2017

The Balancing Act: Ecological Interventions and Decision Tradeoffs to Preserve Wilderness Character

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THE BALANCING ACT: ECOLOGICAL INTERVENTIONS AND DECISION TRADEOFFS TO PRESERVE WILDERNESS CHARACTER

By

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Thesis

presented in partial fulfillment of the requirements
for the degree of

Master of Science
Environmental Studies

The University of Montana
Missoula, MT

May 2017

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Lieberman, Lucille, M.S., Spring 2017 Environmental Studies

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Global climate change, land use intensification and increasing development are impacting federal wildernesses in new and unprecedented ways. Ecological restoration is one tool that that wilderness managers are using to combat degradation, though the decision to intervene in wilderness is complicated by the Wilderness Act's legal mandate to preserve wilderness character and demonstrate managerial restraint. The purpose of this study is to document a baseline of ecological interventions that have occurred in the NWPS over the last five years, and to understand how wilderness managers make decisions related to ecological interventions. I sent a quantitative survey to over five hundred wilderness units to understand the type and degree of interventions taken, and used semi-structured interviews with twelve managers to understand intervention decision-making processes. This is the first study to document the breadth and depth of ecological interventions currently being implemented across the NWPS, and to reveal details about specific intervention proposals including the factors that influenced the decision, the efficacy of the intervention, and the proposer of the project. Results show that wilderness managers are tentative and conflicted about intervening in wilderness, yet management inertia leads to the acceptance of intervention as a wilderness preservation tool. Ecological interventions occurred in 37% of the wilderness units sampled, with the greatest proportion of interventions by agency from the National Park Service. This research highlights a need for consistent approaches to vetting ecological intervention proposals, and for greater agency accountability in documenting interventions. A publically-accessible collection of case studies could create a community of practice for wilderness stewards, while emphasizing best practices for interventions in wilderness.

The Balancing Act

Ecological interventions and decision tradeoffs to preserve wilderness character

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Acknowledgements

The original idea for this thesis stemmed from discussions with Beth Hahn and Peter Landres at the Aldo Leopold Wilderness Research Institute about the difficulty of studying interventions in wilderness without concrete baseline data. The project grew and evolved organically to include not only a quantitative survey, but also interviews with seasoned wilderness professionals. This project would not have been possible without Beth and Peter's support—the agency insights, the survey development, the analysis, and most importantly the ability to express the results in a comprehensive manner. I truly value the support and mentorship they provided me throughout this process. Early on Beth said to me, "Embrace the chaos, order is an illusion," and I have kept that quote on my desktop as a reminder to accept the unexpected ups and downs of this project, of which there were a few. Together, this was truly a group effort between Beth, Peter and myself, along with support from the University of Montana Environmental Studies and Conservation and Society departments.

From the University of Montana (UM), I would like to thank Dan Spencer, my committee chair and advisor, who worked with me from the beginning to shape the theoretical purpose of the study, and provided constant positive encouragement. His class on the Ethics of Restoration helped solidify many of the core ethical debates addressed in this study. Libby Metcalf, my committee member, provided early guidance on survey analysis and sampling which proved to be foundational; and Len Broberg, my third committee member, provided an important scientific and legal perspective. This thesis would not have been possible without critical SPSS and Qualtrics training and analysis from Chuck Harris in the UM Social Sciences Lab. Finally, I want to thank Neva Hassanein, for her introduction to qualitative research methods and early feedback on my interview analysis.

I am indebted to, and continually inspired by Kelly Bush, Rosemary Seifried, and all my fellow wilderness rangers at North Cascades National Park, for their thoughtful discussions and pragmatism on all aspects of wilderness issues. I am thankful to the twelve anonymous wilderness managers who gave their time and energy to share with me their valued opinions and perspectives about wilderness stewardship.

This project would not have been possible without financial support from the interagency Aldo Leopold Wilderness Research Institute. Thank you to the staff at the Arthur Carhart Wilderness Training Center for their eagerness to help me understand agency-specific policies, and for connecting me with field managers to interview.

Also, thank you to my friends (specifically LQM and ATG), who edited drafts, provided solid moral support and never let me lose sight of the bigger picture. Lastly, I want to thank my parents for their constant support, and for instilling in me the value of persistence and balance. I would not be where I am today without their love and encouragement.

For Opa (1924-2017), thanks for your positive encouragement and sense of humor.

Introduction

Across the globe, protected areas provide solace and freedom from development. They act as ecological strongholds, where species are free to grow and survive; self-willed, without domination and exploitation from humans. In 1964, President Lyndon B. Johnson signed the Wilderness Act into law, thereby creating the strongest protected area designation in the United States. The Wilderness Act established the National Wilderness Preservation System (NWPS), which today encompasses 109,129,657 acres and includes 765 unique wildernesses managed by four federal agencies: the National Park Service (NPS), United States Fish and Wildlife Service (FWS), Bureau of Land Management (BLM), and the United States Forest Service (USFS) (Wilderness.net, 2009). The Act defines wilderness as:

> An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvement or human habitation…an area where the earth and its community of life are untrammeled by man…generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable…has outstanding opportunities for solitude or a primitive and unconfined types of recreation…lands designated for preservation and protection in their natural condition. (P.L. 88-577 section 2c)

The concept of wilderness in the United States originally referred to a wild landscape that was both feared and perceived as dangerous (Nash, 2001). As American Romanticism expanded, the notion of untouched wild landscapes became revered and woven into our history with a sense of pride. In the age of increasing rural development beginning in the 1920's, a concern for wild landscapes grew and social movements grew symbiotically to protect natural landscapes from development and resource extraction (Nash, 2001). The pressure to create a strong form of public land protection, such as that provided in the Wilderness Act, arose out of a desire to have some land that was free from development and allowed to exist without the meddling trace of human influence.

Wilderness comprises a small but significant portion of the public land portfolio of the United States and is designated as an IUCN 1b protected area, thereby playing a critical role in global environmental conservation and protection (Keenleyside, Dudley, Cairns, Hall, & Stolton, 2012). Nearly 12% of lands within the United States are classified as protected areas, demonstrating a strong commitment to resource conservation and a strong value supporting public land more broadly (World Conservation Monitoring Centre, 2014). Wilderness provides a variety of social and environmental values including physical and mental health benefits, as well as providing a scientific baseline and reference point to study ecological change (Dawson & Hendee, 2009; Sarrazin & Lecomte, 2016).

Wilderness preserves rare natural ecosystems, and maintains a variety of ecosystem services including provisioning, regulating and cultural services (DeFries, Hansen, Turner, Reid, & Liu, 2007; Harmon & Putney, 2003; Hobbs et al., 2010; Turner et al., 2007). Provisioning services include the direct material or energy outputs such as food, or fresh water, while regulating services include the instrumental value of forests to regulate local climates, sequester carbon and improve air quality. Finally, cultural services refer to the plethora of tourism, recreation, and inspiration to culture, art and design that is created from wilderness. Maintaining opportunities for solitude, another defining characteristic of wilderness, has been shown to be highly valued by the public (Borrie & Roggenbuck, 2001). As stated in the Act, the fundamental purpose of wilderness is to, "ensure for the American people the continuing benefits of wilderness," a uniquely social-centered purpose (Steinhoff, 2011, p. 292).

Wildernesses today are not merely "rock and ice"; they encompass some of the most biodiverse, geologically diverse, and culturally unique environments in the United States (Nash, 2001). Although some wildernesses lie within the boundaries of busy National Parks where recreation dominates, in other remote geographic realms, wilderness simply exists as a place where the natural world can operate freely. Some wildernesses are rarely visited by humans, but that does not diminish their value as a place where humans may never visit but still know they will be protected and respected in a specific way by managers. Yet even without direct management actions, wilderness is not immune to global environmental threats.

Global climate change combined with dramatic land use change are altering the conditions of natural areas in the United States. Species assemblages are changing. Weather patterns are changing. Some landscapes no longer resemble the past. A suite of values held by the public and public land managers, combined with agency policy and federal law, guide management decisions about how we should respond to such changes in the natural landscape. Do we let this change occur unfettered, at the risk of losing rare or precious wild places, species and biodiversity? Or do we intervene to attempt to cling to relics of the past, relics of consistency, reminders of our history?

In federally designated wilderness, management decisions must be guided by the Wilderness Act of 1964, which states that wilderness character must be preserved (P.L. 88-577). A component of wilderness character is the quality of *untrammeled* wilderness—meaning restraint from intentional human control and manipulation. This mandate contrasts sharply with our culture's "action bias", a tendency to want to fix and overcome obstacles and challenges (Iftekhar &

Pannell, 2015). Another wilderness quality, *natural*, which encompasses the indigenous species compositions, structures, and functions of wilderness, must also be preserved (Landres et al., 2015). In the last twenty years, scholars have begun to examine a management dilemma that occurs when ecological intervention is proposed in wilderness, even for the most well-intentioned purposes. An ecological intervention constitutes an intentional manipulation (trammeling) of the ecosystem, despite potentially improving the natural quality of wilderness character. This dilemma is a critical challenge to wilderness management, yet there is a significant gap in knowledge of the extent, scope and type of interventions occurring. It is also unclear if this is purely an academic dilemma or if managers also engage with this potential paradox in wilderness management.

To understand how wilderness managers are balancing wilderness character objectives, a baseline of ecological interventions that have occurred across the National Wilderness Preservation System must be established. The way in which we respond to future ecological threats will set a precedent for wilderness stewardship and this will impact how future generations perceive and engage with these special places. For the sake of this research, the term intervention is used to encompass a range of ecological restoration projects as well as any management action that significantly alters the environment[1]. Millar et al. (2007) provides a useful set of adaptation categories that are synonymous with management actions including

[1] The survey stated, "For the purpose of this research, ecological intervention is defined as an intentional manipulation, or an action that purposefully alters, hinders, restricts, controls, or manipulates "the earth and its community of life." An ecological intervention is one type of trammeling action. Do not include actions that fall below a minimum threshold of scale and scope such as hand pulling a few weeds or restoring a camp site (see Appendix 6, beginning on page 101 in Keeping it Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character across the National Wilderness Preservation System for details on what is and is not a trammeling action).

resistance, resilience and response actions. Resistance actions seek to maintain unchanging conditions while resilience actions attempt to encourage the capacity of systems to absorb disturbances. The most intensive of actions, response actions, seek to intentionally establish possibly novel ecological assemblages that are better suited to dynamic conditions (Millar et al., 2007, p. 2147).

In the face of diverse and persistent ecological threats, wilderness managers are faced with difficult decisions regarding the implementation of measures that could improve natural conditions. In the absence of specific agency policy guiding ecological restoration proposals, narrowly focused case studies and articles show that the NWPS contains a range of ecological intervention projects that have been implemented with varying levels of intensity, scale, success and associated risks (Cole, 2000; Hobbs et al., 2010). Recently, resource managers, biologists, and conservationists have begun to question whether this approach to managing the NWPS—a matrix of varying restoration projects with the goal of improving natural conditions—is an effective, legal and ethical tool for preserving wilderness character (Cole & Yung, 2010; Long & Biber, 2014). Insights gained from this research will address the decision-making process of wilderness interventions, and the factors that constrain and shape decision outcomes, as well as a general baseline of interventions that have been undertaken. Viewpoints from interviews with wilderness managers conducted as a portion of this research, indicate that balancing wilderness character objectives in decision-making is one of the greatest challenges of their position.

Management Options

Wilderness managers have options when prioritizing values among the public and agency. Preserving biodiversity is an important benefit and value of wilderness; another is the encouragement of humility, by preserving the untrammeled quality of wilderness character. Some argue that humility is an important aspect of wilderness because of the explicit statutory language stating that wilderness should be treated differently than other land designations by preserving wildness. Landres, for example, notes, "The increasing rarity of wildness in our increasingly manipulated world argues for greater humility and restraint, for watching change occur—even if this change is not in accord with what managers and scientists think should be happening" (Landres, 2010, p. 93). By solely attempting to preserve biodiversity, we are limited by our knowledge, technology and predictive capabilities. If we intervene to manage towards a more natural state without a high degree of precision, we may preserve most of the biological value and avoid losses, but the resulting wilderness may be neither very natural nor very wild (Cole, 2000). Therefore, how to preserve both qualities remains a formidable challenge.

Given the uncertainty surrounding some restoration actions, and the rarity of wilderness, it is important to consider if wilderness is the right place to be testing experimental or novel ecological restoration practices (Appel, 2015; Hagerman & Satterfield, 2014; Iftekhar & Pannell, 2015). In response to the threats posed to wilderness ecosystems, wilderness managers have two main options: act to restore lands that have been ecologically degraded, or refrain from acting and risk negative ecological and social consequences. Both options are fraught with uncertainty and risk. For example, research from Norton (2009) concludes that most invasive species cannot be completely eradicated from restoration given our knowledge and technology. Further, he

predicts that when restoration occurs to remove invasive species, the outcome will be a novel ecosystem and will most likely include exotic species. Norton states, "Where eradication is not possible, restoration will require ongoing management of invasive species if specific outcome conditions are desired" (Norton, 2009, p. 570). This is problematic for two reasons: one, it highlights the need for future trammeling actions for ongoing management actions and, two, it raises sticky questions about what the "desired conditions" are in wilderness, a place that is supposed to be self-willed.

An alternative to intervening in wilderness is the hands-off approach. This approach promotes the untrammeled quality and preserves wildness by intentionally not intervening, even if historical fidelity, resilience, and ecological integrity may be negatively affected (Higgs, 2003; Landres, 2010). Benefits of this approach include preserving wilderness character by restraining from direct manipulation, which may have the potential to cause adverse effects to the ecosystem. Restraint shows respect for nature's autonomy, fosters scientific humility, facilitates evolutionary change, and sustains non-focal species (Landres, 2010). Collectively, these benefits reduce the unintended adverse consequences and risks associated with interventions while providing ecological benchmarks in areas that are not manipulated.

Long and Biber (2014) note that passive management in wilderness improves adaptation to climate change and protects biodiversity. Passive management refers to restraint from active management to allow the environment to adapt to change autonomously[2] (Long & Biber, 2014).

[2] Specifically, Long and Biber (2014, p. 658) write, "Restraint means, 'selecting certain areas in which no interventions will occur,' or simply: 'leaving some places alone.' Many legal scholars have argued that the restrictive constraints of the Wilderness Act are beneficial because the most appropriate management choice for wilderness areas is a hands-off, passive management regime."

If maintaining biodiversity is the main concern, other strategies should include protecting more habitat from human intervention, improving corridors and creating buffer zones around wilderness. Long and Biber contend that resources may be better spent on active management in severely altered landscapes outside of wilderness. The hands-off approach is a future-minded approach; it preserves options for future management and hedges risk (Landres, 2010; Sarrazin & Lecomte, 2016).

The decision to *act* or to *not* act is associated with significant ecological and social consequences. A legal and political consequence stems from the range of agencies and individual decision-making actors whose lack of consistency in decision-making challenges the cohesiveness of the NWPS. The multitude of unique environmental contexts and agency policies complicates this task. What are the implications of a patchwork approach to stewardship decisions? The hands-off approach may not be feasible or supported by agency actors given dual agency objectives and pressure from the public to preserve iconic features or species (Hobbs et al., 2010; Soulé, 2001). In his 2014 New York Times article, Solomon argues for throwing out the hands-off approach and replacing it with a flexible approach that would allow us to help our wild places adapt and thrive in the "diminished future we've thrust upon them" (Solomon, 2014). In his view, we are required to intervene to save iconic places and to improve landscape resiliency. Yet, in a world of increasing human influence, the rarity of wild places demands a thoughtful approach to stewardship, and the benefits of a hands-off approach are valid.

A potential strategy to increase consistency across the NWPS is to accept interventions in specific cases. In the last several years, a decision-making framework has been developed for

evaluating ecological intervention proposals in wilderness[3]. This framework evolved in response to increasing requests for decision-support related to ecological interventions in wilderness and underscores the need for consistency and clarity in evaluating such decisions. The framework is a supplement to the existing minimum requirements analysis; it is a method for determining whether an action should occur in wilderness, and if so, what is the minimum tool necessary to accomplish project goals while staying within the confines of the Wilderness Act.

Policy Guidance

Each of the four federal agencies who manage wilderness have developed policy regarding wilderness management, and generally these policies are permissive and allow for considerable decision-space to choose to intervene in wilderness. Together, these policies highlight the expectation to preserve wilderness character, including cases where intervention may be acceptable. All agency policy permits management actions like prescribed burns and the use of herbicide in some capacity. The ambiguity in policy language can make it difficult for field-level managers to find specific guidance when evaluating ecological intervention proposals because the policy guidance tends to be broad and vague. Many cases are outlined as cases where the preservation of the natural is acceptable, but there is not an equal incentive to preserve the untrammeled quality. Each agency treats wilderness management slightly differently, but the agency with the greatest prerogative to restore in wilderness is the National Park Service.

[3] Personal communication with Beth Hahn, Deputy Director of the Aldo Leopold Wilderness Research Institute, 3/8/17.

The National Park Service manages the greatest acreage of the National Wilderness Preservation System (43,932,002 acres) (Wilderness.net, 2009). The un-impairment clause in the NPS's Organic Act of 1916 plays a key role in decision-making for NPS wilderness managers by placing additional pressure on managers to act to restore conditions that have been impaired. A 2004 White Paper published by the National Wilderness Steering Committee, focusing on restoration in NPS wilderness states that despite trends of ecological degradation, restoration can be used as a tool to reverse degradation. The authors state, "The pace of landscape change in the United States and the rest of the world is accelerating. So is human appropriation and alteration of nature. Yet locally, although perhaps only temporarily, those changes can largely be stopped, even reversed, with sufficient knowledge and effort. The disturbances introduced by ecological restoration—the loss of wilderness character—need not represent permanent loss" (National Wilderness Steering Committee, 2004, p. 5). The authors acknowledge that trammeling actions constitute a loss of wilderness character, but they believe that in some cases it may be desirable to preserve natural qualities of wilderness character. The paper describes three classification schemes in which restoration in wilderness may be undertaken, along with the risks and benefits ascribed to each. They include: Class I, short-term wilderness disturbance and long-term wilderness character enhancement; Class II, long duration or recurring entry with benefits and costs to wilderness character; and Class III, support of laws or NPS policies but do not directly enhance wilderness character—no activities in any class are precluded by agency policy or law (National Wilderness Steering Committee, 2004, p. 6). Policy and law for the NPS related to restoration in wilderness is outlined in Table 1. This policy has led to significant ecological restoration in NPS-managed wilderness.

Table 1 National Park Service policies and law related to ecological interventions

SOURCE	POLICY/LAW
2006 MANAGEMENT POLICIES	The purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition and, in accordance with the Wilderness Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use. (National Park Service, 2006, p. 78)
1916 NPS ORGANIC ACT	The fundamental purpose of the NPS is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 U.S.C. 1-4)
2006 MANAGEMENT POLICIES	Biological or physical processes altered in the past by human activities may need to be actively managed to restore them to a natural condition. (National Park Service, 2006, p. 37)
2006 MANAGEMENT POLICIES	The Service will re-establish natural functions and processes in human-disturbed components of natural systems in parks unless otherwise directed by Congress. (National Park Service, 2006, p. 39)
2013 REFERENCE MANUAL 41	The principle of non-degradation will be applied to wilderness management, and each wilderness area's condition will be measured and assessed against its own unimpaired standard (National Park Service, 2013, sec. 6.3.7)

The United States Forest Service, managing the most wilderness units (445 of 801 wilderness units), indicates that preserving wilderness character is a top priority. They provide specific guidance on what types of restoration activities are allowed in wilderness (Table 2). Under the Manipulation of Wildlife Habitat section (United States Forest Service, 2007, p. 31), their policy states, "The objective of all projects must be to perpetuate the wilderness resources; projects must be necessary to sustain a primary value of a given wilderness or to perpetuate a federally listed threatened or endangered species" (United States Forest Service, 2007, sec. 2323.35a). Criteria for approving such projects include, "1. The condition needing change is a result of abnormal human influence; 2. The project can be accomplished with assurance that there will be no serious or lasting damage to wilderness values; and 3, There is reasonable assurance that the project will accomplish the desired objectives. Test major projects through a pilot study. The

pilot study should take place in a comparable area outside of wilderness if possible" (United States Forest Service, 2007, sec. 2323.35a). In addition, the USFS also provides guidance for when reintroductions are acceptable as well as prescribed fire, watershed manipulation and other management actions.

Table 2 Forest Service objectives for wilderness management

SOURCE	POLICY
FOREST SERVICE MANUAL 2300: CHAPTER 2320 WILDERNESS MANAGEMENT	5 Objectives to Wilderness Management 1. Maintain and perpetuate the enduring resource of wilderness as one of the multiple uses of National Forest System land. 2. Maintain wilderness in such a manner that ecosystems are unaffected by human manipulation and influences so that plants and animals develop and respond to natural forces. 3. Minimize the impact of those kinds of uses and activities generally prohibited by the Wilderness Act, but specifically excepted by the Act or subsequent legislation. 4. Protect and perpetuate wilderness character and public values including, but not limited to, opportunities for scientific study, education, solitude, physical and mental challenge and stimulation, inspiration, and primitive recreation experiences. 5. Gather information and carry out research in a manner compatible with preserving the wilderness environment to increase understanding of wilderness ecology, wilderness uses, management opportunities, and visitor behavior.

The United States Fish and Wildlife Service uses its sole mission, the stated refuge purpose, as the main decision-making tool for assessing restoration proposals. Their policy states, "Preserving 'wilderness character', referenced throughout the Wilderness Act and this policy, is a primary criterion for judging the appropriateness of proposed refuge management activities and refuge uses…wilderness character increases as it approaches the highest measure of natural

conditions and being untrammeled." To assess proposed action, the policy allows a flexible approach for refuge managers to make decisions (Table 3). "Refuge managers will use sound professional judgement when implementing this policy primarily during the comprehensive conservation planning process to determine: the relationship between refuge purposes and biological integrity, diversity, and environmental health; how to maintain existing levels of all three; and, how and when to appropriately restore lost elements of all three. These determinations are inherently complex" (U.S. Fish and Wildlife Service, 2008, sec. 1.13). Like the USFS, the FWS provides specific direction on common restoration actions such as wildfire management, vegetation control, and generally allows for management intervention in certain cases.

Table 3 Fish and Wildlife Service policy related to intervention in wilderness

SOURCE	POLICY
FWS MANUAL PART 610 SECTION 2.16: HOW DOES THE SERVICE CONSERVE WILDLIFE AND HABITAT IN WILDERNESS?	B. Major ecosystem processes including wildfire, drought, flooding, windstorms, pest and disease outbreaks, and predator/prey fluctuations may be natural ecological and evolutionary processes. (1) We will not interfere with these processes or the wilderness ecosystem's response to such natural events unless necessary to accomplish refuge purposes, including Wilderness Act purposes, or in cases where these processes become unnatural. Examples of unnatural conditions are: (a) Excess fuel loads from past fire suppression activities, (b) Disrupted predator/prey relationships, (c) Elimination of native grazers, and (d) The spread of alien species. (2) In such cases, we encourage the restoration and maintenance of biological integrity and wilderness character.

The Bureau of Land Management follows the USFS in providing more specific guidance for interventions in wilderness, and prioritizes wilderness values as the primary factor in making decision. Their general wilderness policy states, "Manage and protect BLM wilderness areas in such a manner as to preserve wilderness character. Manage wilderness for the public purposes of recreational, scenic, scientific, education, conservation, and historic use while preserving wilderness character" (Bureau of Land Management, 2012, sec. 1.2). The BLM allows specific considerations for fire and vegetation restoration (Table 4).

Table 4 Bureau of Land Management policy related to intervention in wilderness

SOURCE	POLICY
BLM MANUAL 6340 SEC. 1.6 C15 RESTORATION AND VEGETATION MANAGEMENT	Generally, wilderness areas must, at a minimum, be managed to maintain the baseline degree of wilderness character that existed when the areas was designated by Congress. When possible, management activities should emphasize enhancement of wilderness character over time. Natural processes should always be favored to restore disturbed vegetation in order to maintain the Untrammeled, Natural, and Undeveloped qualities of wilderness character, as well as outstanding opportunities for Solitude or Primitive and Unconfined Recreation. However, in some cases, restoration management activities may be needed to restore vegetation and to preserve or enhance the area's wilderness character, despite the impacts of such activities on the Untrammeled quality of wilderness character. The need for active restoration and the alternatives available for conducting restoration activities must be analyzed using the MRDG.

Agency policy for wilderness and restoration is highly flexible and permissive of intervention actions. However, this policy uses ambiguous terminology and may reflect outdated notions and definitions of natural based on the wilderness character monitoring language (Cole & Yung, 2010; Landres et al., 2015). The vague terms could aid in confusion for wilderness and natural

resource managers about what it means to preserve natural conditions and the natural quality of wilderness character, leading to inconsistent decisions.

Significance

The rapid decline of biodiversity globally, combined with strong social values supporting conservation, have increased the pressure to maintain specific species assemblages in wilderness (for example top predators like grizzly bears and wolves) (Teel, Dayer, Manfredo, & Bright, 2005). The small and fragmented nature of certain wildernesses leaves them susceptible to cross-boundary threats, especially small wildernesses in the eastern United States that are impacted by growing and dense urban populations. The current state of biological diversity may only continue to exist through direct management actions; however, intervening may conflict with the very thing wilderness attempts to protect—namely, freedom from intentional manipulation of biophysical resources (Cronon, 1996; Graber, 2003; Wiens & Hobbs, 2015). Proponents of protecting biodiversity in wilderness argue that small heavily-impacted wildernesses, "are wilderness in name only, they require urgent intervention and long-term maintenance simply to preserve what remains—and often what remains is quite irreplaceable. To put it another way, their value as managed reserves of biodiversity exceeds their value as 'wilderness'" (Graber, 2003, p. 38). Navigating these conflicting goals is difficult, yet the Wilderness Act mandates that both untrammeled and natural qualities be preserved (Soulé, 2001). Some managers have chosen to act aggressively by intervening with a range of intervention actions affecting vegetation, wildlife, wildfire and water. The purpose of this research is to quantify this effort and understand the complexities associated with intervention.

The difficulty in balancing public values, agency objectives and the legal mandate to preserve wilderness character forces thoughtful and forward-thinking approaches to management. Studies have demonstrated that manager values and emotions can play an important role in the decision of whether to intervene (Dvorak, Borrie, & Watson, 2013; Hagerman & Satterfield, 2014; Iftekhar & Pannell, 2015). If manager values and emotions do not reflect the best interest and intention of the Wilderness Act, the resulting decisions could be a subjective patch-work of approaches. It is unclear what types of ecological restoration projects exist across the NWPS and how a shift in approaching intervention could impact future wilderness management decisions. In some cases, restoration has been completed, such as with the introduction of extirpated species; however, the success, scale and degree of impact from restoration actions is often unknown and underexplored due to a lack of agency databases and record keeping for interventions (see Current State of Intervention Documentation section). This research will contribute to an understanding of manager values and experiences that may influence the decision to intervene in wilderness to preserve wilderness character.

The practice of ecological restoration is not new; restoration projects have occurred throughout human history and have been formalized in the past century (A. F. Clewell & Aronson, 2014). When the Wilderness Act of 1964 was passed, its authors believed that natural environments would be protected solely by their political boundary. However, dramatic changes in the last fifty years are challenging the belief that wilderness left alone will continue to preserve and protect the values for which they were originally designated. What is missing from the modern debate on intervention in wilderness is a careful survey of what is happening on the ground. How many interventions are occurring? What types and scales of interventions are occurring and what

factors influenced the decision to intervene? Additionally, how do wilderness managers perceive the wilderness management dilemma and how do they navigate the political and ethical challenges of preserving wilderness character? Intervention proposals and actions are not a distant threat to wilderness; they are occurring now, and they are occurring through a patchwork of decision-making. The literature review that follows examines the evolution of the philosophical debate surrounding ecological restoration and its relevance to the wilderness management dilemma. Contemporary issues surrounding ecological restoration in wilderness such as the problem with using "natural" and the issue of rewilding, will also be discussed.

Literature Review

"Wilderness teaches us to ask whether the Other must always bend to our will, and, if not, under what circumstances it should be allowed to flourish without our intervention." (Cronon, 1996, p. 18)

Early Debates on Restoration

The current debate on ecological restoration in wilderness builds on an older philosophical foundation with roots in environmental ethics. Though today the practice of ecological restoration is an accepted and progressive field in resource conservation, its inception was not without opposition. The following recap of the early debate on restoration sheds light on contemporary critiques of ecological interventions in wilderness, and forces careful consideration for proposals that intend to manipulate environments with the goal of mending past human errors. Environmental philosophers Robert Elliot and Eric Katz began the debate with a close examination of ecological restoration and its philosophical implications (Elliot, 1982; Katz, 1993; Light, 2000). They were primarily concerned with the view that if ecological restoration is successful, it could potentially be used by extractive industries to justify degrading nature because these industries could claim that it is acceptable to degrade natural resources because all values will be "restored" through successful restoration.

Robert Elliot sparked the debate in 1982 by posing a thought experiment in which a proposal is made to degrade a landscape, but we are assured that because subsequent restoration will be successful, the area will look the exact same as it did prior to manipulation, and therefore all the value will be restored. He calls this the "restoration thesis," which states that the destruction of what has value is compensated for by the later creation of something of equal value (Elliot, 1982). Elliot challenges this notion and argues that there are elements critical to the naturalness of an area which we value that will not survive the degradation-restoration process, and he likens

these values to the same reason why forged is valued less when compared to original artwork. There is a critical component of original work that came about through unique evolutionary processes that can never be exactly recreated by restoration. Therefore, the restoration thesis demonstrates that restoration cannot wholly replace what is being degraded or destroyed, and it should never be used as a justification for degradation (of wild places).

Eric Katz rejects the restoration thesis and carries Elliot's arguments further by claiming that any time we restore a landscape, it becomes a human artifact (Katz, 1992). Human artifacts are the result of human intention while natural objects, by contrast, lack the purpose and function of artifacts. Katz is concerned with a growing pattern that restoration often means exerting human dominance over natural areas and bending them to meet our wills and desires, even if the intention is to restore natural functions and processes. Even though we evolved in the natural environment, the degree to which we control and construct technology causes a significant change in our relationship to the earth. In his eyes, restoration is a slippery slope which could lead to technologically shaped nature, thereby further distancing humans from the natural world. Hence restoration exemplifies our hubris over nature and leads to a loss of important values, such as wildness and humility. Thus, the promise of restoration will lead to increasing interventions in (wild) nature, leading to a commodified and artifactual nature.

Andrew Light is also concerned with the risk of ecological restoration being used as a justification for degrading natural landscapes, but he is careful to distinguish between types of restoration. He believes the objections of the restoration thesis are valid, but we should differentiate types of restoration. He views restoring degraded areas for nature's sake, without

the desire to further human-centered goals (e.g. natural resource extraction and profit), as different from extraction-based or profit based restoration. This distinction is clarified by categorizing malicious restoration versus benevolent restoration; extreme practices like restoration post-mountain top mining would be viewed as malicious restoration. Other kinds of restoration to simply remove exotic weeds from a natural area for the area's own sake, is considered benevolent restoration (Light, 2000). Malicious restoration is using ecological restoration as a justification for more degradation, whereas benevolent restoration is taking responsibility for previous degradation.

The early critics of restoration raise important questions about the motives and slippery slope potential of restoration, however, a distinction should be made between this type of restoration and the types proposed in federally designated wilderness. For example, pro-development industries are not proposing restoration in wilderness because development is prohibited in wilderness (except in rare circumstances). Those proposing restoration projects in wilderness today are not necessarily arguing that their restoration work will "replace" the old natural features in a domineering fashion, rather they argue that in the face of degraded wilderness, that some positive change is better than none.

Though most restoration ecologists in wilderness would not claim their work as "dominating the natural world," there is an element of manipulation and control that is necessitated. Light might respond that many restoration ecologists view their work as releasing natural processes from the devastating practices of past human actions like mining (Light, 2000). In most cases, restorationists are not imposing their personal preference of design and creativity on the

landscape; rather they are carefully studying natural processes and attempting to remove harmful influences for natural processes to reemerge. Most of the restoration proposed in wilderness today would fit into Light's category of benevolent restoration—taking responsibility for remedying previous degradation unintentionally caused by human actions. Additionally, wilderness provides unique environments for restoration given its complex legal and political status. Specifically, the untrammeled quality of wilderness character adds further criteria for intervention proposals.

The Management Dilemma

A number of management actions in the 1990s led several authors to address the ambiguous language of the Wilderness Act of 1964, particularly the emerging paradox in preserving both the natural and untrammeled qualities of wilderness character (Cole, 2000, 2001; Cole & Landres, 1996; Landres, Brunson, Merigliano, Sydoriak, & Morton, 2000; Landres, White, Aplet, & Zimmerman, 1998). The Wilderness Act states in section 2c, that wilderness is, "an area of where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Wilderness is also defined shortly after as an area, "retaining its primeval character and influence…which is protected and managed so as to preserve its natural conditions." Scientists and managers have struggled with the relationship between naturalness and untrammeled.

In his article, *Paradox of the Primeval*, Cole (2000) described the meaning of "primeval character" in the text of the Wilderness Act as the extent that the present state is consistent with historic pre-aboriginal conditions and the "preservation of natural conditions" as referring to the

absence of post-aboriginal human influence. Untrammeled, by contrast, is about the process of management, and is described as the uncontrolled or wild quality of wilderness. The dilemma emerges when management options initiated to respond to negative post-aboriginal influence (such as the introduction of non-native invasive species or removal of key species) requires action, because any management action is considered a trammeling action and degrades the untrammeled quality of wilderness character. Landres summarizes this dilemma by stating, "While the legislated goal for wilderness is to be both wild and natural, in some situations implementing these goals creates a unique and central dilemma for wilderness managers: not restoring wilderness may allow natural conditions to further degrade, but taking action destroys the symbolic value of restraint and may influence natural conditions in unknown ways. The question is not whether we can take action, it is whether we should" (Landres, 2004, p. 498).

Thus, an ethical dilemma for wilderness decision-makers emerges. Further complicating the issue are questions relating to the scale of restoration, the frequency of trammeling actions a proposal involves to improve natural conditions, and the justification for acting. For example, would it be acceptable to prescribe fire in one acre of wilderness versus 5,000 acres? What if the proposal was not for one prescribed burn this year only, but a burn every year indefinitely? Does it matter whether it was humans who disrupted the natural fire regime of a wilderness, or a global climate change where identifying the causal actors is complex and challenging to predict? There is also the isolation factor, though all wilderness in the NWPS is managed according to the Wilderness Act of 1964, each wilderness and agency tend to operate in isolation, making consistency problematic. Therefore, does it matter that one wilderness manager may choose *not* to prescribe fire even though degradation was due to fire mismanagement in the past, but a

manager in an adjacent wilderness in a similar situation may approved such measures? It is easy to imagine a patchwork of various decisions for proposals to intervene in wilderness. Embedded in these decisions are public values that shape wilderness management, and studies have shown that the public values wilderness both for its natural and wild qualities, among others (Cordell, Tarrant, McDonald, & Bergstrom, 1998; Louter, 2006; Tweed, 2010). Inconsistency in decision making may be a concern if we are to manage the NWPS uniformly among agencies and wilderness units.

Wilderness Context and Current Threats

Fifty years after the passage of the Wilderness Act, new challenges face wilderness managers, most pressing perhaps is the unpredictable and powerful force of climate change. The uncertainty of climate change is changing management practices by increasing inventory and monitoring initiatives, and challenging prior conceptions of conservation (Hobbs et al., 2006). Regional climate shifts are causing increasing pressure to restore collapsing species distributions. Climate change affects natural areas peripherally by compounding trans-boundary threats and creating conditions ripe for invasive species expansion and spreading pollution (DeFries et al., 2007; Hansen et al., 2014; Sanderson et al., 2002). The degree and scale of climate change impacts is critical to informing the wilderness management dilemma and shaping the debate around restoration in wilderness.

Anthropogenic-fueled environmental changes are of serious concern. They include forest insects and disease, fire regime changes, species distribution and windstorms—as well as human threats such as the loss of biodiversity, increasing development and habitat fragmentation, air and water

pollution, and an increasing number of visitors in protected areas impacting resources and wildlife. Anthropogenic climate change is a conduit for modification both on its own and in conjunction with the threats listed above. More directly, climate change is causing type conversion shifts such as from a boreal forest to a savanna/temperate forest in Minnesota's Boundary Waters Canoe Area Wilderness (Frelich & Reich, 2009) and also from the Sonoran Desert to a grass-shrub land in the Saguaro Wilderness (Saguaro National Park, 2014). Generally, climate change increases the likelihood of climate extremes in protected areas (Stocker et al., 2013). The combination of these threats illustrates the pressures to preserve the natural quality of wilderness character. However, the natural quality is only one of five qualities that managers are mandated to preserve.

Whereas past natural management approaches stressed maintaining pre-disturbance conditions, several contemporary ecologists are striving for new goals to guide conservation—namely, a focus on maintaining and supporting biodiversity while conserving ecosystem function. For example, Hobbs et al. (2010), Shackelford et al. (2013) and Higgs (2003) state that a primary aim in conservation today is the maintenance, preservation and restoration of native biodiversity. Collectively with values such as ecological integrity, resilience, historical fidelity and the autonomy of nature, biodiversity has been cited as a restoration goal worthy of wilderness intervention.

The public and resource managers alike have placed a significant role for public land management agencies to preserve biodiversity. For wilderness stewardship, this may include initiatives to preserve specific species or processes, and other natural elements that make the

wilderness unique, even if that means manipulating the biophysical environment and sacrificing wild qualities (Solomon, 2014). Ridder's (2007) focus on biodiversity over wildness suggests further evidence of this shift. Instead of focusing on the value-laden terms of naturalness, he suggest we should focus on protecting biodiversity instead of respect for nature's autonomy. He states, "Restoration practitioners are less likely to become involved in unproductive debates over terminology and values if they emphasize the importance of their work for the conservation of biodiversity rather than naturalness or wildness" (Ridder, 2007, p. 11). However, wilderness managers are restricted to the language set forth in the Wilderness Act and agency policy. Although the specific terminology must be used, striving towards accepting specific definitions of each term, such as those articulated in the wilderness character monitoring protocols, would provide clarity to field-level managers.

Wilderness Character

The Wilderness Act describes wilderness composing five distinct qualities: untrammeled, natural, undeveloped, solitude and other unique qualities (P.L. 88-577). These qualities have been selected to measure the tangible qualities of wilderness character in order to link on-the-ground conditions in wilderness with the outcomes of wilderness stewardship management decisions (Landres et al., 2015). The manual for monitoring wilderness character, developed by the Aldo Leopold Wilderness Research Institute and the Arthur Carhart National Wilderness Training Center (the education and science wing of the NWPS), acknowledge that wilderness is more than the sum of its parts and that these characteristics do not measure intangible qualities of wilderness such as the spiritual or metaphysical aspects. Of primary relevance to ecological restoration, untrammeled has been defined as freedom from direct human control or

manipulation and is often associated with "wildness" (Cole, 2000), while natural has been defined as wilderness ecological systems being free from the effects of modern civilization and include the species, patterns and processes that evolved in the area (Landres et al., 2015).

Wilderness character monitoring is used to examine trends in wilderness management for each individual unit and across the broader NWPS; it allows for managers to see the implications of how their decision to act or not act may impact wilderness character. An example of a management action that would maintain the untrammeled quality would be allowing a wildfire to burn without attempting to suppress it (Landres et al., 2015). For an action to be considered a trammeling, there must be an option for the manager to not act. Therefore, the negative impact of climate change on alpine plants is not considered a trammeling because it is not within the wilderness manager's control to prevent the climate from impacting the alpine plants. In other words, there must be an opportunity for the wilderness manager to show *restraint*. An example of a management action that would improve the natural quality might be removing non-native invasive species by hand. Each action has multiple impacts, and in the former example, removing non-native invasive plants on a large scale with the use of herbicide, may constitute a trammeling action, even though it is simultaneously improving the natural quality of wilderness character. Further examples of trammeling actions include: collecting plants or animals under a research permit, excluding wildlife from an area through fencing, changing hunting regulations to decrease predator populations, and planting vegetation (among others).

Understanding the nuances of trammeling actions has been a source of debate among managers and scholars alike. In 2015, an updated interagency strategy on wilderness character monitoring

provided greater clarity on what constitutes trammeling actions (Landres et al., 2015). The authors explain two crucial concepts of defining a trammeling action *restraint* and *intention*. Restraint from the will and power of humans to control or manipulate wilderness, and intention to deliberately interfere with or control ecosystems are key to framing the untrammeled quality of wilderness character. What becomes confusing, however, are actions that managers take that they do not intend or anticipate to control ecosystems, but nonetheless do control ecosystems, even for a short duration. Here even the authors explain the difficulty in these situations, stating, "A much more complex and nuanced case is whether to include actions whose purpose is not to manipulate 'the earth and its community of life,' but which require some manipulation of the environment to produce the desired outcome. These types of actions can be confusing because they still result in an intentional manipulation of the biophysical environment even though that is not their primary purpose. In general, when such actions have substantial and foreseeable effects on the wilderness ecosystem, they are counted as a trammeling" (Landres et al., 2015, p. 101). It is helpful to conceptualize trammeling actions by comparing management actions.

Examples of actions that may be considered trammeling actions include spraying herbicide to treat non-native invasive plants; capturing, collaring and releasing wildlife; suppressing fire; restoring habitat; and building a trail through sensitive insect habitat. Other actions may include removing all the hazard trees in a large area, and similarly, removing a large amount of soil and plants to restore multiple campsites. Actions that may not be considered trammeling actions would be removing one or a few hazard trees that threaten a designated campsite, routing a trail around a rock slide, installing a research plot with rebar or stakes, landing a helicopter for a search and rescue operation, and hand-pulling a small area of non-indigenous invasive plants

(Landres et al., 2015, p. 105). The difference between these examples may seem nuanced, but in most cases, they are differentiated by the scale, scope and intent of the action. This research has demonstrated, however, that the ambiguity in determining trammeling actions exists for wilderness managers, based on their responses to questions about ecological interventions in wilderness. *Keeping it Wild 2* (Landres et al., 2015), the revised manual on wilderness character monitoring, provides a flowchart to help managers determine if an action is a trammeling. This chart indicates that if there is an opportunity for restraint prior to the action, and the purpose of the action is to intentionally manipulate the earth and its community of life, and the effects of the action are above a minimum threshold for practical monitoring, then the action is a trammeling action.

Any management action affects wilderness character in a multitude of ways. For example, if herbicides are used to remove an invasive plant or animal species, the untrammeled quality would be degraded by the act of controlling the biophysical environment to remove it, while concurrently, the natural quality might be improved by preserving and promoting native species. This so-called "wilderness management dilemma" challenges managers to preserve wilderness character in its entirety, and is the source of debate regarding the need and willingness to intervene in wilderness, even if to improve natural conditions (Alpert, 2004; Cole, 2000; Landres et al., 2000). What is unexplored, however, are baseline statistics for the current state of interventions; how many are occurring, and how managers overcome the wilderness management dilemma.

Although wilderness character monitoring policies have been adopted by each of the four agencies, they have yet to be tested in federal court. The Act mandates that wilderness character be preserved, however the Act does not clearly define what wilderness character is; the definition has been constructed by ecologists and wilderness managers through the process of developing wilderness character monitoring (Appel, 2015). Monitoring trends to measure wilderness character does not directly help managers make decisions regarding intervening in wilderness. However, for each action they take, assessing the impact to wilderness character will help managers understand how their decisions impact multiple wilderness qualities, and whether the action will improve or degrade the quality. Though simple on the surface, determining what "natural" is, and how it should be operationalized, has raised significant debate in the restoration and wilderness field.

The Problem with "Natural"

Preserving the natural quality of wilderness character is problematic for several reasons. Once heralded as a prominent management objective, maintaining natural conditions is not possible today simply through preservation and protective boundaries alone. Additionally, the concept of natural is messy and often misunderstood. Multiple meanings over time have led to confusion over what naturalness is as it pertains to natural resource management, and specifically wilderness stewardship (Hobbs et al., 2010). Three primary problems with the term "natural" exist.

First, nature is generally understood as the opposite of being artificial or human-made. One of Merriam-Webster Dictionary's fifteen definitions of natural includes the phrase, "living in or as

if in a state of nature untouched by the influences of civilization and society" (Merriam-Webster, n.d.). Early managers sought to preserve natural conditions by removing humans from the landscape. However, this definition and subsequent management imperative discount the significant role that Native Americans have played in shaping the ecology of the landscape through practices such as hunting and burning (Kay, 1995; Pyne, 1997). Pervasive evidence of the anthropogenic role of humans in early resource management sharply contradicts the myth of pristine wilderness as being wholly free of human use, beyond simply traveling on the land, but also using it (Cronon, 1996). Therefore, what is natural may also be a place where humans exist and shape the landscape (contrary to wilderness where humans are supposed to be "visitors who do not remain").

Second, early notions of natural within the field of natural resource management focused on outdated paradigms in ecology, specifically the theory of "earth in balance". Early ecologists believed that there was an ideal climax stage for every ecosystem, but contemporary ecological understandings stress the existence multidirectional flows, and change as the norm—this is the basis of non-equilibrium theory. Dynamic ecosystems in constant flux from disturbances create various levels of ecological succession at any one point in time (Wu & Loucks, 1995). Contrary to the "earth in balance" theory, Earth has likely never been in balance and will never be. Problematically, early practices of ecological restoration sought to return systems to a specific prior state in the past. However, since ecosystems are constantly changing, the decision to restore to a specific state is arbitrary and subjective (A. Clewell, Aronson, & Winterhalder, 2004).

Finally, maintaining natural conditions may not be desirable given the impacts of climate change. As indicated earlier, new management goals like preserving biodiversity may conflict with our desire to preserve natural conditions as vignettes of species and landscapes of the past. Preserving natural conditions may even conflict with agency goals and federal laws such as the Endangered Species Act (which may compel agencies to act to modify habitat to protect species) and the Wilderness Act (which emphasizes the goal of preserving wildness through a lack of human control, i.e. untrammeled). Hobbs et al. (2010) write, "In many places, the goal of biodiversity conservation will compel us to actively manage ecosystems to mitigate the inadvertent effects of human activity at regional to global scales, compromising our desire to respect nature's autonomy by avoiding intervention" (Hobbs et al., 2010, p. 21). Despite the difficulties in using natural conditions as baseline measure of preserving wilderness character, ecological restoration projects continue to be proposed with the intent of maintaining natural conditions.

Restoration: the solution or the source of trammeling?

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (A. Clewell et al., 2004). Ecological restoration has been promoted as a tool to combat the impacts of climate change, yet it is riddled with complex ethical, political and legal challenges (Cole & Landres, 1996). Though attempts to combat ecological degradation through restoration actions have been proposed in recent years, the frequency and type of restoration is not well understood (Graber, 2003). Examples of ecological restoration projects that have occurred in wilderness include the reintroduction of extirpated species, adding chemicals to restore water chemistry levels in acidified streams, applying

herbicide to remove nonnative invasive plant species, and reducing fuel loads in pyrogenic ecosystems (Graber, 2003; Landres, 2010; Steinhoff, 2011). The practice of restoration has become a tool for resource managers within certain agencies, however restoration is associated with considerable risk, and in some cases, it remains experimental as techniques develop and their effectiveness is assessed.

Uncertainties are likely to increase with rapidly changing conditions that may exceed ecological thresholds, and result in unintended or adverse consequences (Doak et al., 2008; Wiens & Hobbs, 2015). Examples of failed restoration projects have been documented, and raise concern over conducting such experimental projects in wilderness, even if they are motivated by the best of intentions and ecological need (Foster & Orwig, 2006; Rinella, Maxwell, Fay, Weaver, & Sheley, 2009). For example, a restoration project to restore greenback cutthroat trout to the Mount Massive Wilderness was undertaken in 2009. Before the greenbacks were introduced, nonnative brook trout were exterminated. Based on a 2012 post-study report, the wrong sub-species of greenback cutthroat trout was introduced, they discovered that greenbacks were not native to the drainage, and the initial removal of brook trout failed. Now the brook trout are prolific in the watershed, and thousands of dollars and scientific resources were wasted. For some, this type of worst case scenario can barely be imagined, but despite extensive planning, mistakes are always possible with restoration projects.

Ecological restoration projects are considered interventions in wilderness and degrade the untrammeled quality of wilderness character. Examples of restoration projects cited above such as the removal of non-native species and the addition of previously extirpated species may be a

sample of a greater scope, although a complete and accurate understanding of the actual number of interventions in wilderness is hampered by the lack of agency databases (Kammer, 2013). Other types of interventions that might occur include managed relocation, assisted migration and translocation (Hagerman & Satterfield, 2014; Schwartz et al., 2012; Stephenson & Millar, 2012). These conservation techniques have been suggested to curb the biological impacts of climate change, yet it is unclear if they are occurring in designated wilderness.

Viewpoints among scholars and managers differ on whether ecological restoration is a viable wilderness preservation tool and whether it is consistent with the mandate to preserve wilderness character (Alpert, 2004; Marris, 2011). Anthropogenic climate change is affecting every environment on the planet via weather patterns, variable temperatures and rainfall, despite the administrative boundaries afforded by wilderness (Biber & Esposito, 2016; Stephenson & Millar, 2012; Stocker et al., 2013). Managers are wondering how to protect biodiversity while also planning for future environments that may not resemble past conditions. It is possible that to survive and evolve, certain ecosystems may move beyond the historical range of variation; therefore, if restoration is undertaken, it must be adaptive and dynamic.

Instead of restoring environments to historical benchmarks, the historic range of variability (HRV) was developed as a response to the rapidly increasing extinction rate, through a realization that ecosystems behaved characteristically based on certain disturbances. The HRV theory of resource management accepts the theory of non-equilibrium, yet maintains that the change resides within certain bounds and this ensures protection for the components of the ecosystem (Morgan et al., 1994). Yet even the HRV is being stretched in today's dynamic world.

The rate and scale of this change is leading natural resource managers to consider other, more intensive forms of intervention. The rewilding movement encompasses a further conversation in contemporary wilderness issues related to ecological intervention. The implications of this discussion are critical to the wilderness management debate.

Rewilding: A contemporary application of restoration

The early restoration debate is relevant to wilderness and restoration practice when it comes to the re-wilding debate, and results from this survey could demonstrate if ecological interventions are occurring with the intent or rationale of re-wilding. The re-wilding movement gained popularity from the spread of ecological restoration and conceptions of the Anthropocene (the age we live in, a human-dominated earth). The concept of rewilding gained traction from Dave Foreman's pivotal book, *Rewilding North America: A Vision for Conservation in the 21st century* (Foreman, 2004), and Soulé and Noss's (1998) article, *Rewilding and Biodiversity*. In the latter article, the authors consider a rewilding methodology consisting of "cores, corridors and carnivores" through active restoration. Their theory is based on three arguments: one, top-down ecological interactions are initiated by keystone species; two, these keystone species generally require large cores of protected land; and three, connectivity requires linking core reserves to ensure adequate viability of wide-ranging species (Soulé & Noss, 1998, p. 5). When considering the application of re-wilding as an ecological restoration tool in wilderness, there are several ethical and practical considerations.

The notion of historical continuity in restoration has been raised by Elliot as well as Higgs in *Nature by Design* (Higgs, 2003). Many examples of intervention include the reintroduction of

certain iconic species with the theory that bringing wild animals to a landscape will make a wild landscape. Examples include: reintroducing wolves to Yellowstone National Park, restoring large herbivores to areas in the southwest, and the proposal to reintroduce grizzly bears to North Cascades National Park (North Cascades National Park Service Complex, 2015). Reintroducing these species impinges on the historical continuity of the landscape and evolutionary pressures, however the animals themselves are still the same species with undoubtedly similar character and behavior. Also, the disappearance of those same species may be directly related to humans, such as the rise of sport hunting and recreational hunting pressures. If one believes that humans are part of the natural landscape (not a nature/culture dualist), how do we reconcile that humans once removed certain species, now we plan to restore them, both times with the assumption that what we were doing was right?

Aside from considerations of whether restoration can practically and successfully be completed, many ethical questions remain. First, does a reintroduced species contain the same value as a non-reintroduced species? Due to the resources invested in a species reintroduction, the animals are often collared and tracked for the duration of their lives. In this case, is this truly a wild animal? A reintroduced species may denigrate the symbolic value of wilderness that Cole outlines; namely, that wilderness is a symbol of self-willed landscapes that are not controlled by humans (Cole, 2005). A wolf with a radio collar not only impacts that individual's life indefinitely, it also takes away from the mystery of observing a truly wild wolf. In fact, the image of a wolf with a radio collar for life recalls Katz's fear of the slippery slope of a technology-shaped nature. Restoration, though potentially transformative for biodiversity, is

dependent on the volatile nature of technology and the fallibility of humans (Arts, Fischer, & van der Wal, 2016; Katz, 2000).

Nogues-Bravo et al. (2016) suggest several concerns with the rewilding movement. Most notably, they cite that 70% of reintroductions fail. Another concern assumes ecologists can accurately predict the effects of introduced species, when studies show that context can severely alter the success of such projects (Hillebrand et al., 2007). Introductions are fraught with unintended consequences such as the introduction of rare pathogens that threaten other native species, as well as the increased risk of fire and reduced water availability (Beguería, López-Moreno, Lorente, & García-Ruiz, 2003; Nogués-Bravo et al., 2016). Reintroductions also pose important ethical questions related to animal welfare—for example tranquilizing animals by shooting from helicopters, collaring procedures, etc. (Harrington et al., 2013). Nevertheless, rewilding continues to be used as a justification for interventions in wilderness, specifically with the intention of correcting past human behaviors that resulted in the loss of certain species.

The Eye of the Beholder

In many ways, the challenge of considering interventions in wilderness depend upon the experience and perspective of those assessing the condition. Soulé (2001) deconstructs these perspectives through three philosophical approaches to determining how wilderness should be managed (Figure 1). First, the managerial/political approach stresses multiple use and the need to compromise among all users of the resource. This may include pressing for the removal of non-native invasive grasses that threaten iconic species in the southwest that hold significant biological and cultural values (Saguaro National Park, 2014). Managers must therefore balance

the interest of indigenous groups who value the cultural artifacts that the park protects, with other public interests in protecting the iconic saguaro cacti and recreational opportunities.

The second approach, the ecological/process, stresses the need to remedy our impacts on the planet. This approach includes the perspectives of many in the natural resource field who see a "wounded world" and believe wilderness holds significant value as refugia for biodiversity. In their eyes, the ends of restoration justify the less-than-perfect means of intervention. The third and final approach is the heroic/experiential. These proponents hold the greatest value in wildness and the untrammeled quality of wilderness. Their philosophy condemns control and direct management actions; the ends never justify the imperfect means of intervention (Soulé, 2001, p. 141). Together, these three approaches broadly sum up the debate and criticisms of intervening in wilderness: they highlight the range of values associated with wilderness and raise important considerations for managers making decisions in the public interest. These perspectives also demonstrate the importance of personal reflexivity when assessing past and potential future interventions in wilderness.

Figure 1 Three approaches to intervening in wilderness (Soulé 2001)

TABLE 1

Three archetypic ways of perceiving and saving the wild (or nature)

	Managerial/Political	Ecological/Process	Heroic/Experiential[1]
Proponents	Agencies, managers, utilitarian conservationists	"New" conservationists[2]	Traditional conservationists, wilderness adventurers
Philosophy	Utilitarianism/Ethical, Hedonism[4]	Pragmatism,[3] Deep ecology (for some)	Positivism, Deconstructionism
Dead heroes	Roosevelt, Pinchot, Leopold, Marshall	Muir, Carson, Leopold, Shepard, Abbey	Muir, Marshall, Thoreau, Brower, Shepard, Abbey
Myths/Ideology	Resourcism, multiple use	Paganism, modern biology	Perfectability of society, bioregionalism
God	Pales	Artemis	Daphne
Goals for wilderness	Use, satisfactory resolution of conflicts among users	Protection of nature, experience of living nature and the wild	Experience of untrammeled space and the wild, solitude
Natural allies	Resource extractors, recreationists, hunters	Biologists, ecocentric recreationists, naturalists	Animal rights advocates, mountain climbers
Solution/ Methodology	Consensus, win-win	Planning, analytical, empirical, incremental improvement	Revolution, criticism, restricted usage
Implementation	Top-down, regulatory, user-driven	Activism, incentives, purchase, zoning of land uses, restoration	Hands-off, population reduction, radical change in lifestyle
Perceived obstacles	"Extremists" of all kinds and enemies	Wise use ideology, idealism, wheeled recreationists	Managers, scientists, most ecotourists
Perceived proximal causes of crisis	Proliferation of diverse interest groups	Population, technology, globalization of commerce	Population, scientism, centralization & management
Perceived ultimate causes of crisis	Human irrationality, orneriness	Human greed, arrogance[5]	Human greed, Edenic fall
The ends and means issue	The means are the ends	Ends justify less-than-perfect means	Ends never justify imperfect means

Current State of Intervention Documentation

Each of the four wilderness agencies uses a unique system to report management projects, although generally the range of data is quite limited and inconsistent. For all federal agencies, if an action affects the environment in a significant way, it undergoes some form of National Environmental Policy Act (NEPA) compliance such as a categorical exclusion (CE), an

environmental assessment (EA) or an environmental impact statement (EIS). A CE is used for actions individually or cumulatively which do not have a significant effect on the human environment. An EA is used to determine whether an action has the potential to cause significant environmental effects and includes the environmental impacts of the proposed action and alternatives. If the EA determines the action will not have significant environmental impacts, the agency issues a Finding of No Significant Impact (FONSI). Alternatively, if the EA determines there will be significant impacts, a more intenstive EIS will be prepared (United States Congress, 1970). This law requires that the affected environment and specific resources be assessed, including the impact to the wilderness resource.

National Park Service

The National Park Service uses the website, PEPC-Planning, Environment, and Public Comment, to communicate to the public specific management projects undertaken by each park and opportunities for public comment. The level of NEPA compliance is indicated (CE, EA, or EIS) and associated documents are attached to project pages (National Park Service, 2016). Each project lists the title, project type, and NEPA type. However, not every project is entered into PEPC (Boerke, 2015). Restoration may be documented as a project type, but ecological restoration may also fall into a variety of other categories such as Repair/Rehabilitation, Resource Management Plan, Other Natural/Cultural Resource Activities, Wilderness Plan, etc. It is not possible to determine if the project occurred in wilderness unless one manually scans planning documents and the wilderness resource is listed as an affected area. No general search function exists on the main PEPC page to search all parks by wilderness to find projects taking

place in wilderness. Therefore, for the National Park Service, it is not possible to assess all ecological interventions in wilderness.

Another way to measure the trammeling occurring from ecological restoration would be from documentation in the minimum requirement analysis (MRA: a planning tool used to determine the methodology of projects approved in wilderness), but this would only happen if the proposed action is seeking to use a section 4c prohibited tool to accomplish the project such as a mechanical device used to spray herbicides. MRAs for the NPS are not collected and stored regionally or nationally, but often only on a park level (Leslie, 2015). The NPS does not have an annual reporting system for documenting MRAs. The PEPC system does not require MRAs to be uploaded as part of the compliance package of related documents (Boerke, 2015)

United States Forest Service

The Forest Service uses a national database system, Natural Resource Manager (NRM), to document and track a variety of measures including recreation use, natural resource management and visitor statistics (United States Forest Service, 2016). One measure related to ecological restoration actions in wilderness is the number of authorizations to use mechanization in wilderness. This record includes who authorized the action and the date of action (Boutcher, 2015). Although seemingly minute, this remains the only national data that capture trammeling actions specifically in designated wilderness. MRAs are not required, although encouraged in trainings for the Forest Service, and there is no annual reporting or collective database for minimum requirement decision guides (MRDGs) on a forest or regional level. MRDGs are generally attached to a compliance document such as an environmental assessment or

environmental impact statement as an appendix. It is not possible to search for MRDGs in an individual Forest (Straley, 2015).

Bureau of Land Management

The Bureau of Land Management requires MRAs to be completed for every action taking place in wilderness by a graduate of an Arthur Carhart National Wilderness Training Center course, although this has not been consistent (Barns, 2015). MRAs are held on a state level, but there is no national reporting system or annual collection for interventions in wilderness or for MRAs on a national level. It is not possible to search by BLM wilderness to locate restoration projects that have taken place. Compliance documents such as an EA or EIS will have the MRA attached as an appendix (Ashor, 2015).

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service does not have a central database for storing MRAs or other planning documents related to ecological restoration actions in wilderness. MRAs are required to be filled out by a staff member who has attended an Arthur Carhart National Wilderness Training Center course, and are generally kept at the refuge level. As with the other agencies, there is no annual reporting or documentation on a service-wide level of the MRA document or other ecological restoration interventions in wilderness (Lindsey, 2014). The Fish and Wildlife Database, ServCat has potential for storing these documents in the future, as it already holds a number of completed compliance documents and other refuge management documents (Newman, 2015).

The Information Gap

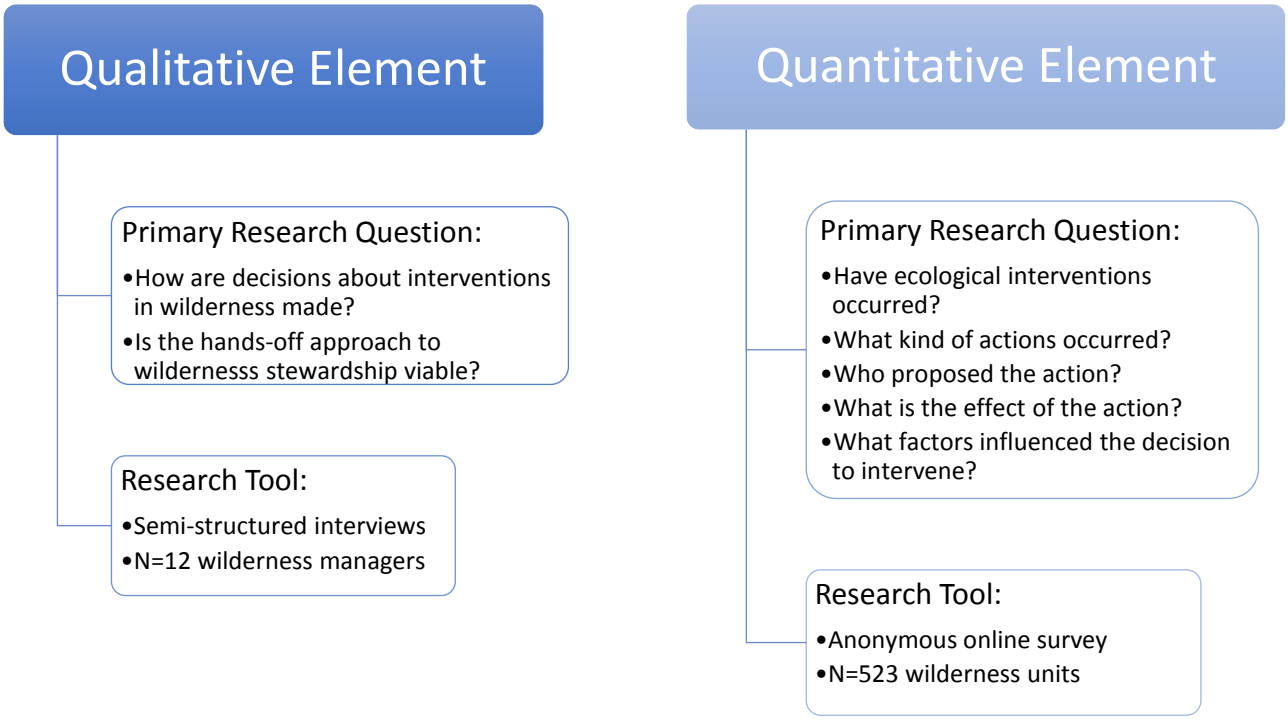
These findings suggest that although each ecological intervention project undergoes compliance to a certain level, collecting and analyzing the cumulative effects of these interventions across the NWPS is nonexistent. An internal national reporting system would be the obvious form of documentation. The contents of this reporting system should include what type of intervention took place, what area was affected, and whether prohibited uses were permitted using a minimum tool analysis or decision guide.

Transparency and consistent documentation are critical to assess the cumulative impacts of restoration actions across the entire NWPS. If, in the future this is created, it could be housed in the Wilderness Character Monitoring Database. This database is used on an inter-agency level to record the status of wilderness character measures. By housing ecological restoration actions in a collective database, it would be possible to identify trends over time and the cumulative effects of each smaller actions. The Wilderness Act states that the minimum tool analysis is used only to documents projects that must be undertaken to meet wilderness management objectives. Therefore, wilderness agencies should document how the project in question contributes to overall wilderness management goals documented in a wilderness stewardship plan or similar document

Methods

A mixed method approach was used to determine how many ecological interventions occurred in the NWPS in the last five years, as well as the decision-making approaches that led to intervention actions and the consequences of such actions (Figure 2). In the Spring and Fall of 2016, I conducted interviews to answer qualitative questions pertaining to my research question, and in the Fall of 2016 I disseminated an anonymous online survey to answer quantitative elements of my research question (Appendix A).

Figure 2 Elements of the mixed-methods approach to research question



Qualitative Methods: Interviews with Wilderness Managers

To understand how wilderness managers navigate the decision-making process while preserving wilderness character, semi-structured interviews were conducted using a purposive sample of twelve retired and active wilderness managers: three managers from each of the four federal

agencies that manage wilderness (National Park Service, Bureau of Land Management, U.S. Forest Service and U.S. Fish and Wildlife Service). The sample criteria included wilderness managers who had been in a wilderness position for at least three years and had experience making ecological intervention decisions. Due to the variation in agency structure of employee hierarchies, wilderness-related position titles varied (Table 5). A sample of such titles include, Recreation and Wilderness Program Manager, Wilderness District Ranger, Program Manager for Wilderness, Program Manager for Wilderness, Wild and Scenic Rivers, and Outfitter Guides, and Wilderness, Recreation and Paleontology Lead.

Table 5 Summary of interview sample

AGENCY	TITLE	STATE	COLLATERAL DUTIES
USFS	Recreation and Wilderness Program Manager	CA	Special use oversight, line officer, Fire Manager
FWS	Refuge Manager	MA	Line officer, Wilderness Manager
NPS	Wilderness District Ranger	WA	Law enforcement, Aviation Manager, Emergency Medical Services Coordinator, Search and Rescue Coordinator
USFS	Program Manager for Wilderness, Wild and Scenic Rivers and Outfitter Guides for the Northern Region of the USFS	MT	None, previously wilderness manager for USFS wilderness in WA
BLM	BLM representative to Carhart National Wilderness Training Center	MT/nation-wide	None currently, previously was the Wilderness, Recreation and Paleontology lead for a BLM district in NM
BLM	Outdoor Recreation and Wilderness Planner	NV	None
NPS	Wilderness Coordinator	CA	Wild and Scenic Rivers Coordinator, acting chief ranger on occasion
FWS	Refuge Manager	NJ	Law enforcement, regional contracting officer, firefighter

FWS	Wilderness Coordinator	OR/NV	Visitor Services Program (outdoor recreation, interpretation, education, wilderness)
BLM	Natural Resource Specialist	CA	Wilderness and Wild and Scenic Rivers State Lead, Visual Resource Management Program Lead
USFS	Assistant District Ranger	NH	Wilderness staff officer, recreation and wilderness, district safety officer, search and rescue point person
NPS	Supervisory Park Planner	FL	None

Participants were chosen with assistance from staff at the Arthur Carhart National Wilderness Training Center to ensure interviewees had a thorough wilderness background and had been in a wilderness management position for at least three years. The twelve managers who were contacted were each receptive and willing to participate, although a few requested assurance regarding confidentiality in final reports. Nine male and three female wilderness managers were interviewed for an average time of 54:43 minutes. Eight managers were interviewed in the spring of 2016 and the final four were interviewed in October of 2016. Due to the geographic breadth of the sample, ten managers were interviewed over the phone and two were interviewed in person. This mixed mode approach of phone and in-person interviews may have skewed the results because it was generally easier to build a rapport in person versus over the phone, and it allowed the observation of body language that went undetected with phone interviews.

Retired managers were included because of the assumption that they would be more open to commenting on ethically and politically challenging agency actions, as well as agency culture. Retired employees tend to have more time to discuss intervention issues and generally had more experience than active managers. Interviewing retired managers was beneficial because they

could reflect on their career from a removed perspective to openly analyze wilderness issues from the perspective of the NWPS, not through a specific agency or place. Wilderness management experience ranged from five years to thirty years, with an average of fifteen years.

To ensure consistency, an interview guide was utilized to structure each interview (Appendix B). Each interview began with a summary of the purpose of the research and how it was ultimately linked to a larger thesis project. To build rapport and document the breadth of experience, initial questions focused on participant background and professional duties. The next set of questions explored the participants' wilderness ideology including whether they believe intervention is important for protecting wilderness qualities over a hands-off approach to management. Questions about decision-making processes and functions, types of ecological restoration projects that occurred under their tenure as manager, and factors that improved or hindered decision-making processes were also asked. Probes were used to collect more detailed information and opportunities for participants to talk about experiences beyond the formal questions were encouraged and frequent.

All interviews were recorded, transcribed verbatim, and coded using a selective coding process that linked responses to common themes of interest in a systematic method (Hesse-Biber & Leavy, 2010). Phone interviews were recorded using the *Tape A Call Pro* application. Codes were developed based on the frequency of statements observed across the interviews. Categories of responses were also developed from answers to questions from the interview guide, specifically how managers preserve the untrammeled and natural qualities of wilderness character, as well as decision-making processes. Questions in the interview guide focused on

how wilderness managers make decisions because this data could not be attained easily through the quantitative survey. The complexity of understanding decision-making processes was best suited as an interview question which allowed me to probe respondents further and understand the nuances and meanings behind their decisions. In addition to pre-identified themes, a variety of concepts emerged organically. To ensure confidentiality, personally identifiable information was removed and replaced with a letter code.

Quantitative Methods: Survey on Ecological Interventions in Wilderness

Sampling

At the time this study occurred, the National Wilderness Preservation System consisted of 765 wilderness units, however some units are split and divided by two different agencies making the total units 801[4]. To produce a confidence interval of 95%, with a 5% margin of error, required a goal of collecting 260 surveys from wilderness managers (Vaske, 2008). I estimated a response rate of 50% which required sending out 520 surveys. To reflect the proportion that each agency manages, I multiplied the total number of wildernesses by the percent of wilderness units managed (Table 6).

Table 6 The number of wilderness units sampled per agency was found by multiplying the percentage of wilderness units managed by the agency by the goal number of surveys (520).

Agency	**% of NWPS wilderness units managed by the agency**	**# of surveys x % of NWPS**	**# of Agency wilderness units to receive a survey**
USFS	56%	520 x .56 =	291 wilderness units
BLM	28%	520 x .28 =	145 wilderness units

[4] The same wilderness may have the same name but is managed separately, so I considered these separate units.

FWS	9%	520 x .09 =	46 wilderness units
NPS	8%	520 x .08 =	41 wilderness units

All wilderness units for each agency were downloaded into an Excel spreadsheet and a random number generator was used to determine the wilderness units that would receive a survey.

Collecting Agency Contact Information

Selected wilderness units were entered into a spreadsheet, and using a variety of contact methods (email, phone, soliciting from regional wilderness leads), wilderness manager contact information was uploaded into the spreadsheet including a corresponding name and email address for each wilderness contact. Many wilderness leads were found by soliciting contact information from the Arthur Carhart National Wilderness Training Center Staff. When names and emails were outdated, I called wilderness units and asked for the wilderness manager (or equivalent position) contact information. Despite the various roles and position titles of wilderness managers, there was usually one person per wilderness unit who was specifically in charge of wilderness planning duties.

Agency Communication

Once the contact information was collected, each agency was informed about the survey and the agency wilderness leads and national regional teams were briefed on the purpose and goal of the survey (Appendix C). The agency representatives to the Wilderness Steering Committee were briefed on the project via email and provided their support. Agency officials were informed

about the survey to ensure field-level buy-in and to inform them of the survey purpose and application.

Survey Development

The ecological intervention survey was developed using Qualtrics Survey Software (Qualtrics, 2016) and was created between April and August of 2016. In August, the survey was pilot tested by four current and retired wilderness managers, and staff from the Aldo Leopold Wilderness Research Institute. The survey consisted of multiple-choice and open-ended questions focusing on a range of ecological intervention projects undertaken by the agency in the previous five years (see the Survey for exact questions). The first part of the survey focused on the respondent's position at the agency and their wilderness background.

The second section contained the main research question: if any ecological interventions have occurred in the past five years, what kind were they and how frequently have they occurred? The survey asked how often interventions occurred, what the primary reason was for acting, who proposed the project, what factors influenced the decision, the efficacy of the intervention, 4c prohibited uses, post-action monitoring, and legal appeals. Partial responses were accepted into survey results and respondents were permitted to skip questions.

To understand what types of vegetation interventions occurred between 2011 and 2015, respondents were prompted about four common types of ecological interventions: vegetation, wildfire, wildlife or water interventions. In addition, they were prompted to provide information on the most recent project in each of the sub-categories for added detail (Table 7).

Table 7 Ecological intervention categories

Intervention Category	Sub-Categories
Vegetation	• Applying herbicide • Planting vegetation • Mechanical removal of vegetation • Biocontrol • Other vegetation actions

Wildfire	• Fuels management
	• Initial attack (full suppression)
	• Control Lines
	• Application of fire retardant
	• Post-Wildfire Restoration
	  ○ Planting seeds
	  ○ Stabilizing hill slopes
	  ○ Application of soil and mulch
	  ○ Application of log terraces
	• Other wildfire actions

Wildlife	• Removal of wildlife • Introduction or reintroduction of wildlife • Other wildlife actions
Water	• Installation of structures • Addition of chemicals • Modification of water flow • Other water actions

Survey Activation

Using Qualtrics survey software, the survey was sent to 527 wilderness professionals on September 9th, 2016 and was open for responses through October 9th, 2016 (Qualtrics, 2016). After the initial distribution, roughly 50 emails bounced back, requiring further follow-up with the wilderness unit to locate the correct person.

Survey dissemination resulted in USFS emails labeled as "containing a suspicious link", resulting in a significantly lower response rate from the USFS compared with the other three agencies (a response rate of 25%). A follow-up electronic message explaining the survey source

and purpose, coupled with phone contact and adding another sub-set of USFS wilderness units, increased USFS response.

Data Analysis

The dataset was exported from Qualtrics to SPSS statistics software (IBM, 2016) and agency information was merged into this database. Duplicate surveys were eliminated using the most completed survey or the survey completed by a higher-ranking respondent. To protect respondent confidentiality, the return email address and i.p. address was removed from the working dataset and protected by the researcher.

Each variable was recoded to reflect the corresponding question and converted to a patterned format for easier analysis between intervention categories. I used SPSS to generate descriptive statistics of survey results, primarily frequencies and cross tabulations.

Results

Semi-Structured Interviews

Types of Restoration Actions

While only 37% of the 210 survey respondents took ecological intervention actions in wilderness, 92% (n=12) of the wilderness managers I interviewed had taken ecological intervention actions. Many of the wilderness managers interviewed had long careers, therefore interventions may have been more likely (potential selection bias). Manager responses varied on the types of ecological interventions that occurred in wildernesses they managed. Consistent with survey results, the most common type of restoration was vegetation related. The survey indicated that wildfire interventions were the second-most common type of restoration, however the interviews showed that wildlife restoration was the second-most common. For the online survey, participants were prompted by the four categories of restoration I chose to focus on (vegetation, wildlife, wildfire and water), while the interview questions focused on restoration actions more broadly.

Table 8 Types of ecological interventions from interviews with wilderness managers

AGENCY	TYPE OF RESTORATION	ACTION
USFS	Wildlife	Reintroducing native fish species, reintroducing bighorn sheep
FWS	Vegetation Wildlife	Revegetating coastal dune beach systems: planting American beech grass and seaside golden rod; enhancing habitat for the roseate tern
NPS	Vegetation Wildlife	Plant revegetation projects; Non-native fish eradication; Mountain goat inventory and collaring; reintroducing fishers

USFS	Wildlife	Non-native fish eradication and reintroduction of native westslope cutthroat trout (native to the state, but not native to the lakes they were introduced to)
BLM	Water Vegetation	Removal of abandoned stock ponds (from grazing operations before wilderness status), root rehabilitation
BLM	Vegetation Fire	Prescribed fire; weed treatments
NPS	Wildlife Vegetation Fire	Restoration of mountain yellow-legged frog (including rearing frogs outside of wilderness and dosing them with drugs to protect them from chytrid fungus); prescribed fire; velvet grass removal through hand pulling and tarping, meadow restoration; reintroduction of bighorn sheep
FWS	Vegetation Water	Superfund site cleanup; wetland restoration; use of biocontrol agents to reduce purple loosestrife
FWS	Wildlife	Feral horse and burro removal using helicopters to round them up, removing livestock developments like fences and water troughs
BLM	Wildlife	Wild horse and burro removal
USFS	None	None
NPS	Vegetation Water	Channel dredging to remove human-made channels from ocean to rivers; invasive species removal

Perceptions of the Wilderness Management Dilemma

The qualitative semi-structured interviews with wilderness managers provided depth and detail to the topics addressed in the quantitative survey. One goal of conducting interviews was to ascertain if wilderness managers perceived the wilderness management dilemma that policy-makers, scholars, and wilderness advocates describe; namely, how do we preserve both natural and untrammeled qualities of wilderness character when there may be an inherent paradox in preserving both? Discussions about wilderness stewardship and the debate surrounding

intervening in wilderness have largely taken place in the academic realm; therefore, it was important for me to understand manager perspectives and how they interpret law and policy regarding interventions. The interviews also focused on questions about decision-making processes revolving around ecological interventions in wilderness.

Manager responses supported the claim that interventions in wilderness pose serious threats to preserving wilderness character. Indeed, eight of the twelve managers interviewed cited human intervention—even for ecologically-focused reasons—as major threats to wilderness (Managers A, C, D, E, F, H, I, L). Examples of how interventions are threats ranged from fire mismanagement and wildlife control, to the desire to open wildernesses up for nonconforming purposes such as oil drilling. When asked what the greatest threats to wilderness were, one manager (E) responded, "The most dangerous threat to wilderness over which we have complete control is the desire on the part of the state fish and game agencies to turn wildernesses into fenceless game farms." This manager was referring to predator control interventions and ungulate augmentation programs that have been proposed and implemented by state fish and game agencies. Other managers spoke more broadly about the threat of interventions, even if they were for the most noble of purposes. One manager (D) said, "[The greatest threat is] a desire to tinker…especially with climate change, I just can see where people are going to have a hard time keeping their hands off!" Overwhelmingly, managers felt active manipulations in wilderness were likely to increase in the future, and this posed a serious risk to preserving wilderness character. Managers cited grappling with the question of intervention as a major struggle and challenge for management of their respective public lands.

The hands-off approach (HOA) has been described as a wilderness stewardship strategy that preserves wilderness character by maintaining the untrammeled quality and hedging risk associated with intervention activities, even if the intention is to improve natural conditions (Landres, 2010). To understand if managers perceived the wilderness management dilemma regarding the apparent paradox of managing wilderness (namely, that intervening to improve natural conditions degrades the untrammeled quality), I asked the following question:

> *Natural environments are rapidly changing today. Given this reality and the constraints of the Wilderness Act, do you think it is more important to protect all natural elements like species or processes, or is it more important to employ a hands-off philosophy and allow changes to occur?*

It was difficult for managers to assertively prefer the hands-off philosophy over intervening to protecting natural qualities of wilderness. Most managers believed some level of intervention is necessary to preserve natural qualities, as well as to comply with agency policy. For example, several managers said that the HOA is not realistic given current threats like invasive species and climate change (Managers A, B, D, E, H). They argue that simply "doing nothing" would allow more resource degradation and could lead to the loss of specific ecological processes and species. In some cases, they argued that there is no harm in "giving nature a boost" by using prescribed burns to restore natural fire regimes, or using chemical herbicides to prevent the spread of invasive species if it allows native species to flourish.

The same managers who said the HOA was not a viable strategy, also stipulated that context is extremely important for deciding whether to intervene, and careful, thoughtful decision-making should be at the core of the process. Every situation is different and it is unwise to generalize decisions across dynamic ecosystems. In some cases, the decision to take an action is necessary

for species preservation which may be mandated by other agency or federal policy. For example, in wildernesses managed by the FWS, establishing legislation may specifically advocate measures to protect a certain species. Additionally, the Endangered Species Act (ESA) may require specific action to protect wildlife habitat and enhance protection of a specific species. Therefore, both FWS managers (B and H) indicated that the HOA is simply not possible given their agency directives and potential additional ESA requirements.

Many managers cited the desire to preserve both qualities, and this means vetting interventions on an individual basis and striking a balance between intervening in certain circumstances and stepping back and not intervening in other cases. The table below provides additional manager responses in more detail to this question (Table 9).

Table 9 Selected quotes related to the natural/untrammeled paradox. Respondents were asked, "Natural environments are rapidly changing today. Given this reality and the constraints of the Wilderness Act, do you think it's more important to protect all natural elements like species or processes, or is it more important to employ a hands-off philosophy and allow changes to occur?"

Manager	**Agency**	**Preference on intervention**	**Selected Quotes**
C	NPS	Hands-off approach	It's very hard for me to pick but I feel like I'm coming down on the side of the hands-off approach, or that I wish we had enough wilderness, and maybe they would even be called something else, where you did have land that you could just do the hands-off approach and you would have another type of wilderness that is more common at least in the NPS that has quite active manipulation.
A	USFS	Intervention necessary to protect natural qualities/hands-off approach ineffective	If you don't do anything, invasive weeds are going to be completely out of control and you're simply not going to have the natural environment you started out with. So, hands-off doesn't work, but you've got to be smart about it and you have to be careful about it.

B	FWS	Hands-off approach not possible, must strike balance	It's impossible to sustain the X Wilderness and a lot of other particularly eastern wildernesses without some manipulation and still be in compliance with the other purposes for which land was being managed for prior to the Wilderness Act designation. The FWS has bird and endangered species act responsibilities as primary responsibilities. No other agency has this primary responsibility. So, I think we have to strike a compromise somewhere between completely hands off and what we were doing when I arrived in 2010 (not considering wilderness).
D	USFS	Some intervention acceptable, some absolutely not, depends on issue	I am a strong supporter of treating invasive plants to restore and protect our native species. But on the other hand, I have a hard time with fish stocking and those kinds of things...so for me it depends.
E	BLM	Intervention necessary to protect natural qualities/must preserve both	I've always taken the—maybe it's the cowards way or the manager-who-doesn't-want-to-make-a-decision's way out—saying if the rapid change of the environment isn't stopped outside of wilderness, it makes no difference whether or not we stop it in wilderness.
F	BLM	Intervention acceptable in some situations, requires careful consideration and prioritization	Trying to prioritize where the risks to the natural environment were the most severe and/or where they had the highest potential of success from intervention. Considering intervention in those locations, conversely the areas where they weren't as far along as far as degradation and leaving those hands-off. So, you're trying to really balance resource manager's perspectives within the wilderness context and really trying to draw that line between necessity and maybe just a want.
G	NPS	Depends on situation, acceptable in certain situations; avoid many small interventions, there must be an achievable end result/goal	I think we need to be cautious about choosing either side about that particular battle and look at things individually. The key is analyzing what it might get you and what effect you think it's going to have, and trying to think that through with open minds and with humility and lack of arrogance, and not thinking that we're really going to be that effective…they really need to be individually assessed and looked at with very critical eyes. I would have to say the NPS tends to be an agency of action, not much of restraint.
H	FWS	Hands-off approach not desirable, value natural qualities	I don't agree on the hands-off approach in the sense of just accepting what's going on and laying down. I'm also not thinking spitting in the wind is going to get you anywhere either. In other words, the glaciers are melting, the vegetation is changing, the animal life is making at first some subtle changes. Trying to fight

			with such small resources that you would have, trying to fight the bigger battle would be a losing battle.
I	FWS	Interventions acceptable, but we need to be careful and be more receptive to HOA	I think where we can we need to be very careful about taking actions to try and preserve natural character, and be more receptive to just allowing those processes to continue, even though we may not necessarily be happy with the outcome from a management perspective. I think a lot of times we overlook the inherent value of having that process continue without any intervention. I feel that managers often want to do something.
J	BLM	Intervention acceptable in some situations	I'm not 100% hands off if I feel like we have an opportunity to stop non-native species from moving in, then I would say let's try and treat them if we can, but if there's a native species that's migrating further north or further south because of climate change, then I'm more hands off. I feel like at least on the boundaries, we need to sort of play a little bit more of a hands-on role and then hopefully within the wilderness itself it's more hands-off.
K	USFS	Intervention acceptable in some situations	I think it's a tricky question because it is posed as an either or, and not necessarily each potentially being looked at with equal value. If I were to lean one way I would lean towards the unmanipulated, free to evolve on its own will, and let natural processes run wild essentially over trying to preserve a specific assemblage of species or communities. But I don't think that untrammeled always trumps natural.
L	NPS	Depends on situation	Every situation needs to be looked at on a case by case information awareness basis. I don't think there's a yes or no to either, always try to protect all species or let nature take its course. I don't think it's either/or. I think there are definitely situations where from what I know whether at X or elsewhere that you would want to intervene because there seems to be evidence that you can have a good outcome if you're intervening for a specified period of time. The protection of an ESA animal/plant or critical habitat might otherwise be lost or be degraded in a more rapid way; there may be reasons for taking action.

Although some managers highly value the hands-off approach, some did not think it was possible to implement due to conflicting mandates and policies. For example, two interviewees (C and G) cited that a hands-off approach to wilderness management was valued less compared with promoting strong research and science programs. The NPS promotes a robust science program that conducts a host of inventory, monitoring, climate change, biological and physical

science projects; it is also well funded nationally. NPS policy not only permits, but encourages ecological restoration where degradation of natural resources is documented. Two NPS managers agreed that the NPS has a strong tendency for action, reflecting an agency preference for proactive action with the resources to conduct large-scale projects. A NPS manager (G) stated, "We always questioned, is that really the best way to get the information that you think you need and are there ways to change logistical methods to remove some of those inherent intrusions to wilderness? So, where is it restoration? And where is it interference? Sort of becomes the question, and I tended to think that a lot of science that is occurring is a little bit too arrogant." Following this, Manager G stated that we used to think our best scientific strategy was preventing wildfires from burning, and now we know that is not in line with contemporary ecological understandings. In other words, we need to be humble and recognize that our knowledge is always imperfect and subject to change.

A strong NPS science program inevitably leads to more proposals to intervene in wilderness, even if this intervention is simply to monitor changing conditions. Monitoring alone does not necessarily constitute a trammeling, but the permanent installation of structures for monitoring and the use of motorized transportation degrades the undeveloped quality of wilderness character in addition to the untrammeled quality. For example, one proposal to monitor trends in glaciers included using aerial drones delivered to the glacier site via a helicopter. A trend towards valuing and prioritizing the importance of science in public land management is consistent with the theory of environmental governance, which postulates that knowledge of the environment has become a rationality to rule, using power over those who do not have such knowledge (Valdivia,

2015). An NPS manager observed this phenomenon when commenting on the status and role that such scientists have in certain places. The manager (C) stated:

> We have hired a GS-12 professional aquatic biologist and ecologists in year-round professional jobs, and they've been hired to do the state of the art thing that is in their discipline, so of course they're going to want to eradicate fish that aren't native, and they're going to want to do it by pouring piscicides in the lake, because that's the state of the art thing in their discipline. So, it's very hard then when they bring this up in a [wilderness] committee, which is a group that aren't scientists and some are, but many aren't. And then have them weigh in on what method we should use, and it just became very difficult to have an objective look with a regard to wilderness and the Wilderness Act, and what it says you will and will not do and the prohibitions listed in the 4c area. It always felt predetermined, well there's no way we're going to tell a team of GS-12 professionals, 'well I'm sorry but you can't do that'.

A FS wilderness manager said that the HOA may be possible theoretically, but it may not be the best approach to achieve agency or wilderness goals and objectives. In some cases, the very thing that led to wilderness designation may be under threat. Should managers simply let these natural qualities go? Public and agency values may push for the protection of iconic species like trout in the acidified streams of West Virginia or fishers in the Pacific Northwest—which would require adding chemicals to adjust the stream quality or reintroducing species. The higher the public values the greater the pressure to intervene to protect them.

For most agencies, the ability to protect a certain species is an important responsibility, yet deciding on the project scope and degree of intervention to protect a species varies greatly. Summarizing agency responses regarding the viability of the HOA can be described as either possible or not possible to implement, and desired or not desired. Five out of twelve managers believed the HOA was not possible, but desired; four believed the HOA was possible but not desired; three believed the HOA is not possible or desired. This means that no manager believed that the HOA was both possible and desired.

Decision-Making Processes

The ability to make good wilderness stewardship decisions—ones that preserve wilderness character and are consistent with the Wilderness Act—is an integral part of ensuring the National Wilderness Preservation System is achieving its purpose to preserve land retaining its primeval character without permanent improvement, and provide an enduring resource of wilderness (P.L. 88-577). The flexibility in decision-making afforded to public land managers at the field level is quite high in some cases, reflecting the agency culture and policy parameters that each unit operates within. Successful wilderness stewardship preserves wilderness character through a thoughtful process of project deliberation among key decision makers. It entails following agency policy related to wilderness management and natural resource management (Dawson & Hendee, 2009). As expressed by the wilderness managers I interviewed, the important aspect of decision-making was not necessarily determining whether to take the action (although this should always be the first step), it was determining a "wilderness-friendly" approach to achieving project goals (Manager B). Managers indicated that good decisions involve incorporating and filtering all relevant law and policy for a specific proposal, assessing the risk, and ensuring the public is informed and involved (when necessitated by NEPA). Yet the decision trade-off for evaluating ecological interventions in wilderness is complex and varied. As the results below indicate, each manager operates within their own sphere of influence from agency policy, personal background, and wilderness unit culture.

The approaches that follow entail a variety of procedural tools that managers discussed through the interviews such as the Minimum Requirements Analysis and referencing wilderness

management plans for guidance. When these established and institutional processes fail, managers rely on other forms of decision-making that I have labeled individual approaches.

Procedural Approaches

Wilderness managers and compliance specialists have attempted to combat the variability in decision-making and ambiguity in policy guidance on intervening in wilderness by employing two procedural methods. One method is the interdisciplinary process (IDT), whereby the wilderness manager meets with the project proponent, as well as other specialists (biologist, geologist, fire manager, environmental planner, etc.) to determine if intervention is necessary, shape project parameters, and determine the best method for achieving project goals. Another procedural approach to achieving consistency in decision-making is using the minimum requirements analysis (MRA) or minimum requirements decision guide (MRDG, as established by the Arthur Carhart National Wilderness Training Center) which asks a series of questions beginning with whether it is necessary to take action in wilderness, and secondly, what is the minimum tool necessary to achieve project goals given restrictions in the Wilderness Act (4c prohibited uses such as mechanization, motorized tools, etc.)?

The MRA and MRDG ask the project proponent to demonstrate how the action will impact each quality of wilderness character and documents the rationale and motivation for acting. The goal of both the MRA and the MRDG is to make and document wilderness decisions that follow pertinent law and policy. For example, one manager (B) said, "The first step was really doing the MRDG guide and in some cases the most challenging part of that was simply narrowing down what actually was the management action we were talking about doing….it actually required

everyone to take a step back and say, 'alright, let's break down what we're doing into very small pieces and maybe we can repackage these things into programmatic MRAs'."

The ability to make wilderness stewardship decisions was shaped by the presence or condition of an existing wilderness management plan (WMP). To navigate the time-consuming and resource-intensive process of completing NEPA compliance for individual projects, many wildernesses have shifted to plans with a larger scope that encompass programmatic and common or routine actions. Compliance work and planning is reduced by approving actions under a single, comprehensive NEPA review (the level of NEPA analysis depends on the impact of the action but can range from a categorical exclusion to a full environmental impact statement). In the BLM, this takes shape in the form of watershed plans; in the FWS they use Comprehensive Conservation Plans (CCPs); in the USFS, a Forest Plan; and in the NPS, this may be a park or wilderness management plan. Ideally, a wilderness management plan is a separate document that indicates how specific objectives will be achieved through a wilderness filter. A WMP can be used to make decisions about potential future actions and articulates what approaches and methods will be used; for some agencies, the wilderness plan is a piece of a larger forest plan with a specific subsection on wilderness. The WMP avoids a piecemeal approach to decisions about interventions in wilderness and allows for categorical decisions about likely future actions based on specific standards and methods outlined in the WMP. For example, a WMP may indicate under what conditions a new bridge may be built, and how to respond to increasing visitor use and resource impacts on trails.

In response to an outdated WMP, a manager (C) said the following:

> This is where some of the issues arose—without having an (updated) WMP that was actively used and approved in the first place. If we had such a document, it would say this is what the objectives and programs by which we are using in this wilderness will be, and from this you would do whatever projects are mandated by that plan. But instead it seemed to me that we had various work groups who were hired to do certain work, but that was never really looked at against any of the wilderness management or the Wilderness Act or NEPA to be screened first.

Another manager was working on several WMPs throughout the district and cited the importance of having a WMP backed up by NEPA. This manager (A) stated, "We kind of piece-meal our way through it and we're navigating two separate forest plans. It's the proverbial sausage making and the process is ugly, but in the end, once you get that document done, you are light years ahead because then you can start making some management decisions that are backed up by a NEPA document."

Most managers viewed the MRA as a wilderness education tool. For some natural resource managers, the MRA may be the only place where they are exposed to the requirements of wilderness-specific policy. Manager K stated, "I think it definitely has an important value that it brings to the decision-making process in multiple ways. One, I think it educates park managers or program managers; often our MRAs are done by cooperators who are doing research or science activity in the X, so not just infrastructure or other types of X operational, so there's a lot of research and the question is how do you access a wilderness? What if any installations do you put in? Those kind of routine activities that go with projects are a big part of what gets scrutinized in the MRA process at X, so I think it's a really important part because it educates and makes people aware of what wilderness is and what the law requires. What are our responsibilities as an agency?"

Manager B also talked about the importance of using the MRDG as an educational tool. He said, "Changing the paradigm is important. How can we make it work and be a little kinder and a little gentler on wilderness in the process? Naturalness and the wildness attributes, and teaching them, and sitting down and working through the MRDG process probably went the furthest to them losing their apprehension and began to buy into the process of thinking about being a little more hands off, a little less impacting on the resource." Similarly, Manager G stated:

> Well you know if an action is really justified, somebody's going to find a way to make it happen. Or if they think it's justified. I think the key to the MRA process is that the analysis occurs through different eyes. If just the biologists are going to do it, they have their perspectives and their views, and they're going to do what they want to do; but then when you start bringing in in other people to look at it—such as the wilderness specialist—to apply the Wilderness Act to it, it starts changing it a little bit and certainly here we've seen projects modified pretty significantly after we've started analyzing and commenting on them. We have said no to some projects, but like any other system it can be gamed if you're smart about it, but it does at least make everybody stop and start looking at a lot of different aspects of a particular action and what effects it's going to have.

Limitations of the MRA

The Wilderness Act provides a list of prohibited uses in section 4c, however managers are exempt from the prohibition if that prohibited use is the minimum tool necessary to manage the area as wilderness. One question that recurred throughout the interviews was whether the MRA is an effective tool for evaluating proposals to intervene in wilderness. This was not a question originally proposed in my interview guide, but in an early interview a manager had talked about how the MRA was pre-decisional—managers generally knew what action they wanted to take and with what means, so they completed the MRA to fit their goal. This assertion motivated me to ask future managers about the efficacy of the MRA.

A NPS manager (C) first mentioned the ineffectiveness of the MRA process. The manager stated:

> So it [the MRA] became to me, very predetermined, and those papers, which in that case was the MRA that we're filing, they would be written to meet it. There were times where even the person who said, 'oh yeah, I've already ordered the X chemical, and I've ordered my crew, and I've scheduled the helicopter. Oh yea, I forgot I've got to do that MRA.' So they would hurry up and do the MRA, and this was common with Trails; they would rush that in and it would be kind of sub-standard, so I would see the person meeting with our compliance person actually working them through it, and saying 'no you should say this or say that.' Working the document backwards and that's how you end up with doing all these activities and saying they're the minimum requirement. But are they? I don't know. I feel like (the MRA) was basically used to cover us legally, should Wilderness Watch ever turn its eye to X Wilderness.

This manager was concerned that the initial proposal to intervene was not assessed for its consistency with wilderness policy and law as a starting point. Instead, the proposal may not have been checked for appropriateness in wilderness until later, therefore, the MRA was viewed as an afterthought, a mere piece of compliance that was required for liability. Several other managers agreed with this sentiment and discussed how the MRA has been misused. A FWS manager (B) shared a time when the MRA was incorrectly applied to a project. The manager said, "We ran it through the MRDG process, but in my opinion it actually became politicized. I was pretty much compelled to sign off on an MRDG that I did not feel was yet ready to be signed off on for budget reasons. And for basically the political fallout of not getting that money obligated, and then lost to the agency. Money actually drove that train."

A USFS manager (D) reflected on the limitations and advantages of the MRA. The manager stated, "Most of the time people knew what they wanted before they started, but there were times when they went through the analysis and were like, 'wow, we don't have justification for replacing that bridge. There is no justification.' The other good thing about that process is that it

would provide the decision maker, and other people who are supporting that decision, with that documentation and that justification. Later on, if the decision was made to go ahead with that action and it was appealed, then that document becomes really important. If it's done honestly then you can really justify your decision or you can say no, this decision is not good."

A BLM manager (I) believed the MRA did not have the ability to analyze future decisions in an effective way. The manager stated, "I think it's effective in making the decision for that initial action; I feel what often gets missed…is what needs to happen after that initial action? So really evaluating, what if this initial action doesn't have the intended outcome? Are we going to be looking at taking another action after that? A lot of those things can turn into three, four, five additional actions over time, all related to that same initial decision. I don't know that the MRDG does a very effective job having the managers think through that." The MRA focuses on the immediate proposed action, and does not consider cumulative effects or the slippery-slope concern that an action now may be used to justify a similar action in the future.

Individual Approaches

Applying individual management approaches to make wilderness decisions depended on the autonomy the manager had over decision and agency culture. One manager was responsible for over twenty wildernesses, and prioritized certain actions within these wildernesses depending on the necessity and degree of action. For example, this manager chose to leave some wildernesses as "hands-off" management areas. In contrast, some wildernesses required restoration as determined by larger regional plans, so the manager (E) concentrated management actions into these specific areas and set restoration priorities. This manager worked for the BLM where

overseeing multiple wildernesses is common and managers often have the flexibility and discretion to implement their own approaches.

In contrast, an NPS manager (C) felt that in cases where the decision to intervene had already been approved by resource managers, at least they should employ what the manager called a "natural approach" to intervention. This approach prioritizes natural elements as the material and methods, such as using local logs to build bridges rather than transporting steel beams into wilderness via helicopter. This natural approach would reduce the risk that a storm could wash the bridge downstream leaving the metal as a permanent fixture of the landscape as essentially trash, and reduce the need for motorized transportation.

A third individual approach to improving wilderness intervention decision-making was having wilderness managers educate their co-workers to facilitate wilderness-friendly decisions. All interviewees indicated that the level of wilderness education at each unit varied significantly and this occasionally led to projects that were inappropriate in wilderness. Educating co-workers on the laws that make wilderness unique was a key element to positive outcomes. Two managers indicated that when they first began working at their respective wildernesses, the level of wilderness stewardship awareness was low, and there was no MRA process in place. Over time, these wilderness managers slowly raised awareness among co-workers and reviewed common management actions to determine if they were necessary. Actions that were deemed necessary were altered to conform with wilderness objectives. For example, in an area where wheel barrows were used to transport supplies (wheels are considered mechanized transport and are forbidden in wilderness), project leaders eventually hired an additional employee to transport

supplies in by foot (Manager B). Manager B discussed the IDT process as a slow and steady approach to gaining mutual acceptance from unit staff.

> Sitting down and working through the MRDG process probably went the farthest for them losing their apprehension and really began to buy into the process of thinking about being a little more hands-off, a little less impactful on the resource through the manner in which we go about things. It seemed to lead to gradual acceptance on their part, as well as the decisions that came out of it. Because they were involved in the decision-making process, they had ownership when it was time to put that decision in place on the ground.

In this example, the interdisciplinary process combined with wilderness education led to positive results.

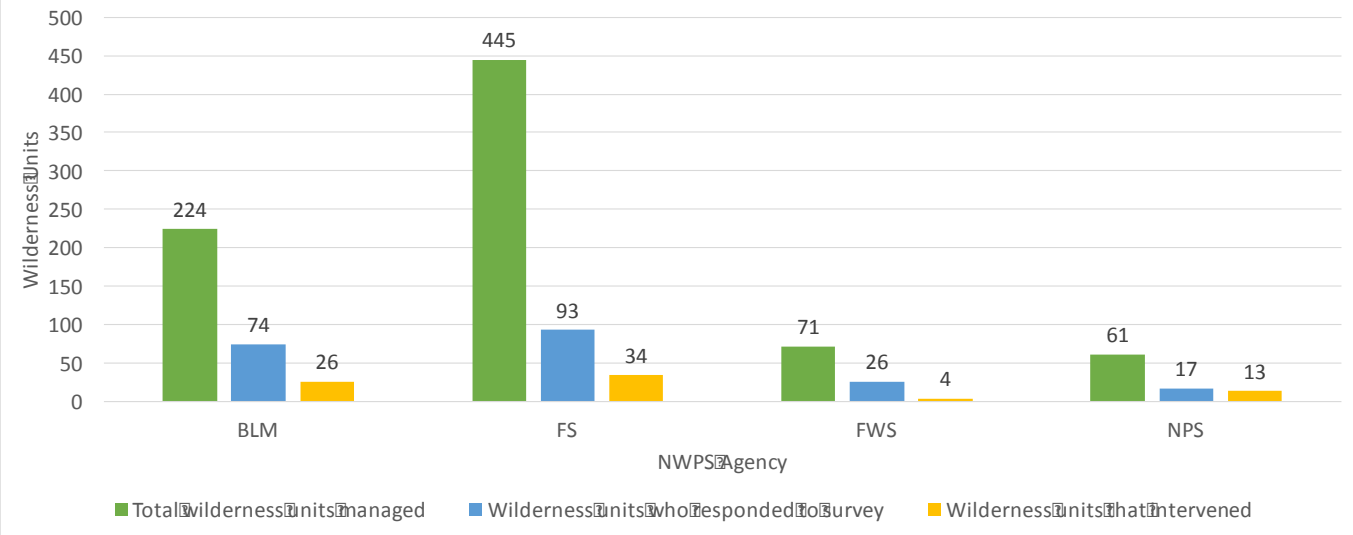
In some cases, the decision-making process itself may be moot because the final decision-making power rests with higher-ranking agency officials who may not be intimately connected and informed about wilderness parameters. The final decision-maker may also have limited wilderness understanding or is not willing to prioritize wilderness over competing interests like resource protection. For example, a wilderness manager in the NPS reports to the park superintendent who ultimately makes the decision. The manager (G) said, "Sometimes my take on things was often to err on the side of preservation and being conservative about actions that are out there that might potentially have impacts. But the decision-makers, the superintendent might have other factors involved like political pressure from user groups or congressional delegations or whatever. Politics is certainly a factor, and I'm using that in a very general sense there. It's certainly a factor on why my preferences might not have been chosen at times." This dilemma of having adequate decision-making processes, but the possibility that they could decisions be overruled at any point raises concern over the effectiveness of individual manager discretion and a wide-decision space versus more defined policy.

Survey Results

Frequency of Ecological Interventions

Of the 527 wilderness units who received the survey, 210 wilderness units completed the survey (including partial surveys), for a response rate of 40%. Seventy-seven of the 210 respondents[5] indicated in the past five years (2011-2015), they intervened in wilderness for ecological intervention activities. Therefore, across the NWPS, 37% of wilderness units surveyed indicated they have intervened in wilderness in the past five years (Figure 2). Many of these wilderness units have intervened multiple times.

Figure 2 Proportion of wilderness units who responded to the survey and took ecological interventions by agency



The figure below illustrates the survey responses in relation to how many wilderness units intervened in wilderness for ecological interventions (**Error! Reference source not found.**). Though the total number of wilderness units that intervened was 77, many of these wilderness

[5] The survey was completed by natural resource specialists, rangers, recreation planners, etc. which are considered "wilderness managers"

units intervened multiple times in various categories of intervention types—vegetation, wildfire, wildlife or water—for a total of 111 intervention actions.

Figure 3 Summary map of survey responses

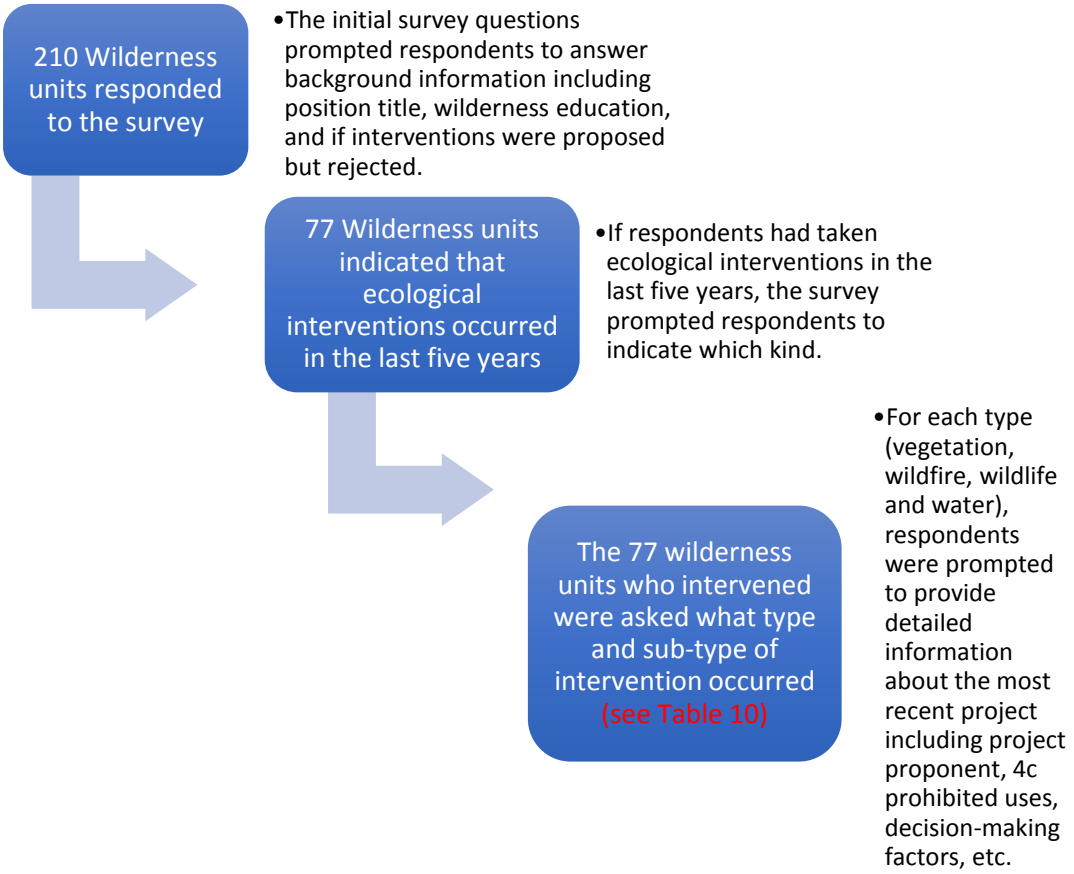


Table 10 Number of each type of ecological intervention from the 77 wilderness units who intervened (n=111 intervention actions from 77 wilderness units)

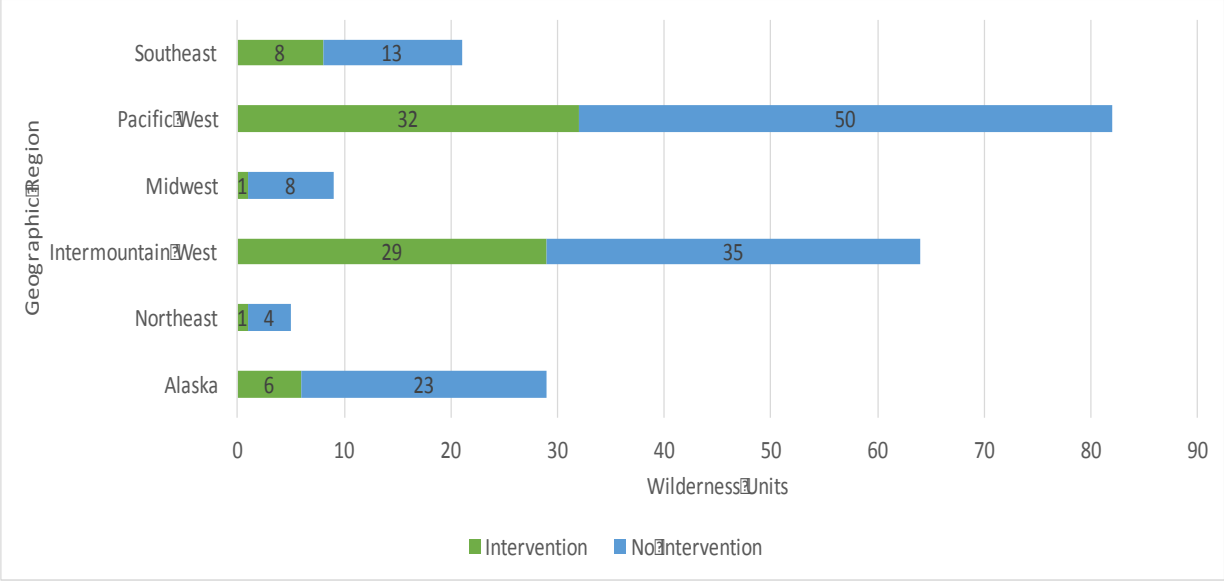
	VEGETATION INTERVENTIONS	WILDFIRE INTERVENTIONS	WILDLIFE INTERVENTIONS	WATER INTERVENTIONS	TOTAL
BLM	9	11	3	0	23
FS	28	17	9	0	54
FWS	3	2	2	0	7

NPS	11	9	6	1	27
TOTAL	51	39	20	1	111

Geographic Distribution

Survey data show that across the NWPS, the Pacific West Region had the most wilderness units that responded to the survey (82 units) as well as the most wilderness units that had intervened in wilderness in the last five years, with 32 wilderness units (n=210 wilderness units) (Figure 4). The Intermountain Region closely followed with 64 wilderness units responding to the survey and 29 wilderness units (n=210) indicating intervention actions occurred. The Alaska Region followed with 29 wilderness units responding to the survey and 6 units indicating intervention. The Southeast Region had 21 wilderness units respond to the survey and the third-most wilderness units that indicated intervention with 8 wilderness units (n=210) wilderness units.

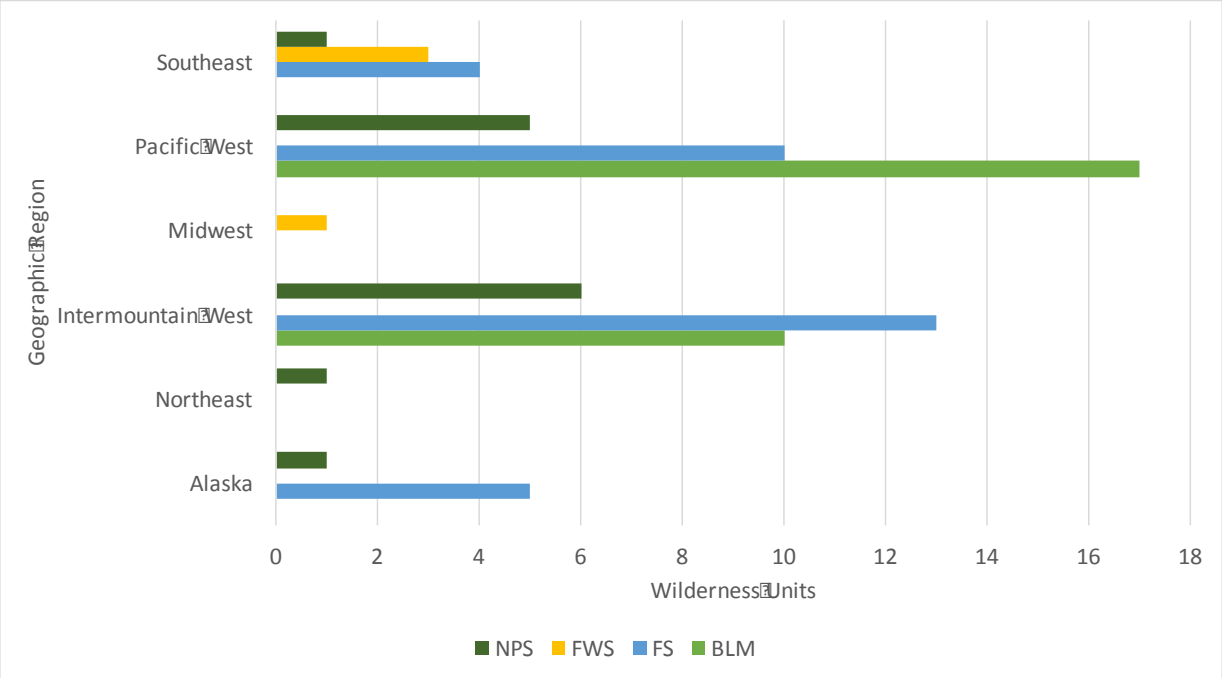
Figure 4 Ecological interventions by geographic region (n=210 wilderness units). Regions were selected using the National Park Service map of geographic regions wildernesses were coded to a region by state.



Proportional to the amount of wilderness units that responded to the survey per region, the Intermountain Region had the greatest rate of intervention compared with the other five regions. Twenty-nine out of the 64 wilderness units responding from the Intermountain Region indicated interventions occurred, or 45%. The Pacific West Region had the second greatest proportion of wilderness units that indicated ecological intervention with 32 out of 82 wilderness units, or 39%. Although only one wilderness unit in the Northeast Region intervened, because only 5 wilderness units who responded to the survey were from the Northeast Region, 20% of wilderness units in the Northeast Region intervened in wilderness in the last five years.

Looking at geographic distribution by agency, the BLM wilderness units in the Pacific West had the most wilderness units that took ecological interventions, followed by the FS in the Intermountain West Region (Figure 5).

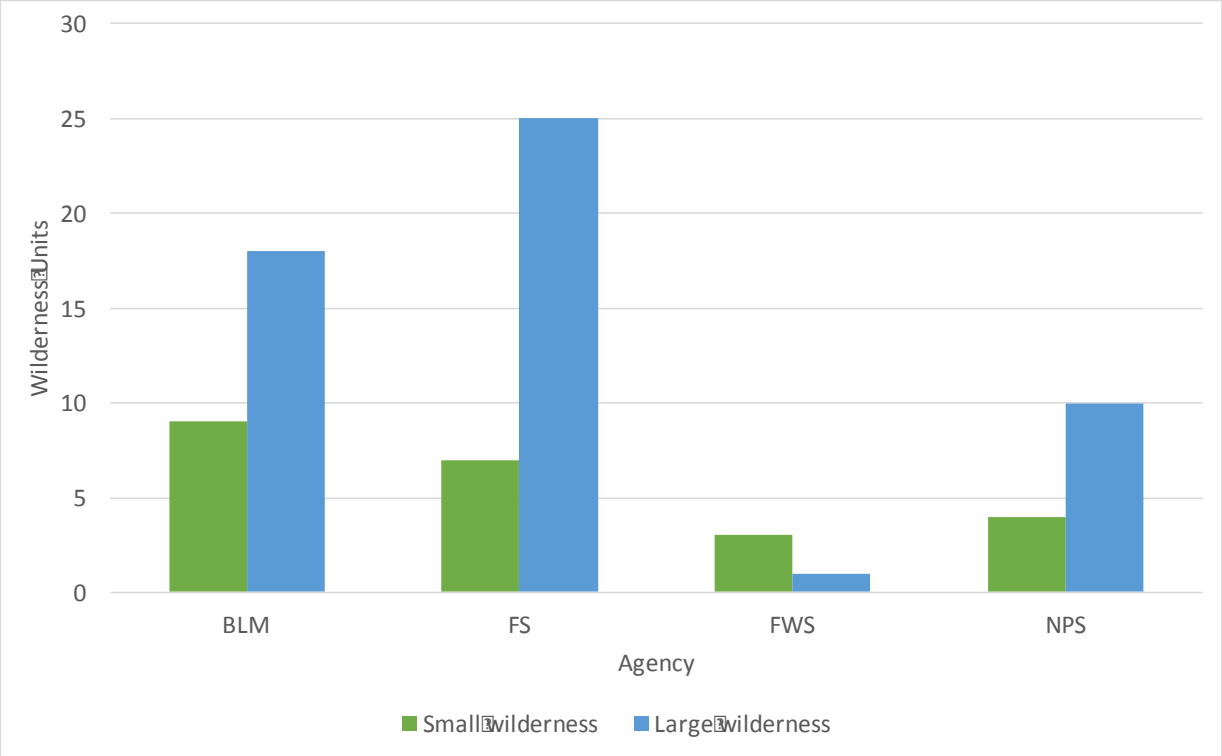
Figure 5 Wilderness units that intervened by geographic region and agency (n=77 wilderness units)



Wilderness Size

Each wilderness was ranked according to acreage and distributed to find the median. Wildernesses were labeled "small" if they were between 1 and 26,467 acres (the median) and were considered "large" if they were between 26,468 acres or above. Most of the wilderness units sampled in the survey were large wildernesses (**Error! Reference source not found.**).

Figure 6 Distribution of wilderness units by size and agency (n=210 wilderness units)

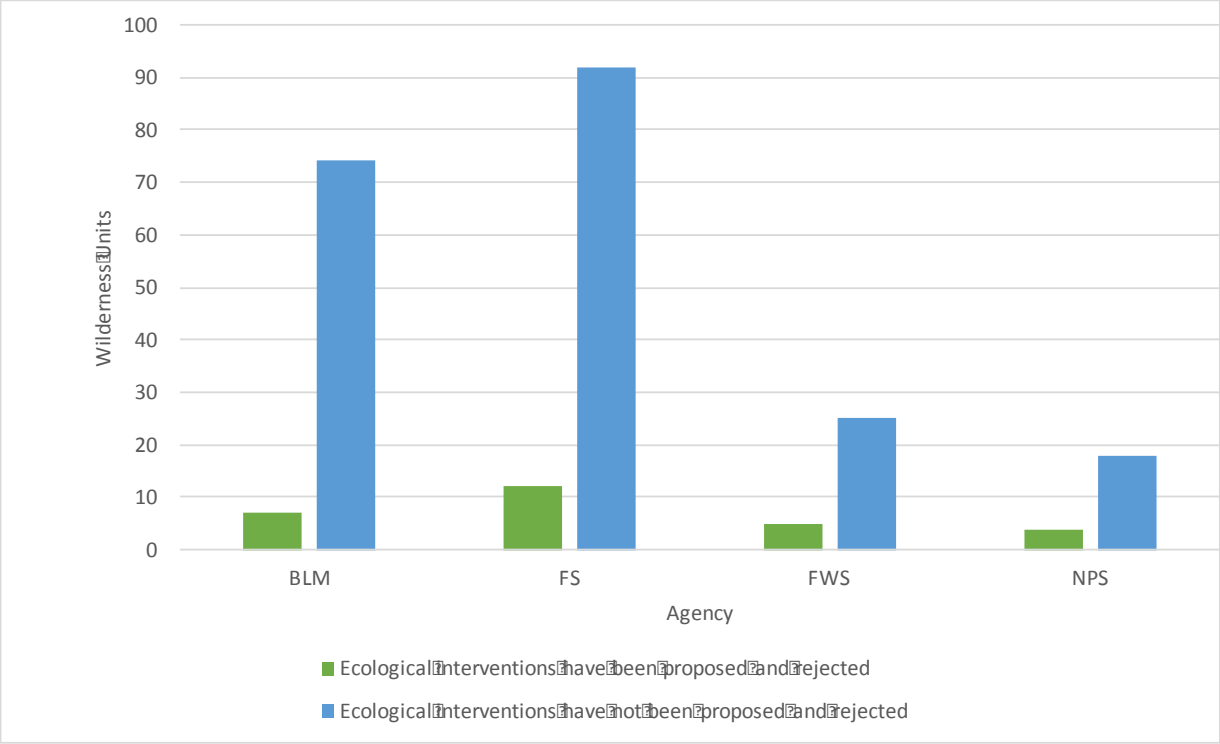


Thirty percent of wilderness units that had intervened were small wildernesses (n=77 wilderness units), while 70% of wildernesses that intervened were large wildernesses. Sixty-two percent of wilderness units that did not intervene were small, while 38% of wilderness units that did not intervene were large.

Ecological Interventions Proposed and Rejected

Thirteen percent of wilderness units (n=209 wilderness units[6]) across the NWPS indicated that proposals to intervene in wilderness have been proposed but rejected in the last five years (Figure 7). The NPS has the greatest proportion of wilderness units, 22%, that had proposals to intervene that were rejected. The FWS followed with 20%, the USFS with 13%, and the BLM had the lowest rate with 9%.

Figure 7 Wilderness units indicating ecological interventions have been proposed but ultimately rejected in the last five years by total agency responses (n=209 wilderness units)

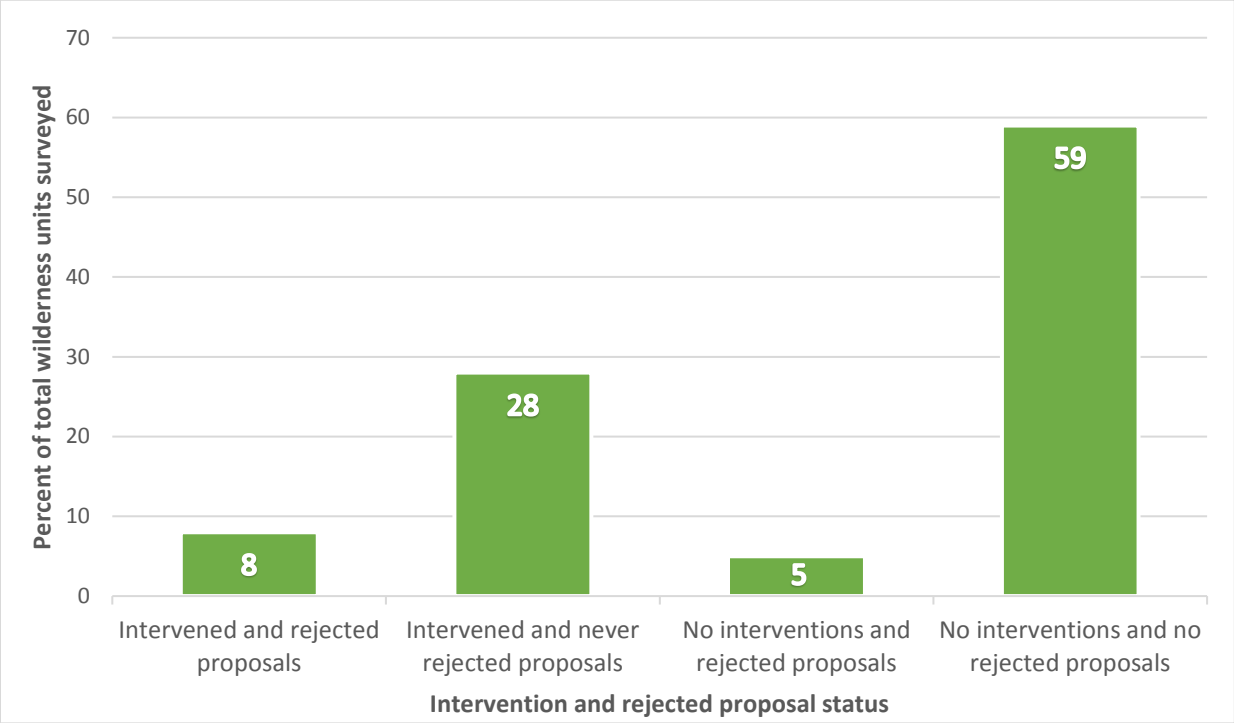


Further analysis broke the number of wilderness units into four categories: wilderness units who intervened and had proposals to intervene but were rejected; wilderness units who intervened and did not have proposals to intervene that were rejected; wilderness units who did not intervene but had proposals to intervene that were rejected; and, wilderness units who did not intervene and

[6] One wilderness unit omitted this question.

did not have proposals to intervene that were rejected. Most wilderness units sampled did not have ecological intervention projects in the last five years and could not recall any proposals to intervene that were rejected (Figure 8). Twenty-eight percent of wilderness units (n=209) had both intervened and never rejected proposals to intervene.

Figure 8 : Percent of wilderness units with ecological intervention and "proposed but rejected intervention projects" status (n=209 wilderness units)



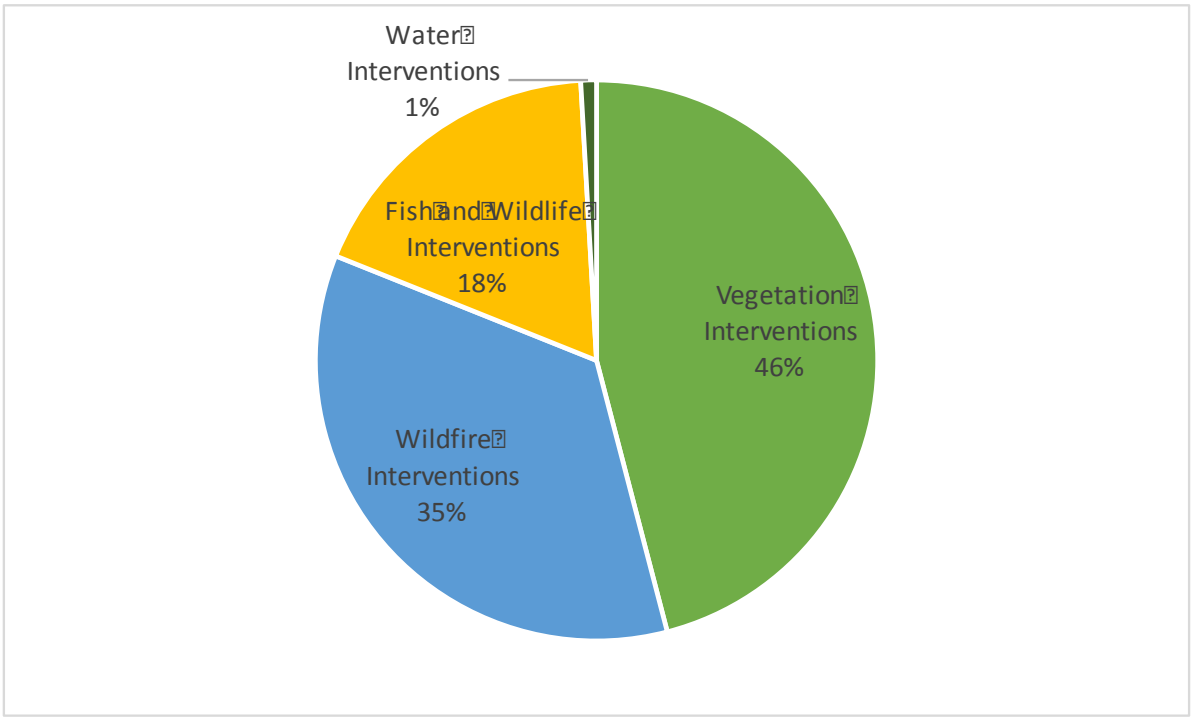
Broad Agency Trends

The NPS overwhelmingly had the highest rate of intervention with 75% of NPS wilderness units indicating interventions occurred. The USFS had the second highest rate of intervention with 37%, and the BLM followed with 35% of units undertaking intervention actions. The FWS had the lowest rate with 15%. The data show that, of the 77 wilderness units who indicated they had intervened in wilderness, the agency with the most number of wilderness units that took intervention actions was the USFS with 34 wilderness units (n=77 wilderness units that

intervened, however there are more USFS wilderness units across the NWPS, therefore they received more surveys), followed by the BLM with 26 interventions, the NPS with 13, and the FWS with 4.

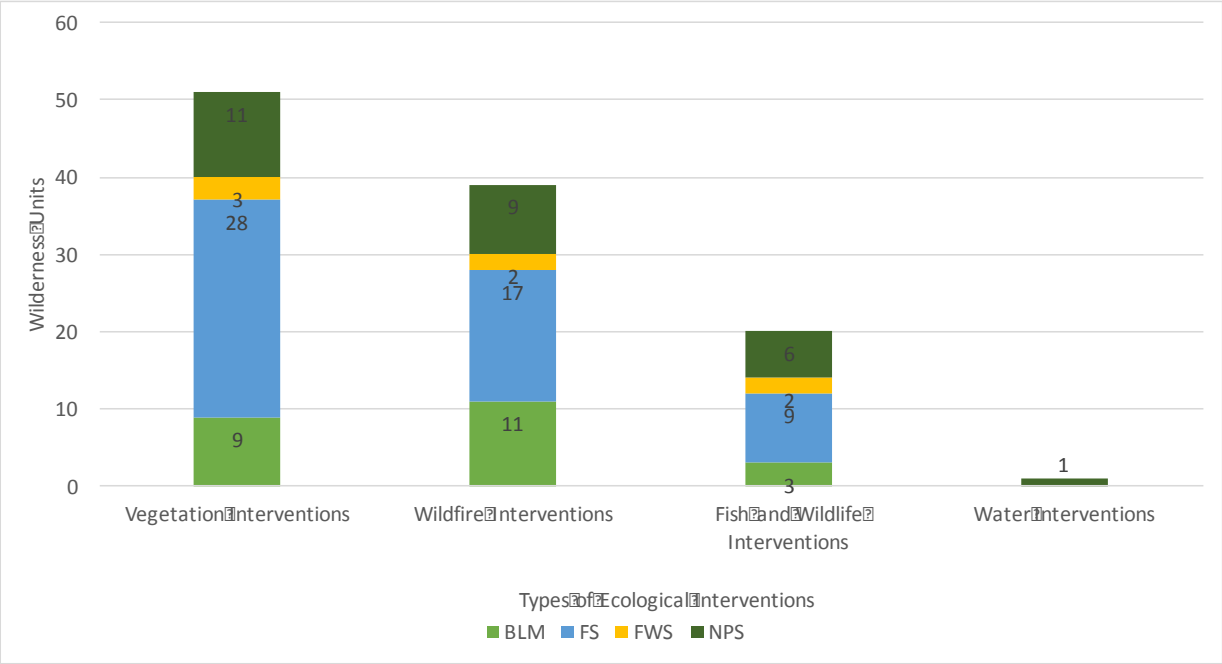
The most common type of intervention action across the NWPS was vegetation actions, with 51 wilderness units indicating they acted to sustain, restore, or manage vegetation (n=111 intervention actions from 77 wilderness units)[7] (Figure 9 and Figure 10). Wildfire interventions were the second-most common type of intervention with 39 actions, followed by 20 wildlife actions, and one water action.

Figure 9 Frequency of types of ecological intervention actions across the NWPS (n=111 vegetation, wildfire, fish & wildlife actions from 77 wilderness units)



[7] This number is larger because, although 77 units indicated ecological interventions have occurred in the past five years, in later survey questions, a sum of the four sub-categories of actions indicate that 111 units have taken at least one action to specifically manage vegetation, wildfire, wildlife or water.

Figure 10 Frequency of NWPS wilderness units indicating they had intervened in wilderness by type of ecological intervention and agency (n=111 vegetation, wildfire, wildlife and water intervention actions from 77 wilderness units)



Though vegetation interventions were the most frequent category of ecological intervention, the most frequent type of specific ecological intervention was establishing control lines to control wildfire with 29 projects documented, followed by herbicide interventions with 28 projects, and wildland initial attack interventions with the goal of suppressing fire at 25 projects.

Trends in Ecological Intervention Types

Vegetation

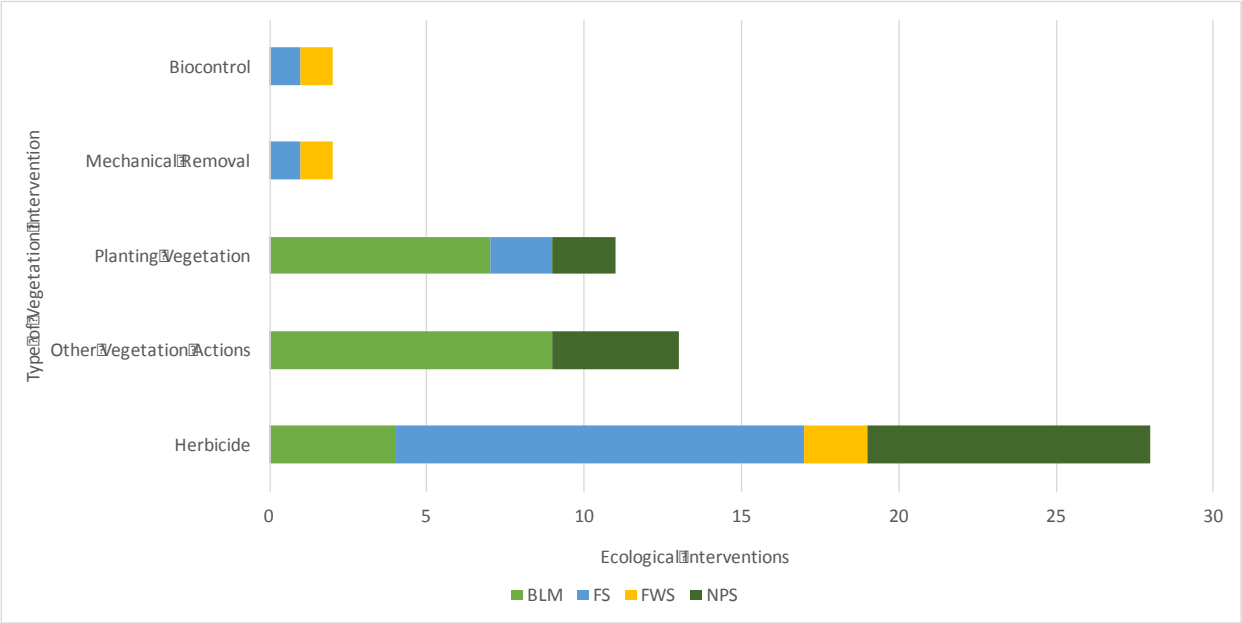
Survey data show that across the NWPS, the most common type of vegetation intervention was applying herbicide, with 28 wilderness units indicating they had completed projects to apply herbicide in the last five years[8] (n=56 total vegetation actions from 77 wilderness units) (Figure

[8] Respondents could have taken multiple vegetation actions, therefore although there are 51 vegetation interventions documented, the number of sub-vegetation actions exceeds 51 interventions.

11). The second most common type of vegetation intervention across the NWPS was "other" category projects, with 13 "other" vegetation projects documented. This category includes vegetation actions that did not fit under herbicide application, planting vegetation, mechanical removal of vegetation, and the use of biocontrol. The most common type of "other" vegetation was the restoration of off-highway vehicle (OHV) incursions in wilderness units managed by the BLM. Additionally, restoring sites with illegal marijuana operations were common sources of "other" vegetation interventions. The third most common type of vegetation intervention across the NWPS was planting vegetation, with 11 projects documented. Mechanical removal and the use of biocontrol had the two lowest number of projects across the NWPS with two projects each.

By agency, the NPS reported the greatest proportion of wilderness units that had undertaken vegetation interventions, with 85% of NPS units (n=13 NPS wilderness units who indicated interventions occurred in last five years). The USFS had the second greatest proportion of wilderness units who took vegetation interventions with 82% (n=34 USFS wilderness units who indicate interventions occurred in the last five years). The FWS followed with 75% (n=4 FWS wilderness units indicating interventions occurred), and the BLM with 35% (n=26 BLM wilderness units). However, looking at the total frequency of agency wilderness units that completed vegetation interventions, the USFS had the greatest frequency of wilderness units out of the total agency wilderness units with 55%, followed by the NPS with 22%, 18% for the BLM and 6% for the FWS. Five year trends indicate that vegetation interventions are slowly increasing over time (see Appendix D).

Figure 11 Frequency of Vegetation Interventions per Agency (n=56 vegetation intervention actions from 77 wilderness units)



Wildfire

Wildfire interventions were the second most common type of ecological intervention in wilderness, with 39 wilderness units across the NWPS indicating they had taken wildfire-related interventions (n=111 intervention actions from 77 wilderness units). The USFS reported the most wildfire interventions with 17 (n=39 wilderness units who indicated they had taken wildfire interventions), the BLM followed with 11, the NPS reported nine and the FWS reported two wildfire interventions.

Of the four sub-categories mentioned above, the most common type of wildfire intervention was establishing control lines with the goal of containing the fire[9]. Across the NWPS, the USFS had the most wilderness units who took control line actions, with 14 wilderness units (n=29

[9] Note: Respondents were only asked if control lines were established if they affirmed that fuel reduction interventions were taken.

wilderness units who took control line actions), and the USFS also had the greatest proportion of initial attack projects with 48% (14/29 control line projects were from the USFS). Thirty-one percent of BLM wilderness units took control line wildfire interventions, followed by the NPS with 17%, and the FWS with 3% (only one control line action).

If wilderness units indicated that control lines were established with the goal of containing the fire, a sub-question asked the respondent to document how many time fire retardant was dropped from aircraft in each of the last five years (2011 to 2015). Cumulatively among agencies, fire retardant was dropped 140 times. The USFS had the most drops with 65 (n=140 or 46%), followed by the BLM with 45 drops (n=140 or 32%), the NPS with 25 drops (n=140 or 18%) and the FWS with five drops (n=140 or 4%).

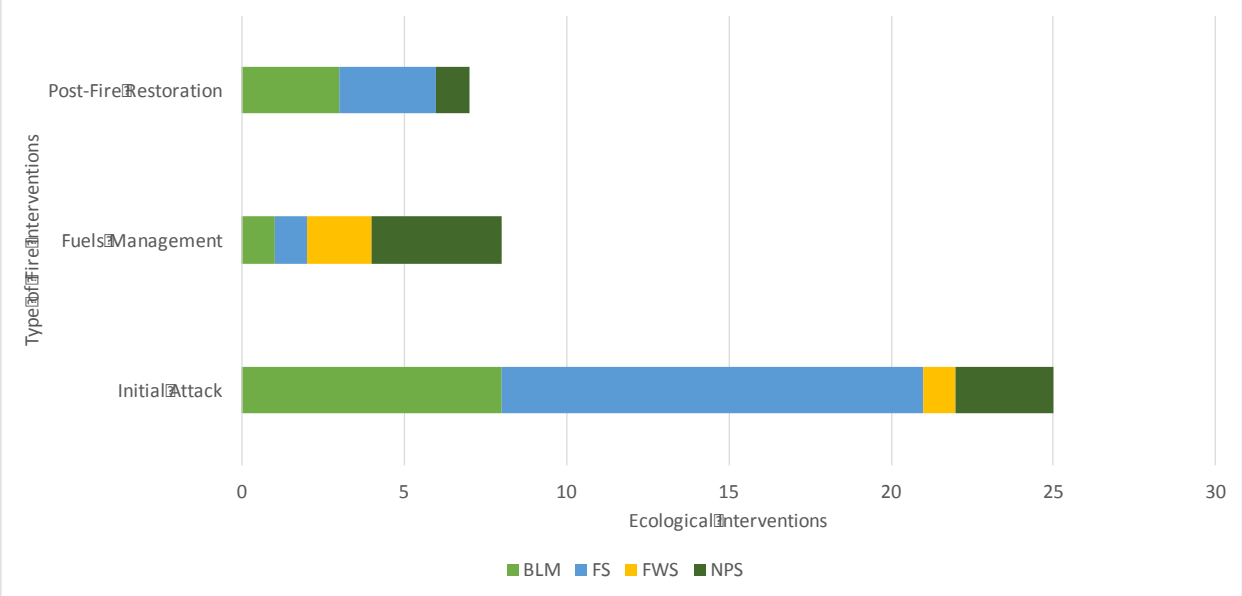
The second most-common type of wildfire intervention was initial attack interventions, the aggressive initial attack response with the intent of extinguishing natural fire ignitions (Figure 12). Across the entire NWPS, the USFS had the most wilderness units who took initial attack interventions with 13 USFS wilderness units (n=25 wilderness units who took initial attack interventions) or 52%. The BLM followed with eight initial attack interventions (n=25) or 32%. The NPS had three initial attack projects or 12% of the total initial attack projects. The FWS only had one initial attack project, or 4% (n=25).

The third most-common type of wildfire intervention was fuels management projects, which included prescribed burning or thinning used to reduce flammable fuels or to modify vegetation for wildlife habitat. Eight total interventions were taken, with half from the NPS (n=8 or 50%),

followed by the FWS with 2 (n=8 or 25%) and the BLM and USFS with one intervention each (n=8 or 13%).

Among all agencies there were relatively few post-fire restoration projects, with only seven projects documented; there were also five projects that included planting seeds, two projects that included stabilizing hill slopes, one project that applied soil and mulch, and no projects that included installing log terraces or straw wattles.

Figure 12 Frequency of the three main wildfire intervention actions per agency (n=39 wildfire intervention actions from 77 wilderness units)

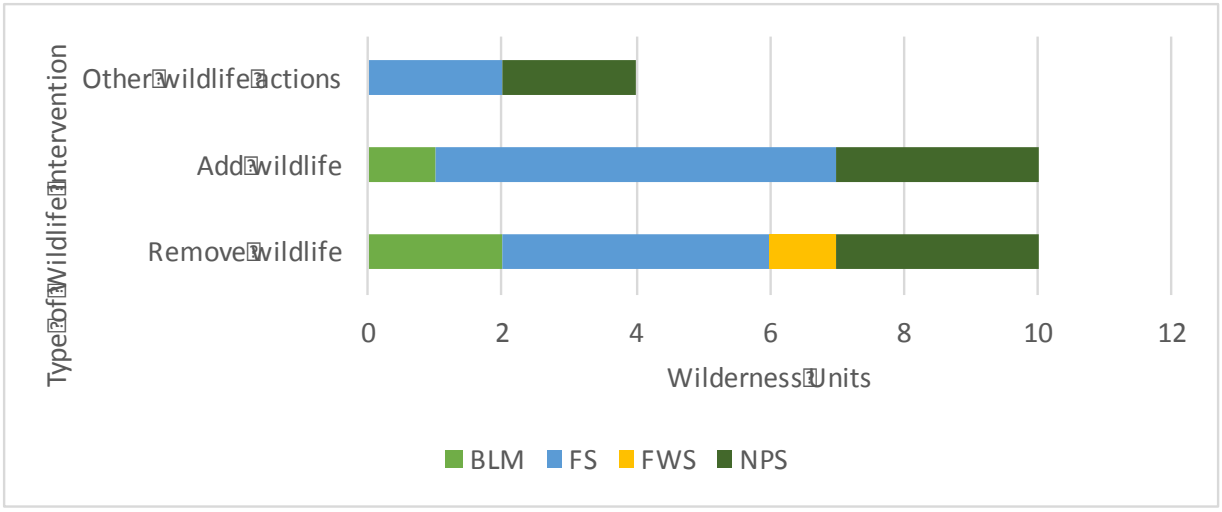


The NPS had the greatest proportion of wilderness units who took wildfire interventions out of the total number of NPS wilderness units who intervened, with 69% (n=13 NPS units who took intervention actions). Fifty percent of FS and FWS wilderness units indicated wildfire interventions (n=34 FS wilderness units and n=4 FWS wilderness units).

Wildlife

Ecological interventions for wildlife were the third most common type of intervention, with 20 wilderness units indicating that they had taken wildlife interventions in the last five years (n=111 total vegetation, wildfire, wildlife or water interventions intervention actions from 77 wilderness units). The USFS reported the most wildlife interventions with nine (n=20 wilderness units that took fish and wildlife interventions), followed by the NPS with six, the BLM with three, and the FWS with two. Three sub-categories of wildlife interventions asked respondents whether wildlife was added to their wilderness in the previous five years, removed in the past five years, or other wildlife interventions. Respondents indicated ten projects to remove wildlife and ten projects to add wildlife, with four projects in the "other" category (Figure 13).

Figure 13 Frequency of wildlife interventions per agency (n=24 wildlife intervention actions from 77 wilderness units)



The four projects in the "other" category included efforts to protect threatened species by trapping or fencing small predators. For example, in one case wire mesh was placed around nests of threatened bird species to protect the fledglings and try and increase the number of breeding pairs. Another case involves manipulating a water channel using dynamite to improve the ability

for salmon to migrate up the stream. Although the intervention itself was to the water flow, the intention of the action was to improve habitat for salmon, and therefore it was counted as a wildlife intervention.

The FWS had the greatest proportion of wilderness units that took wildlife interventions with 50% of FWS wilderness units indicating that wildlife interventions occurred (n=4 FWS wilderness units that indicated interventions have occurred). The NPS followed with 46% of NPS wilderness units indicating that wildlife interventions occurred (n=13 NPS wilderness units that indicated interventions occurred). Data indicated that 26% of USFS wilderness units took wildlife interventions (n=34 USFS wilderness units that indicated interventions occurred) and 12% of BLM wilderness units took wildlife interventions (n=26 BLM wilderness units).

Across the NWPS, the USFS had the greatest frequency of wildlife removal actions with 40% of all agency wildlife removal interventions, followed by the NPS with 30%, the BLM with 20% and the FWS with one project or 10%. Similarly, for wildlife addition projects, the USFS had the greatest frequency of wildlife intervention actions with 60% of wildlife additions, followed by the NPS with 30%, the BLM 10% and the FWS with zero projects.

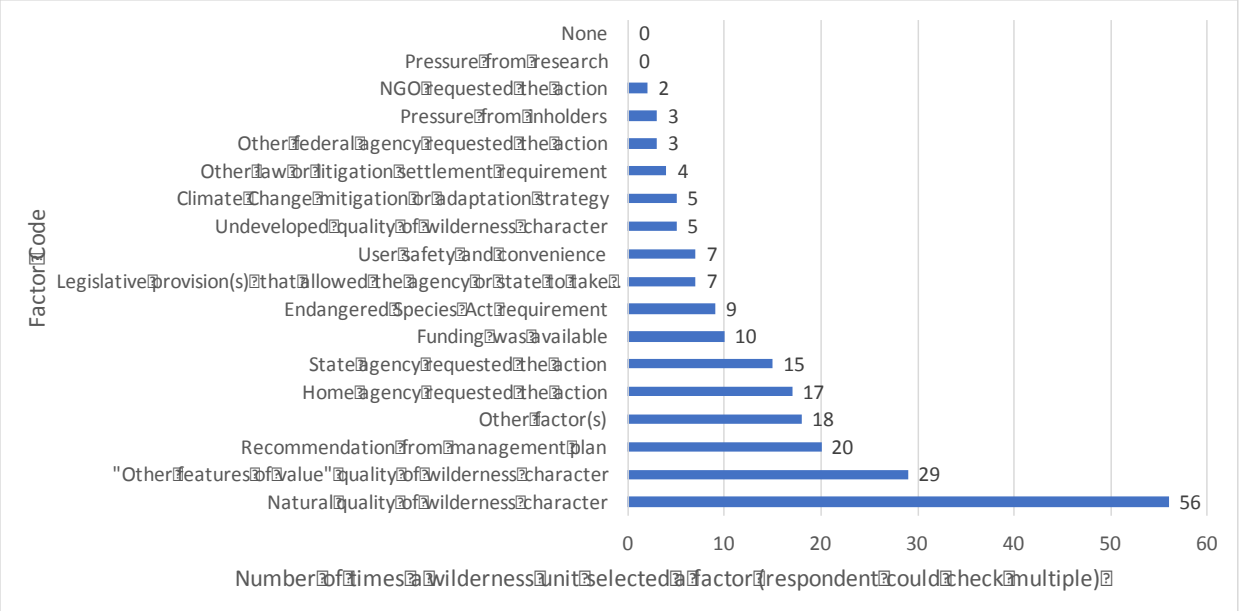
Water

Water interventions were the least-common type of ecological intervention, with only one action documented by the NPS to install a water structure.

Decision-Making Factors

Among all wilderness units across the four agencies, cumulatively the top five factors that influenced the decision to intervene were: one, a desire to improve the natural quality of wilderness character (56 wilderness units); two, a desire to improve the "other features of value" quality of wilderness character (29 wilderness units); three, recommendation from management plan (20 wilderness units); four, other factors (18 wilderness units); and finally five, home agency requested the action (17 wilderness units) (n=213 decision-making factors cited from 95 wilderness units) (Figure 14).

Figure 14 Frequency of decision-making factors cited as influencing the decision to intervene across all agencies (n=213 decision-making factors cited from 95 wilderness units)



Ninety-five wilderness units responded to the decision-making factor question. Most wilderness units (36), selected only two factors that influenced the decision to intervene, whereas 25 wilderness units selected only one factor that influenced their decision to intervene. Six wilderness units selected six factors that influenced decision-making regarding fuels management actions.

Intervention Project Proponent

For 43% of all intervention actions, the project proponent was the natural resources manager[10], followed by the wilderness manager 25% of the time, "other staff" 17% of the time, the state agency 9% of the time, other federal agencies 3% of the time and an NGO and other each 1% of the time. Eighty-five percent of the time the intervention action proponent was internal to the agency.

Reasons for Intervention

Overwhelmingly, the most common reason cited for intervening in wilderness was ecological (74%), particularly the removal of non-native invasive species (52%). The outliers for the reason for intervening in wilderness stated that recreation (14%) and political reasons (4%) motivated the intervention.

Despite information for respondents at the beginning of the survey indicating the focus of the survey on ecological interventions, eleven wilderness units cited recreation reasons for acting. Examples include cases such as, "providing access to overnight shelters and day use trails", "closed motor vehicle routes receiving illegal use", "reduce bare ground impacts and social trails in wilderness", "provide the public access to water trails", "make sure there's good fishing for visitors", "provide for sport fishing", and "state department of fish and wildlife stocks high alpine lakes for fishing." Recreation reasons occasionally overlapped with what I categorized as

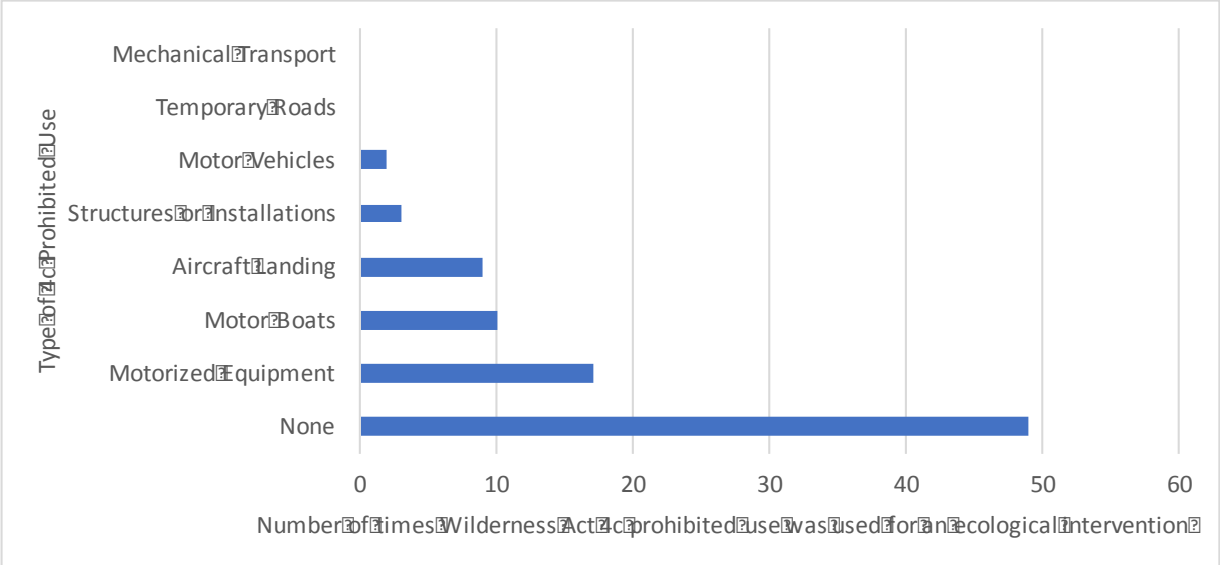
[10] For each sub-category of intervention action, the survey respondent could select at least one project proponent, which is why there are 117 project proponents chosen instead of 111 total intervention actions from 77 wilderness units.

political reasons, such as allowing the state to facilitate fish stocking in certain lakes, or one intervention that was prompted by a federal law. One fire-related intervention was prompted by the desire to provide protection for structures outside of the park.

4c Prohibited Uses and Legal Appeals

Survey data show that 54% of wilderness units who intervened did not use 4c prohibited uses (n=90 intervention actions from 77 wilderness units that responded to the 4c prohibited use question[11]) (Figure 15). However, for the interventions that did involve 4c prohibited uses, the most common type was motorized equipment (19%); followed by motor boats (11%), and aircraft landing (10%). Two vegetation projects, one wildfire and one wildlife interventions required the most 4c prohibited uses. For example, applying herbicide used the most 4c prohibited uses (11, though some of the same prohibited use was used more than once).

Figure 15 Number of times a Wilderness Act 4c prohibited use was used (n=90 wilderness unit responses; respondents could check multiple4c uses per project)



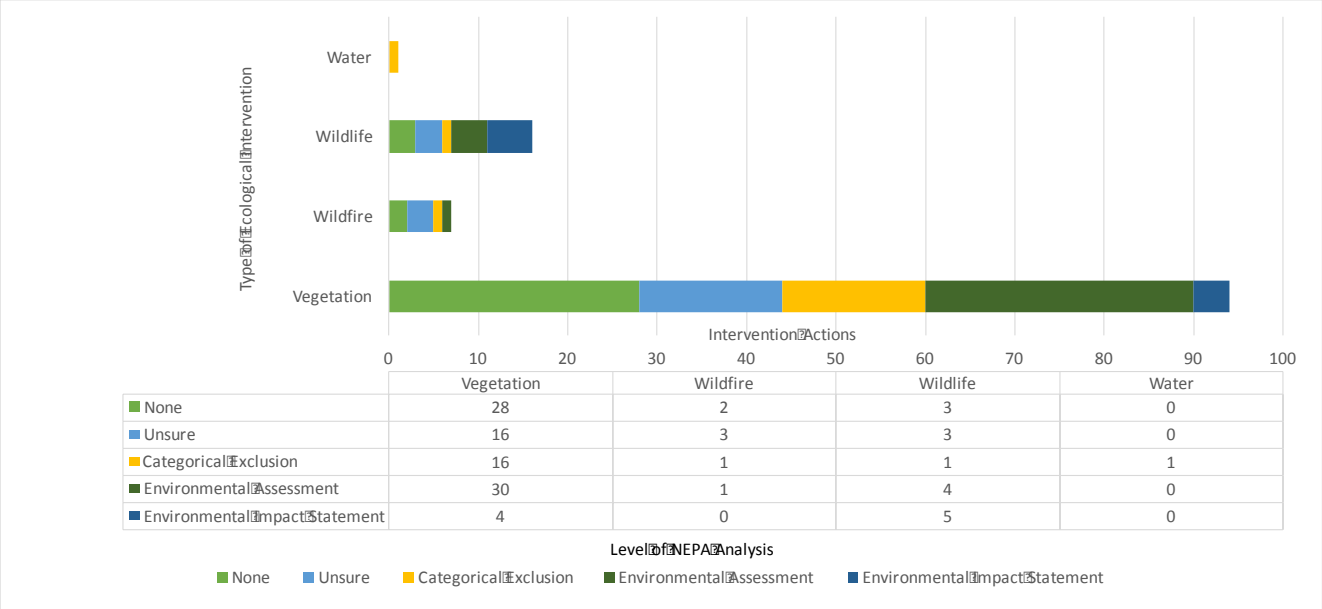
[11] For each intervention action described, a wilderness unit could select more than one 4c prohibited use.

There were no legal appeals taken in response to vegetation interventions, fire interventions or water interventions. One case of a wildlife addition intervention did result in a legal appeal.

Level of NEPA Analysis

For the most recent project within the sub-category of each ecological intervention, the respondent was asked to provide the level of NEPA analysis that the project received. Across the NWPS, environmental assessments (EA) were the most common level of NEPA analysis for ecological interventions in wilderness, with 30% of projects or 35 projects (n=118) completing an EA (Figure 16).

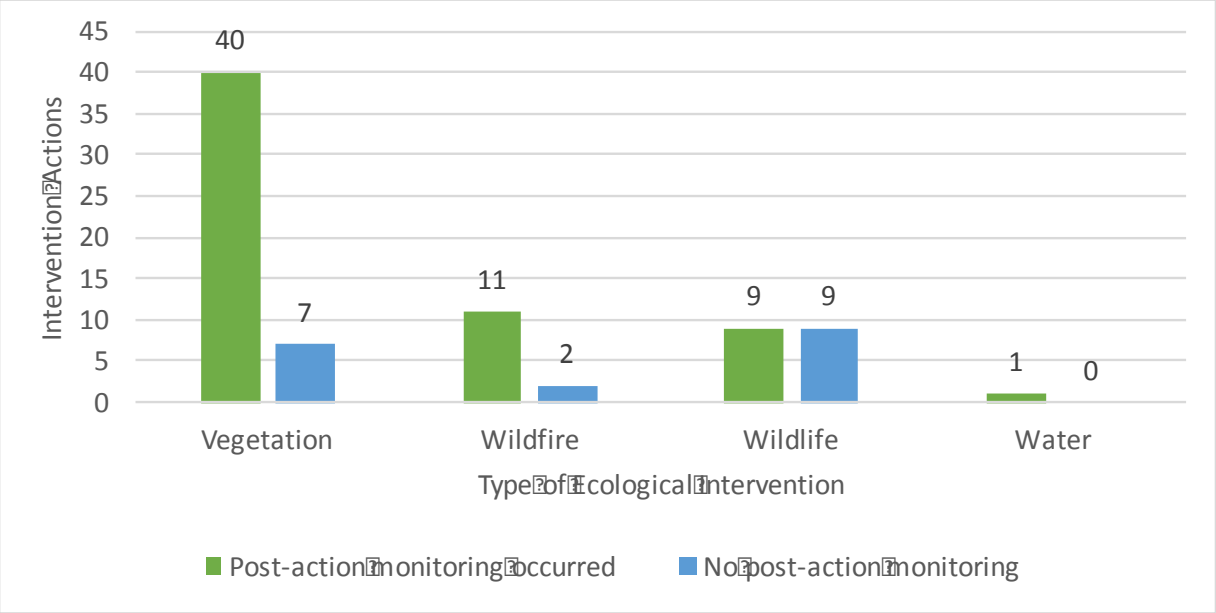
Figure 16 Level of NEPA Analysis by Type of Ecological Intervention (n=118 intervention actions from 77 wilderness units)



Post-action Monitoring

Seventy-nine out of 111 intervention actions from 77 wilderness units responded to the post-action monitoring question. Data from these 79 intervention actions demonstrate that post-action monitoring after the ecological intervention occurred in 77% of case (n=79 intervention actions from 77 wilderness units) (Figure 17).

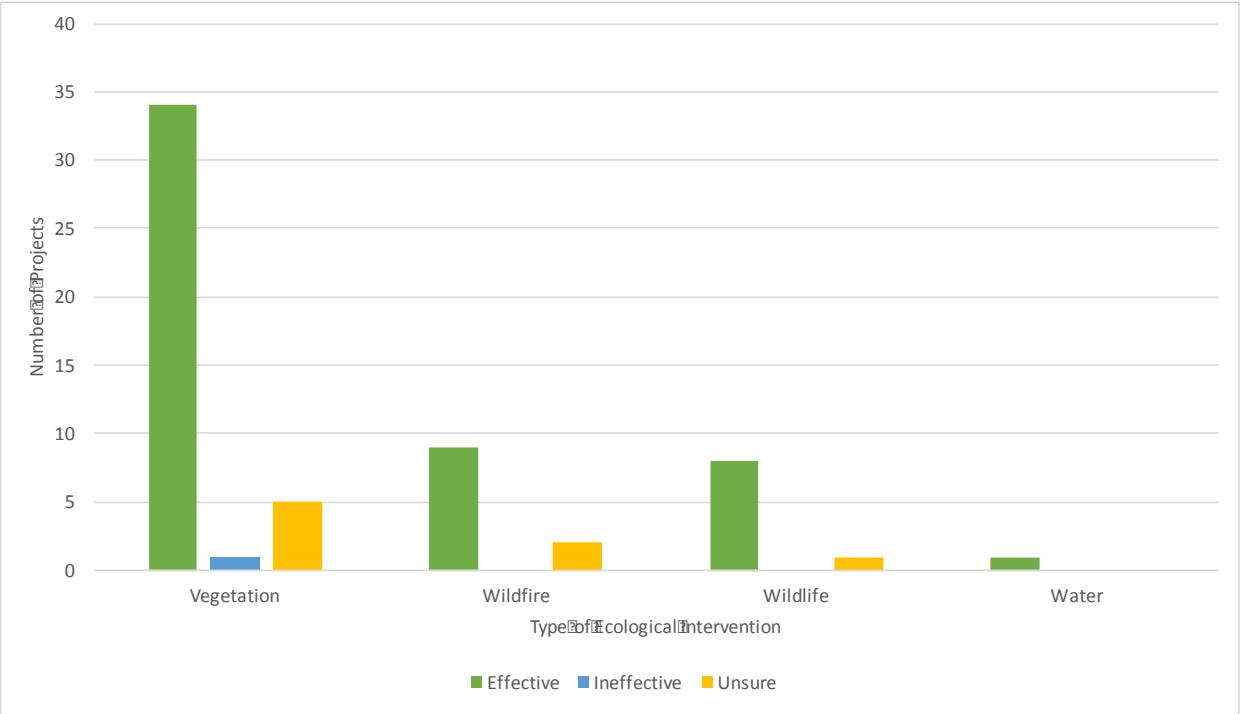
Figure 17 Post-action monitoring for intervention actions per type of ecological intervention (n=79 intervention actions from 77 wilderness units)



Effectiveness of Ecological Intervention

For each ecological intervention action, survey respondents were asked if the action was effective in completing project goals and objectives. Eighty-five percent of respondents who answered this question (n=61 intervention actions from 77 wilderness units) reported that the project was effective in completing project goals, while 2% reported that the project was ineffective in completing project goals and 13% were unsure (Figure 18).

Figure 18 Results of Ecological Interventions (n=61 intervention actions from 77 wilderness units)



Discussion

This research is the first study to document the breadth and depth of ecological interventions being implemented within the NWPS. Findings from this survey create a baseline of ecological interventions and detail the motivation and after-effects of interventions. Further, qualitative data provide context and depth to the quantitative survey data, allowing for a deeper understanding of the decision-making process for wilderness management actions. The NWPS encompasses over 800 wilderness units, 210 of which are represented in this exploratory research survey. Results of the quantitative survey demonstrate that ecological interventions, defined as a trammeling action (intentional manipulation) that significantly manipulates earth and its community of life, are occurring in designated wilderness. Thirty-seven percent of the wilderness units surveyed indicated that ecological interventions had been taken in the last five years (n=210).

Size of Wilderness and Type of Intervention

Soulé (2001) states that larger wildernesses are less likely to require invasive management compared with small wildernesses due to the "edge effects". The smaller the wilderness, he states, the greater proportion of edge and therefore the more encroachment and possible degradation. This study, however, demonstrated that more interventions occurred in large wildernesses sampled (26,468 acres and above) compared with small wildernesses (0-26,467 acres). Quantitative data show that 54 large wildernesses had interventions compared with only 23 small ones, therefore 51% of large wildernesses intervened versus 22% of small wildernesses.

There may be more interventions in large wildernesses because managers may believe small and effective interventions on the boundaries of wilderness would protect the greater core area.

Managers may also believe that because the wilderness is so large, they have more area to experiment with restoration, where small wildernesses be less willing to take risks with ecological restoration projects, especially if they are experimental. Large wildernesses play a critical role in habitat connectivity, therefore they are also more likely to support successful animal reintroductions, where a small wilderness may have less success due to edge effects and encroachment from development.

There are several reasons why vegetation interventions are the most common form of restoration type among the agencies. Combating non-native invasive species was cited as the most common reason for intervening among wilderness managers interviewed, and funding for non-native species removal is high. Studies show that rapid response techniques can be successful in removing non-native plants, which could explain this result (Beric & MacIsaac, 2015). The vegetation category was also first in the survey, and because the survey was long, respondents may have been more likely to fully answer the first section and taper out responses due to survey fatigue for the other three types of interventions. Additionally, vegetation interventions are less controversial than large mammal reintroductions or wildfire interventions, for example, where social values may play a large part in promoting or hindering intervention actions.

Wildfire interventions were the second most common type of ecological intervention in wilderness. This may be due to the increasing threat of fuel accumulation combined with record dry years, making fire danger a serious threat in some locations (Agee, 2002; Miller & Aplet, 2016). The rise in large wildfires over recent years has led to the reallocation of budgets toward firefighting operations, therefore, resources are in place for potential interventions. For example,

as a percentage of the Forest Service's budget, wildland fire was only 16% in 1995, yet in 2015 it rose to 52%, and it is projected to rise to 67% of the total budget by 2025 (United States Forest Service, 2015).

Survey data indicated that water interventions were the least-common type of intervention, with only the BLM documenting one water intervention. This response is a lower rate of occurrence than I know to be true because I was aware of several water-related interventions that have occurred in the past five years in wilderness units sampled that were not documented through this survey. For example, I was aware of several water guzzlers that have been installed in wildernesses in the southwest to support ungulate populations, as well as water chemistry interventions in the southeast to combat the effects of acid rain on sensitive watersheds. Therefore, this type of intervention may be underreported in this survey.

Intervention Decision-Making

The process of working through a minimum requirements analysis (MRA) has the potential to improve decision-making significantly, but its success is dependent on the openness, honesty and flexibility of those working through the analysis. Twenty-five percent of the managers I interviewed believed the minimum requirements analysis was an ineffective tool because it was often done pro forma, when a decision had already been made and paperwork was necessary to document the decision (MRAs are required to be done for every action occurring in wilderness). As MRAs are the main procedural tool used to integrate wilderness considerations into decision-making, it would be worth analyzing the effectiveness of this tool for future research. Other managers, however, believed the MRA had value in gathering project proponents to discuss the

effects the action could have on wilderness character. These managers believed the MRA process was believed to increased wilderness education among other specialists, an important element to good wilderness decision-making.

Wilderness management plans may provide programmatic approaches to intervention and avoid piecemeal decisions, however they are often outdated, not assessed with a strong wilderness filter, or their use may not be mandated or enforced. In some cases, wilderness plans are referred to as "just another plan sitting on the shelf." In other words, without strong wilderness leadership and advocacy, the strength of a wilderness plan does not guarantee good guiding decision-making.

Several barriers existed to using the interdisciplinary process. Some managers believed the fear of upsetting or offending co-workers impacted the way they handled wilderness decisions, and in some cases led to compromises that negatively affected wilderness. The process of deciding on different intervention approaches was also likely to be contested. One manager cited the pressure of having to allocate federal funds within a set amount of time as a significant factor affecting decision-making and methodology.

Qualitative data from the interviews suggest that the question of how to accomplish ecological interventions is more common than discussing if ecological interventions should occur. Wilderness manager responses differed on whether a paradox exists in preserving wilderness character through ecological interventions. Some managers desired a hands-off approach, yet they felt stymied by a variety of pressures that support intervening. Other managers felt

interventions were a critical part of their job to preserve the landscape for future generations, especially with severe and persistent threats such as climate change. In all cases, managers believed that they made the greatest contribution to preserving wilderness character, not through the actual decision to intervene, rather from establishing a creative methodology to accomplish goals in a wilderness-friendly manner. It was not whether to intervene, but how? Creativity was critical to coming up with new ways of completing a task that complied with wilderness law. For example, the work one manager (E) undertook to develop processes for vertebrate paleontology excavations in wilderness was so successful that it went on to become standard protocol for the BLM, and consequently was supported by the Society of Vertebrate Paleontology.

Thus, if wilderness stewardship approaches were placed on a continuum with one end representing "wilderness purists" who do not believe intervention is ever justified (priority placed on leaving wilderness untrammeled), and on the other end are "wilderness realists" who believe today's rapidly changing conditions necessitate intensive restoration action (priority placed on improving natural conditions), most managers interviewed fell in the middle. This suggests that in practice, a sharp dichotomy between wilderness purists and wilderness realists rarely exists. Again, managers emphasize that project methodology (tools and equipment) was where wilderness values tended to differ. Interpretations on wilderness-friendly methodologies varied greatly. One manager (H) felt that bulldozers and other heavy machinery were the obvious choice of the minimal tool required to complete a restoration action, yet another manager (A) was opposed to the use of prolonged helicopter trips with no landings in wilderness.

Conventional Strategies, Management Inertia and the Hands-Off Approach

Contrary to predictions cited by Schwartz et al. (2012) that climate change will increase proposals for managed relocation, assisted migration and translocation as conservation strategies, none of these types of intervention were documented in the survey. These findings are consistent with Hagerman and Satterfield's (2014) findings that conservation experts prefer conventional strategies for conservation such as expanding protected areas, reducing climate stressors and using tools already integrated into institutions. They tend to prefer these measures over unconventional ("taboo") measures such as managed relocation, assisted migration or climate-change triaging principles. This survey revealed ten cases of reintroducing wildlife, however these tended to be cases of reintroducing previously extirpated species that were originally native to the wilderness and were removed primarily due to human causes (such as hunting); these are considered conventional resource management strategies.

Quantitative data demonstrate that among the sample of 210 wilderness units who responded to the survey, 37% engaged in ecological interventions in the last five years, with many units intervening multiple times. Of those units that intervened, 28% never rejected proposals to intervene, which indicates a potential action bias, or possibly an exorbitant degree of ecological degradation. Of the 37% of units who intervened, only 8% rejected proposed interventions. The data on rejected proposals indicate the viability of the hands-off approach, where a high rate of rejected proposals would indicate a propensity towards the hands-off approach and a high rate of approval would indicate a propensity toward intervention. All agencies had an intervention proposal rejection rate of under 23%, meaning that most proposals to intervene were approved in

wilderness, by a large margin[12]. Though 37% of wilderness units took intervention actions, it is not clear if the remaining wilderness units desired to intervene and were limited by resources such as staff, funding and technology. Additionally, the question did not address whether proposals were modified to reduce conflict with wilderness regulations, and if so, how?

Both sources of data (qualitative and quantitative) point to a theme of management inertia that persists throughout the NWPS. As the first study to quantitatively assess the amount of ecological interventions occurring in wilderness, it is difficult to ascertain whether the findings are surprising. For those who believe ecological interventions are relatively rare, or that the baseline is zero interventions, a 37% rate of intervention may seem high. For others, 37% may seem relatively low given the resource management objectives of several agencies, and the knowledge of past interventions. Findings from the qualitative interviews are consistent with the survey data showing that despite hesitancy to intervene in some cases, and disagreement over restoration methodology, interventions exist as part of wilderness stewardship actions. Ecological interventions may be occurring because of a strong propensity to take some action, rather than no action and suffer the consequences of losing an iconic landscape or species. Possible reasons for this action bias may be attributing higher weight to things that are readily observable (instead of things that are delayed or unobservable), such as visible ecological degradation, and environmental managers may believe that the public or the agency will praise them for action instead of inaction (Iftekhar & Pannell, 2015).

[12] However, some ideas to intervene may have been rejected before they were formally developed into proposals, therefore this question is not a perfect summary of action bias. The definition of a proposal was also not formally defined in the survey.

An intervention rate of 37% may suggest that action bias could have a strong role in supporting interventions in wilderness. For example, Iftekhar and Pannell (2015) suggest that an action bias could be increased by uncertainty, which many managers stated as a concern—namely, trying to make decisions with little information, or without knowing the whole ecological picture. This assertion is supported by research from Nelson (2013), whose census of NPS climate change adaptation actions in wilderness demonstrated an increasing propensity to take action in NPS wildernesses. She found that of the 61 NPS wildernesses, 68% had taken management actions (including monitoring) to address climate change and its effects in NPS wilderness (Nelson, 2013). Comparatively, this study showed that 75% of NPS wildernesses took intervention actions.

A consistent and systematic approach to vetting intervention proposals currently does not exist within the NWPS, yet the prerogative to act is strong. Further, local pressure and agency politics could have specific influences that make consistency among agency and region more difficult. For example, a wilderness island in the Alaska Maritime National Wildlife Refuge has proposed to remove non-native caribou who swam to the island (from an adjacent island where they were artificially relocated) and are threatening essential bird habitat for over 40 million seabirds. Protecting seabird habitat is specifically mentioned in the refuge's mission statement, and this rationale was used in the approved environmental assessment for the action (United States Fish and Wildlife Service, 2014). This case also presents an example where the source of the degradation is outside the wilderness boundary, and therefore outside the control of the wilderness manager. Determining if a slippery slope of ecological intervention exists requires

analyzing the rate of ecological interventions over time. Therefore, repeat studies of intervention frequency may show if action biases exist and if management inertia could be an explanation.

Interestingly, most of the wilderness managers interviewed expressed skepticism and doubt about ecological interventions in wilderness, yet they also said the hands-off approach is not possible due to a range of pressures (policy, climate change adaptation measures, funding, etc.). Findings from the qualitative interviews are consistent with the survey findings that despite hesitancy to intervene in some cases, and disagreement over restoration methodology, interventions are occurring in designated wilderness, at a rate of 37% of wilderness units surveyed. The interviews speak towards a tension between wilderness managers and resource managers who have specific roles to preserve natural resources, but their wilderness knowledge may be limited, making compromise for management action methodology a difficult compromise. Some wilderness managers believe they should not have to compromise, yet managing wilderness is one of many considerations that public land managers must balance, especially if wilderness is only a portion of manager responsibilities. A critical and yet unanswered question from this research is, how do we balance wilderness stewardship objectives (e.g., preserving wilderness character) with other agency objectives? How do we manage the NWPS as a cohesive unit and ensure consistency in decision-making?

Hagerman and Satterfield (2014) conducted a study assessing biodiversity expert views on a range of taboo conservation options. From 160 responses collected, they found two interesting findings relevant to this research. First, the respondents indicated overwhelmingly that there are limits to active management, and that revisiting prioritization schemes and metrics of success in

response to shifting ranges and novel ecosystems is critical. Second, 56% of respondents reported very negative or negative feelings about strong interventionist active management actions (such as species reintroductions) in conservation areas. If the respondents from this survey believed there were limits to active management and more than half indicated negative feelings towards intervention, why did managers intervene in such a substantial percentage of wilderness units in this study (37% of wilderness units)? This may speak to the inherent pressure that wilderness managers feel to allow intervention, despite feelings of skepticism or disapproval. If managers are skeptical or disapprove of interventions, why do they continue to occur?

Understanding the Untrammeled Quality

Despite over 70% of wilderness managers from the survey indicating they have taken wilderness trainings, survey results and the qualitative interviews suggest widespread misunderstanding of the untrammeled quality of wilderness character (see Appendix E for survey results on wilderness training). An analysis of the open-ended question asking what the primary reason was for taking action revealed projects that were not considered trammeling actions as defined in *Keeping it Wild 2* (Landres et al., 2015). For example, several survey respondents indicated that the reason for acting was to remove social trails or rehabilitate illegal campsites. These small forms of restoration are not wide enough in scope to be considered trammeling actions, though they do manipulate the wilderness on a small, localized level, albeit for positive intentions (removing the human footprint).

Other actions that are not considered trammeling actions and do not constitute an ecological intervention, yet were documented as the reason for acting, include "clearing trails for the safe portage of non-motorized boats," and "providing access to overnight shelters". There were also several examples of projects that did not represent the tension between the untrammeled and the natural qualities of wilderness character because the intent was not to improve the natural quality of wilderness character; rather their goal was to improve other qualities. For example, one respondent cited the reason for reducing wildfire fuels was to protect structures outside of the wilderness, and another cited protecting park housing. As noted in the results section, two of the reasons for acting represent purely recreational goals, such as improving sport fishing for visitors, and this survey's purpose was to document ecological interventions. These discrepancies indicate misunderstanding of the untrammeled quality, which makes the preservation of wilderness character more challenging. All wilderness managers need to understand the complexities of the five wilderness qualities in order for them to preserve them.

Understanding the complexity and operation of the untrammeled quality in management decisions is critical for wilderness preservation. The unequal pressures managers face to preserve the natural quality of wilderness character, combined with a propensity to compromise to meet resource management goals (without "rocking the boat"), may threaten the few remaining wild places in the NWPS. Although wildernesses face a variety of pressures outlined in the research, once a decision is made to act in wilderness, there is no going back. The trammeling action becomes part of the wilderness's history. For this reason, decision-making must be thoughtful, and rely on a firm understanding of wilderness law. This research demonstrates that despite high

levels of wilderness training on the part of managers, they often feel pressure to intervene from a variety of sources, and in the end compromise for other management goals.

Novel Ecosystems and Cumulative Impacts

Agency policy and law play a role in determining whether and how to intervene in wilderness, though part of the decision relies on the individual making or vetting the initial proposal. Who is classifying the wilderness as degraded and what does this mean? Hobbs (2016) discusses the ambiguity in the definition of degraded, and whether some ecosystems are merely different, not degraded—the boundary often rests on value judgements. A strong consensus exists in viewing non-native species as a dangerous threat, which is consistent with the survey finding that most interventions were to remove non-native species, but Hobbs warns that jumping to this conclusion could be harmful. He states,

> Many restoration efforts are focused wholly or partially on removal of invasive species, often rightly so because of the well-evidenced impacts of these species on the native ecosystem. In some cases, however, impacts are assumed rather than confirmed, and the species concerned are now an established part of the local ecological community. Hence their removal may either be unjustified or unwise, particularly where the methods of removal have potential flow-on ecosystem effects, and may waste scarce management resources" (Hobbs, 2016, p. 4).

The reality is wilderness ecosystems change and always will. Agency policy may direct managers to rapidly respond to non-native species (NPS policy, for example), but these actions are often shaped by public values regarding approval or disapproval of the certain species. Managers must remain neutral when assessing intervention proposals, and practice introspection, reflexivity and transparency. Allowing the ecosystem to continue to evolve self-willed, even with the presence of non-native species, may be the best course of action.

A trend observed from the qualitative interviews suggests that there is a strong commitment to completing an intervention project once it begins. However, there are very few restoration actions that are short term; in fact most are long term or will require repeat actions. Once the initial action occurs there is an assumption that the restoration will continue either to maintain the restoration work that has begun, or to ensure the success of the action. Interventions spark a restoration relationship. There may be many reasons for this; there is an understanding that restoration actions take an enormous amount of staff time and resources. Once an action is started, staff, as well as the public want to see a project succeed. The implications, however, may lead to repeated trammeling actions over time, thereby further degrading wilderness character.

The duration of the intervention is an important factor in assessing intervention proposals. To remedy the potential for multiple incursions into wilderness for the same restoration intervention, clear project objectives must be agreed upon before initiation, along with a plan for monitoring project success. As restoration interventions are often experimental, the ability to accept project failures is important, and reassessment procedures should be integrated into the monitoring protocol. A proposal requiring multiple and resource intensive incursions into wilderness over time should be assessed more critically than one-time actions.

A second reason for long-term ecological interventions is prompted by the source of degradation remaining outside of wilderness boundaries, and therefore beyond the control of wilderness managers. In an ideal situation, the source of degradation would be removed, the negative impact of that source would be mitigated, and no further restoration would be required. Today, with multiple threats beyond the wilderness boundary, containment is often a challenge in and of

itself. For example, most of the ecological interventions documented in the survey were vegetation related, and managers stated that non-native invasive species was the most commonly cited reason for acting. Accurately documenting these actions at the unit, agency and NWPS-wide level is currently hampered by a lack of databases, yet the information would help understand cumulative impacts and aid in the decision-making process for ecological interventions.

Intervention Efficacy and Desired States

A component of analyzing the risk of an ecological intervention is understanding the effectiveness of the action. Survey results demonstrate that most ecological interventions were effective in completing project goals, and only two of the 61 respondents to the efficacy question reported the project to be ineffective[13]. Should we be striving for 100% efficacy or are ineffective projects inevitable in the quest to preserve wilderness character? Further, if a project is effective, does that mean that it was justified as a trammeling action? In other words, do the ends justify the means? Efficacy analyzed post-intervention should not be used as justification for future interventions; all interventions must be analyzed individually with the testing of assumptions underlying the proposed intervention. Naficy et al. (2016) discusses this importance, because often the assumptions underlying the intervention are rarely tested. They state, "The implied need for greater intervention in protected areas appears to be based on the premise that without it, preventable and significant ecological harm will occur. However, intervention proposals often lack the detail required to evaluate either the magnitude of the ecological threat or the likelihood that intervention will be successful" (Naficy et al., 2016, p. 392). To evaluate

[13] Though self-reporting may overstate effectiveness.

intervention proposals, a detailed picture of existing conditions, desired states, and likely outcomes is necessary.

Agency policy currently allows for a range of ecological interventions under certain circumstances (see policy section). These policies tend to endorse the natural quality, and are focused on the process rather than the desired condition. If the desired condition is one that emphasizes biodiversity and ecosystems that are resilient to climate change, the current policy is acceptable. However, if the desired condition is a wild place (untrammeled), the policy does not promote this as an end in its own. Wilderness character requires preserving all five qualities of wilderness character, but if the policy does not equally support having some wild places, there will be no truly uncontrolled or wild places because of the actions required to preserve one of the other four qualities.

To address this unequal preference for the natural quality of wilderness character, Cole has suggested that wildernesses should be divided; interventions could be allowed in some areas and prohibited in others (Cole, 2014). However, this option does not fulfill the Wilderness Act's requirement of preserving wilderness character in its entirety for every wilderness. It could also establish slippery slope management practices where "pro-intervention wildernesses" that focus on the natural quality could be subjected to serious experimentation and degradation and lose the purpose for which it was designated. Preserving the "wild", is after all, an essential characteristic of wilderness. Secondly, no legal precedent exists for supporting divergent management objectives based on wilderness character. This could lead to legal challenges and raises the

question of how wildernesses would be sorted into intervention versus no-intervention wildernesses?

Increasing compliance measures, stemming from NEPA and agency directives, are creating new paradigms for public land management. Since NEPA reviews are both time and resource intensive, many wilderness managers prefer to combine management actions into broader plans. Revising or developing plans to reflect potential interventions for current and future threats is also resource-intensive. These plans may facilitate a proactive approach to intervention, but they have the potential to set precedents that may degrade wilderness character by incorporating allowances for broad-scale actions without individual review.

The complexity of public land management demonstrates that navigating decisions to intervene in wilderness is a complex phenomenon influenced by a variety of personal, procedural and ecological factors. The range in NEPA levels for intervention projects highlights the lack of consistency for wilderness interventions. For example, 33 intervention actions from 77 wilderness units did not provide any NEPA documentation, which means there was no opportunity for public engagement, and possibly no analysis of how the action could degrade wilderness character.

Research Limitations

A constraining factor for the implications of this research is the sample size of 210 out of the 801 wilderness units in the NWPS. Overcoming survey fatigue from agency officials remains a formidable task, and the associated email burden may have negatively impacted response rates

due to the time required to recall interventions in the past five years. Further, the difficulty in making sure the appropriate person who has the most knowledge of ecological interventions in wilderness was completing the survey, presented another obstacle to high response rates. Due to the constant fluctuation in agency staffing and turnover, the person completing the survey may not be familiar with past wilderness interventions. Therefore, gaining an accurate picture of the historical actions for each wilderness remains a challenge.

A further limitation of this research is survey questions failed to capture the scale of the action, although other details about the ecological intervention were pursued. For example, the data collected do not provide detail on how many acres have been sprayed with herbicide per intervention, or how many repeated helicopter flights a fire suppression action required. The survey treats the type of actions as equal, even though some actions inevitably have greater impacts to wilderness, ecological functions and recreation experiences. Although this aspect of an ecological intervention was considered important prior to survey design, I thought the response rate would be negatively impacted by asking this level of detail per intervention action. This type of information would require the respondent to review numerous project documents, a potentially long time commitment. Therefore, this information was purposefully omitted in exchange for collecting a wider scope of actions.

I was curious about not only how ecological intervention decisions are made, but specifically *why* the decision was made. This proved to be difficult information to gather, and research findings do not clearly answer this question due its complexity. It is elusive for a variety of reasons: it is psychological and potentially sub-conscious in nature; perhaps decision-makers are

not aware of why they acted, and instead would default to answers that make good justifications. For example, what if the passion and desire of one resource manager to approve a specific project contradicted scientific findings that would oppose an action? How does the financial incentive of reintroducing fish and wildlife impact decisions? I tried to approach this question by asking what factors influenced the decision to intervene, however by providing survey respondents with a list of potential answers, I limited their response. Although patterns may be drawn from these results, factors that influence a decision are different from *why* an action was taken.

Future research could utilize participant observation techniques to understand how managers weigh competing interests to preserve wilderness character in real-life settings. This information would add to this breadth of knowledge by triangulating and therefore increase validity of the results (Hesse-Biber & Leavy, 2010).

Future Research Opportunities

A key method for tracking future interventions, and for understanding the impact and effectiveness of interventions, is the creation of an internal database to store intervention projects that could be reviewed by policy makers such as the Wilderness Policy Council and the Wilderness Leadership Steering Committee (both committees comprise representation from the four managing agencies)[14]. Building on the existing wilderness character monitoring database to

[14] I recommend an internal database because a publically-accessible database may be a concern to agencies due to potential threats of litigation. The goal would be not to target specific wildernesses, but to learn best practices and assess trends over time, regardless of the intervention outcome.

store ecological intervention projects could help policy makers and wilderness managers assess broad trends and patterns in wilderness interventions.

A second element could be a publically available set of case studies demonstrating best practices for ecological intervention in wilderness. Currently, a lack of transparency in ecological interventions throughout the NWPS makes public participation and academic engagement difficult; both are necessary elements for management decisions pertaining to public lands. The potential for a collection of case studies on ecological interventions in wilderness is currently an untapped resource for wilderness and natural resource managers. This collection could serve to support a community of practice for wilderness stewards confronted with similarly challenging and ethically murky restoration questions. Outside institutions such as the Arthur Carhart Wilderness Training Center and the Aldo Leopold Wilderness Research Institute could evaluate the case studies and provide feedback for similar restoration in the future. As a response to increasing decision-making support related to ecological interventions, wilderness scientists at ALWRI have recently developed an evaluation framework for proposed ecological restoration projects designed to facilitate thoughtful decision-making for ecological interventions. The demand for such a framework demonstrates how field managers struggle with decision-making surrounding interventions in wilderness, and may benefit from additional resources.

Several authors have acknowledged this need, not only to assist in developing proposals, but as a tool to engage multiple perspectives including the public and academia (Hagerman & Satterfield, 2014; Iftekhar & Pannell, 2015; Schwartz et al., 2012). For example, in order to address adaptive resource management biases, Iftekhar and Pannell (2015) cite the need for agencies to promote a

culture of learning. They state, "It needs to be recognized that both successful and failed projects generate valuable information about the future state and expected impacts of the management interventions" (Iftekhar & Pannell, 2015, p. 393). Should intervention proposals be approved, a community of practice could provide a space to share minimally intrusive restoration techniques and develop approaches with professional feedback.

Agency policy and wilderness stewardship initiatives, like the interagency *Wilderness 2020 Vision* document signed at the 2014 National Wilderness Conference, explicitly advocate for restoring wilderness ecosystems. With this pressure, and other factors, interventions will likely continue to increase in the future. Each proposal will need to be analyzed through its own context, however the way in which proposals are vetted should be consistent. The evaluation framework developed by the ALWRI for proposed ecological restoration, is one way in which consistency can be applied to the decision-making process. The framework seeks to help managers and interdisciplinary teams come to a justified outcome by working through a set of guiding questions to make sure the legal, scientific and ethical dimensions of the proposal are solid. The end effect is a justified decision where the proposed project's effect on wilderness character is appropriately identified and documented. Though we may not be able to change the outcome of an intervention proposal, we can aim for the same set of standards and expectations in the approach used to review ecological intervention proposals. Future research should analyze and assess the efficacy of the evaluation framework. Specifically, how is it improving ecological intervention decision-making, and is it leading to more interventions over time?

To track trends in ecological interventions over time, future research should consider conducting a similar survey every five to ten years to gauge a NWPS-wide understanding of interventions in wilderness to assess cumulative impacts to wilderness character. As this is the first study to document a baseline of ecological interventions, trends are hard to identify for only a five-year period. Resurveying wilderness managers over time could aid in broad policy-level understandings of impacts to wilderness character and would allow managers to see how their actions relate to other actions across the NWPS.

Conclusion

Implications of this research demonstrate increasing pressure to preserve the untrammeled and natural qualities of wilderness character. The scales are being tipped in favor of preserving the natural quality, as evidenced by the low frequency of rejected intervention proposals, as well as the trend toward more intervention projects in the last five years. The pressure to intervene arises from the laws (e.g. Endangered Species Act, Migratory Bird Treaty Act, NPS Organic Act, etc.), policies (e.g. the non-degradation principle, climate change adaptation policy), enabling legislation (e.g. allowing construction and maintenance of water structures), management plans (e.g. wilderness management plans and regional or weed management districts), partner interests (e.g. state fish and wildlife agencies, friend groups, NGOs, local politics, and recreationists) and managers (e.g. generally wilderness unit staff) that may advocate for intervention in wilderness. Pressure to preserve the untrammeled quality of wilderness character stems from advocates seeking to preserve the "wildness of wilderness", defined by a lack of management action (e.g. the wilderness manager, NGOs like Wilderness Watch, scientists looking for ecological benchmarks of unmanipulated landscapes, and recreationists).

These perspectives all reflect the three different ways of perceiving and saving the wild that Soulé proposes in *Should Wilderness Be Managed?*: managerial/political versus ecological/process versus heroic/experiential (Soulé, 2001). In the end, it is the wilderness managers who have the most influence over ecological intervention decisions: their goals for wilderness include the resolution of conflicts among users and multiple use (Soulé, 2001). Though wilderness policy and law structure their decisions, they are influenced heavily by natural resource managers and public users. Proposals to intervene may be heavily scrutinized,

yet finding a balance between all management objectives may still result in the degradation of the untrammeled quality and a preference for improving the natural quality. On the other hand, the ecology perspective views the goal of wilderness as the protection of nature, where the ends justify less-than-perfect means. This research demonstrates that ecological interventions are integrated into wilderness stewardship approaches, however it is not clear if the ends have justified the means. Wilderness is the last place in the United States where nature is to be preserved for its own sake and for the American public to enjoy. Interpreting how to preserve the Wilderness Act's intent to preserve the natural and untrammeled qualities of wilderness character despite dynamic ecological and anthropogenic forces, will continue to provide a challenge for future wilderness stewards. This research provides a baseline of knowledge which will allow for future deliberation, debate, and ultimately more consistency in decision-making for wilderness interventions.

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Appendices

A. Survey

Ecological Intervention Survey exported from Qualtrics Survey Software:

Q1.1 Thank you for agreeing to participate in this study on ecological interventions in wilderness. The purpose of this study is to understand the amount and variation of ecological interventions occurring throughout the National Wilderness Preservation System in order to craft science and assist with field level decision-making to improve wilderness stewardship. This survey is supported by the Interagency Wilderness Stewardship Committee. Participation in this survey is voluntary, and responses will be kept confidential. You have the option to not respond to any questions that you choose. Participation or non-participation will not impact your relationship with the University of Montana or the Aldo Leopold Wilderness Research Institute. Submission of the survey will be interpreted as your informed consent to participate and that you affirm that you are at least 18 years of age. If you have any questions about the research, please contact Lucy Lieberman (lucy.lieberman@umontana.edu) or Dan Spencer (daniel.spencer@umontana.edu). If you have any questions regarding your rights as a research subject, contact the UM Institutional Review Board (IRB) at (406) 243-6672.

- ❍ I agree to the terms of this survey and understand that my responses will be kept confidential and results will not be directly linked to me. (1)
- ❍ I do not agree to the terms listed above. (2)

Q313 Please confirm the wilderness name that was sent to you in the survey distribution email that this survey corresponds to.

(Table Truncated to 63 Columns)

Q2.1 Job Title:

Q2.2 Have you taken any wilderness trainings from the Arthur Carhart National Wilderness Training Center?

- ❍ Yes (1)
- ❍ No (2)

Q2.3 The following questions will ask you to reflect on the type of ecological interventions that have occurred in this individual wilderness in the last five years. The survey is divided into four categories: vegetation, fire, wildlife and water. An example of a vegetation action would include using biocontrol agents to control non-native invasive plants. An example of a fire action would include using prescribed burn to reduce forest fuels. An example of a wildlife action would include reintroducing previously extirpated wildlife. An example of a water action may include installing water structures to support wildlife. If specific actions are not identified, you will have the option to write in projects at the end of each section. You will have the ability to move forwards and backwards within each category, but you cannot return to a category once you have moved on. For the purpose of this research, ecological intervention is defined as an intentional manipulation, or an action that purposefully alters, hinders, restricts, controls, or manipulates "the earth and its community of life." An ecological intervention is one type of trammeling action. Do not include actions that fall below a minimum threshold of scale and scope such as hand pulling a few weeds or restoring a camp site (see Appendix 6, beginning on page 101 in Keeping it Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character across the National Wilderness Preservation System for details on what is and is not a trammeling action).

Q2.4 Have any ecological interventions been proposed but ultimately rejected in the last five years (January 2011 through December 2015)?

- ❍ Yes (4)
- ❍ No (5)

Display This Question:

If Have any ecological interventions been proposed but ultimately rejected in the last five years (January 2011 through December 2015)? Yes Is Selected

Q2.5 Please provide a brief description of the proposal(s) and why the project(s) was rejected.

Q2.6 Have any ecological interventions been implemented in the last five years (January 2011 through December 2015)?

- ❍ Yes (5)
- ❍ No (6)

If No Is Selected, Then Skip To End of Survey

Display This Question:

If Have any ecological interventions been implemented in the last five years (January 2011 through December 2015)? Yes Is Selected

Q3.1 Have you taken any action(s) to manage vegetation? (examples may include hand-pulling invasive plants, using biological control agents, using herbicide, planting trees, mechanical removal of vegetation, etc.)

- ❍ Yes (5)
- ❍ No (6)

Display This Question:

If Have you taken any action(s) to sustain, restore or manage vegetation? (examples may include hand... Yes Is Selected

Q4.1 Was herbicide applied? (An example may include spraying glyphosate)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Was herbicide applied? Yes Is Selected

Q4.2 Please indicate how many management projects that included the application of herbicides were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Was herbicide applied? (An example may include spraying glyphosate) Yes Is Selected

Q4.3 For the most recent herbicide application project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Was herbicide applied? (An example may include spraying glyphosate) Yes Is Selected

Q4.4 For the most recent herbicide application project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Was herbicide applied? (An example may include spraying glyphosate) Yes Is Selected

Q4.5 For the most recent herbicide application project, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Was herbicide applied? Yes Is Selected

Q4.6 Which factors below influenced the decision to apply herbicide? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (9)
- ❑ Other law or litigation settlement requirement (10)
- ❑ State agency requested the action (7)
- ❑ Other federal agency requested the action (8)
- ❑ Home agency requested the action (23)
- ❑ Non-governmental organization (NGO) requested the action (24)
- ❑ Pressure from inholders (21)
- ❑ Climate change mitigation or adaptation strategy (11)
- ❑ Recommendation from management plan (12)
- ❑ Funding was available (20)
- ❑ Pressure from research (26)
- ❑ Other factor(s) (22)
- ❑ None (25)

Display This Question:

If Did any of the factors below influence the decision to apply herbicide? You may select more than one. Legislative provision(s) that allow the State or other Federal agencies to take action Is Selected

Q4.7 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the factors below influence the decision to apply herbicide? You may select more than one. Other law or litigation settlement requirement Is Selected

Q4.8 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the factors below influence the decision to apply herbicide? You may select more than one. State agency requested the action Is Selected

Q4.9 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to apply herbicide? You may select more than one. Other federal agency requested the action Is Selected

Q4.10 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the following factors influence the decision to apply herbicide? You may select more t... Recommendation from management plan Is Selected

Or Did any of the following factors influence the decision to apply herbicide? You may select more t... Non-governmental organization (NGO) requested the action Is Selected

Q294 Please indicate the NGO/climate strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more than one. Other factor(s) Is Selected

Q4.11 What other factor(s) influenced the decision to act?

Display This Question:

If Was herbicide applied? Yes Is Selected

Q4.12 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who proposed the project? Other Is Selected

Q4.13 If other, please indicate who proposed the project?

Display This Question:

If Who first proposed the project? Other federal agency Is Selected

Q4.15 Which federal agency proposed the project?

Display This Question:

If Who proposed the project? State agency Is Selected

Q4.16 Which state agency proposed the project?

Display This Question:

If Who first proposed the project? Non-governmental organization Is Selected

Q4.17 Which non-governmental organization proposed the project?

Display This Question:

If Was herbicide applied? Yes Is Selected

Q4.18 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (3)
- ❑ Motor boats (4)
- ❑ Motorized equipment (5)
- ❑ Landing of aircraft (6)
- ❑ Mechanical transport (7)
- ❑ Structures or installations (8)
- ❑ None (9)

Display This Question:

If For the first project, did it require any 4c prohibited uses? (including motorized or mechanized... Yes Is Selected

Q4.19 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Was herbicide applied? Yes Is Selected

Q4.20 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If For the first project, was post-action monitoring completed for the intervention? Yes Is Selected

Q4.21 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:

If How effective was the action in completing project goals and objectives? Effective Is Selected

Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q4.22 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:

If How do you know? Other Is Selected

Q4.23 What other method was used to determine the effectiveness of the project?

Display This Question:

If Was herbicide applied? Yes Is Selected

Q4.24 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Have you taken any action(s) to manage vegetation? (examples may include hand-pulling invasive pl... Yes Is Selected

Q5.1 Was vegetation planted in the last five years? (This may include planting seeds, grasses, forbs, shrubs, or trees)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Was vegetation planted in the last five years? (This may include planting tree seedlings, flowers... Yes Is Selected

Q5.2 Please indicate how many management projects that included the planting of vegetation were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Was vegetation planted in the last five years? () Yes Is Selected

Q5.3 For the most recent vegetation planting project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Was vegetation planted in the last five years? () Yes Is Selected

Q5.4 For the most recent vegetation planting herbicide project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Was herbicide applied? Yes Is Selected

Q5.5 For the most recent project to plant vegetation, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Was vegetation planted in the last five years? (This includes woody shrubs, flowers, trees, etc.) Yes Is Selected

Q5.6 Which factors below influenced the decision to plant vegetation? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (17)
- ❑ Desire to improve the undeveloped quality of wilderness character (18)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve visitor safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (20)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (23)
- ❑ Non-governmental organization (NGO) requested the action (24)
- ❑ Pressure from inholders (19)
- ❑ Climate change mitigation or adaptation strategy (9)
- ❑ Recommendation from management plan (2)
- ❑ Funding was available (13)
- ❑ Pressure from research (26)
- ❑ Other factor(s) (15)
- ❑ None (25)

Display This Question:

If Did any of the factors below influence the decision to plant vegetation? (you may select more tha... Legislative provision(s) that allowed the agency or state to take action Is Selected

Q253 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the factors below influence the decision to plant vegetation? (you may select more tha... Other law or litigation settlement requirement Is Selected

Q254 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... State agency requested the action Is Selected

Q255 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... Other federal agency requested the action Is Selected

Q256 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to plant vegetation? (you may select more tha... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the factors below influence the decision to plant vegetation? (you may select more tha... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the factors below influence the decision to plant vegetation? (you may select more tha... Recommendation from management plan Is Selected

Q295 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... Other factor(s) Is Selected

Q257 What other factors influenced the decision to act?

Display This Question:

If Were plants mechanically removed in the last five years? Yes Is Selected

Q5.7 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who first proposed the project? Other Is Selected

Q5.8 If other, please indicate who proposed the project?

Display This Question:

If Who first proposed the project? Other federal agency Is Selected

Q5.10 Which federal agency proposed the project?

Display This Question:

If Who proposed the project? State agency Is Selected

Q5.11 Which state agency proposed the project?

Display This Question:

If Who first proposed the project? Non-governmental organization Is Selected

Q5.12 Which non-governmental organization proposed the project?

Display This Question:

If Were plants mechanically removed in the last five years? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q5.15 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:

If Was vegetation planted in the last five years? (This includes woody shrubs, flowers, trees, etc.) Yes Is Selected

Q5.16 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were plants mechanically removed in the last five years? Yes Is Selected

Q5.17 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Was post-action monitoring completed after the vegetation was planted? Yes Is Selected

Q5.18 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:

If How effective was the action in completing project goals and objectives? Effective Is Selected

Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q5.19 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:

If How do you know? Other Is Selected

Q258 What other method was used to determine the effectiveness of the project?

Display This Question:

If Were plants mechanically removed in the last five years? Yes Is Selected

Q5.20 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Have you taken any action(s) to manage vegetation? (examples may include hand-pulling invasive pl... Yes Is Selected

Q6.1 Was vegetation removed through mechanical means (non-chemical)? (Examples include hand pulling invasive weeds in a large area, or cutting down trees or shrubs and leaving them where they are cut, or using prescribed fire.)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Was vegetation mechanically removed in the last five years? (An example may include pulling invas... Yes Is Selected

Q6.2 Please indicate how many management projects that included the mechanical removal of vegetation were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Was herbicide applied? Yes Is Selected

Q6.3 For the most recent project to mechanically remove vegetation, what was the title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Was vegetation removed through non-chemical means? (Examples include hand pulling invasive weeds... Yes Is Selected

Q260 For the most recent mechanical removal of vegetation project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Was vegetation removed through non-chemical means? (Examples include hand pulling invasive weeds... Yes Is Selected

Q261 For the most recent mechanical removal of vegetation project, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were plants mechanically removed in the last five years? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q6.4 Which factors below influenced the decision to mechanically remove vegetation? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the factors below influence the decision to mechanically remove vegetation? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q262 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... Other law or litigation settlement requirement Is Selected

Q263 Please indicate which specific law or litigation settlement requirement influenced the decision to act.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... State agency requested the action Is Selected

Q264 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... Other federal agency requested the action Is Selected

Q265 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to mechanically remove vegetation? You may se... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the factors below influence the decision to mechanically remove vegetation? You may se... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the factors below influence the decision to mechanically remove vegetation? You may se... Recommendation from management plan Is Selected

Q296 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to apply herbicide? You may select more t... Other factor(s) Is Selected

Q266 What other factor(s) influenced the decision to act?

Display This Question:

If Were plants mechanically removed in the last five years? Yes Is Selected

Q6.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who first proposed the project? Other Is Selected

Q6.6 If other, please indicate who proposed the project?

Display This Question:
If Who first proposed the project? Other federal agency Is Selected

Q6.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q6.9 Which state agency proposed the project?

Display This Question:
If Who first proposed the project? Non-governmental organization Is Selected

Q6.10 Which non-governmental organization proposed the project?

Display This Question:
If Were plants mechanically removed in the last five years? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q6.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q6.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were plants mechanically removed in the last five years? Yes Is Selected

Q6.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed after herbicide was applied? Yes Is Selected

Q6.16 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q6.17 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q267 What other method was used to determine the effectiveness of the project?

Display This Question:
If Was vegetation mechanically removed in the last five years? (An example may include pulling invasive weeds by hand in a large area, or cutting down trees) Yes Is Selected

Q6.18 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage vegetation? (examples may include hand-pulling invasive pl... Yes Is Selected

Q7.1 Were any biocontrol agents used in the past five years to manage vegetation?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Q7.2 Please indicate how many management projects that included the application of biocontrol agents were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were any biocontrol agents used in the past five years to manage vegetation? Yes Is Selected

Q271 For the most recent biocontrol project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Were any biocontrol agents used in the past five years to manage vegetation? Yes Is Selected

Q269 For the most recent biocontrol project, what level of NEPA analysis did the project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Q7.3 For the most recent project to use biocontrol agents to manage vegetation, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q7.4 Which factors below influenced the decision to use biocontrol agents? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the following factors influence the decision to use biocontrol agents? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q273 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the following factors influence the decision to use biocontrol agents? You may select more than one. Other law or litigation settlement requirement Is Selected

Q274 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the following factors influence the decision to use biocontrol agents? You may select more than one. State agency requested the action Is Selected

Q275 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to use biocontrol agents? You may select more than one. Other federal agency requested the action Is Selected

Q276 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to use biocontrol agents? You may select... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the following factors influence the decision to use biocontrol agents? You may select... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the following factors influence the decision to use biocontrol agents? You may select... Recommendation from management plan Is Selected

Q297 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to use biocontrol agents? You may select more than one. Other factor(s) Is Selected

Q277 What other factor(s) influenced the decision to act?

Display This Question:

If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Q7.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who first proposed the project? Other Is Selected

Q7.6 If other, please indicate who proposed the project?

Display This Question:
If Who first proposed the project? Other federal agency Is Selected

Q7.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q7.9 Which state agency proposed the project?

Display This Question:
If Who first proposed the project? Non-governmental organization Is Selected

Q7.10 Which non-governmental organization proposed the project?

Display This Question:
If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q7.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q7.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Q7.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q7.16 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q7.17 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q278 What other method was used to determine the effectiveness of the project?

Display This Question:
If Were any biocontrol agents used in the past five years to manage vegetation? Examples may include the use of Yes Is Selected

Q7.18 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage vegetation? (examples may include hand-pulling invasive pl... Yes Is Selected

Q8.1 Have you taken any other actions to manage vegetation in the last five years? Please describe in detail the additional projects below. Include time frames for projects, who proposed the project, what was the motivation for taking action, and if the project was successful in achieving project objectives.

Q298 This concludes the Vegetation Section.

Q9.1 Have you taken any action(s) to manage wildfire? (examples may include mechanically reducing fuels, prescribing fire or suppressing wildfire)

- ❍ Yes (4)
- ❍ No (5)

Display This Question:

If Have you taken any action(s) to manage wildfire? (examples may include mechanically reducing fuel... Yes Is Selected

Q373 Were fuels management projects implemented? For example, was prescribed burning or thinning used for the purpose of reducing flammable fuels or modifying vegetation for wildlife habitat? Please do not include projects that were full suppression responses to natural ignitions.

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to... Yes Is Selected

Q374 How many times were fuels management projects implemented in each of the past five years?

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to thin forests? Yes Is Selected

Q375 For the most recent project to thin forests or reduce fuel, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to... Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q376 Which factors below influenced the decision to thin forests or reduce fuels? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Legislative provision(s) that allowed the agency or state to take action Is Selected

Q299 Please indicate which legislative provision allowed the agency or state to take action.

Display This Question:

If Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Other law or litigation settlement requirement Is Selected

Q300 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) State agency requested the action Is Selected

Q301 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Other federal agency requested the action Is Selected

Q302 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Climate change mitigation or adaptation strategy Is Selected

Or Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Recommendation from management plan Is Selected

Q316 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the factors below influence the decision to thin forests or reduce fuels? (may select more than one) Other factor(s) Is Selected

Q303 What other factor(s) influenced the decision to act?

Display This Question:

If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to... Yes Is Selected

Q377 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who proposed the project? Other Is Selected

Q378 If other, please list who proposed the project?

Display This Question:
If Who proposed the project? Other federal agency Is Selected

Q380 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q381 Which state agency proposed the project?

Display This Question:
If Who proposed the project? Non-governmental organization Is Selected

Q382 Which non-governmental organization proposed the project?

Display This Question:
If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to thin forests? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q383 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If For the first project, did it require any 4c prohibited uses? (including motorized or mechanized... Yes Is Selected

Q384 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to thin forests? Yes Is Selected

Q385 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q386 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q387 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q388 What other method was used to determine the effectiveness of the project?

Display This Question:
If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to thin forests? Yes Is Selected

Q389 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage wildfire? (examples may include mechanically reducing fuel... Yes Is Selected

Q10.1 Did any natural fire ignitions receive an aggressive initial attack response (in other words, with the intent of extinguishing the fire)?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Did any natural fire ignitions receive a full suppression response? Yes Is Selected

Q10.2 Please indicate how many times a natural fire ignition received an aggressive initial attack response in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Have you taken any action(s) to manage wildfire? (examples may include mechanically reducing fuel... Yes Is Selected

Q11.1 Were any management actions taken to establish control lines with the goal of containing the fire perimeter? Control lines include natural or constructed barriers to stop or check the spread of a fire.

❍ Yes (1)
❍ No (2)

Display This Question:

If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to... Yes Is Selected

Q11.2 How many times were control lines established with the goal of containing the fire perimeter in each of the last five years?

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were any management actions taken to establish control lines with the goal of containing the fire... Yes Is Selected

Q314 How many times was fire retardant or water dropped from aircraft in each of the last five years?

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were forest thinning or fuel reduction projects implemented? For example, were chainsaws used to thin forests? Yes Is Selected

Q11.18 Were any legal or administrative appeals taken in response to these action(s)?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Have you taken any action(s) to manage wildfire? (examples may include mechanically reducing fuel... Yes Is Selected

Q12.1 Were any post wildfire ecological intervention projects completed? Examples include planting seeds, stabilizing hill slopes, applying soil, using contour log terraces or straw wattles, etc.

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Q12.2 How many have each of the following post-fire projects occurred in the last five years?

_____ Planting seeds (2)
_____ Stabilizing hill slopes (3)
_____ Applying soil and mulch (4)
_____ Using contour log terraces or straw wattles (5)
_____ Other post-fire projects (6)

Display This Question:

If Were any post wildfire ecological intervention projects completed? Examples include planting seed... Yes Is Selected

Q304 For the most recent post-wildfire ecological intervention project, what was the title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Were any post wildfire ecological intervention projects completed? Examples include planting seed... Yes Is Selected

Q305 For the most recent post-wildfire ecological intervention project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Q12.3 For the most recent post-wildfire project, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q12.4 Which factors below influenced the decision to conduct post-fire restoration projects? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the factors below influence the decision to conduct post-fire restoration actions? Legislative provision(s) that allowed the agency or state to take action Is Selected

Q306 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the factors below influence the decision to conduct post-fire restoration actions? Other law or litigation settlement requirement Is Selected

Q307 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the factors below influence the decision to conduct post-fire restoration actions? State agency requested the action Is Selected

Q308 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to conduct post-fire restoration actions? Other federal agency requested the action Is Selected

Q309 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to conduct post-fire restoration actions? Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the factors below influence the decision to conduct post-fire restoration actions? Climate change mitigation or adaptation strategy Is Selected

Or Did any of the factors below influence the decision to conduct post-fire restoration actions? Recommendation from management plan Is Selected

Q310 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Q12.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who first proposed the project? Other Is Selected

Q12.6 If other, please indicate who proposed the project?

Display This Question:
If Who first proposed the project? Other federal agency Is Selected

Q12.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q12.9 Which state agency proposed the project?

Display This Question:
If Who first proposed the project? Non-governmental organization Is Selected

Q12.10 Which non-governmental organization proposed the project?

Display This Question:
If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q12.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q12.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Q12.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q12.16 How effective was the action in completing project goals and objectives?
- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q12.17 How do you know that the project was effective?
- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q316 What other methods for determining the effectiveness of the project was used?

Display This Question:
If Were any naturally-ignited wildfires suppressed in the last five years? Yes Is Selected

Q12.18 Were any legal or administrative appeals taken in response to this intervention?
- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage wildfire? (examples may include mechanically reducing fuel... Yes Is Selected

Q13.1 Have you taken any other actions to manage wildfire in the last five years? Please describe in detail the additional projects below. Include time frames for projects, who proposed the project, what was the motivation for taking action, and if the project was successful in achieving project objectives.

Q317 This concludes the Fire Section.

Q14.1 Have you taken any action(s) to manage fish and wildlife? (examples may include introducing species, augmenting existing wildlife populations, or removing/killing species)
- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Have you taken any action(s) to manage fish and wildlife? (examples may include introducing speci... Yes Is Selected

Q15.1 Were fish and wildlife added to this wilderness as a result of management actions in the last five years? (Examples include reintroducing bighorn sheep, introducing other species, translocating animals to supplement a population, etc.)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were fish and wildlife artificially added to this wilderness in the last five years? (Examples in... Yes Is Selected

Q15.2 Please indicate how many management projects that included the artificial addition of fish or wildlife were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were fish and wildlife artificially added to this wilderness in the last five years? (Examples in... Yes Is Selected

Q280 For the most recent wildlife addition project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Were fish and wildlife artificially added to this wilderness in the last five years? (Examples in... Yes Is Selected

Q281 For the most recent wildlife addition project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Were wildlife introduction or reintroduction projects implemented in the last five years? (An example may include reintroducing bighorn sheep or west slope cutthroat trout) Yes Is Selected

Q15.3 For the most recent wildlife addition project, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If For the most recent wildlife addition project, what was the primary reason for taking action? (What was the problem the action was intended to correct?) Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q15.4 Which factors below influenced the decision to add wildlife? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the factors below influence the decision to add wildlife? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q282 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:
If Did any of the factors below influence the decision to add wildlife? You may select more than one. Other law or litigation settlement requirement Is Selected

Q283 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:
If Did any of the factors below influence the decision to add wildlife? You may select more than one. State agency requested the action Is Selected

Q284 Please indicate the state agency that requested the action.

Display This Question:
If Did any of the factors below influence the decision to add wildlife? You may select more than one. Other federal agency requested the action Is Selected

Q285 Please indicate the other federal agency that requested the action.

Display This Question:
If Did any of the factors below influence the decision to add wildlife? You may select more than one. Non-governmental organization (NGO) requested the action Is Selected
Or Did any of the factors below influence the decision to add wildlife? You may select more than one. Climate change mitigation or adaptation strategy Is Selected
Or Did any of the factors below influence the decision to add wildlife? You may select more than one. Recommendation from management plan Is Selected

Q311 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:
If Did any of the factors below influence the decision to add wildlife? You may select more than one. Other factor(s) Is Selected

Q286 What other factor(s) influenced the decision to act?

Display This Question:
If Were wildlife introduction or reintroduction projects implemented in the last five years? (An example may include reintroducing bighorn sheep or west slope cutthroat trout) Yes Is Selected

Q15.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:
If Who first proposed the project? Other Is Selected

Q15.6 If other, please list who proposed the project?

Display This Question:
If Who first proposed the project? Other federal agency Is Selected

Q15.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q15.9 Which state agency proposed the project?

Display This Question:
If Who first proposed the project? Non-governmental organization Is Selected

Q15.10 Which non-governmental organization proposed the project?

Display This Question:
If Were wildlife introduction or reintroduction projects implemented in the last five years? (An example may include reintroducing bighorn sheep or west slope cutthroat trout) Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q15.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q15.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were wildlife introduction or reintroduction projects implemented in the last five years? (An example may include reintroducing bighorn sheep or west slope cutthroat trout) Yes Is Selected

Q15.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q15.16 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q15.17 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q287 What other method was used to determine the effectiveness of the project?

Display This Question:
If Were wildlife introduction or reintroduction projects implemented in the last five years? (An example may include reintroducing bighorn sheep or west slope cutthroat trout) Yes Is Selected

Q15.18 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage fish and wildlife? (examples may include introducing speci... Yes Is Selected

Q16.1 Were fish and wildlife removed from this wilderness in the last five years? (For example, were fish removed by mechanical or chemical means, were animals culled, were animals translocated out of this wilderness, were predators controlled, etc.)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Q16.2 Please indicate how many management projects that included the removal of fish or wildlife were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were fish and wildlife removed from this wilderness in the last five years? (For example, were fish removed by mechanical or chemical means, were animals culled, were animals translocated out of th... Yes Is Selected

Q289 For the most recent wildlife removal project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Were fish and wildlife removed from this wilderness in the last five years? (For example, were fi... Yes Is Selected

Q290 For the most recent wildlife removal project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Q16.3 For the most recent wildlife removal project, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q16.4 Which factors below influenced the decision to remove wildlife? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the following factors influence the decision to remove wildlife? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q291 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the following factors influence the decision to remove wildlife? You may select more than one. Other law or litigation settlement requirement Is Selected

Q292 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the following factors influence the decision to remove wildlife? You may select more than one. State agency requested the action Is Selected

Q293 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to remove wildlife? You may select more than one. Other federal agency requested the action Is Selected

Q294 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to remove wildlife? You may select more... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the following factors influence the decision to remove wildlife? You may select more... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the following factors influence the decision to remove wildlife? You may select more... Recommendation from management plan Is Selected

Q312 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to remove wildlife? You may select more than one. Other factor(s) Is Selected

Q295 What other factor(s) influenced the decision to act?

Display This Question:

If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Q16.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who proposed the project? Other Is Selected

Q16.6 If other, please indicate who proposed the project?

Display This Question:
If Who proposed the project? Other federal agency Is Selected

Q16.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q16.9 Which state agency proposed the project?

Display This Question:
If Who proposed the project? Non-governmental organization Is Selected

Q16.10 Which non-governmental organization proposed the project?

Display This Question:
If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q16.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q16.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Q16.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q16.16 How effective was the action in completing project goals and objectives?
- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q16.17 How do you know that the project was effective?
- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q296 What other method was used to determine the effectiveness of the project?

Display This Question:
If Was wildlife killed for management purposes in the last five years? (for example, were fish removed by mechanical or chemical means, were non-native mammals culled? Yes Is Selected

Q16.18 Were any legal or administrative appeals taken in response to this intervention?
- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage fish and wildlife? (examples may include introducing speci... Yes Is Selected

Q17.1 Have you taken any other action(s) to manage fish and wildlife in the last five years? Please describe in detail the additional projects below. Include time frames for projects, who proposed the project, what was the motivation for taking action, and if the project was successful in achieving project objectives.

Q318 This concludes the Wildlife Section.

Q18.1 Have you taken any action(s) to manage water sources? (examples may include installing water guzzlers, adding buffering chemicals to water, installing dams, etc.)
- ❍ Yes (5)
- ❍ No (6)

Display This Question:

If Have you taken any action(s) to manage water sources? (examples may include installing water guzz... Yes Is Selected

Q19.1 Were structures installed to provide water for wildlife? (Examples include water guzzlers, fencing to exclude certain species, structures to reduce evapotranspiration, or other structures to increase water quantity and quality.)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Q19.2 Please indicate how many management projects that included the installation of structures to provide water for wildlife were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were structures installed to provide water for wildlife? (Examples include water guzzlers, fencin... Yes Is Selected

Q298 For the most recent project to install water structures for wildlife, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Were structures installed to provide water for wildlife? (Examples include water guzzlers, fencin... Yes Is Selected

Q299 For the most recent water structure installation project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Q19.3 For the most recent project to install water structures for wildlife, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q19.4 Which factors below influenced the decision to install water structures for wildlife? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the following factors influence the decision to install water structures for wildlife? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q300 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the following factors influence the decision to install water structures for wildlife? You may select more than one. Other law or litigation settlement requirement Is Selected

Q301 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the following factors influence the decision to install water structures for wildlife? You may select more than one. State agency requested the action Is Selected

Q302 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to install water structures for wildlife? You may select more than one. Other federal agency requested the action Is Selected

Q303 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to install water structures for wildlife?... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the following factors influence the decision to install water structures for wildlife?... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the following factors influence the decision to install water structures for wildlife?... Recommendation from management plan Is Selected

Q313 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to install water structures for wildlife? You may select more than one. Other factor(s) Is Selected

Q304 What other factor(s) influenced the decision to act?

Display This Question:

If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Q19.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:
If Who proposed the project? Other Is Selected

Q19.6 If other, please list who proposed the project?

Display This Question:
If Who proposed the project? Other federal agency Is Selected

Q19.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q19.9 Which state agency proposed the project?

Display This Question:
If Who proposed the project? Non-governmental organization Is Selected

Q19.10 Which non-governmental organization proposed the project?

Display This Question:
If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q19.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q19.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Q19.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q19.16 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q19.17 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q305 What other method was used to determine the effectiveness of the project?

Display This Question:
If Were water guzzlers installed in the last five years? (An example may include installing a water guzzler as a drinking source for desert bighorn sheep) Yes Is Selected

Q19.18 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage water sources? (examples may include installing water guzz... Yes Is Selected

Q20.1 Were chemicals added? (For example, was lime added to streams to buffer the effects of acid rain?)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were chemicals added to water sources? (for example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q20.2 Please indicate how many management projects that included the addition of chemicals to water sources were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were chemicals added? (For example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q307 For the most recent chemical application project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If Were chemicals added? (For example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q308 For the most recent chemical application application project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Were chemicals added to water sources? (for example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q20.3 For the most recent chemical application to water, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were chemicals added to water sources? (for example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q20.4 Which factors below influenced the decision to apply chemicals to water sources? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the factors below influence the decision to apply chemicals to water sources? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q309 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the factors below influence the decision to apply chemicals to water sources? You may select more than one. Other law or litigation settlement requirement Is Selected

Q310 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the factors below influence the decision to apply chemicals to water sources? You may select more than one. State agency requested the action Is Selected

Q311 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to apply chemicals to water sources? You may select more than one. Other federal agency requested the action Is Selected

Q312 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the factors below influence the decision to apply chemicals to water sources? You may... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the factors below influence the decision to apply chemicals to water sources? You may... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the factors below influence the decision to apply chemicals to water sources? You may... Recommendation from management plan Is Selected

Q314 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the factors below influence the decision to apply chemicals to water sources? You may select more than one. Other factor(s) Is Selected

Q313 What other factor(s) influenced the decision to act?

Display This Question:

If Were chemicals added to water sources? (for example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q20.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who proposed the project? Other Is Selected

Q20.6 If other, please indicate who proposed the project?

Display This Question:
If Who proposed the project? Other federal agency Is Selected

Q20.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q20.9 Which state agency proposed the project?

Display This Question:
If Who proposed the project? Non-governmental organization Is Selected

Q20.10 Which non-governmental organization proposed the project?

Display This Question:
If Was herbicide applied? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q20.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If Did this action require any 4c prohibited uses? (motorized equipment, mechanized transport, landi... Yes Is Selected

Q20.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were chemicals added to water sources? (for example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q20.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q20.16 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q20.17 How do you know that the project was effective?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q314 What other method was used to determine the effectiveness of the project?

Display This Question:
If Were chemicals added to water sources? (for example, was lime added to streams to buffer the effects of acid rain?) Yes Is Selected

Q20.18 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage water sources? (examples may include installing water guzz... Yes Is Selected

Q21.1 Were any structures installed, or natural barriers removed, that modified the flow of water (For example were fish barriers, dams, gauging stations, or fish ladders installed? Do not include water installations to provide water for wildlife.)

- ❍ Yes (1)
- ❍ No (2)

Display This Question:

If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Q21.2 Please indicate how many management projects that included the modification of water were implemented in each of the last five years.

_____ 2011 (1)
_____ 2012 (2)
_____ 2013 (3)
_____ 2014 (4)
_____ 2015 (5)

Display This Question:

If Were any structures installed, or natural barriers removed, that modified the flow of water (For... Yes Is Selected

Q316 For the most recent water modification project, what was title of the project? If this project included a variety of actions, please use the same title for each subsection throughout this survey.

Display This Question:

If For the most recent water modification project, what level of NEPA analysis did this project receive? NEPA level of analysis Is Selected

Q317 For the most recent water modification project, what level of NEPA analysis did this project receive?

	None (1)	Unsure (2)	Categorical Exclusion (CE) (3)	Environmental Assessment (EA) (4)	Environmental Impact Statement (EIS) (5)
NEPA level of analysis (1)					

Display This Question:

If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Q21.3 For the most recent water modification project, what was the primary reason for taking action? (What was the problem the action was intended to correct?)

Display This Question:

If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Which factors below influenced the decision to apply herbicide? (select all that apply) "

Q21.4 Which factors below influenced the decision to install water modification structures? (select all that apply)

- ❑ Desire to improve the natural quality of wilderness character (1)
- ❑ Desire to improve the undeveloped quality of wilderness character (2)
- ❑ Desire to improve the solitude quality of wilderness character (3)
- ❑ Desire to improve the "other features of value" quality of wilderness character (4)
- ❑ Desire to improve user safety and convenience (5)
- ❑ Legislative provision(s) that allowed the agency or state to take action (6)
- ❑ Endangered Species Act requirement (7)
- ❑ Other law or litigation settlement requirement (8)
- ❑ State agency requested the action (9)
- ❑ Other federal agency requested the action (10)
- ❑ Home agency requested the action (11)
- ❑ Non-governmental organization (NGO) requested the action (12)
- ❑ Pressure from inholders (13)
- ❑ Climate change mitigation or adaptation strategy (14)
- ❑ Recommendation from management plan (15)
- ❑ Funding was available (16)
- ❑ Pressure from research (17)
- ❑ Other factor(s) (18)
- ❑ None (19)

Display This Question:

If Did any of the following factors influence the decision to install water modification structures? You may select more than one. Legislative provision(s) that allowed the agency or state to take action Is Selected

Q318 Please indicate which legislative provision(s) allowed the state or other federal agencies to take action.

Display This Question:

If Did any of the following factors influence the decision to install water modification structures? You may select more than one. Other law or litigation settlement requirement Is Selected

Q320 Please indicate which specific law or litigation settlement requirement influenced the decision to take action.

Display This Question:

If Did any of the following factors influence the decision to install water modification structures? You may select more than one. State agency requested the action Is Selected

Q319 Please indicate the state agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to install water modification structures? You may select more than one. Other federal agency requested the action Is Selected

Q321 Please indicate the other federal agency that requested the action.

Display This Question:

If Did any of the following factors influence the decision to install water modification structures?... Non-governmental organization (NGO) requested the action Is Selected

Or Did any of the following factors influence the decision to install water modification structures?... Climate change mitigation or adaptation strategy Is Selected

Or Did any of the following factors influence the decision to install water modification structures?... Recommendation from management plan Is Selected

Q315 Please indicate the NGO/climate adaptation strategy/management plan that recommended the action.

Display This Question:

If Did any of the following factors influence the decision to install water modification structures? You may select more than one. Other factor(s) Is Selected

Q322 What other factor(s) influenced the decision to act?

Display This Question:

If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Q21.5 Who proposed the project?

- ❑ Wilderness manager (1)
- ❑ Natural resources manager (2)
- ❑ Other staff (not wilderness manager or resource managers) (3)
- ❑ Other federal agency (8)
- ❑ State agency (5)
- ❑ Non-governmental organization (6)
- ❑ Other (7)

Display This Question:

If Who proposed the project? Other Is Selected

Q21.6 If other, please indicate who proposed the project?

Display This Question:
If Who proposed the project? Other federal agency Is Selected

Q21.8 Which federal agency proposed the project?

Display This Question:
If Who proposed the project? State agency Is Selected

Q21.9 Which state agency proposed the project?

Display This Question:
If Who proposed the project? Non-governmental organization Is Selected

Q21.10 Which non-governmental organization proposed the project?

Display This Question:
If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Carry Forward All Choices - Displayed & Hidden from "Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)"

Q21.13 Did this action require any Wilderness Act section 4(c) prohibited uses? (select all that apply)

- ❑ Temporary roads (1)
- ❑ Motor vehicles (2)
- ❑ Motor boats (3)
- ❑ Motorized equipment (4)
- ❑ Landing of aircraft (5)
- ❑ Mechanical transport (6)
- ❑ Structures or installations (7)
- ❑ None (8)

Display This Question:
If For the first project, did it require any 4c prohibited uses? (including motorized or mechanized... Yes Is Selected

Q21.14 Was a minimum requirements analysis (MRA) completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Q21.15 Was post-action monitoring completed?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Was post-action monitoring completed? Yes Is Selected

Q21.16 How effective was the action in completing project goals and objectives?

- ❍ Effective (1)
- ❍ Not effective (2)
- ❍ Unsure (3)

Display This Question:
If How effective was the action in completing project goals and objectives? Effective Is Selected
Or How effective was the action in completing project goals and objectives? Not effective Is Selected

Q21.17 How do you know?

- ❍ Monitoring data (1)
- ❍ Professional judgement (2)
- ❍ Other (3)

Display This Question:
If How do you know? Other Is Selected

Q323 What other method was used to determine the effectiveness of the project?

Display This Question:
If Were fish barriers or dams installed in the last five years? For example, was a fish barrier installed to prevent the migration of non-native fish to a certain location? Yes Is Selected

Q21.18 Were any legal or administrative appeals taken in response to this intervention?

- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If Have you taken any action(s) to manage water sources? (examples may include installing water guzz... Yes Is Selected

Q22.1 Have you taken any other actions to manage water sources in the last five years? Please describe in detail the additional projects below. Include time frames for projects, who proposed the project, what was the motivation for taking action, and if the project was successful in achieving project objectives.

Q319 This concludes the Water Section.

Q23.1 In the last five years, were any other ecological interventions implemented that did not fit into a category above?

- ❍ Yes (4)
- ❍ No (5)

Display This Question:

If In the last five years, were any other ecological intervention projects implemented that did not fit into a category above? Yes Is Selected

Q23.2 Please describe the project(s) below and include the reason for taking action, a brief description of the ecological intervention, and the result of the action.

Q23.3 Do you expect the number of ecological intervention projects to increase in this wilderness over the next five years?

- ❍ Yes (4)
- ❍ No (5)

Q23.4 Thank you for taking the time to complete this confidential survey on ecological interventions occurring in the National Wilderness Preservation System. If you have any feedback, questions, or concerns, please contact Lucy Lieberman at lucy.lieberman@umontana.edu or 802-989-0484.

B. Interview Guide

Reflections on Wilderness Management: History, decision-making, and navigating future wilderness stewardship challenges

Research Question
How are wilderness decisions made across the four wilderness management agencies, and how does the wilderness ideology of managers affect their decisions?

Sample
A purposive sample consisting of two former wilderness managers from each of the four wilderness management agencies (Forest Service, USDA; National Park Service, Fish and Wildlife Service, Bureau of Land Management, DOI) will be interviewed in a semi-structured format by phone.

Pre-Interview
- Verify recording app is in place and turned on.
- Prepare a blank interview guide ready to fill in with responses/notes.
- Place a subject code on the heading with the interviewee's name.

Introduction
Thank you for agreeing to participate in this interview. These interviews will be part of a larger study looking at ecological restoration issues in designated wilderness, in cooperation with the University of Montana and the Aldo Leopold Wilderness Research Institute. Today I'll be asking you about your wilderness background and experience managing wilderness and your responses will help me craft survey questions for current managers.

Your identity as a participant in this study will remain confidential and your name will not be used in the analysis and following reports. If it is okay with you, I would like to record the interview to ensure that your views are accurately recorded. Is that okay with you? (If yes, turn on recorder)

Interview Questions
History: Let's begin with your history as a wilderness manager.

1. What was your most recent title and which wilderness units have you managed?
    a. How long did you serve in that role?
2. What, if any, collateral duties did you have?
3. Why were you interested in becoming a wilderness manager?
    a. Probe: Any other factors that attracted you to the position?

Wilderness Ideology: Now I would like to talk some of the benefits and threats to wilderness.

4. What do you believe are the greatest benefits of wilderness?
    a. Probe: Any other benefits?
5. What do you believe are the greatest threats to wilderness?

    a. Probe: Any other threats you think are important?
6. Natural environments are rapidly changing today. Given this reality and the constraints of the Wilderness Act, do you think it's more important to protect all natural elements like species or processes, or is it more important to employ a hands-off philosophy and allow changes to occur?
    a. Probe: Why?

Decision-making: The next set of questions I have for you focus on how management decisions were made at your wilderness unit. I'm interested in decisions that led to significant management actions such as visitor use management, resource management activities, that kind of thing. I realize there is no standard protocol for how decisions are made, so I'm trying to understand the variation between agencies and individual wilderness units.

7. How did you decide whether to pursue an action that would trigger a NEPA analysis?
    a. Did you have a system for analyzing actions?
8. When major actions were proposed, were there specific processes in place to analyze these actions?
    a. Probe: What did these processes consist of?
9. How were ecological restoration decisions made?
    a. Any main differences between ecological restoration decisions and other types of management decisions?
10. If any ecological restoration projects occurred in your wilderness, what kind of projects were they?
    a. Who proposed these projects?
11. Can you think of any ecological restoration projects that were proposed, but ultimately rejected, and if so, why?
12. Reflecting on your career as a wilderness manager, what was the best decision you made that improved wilderness stewardship?
    a. Why was this the best decision?
13. What factors improved the decision-making process in that case?
14. Reflecting on decisions that may not have achieved your desired goals, what factors contributed to that outcome?

Wrap-up: I'm also interested in ways of improving wilderness stewardship.

15. Based on your experience, what advice do you have for current wilderness managers about how best to preserve wilderness?

Thank you very much for your time speaking with me today. Is there anything that we talked about today that you want to explore further, or anything else you think I should know?

Thanks again for sharing your experiences with me today. Please feel free to contact me if you have further questions.

C. Communication Strategy

ECOLOGICAL INTERVENTIONS ACROSS THE NATIONAL WILDERNESS PRESERVATION SYSTEM

SEPTEMBER 2016

Dear Wilderness Manager,

In the next two weeks you will be receiving a link to participate in the first National Wilderness Preservation-wide survey on ecological interventions in wilderness. This research is part of a University of Montana master's thesis in coordination with the Aldo Leopold Wilderness Research Institute. The purpose of this confidential survey is to collect a baseline of information from over 500 randomly selected wildernesses on the amount and variation of ecological interventions occurring throughout the National Wilderness Preservation System.

Your voluntary participation is appreciated and critical to providing us with information that is not collected in agency databases or records. This research is part of a larger suite of research projects conducted by the Aldo Leopold Wilderness Research Institute to support agency decision making. Additionally, understanding the extent of ecological interventions was cited as a research need in the Wilderness 2020 Vision Statement, as well as the 2014 Wilderness Manager's Survey.

Depending on how many wilderness units you manage, the survey should take fifteen to sixty minutes to complete. Due to the fact that wildernesses were randomly selected, it is possible that one person may receive multiple links to complete the survey. It may be helpful to have NEPA documents or historical records for ecological interventions accessible, though the questions focus specifically on actions taken within the last five years. Please follow the directions below upon receipt of the online survey link.

1. The survey link will be sent in an email with the wilderness unit in the subject line. For those managing multiple wildernesses, you will receive a distinct email for each wilderness, and fill out a separate survey.
2. Follow the link in the email to the online survey
3. The first question of the survey will ask you to identify which wilderness the survey is for. Please refer to the initial email and use the drop-down menu to select the wilderness.
4. Once you complete the survey, the results will automatically be sent to the survey software. Close the survey window once you have completed the survey.

You have the option to not respond to any questions that you choose. Participation or nonparticipation will not impact your relationship with the University of Montana or the

Phone script for re-contacting and sampling USFS units

Hi _____,
My name is Lucy Lieberman and I'm a graduate student at the University of Montana conducting research on ecological interventions in wilderness. You received a few emails from me this Fall asking you to participate in a confidential online survey about wilderness interventions.

Overall the USFS had a relatively low response rate compared with the other 3 wilderness agencies, part of that was due to the fact that every email I sent was flagged for the FS as containing a suspicious link. Because of this low response rate, I'm calling a randomly selected sub sample of the wildernesses selected to try and boost the response rate, and I was wondering if you would be willing to complete the survey for _____wilderness? I am happy to fill out the survey for you over the phone, or I could also resend you the online survey link and you can complete it whenever you have time available in the next week. I only require 30 more surveys until I hit my goal and can make statistical inferences about the USFS as an agency.

Message:
Hello _____

Dear Wilderness Manager,
A few months ago you received an invitation to participate in a confidential survey about ecological interventions in wilderness. This research is part of a University of Montana master's thesis in coordination with the Aldo Leopold Wilderness Research Institute. The purpose of this confidential survey is to collect a baseline of information from over 500 randomly selected wildernesses on the amount, type and variation of ecological interventions occurring throughout the National Wilderness Preservation System. Overall, the Forest Service had a low response rate relative to the other three wilderness agencies (BLM, NPS and FWS), therefore I am resampling a subsample of USFS wildernesses to try and boost the response rate for my analysis.

It would be extremely helpful to me if you could complete the survey in the two weeks. Again, I greatly appreciate your support and participation, and if there's anything I can do to make this process easier, please let me know. I am happy to complete the survey for you over the phone if that is helpful. I will be following up by phone in the next two weeks to answer any additional questions you may have.

Thank you for your help on this research endeavor. If you have any questions regarding your rights as a research subject, contact the UM Institutional Review Board (IRB) at (406) 243-6672.

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D. Trends in Intervention Projects

By observing the number of intervention projects each year (2011-2015), trends on ecological interventions were observed. Though sample sizes vary by sub-category of intervention, there is a slight positive trend for vegetation and wildlife interventions over time. Wildfire interventions per year varied, with 2013 and 2014 being relatively high years for interventions fuels management and initial attack projects, while control lines and the application of fire retardant remained fairly stable over the five years (Figure 19, Figure 20, Figure 21, Figure 22).

Figure 19 Interagency mean number of vegetation intervention projects by year (sample sizes varied: herbicide n=20, planting n=8, mechanical removal n=22, biocontrol n=2)

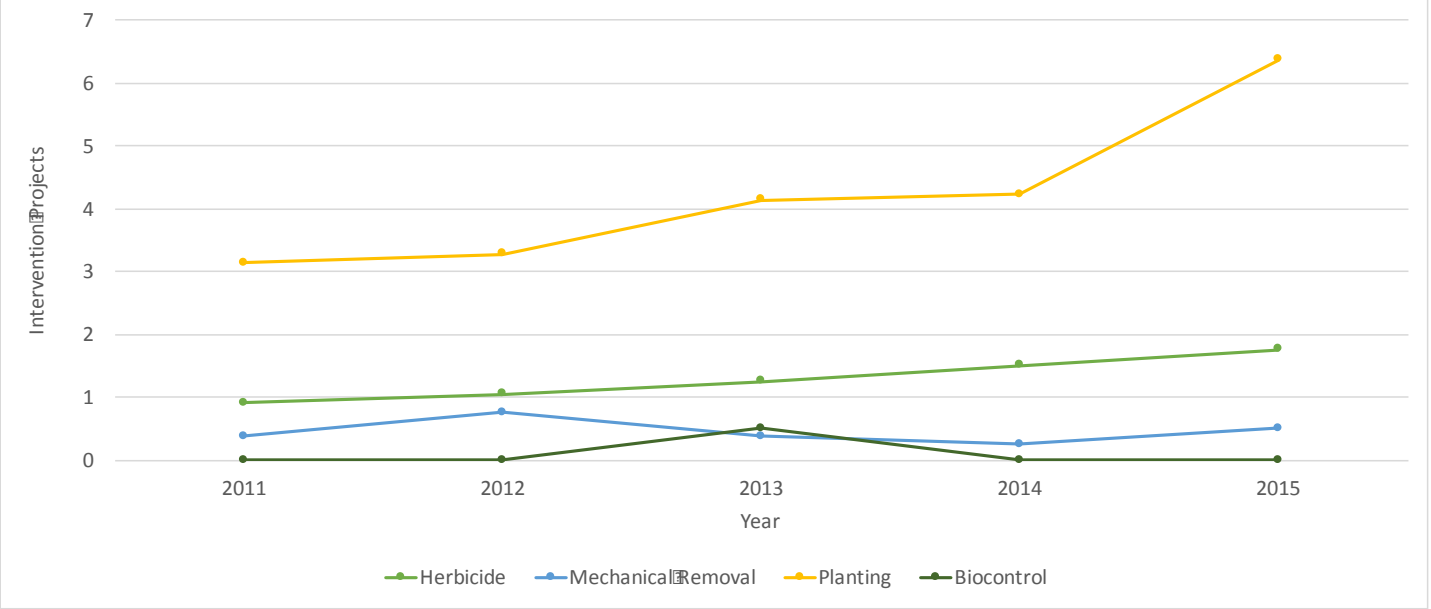


Figure 20 Interagency mean number of wildfire intervention projects by year (Sample sizes varied: fuels management n=7, initial attack n=25, control lines n=27, fire retardant use n=22)

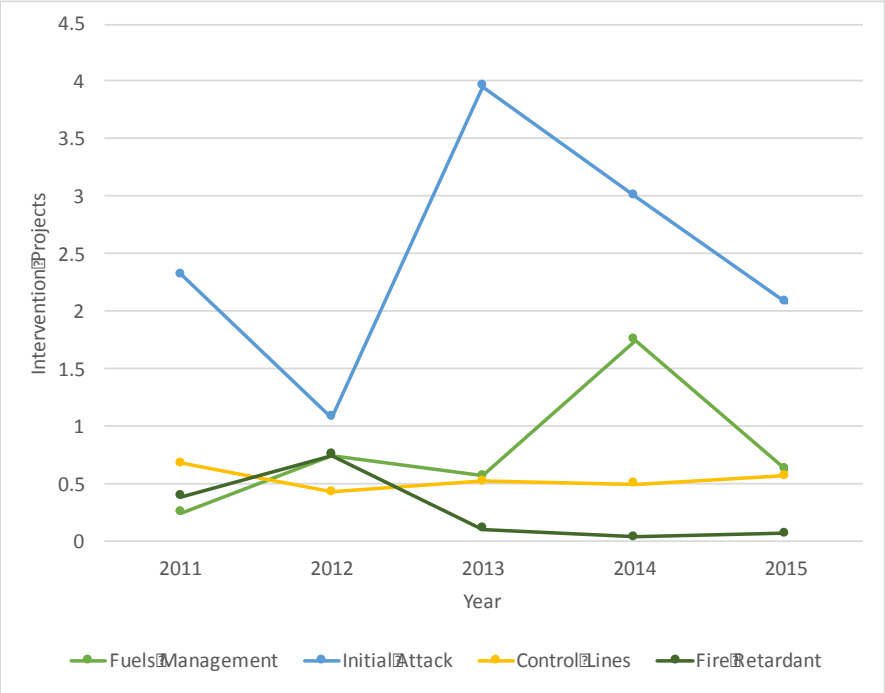


Figure 21 Interagency mean number of wildlife intervention projects by year (Sample sizes varied: wildlife removal n=8, wildlife addition n=9)

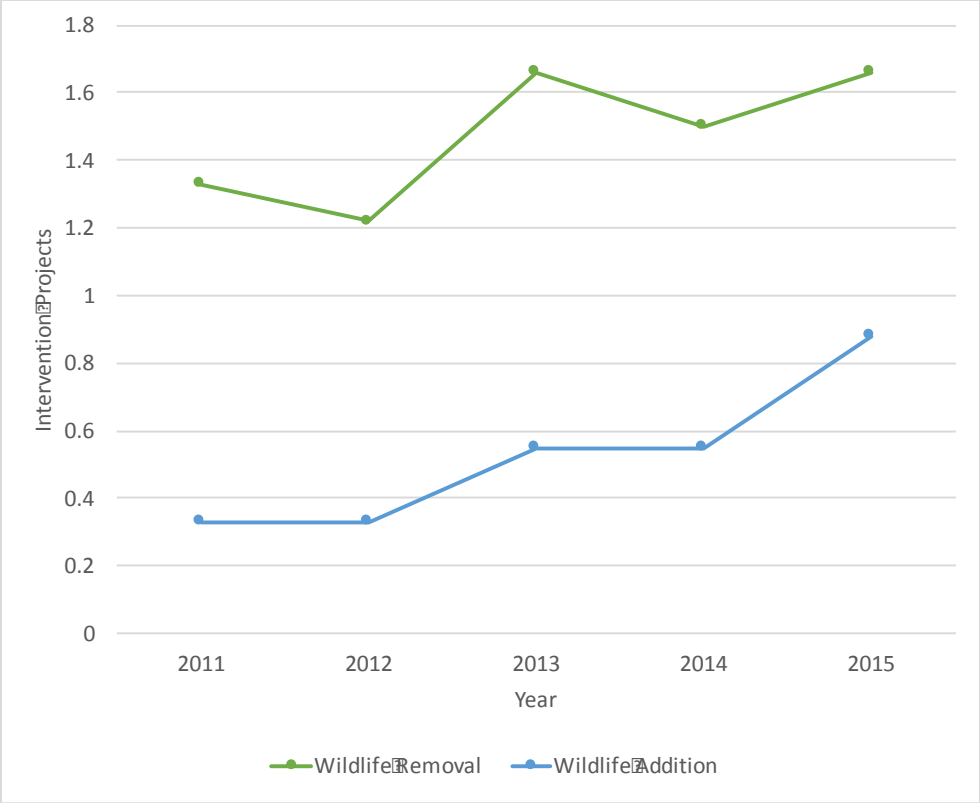
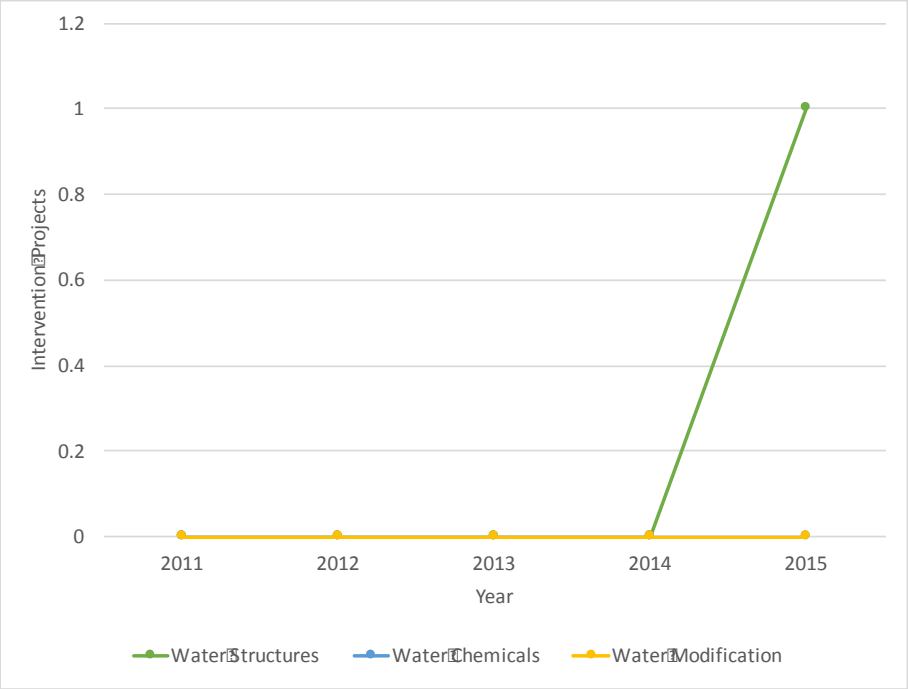


Figure 22 Interagency mean number of water intervention projects per year (Sample sizes varied: water modification n=1, water structures n=0, water chemicals added n=0)



E. Wilderness Training

Most survey respondents indicated completing wilderness trainings from the Arthur Carhart National Wilderness Training Center in Missoula, MT—the primary institution responsible for wilderness education and training (**Error! Reference source not found.**). The FWS reported the highest percentage of respondents who had completed wilderness trainings, with 92% (n=210 wilderness units). The BLM had the second-highest proportion of respondents who had attended Carhart trainings with 86% (n=210 wilderness units).

Figure 23 Wilderness units that have taken wilderness trainings from the Arthur Carhart National Wilderness Training Center (n=210 wilderness units)