the Forest Service has attempted to address climate change, how effective or successful those efforts have been, and what gaps might exist between policy and implementation; or between decisions made at the top of the agency and actions taken on the ground through management; and why. A better understanding of the climate change adaptation efforts made and potential gaps between plan and action regarding adaptation, could reveal potential areas for improvement or aspects of the Forest Service's adaptation strategies that can be targeted and improved to facilitate better forest management in the future of a changing climate.

Through a series of key-informant interviews followed by a larger Internet survey, this research compares perceptions about barriers to implementation, forest management challenges, climate change and forest resilience, and communication of climate change information across levels of the agency. This comparison intends to determine if opinions regarding climate change, and the related subjects previously mentioned, vary depending on whether the employee works at the regional, National Forest, or district level.

Thesis Structure

This thesis is structured in a multi-paper format with two main chapters prepared for publication. These chapters together describe the efforts of the Forest Service in

adapting to climate change, how perceptions of these efforts and related factors vary at differing levels of agency management, and recommendations for future management strategies based on employee feedback and our own analysis. Data for this research was collected between spring and fall of 2013.

Chapter 2 of this thesis will analyze, from a theoretical standpoint, how climate change-related knowledge and directions are transferred and communicated within the Forest Service, and how the success of this knowledge transfer and communication could affect implementation of climate change plans and policies. We will determine if a communication gap exists between the levels of the agency by analyzing interview and survey data on the subjects of climate change-related communication, knowledge of climate change policy and guidance, and employees' confidence being heard by their superiors. Chapter 3 of this thesis aims to better understand the broader implementation efforts with respect to climate change adaptation beyond just communication efforts. This chapter will present interview and survey data that focus on the perspectives of Forest Service employees regarding forest management challenges, forest resilience, the constraints forest managers face, and tools or resources employees believe are needed to improve future forest management. This new understanding of employee perceptions of climate change and forest management will provide invaluable insight into the challenges introduced by climate change and will help identify opportunities for strengthening the agency's ability to adapt to climate change in the future. Finally, in Chapter 4, conclusions from this research as a whole will be presented and recommendations for Forest Service's future climate change adaptation efforts will be discussed.

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CHAPTER 2

FACILITATING EFFECTIVE CLIMATE CHANGE COMMUNICATION AND

INTRA-ORGANIZATIONAL KNOWLEDGE TRANSFER:

LESSONS LEARNED FROM THE USDA FOREST SERVICE[1]

Abstract

The USDA Forest Service (FS) currently faces significant challenges due to climate change and has created a suite of new plans and policies designed to address those challenges. However, as evidenced by a review of previous literature and three key FS documents that relate to the agency's climate change adaptation strategy, the FS struggles with implementation of its new plans as action on-the-ground. A major driver of this lack of implementation is a communication gap resulting from the ineffective transfer of climate change-related knowledge and information within the FS. The efforts of a dozen key-informant interviews and a wider Internet survey of over 1,600 FS employees in the Intermountain West further illustrates this communication gap and reveals a lack of confidence among employees, especially at the lower levels of the agency, in their ability to provide feedback to and be heard by the upper-levels of management, where decision-making occurs. The FS must strategize more efficient and effective methods of communicating climate change information within the agency, facilitate greater horizontal information flow and informal social networks, and make a greater effort to solicit feedback from and include lower-level employees in decision-making processes.

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[1] This chapter was co-authored by Jamie Laatsch and Dr. Zhao Ma

Introduction

      A number of things about working for the USDA Forest Service (FS) today have changed from the time when Herbert Kaufman conducted his landmark study of District Rangers half a century ago. According to Kaufman (1960), District Rangers prior to 1960 spent approximately 50% of their time in the field, and had to make many management decisions without consulting their superiors because the cost of telephone calls was too great and distances to reach field stations too far. Today, the amount of time spent in the field has certainly decreased (Tipple & Wellman, 1991) and communication is less expensive and more convenient. On one hand this may present great opportunities for more informed decision making, yet on the other hand may present potential burden from extensive reporting and approval requirements before any action can be taken on the ground. In Kaufman's time, agency leadership requested reports from employees working at the lower levels of the agency. This upward reporting was meant to keep upper-level management informed about activities on the ground in a timely manner, and to provide upper-level management with information to assess whether on-the-ground activities were addressing agency policies and following relevant requirements (Kaufman, 1960). Among these reports were official diaries for District Rangers to document how their days were spent to the nearest ½ hour. In his own words, Kaufman (1960) described the flow of information from the Ranger Districts up to the upper levels of the FS as "steady, massive, detailed, and comprehensive" (p. 129). Other opportunities for FS employees to share feedback up the chain of command included inspections. Depending on the type of inspections and the level of the agency being inspected, inspections could occur anywhere between once every five years to once a

year (Kaufman, 1960). The employees under inspection were said to have rarely missed the chance to give suggestions, criticisms, and other thoughts to inspectors. Such practices were encouraged, which made employees feel confident that they were being heard by upper-level management (Kaufman, 1960).

Since the 1960s, reporting required by the upper levels of the FS has increased in frequency and complexity. Although daily diaries once completed by District Rangers are no longer in use, inspections still occur but are now called reviews to give them a more positive connotation (Bullis & Tompkins, 1989). Generally speaking, the "network of communication practices" has become stronger since the 1960s; however, these communication practices represent an effort to identify and discourage deviations and to maintain bureaucratic control over lower-level employees, rather than to solicit feedback or gain knowledge from local experience (Bullis & Tompkins, 1989, p. 296). Compared to the 1960s, many upper-level managers today no longer begin their FS career with on-the-ground training. Resource specialists with certain academic and professional backgrounds no longer need to work their way up from a Ranger District and are likely to be hired directly to the National Forest Supervisor or regional office level (Bullis & Tompkins, 1989).

It is important to note that not only have the day-to-day operations changed in the FS, the composition, culture, and structure of the FS have also changed dramatically in recent decades. Just before the 1960s, 90% of the professional positions in the FS were filled by foresters (Tipple & Wellman, 1991), while today FS professionals have much more diverse backgrounds, ranging from social science to geographic information science, from environmental education to planning and policy making, from forestry to

wildlife biology. The approach to natural resource management has also become more complex, and more emphasis has been given to ecosystem-based management and the coupled human-natural systems approach (Grumbine, 1994; Liu et al., 2007). Since the 1960s, the expectation for meaningful public involvement has grown (Bullis & Tompkins, 1989; Tipple & Wellman, 1991). More legislation, including the National Forest Management Act, National Environmental Policy Act, and Resources Planning Act, explicitly require the FS to take into account the multiple, often conflicting societal values when making forest management and policy decisions (Bullis & Tompkins, 1989; Tipple & Wellman, 1991).

It is also important to note that the ecological challenges facing the FS have evolved over time. The FS has acknowledged that climate change poses a significant threat to the agency's ability to fulfill its mission to "[s]ustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations" (USDA Forest Service, 2008, p. 2). The potential impacts of climate change have been well documented at the national level, including drought, rising sea levels, and extreme weather events (ICCATF, 2011). The FS has also documented current impacts seen on the National Forests and Grasslands they believe to be driven, at least in part, by changing climate. These include bark beetle infestations, increased severity and size of wildfires, and shifting water regimes (USDA Forest Service, 2008).

Given the increasing ecological threats posed by climate change, the FS has made significant efforts to adjust and prepare for new conditions created by the changing climate (adaptation) and to reduce the amount of greenhouse gases present in the atmosphere (mitigation) (USDA Forest Service, 2011c). The backbone of the FS' efforts

is reflected in three key documents: the Strategic Framework for Responding to Climate Change (hereafter, Strategic Framework), the National Roadmap for Responding to Climate Change (hereafter, Roadmap), and the Performance Scorecard for Implementing the Forest Service Climate Change Strategy (hereafter, the Scorecard). The Strategic Framework sets seven goals to address climate change, including advancing science, enhancing adaptive capacity, promoting mitigation, integrating policies, promoting sustainable operations, enhancing education, and establishing alliances. To achieve these goals, the FS then developed the Roadmap, centering on three types of actions: "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 as well as in human communities, through adaptation, mitigation, and sustainable consumption strategies" (USDA Forest Service, 2011c, p. 1). Finally, the Scorecard was created in 2011 to maintain accountability and to measure progress towards the goals and objectives that were established in the Strategic Framework and the Roadmap, by requiring each National Forest and Grassland (unit) to use a 10-point form to report accomplishments and plans for improvement on ten questions in four dimensions—organizational capacity, engagement, adaptation, and mitigation (Pew Center on Global Climate Change, 2010; USDA Forest Service, 2011b). All three key documents acknowledge the challenges and barriers the FS faces and recognize, in particular, that "Climate change response is not about adding on an entirely new climate change program, but rather about building climate change considerations and activities into our existing programs" (USDA Forest Service, 2011b, p. 24).

With respect to implementation, by 2015 the FS expects each unit to answer yes to at least seven of the ten Scorecard questions, with at least one yes in each dimension (USDA Forest Service, 2011b). A baseline assessment was conducted in 2011, indicating that 16% of all units answered yes to seven of the ten Scorecard questions (Cleaves, 2011). In 2012, the number was 40% and in 2013, it increased to 49% (Cleaves, 2013). While progress is obvious, there is more to be learned about why 51% of National Forests and Grasslands have not been able to meet the expectation of the FS and what can be done to help facilitate more effective implementation. When looking at an organization like the FS, we recognize that policy creation and implementation is likely to be challenging because the organization is geographically spread out with each of its units facing different challenges based on their unique environment and local conditions. This requires that any policy or guidance from the central management office—the Washington office in the case of the FS—must be written in broad terms so that it will apply to all possible conditions found in various National Forests (Kaufman, 1960). However, this puts the pressure of interpreting and translating a policy, adapting it to local conditions, and implementing it on the shoulders of the employees at the lower levels of the organization, such as those in the Ranger Districts (Kaufman, 1960; Milward, 1982; Dovers & Hezri, 2010). As Kaufman (1960) put it, from the perspective of the District Rangers, the FS looks like a funnel and they are at the throat of it with information and directions pouring down at them. The Rangers must take this information and direction and turn them into actions on the ground. Jantarasami et al. (2010) conducted a series of interviews with local National Forest and Park employees in the state of Washington and found that unclear directives from upper levels of agency

management inhibited implementation and adaptation, and in some cases, the employees were not even convinced that policy directives demanded any real action. This indicates that effective communication and sharing of information between upper levels of agency management and those on the ground are crucial for facilitating effective implementation of policy goals and objectives generated by decision makers at the top of the hierarchy.

Given the changes that have occurred in the FS and increasing policy efforts on climate change mitigation and adaptation, this study examines how the FS, as an organization, has taken on the challenge of addressing and responding to climate change with a focus on communication and knowledge transfer between different levels of agency management. This study also identifies the barriers to and opportunities for effective communication of climate information. Building upon an analysis of interview and survey data, this study suggests that a communication gap exists within the FS that has manifested itself through an inability to effectively transfer knowledge and actionable directions between the various levels of agency management. Suggestions are made at the end to inform improvement of future communication strategies.

The existing literature has examined the value of knowledge transfer within an organization, and key ways to improve that transfer, and has provided useful insights into the design of this research and sheds light on the interpretation of the data. Knowledge is influenced by values, context, and experience and can be seen as affording a framework for analyzing and integrating new information and experiences (Davenport & Prusak, 2000). Knowledge becomes ingrained in all aspects of an organization's operation, including documents, processes, routines, and organizational norms (Davenport & Prusak, 2000). An organization's store of knowledge and its ability to gain and transfer

knowledge within its units or levels of management can affect its potential to be innovative (Nonaka, 1994). This is especially important for the FS in a time when crafting innovative solutions to complex problems, such as climate change, is a top priority (USDA Forest Service, 2011a; ICCATF, 2011). As Ingram and Endter-Wada (2009) pointed out, ecosystem "resilience and adaptability in face of climate change is largely dependent upon the ways in which framing occurs and knowledge is produced and diffused" (p. 1). Given the resource management complexities climate change is introducing, the FS needs to focus on ways to increase intra-organizational knowledge transfer and sharing (Tsai & Ghoshal, 1998; Tsai, 2002), and to promote learning, problem-solving, and the creation of new insights (Goh, 2002) in order to enhance its ability to be adaptable, resilient, and innovative in its management of the National Forest System.

There are a number of ways to improve knowledge transfer within organizations, including facilitating horizontal information flow and informal social networks, incorporating local knowledge into decision making, adopting appropriate information technology, and effective leadership practices (Senge, 1990; Goh, 1998; 2002). One of the most important ways that knowledge is transferred within an organization is through horizontal information flows and informal social networks (Nonaka, 1994; Prusak, 1997; Bartlett & Ghoshal, 1998; O'Dell & Grayson Jr., 1999; Adler & Kwon, 2002; Goh, 2002; Tsai, 2002; Carlile, 2004; van Wijk et al., 2008). Prusak (1997) argues that a significant amount of the work of an organization will happen in spite of its formal structures, and the informal aspects of the organization, such as the relationships formed across units and functions, aid in accomplishing tasks quickly. This may be due to the fact that direct

interactions among individuals within an organization increase their access to the knowledge they need for specific tasks (van Wijk et al., 2008). Thus, building these relationships through direct interactions and horizontal information flow leads to increased knowledge transfer (Rowley et al., 2000; Reagans & McEvily, 2003; van Wijk et al., 2008) and these relationships are made stronger through increased frequency of communication and contact (Hansen, 1999; van Wijk et al., 2008). In the case of the FS, interdisciplinary teams are often brought together to work on complex issues, such as climate change. These interdisciplinary teams may be composed of individuals with diverse personal and scientific backgrounds, who may have different values, ways of looking at a given problem, and familiarity with specific terminology or jargon. Thus, to facilitate effective information sharing and knowledge transfer requires a certain degree of framing, translating, and finding commonalities, especially in language (Nonaka, 1994; Carlile, 2004; Ingram & Endter-Wada, 2009), and through shared experiences (Nonaka, 1994; Prusak, 1997; Schneider & Ingram, 2007).

As horizontal information flows and informal social networks are so crucial for transferring and sharing knowledge within an organization, it is important to consider why centralized organizations, such as the FS, often have difficulty in facilitating this kind of communication. Tsai (2002) asserts that centralized, formal hierarchal structure is negatively associated with knowledge transfer. Many government agencies are organized with centralized, formal hierarchical structures, which may contribute to the durability of the organization, but tend to make them less flexible and more difficult to transform (Levi, 1990). This can imply that they have more trouble gathering, communicating, and acting upon information, and may be more susceptible to loss or

distortion of information (Blomquist, 1992; Imperial, 1999). These issues may become compounded as an organization ages, and as the level of commitment of employees decreases as they become disenchanted with bureaucratic processes and are eventually replaced by employees who are more concerned with organizational stability and security than being innovative problem solvers (Mazmanian & Sabatier, 1983).

One important consideration for facilitating knowledge transfer in a centralized organization is to recognize that individuals working at the local level can provide important information and experience (Tsai, 2002; Dovers & Hezri, 2010), and that this local knowledge can be helpful in problem solving (Le Tissier et al., 2004). There has been an increasing recognition by many in centralized organizations that employees from local offices should be involved in upper-level decision-making (Kaufman, 1960; Goh, 1998). As Senge (1990) suggests, the traditional decision making model, where thinking and decisions occur at the upper level and corresponding implementation actions take place locally, must make room for thinking and decisions at all levels. This implies that effective knowledge transfer within an organization cannot simply occur in one direction, and mechanisms must be established for critical local knowledge to be transferred to upper-level decision makers who may not have personal experience with local issues.

Information technology, such as intranet and videoconferencing, can be a valuable tool for facilitating horizontal information flow, bridging the different vertical levels of an organization, highlighting the importance of local knowledge, and ultimately, improving knowledge transfer in organizations that are geographically spread out (Goh, 2002), like the FS. That is not to say, however, that having advanced information technology would guarantee the transfer of knowledge, especially when the

organization's culture does not encourage or allow for sharing (Davenport & Prusak, 2000). Further, O'Dell and Grayson Jr. (1999) caution that information technology may overload employees with information rather than knowledge. Knowledge sharing can be hindered where there are no obvious, direct rewards in place for sharing behavior, or where there is a lack of trust or a high level of competitiveness among employees or units (Goh, 2002). Thus, organizations must foster a culture of knowledge sharing and provide appropriate incentives for such behavior (Imperial, 1999; O'Dell & Grayson, 1999; Lee & Ahn, 2007).

The ability of the leadership in an organization to clearly communicate goals and objectives is an important prerequisite for effective knowledge transfer (Tsai & Ghoshal, 1998; Li, 2005). It facilitates employee buy-in and encourages them to be more accepting of new knowledge, especially when they feel the knowledge might be irrelevant to them (Li, 2005). It also makes employees feel more confident when undertaking an initiative and more likely to act in ways aligned with the goals and objectives of the organization (Goh, 1998). The challenge is that simply explaining how dire the organization's current state is will not motivate employees to act or to change. The key is to explain the juxtaposition and tension between the current and desired states, and to focus on a positive rather than negative vision to avoid a sense of powerlessness (Senge, 1990; Whyte, 1991). In the case of communicating climate change within the FS, statements that emphasize only the negative effects of human-induced climate change may be less effective than pro-stewardship messages.

Organizations with a desire to increase knowledge transfer should pay particular attention to building strong and trustworthy relationships within the organization,

particularly between the leadership and employees (Nonaka, 1994; Smith et al., 1995;

Bartlett & Ghoshal, 1998; Imperial, 1999; Tsai, 2002; Li, 2005; Lee & Ahn, 2007;

Schneider & Ingram, 2007; van Wijk et al., 2008). To do so, the leadership must be self-

reflective, be willing to take a wide perspective about how to increase the quality of

knowledge created and shared within the organization (Nonaka, 1994), be open to

feedback and potential criticism (Goh, 1998), be willing to adjust existing organizational

structures, and be able to design innovative strategies and learning processes so the goals

and objectives of the organization's policies can be clearly communicated to all

employees (Senge, 1990). Additionally, it is important for leadership to invest in

nurturing an organizational culture that encourages problem seeking as well as problem

solving (Goh, 1998; 2002), which includes experimentation or learning from experience

(Senge, 1990; Nonaka, 1994; Bartlett & Ghoshal, 1998; O'Dell & Grayson, 1999; Garvin

et al., 2008). This organizational culture will allow failures or mistakes to become

lessons and not reasons for punishing employees (Goh, 2002).

Methods

The geographic area of interest of this study was the Intermountain West region

of the United States, which includes Arizona, Colorado, Idaho, Montana, Nevada, New

Mexico, Utah, and Wyoming and contains parts of Forest Service Regions 1 through 4.

Both qualitative and quantitative data were collected in two phases through a mixed-

methods approach. Phase one consisted of key-informant interviews and the results were

used to inform the development of an Internet survey in phase two. Utah State University

(USU) Institutional Review Board approval was obtained before the start of each phase

and a letter of information was provided to all study participants explaining procedures to

protect confidentiality, the voluntary nature of the study, and any possible risks to the

respondent.

Key-Informant Interviews

Key-informant interviews are often conducted when preliminary information is

needed about a specific research subject or a population of interest to help shape the

questions for a wider survey (Tremblay, 1957). We conducted 12 key-informant

interviews between May and June of 2013 to gain a basic understanding of FS

employees' views on forest management in the face of climate change. Our interviewees

were comprised of FS employees at various levels of the agency, including three from

district offices, two from National Forest Supervisor's offices, and four from regional

offices, as well as three key personnel from the Washington office and the Rocky

Mountain Research Station. They were identified by searching FS websites and talking

to forestry researchers working at or affiliated with USU. Each interview lasted

approximately 40 minutes, was conducted via telephone or in-person, and was audio

recorded with the permission of the interviewee. Each interviewee was asked open-

ended questions about key forest management challenges and how they relate to climate

change, the current adaptive capacity of the FS and perceived barriers to climate change

adaptation, personal familiarity with climate change-related policies, current mechanisms

used by the FS to communicate climate information, and potential tools and resources

needed for improving the management of the National Forests. The key-informant

interview protocol can be found in Appendix A.

Internet Survey

The Internet survey was developed and administered following the Dillman Tailored Design Method (Dillman et al., 2008) and using Qualtrics software. The survey had six sections with 29 questions covering topics that were explored during the key-informant interviews and was designed to take approximately 30 minutes to complete. The survey questionnaire can be found in Appendix B. The survey was pre-tested with a group of forestry researchers at USU and eligible FS employees. The survey was administered as a census of all eligible FS employees in our region of interest, instead of using a sampling approach. Eligible FS employees included everyone working in the National Forest System in the Intermountain West (as previously defined) who fit our job category selection criterion, and did not include employees from Research Stations or the Washington office. The criterion was that an employee must have a direct role in the management of a National Forest and its natural resources, as a manager, specialist, scientist, technician, planner, administrator, or coordinator. Examples of the eligible job titles included but were not limited to Planner, Field Practitioner/Technician, Administrator/Director, Wildlife Specialist/Manager, Recreation Specialist/Manager, Fire/Fuels Specialist/Manager, Forestry/Timber/Vegetation Manager, Water/Hydrology/Aquatics/Fisheries Specialist/Manager, Natural Resource Specialist, Staff Scientist (e.g., Biology, Entomology, Soils, Botany, Geology, Ecology), Air Quality Specialist, Archeologist, GIS/Remote Sensing Specialist, Rangeland Specialist/Manager, Education/Public Outreach Specialist, Policy/Litigation/Appeals/NEPA Specialist, Environmental Engineer, and Social Scientist. Examples of job titles that did not meet

our criterion included IT Specialist, Purchasing Agent, Special Agent/LEO, Facilities/Maintenance Engineer, and HR Specialist. Names and job titles of all eligible FS employees were gathered from FS telephone directories, region-by-region and National Forest-by-National Forest, and were confirmed and searched using the "Employee Search" feature on the FS website to obtain the email address of each eligible employee. The telephone directory for the Bridger-Teton National Forest could not be obtained, thus no employees working at that National Forest were included in the survey. The survey was administered between September and December 2013 in two stages. The survey was sent to all regional office employees in the first stage, followed by the second stage during which the survey was sent to all forest- and district-level employees. This two-staged approach was taken to enhance response rate, by avoiding regional office employees receiving the survey invitation during transition to a new fiscal year and forest- and district-level employees receiving the survey invitation during peak wildfire season. In total, 3,475 FS employees were invited to take the survey and 1,623 responded with usable data, representing a response rate of 47%.

A software package, Stata 12.0, was used for survey data analysis. Non-response bias was tested by comparing characteristics of the first and second half of the forest- and district-level respondents, as well as by comparing forest- and district-level respondents who began the survey within the first week of the invitation with those who began during the last week before the Internet survey was closed. No significant differences were found in terms of how respondents felt about climate change as a new management challenge for the FS, how long respondents had worked for the FS, their position or job title in the FS, highest level of education they had completed, their GS-level, which

Forest Service Region they were affiliated with, and which level of management they were affiliated with. Univariate descriptive statistics were computed for all variables to assess their distributions and identify potential outliers. Bivariate statistics were calculated using chi-square tests in order to assess relationships between key variables.

Results

Profile of Survey Respondents

Of the 1,623 FS employees who responded to the Internet survey, 7% were affiliated with a regional office, 29% with a National Forest Supervisor's office, and 64% with a district office. Twenty-eight percent of respondents worked in Region 1, the Northern Region; 22% in Region 2, the Rocky Mountain Region; 26% in Region 3, the Southwestern Region; and 24% in Region 4, the Intermountain Region. Thirty percent of respondents had achieved a graduate degree, 56% had a bachelor's degree, 4% had an associate's degree, and the remaining 11% did not have a degree from higher education. Four percent of respondents were GS-6 or below, 39% were GS-7 through GS-10, 56% were GS-11 through GS-14, and less than 1% were GS-15 or above. Twelve percent of respondents were considered scientists, engineers, or GIS/Remote Sensing specialists, 69% were considered mangers or resource specialists, 11% were administrators/planners, and 7% fell into the "other" category (e.g., Landscape Architect, Inventory and Analysis Specialist, Lands and Minerals, and Renewable Resources Analyst). Finally, the average number of years respondents had worked for the Forest Service was 19 years.

Knowledge of Climate Change Policy and
Guidance

Survey respondents were asked if they were aware of any formal federal policies that require forest managers to address climate change when managing the National Forests. Formal federal policies were defined as legislative acts, agency regulations, or executive orders. They were also asked about their awareness of any federal documents, such as manuals or handbooks that provide guidance for forest mangers to address climate change when managing the National Forests. Thirty-four percent of respondents were aware of at least one formal federal policy and 36% were aware of at least one federal guidance document. We further asked respondents to name these formal federal policies or guidance documents. The National Environmental Policy Act (NEPA) was named by 166 respondents, which makes it the most frequently cited formal federal policy that requires forest management actions to take climate change into consideration. Sixty-three respondents named the Strategic Framework, the Roadmap, and/or the Scorecard as formal federal policies, while 73 respondents identified at least one of these three as a federal guidance document. Some respondents voluntarily offered comments on this section of the survey questionnaire, indicating that they were "[n]ot paying a lot of attention" or "[t]here is too much work to do to get caught up in a concept that is largely unproven."

Addressing Climate Change as a
Management Challenge

About three-quarters of respondents identified climate change as a moderate or significant concern facing forest managers in the National Forest System today, and over

60% thought climate change moderately or significantly affects the work they do. We also asked our respondents to rate the extent that "managing the National Forests to address climate change" is currently prioritized by forest managers in their management activities and planning efforts. Sixty-four percent believed it is minimally or not at all prioritized, while 36% believed it is moderately or highly prioritized. We then asked a follow-up question about the extent to which they think climate change *should* be prioritized in an ideal world. Nearly three-quarters of respondents believed that climate change should be moderately or highly prioritized by forest managers in the National Forest System, while 6% believed that it should not be prioritized at all. In addition, we asked the respondents to think broadly about the general approach to addressing climate change and to share with us how they think climate change could be addressed by the FS. A majority of respondents (62%) felt that FS employees do not necessarily need to change the way they think about their jobs, but some adjustments may be needed to better incorporate climate change into their management and planning considerations. About a quarter of respondents felt that FS employees do need to change the way they think about and do their jobs, and that a new approach is needed for managing the National Forests in order to really address climate change related issues. The remaining respondents (15%) believed that FS employees do not need to change the way they think about or do their jobs, and they just need to be able to continue doing what they are already doing or planning to do on the ground.

We observed some positive relationships between how FS employees view climate change and how they think it should be addressed. More specifically, those who felt stronger about how climate change affects the work they do personally were more

likely to view climate change as a current concern for forest managers (χ^2=1.2e+03, p<0.001), to believe that climate change should be prioritized by forest managers (χ^2=873.54, p<0.001), and to consider that the FS would need a new way to approach and address climate change (χ^2=416.96, p<0.001). FS employees' perceptions were also associated with their education level and their affiliation with certain levels of agency management. More specifically, as level of education and level of agency management a respondent is associated with increased, the more likely the respondents were to view climate change as a current concern for forest managers, to believe that climate change should be prioritized by forest managers, and to consider that the FS would need a new way to approach and address climate change (Table 2-1).

Employee perceptions were not statistically significantly associated with years of service for the FS or GS-level. Finally, there seemed to be a regional difference in certain perceptions of climate change. FS employees in Region 3 tended to be more concerned about climate change as a challenge facing forest managers (χ^2=27.01, p=0.001) and were more likely to think climate change should be highly prioritized by forest managers (χ^2=19.27, p=0.023). However, there was no statistically significant association between which region a respondent was affiliated with and how they believed climate change should be addressed by the FS, as well as whether or not they believed climate change was a new challenge facing the FS or simply a buzzword.

Communication and Information Sharing
from an Employee Perspective

When asked respondents to characterize the overall effectiveness of communication of climate change information within the FS, 11% of respondents

Table 2-1

Perceptions of climate change as they vary by level of education and agency management.

	Climate change as a current concern for forest managers	Climate change should be prioritized by forest managers	FS needs a new approach to address climate change
Education level	χ^2=56.25, p<0.001	χ^2=39.96, p<0.001	χ^2=38.79, p<0.001
Level of agency management	χ^2=23.84, p=0.001	χ^2=14.47, p=0.025	χ^2=18.03, p=0.001

considered current communication not effective at all, over half of respondents considered it minimally effective, one-third considered it moderately effective, and 3% considered it very effective. We then asked the respondents about their personal experience as the recipient of climate change information, particularly the ways in which climate change information has been communicated to them within the FS and the effectiveness of those specific communication strategies (Table 2-2). The three most common ways in which the respondents have received climate change information included informal conversations/discussions among colleagues (79%), research papers produced outside and by the FS (62% and 61%, respectively), and the E-newsletters from the Washington office (53%). The three least common ways in which the respondents have received climate change information included manuals and guidebooks (24%), webinars offered by other agencies or groups (27%), and formal email communication from a National Forest Supervisor's office (28%). In terms of the effectiveness of communication strategies used within the FS, organized meetings/conferences/workshops regarding climate change were rated as moderately or very effective by 75% of respondents who had received climate change information this way. The second and third most effective strategies of communication were research papers produced outside

the FS and by the FS Research Stations (70% of respondents, respectively), and informal conversations/discussions among colleagues (65%). The three least effective strategies of communication identified by respondents were E-newsletters from the Washington office (i.e., 70% of respondents considered it minimally or not effective), formal email communication regarding climate change from a regional office (i.e., 62% considered it minimally or not effective), and formal email communication regarding climate change from a National Forest Supervisor's office (i.e., 56% considered it minimally or not effective).

Finally, we asked the respondents about the extent to which they feel confident in their ability to share information and ideas with or to provide feedback to the various levels of agency management. A majority of respondents felt minimally confident or not confident at all (86%) in their ability to share information and ideas with or to provide feedback to the Washington office (Figure 2-1). The level of confidence increased as the level of agency management in question lowered, with 31% of respondents feeling somewhat or very confident in communicating with a regional office, 60% feeling somewhat or very confident in communicating with a National Forest Supervisor's office, and 75 % feeling somewhat or very confident in communicating with a district office. There was a negative relationship between respondents' affiliation with lower-levels of agency management and their confidence in being heard (Table 2-3). More specifically, FS employees at the district level were less confident in their ability to be heard by the regional (χ^2=187.73, p<0.001) or Washington office (χ^2=109.82, p<0.001). In addition, respondents who hold more senior positions in the FS (i.e., higher GS-levels) were more likely to feel confident in their ability to share information and provide feedback within

Table 2-2
Climate change communication strategies used within the Forest Service and their perceived effectiveness.

Potential climate change communication strategy	% of respondents who received information	Perceived effectiveness of the strategy by those who received information (%)			
		Not effective	Minimally effective	Moderately effective	Very effective
Webinars regarding climate change offered by the FS	41.1	12.0	30.5	44.5	13.0
Webinars regarding climate change offered by other agencies or groups	27.4	15.1	28.5	41.7	14.7
Research papers produced by FS research stations regarding climate change	60.5	4.8	25.6	51.2	18.4
Research papers produced outside the FS regarding climate change	62.1	5.7	24.3	52.3	17.8
E-newsletters regarding climate change from the Washington office	53.1	24.8	44.8	24.8	5.5
Formal email communication regarding climate change from a regional office	46.6	19.9	42.0	31.3	6.8
Formal email communication regarding climate change from a National Forest Supervisor's office	28.4	16.9	38.7	36.3	8.2
Organized meetings/ conferences/workshops regarding climate change	32.5	8.7	16.5	39.1	35.7
Manuals or guidebooks regarding climate change	24.1	11.3	29.2	40.0	19.5
Informal conversations/ discussions among colleagues about climate change	79.4	5.7	29.7	42.9	21.7
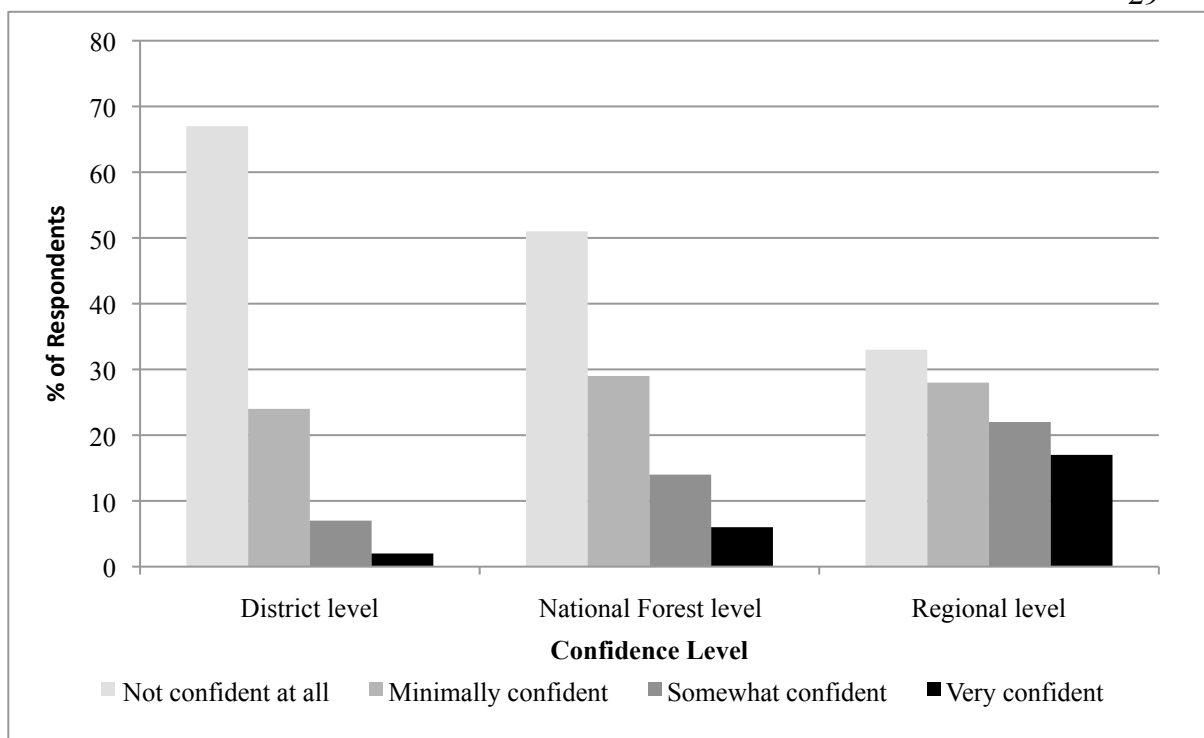
Figure 2-1
Employees' confidence in their ability to share information and ideas with or to provide feedback to the Washington office.

Table 2-3
Percentages of Forest Service employees from different levels of agency management who felt somewhat or very confident in their ability to share information and provide feedback within the Forest Service.

	% of respondents who felt somewhat or very confident in their ability to communicate with…			
	District office	National Forest Supervisor's office	Regional office	Washington office
Respondents from a district office	80%	55%	21%	9%
Respondents from a National Forest Supervisor's office	70%	71%	45%	20%
Respondents from a regional office	56%	58%	67%	39%
Chi-squared statistic	χ^2=53.08, p<0.001	χ^2=73.14, p<0.001	χ^2=187.73, p<0.001	χ^2=109.82, p<0.001

the agency (χ^2=30.15, p=0.003 for communicating with the district office; χ^2=168.17,

p<0.001 for communicating with the National Forest Supervisor's office; χ^2=198.14,

p<0.001 for communicating with the regional office; χ^2=139.47, p<0.001 for

communicating with the Washington office). The same is true for respondents with

higher levels of education (χ^2=23.41, p=0.024 for communicating with the district office;

χ^2=56.43, p<0.001 for communicating with the National Forest Supervisor's office;

χ^2=45.81, p<0.001 for communicating with the regional office), but not for

communicating with the Washington office for which there is no clear trend. Lastly,

respondents' confidence level did not seem to be associated with the number of years

they had worked for the FS.

Discussion

Only a third of respondents were aware of any formal federal policies or guidance

documents regarding climate change, and even fewer could provide an example of such

policies or documents, including the aforementioned three key documents as part of the

FS' effort to address climate change. This seems to suggest ineffective communication

within the FS about climate change related initiatives. As previous studies have

suggested, the leadership of an organization must be able to clearly communicate the

organization's goals and objectives (Tsai & Ghoshal, 1998; Li, 2005). In the case of the

FS, absence of such communication will hinder effective knowledge transfer about

climate change and undermine relevant management efforts occurring on the ground

(Goh, 2002). Thus, the Washington office needs to develop new strategies to increase

awareness of both formal climate change policies and informal guidance documents

among its employees, especially targeting those at the district level who are largely

responsible for implementing management plans and relevant climate change mitigation and adaptation measures (Kaufman, 1960).

A majority of respondents believed that climate change is a concern for forest managers in general, but does not necessarily affect the work they do personally, although they tended to agree that more work needs to be done to make climate change a high priority for the FS in the future. These perceptions present both opportunities and challenges. The opportunities reside within the desire FS employees have to further address climate change in the management of National Forests. The challenges reside within the sense that although climate change is important, it is effecting the work of someone else and, we might infer, for someone else to deal with. In order to further explore the opportunities and address the challenges, the FS leadership will need to develop strategies to better communicate with their employees and help them see how climate change relates to management on the ground, and the various ways they can contribute to addressing climate change in the work they do (Senge, 1990). Finding ways to relate the idea of climate change to the specific resource conditions within a National Forest or to the particular employee specializations might increase employee buy-in and give employees more confidence in their ability to address climate change. It is also important to use local examples in future communication to make climate change information more relatable to employees at lower levels of agency management. These local examples may also stimulate voluntary contacts and exchanges across different Ranger Districts or National Forests and promote horizontal information flow through informal conversations and discussions within the agency.

As previous studies have suggested, horizontal information flow through informal social networks is an important mechanism of transferring knowledge within an organization (Nonaka, 1994; Prusak, 1997; Bartlett & Ghoshal, 1998; O'Dell & Grayson, 1999; Adler & Kwon, 2002; Goh, 2002; Tsai, 2002; Carlile, 2004; van Wijk et al., 2008). This is confirmed by our study results. Within the FS, informal conversations and discussions were identified as the most common and one of the most effective ways for employees to receive climate change information. Thus, these channels of information and knowledge sharing should be maintained and reinforced. To do so, the FS could host employee discussion boards on its intranet website or organize lunch meetings, camping trips, after-hours get-togethers, or other informal gatherings and events for those who are interested in climate change to discuss with each other, share experiences, and to hear from invited guest experts on related topics in a friendly, communicative environment. It would be useful, however, to have someone with expertise on climate change related topics monitor the online discussion boards or attend those organized informal meetings to ensure the knowledge and ideas shared are scientifically accurate. This also points to a potential area for future research. Our study asked respondents to rate the self-assessed effectiveness of each climate change information communication strategy. More attention is needed to investigate the quality of information received in order to evaluate the actual effectiveness of each strategy. For example, if a significant portion of climate change information shared among peers through informal conversations or discussions is inaccurate, this communication strategy may in fact cause more harm than good even though it is popular among FS employees because it will perpetuate inaccurate

information. In this case, interventions will be needed to correct previously disseminated misconceptions and to improve information quality for future communication.

One method of communication that was considered highly effective but not frequently used was organized meetings, conferences, and workshops. Although under the current economic conditions, the FS' ability to send employees to attend conferences in person may be limited. One possible idea is to take advantage of various information technologies so that the FS and its employees can organize and participate in videoconferences and webinars to obtain scientific and professional information and training about climate change. This approach will also be less costly and less time consuming for the FS than paying its employees to travel. Organized videoconferencing can also be used to facilitate networking by connecting employees located in different offices and inviting them to share their knowledge about climate change and stories of addressing it so that horizontal information flow may occur among those who would not normally interact. Finally, organized meetings through videoconferencing can serve as additional opportunities for FS leaders to communicate their vision for addressing climate change in the National Forest System.

The strategy of communication considered least effective but frequently used was email communication from all three levels of agency management beyond the district offices, namely the Washington, regional, and National Forest Supervisor's offices. One respondent commented, "I have 500 emails in my inbox. If the Chief"s office sends me something to read on climate change, I feel like I have to read it on my own time if I am interested, which I am." Another respondent expanded on this idea by saying "[a]s a land manager at the local level, it makes my ability to translate climate change issues to on-

the-ground applications extremely difficult, given all the different viewpoints and amount of information." As previous research has indicated, new technologies—like email—are quick and convenient, but that convenience can lead to information overload rather than effective knowledge transfer (O'Dell & Grayson, 1999). Thus, all levels of the FS need to be judicial in their use of email to share important climate change information and more emphasis may need to be put on other communication strategies that are more personal, such as previously mentioned lunch meetings or videoconferencing.

Interestingly, the majority of FS employees did not feel confident in their ability to share information and ideas or to provide feedback to the Washington office and be heard. This lack of confidence was shared among employees at the regional, National Forest, and district levels. Combined with the sentiment shared among FS employees in terms of the overwhelming amount of information constantly being sent to them from upper levels of agency management, this lack of confidence indicates that there is not only an issue with too much information flowing from top to bottom, but also an issue with information not flowing up the hierarchical structure of the FS. A comment from a respondent captured this problem precisely, stating that "Nobody asks the field staff what they have to say about climate change or how it may be affecting us. Nobody asks what our publics are telling us or what active projects are being conducted by other groups on FS lands regarding this topic." To address this unidirectional information flow and the potential resentment among lower-level employees, more efforts are needed to understand local conditions and local solutions within the context of climate change and to incorporate that local knowledge into agency-wide decision-making processes with respect to mitigating and adapting to climate change. Previous research has discussed

the value of local knowledge and experience in institutions and organizations (Kaufman, 1960; Tsai, 2002; Le Tissier et al., 2004; Dovers & Hezri, 2010). It is in the interest of the FS to take advantage of the knowledge and experience of its employees, particularly at the National Forest and Ranger District levels, by providing greater opportunities for feedback. One example of such opportunities may be periodical videoconferences between the Washington office and various National Forest Supervisor's or Ranger District offices to understand local conditions, innovations, and challenges. The key is to make it an empowering process for lower-level employees rather than further burdening these employees with additional work. The FS should try its best to avoid a sense of frustration shared by many of our study participants from various district offices that they "are rarely invited to participate in substantive meetings to discuss issues such as climate change or even be afforded the opportunity to attend training sessions on the subject." This kind of frustration can have a negative impact on employee morale. One respondent commented, "This attitude [of disregarding lower-level employees] from the Washington office generates a feeling that you have to sit and wait for the upper administration to tell you what to do. This also generates a sense of apathy and disengagement among employees."

Conclusion

As climate change continues to pose significant challenges to the management of the National Forest System, it is increasingly important to understand how the FS has addressed climate change, how effective those efforts have been, and how to improve those efforts in the future. The results of this study shed light on the communication and

knowledge sharing aspect of the FS' efforts and can be used to aid the FS in addressing

the current communication gap as well as facilitate the development of effective

communication strategies targeting district- and National Forest-level employees

responsible for implementing climate change adaptation policies and plans on the ground.

The FS needs to simplify and prioritize the ways in which they communicate climate

change information and policies within the agency. Efforts are needed to enhance

knowledge transfer and sharing both horizontally and vertically with an emphasis on

incorporating local perspectives and knowledge into upper-level climate change-related

decision-making processes.

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CHAPTER 3

MANAGING THE NATIONAL FORESTS IN A CHANGING CLIMATE:

PERSPECTIVES ACROSS AN ORGANIZATIONAL HIERARCHY[2]

Abstract

Climate change is currently causing substantial challenges for the USDA Forest Service (FS) and poses a real threat to the agency's ability to fulfill its mission. To address these challenges and present a strategy for adapting to and mitigating the effects of climate change, the FS created three key documents: the Strategic Framework for Responding to Climate Change, the National Roadmap for Responding to Climate Change, and the Performance Scorecard. However, based on a review of literature and self-monitoring assessments completed by the FS, implementation of these new strategies and plans to address climate change has been weak. Through a series of key-informant interviews and a wider Internet survey, this study assesses FS employee perceptions regarding climate change and forest resilience, constraints to climate change adaptation efforts as well as tools and resources needed to address climate change through forest management in the future. To achieve more successful implementation of climate change adaptation and mitigation strategies, the FS must find innovative ways to engage employees in climate change related management and planning initiatives, support the work of forest managers through the Forest Service's in-house research capacity and various advanced information technologies, and make sure upper-level decision makers take local knowledge, experiences, needs, and concerns into consideration, to better

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[2] This chapter was co-authored by Jamie Laatsch and Dr. Zhao Ma

identify common ground where they can work with agency professionals to incorporate

climate change considerations into the management of National Forests.

Introduction

  The USDA Forest Service (2008) has acknowledged that climate change poses a

threat to the agency's ability to fulfill its mission to "[s]ustain the health, diversity, and

productivity of the Nation's forests and grasslands to meet the needs of present and future

generations" (p. 2). The Forest Service has also documented current impacts observed on

the National Forests and Grasslands that are driven, at least in part, by the changing

climate. These include increased size and severity of wildfires (Marlon et al. 2012), bark

beetle population outbreaks (Bentz et al. 2010), decreased aspen resilience (Rogers et al.

2013), and shifting water availability associated with changes in the amount and forms of

precipitation, as well as the timing and intensity of precipitation (Barnett et al. 2005,

USDA Forest Service 2008). In the western United States, more specifically, the most

significant impact of climate change was found to be a large reduction in mountain snow

pack and a substantial shift in stream-flow seasonality, which means earlier spring runoff

and drier summers (Barnett et al. 2005, Mote et al. 2005, Stewart et al. 2005). These

changes in precipitation patterns, coupled with projected increases in winter and spring

temperatures, will have substantial effects on the hydrology of the region and pose

serious challenges to plant and animal life and how National Forests and Grasslands

should be managed in such a changing climate (Mote et al. 2005).

  In an effort to respond to climate change, the Forest Service has created a suite of

policies and plans. The backbone of the Forest Service's efforts is reflected in three key

documents: the Strategic Framework for Responding to Climate Change (hereafter,

Strategic Framework), the National Roadmap for Responding to Climate Change

(hereafter, Roadmap), and the Performance Scorecard for Implementing the Forest

Service Climate Change Strategy (hereafter, the Scorecard). The Strategic Framework

sets seven goals to address climate change, including advancing science, enhancing

adaptive capacity, promoting mitigation, integrating policies, promoting sustainable

operations, enhancing education, and establishing alliances. To achieve these goals, the

Forest Service then developed the Roadmap, centering on three types of actions:

"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 as well

as in human communities, through adaptation, mitigation, and sustainable consumption

strategies" (USDA Forest Service 2011b, p. 1). Finally, the Scorecard was created in

2011 to maintain accountability and to measure progress towards the goals and objectives

that were established in the Strategic Framework and the Roadmap, by requiring each

National Forest and Grassland (unit) to use a 10-point scorecard to report annually their

accomplishments and plans for improvement on ten questions in four dimensions—

organizational capacity, engagement, adaptation, and mitigation (Pew Center on Global

Climate Change 2010, USDA Forest Service 2011a). The guidance document that

accompanies the Scorecard emphasizes that even though the units are responsible for

completing and reporting the Scorecard, all employees play an important part in this

process as various Scorecard elements need to be carried out at different levels of the

agency (USDA Forest Service 2011a). All three key documents acknowledge the

challenges and barriers the Forest Service faces and recognize, in particular, that "Climate change response is not about adding on an entirely new climate change program, but rather about building climate change considerations and activities into our existing programs" (USDA Forest Service 2011a, p. 24). These documents demonstrate that the Forest Service leadership understands that the Forest Service does not have the resources or capacity to take on climate change as a brand new or additional initiative; instead, actions to adapt to climate change must be incorporated into existing agency operations and activities.

After the scorecard was created, the Forest Service set a goal that 100% of the units should be able to answer "yes" to seven of the ten questions listed in the Scorecard by 2015 (USDA Forest Service 2011a). When a baseline assessment was conducted in 2011, approximately 16% of the units had met the goal (Cleaves 2011). In 2012, a significant increase occurred and 40% of the units were able to meet the goal, and by 2013, 49% of the units had met the goal (Cleaves 2013). While progress is obvious, the question remains as to why over half of the National Forests and Grasslands have not been able to sufficiently address questions raised in the Scorecard and what can be done to help facilitate more effective implementation.

Previous studies have suggested federal land management agencies, including the Forest Service, are generally struggling with implementing their climate change adaptation policies and plans (Jantarasami et al. 2010, Berrang-Ford et al. 2011, Archie et al. 2012, Ellenwood et al. 2012). A number of barriers that hinder adaptation implementation at the institutional level have been identified, including a lack of climate information at relevant scales, information uncertainty about future climatic conditions,

budget constraints, and multiple or conflicting values within an agency (Koontz and Bodine 2008, Archie et al. 2012, Ellenwood et al. 2012, Bierbaum et al. 2013). More research is needed to examine these barriers from the perspective of on-the-ground forest managers as they are responsible for addressing climate change in their management practices on a day-to-day basis and to identify the tools and resources that will enable forest managers to better adapt to the changing climate. Building upon existing literature, this paper will examine how employees in the Forest Service view climate change and its interaction with other forest management challenges, how they address climate change in their current work, and how they perceive barriers to and opportunities for adapting to climate change within the National Forest System. This paper will compare employees' perspectives across various levels of agency management (i.e., district office, National Forest Supervisor's office, regional office). By focusing on employees at different levels in the Forest Service, this study will provide practical insights into the internal struggles of a large natural resource agency within the context of global environmental change. The results of the study will not only contribute to the Forest Service's continuing efforts to adapt to climate change but also reveal important considerations that can benefit other natural resource agencies in addressing challenges associated with a changing climate.

Methods

The geographic focus of this study is the Intermountain West region, comprised of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, which, in terms of Forest Service Regions, includes parts of Regions 1, 2, 3, and 4. Both qualitative and quantitative data were collected, using a mixed-methods approach. Utah

State University Institutional Review Board (IRB) approval was obtained before data

collection began. First, 12 key-informant interviews were conducted between May and

June of 2013 to gain a basic understanding of Forest Service employees' views on forest

management in the face of climate change. Our interviewees were comprised of Forest

Service employees at various levels of the agency, including three from district offices,

two from supervisor's offices, four from regional offices, and three from the Washington

office and the Rocky Mountain Research Station. They were identified by searching

Forest Service websites and talking to forestry researchers working at or affiliated with

USU. Each interview lasted approximately 40 minutes, and each interviewee was asked

open-ended questions about key forest management challenges and how they relate to

climate change, the current adaptive capacity of the Forest Service and perceived barriers

to climate change adaptation, personal familiarity with climate change-related polices,

current mechanisms used by the Forest Service to communicate climate information, and

potential tools and resources needed for improving the management of the National

Forests. The key-informant interview protocol can be found in Appendix A.

     The survey was developed and administered following the Dillman Tailored

Design Method (Dillman et al. 2008) and using Qualtrics software. The survey has six

sections with 29 questions covering topics including forest management challenges,

perceptions of forest management in a changing climate, policies and guidance for forest

management in a changing climate, limiting factors and support needed for forest

management in a changing climate, and communication of climate change information

within the Forest Service. The surveys were designed to take approximately 30 minutes

and the survey protocol can be found in Appendix B. The survey was administered as a

census of all eligible Forest Service employees in our region of interest, instead of using a

sampling approach. Eligible Forest Service employees included everyone working in the

National Forest System in the Intermountain West who fit our job category selection

criterion. The criterion was that an employee must have a direct role in the management

of a National Forest and its natural resources, as a manager, specialist, scientist,

technician, planner, administrator, or coordinator. Examples of the eligible job titles and

job titles that did not meet our criterion can be found in Laatsch and Ma (*In review*).

Names and job titles of all eligible Forest Service employees were gathered from Forest

Service telephone directories and were confirmed and searched using the "Employee

Search" feature on the Forest Service website to obtain the email address of each eligible

employee. A telephone directory for the Bridger-Teton National Forest could not be

obtained, thus no employees working at that National Forest were included in the survey.

The survey was administered between September and December 2013. A total of 3,475

Forest Service employees were invited to take the survey and 1,623 responded with

usable data, representing a response rate of 47%.

A software package, Stata 12.0, was used for survey data analysis. Non-response

bias was tested by comparing characteristics of the first and second half of the forest- and

district-level respondents, as well as by comparing forest- and district-level respondents

who began the survey within the first week of the invitation with those who began during

the last week before the online survey was closed. No significant differences were found

in terms of how respondents felt about climate change as a new management challenge

for the Forest Service, how long respondents had worked for the Forest Service in years,

their position or job title in the Forest Service, highest level of education they had

completed, their GS-level, which Forest Service Region they were affiliated with, and which level of management they were affiliated with. Univariate descriptive statistics were computed for all variables to assess their distributions and identify potential outliers. Bivariate statistics were calculated using Chi-square tests in order to assess relationships between key variables.

Results

Profile of Survey Respondents

Of the 1,623 survey respondents, 7% were affiliated with a regional office, 29% with a National Forest Supervisor's office, and 64% with a district office. Twenty-eight percent of respondents were affiliated with Forest Service Region 1, the Northern Region; 22% affiliated with Region 2, the Rocky Mountain Region; 26% affiliated with Region 3, the Southwestern Region; and 24% affiliated with Region 4, the Intermountain Region. Thirty percent of respondents had a graduate degree, 55% had a bachelor's degree, 4% had an associate's degree, and the remaining 11% did not have a degree from higher education. On average, respondents had worked for the Forest Service for about 19 years. We also asked respondents to report their GS-level, which is the predominant pay scale within the United States Federal Civil Service. Higher GS-levels generally indicate higher income and more senior positions within a federal agency. Four percent of respondents were GS-6 or below, 39% were GS-7 through GS-10, 56% were GS-11 through GS-14, and less than 1% were GS-15 or above. In terms of respondents' technical background and expertise, 12% of respondents could be categorized as scientists, engineers, or GIS/Remote Sensing specialists, 69% as mangers or resource

specialists, 11% as administrators or planners, and 7% fell into the "other" category (e.g., Landscape Architect, Inventory and Analysis Specialist, Lands and Minerals, and Renewable Resources Analyst).

Perceptions of Climate Change and
Forest Resilience

About three-quarters of respondents identified climate change as a moderate or significant concern facing forest managers in the National Forest System today, and over 60% thought climate change moderately or significantly affects the work they do personally. A majority of respondents (63%) considered climate change as a new challenge for the Forest Service, presenting new conditions and issues unlike the past; while 37% thought that climate change is not a new challenge, but mostly a new phrase or buzzword. In addition to the general perceptions of climate change, we asked respondents to detail the various forest management challenges they face in their work and the extent to which they think these challenges are related to or influenced by climate change. A wide range of challenges were identified by over half of respondents, including invasive species (96%), insect infestations (96%), soil erosion (95%), issues in wildland-urban interface areas (94%), policy constraints (93%), changes in wildfire regimes (90%), changes in species composition (87%), changing weather (86%), stakeholder conflicts (86%), water quantity/quality issues (84%), wildlife habitat loss (83%), and lack of a good timber market (78%). Among these identified challenges, three seemed to be particularly concerning to most respondents with respect to how they interact with climate change. Specifically, 77% of respondents considered changes in wildfire regimes, 70% considered insect infestations (e.g., bark beetle), and 65%

considered changes in species composition (e.g., aspen die back) to be moderately or significantly related to or influenced by climate change.

We also asked respondents to rate the extent to which "managing the National Forests to address climate change" is prioritized by forest managers in their management activities and planning efforts. Sixty-four percent considered it minimally prioritized, while 36% considered it moderately or highly prioritized. When asked about the extent to which climate change *should* be prioritized by forest managers in an ideal world, nearly three-quarters of respondents thought that climate change *should* be considered a moderate or high priority in the management of the National Forest System. In the literature, climate change has been discussed as a threat to forest resilience (Macqueen & Vermeulen 2006, Johnstone et al. 2010, Rogers et al. 2013). Thus, we asked our respondents to think about the nature of the relationship between "managing the National Forests to enhance forest resilience" and "managing the National Forests to address climate change." An overwhelming 95% of respondents believed that forest resilience *should* be moderately or highly prioritized by forest managers in their management activities and planning efforts. And over 60% of respondents believed that although managing the National Forests to address climate change and to enhance forest resilience are not exactly the same, there is a strong relationship between the two and one cannot enhance forest resilience without addressing climate change, and vice versa.

Current Efforts, Constraints, and
Opportunities for Addressing Climate
Change

Respondents were asked about the activities they have engaged in with respect to

dealing with and/or planning for climate change in the work they do. Among the eight

items provided in the survey, 80% of respondents identified that they have taken part in

conversations about climate change, whether formal or informal. About three-quarters of

respondents have taken climate change into consideration while managing the National

Forests and have taken actions to build resilience into the forest they manage. Thirty-

nine percent have made changes to actions taken on the ground to address a climate

change related issue, 23% have engaged in making changes to forest management plans

to incorporate climate change considerations, and 19% have taken part in

projects/collaborations specifically designed to address climate change. Fewer

respondents have engaged in conducting climate change related scientific research or

have contributed to a new handbook, manual or other technical publication to help

managers plan for and adapt to climate change (8% and 7%, respectively).

Respondents also identified a number of constraints limiting their ability to

address climate change in the work they do (Figure 3-1). The top three constraints were

lack of time due to excessive workload, insufficient funds/budget, and lack of personnel

for the different management responsibilities in their unit. Approximately 80% of

respondents identified at least one of these three as moderate or significant constraints. A

majority of respondents also considered no additional funding specifically for climate

change work (77%) and lack of direction for on-the-ground action/management (65%) as

moderate or significant constraints. Interestingly, 23% of respondents thought that their

ability to address climate change is constrained by the fact that dealing with climate

change is not part of their performance evaluation (i.e., viewing it as a moderate or

significant constraint) and 15% felt that their supervisor does not care enough about

climate change for them to feel motivated to do something about it (i.e., viewing it as a
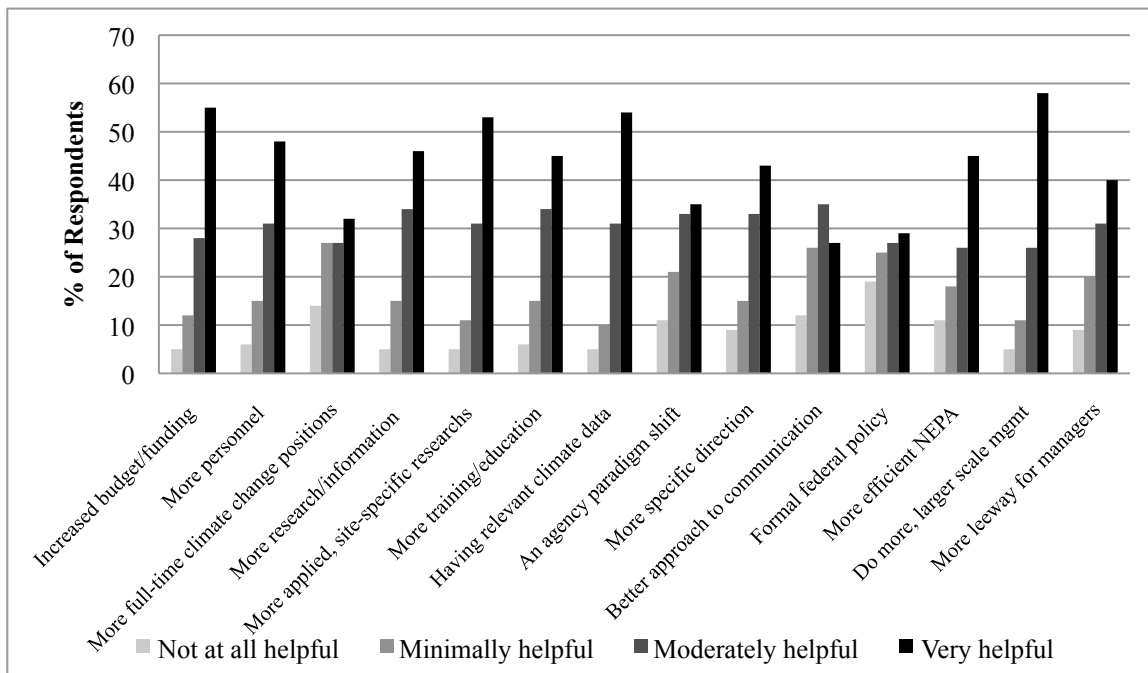
moderate or significant constraint).

Finally, respondents were asked to identify what would help forest managers

better address climate change when managing the National Forests (Figure 3-2). Among

the 14 items describing opportunities within the Forest Service, eight were identified as

being moderately or very helpful by more than three-quarters of respondents. These

included 1) having relevant climate data for a specific National Forest or district (85%),

2) more applied, site-specific research based on managers' needs (85%), 3) ability to do

more, larger scale management, such as thinning and prescribed burns (84%), 4)

increased budget/funding (83%), 5) more research/information regarding climate change

(80%), 6) more training/education about dealing with climate change and relevant

management options (79%), 7) more personnel (79%), and 8) more specific direction for

on-the-ground action/management (76%). Interestingly, no item was considered

particularly unhelpful.

**Comparing Perspectives across Various
Management Levels**

We further compared respondents' perceptions of climate change, their current

efforts to address climate change, and perceived barriers and opportunities across three

levels of agency management within the Forest Service, namely the district, forest, and

regional levels. There are several statistically significant differences in how Forest
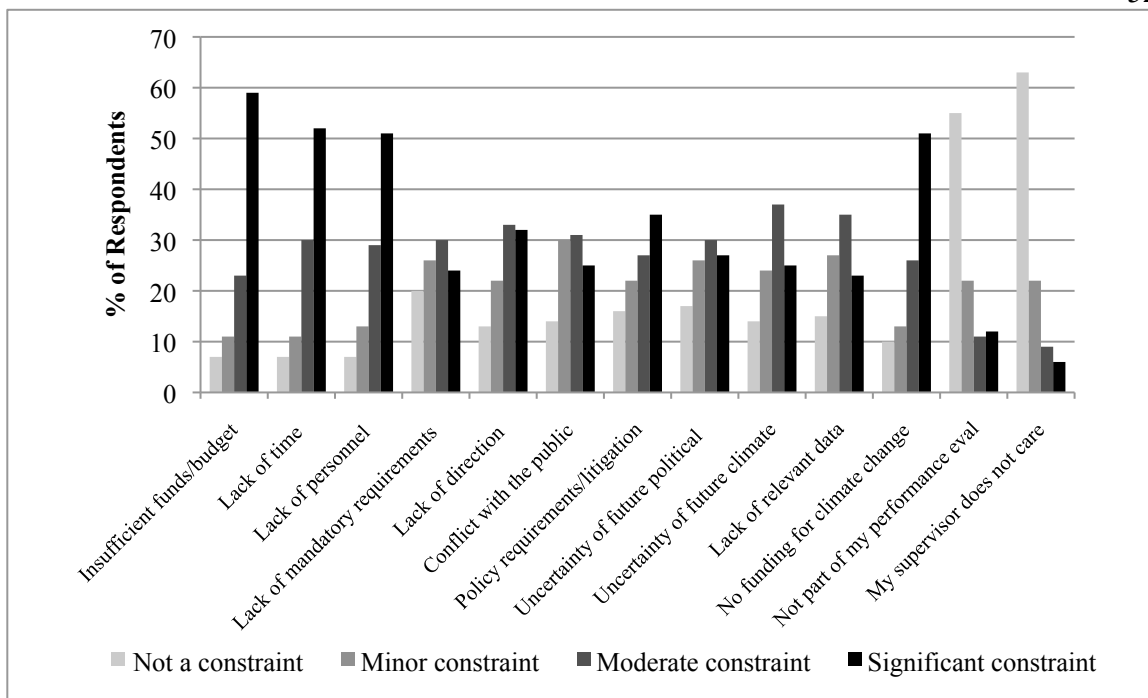
Figure 3-1. Employee perceptions regarding constraints that limit their ability to address climate change in the work they do.

Figure 3-2. Employee perceptions regarding tools and resources that would help forest managers better address climate change when managing the National Forests.

Service employees at different levels of agency management view climate change. For example, regional-level employees tended to be more likely to consider climate change as a moderate or significant concern for forest managers within the National Forest System than did employees at the forest or district levels (χ^2=23.84, p=0.001). Regional- and forest-level employees tended to be more likely to consider climate change a new challenge facing the Forest Service rather than a buzzword than did their colleagues at the district level (χ^2=23.56, p<0.001). These regional- and forest-level employees were also more likely to think climate change moderately or significantly affects the work they do personally (χ^2=22.20, p=0.001). In terms of the general approach to addressing climate change, regional-level employees were more likely to believe that they need to change the way they think about and do their jobs and a new approach is needed for managing the National Forests in order to really address climate change related issues, compared to employees at lower levels of the hierarchy (χ^2=18.03, p=0.001). On the other hand, district-level employees seemed to be more likely to believe that they do not need to change the way they think about or do their jobs and they just need the ability to continue to do what they are already doing and/or planning to do, compared to employees at upper levels of the hierarchy (χ^2=18.03, p=0.001). Overall though, a majority of respondents at each level of agency management (62%, 61%, and 56%, respectively) believed that although they do not necessarily need to change the way they think about their jobs, some adjustments may be needed to better incorporate climate change into their management and planning considerations.

Another interesting finding about differences in Forest Service employees' perceptions of climate change relates to how they view climate change and forest

resilience at different levels of agency management. Respondents associated with upper-level management tended to be more likely to believe that managing the National Forests to address climate change should be a priority for forest managers (χ^2=14.47, p=0.025), while no statistically significant difference was observed among respondents across the organizational hierarchy regarding the need to prioritize managing the National Forests to enhance forest resilience (χ^2=6.05, p=0.417).

In addition, Forest Service employees seemed to have different understandings with respect to a few specific barriers and opportunities in terms of enhancing the ability of forest managers within the National Forest System to address climate change (Table 3-1). More specifically, the higher the level of an agency employee, the less likely s/he would consider lack of mandatory requirements to address climate change (χ^2=16.04, p=0.014), policy requirements/litigation (χ^2=47.25, p<0.001), and uncertainty of future political conditions (χ^2=15.10, p=0.020) as moderate or significant constraints. No other statistically significant difference was observed with respect to other constraints identified across the organizational hierarchy. Similarly, there was a generally shared vision with respect to opportunities for better addressing climate change in the National Forest System and a statistically significant difference was only observed among respondents at different levels of agency management with respect to four out of the 14 items listed in our survey (Table 3-1). Specifically, the lower the level of agency management an employee is associated with, the more likely s/he would believe more specific direction for on-the-ground action/management (χ^2=12.76, p=0.047), more efficient NEPA and related requirements (χ^2=16.56, p=0.011), ability to do more, larger scale management (χ^2=15.31, p=0.018), and more leeway for managers to use their own

Table 3-1. Comparison of Forest Service employees' perceptions of climate change, their current efforts to address climate change, and perceived barriers and opportunities across three levels of agency management.

	% of respondents at the following levels who agreed with the listed statements about climate change			Chi-square statistic
	Regional Office	National Forest	Ranger District	(p-value)
Perceptions of Climate Change				
Climate change is a moderate or significant concern facing forest managers within the National Forest System.	89%	82%	76%	23.84 (0.001)
Climate change is a new challenge, presenting new conditions and issues unlike the past, rather than just a new phrase or buzzword.	74%	71%	59%	23.56 (<0.001)
Climate change moderately or significantly affects the work I do within the National Forest System.	68%	67%	58%	22.20 (0.001)
We need to change the way we think about and do our jobs. We need a new approach in the way we manage the National Forests to really address climate change related issues.	34%	28%	21%	13.21 (0.001)
We do not need to change the way we think about or do our jobs. We just need the ability to continue to do what we are already doing and/or planning to do on the ground.	10%	11%	17%	8.72 (0.013)
Managing the National Forests to address climate change should be moderately or highly prioritized by forest managers in their management activities and planning efforts.	82%	77%	69%	14.47 (0.025)
Managing the National Forests to enhance forest resilience should be moderately or highly prioritized by forest managers in their management activities and planning efforts.	97%	96%	95%	6.05 (0.417)
Constraint to respondents' ability to address climate change in the work they do				
Lack of mandatory requirements to address climate change is a moderate or significant constraint.	38%	53%	57%	16.04 (0.014)
Policy requirements/litigation (e.g., NEPA) is a moderate or significant constraint.	48%	53%	68%	47.25 (<0.001)
Uncertainty of future political conditions (e.g., potential changes in legislation) is a moderate or significant constraint.	44%	56%	59%	15.10 (0.020)
Opportunities that enable forest managers to better address climate change when managing the National Forests				
More specific direction for on-the-ground action/management would be moderately or very helpful.	69%	75%	77%	12.76 (0.047)

More efficient NEPA and related requirements would be moderately or very helpful.	64%	71%	73%	16.56 (0.011)
Ability to do more, larger scale management (e.g., thinning, prescribed burns) would be moderately or very helpful.	77%	83%	85%	15.31 (0.018)
More leeway for managers to use their own discretion would be moderately or very helpful.	58%	65%	75%	36.38 (<0.001)

discretion (χ^2=36.38, p<0.001) were moderately or very helpful for forest managers in their efforts to address climate change.

Discussion

A number of studies have examined institutional barriers and potential for addressing climate change in several natural resource agencies in the United States (Koontz and Bodine 2008, Archie et al. 2012, Ellenwood et al. 2012, Bierbaum et al. 2013). This study further explores challenges facing forest managers within the context of climate change, efforts taken by forest managers to address climate change, and the perceived constraints and opportunities for more effectively incorporating climate change into the day-to-day management of National Forests, with a focus on individual perspectives within the Forest Service. One noteworthy result is that although the majority of Forest Service employees were concerned about climate change and how it affects themselves and forest managers in general, nearly 40% of employees surveyed viewed climate change as just a new phrase or buzzword. This attitude creates both challenges and opportunities for the Forest Service to effectively engage its employees in climate change-related management and planning initiatives. Although at the institutional level the Forest Service has recognized the need to build climate change considerations and activities into its existing programs (USDA Forest Service 2011a), the

question remains as to how to operationalize such integration. Our study results provide

some directions for future efforts. For example, a majority of Forest Service employees

have observed and/or experienced changes in wildfire regimes, increased insect

infestations, and changes in species composition in their job, and were aware of how

these changes may be related to or influenced by climate change. Thus, instead of

emphasizing how climate change is a new challenge and presents new conditions and

issues unlike the past, more efforts may be needed to document how climate change

interacts with the aforementioned forest management challenges and to identify strategies

that can help forest managers better account for climate change when addressing those

challenges that concern them. Another opportunity resides within forest managers'

shared vision and recognized need for enhancing forest resilience in their management

activities and planning efforts. As pointed out in the literature (Macqueen and

Vermeulen 2006, Johnstone et al. 2010, Rogers et al. 2013) and by forest managers we

surveyed, one cannot enhance forest resilience without addressing climate change, and

vice versa. Thus, the Forest Service may want to explore ways to discuss climate change

related management and planning initiatives within the framework of forest resilience in

order to garner support from and motivate forest managers who simply view climate

change as a buzzword.

Our study results also suggest that current efforts for addressing climate change

within the National Forest System have been mostly about engaging in conversations and

thinking about climate change. Relatively little has been done on the ground with respect

to adapting current management actions or making changes to the forest management

plan of each National Forest, and even less has been done to undertake projects specially

designed to address climate change. Thus, the question becomes what can be done to bring the idea of climate change from a conceptual level to a practical level within the Forest Service. When examining the identified issues that constrain Forest Service employees' ability to address climate change in the work they do, one may get discouraged quickly. Excessive workload, insufficient funding, and lack of personnel, as suggested by our study and some previous research, are all issues inherent to the current political and economic environments and are beyond the control of the Forest Service, or any individual natural resource management agencies in the United States. However, we believe there are strategies that can improve forest managers' willingness and ability to address climate change. As shown by our survey, the majority of Forest Service employees (71% of respondents) work for the Forest Service because they are motivated by knowing that they are working to sustainably manage and conserve the environment and natural resources. As one respondent commented, "Most individuals in this agency manage the workload of three people practically. I am continually amazed at the drive that keeps these people going and am quite certain it is a love of the land and our country and people that fuels some of them, whether they express that or not, their enduring efforts show it. I am also not surprised when I see burnout." Thus, the key is to effectively and continuously communicate with forest managers that what they do on the ground to address climate change does matter to the sustainability of National Forests, and to support their work within the reach of Forest Service, both morally and practically. Our study results suggest a number of opportunities for supporting forest managers that may not require substantial financial investment from the Forest Service. For example, many voiced their need for more scale-relevant climate data (e.g., National Forest) and

more applied, site-specific research, which could be potentially addressed by Forest Service Research Stations across the country if appropriate incentives, funding, and directions can be provided to in-house research scientists. Many forest managers identified the need for more training about relevant management options for dealing with climate change and more specific directions for on-the ground actions. Although few resources may be available to support employees to travel to workshops or visit demonstration sites and projects, opportunities do exist in advanced information technologies, such as webinar, videoconferencing, virtual tour, and chat room. Deliberate efforts are needed to take advantage of these information technologies and to establish platforms where forest managers can obtain new knowledge, exchange information, "see" and learn from each other's successes and mistakes, and feel connected, supported, and empowered within a network of peers (and supervisors) within the National Forest System. These efforts may also help motivate forest managers and boost their morale, which is particularly important giving that some Forest Service employees feel that their supervisor does not care enough about climate change for them to feel motivated to do something about it.

Finally, our results suggest two perception gaps between upper-level and lower-level Forest Service employees. The first perception gap relates to how they conceptualize and approach climate change. Those at the regional and forest levels seemed to be more concerned about climate change and more likely to conceptualize it as a new challenge presenting new conditions and issues unlike the past than did their counterparts at the district level. Consequently, these upper-level employees were more likely to feel a need for forest managers to rethink their job and approach it differently.

This perception was not shared by district-level employees, who were more likely to want to be able to continue what they do and/or plan to do. The second perception gap relates to how Forest Service employees view barriers to and opportunities for addressing climate change. Forest managers on the ground seemed to be more concerned about uncertainties related to the current policy environment and future political conditions than did their upper-level counterparts. Consequently, they were more likely to believe that opportunities for addressing climate change exist in their own jurisdiction; thus, they want more leeway to use their own discretion and more flexibility to carry out large-scale management projects as they were once able to do before the age of environmental regulations and public opinions. Although easier said than done, innovative strategies and structures need to be developed to bridge these gaps if the Forest Service wants to enhance its ability to manage the National Forests in a changing climate. We believe that recognizing these gaps is a step in the right direction. More needs to be done to facilitate effective communication across the organizational hierarchy of the Forest Service and to find middle ground where upper-level decision makers and local forest managers can share their vision and work together to incorporate climate change into the management of National Forests. As previously discussed, advanced information technologies may be helpful tools, but more importantly, upper-level decision makers need to listen to forest managers, who spend significant time out in the forest, take their knowledge and experiences into consideration, and try to see, feel, and deal with climate change from their perspectives on the ground.

Another thing that might be holding the Forest Service back in terms of implementation of climate change adaptation plans, is the lack of agreement on the

definition of climate change among employees. Respondents were invited to provide

comments at the conclusion of the survey. It became clear from these comments that

there are two distinct definitions of climate change and Forest Service employees have

different ways of thinking depending on which definition they are considering. One

respondent explained it well by saying, "[t]here are two schools of thought regarding

"climate change." One is that humans are causing it and therefore we need to be proactive

about trying to stem or halt it; and the other is that it is a natural cyclic event and that

humans have a minimal impact on its change (yes they do have an influence, but it would

be happening anyway)." A potential solution might be to focus suggested management

plans or actions on other words such as forest resilience (which received more support

than climate change), stewardship or even simply avoid these "buzzwords" and instead

focus on something like "responsible management" or "ecosystem health and sustainable

management." One respondent commented on this idea saying, "The Forest Service was

created to provide products for US citizens while protecting those resources also. We

need to get back to providing clean water, timber, and recreation while maintaining

sustainable forests."

Conclusions

As federal natural resource agencies in the United States continue their efforts to

address climate change in their management plans and actions, understanding how their

employees perceive these efforts becomes increasingly important and informative. This

study was focused on the Forests Service in eight states across the Intermountain West

region, examining how its employees view and approach climate change in their job,

assessing how they perceive barriers to and opportunities for adapting to climate change

within the National Forest System, and comparing their perspectives across the organizational hierarchy. We found that although many in the Forest Service consider climate change a buzzword, opportunities do exist to engage them in climate change related management and planning initiatives within the context of enhancing forest resilience and addressing management challenges that interact with climate change. We also found that actions taken by forest managers to address climate change have been mostly about engaging in conversations and thinking about climate change and relatively little has been done on the ground. Efforts are needed to motivate forest managers and support their work morally and practically by taking advantage of Forest Service's in-house research capacity and various advanced information technologies.

Our study identified two perception gaps within the Forest Service with respect to how different levels of management conceptualize and approach the issue of climate change. Although advanced information technologies may be helpful for enhancing communication across the organizational hierarchy, more emphasis is needed on making upper-level decision makers take local knowledge, experiences, needs, and concerns into consideration, and identifying common ground where they can work with forest managers on the ground to incorporate climate change considerations into the management of National Forests. The insights from this study not only contribute to the Forest Service's continuous efforts to adapt to climate change, but also shed light on strategies that can be tailored by other natural resource agencies to address various management challenges within the context of global environmental change.

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CHAPTER 4

SUMMARY AND CONCLUSIONS

The USDA Forest Service has developed new plans and policies to adapt to climate change (USDA Forest Service, 2008; 2011a; 2011b; ICCATF, 2011), but based on its self-monitoring Scorecard assessments and a review of the literature, still struggles with implementing these plans as action on the ground (Jantarasami et al., 2010; Archie et al., 2012). This research gathered employee perspectives regarding climate change and forest management to better explain the communication gap that is preventing new plans and policies from being successfully implemented. The research also identified the tools and resources employees believe are needed to better manage the National Forests in the future. From this line of research, a few key recommendations can be made.

First, the Forest Service needs to simplify and prioritize both the messages it is sending regarding climate change as well as the methods used to communicate that information. Employees are receiving, or at least have access to, a great deal of information regarding climate change. However, they are feeling overwhelmed both by the volume of information and the amount of work they are responsible for, which does not afford them the time to seek out or absorb the climate change information. Employees identified informal conversations, research papers, and conferences, meetings or workshops as the most effective methods of receiving climate change information. So, the Forest Service ought to focus on these methods already considered effective, and find ways to strengthen and increase these few, targeted information pathways. These might include opportunities for greater horizontal information flow and informal social networks like lunch meetings, camping trips, after-hours get-togethers, videoconferences

and online workshops, while being sure to include a climate expert among the participants to ensure the information and knowledge being shared is scientifically accurate.

Second, this research found that there was a statistically significant difference between how various levels of agency management (i.e., employees associated with the regional level vs. employees associated with the forest or district levels) perceived various climate change related issues. In general, the trend seems to be that the higher the level of agency management an employee is associated with, the greater the perceived importance or significance of climate change and its potential impacts. Regional-level employees are most likely to already be on board with the idea that climate change is a new challenge, not a buzzword, and that it is already impacting forest managers and forest management issues. The Forest Service ought to focus its efforts on the lowest levels of management, especially the district level. These employees work "on-the-ground" where they interact with local stakeholders and see these forest management issues first-hand. There is a great deal of knowledge at the National Forest and district levels that comes from experiencing local forest management challenges first-hand and interacting with local stakeholders, and could greatly benefit upper-level decision-makers. The Forest Service needs to consider providing more opportunities for climate change education and training for district-level employees, making efforts to gather more feedback from these lower levels of agency management, and emphasizing that the work these forest managers do to address climate change on the ground matters to the sustainability of the National Forests by supporting their efforts with relevant climate data and more site-specific research. The agency also needs to connect higher-level

decision makers to these lower-levels through videoconferences so they can better understand the issues forest managers face on the ground. There are many ways the Forest Service can take advantage of local knowledge and boost employee morale by making these employees feel more heard and included in decision-making processes.

Finally, this research identified a lack of agreement among Forest Service employees surrounding the definition of "climate change." It became clear that there are two distinct definitions of climate change held by Forest Service employees. One involves climate change being human-caused, and the other considers climate change to be natural and cyclic whereby humans can have no significant impact on it. For the Forest Service and its planning efforts, this means that there is potential to gain more employee support and avoid further conflict or disagreement by finding ways to engage employees in climate change-related management and planning within the context of forest resilience or through addressing forest management challenges that interact with climate change, such as bark beetle infestations, changes in wildfire regimes, and changes in species composition within a forest. Focusing on ideas such as stewardship, responsible management, and/or healthy forests and ecosystems might also be potential solutions. By finding a less controversial buzzword or phrase, the Forest Service could relieve some pressure or stress felt by employees surrounding the words "climate change," and perhaps even find something new for employees to rally around, such as stewardship, resilience, or responsible management. Along with giving more focus to the needs and thoughts of lower-level employees in upper-level decision-making, these actions could contribute a great deal to improving employee morale.

This research focused on increasing the understanding of Forest Service efforts to address climate change by analyzing its climate change communication methods, the tools and resources employees believe are needed to better manage the National Forests in the future, and how these climate change and forest management perceptions vary at different levels of agency management. Lessons learned will help Forest Service managers, decision-makers, and planners as they continue efforts to adapt to climate change through forest management in the future. The findings from this study not only contribute to the Forest Service's ongoing efforts to adapt to and address climate change, but also reveals strategies that can be adapted by other natural resource agencies to address various management and communication challenges within the context of global environmental change.

However, there are certainly other factors involved in the effectiveness of climate change adaptation efforts that have not been covered here. Future research might investigate the Forest Service and federal budget structure, how funds are allocated, and the role litigation and appeals processes play in the effectiveness of climate change adaptation efforts. A review of how other federal agencies approach climate change adaptation in their plans and management may also provide useful insights into the factors involved in successful policy development, communication, and climate change adaptation.

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APPENDICES

APPENDIX A

INTERVIEW PROTOCOL

**U.S. Forest Service Perspectives on Forest Management in a Changing Climate –
Key Issues in the Intermountain West
Protocol for Key Informant Interviews with Selected U.S. Forest Service Employees**

Interviewer:
Interviewee:
Date of interview:
Location of interview:

Introduction:

*Thank you for taking the time to participate in this study. I am a graduate student at
Utah State University working with Dr. Zhao Ma. We are conducting a study to better
understand U.S. Forest Service perceptions of forest management in the face of climate
change, at varying levels of management. This interview should take no more than one
hour. Everything you tell me during the interview will be kept strictly confidential and
your name will not be revealed to anyone beyond the research team. For the purpose of
data coding and analysis, it will be really helpful for me to record this conversation.
Would you feel comfortable with it? If not, please let me know now. Again, thank you for
your willingness to participate in this interview. Unless you have any questions, let's go
ahead and get started.*

Questions:

I'll start just by asking a few questions about you and your work in the Forest Service.

1. We read on your website that you [do the following] in the U.S Forest Service. Is
   this still your major responsibility?

   > Probe: Is there anything else you are responsible for managing and
   > making decisions about?

2. How many years have you worked for the Forest Service?

Now, I'll move on to a few questions about forest management, in general.

3. From your perspective, what are the most pressing forest management challenges
   faced by the National Forest System in the Intermountain West? *(Be sure to ask
   about their specific district, etc. if they don't talk about it)*

   > Probe: In your opinion, how does climate change relate to or interact with
   > the forest management challenges you just mentioned?

Probe: How does climate change make these existing challenges such as [list the challenges they just mentioned one by one] worse?
Probe: How does climate change create new management challenges for the Forest Service?

(If the interviewee did not mention aspen die back, fire management and/or bark beetle infestation, use Question 4 to ask about these three issues. If the interviewee just discussed all three issues, then skip Question 4 and ask Question 5.)

4. We have been hearing about issues related to changes in species composition in National Forests (e.g., aspen die back), changing fire regimes, and insect infestations (e.g., bark beetle outbreak). How do you think these issues might be related to climate change?

   Probe: Can you give me any specific evidence or examples?

5. What, if anything, are you currently doing to deal with or plan for climate change **in your work** (i.e., management actions, research, etc.)?

   Probe: If nothing, what prevents you from doing anything?

   Probe: What do you wish you could be doing to address the potential impacts of climate change?

6. What additional effects or changes do you see or expect to see come about because of climate change (i.e. drought, more frequent/severe wildfires, changes in temperature, species migration, etc.)?

7. Forest resilience seems to be getting quite a bit of attention in the field of forest science and management. How would you define forest resilience?

   Probe: In your mind, what is the relationship between forest resilience and climate change?

8. To what extent do you think managing for forest resilience is important to the Forest Service? Is it more or less important than climate change, or is it part of dealing with and planning for climate change?

9. We learned about Forest Service's National Roadmap for Responding to Climate Change and Performance Scorecard. To what extent do you think the Scorecard has been implemented within the National Forest System in general and how has it affected the work you do specifically?

   Probe: In addition to the Roadmap and Performance Scorecard, can you point us to any other policies, formal or informal, such as particular federal legislation (i.e., act), agency regulation, policy directive, manual,

or guidebook that address the interaction between forest management and climate change?

10. How would you describe Forest Service's current capacity to address climate change in the management of the National Forests?

    Probe: Are there any specific challenges you and others in the Forest Service are facing?

11. In an ideal world, what resources and support would you need to more effectively address potential impacts of climate change when managing National Forests?

    Probe: What information with respect to forest management and climate change would help you manage?

    Probe: What policy changes or directions with respect to climate change would you like to see from the agency?

    Probe: To what extent funding is a limitation to your ability to address climate change in the management of National Forests?

    Probe: What types of collaboration with the research community or other federal, state and local agencies or non-profit organizations would help you address climate change?

Now we'll move on to the last group of questions about communicating climate change information.

12. How has climate change information been communicated within the Forest Service (e.g., agency reports, webinars, e-newsletters, organized meetings, informal conversations, etc.)?

13. From the climate change information you've received, what was the content of those messages? (e.g., Has the communication been about specific impacts of climate change, public perceptions of climate change, etc.)?

14. To what extent has communication within the Forest Service helped you better understand climate change and its implications on forest management in your job?

    That's all my questions, but before we end…

15. Is there anything you would like to add with respect to the questions we discussed or the general topic of forest management and climate change?

Thank you so much for taking the time to help us with this study.

APPENDIX B

SURVEY INSTRUMENT

USFS Perspectives on Forest Management in a Changing Climate

Welcome to the survey! Your responses are extremely important to us. You can navigate back and forth between these questions using the BACK and NEXT buttons at the bottom of each page. Thank you for your participation.

Section 1. Forest Management Challenges

1. What do you enjoy most about working for the Forest Service? Please check all that apply.
❑ The opportunity to work outdoors and spend time in nature.
❑ Meeting new people and sharing ideas/knowledge.
❑ Knowing that I am working to sustainably manage/conserve our environment and natural resources.
❑ Other, please explain: _____

2. Please indicate your own experiences and opinions with respect to the following issues.

	Have you seen this issue in your job?		Have you done anything to address this issue in your job?		To what extent do you think this issue is related to/influenced by climate change? (Even if you have not previously considered an issue, please offer your best estimate.)			
	Yes	No	Yes	No	Significantly related	Moderately related	Minimally related	Not related
Insect infestations (e.g., bark beetle)	❍	❍	❍	❍	❍	❍	❍	❍
Invasive species	❍	❍	❍	❍	❍	❍	❍	❍
Soil erosion	❍	❍	❍	❍	❍	❍	❍	❍
Changes in wildfire regimes	❍	❍	❍	❍	❍	❍	❍	❍
Changes in species composition (e.g., aspen die back)	❍	❍	❍	❍	❍	❍	❍	❍
Wildlife habitat loss	❍	❍	❍	❍	❍	❍	❍	❍
Water quantity/quality issues	❍	❍	❍	❍	❍	❍	❍	❍
Issues in wildland-urban interface areas (e.g., development pressure, fire management challenges, recreation pressure)	❍	❍	❍	❍	❍	❍	❍	❍
Changing weather (e.g.,	❍	❍	❍	❍	❍	❍	❍	❍

increased extreme weather conditions, decreased snow pack, more arid conditions)								
Lack of good timber market	○	○	○	○	○	○	○	○
Policy constraints (e.g., NEPA requirements)	○	○	○	○	○	○	○	○
Stakeholder conflicts	○	○	○	○	○	○	○	○
Other, please specify:	○	○	○	○	○	○	○	○

Section 2. Perceptions of Forest Management in a Changing Climate

3. To what extent do you think that climate change is, or is not, a concern facing forest managers within the National Forest System today?
○ A significant concern
○ A moderate concern
○ A minor concern
○ Not a concern at all

4. To what extent do you think that climate change affects the work you do within the National Forest System?
○ Significantly affects my work
○ Moderately affects my work
○ Minimally affects my work
○ Does not affect my work at all

5. Which of the following better describes how you feel about climate change as a new management challenge for the Forest Service?

○ Climate change is not a new challenge for the Forest Service, but mostly a new phrase/buzzword.

○ Climate change is certainly a new challenge, presenting new conditions and issues unlike the past.

6. Please think broadly about the general approach to addressing climate change when responding to this question. How do you feel climate change should be addressed by the Forest Service, in general?

○ We need to change the way we think about and do our jobs. We need a new approach in the way we manage the National Forests to really address climate change related issues.

○ We do not necessarily need to change the way we think about our jobs. However, some adjustments may be needed to better incorporate climate change into our management and planning considerations.

○ We do not need to change the way we think about or do our jobs. We just need the ability to continue to do what we are already doing and/or planning to do on the ground.

7. Currently, to what extent do you think "managing the National Forests to address climate change" is prioritized by forest managers in their management activities and planning efforts?

○ Highly prioritized

○ Moderately prioritized

○ Minimally prioritized

○ Not prioritized at all

8. In an ideal world, to what extent do you think "managing the National Forests to address climate change" should be prioritized by forest mangers in their management activities and planning efforts?

○ Highly prioritized

○ Moderately prioritized

○ Minimally prioritized

○ Not prioritized at all

9. Currently, to what extent do you think "managing the National Forests to enhance forest resilience" is prioritized by forest managers in their management activities and planning efforts?
- ○ Highly prioritized
- ○ Moderately prioritized
- ○ Minimally prioritized
- ○ Not prioritized at all

10. In an ideal world, to what extent do you think "managing the National Forests to enhance forest resilience" should be prioritized by forest managers in their management activities and planning efforts?
- ○ Highly prioritized
- ○ Moderately prioritized
- ○ Minimally prioritized
- ○ Not prioritized at all

11. Which of the following most closely matches your definition/idea of forest resilience?
- ○ Ability of a system to bounce back to its previous state after disturbance without any changes to species composition.
- ○ Ability of a system to bounce back to some previous state after disturbance with minimal changes to species composition.
- ○ Ability of a system to bounce back after disturbance even if species composition has changed and the system may be pushed into a new state, as long as some targeted ecosystem services can be retained.
- ○ None of the above, please explain: _____

12. What do you think is the nature of the relationship between "managing the National Forests to enhance forest resilience" and "managing the National Forests to address climate change"?
- ○ They are exactly the same.
- ○ They are not exactly the same, but you cannot enhance forest resilience without addressing climate change, and vice versa.
- ○ They might be related, but you do not need to address one for the other.
- ○ They are not related.

Section 3. Policies and Guidance for Forest Management in a Changing Climate

13. Are you aware of any formal federal policies (e.g., legislation, agency regulations or directives, executive orders, etc.) that require forest managers to address climate change when managing the National Forests?

❍ Yes

❍ No

14. If yes, what is(are) the name(s) of the policy(policies)?

15. Are you aware of any federal documents (e.g., manuals, guidebooks, etc.) that provide guidance for forest managers to address climate change when managing the National Forests?

❍ Yes

❍ No

16. If yes, what is(are) the name(s) of the document(s)?

Section 4. Limiting Factors and Support Needed for Forest Management in a Changing Climate

17. Which of the following activities have you engaged in with respect to dealing with and/or planning for climate change in the work you do?

	Yes	No
Conducting climate change-related scientific research	○	○
Taking part in conversations about climate change, whether formal or informal	○	○
Thinking about climate change while managing the National Forests	○	○
Making changes to forest management plans to incorporate climate change considerations	○	○
Changing actions taken on the ground to address climate change-related issues	○	○
Taking actions to build resilience into the forest	○	○
Contributing to a new handbook, manual or other technical publication to help managers plan for and adapt to climate change	○	○
Taking part in projects/collaborations specifically designed to address climate change	○	○
Other, please specify:	○	○

18. To what extent do you think the following have constrained/would constrain your ability to address climate change in the work you do?

	Significant constraint	Moderate constraint	Minor constraint	Not a constraint
Insufficient funds/budget	○	○	○	○
Lack of time due to excessive workload	○	○	○	○
Lack of personnel for the different management responsibilities in my unit	○	○	○	○
Lack of mandatory requirements to address climate change	○	○	○	○
Lack of direction for on-the-ground action/management	○	○	○	○
Conflict with the public/other stakeholders	○	○	○	○
Policy requirements/litigation (e.g., NEPA)	○	○	○	○
Uncertainty of future political conditions (e.g., potential changes in legislation, etc.)	○	○	○	○
Uncertainty of future environmental/climatic conditions	○	○	○	○
Lack of relevant climate-related information/data	○	○	○	○
No additional funding specifically for climate change work	○	○	○	○

Dealing with climate change is not part of my performance evaluation	○	○	○	○
My supervisor does not care enough about climate change for me to feel motivated to do something about it	○	○	○	○
Other, please specify:	○	○	○	○

19. To what extent do you think the following would help forest managers better address climate change when managing the National Forests?

	Very helpful	Moderately helpful	Minimally helpful	Not at all helpful
Increased budget/funding	○	○	○	○
More personnel	○	○	○	○
More full-time positions dedicated to climate change	○	○	○	○
More research/information regarding climate change	○	○	○	○
More applied, site-specific research based on managers' needs	○	○	○	○
More training/education about dealing with climate change and relevant management options	○	○	○	○
Having relevant climate data for a specific National Forest or district	○	○	○	○
An agency paradigm shift in favor of managing in the face of uncertainty	○	○	○	○
More specific direction for on-the-ground action/management	○	○	○	○
Better approach to communicating with the public	○	○	○	○

Formal federal policy (e.g., legislation, agency regulations or directives, executive orders, etc.) about addressing climate change when managing the National Forests	○	○	○	○
More efficient NEPA and related requirements	○	○	○	○
Ability to do more, larger scale management (e.g., thinning, prescribed burns, etc.)	○	○	○	○
More leeway for managers to use their own discretion	○	○	○	○
Other, please specify:	○	○	○	○

Section 5. Communication of Climate Change Information Within the Forest Service

20. How would you characterize the overall effectiveness of communication of climate change information within the U.S. Forest Service?
○ Very effective
○ Moderately effective
○ Minimally effective
○ Not effective at all

21. Based on your personal experience as the recipient of information, which of the following has been effective when it comes to receiving information about climate change?   Feel free to add other ways of receiving information you find valuable in the "Other" space provided.

	Have you received information this way?		If yes, how effective was this method of communication?			
	Yes	No	Very effective	Moderately effective	Minimally effective	Not effective
Webinars regarding climate change offered by the Forest Service	❍	❍	❍	❍	❍	❍
Webinars regarding climate change offered by other agencies or groups	❍	❍	❍	❍	❍	❍
Research papers produced by Forest Service research stations regarding climate change	❍	❍	❍	❍	❍	❍
Research papers produced outside the Forest Service regarding climate change	❍	❍	❍	❍	❍	❍
E-newsletters regarding climate change from the Washington Office	❍	❍	❍	❍	❍	❍
Formal email communication regarding climate change from a Regional Office	❍	❍	❍	❍	❍	❍
Formal email communication regarding climate change from a Forest Supervisor's Office	❍	❍	❍	❍	❍	❍
Organized meetings/conferences/workshops regarding climate change	❍	❍	❍	❍	❍	❍
Manuals or guidebooks regarding climate change	❍	❍	❍	❍	❍	❍
Informal	❍	❍	❍	❍	❍	❍

conversations/discussions among colleagues about climate change					
Other, please specify:	❍	❍	❍	❍	❍	❍

22. How confident do you feel about your ability to share information/ideas with or provide feedback to the following offices and be heard?

	Very confident	Somewhat confident	Minimally confident	Not confident at all
Washington Office	❍	❍	❍	❍
Regional Office	❍	❍	❍	❍
Forest Supervisor's Office	❍	❍	❍	❍
District Office	❍	❍	❍	❍

Section 6. Background Information

23. How long have you worked for the Forest Service?   Please provide your answer to the nearest year (e.g., 1 year, 13 years, etc.)

24. Which of the following best describes your position in the Forest Service?
- ○ Administration/Director
- ○ Planner
- ○ Education/Public Outreach
- ○ Policy/Litigation/Appeals/NEPA
- ○ Social Scientist
- ○ Archaeologist
- ○ GIS/Remote Sensing Specialist
- ○ Staff Scientist (Biology, Entomology, Soils, Botany, Geology, Ecology, etc.)
- ○ Field Practitioner/Technician
- ○ Environmental Engineer
- ○ Forestry/Timber/Vegetation Manager
- ○ Fire/Fuels Specialist/Manager
- ○ Natural Resource Specialist/Manager
- ○ Wildlife Biologist/Specialist/Manager
- ○ Rangeland Specialist/Manager
- ○ Recreation Specialist/Manager
- ○ Hydrology/Water Specialist/Manager
- ○ Aquatics/Fisheries Specialist/Manager
- ○ Other, please specify: _____

25. What is the highest level of education you have completed?
- ○ Did not graduate high school
- ○ High school graduate or equivalent
- ○ Some college, no degree
- ○ Associate's degree
- ○ Bachelor's degree
- ○ Graduate degree

26. What is your current GS-level?
○ GS-4 or below
○ GS-5
○ GS-6
○ GS-7
○ GS-8
○ GS-9
○ GS-10
○ GS-11
○ GS-12
○ GS-13
○ GS-14
○ GS-15 or above

27. Which Forest Service Region are you affiliated with?
○ 1 - Northern Region
○ 2 - Rocky Mountain Region
○ 3 - Southwestern Region
○ 4 - Intermountain Region

28. Which level of management are you affiliated with?
○ District Office
○ Forest Supervisor's Office
○ Regional Office
○ Washington Office (national headquarters)
○ Research Station

29. Is there anything else you would like to discuss with respect to dealing with climate change, forest resilience or forest management in general?

You have reached the end of the survey. If you would like to edit any of your answers, select the BACK button. If you are ready to submit your answers, select NEXT and your answers will be submitted.