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RESPONSES TO CLIMATE CHANGE IN NATIONAL PARK SERVICE WILDERNESS  
WHAT IS HAPPENING IN THE FIELD?

By

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Thesis

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RESPONSES TO CLIMATE CHANGE IN NATIONAL PARK SERVICE WILDERNESS  
WHAT IS HAPPENING IN THE FIELD?

Chairperson: Neva Hassanein

As scholars debate whether climate change warrants more or less active management in wilderness, this baseline study identifies what is happening on the ground. This study focuses attention on National Park Service units that administer designated wilderness. Representatives who had been identified by the superintendents from each of these units responded to an online survey (with a 94% response rate). Respondents reported on their concerns, monitoring, and management projects driven by climate change happening in their wilderness. Respondents also discussed whether and how these activities affected wilderness character. This is the first study to characterize the response to climate change in wilderness at a national scale. A majority of park units are conducting stewardship activities in wilderness to address and track the effects of climate change. Invasive species and fire are receiving much attention in the process. As park units respond to climate change in wilderness they cite perceived improvements to the natural quality of wilderness character. They also indicate that these activities harm the natural quality of wilderness character along with a suite of other qualities that have been left out of the academic discussion regarding appropriate management responses. The findings thus provide basic information to NPS administrators about what is happening in the field. They also give those discussing appropriate stewardship responses the fabric within which to sew their arguments. Finally, this study explores lessons learned from climate change adaptation in wilderness that may be applicable to adaptation activities happening elsewhere.



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Thank you .

# Executive Summary

## Study description

As scholars debate whether climate change warrants more or less active management in wilderness, this baseline study identifies what is happening on the ground. This study focuses attention on National Park Service (NPS) units that administer designated wilderness. Representatives who had been identified by the superintendents from each of these units responded to an online survey (with a 94% response rate). Respondents reported on their concerns, monitoring, and management projects driven by climate change happening in their wilderness. Respondents also discussed whether and how these activities affected wilderness character. This is the first study to characterize the response to climate change in wilderness at a national scale. In doing so it provides basic information to NPS administrators about what is happening in the field, it grounds the debate over appropriate approaches to wilderness stewardship with data about how wilderness coordinators are currently responding to climate change, and it also uses wilderness as a lens through which to examine ethical means for climate change adaptation.

## Findings

A majority of park units (68%) that administer designated wilderness are conducting stewardship projects in their wilderness that have been designed to address and track the effects of climate change. A third of the park units were conducting management activities, 60% were monitoring, and many were doing both with regards to climate change. Several respondents commented that they were doing additional activities that went unreported in the survey because those activities had been related to climate change and not driven by it. Other park units mentioned that they were just beginning to address climate change. For those park units that were already doing so, invasive species and fire were among the topics most commonly of concern, monitored, and managed, regards to climate change.

Of the management actions addressing climate change, 60% had approved a 4(c) use to complete the task. These uses (motorized equipment, mechanical transport, and structures, for instance) are prohibited in Section 4.c. of the Wilderness Act, except as required to meet the minimum requirements for the administration of the area as wilderness. Yet fire-related activities were most likely to have a 4(c) approved at 93%.

This study also explored completion rates for Minimum Requirement Analyses (MRAs) with regards to management actions addressing climate change. MRAs are required by NPS policy to help wilderness coordinators to comply with the Wilderness Act and to determine appropriate stewardship actions in their wilderness. Overall 76% of the reported management actions had a completed MRA. Fire suppression was the management action least likely to have a completed

MRA at 50%. However, prescribing fire, creating fire breaks, and thinning vegetation (unclear if the latter was a fire-driven activity) were actions with a 100% MRA completion rate.

Survey questions also asked respondents to describe changes in visitation frequency, amount, seasonality, and use-patterns happening in their wilderness that they attributed to climate change. A longer visitation season was the most commonly reported visitor use shift. A couple of park units had responded to this shift by extending patrols into traditional shoulder seasons. Decreased visitation was another reported shift, the reasons for which varied greatly—closures due to fire danger and hurricane debris, access issues due to washed out roads and damaged facilities, as well as drought. Park units responded by repairing roads and facilities.

Finally, the survey asked respondents how climate change-driven stewardship activities had impacted wilderness character. As park units respond to climate change in wilderness they cite perceived improvements to the natural quality of wilderness character. They also indicate that these activities harm the natural quality of wilderness character along with the untrammeled, undeveloped, solitude or primitive and unconfined recreation qualities.

## **Discussion and Recommendations**

Although the study succeeds in providing basic information to NPS administrators about what is happening in the field, it also demonstrates the need for greater transparency and accountability as these activities reportedly degrade wilderness character. Existing databases that track activities happening throughout the parks could also indicate which of these activities are happening in wilderness. They could also require that activities happening in designated wilderness have completed MRAs. MRAs themselves could be archived into a centralized database. This would ensure completion, provide accountability and transparency while also serving as an educational tool to teach wilderness coordinators what considerations need to be made to ensure appropriate wilderness stewardship.

The study also demonstrates that wilderness programs consider the financial implications of choosing to repair infrastructure and facilities damaged by the effects of climate change. Beyond that the study demonstrates the need to lengthen seasonal staffing periods in order to cover extending visitation seasons.

These findings give those discussing appropriate stewardship responses the fabric within which to sew their arguments. The wilderness stewardship debate has often framed the active approach as improving the natural quality of wilderness character and the hands-off approach as improving the untrammeled quality. However, these data demonstrate that such decisions are not a simple trade-off between two values.

Finally, this study explores lessons learned from climate change adaptation in wilderness that may be applicable to adaptation activities happening elsewhere. Prohibiting 4(c) uses teaches us that we can creatively avoid uses that emit greenhouse gases as we adapt to climate change. Decisions to act or to refrain from doing so can improve and degrade different qualities of wilderness character. Wilderness character thus demonstrates that the relationship between humans and nature is complex.

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## Introduction

The apparent effects of climate change have reignited an ethical debate over how to properly steward congressionally designated wilderness. The debate concerns whether humans should exercise our responsibility do everything we can to monitor, mitigate, and adapt to climate change in these most protected places, or whether we should instead exercise humility and place faith in non-human nature by restraining ourselves from meddling further with these ecosystems in potentially problematic ways. These different perspectives reflect a lively debate over how to appropriately adapt to climate change in wilderness. Increasingly, wilderness coordinators are faced with this either-or dilemma. They could use active management to maintain species composition and ecosystem function at the expense of wildness. Or they could invoke a hands-off approach to preserve wildness and to allow the landscapes to adapt. Often context-dependent factors—such as local geography, politics, legal obligations, and economic constraints— influence the approach. However, individual interpretations of wilderness character also shape the decision making process.

A layer of this debate concerns these more subjective factors, specifically how can and should qualities of wilderness character guide wilderness coordinators to an appropriate climate change response. In this light, Emma Marris’s influential *End of the Wild* essay, asks the reader to “imagine Montana’s Glacier National Park without glaciers; California’s Joshua Tree National Park with no Joshua trees.... In 50 years’ time, climate change will have altered some US parks so profoundly that their very names will be anachronisms” (2011a, p. 150). When a namesake feature of a national

park is threatened, managers in the National Park Service (hereafter NPS or Park Service) must either try to maintain those features or somehow redefine the park's identity.

Glacier National Park, for instance, has been the go-to example for climate change impacts on National Parks. More than 90% of the park unit and many of its highest reaches have been reserved as recommended wilderness (NPS 2008). In these areas Glacier National Park now draws attention to its "glacial-carved terrain" (NPS 2013a) as its once more prominent glaciers melt. Aside from investing in green technologies and educating visitors about strategies to reduce their individual carbon output, few management options exist for the park to maintain the current extent of its glaciers.

Joshua Tree National Park, on the other hand, may have more viable options to consider. Three quarters of Joshua Tree National Park is designated wilderness (Wilderness.net 2012). Although wilderness designation attempts to give these lands the highest level of federal protection, their artificial boundaries do not necessarily prevent the human-induced climatic shifts now threatening the park's namesake species, the Joshua tree (*Yucca brevifolia*). As temperatures warm, Joshua trees are expected to undergo dramatic redistributions—eventually inhabiting only ten percent or less of their current range within the park's boundaries (Barrows and Murphy-Mariscal 2012; Cole, et al. 2011; Dole, Loik and Sloan 2003).

Wilderness coordinators could allow the use of drip-irrigation to maintain the namesake species in its current range. But should they? What about introducing Joshua trees to other areas of the wilderness that are expected to harbor more favorable habitat in the future? Or perhaps they could introduce other "neo-native" species to areas left in the

wake of dying Joshua trees? Should park officials refrain from such interventions and instead allow “nature” to take its course—accepting whatever evolves as a novel ecosystem? Would pursuing management restraint justify increased monitoring to document and learn from Joshua tree retreat? What if this monitoring compromises other wilderness qualities? These are the kinds of questions facing wilderness coordinators and scholars—not only with respect to Joshua Tree National Park, but in park units across the nation. At base, climate change begs the question, “How should we respond?” Embedded within this question are dozens of others regarding project goals, feasibility, expected outcomes, necessary approaches, appropriate methods, unintended consequences, and accountability.

This study examines responses to climate change through the lens of designated wilderness. Stewardship decisions affecting wilderness must comply with conditions set forth in the Wilderness Act. These decisions are weighed and made at the local level, decision-making assessments, called Minimum Requirement Analyses (MRAs), are required by regulation but there is little oversight to ensure compliance. MRAs are not currently entered into a central database. Decision-makers are not necessarily required to seek approval from higher level officials. Though guided by science, legislation and administrative policies, responses seem to come down to individual wilderness coordinators selecting from stewardship options that reflect competing sets of values. As these values orient decision-makers toward different interpretations of wilderness, they become expressed by different stewardship approaches and climate change adaptation activities happening on the ground.

Through a survey of representatives from 46 of the 49 park units administering designated wilderness, this study takes the first nation-wide snapshot of wilderness stewardship as it attempts to address climate change. By identifying the ways in which NPS wilderness coordinators adapt to climate change on the ground, it provides basic information to the NPS about what actions are currently underway. It sheds light upon the stewardship approaches and the values embedded within the choices made. At a pivotal stage in wilderness stewardship, this study serves as a baseline to anchor the academic and practitioner debates with regards to differing interpretations of wilderness, stewardship approaches, and management goals. From this anchor will ripple more defined waves of discussion over whether and how to reshape or guide wilderness stewardship in an era of global change. This study also teaches us about how we react to climate change more generally—for if this study captures the response to climate change happening in areas where non-intervention is a valued alternative, then how might humans respond elsewhere? The analysis applies lessons learned in NPS wilderness to climate change adaptation. In doing so the aim is to mature the conversation about climate change adaptation and lay the groundwork to ensure that adaptation activities are carried out in the most effective and ethical ways possible.

# Chapter 1

## Study Significance

The management implications for protecting species, biological communities, and physical resources within finite land management boundaries in a rapidly changing climate are complex and without precedent.

—Jon Jarvis, National Park Service Director (NPS 2012a)

This study operates on three levels. (1) It provides basic information to NPS administrators about stewardship activities happening in the field. (2) It anchors the debate over appropriate approaches to wilderness stewardship in a nation-wide dataset that captures a baseline of stewardship responses to climate change in wilderness. (3) Finally it uses the wilderness character and the wilderness stewardship debate to help define ethical adaptation to climate change. To help set the stage for this multilayered study, I conducted a literature review to shape the survey's content and provide the analytical context within which to examine its results. This literature review begins with a broad picture of what it means to adapt to climate change and also, what it means to do so in federally designated wilderness. I explore the literature defining “wilderness” in both legal and cultural contexts. Then I provide overviews of two different approaches to wilderness stewardship: the active approach and the hands-off approach. Finally I conclude with examples of known stewardship responses but make the case that a system-wide understanding of stewardship is critical. As such this section situates the study in a larger theoretical framework, points out knowledge gaps that this study aims to fill, while also providing the context necessary to thoughtfully analyze these findings.

## **Responding to Climate Change**

### MITIGATION

From international agreements to individual consumer choices, the reigning approach to address climate change has been to prevent carbon emissions from reaching some scientifically determined threshold. The year before last, activists hoped to prevent a global temperature increase of 1.5°C. Last year they aimed for 2°C. Last November they had given in to the 4 - 6°C range (Economist 2012). Yet even the latter, more taciturn, goal inspired little action from the international negotiations which managed to sanction only a shell of the former Kyoto Protocol (the international agreement to reduce carbon emissions in the world's most developed countries). Without the popular support, effective efforts to reduce greenhouse gasses (and thus curtail the escalation of climate change) remain unlikely. Collectively, the efforts to reduce greenhouse gas emissions and to stem climate change are referred to as mitigation activities. Without mitigation, Glacier National Park will lose its glaciers, as other park wildernesses endure similarly dramatic repercussions.

Some have called for a social movement to inspire (or provoke) climate change mitigation that prevents such undesired consequences (Shellenberger and Nordhaus 2004; Brulle 2010). Yet a popular movement to reduce greenhouse gas emissions has failed to materialize significant emission reductions—the reasons for which are numerous and complex. Rhetorical manipulations have successfully polarized climate change as a political debate (Dunlap and McCright 2008). Proponents of mitigation have thus found themselves in a narrative rut; persuading the public that climate change exists (McNeely and Huntington 2007) by amassing mounds of scientific evidence (for example, Oreskes

2004). Yet their scientific evidence has been met with skepticism from much of the general public (Dunwoody 2007).

The sheer scale of climate change presents a further challenge to mitigation efforts. Climate change is a global phenomenon caused by the cumulative output of greenhouse gases all around the world and over the last hundred and fifty years. The act of emitting greenhouse gases is enshrined in the economic, political, and social systems that dominate a global culture. All this only reinforces the sense that human actions inherently harm nature (Jordan 1994; 2003). As a consequence, it is easy to feel helpless about climate change (Killingsworth and Palmer 1996; Russill 2008). Individuals are often lacking a sense of agency—a sense that their actions matter (Lubell 2002; 2008), as well as a sense that their actions can really have a positive effect on nature (Jordan 1994; 2003).

## ADAPTATION

Yet greenhouse gas mitigation is only one response to climate change. Another is adaptation. This is where Joshua trees come in. To adapt to climate change one must accept that climate change exists, anticipate what changes are happening or will happen, and then respond accordingly. By recognizing the effects of climate change, on the charismatic Joshua tree for instance, the dominant climate change narrative extracts itself from the rut of scientific persuasion and embeds itself in a tangible example. The climate change narrative evolves; becoming more complex, dynamic, and engaging as it grapples with perceptible observations, uncertain predictions, and ethical considerations for how and whether to respond to climate change in wilderness.

When it comes to addressing climate change, adaptation is not without critics. From a social justice perspective, climate change disproportionately affects those with the least capacity to adapt (Adger et al. 2007). Adaptation is thus perceived as a luxury to be enjoyed only by the world's wealthiest countries, which have also contributed a larger share of greenhouse gas emissions. Accepting climate change might be dangerous if acceptance is used to undermine mitigation efforts. Shifting resources to adaptation and away from mitigation can also be problematic. Adaptation indeed treats symptoms (climate change effects) more than the root cause (greenhouse gas emissions). It thus embodies an imperfect analogy: if someone is having a heart attack, the doctor does not tell that person to exercise more and eat better. The doctor sends for an ambulance—responding to the immediate and pressing concern. Sometimes it takes going through consequences to incite preventive actions.

Responding to climate change is not a question of whether to carry out either mitigation or adaptation; both can and must occur. A dual approach is already underway at the international scale. In some ways, adaptation may, ironically, pave the way for mitigation. By recognizing climate change and involving people in the effort to address it at local scales, adaptation has the potential to push popular momentum to tackle the larger scale challenge of climate change mitigation.

## ADAPTATION IN WILDERNESS

As alluded to in the Joshua tree example, climate change adaptation requires selecting from among a diverse set of options. As ecologists, Stephenson and Millar (2011-2012) suggest that wilderness coordinators consider managing for resilience, resistance, realignment or restraint when adapting to climate change in wilderness.

Managing for resilience facilitates the ecosystem's capacity to absorb stress. Managing for resistance attempts to thwart undesired changes. These two options are considered short term solutions that will be less and less feasible over the long-run. The long term option, realignment, guides ecosystem shifts in wilderness to maintain desired characteristics and functions. A fourth option, management restraint, is also a valid and valued climate change adaptation strategy in designated wilderness. Restraint is even considered the default approach to climate change adaptation in wilderness. More active approaches are said to happen in "parts of a wilderness that are strategically selected for intervention" (p. 35).

This study documents climate change adaptation activities happening in NPS wilderness. To contextualize wilderness stewardship activities undertaken in response to climate change, I consider (1) the debate about appropriate approaches to wilderness stewardship and (2) qualities of wilderness character as identified in the Wilderness Act. As the stewardship debate endeavors to articulate the benefits and drawbacks of each stewardship approach, it can teach us more about the implications of actively adapting to climate change in wilderness and elsewhere. Examining how these activities improve and degrade wilderness character provides another layer of ethical consideration. Together these lenses can teach us more about the values held and expressed by wilderness coordinators enacting the decision to actively steward designated wilderness. As these lessons are applied to climate change adaptation activities happening elsewhere, they move the dominant narrative about climate change from one of persuasion to an engaging dialogue about appropriate responses.

## **Wilderness Stewardship**

The debate over active versus hands-off stewardship in wilderness is by no means novel, especially as the discussion relates to boundary-crossing impacts triggered by human actions. Examples of issues sparking similar debates include the legacies of fire suppression (Agee 2002; van Wagendonk 2011-2012) and predator eradication. More recently, boundary-crossing threats are presented by pests, like pine beetles, and invasive species, like whitebark pine blister-rust, which dramatically transform many wilderness landscapes [United States Forest Service (USFS) 2012]. Climate change, however, brings the deliberation to a whole new level as it exacerbates these and other stewardship challenges. As a result, climate change will likely be one of the primary forces shaping wilderness and its administration for years to come (Cole and Landres 1996; Graber 2011-2012; Stephenson and Millar 2011-2012).

### **DESIGNATED WILDERNESS**

The Wilderness Act of 1964 described the meaning of wilderness as:

...in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

This legislation affords wilderness the highest level of federal protection. The act prohibits the use of motorized vehicles and equipment, roads, commercial enterprise, mechanical transport, structures, and installations, in designated wilderness “except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act” (U.S. Wilderness Act 1964). These so called “4(c) uses” must to meet these minimum requirements in order to be permitted. Accordingly to determine whether the stewardship activity is necessary in wilderness, monitoring and management proposals undergo a Minimum Requirement Analysis (MRA). Opinions about MRAs tend to range from annoyance at the bureaucratic hoops it presents to celebration of the thoughtful reflection they require. Nevertheless these decision-making frameworks influence the stewardship of millions of acres of federal lands.

When passed in 1964, the Wilderness Act designated 9.1 million acres to the National Wilderness Preservation System (Wilderness.net 2012). Through later acts of Congress, the system has grown to encompass more than 109 million acres (2012). These areas fall within the purview of four federal lands jurisdictions including the Bureau of Land Management, USFS, U.S. Fish and Wildlife Service, and the NPS, which is the focus of this study. Each agency or bureau is responsible for overseeing wilderness established on lands within their jurisdiction.

### ***National Park Service Wilderness***

The Park Service is responsible for managing wilderness established in National Parks, National Recreation Areas, National Monuments, National Seashores, and National Preserves. In accordance with the NPS Organic Act of 1916, all NPS lands are managed “...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” (US NPS Organic Act 1916). The Park Service considers that statement to be their mission, obligating their decision-makers to abide by dual, and occasionally conflicting, mandates of maintaining recreational opportunities while also preserving the “unimpaired” landscape (NPS 2003). Until the mid-1960s, many NPS lands had been managed primarily to enable and enhance recreational opportunities for park visitors (Miles 2009). Yet in 1964 the Wilderness Act designated a large portion of NPS lands as wilderness. This new designation shifted the focus of management toward preserving the unimpaired landscape. NPS policy began to require MRAs to determine appropriate stewardship activities happening within wilderness boundaries on NPS lands (NPS 2006a).

## **Approaches to Wilderness Stewardship**

### **MONITORING**

Under the 1964 Wilderness Act, the opportunity for scientific inquiry is a valued feature of designated wilderness. Prior to conducting a scientific activity, however, research and monitoring proposals must undergo an MRA. In part, this review ensures that the research meets the minimum requirements of the act. In particular, a scientific proposal can be evaluated according to whether (Landres, Alderson, and Parsons 2003):

- the scientific activity is necessary for the management of the area as wilderness,
- it is necessary to conduct the scientific activity in wilderness,
- the scientific activity will cause unacceptable impacts to wilderness

Even if a proposal for scientific monitoring is approved according to these terms, some data collection methods need to comply with conditions put forth by the act. For instance, because the use of motorized equipment and installations are constrained in wilderness, remote climate stations, radio-transmitters, and other monitoring devices are also limited (Hood 2011-2012; Landres, Alderson, and Parsons 2003). Because prohibited uses may be permitted if they are considered necessary for the administration of wilderness, limitations on them extend only as far as the wilderness coordinators deem necessary. As climate change increasingly impacts wilderness and the desire to document and respond to these changes grows, pressure will likely increase to relieve some of these constraints and enable more comprehensive data collection (Graber 2011-2012). Thus the NPS Wilderness Stewardship Division is interested in documenting the number and type of studies being done specifically to monitor climate change and its effects.

At this time the NPS tries to track research conducted within its jurisdiction. However its databases cannot sort according to whether research is carried out in designated wildernesses. Nor can they sort according to whether the research is “related to” or “driven by” climate change. This study helps fill these information gaps. It also identifies existing priorities for climate change monitoring in wilderness. In doing so, it gives NPS administrators a better sense for how their wilderness coordinators currently evaluate climate change-driven monitoring proposals. As such this study provides an important baseline for future research. Over time, follow-up research may document shifts in the types and level of climate change-driven monitoring in wilderness. These shifts could help gauge how future policy guidelines shape stewardship approaches as they are carried out on the ground.

## ACTIVE APPROACH

The option to monitor is only one, and perhaps in many cases the most benign, approach that wilderness coordinators consider as climate change affects NPS wilderness. More active approaches include facilitating ecosystem realignment, improving ecosystem resilience, and/or maintaining wilderness to resist its effects (Stephenson and Millar 2011-2012). These intentional and interventionist stewardship actions embody what I refer to as the active approach.

Scholars and practitioners supporting active management point to the globally-pervasive scale of anthropogenic impacts on ecosystems (e.g., Sanderson, et al. 2002) as evidence that action must be taken (Frelich and Reich 2009; Graber 2003; Hobbes and Harris 2001). Yet, as with scientific monitoring, the active approach to wilderness stewardship is constrained by legal conditions set forth in the Wilderness Act (Frelich and Reich 2009; Graber 2003). These constraints frustrate some advocates of the active approach who argue that the Wilderness Act's authors could not have foreseen the boundary-crossing threats of today's world (Frelich and Reich 2009; Graber 2003; Graber 2011-2012; Stephenson and Millar 2011-2012). Other critics deride the concept of wilderness altogether. They suggest that an untrammled and pristine wilderness is an idealized concept that fails to reflect the reality of human influences over the landscape (Cronon 1995; Graber 2003). Upon the bed of these critiques, active management advocates recommend intentionally guiding wilderness to maintain biodiversity and ecosystem functions rather than preserving it for an idealized untrammled quality (Frelich and Reich 2009; Graber 2011-2012; Stephenson and Millar 2011-2012). Indeed most climate change adaptation options (resilience, resistance, or realignment) fall within

this approach. Some have characterized the active approach as maintaining “naturalness” rather than preserving “wildness” (Graber 2003).

### *Naturalness versus wildness*

Preference for either the naturalness goal or the wildness goal has sparked arguments that parallel a debate between active and hands-off approaches to wilderness stewardship (Ridder 2007). Managing for naturalness is defined as managing for biodiversity and valued ecosystem functions (Landres, Brunson and Merigaliano 2001; Ridder 2007). As such, the goal of naturalness is invoked as a motive for taking a more active approach to maintain these qualities when they are threatened by anthropogenic forces like climate change (Landres, Brunson and Merigaliano 2001; Ridder 2007). Some even consider managing for naturalness as the only viable option. This camp contends that the extent of global human influence on the landscape renders the goal of wildness impossible and the argument between the two moot (Graber 2003). By contrast, others argue that wildness enables nature to retain its autonomy—its ability to organize and adapt to changing conditions in a manner free from intentional human intervention (Cole 2001; Landres, Brunson and Merigaliano 2001; Ridder 2007). This interpretation acknowledges existing anthropogenic effects upon the landscape (whether it be fire suppression or climate change), but argues for restraint when considering additional interventions (Friskics 2008). Accordingly, wilderness coordinators tending to uphold wildness do so via a hands-off approach (Landres, Brunson and Merigaliano 2001; Ridder 2007). Yet, as a critic of the naturalness versus wildness debate suggests, a distinct line between the two management goals remains unclear (Ridder 2007).

### *Qualities of wilderness character*

Though unresolved, the discussion has emphasized two qualities of wilderness character—the natural and untrammeled qualities. Interagency guidelines, however, recommend that wilderness coordinators look at a total of five qualities of wilderness character when considering management actions. Four of these qualities include (Landres, et al. 2008):

- Untrammeled— Wilderness is essentially unhindered and free from modern human control or manipulation;
- Natural— Wilderness ecological systems are substantially free from the effects of modern civilization;
- Undeveloped— Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation;
- Solitude or primitive and unconfined recreation— Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation

Recently, more attention has been drawn to the fifth quality of wilderness character; the “other features of value quality” (Barns 2013; Landres, Vagias, and Stutzman 2012), which emphasizes preservation of a suite of wilderness-specific values including “ecological, geological, or other features of scientific, educational, scenic, or historical value[s]” stated in the 1964 Wilderness Act. Barns is careful to draw a distinction between values and activities. For instance, educational activities in wilderness are not necessarily permitted by the Wilderness Act. Instead, the other features of value quality in the Wilderness Act protects the educational value of a wilderness.

Whereas the untrammeled and undeveloped qualities describe what wilderness *is not*; the natural, other features of value and the solitude and recreation qualities describe what wilderness *is*. Yet few in the scholarly literature have dwelled on how climate

change adaptation activities impact the other features of value, undeveloped, and solitude and recreation qualities. This discussion gap may be a result of conflation. As just alluded to above, the other features of value quality has been misinterpreted as protecting wilderness activities instead of wilderness values (Barns 2013). The other qualities may be conflated with the untrammeled quality.

Only recently has the dominant narrative about climate change in the U.S. shifted to consider the impacts upon people—in addition to the effects felt by non-human nature. That said, bear in mind the compounding obligations for the NPS to protect recreational opportunities in wilderness. The NPS Organic Act mandates the protection of these opportunities. The Wilderness Act requires that park units preserve particular qualities of those opportunities (solitary, primitive, unconfined). Despite these mandates, impacts to the solitude and recreation quality of wilderness character have been largely neglected within the discussion about appropriate wilderness stewardship responses to climate change.

This study sheds light upon whether other qualities are considered alongside the naturalness and untrammeled qualities as decision makers evaluate stewardship activities driven by climate change. It also clarifies whether scholarly assumptions about the natural and untrammeled qualities resonate with participant observations in the field.

The imprecise distinction between the untrammeled and naturalness goals is refracted in a wide pool of proposed stewardship guidelines. Suggestions include identifying some areas within wilderness to be actively managed for naturalness and other areas to be managed in a hands-off approach for wilderness (Aplet and Gallo 2012; Cole 2001). Other scholars offer guidelines for weighing the two approaches on a case-

by-case basis. This balance tends to lean on the assumption that the hands-off approach is the default approach to wilderness stewardship (e.g., Stephenson and Millar 2011-2012). This camp nods to the notion that meaningful active management is simply not feasible in many remote wildernesses (Higgs and Roush 2011; Stephenson and Millar 2011-2012). Proponents of the active approach encourage stewards to consider active management when the occasion warrants. Yet they also caution stewards that the active approach should only be used when the benefits of doing so would likely outweigh the costs (Graber 2003).

One of the biggest challenges in weighing the costs and benefits of wilderness stewardship activities is the wild card of climate change. Climate change necessitates aiming for a moving target as management outcomes become less predictable (Harris, et al. 2006). This challenge intensifies the concern for unforeseen and unintended consequences. The risk of inadvertent repercussions undergirds arguments brought forward by proponents of the hands-off approach to wilderness stewardship.

## HANDS-OFF APPROACH

Advocates for the hands-off approach to wilderness stewardship graft their arguments on the Howard Zahniser's definition of the word "untrammeled" (Landres 2010; Nickas 2004). As one of the primary visionaries behind the Wilderness Act, Zahniser intended the word "untrammeled" to be interpreted as "not being subjected to human controls and manipulations that hamper the free play of natural forces" (quoted in Scott 2004, p. 2). By invoking this term and carefully wording the Wilderness Act to recognize human impacts upon wilderness landscapes, Zahniser apparently sought to avoid excluding lands from wilderness designation that could not qualify as perfectly

pristine and absolutely free from human intervention (Friskics 2008; Scott 2004). This intention has been buttressed by subsequent Congressional designations that have interpreted the definition of wilderness to include historically manipulated lands of the eastern United States (Scott 2004). Through his careful wording, Zahniser created a definition for “designated wilderness” that is different than the cultural notion of pristine wilderness. This definition recognizes the very real effects of human activity upon the landscape. In doing so, the legal definition of wilderness undermines one of the more pertinent critiques of the traditional wilderness concept—that it enshrines a dualism between humans and nature. Beyond that, the “untrammelled” concept also solidifies the fundamental obligation for wilderness stewardship—to maintain the wilderness’s wild and unmanipulated qualities by carefully considering whether stewardship activities are warranted.

Besides finding backing in the legal definition within the Wilderness Act, advocates of the hands-off approach offer other justifications for their position. Among them is the argument that wilderness ought to remain a baseline of minimal management activity against which management actions, conducted outside of wilderness, can be assessed (Landres 2004; Landres 2010; Nickas 2004). This is sometimes referred to as the “observation approach” (Marris 2013; Aplet and Gallo 2012). As noted earlier, some classify the hands-off approach as the default approach—simply because active management is thought to be less feasible in many large, remote wildernesses (Higgs and Roush 2011; Stephenson and Millar 2011-2012). Beyond the default perspective, advocates of the hands-off approach take more value-laden stances. Some contend that the hands-off approach provides opportunities for people to acknowledge, with humility,

the limitations of human capacity to understand the full complexity of non-human nature (Landres 2004; Throop and Purdom 2006). Through humility people may be implored to feel remorse and learn to better evaluate actions in a way that minimizes inadvertent consequences (Sandler 2010). The hands-off approach thus encourages people to mindfully consider the existing relationship between themselves and nature before acting in potentially problematic ways. It also values restraint as a valid management approach (Nickas 2004; Throop and Purdom 2006). In doing so the hands-off approach celebrates nature's own capacity to adapt and evolve (Marris 2011*b*; 2013).

In several ways this study advances conversations regarding appropriate approaches to wilderness stewardship in an era of climate change. The study gathers information about the current extent of climate change adaptation activities happening in wilderness. It describes what topics are being monitored and managed, what management activities are being undertaken, and whether 4(c) uses have been permitted alongside them. It also clarifies how qualities of wilderness character are impacted by wilderness stewardship activities driven by climate change (Landres, et al. 2008; Landres, Vegas, Stutzman 2012). Through the first nationwide assessment of its kind, this study provides the fabric within which to sew arguments about appropriate approaches to both wilderness stewardship and climate change adaptation.

## KNOWN STEWARDSHIP RESPONSES

At present, NPS wilderness coordinators have used and/or permitted a variety of management actions within the boundaries of designated wilderness. Some of these actions include: removing species of introduced fish from high alpine lakes, reigniting historic fire regimes, and restoring a meadow in the Sequoia and Kings Canyon

Wilderness; reintroducing fish to the Olympic Wilderness; restoring vegetation and protecting archeological sites in the Bandelier Wilderness; removing invasive pigs and plants from the Hawaii Volcanoes Wilderness; and recontouring a road and power corridor in the Mojave Wilderness (Graber 2009). Other parks units are debating responses to climate change in wilderness as this paper is written; for instance, Isle Royale National Park is weighing whether to reintroduce wolves as their populations decrease due, in part, to climate change (Vucetich, Nelson, and Peterson 2012).

That said, climate change-driven stewardship activities occurring in NPS wilderness have only been tracked on an ad hoc basis. Although NPS wilderness coordinators are expected to complete a Minimum Requirement Analysis (MRA) to assess management actions taken in wilderness (NPS 2006a), there is no database collecting these assessments at the national level. As discussed earlier, databases tracking scientific research remain inadequate. The same is true for wilderness management activities. In the summer of 2012, staff in the NPS Wilderness Stewardship Division searched several of these databases for existing information regarding climate change activities in wilderness. This search included the Inventory and Monitoring Program's protocol and Vital Signs databases, the Facility Management Software System, and the Research Permit and Reporting System's Investigator Annual Reports. While information about climate change activities happening within the National Park System do exist, the data do not necessarily specify whether these activities were happening in or outside of designated wilderness. Thus, at this time, the extent and array of climate change-driven stewardship activities happening in NPS wilderness remains unknown.

By anchoring the discussion in a nationwide assessment of climate change responses in NPS wilderness, this study provides the first systematic account for how wilderness coordinators across the country weigh the costs and benefits of climate change-related activities as these activities affect wilderness character. As a consequence, NPS administrators will have the first comprehensive glimpse into how wilderness coordinators are evaluating stewardship proposals. The study also draws attention to dissonant decision-making frames and to other factors that may influence frame variations. These findings may enable the NPS Wilderness Stewardship Program to develop policy guidelines to realign the dominant frame or synchronize variations. Beyond that, the findings will be used to frame screens through which to filter appropriate climate change adaptation strategies.

## Chapter 2

### Methods

This descriptive baseline study documents actions within the National Park Service (NPS) as they express wilderness stewardship goals, approaches, and values. Carried out in partnership with the NPS Wilderness Stewardship Division and the Aldo Leopold Research Institute, the study aims to achieve the following objectives:

- Inform wilderness administrators about the range and degree of climate change concerns and stewardship activities happening in wilderness throughout the National Park System,
- Help administrators get a sense for how wilderness use is shifting due to climate change and how management is responding in the field,
- Clarify how wilderness character is interpreted when decisions are made to conduct climate change activities in NPS wilderness,
- Situate empirical data within the larger debate regarding the ethics of acting on climate change in wilderness, and
- Use the lens of wilderness to examine appropriate climate change adaptation strategies—thereby maturing the climate change narrative.

### Question Development

Following Dillman’s advice (2007, p. 32) for writing good questions, this study aims “to develop a query that every respondent will interpret in the same way, be able to respond to accurately, and be willing to answer.” This is a difficult task, especially given the complex and abstract objects of study (climate change and wilderness). The fundamental goal was to ensure that questions did not lead participants to think that I preferred more, less, or particular climate change activities in wilderness. Yet I was also challenged to accommodate a wide range in responses and to anticipate imperfect knowledge on the part of the researchers.

Because this baseline study covers a subject that has never been assessed by a survey, I decided to cast my net wide and develop a sense for the variety of climate change activities happening in a diverse array of park units. This sacrifice of greater depth is significant given the various regions, topography and climates within which the participants had contextualized their responses. Park units are also of different sizes, managed for different purposes, and by people with different philosophies. To facilitate recall, demonstrate examples, and get the most information out of this national survey of diverse park units, I opted to provide prompts in some of the survey questions. These prompts arose from a literature review conducted during the summer of 2012. I searched peer-reviewed journals for climate change case study activities currently happening in designated wilderness (administered by the NPS and other federal agencies). I also searched for articles recommending different approaches to managing and monitoring climate change in wilderness. Many of these articles provided examples of actions that have happened or scenarios that could happen given different approaches.

I developed a list of 17 topics that may be monitored or managed in wilderness due to climate change. From this literature review I also generated a list of 16 management actions that may be carried out to address climate change impacts in wilderness. Respondents were asked to rank their top 5 climate change-related concerns from among this list of 17 topics. Ensuing questions asked respondents whether these topics were being monitored or managed for the expressed purpose of addressing climate change. Survey questions also asked which of the 16 management actions were conducted in wilderness to address the effects of climate change. Because individual participants had varying levels and areas of experience, I hoped that prompting would

encourage more involved thought processes and would subsequently lead to more comprehensive answers. Even still, I wanted to enable participants to write-in responses that I could not foresee. Questions featuring prompts therefore also offered “write in” boxes to capture “other,” unanticipated responses, that had not been generated by the literature review (See Appendix 1 for survey questions).

Qualitative questions asked respondents about how climate change was influencing wilderness visitor use and how climate change-related stewardship activities were affecting wilderness character. The open-ended nature of these questions was intended to capture emergent findings. However, in the wilderness character questions, I opted to prompt responses by including a list of the five qualities of wilderness character as identified in the Wilderness Act. In doing so I endeavored to understand which qualities of wilderness character caught the attention of respondents while also allowing respondents to describe other factors they saw affecting wilderness character.

Even with these prompts and accommodations, it remains possible that some survey respondents were unaware of the full range of climate change activities happening in their park unit’s wilderness. Some respondents may have also assumed that certain activities were driven by climate change when in fact they were not, and vice versa. It is prudent to recognize the difficulty in linking impacts at the local scale with something as complex and global in scope as climate change. However, the difficulty in drawing these links does not preclude their existence. Bearing this in mind, the data should be considered a broad but imperfect sweep of information intended to reveal a “general sense” for how climate change is being responded to in NPS wilderness on a system-wide basis.

## Participant Recruitment

Throughout this study the term *participant* or *respondent* interchangeably refer to those who submitted surveys. To identify potential respondents, permission was first secured from each NPS regional director. See Appendix 2.1 for emails sent to regional directors. With the help of the NPS Wilderness Stewardship Division, I contacted the superintendent at each of the 49 park units that administer a designated wilderness was contacted (as of December 2012). In some cases I got in touch with the acting superintendent if the superintendent position was unfilled. These administrators provided the name and contact information for individuals who could (1) speak to their unit's climate change and wilderness issues and (2) represent their unit in this study (See Appendix 2.2 for emails sent to superintendents). Accordingly each park unit responded to this inquiry with the name of at least one individual who might participate in the study.

In a methodological sequence designed to maximize response rates, I contacted potential participants up to five times (Dillman 2007). Potential participants were first greeted with a personalized notice explaining that they would soon receive an email survey about climate change and wilderness. See Appendix 2.3 for emails sent to potential participants. The notice indicated that the NPS regional director had approved the study and that NPS park superintendents had selected the pre-notice recipient as someone who could best speak to these queries. A few days later contacts received an email containing a link to the survey. This message reminded recipients about the study's purpose and gave them the names and phone numbers of individuals to contact in case they had questions about the survey or about wilderness stewardship in general. Ten days later, those who had not yet responded were sent a reminder. This email reminded

recipients that the survey was voluntary but also encouraged them to follow-through. Twenty days after that, a few remaining non-respondents received a second follow-up. This email indicated that many other participants had already responded and that the survey's administrator hoped to receive the recipient's input soon. This email was more highly personalized—including two references to the participant's park unit. A few days later the last few non-respondents received their final contact by phone—a call that encouraged their participation and enabled them to ask questions.

Ultimately this recruitment process proved highly successful. Representatives from 46 of the 49 units returned at least a partially completed survey—for a response rate of 94%. The respondents constituted a knowledgeable group, having been identified by the park unit superintendent. At the time of the survey, respondents had spent an average of 9.4 years working in their park unit. They had also accumulated an average of 11.4 years of experience working in wilderness stewardship. Respondents held a variety of positions. Many were chiefs of resources management or chief rangers. Biologists and geologists also responded. Some superintendents filled out the survey themselves. About one-half (48%) of the 46 respondents, indicated that they served as the wilderness coordinator for their park unit. Their different backgrounds, training, and areas of expertise likely affected how questions were interpreted and how participants responded. Location also likely impacted their responses. All of the NPS Regions that administer designated wilderness were represented in this study—Alaska (n = 6), Northeast (n = 2), Pacific West (n = 16), Intermountain (n = 11), Southeast (n = 4), Midwest (n = 6).

The interpretive nature of this study is demonstrated by a few cases when single park unit returned multiple surveys. Such circumstances required me to make some

judgments for the sake of consistency. In one case I received two surveys from two different respondents within one park unit. I decided to retain the survey that had come from the respondent identified by the superintendent. In another case a superintendent had given us the name of three respondents. When recruiting one survey participant from among these contacts, the recruitment email had asked the group to either elect a single participant to complete a single survey or to work together to complete a single survey for the park unit. Despite these instructions, two contacts each completed surveys for one park unit. I followed up with these two respondents by email and reminded them that I could only analyze one survey per park unit. One of these two respondents recommended that I use the other's survey. In two other circumstances I initially received a partially completed survey and later a fully completed survey; I retained the fully completed versions. Thus in the end, I analyzed one survey from each of the 46 responding park units. However, the multiple responses gave us the opportunity to consider the variation among different respondents from a single park unit. Although there was overlap among responses, there were also discrepancies. Factors contributing to these discrepancies likely included the respondents' individual areas of expertise and interpretation of how and whether to attribute certain concerns, activities, and uses to climate change. These limiting factors should be considered when interpreting the following results.

## **Analyses**

### QUANTITATIVE ANALYSES

Quantitative responses were exported from the online survey mechanism Survey Gizmo (see [www.surveygizmo.com](http://www.surveygizmo.com)) into a file compatible with the data management software program, *Statistical Package for the Social Sciences* (SPSS). SPSS and

*Microsoft Excel* enabled the quantitative analysis that follows. These data help us understand the level and range of NPS response to climate change in wilderness. To roughly measure the level of stewardship responses, four measures were used: the number of climate change-driven monitoring projects, management projects, and management actions, as well as the number of management actions employing a 4(c) use that is constrained by the Wilderness Act. In the context of this study, the term *project* describes a stewardship activity happening in wilderness that may consist of several different actions or components coordinated to achieve a set of objectives. The term *project* is also intended to capture the number of decision-points that have been made to approve climate change adaptation activities in wilderness. *Monitoring projects* identified in this study have been driven by the intention to observe and track climate change and its effects within wilderness boundaries. *Management projects* intervene to modify or guide the effects of climate change in wilderness. *Management actions* are the more discrete components of a management project; a management project may be made up of many types of management actions. Asking respondents about the types of management actions happening in wilderness was intended to develop a better understanding for how management projects are carried out. I generated a layer of detail about the impact of management actions by asking whether uses constrained by the Wilderness Act had been approved in the process. I refer to these constrained uses (motorized vehicles and equipment, roads, commercial enterprise, mechanical transport, structures and installations) as *4(c) uses*. Monitoring and management project, management actions, and 4(c) uses are referred to collectively as *stewardship activities* or *climate change adaptation activities*.

These measures have their limitations. For instance, two park units could indicate that they are monitoring endangered species. One park unit could be monitoring pikas through volunteer field surveys, whereas another could be monitoring pikas and frogs in a similar manner, but also bighorn with helicopter surveys, and trout by electro-fishing in high alpine streams. A qualitative follow-up study would help clarify these differences. However, this baseline survey data gives us a preliminary sense for the range of topics being tracked and addressed in wilderness due to climate change as well as the range of management actions being used to achieve these goals.

### ***Analysis of Monitoring***

Park units monitor in wilderness for a variety of purposes unrelated to climate change. Many of these projects can be used to track climate change and its effects. For instance, the NPS Inventory and Monitoring Program (I&M) gathers data (called Vital Signs) about a wide range of natural resources to provide references. These references are used in comparison with more altered environments. They also enable administrators to incorporate science into “planning, management, and decision making” and share information with their partners (NPS 2013b: 1). Although Vital Signs can be used to indicate climate change and its effects, this monitoring program is not necessarily driven by the intention to do so. To get a better sense for how climate change justifies additional monitoring in wilderness, I asked respondents to let me know the number of monitoring projects that have been carried out for the “expressed purpose of tracking climate change and its effects” (See Appendix 1 for question phrasing). Several respondents understandably reported that the numbers they provided did not include additional monitoring projects that were related to climate change but not driven by it. The study’s

focus on projects driven by climate change helps concentrate attention upon the additional monitoring projects that have been justified by the need or desire to address climate change and its effects.

### *Analysis of Management Projects and Actions*

Some management actions, such as thinning vegetation or reintroducing extirpated species, have been used as hypothetical examples in the discussion on appropriate wilderness stewardship approaches. This study documents which actions are actually occurring in NPS wilderness. At this level of greater detail, I asked respondents whether 4(c) uses had been approved in order to carry out each type of management action. Drawing on a combination of monitoring and management projects, management actions and 4(c) uses, the analysis depicts rough measures of the level of stewardship response to climate change.

Given the broad scope of this baseline study, these measures admittedly provide only a rough sketch of this response. These data do not indicate the extent of wilderness area affected, the duration of response, its frequency, nor the overall degree of intervention. For instance, two park units may report approving a 4(c) use to remove invasive species. One park unit may have permitted the one-time use of a wheel barrow to help volunteers remove invasive plant material that had been weeded by hand. Another park unit may have approved regular aerial spraying of pesticides from a low-flying aircraft. These hypothetical examples demonstrate extreme ends of the possible 4(c) use spectrum. However, a qualitative follow-up study would help define these ends and clarify where along the spectrum lies the majority of park unit stewardship activities. However, as the first of its kind, this system-wide baseline study gives NPS

administrators the broad sweep of information necessary to determine whether current level of response warrants more qualitative follow-up studies or additional policy guidance.

## QUALITATIVE ANALYSES

Qualitative questions included in this study were analyzed through content analysis, which involved open-coding a large portion of the textual survey responses. Through this process, several overarching themes emerged that I classified into consistent concepts (Hesse-Biber and Leavy 2011). I incorporated the strongest of these themes and concepts, as well as notable outliers, into the discussion below.

Some of the qualitative findings considered below emerged from unsolicited commentary. A few open-ended questions asked participants to provide examples of other monitoring or management projects that their park unit is carrying out in regards to climate change. Despite the instructions, several respondents used these questions to discuss how climate change could impact wilderness stewardship more generally. I opted to welcome these insights and analyzed them accordingly. However, there are limitations for how these emergent findings can be used. Because these comments and subsequent themes were diversions from the question asked, the frequency with which these themes emerged may not fully represent the breadth of these sentiments among participants. As such these comments were analyzed as notable outliers.

Open-ended qualitative questions were undoubtedly influenced by prompting written into in the survey questions. Questions about wilderness character, for example, included a parenthetical list of the five qualities of wilderness character. Responses by-and-large referenced these provided qualities. Although prompting may have encouraged

respondents to use these terms, many respondents, particularly wilderness coordinators, were likely already familiar with the concept of wilderness character. Nevertheless, some responses did contain emergent themes. These themes may have been significant given that they expanded beyond and persisted in spite of the provided prompts and recommended Minimum Requirement Analysis (MRA) decision-making frameworks.

Despite efforts to carefully word questions to avoid biases, there is also the potential for participants to perceive bias in a survey. Because the debate between the active and the hands-off approach is ongoing, this potential may have been quite salient. The only evidence that respondents may have perceived a bias in our survey surfaced in the question about impacts to wilderness character. When describing instances where wilderness character had been degraded several participants qualified their answers as minor or temporary. This may have been a response to the term “degraded” which carries a negative connotation. The qualified responses may have been a frame to reassure me that they had considered wilderness character and were making efforts to reduce their impacts to it. However they may also simply reflect legal obligations to minimize impacts to wilderness character.

Despite the limitations recognized here, these methods do succeed in sketching out the current landscape of stewardship responses to climate change in wilderness. As such this research aims to clarify what stewardship activities are happening in NPS wilderness, shed light on how these activities impact wilderness character, and examine climate change adaptation through the lens of wilderness stewardship. Though more qualitative follow-up studies may add color and depth to the scene presented here, these sketches offer a baseline.



## Chapter 3

### Concerns about climate change

Concerns about climate change come in many degrees. The top concern in one park unit may be more or less acute than the top concern expressed by a respondent from another park unit. Even still, an assessment of climate change-driven concern across NPS wilderness can help us understand what issues are most on the minds of park scientists and stewards as they grapple with whether and how to adapt to climate change. To do so I developed a list of 17 topics that may concern decision-makers as they weigh options to respond to climate change in wilderness. Respondents were asked to indicate which topics were among their top 5 concerns as they deal with climate change and its effects in their park unit's wilderness. Two measures were used to assess the range of concerns that respondents had—one is the intensity of concern by topic and another measures the commonness of the concern across NPS wilderness.

## Results

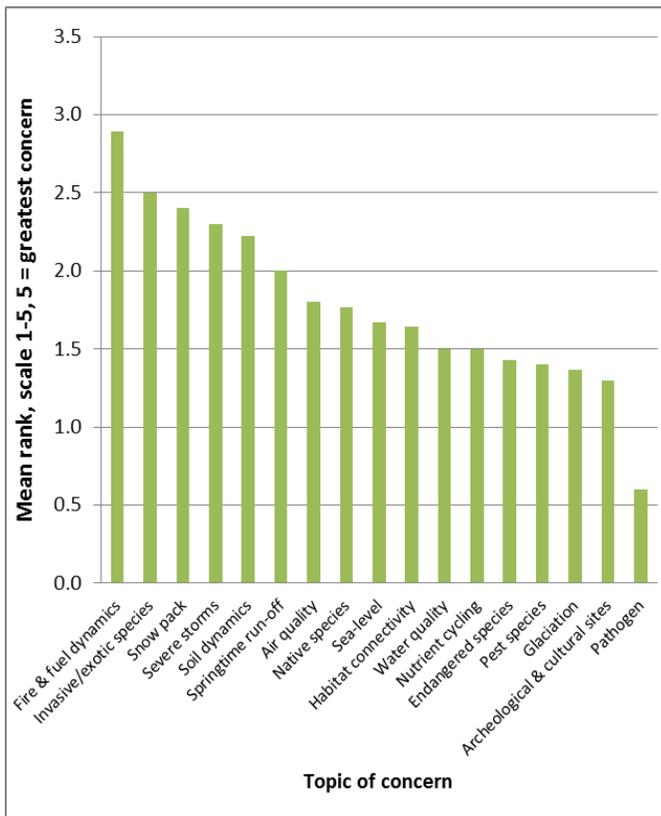
### INTENSITY OF CONCERN

Few park units may deal with a topic, like air quality, but those that do consistently may rank it among their top 1, 2, or 3 concerns. This topic would thus receive a higher intensity score, despite being less common overall. Another topic, like endangered species, may be more commonly included among the top 5 list of climate change-driven concerns, however, it may also be consistently ranked as a 4<sup>th</sup> or 5<sup>th</sup> top concern. Thus this topic would receive a lower intensity score, despite being more

common. To produce this measure of intensity, I calculated the mean rank for each concern. The means enabled me to see which topics were consistently ranked among the top 1 or 2 concerns and which were more consistently ranked as a 4<sup>th</sup> or 5<sup>th</sup> concern. I then inverted this calculation so that the greater intensity score would correlate to a consistent 1<sup>st</sup> or 2<sup>nd</sup> top concern ranking, as reported in Chart 1.

Respondents consistently rated fire and fuel dynamics as one of their most pressing climate change-driven concerns in their wildernesses. This climate change-driven

**Chart 1: Level of concern respondents had for topics in their park unit's wilderness that are impacted by climate change and its effects, n= 46**



concern for fire is layered upon the legacy of fire suppression and the fire management challenges that resulted. Along with risks that fire poses to the wilderness itself, decision makers must also consider the potential risks for people and property within the wilderness and its environs (Cole and Landres 1996).

Invasive and exotic species followed as the second most pressing concern in NPS

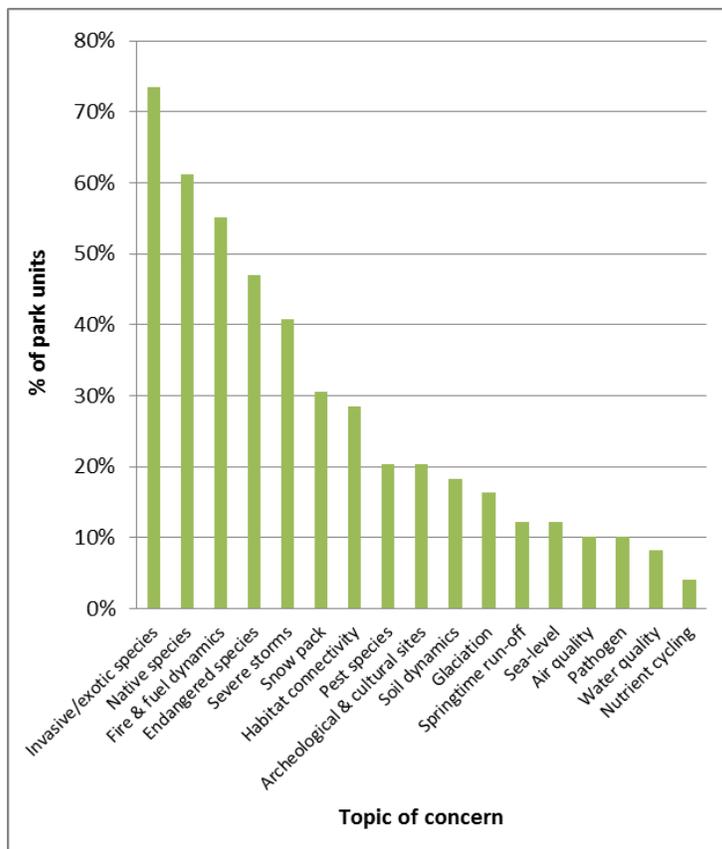
wilderness due to climate change. This attention echoes the writing of Frelich and Reich who assemble arguments in favor of climate change adaptation in wilderness around their

concerns about invasive species (2009). A few other highly ranked topics, like snow pack and springtime runoff, relate to water movement and resources.

**COMMONNESS OF CONCERN ACROSS NPS WILDERNESS**

To get a better sense for how widespread these concerns are among reporting park units, I developed a measure to assess the relative prevalence (or commonness) of the concern across the NPS wilderness system. To do so, I gave the top five ranked concerns the same weight. For example, a #1 concern received the same weight as a 5<sup>th</sup> most pressing concern. As a result the study could convey the prevalence with which each

**Chart 2: Frequency with which a topic was ranked among the top five concerns that respondents had for climate change impacts to their wilderness, n = 46.**



concern included among the top five. When compared with the mean rank, this measure helps me tease out which topics may be of disproportionate concern to a small number of park units. It also provides a fuller picture for which concerns are more common throughout the country. All items on the survey were ranked by at least a few participants as is shown in Chart 2.

Several species-related topics (invasive/exotic species, native species, and endangered species) were among the four most common concerns respondents had about climate change in NPS wilderness. Concern about invasive and exotic species was the most common overall with 36 of the 46 park units (73.5%) including it among their top concerns. Fire and fuel dynamics was the third most common with just over half, 27 of the 46 respondents, ranking it.

### ***Additional concerns***

More than a third, 18 of the 46 survey respondents, listed other topics they were concerned about with regards to climate change in wilderness. Thirteen respondents wrote in concerns for water resources and movement. Water resources included watersheds, wetlands, ponds, fisheries, and ephemeral playa. Respondents discussed water movement in terms of flow, timing, levels, and persistence. Seven park units brought up concerns for ecological communities like wetlands, “coastal plant communities,” and “old growth bottomland forest ecosystems.” Four mentioned erosion. Three discussed visitor use—both in terms of visitor impacts on the landscape and visitor experience from the landscape. Two respondents were concerned about installations such as oil and gas development happening within the wilderness viewsheds as well as the likelihood of “wilderness area... conver[sion] to reservoirs.” Changes in permafrost were also discussed by two respondents, one stating that it was among the park unit’s top two concerns. Individuals also brought up a variety of other matters. These included the melting of cave ice, impacts to fossils and paleontological resources, and changes to micro-climates. One respondent declared that species listed in their enabling legislation would be extirpated due to climate change.

## INTERPRETING CONCERNS

Several respondents took it upon themselves to explain why they ranked topics the way they did. These justifications appeared in open-ended questions asking respondents to list additional concerns. A couple of respondents weighed the concern's potential as an ecosystem driver (specifically with severe storms and sea level). A couple more considered how topics, such as snow pack and spring runoff, would impact the surrounding communities. One seemed concerned that climate change would spur development within the wilderness: “[s]ocioeconomic demand for water in the thirsty California Central Valley will cause many wilderness areas to be converted to reservoirs.” Another respondent brought up the stewardship challenge of addressing the inevitable extirpation or extinction of a native species that had been named in enabling legislation. Factors contributing to respondent concerns were quite varied.

## Discussion

Although some topics were a more common concern throughout the NPS wilderness system (such as native species and endangered species), these topics were not necessarily ranked consistently among the top 1 or 2 concerns. Although common, these concerns were relatively less intense. Several species-related topics (native and endangered species, for instance) fell into this category. Their relative commonness undoubtedly reflects a tendency for respondents to link these topics with climate change. However their commonness may also reflect that these topics are less context-dependent upon specific ecological or climatic regions. For example, because native species are found in all wildernesses, this topic would have a greater likelihood of being a top concern than say, glaciation, which directly affects fewer wildernesses. Obligations

mandated by legislation or policy could have also influenced concern rankings. For instance, the Endangered Species Act may have resulted in endangered species being a commonly listed concern although it did not consistently receive the highest intensity rankings.

Conversely a few topics that had high intensity rankings were not very prevalent throughout the NPS wilderness system. Such topics—like snow pack, spring runoff, and air quality—may impact fewer park units but may do so to a greater degree. Several topics directly related to water resources and movement (snow pack, severe storms, and springtime runoff) also received relatively higher rankings. Correspondingly, water-related topics arose in a majority of the concerns added by respondents. As an ecosystem driver, climate change induced shifts to water resources and movement have the potential provoke cascading consequences throughout wilderness.

## Chapter 4

### Monitoring and management topics

Using the same list of topics that had been ranked in terms of concern, respondents were asked place a checkmark next to the topics, from the list of 17, that their park unit monitored and managed “for the expressed purpose of addressing climate change and its effects” in wilderness (see questions in Appendix 1). These questions gave us a sense for which concerns most saliently instigated stewardship responses.

### Results

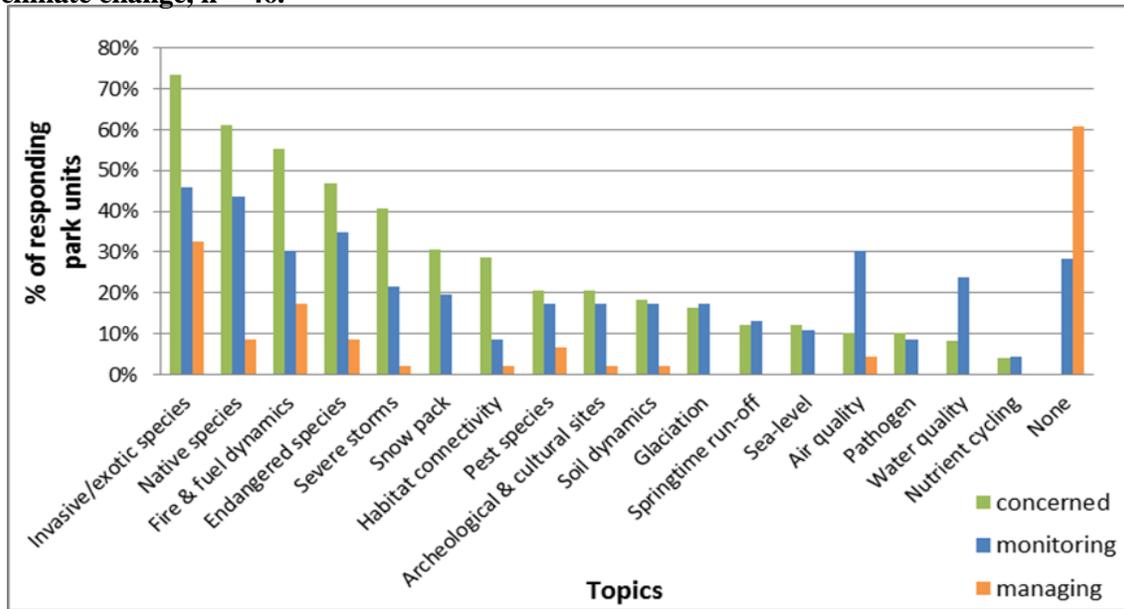
#### TOPICS OF CONCERN, MONITORED AND MANAGED

Invasive and exotic species was the topic of most common concern, most commonly monitored, and most commonly managed in wilderness due to climate change. Although invasive and exotic species held the most attention overall, a mixture of three other topics—native species, endangered species, and fire and fuel dynamics—immediately and consistently followed as common concerns, and commonly monitored and managed topics in wilderness due to climate change. As depicted in Chart 3, more common concerns tended also to be frequently monitored and managed in wilderness due to climate change. However there were notable exceptions.

The relationship between concern and response can be influenced by other factors, such as priorities defined by legislation or policy. For instance, air and water quality monitoring were fairly common despite the fact that relatively few park units reported being concerned about them in a climate change context. This likely reflects

efforts to comply with monitoring requirements set by the Clean Air Act and the Clean Water Act. Other topics generated a high frequency of concern, a high level of monitoring, but little or no management response. These included snow pack, severe storms, and glaciation.

**Chart 3: Topics of concern, monitored, and managed in NPS wilderness in response to climate change, n = 46.**



#### ADDITIONAL TOPICS MONITORED AND MANAGED

More than half of the 46 respondents to this survey added other topics, beyond the provided list of 17, which they were monitoring to track climate change and its effects in wilderness. Seven respondents added water resources and movement to the list of monitored topics. Seven more spoke about monitoring climate and weather. Four park units reported monitoring ecological communities such as “lake communities,” “subalpine/alpine plant communities,” and “sandspit communities.” Climate change refugia received monitoring attention from two park units. Beyond that, individual park

units spread their attention more broadly. Single respondents reported that their park units monitored micro-climates, visitor use, permafrost, structures, shoreline profiles, paleontological sites, and cave ice to track climate change and its effects in wilderness.

About 13 of the 46 survey participants responded to the question asking them to list additional topics that were managed in wilderness due to climate change. Four respondents used this question as an opportunity to clarify answers that they had checked in the list of 17 provided topics. For instance, one specified invasive/exotic species as “invasive plants,” another as “invasive ungulates.” Another four expressed that their park unit had carried out management projects, but not “specifically because of climate change.” Despite these departures from the question asked, some respondents did add to the list of topics managed in wilderness in response to climate change. A couple of respondents reported removing structures like culverts, canals, and dams. Two others described addressing the effects of climate change on ecological communities. Individual respondents reported that they were also managing water resources and paleontological resources in response to climate change. A final respondent reported that their park unit was considering potential climate change responses during their planning process.

## **Discussion**

### PERSPECTIVES ON INVASIVES AND EXOTICS

Invasives and exotics capture the attention of survey respondents and scholars alike when it comes to climate change adaptation in wilderness. Those on either side of the wilderness stewardship debate have marshaled their arguments around whether or not to accept invasive and exotic species. For proponents of active management, native species stressed by climate change will be subject to increasing competition from

traditionally invasive and exotic species (Frelich and Reich 2009). There is also the concern about competition from species migrating into new and former geographic ranges along with shifts in climatic envelopes. These invasive and migrating species can result in the re-assembly of ecological communities into what is now termed “novel ecosystems” (Hobbs, et al. 2006, p.1). Marris (2011b; 2013), who has advocated for the observation approach to wilderness stewardship, argues that we ought to accept invasive and exotic species brought in and enabled by climate change as “the new wild.”

At this time, the prospect of embracing invasive and exotic species is not a widely shared reaction to climate change. Indeed this perspective has even drawn ire (Wuerthner 2012). As the data reflect, invasives and exotics dominate the attention of wilderness stewardship as it wrestles with climate change. Yet Marris’ provocative questions have caught the eye of park managers and ecologists. She was recently the keynote speaker alongside Michael Soulé at the George Wright Society Conference, a meeting that bills itself as the “U.S.A.’s premier interdisciplinary conference on protected areas” (George Wright Society 2013). Marris asks ecologists and land managers to accept that nature is dynamic and to celebrate nature’s ability to adapt to and evolve through these changes (2013). She points out that some studies of invasive-dominant ecosystems actually find greater levels of biodiversity and production. As this view receives a wider audience, perhaps perspectives of and attention to invasive/exotic species will shift alongside approaches to wilderness stewardship.

## SCALE AND RESPONSE

Although in this study invasive and exotic species held the most attention overall, a mixture of three other topics—native species, endangered species, and fire and fuel dynamics—immediately and consistently followed as common concerns, topics monitored and topics managed in wilderness due to climate change. The ability for wilderness coordinators and/or scientists to address these concerns at the local scale may also increase their tendency to be addressed. Species can be managed and moved. Fire can be prescribed and put out. These actions can happen at the local level and directly affect outcomes at the local level. Actions to mitigate de-glaciation and sea level rise (through carbon sequestration or mitigation activities, for instance) involves more oblique and less certain outcomes at a local scale—and thus such actions may be less likely.

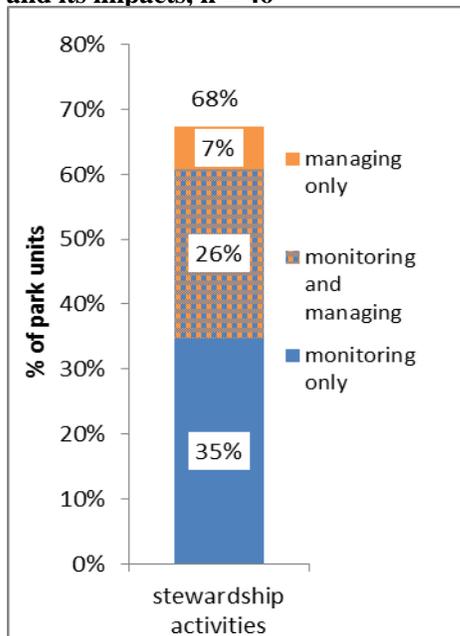


## Chapter 5

### Amount and type of stewardship activities

In the debate between different approaches to wilderness stewardship, contributors have nested their arguments in the assumption that the hands-off approach has been, is, and will likely remain the default approach (e.g., Higgs and Roush 2011). This default is deemed a simple matter of feasibility—effective responses to climate change are considered impractical in large, remote wildernesses due to scale and access difficulties. If this assumption is made, then the existence of climate change adaptation activities in wilderness reflects intentional and atypical choices by administrators to choose a response outside of the normative hands-off approach. Yet as we will see, this choice may be less normative than has been supposed.

**Chart 4: Percent of park units monitoring and managing in wilderness to address climate change and its impacts, n = 46**



## Results

### NUMBER OF PROJECTS

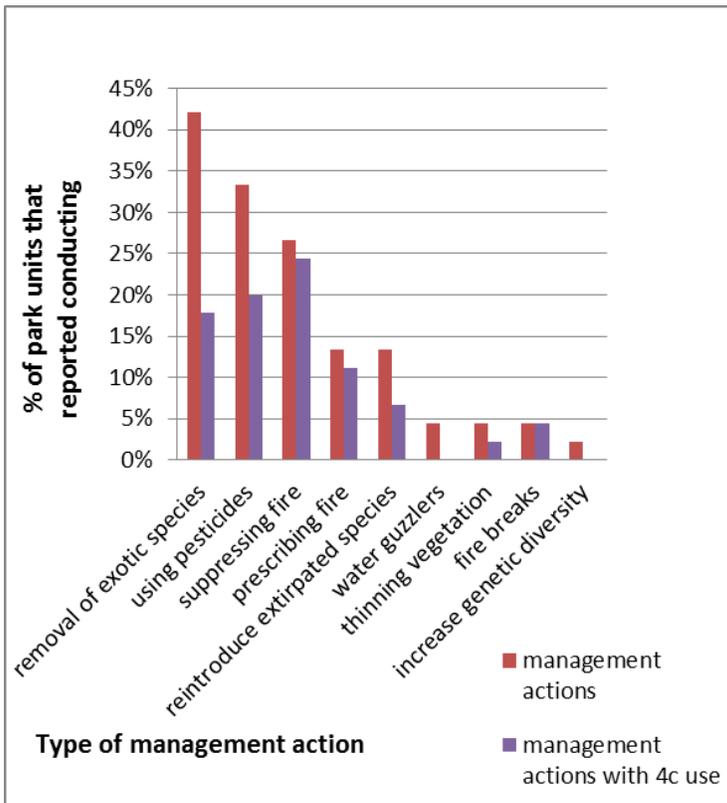
As demonstrated in Chart 4, the findings reveal that a large percentage of park units have made the choice to actively address climate change in their wildernesses. Of the 46 responding park units, 16 reported carrying out only monitoring projects, 12 had carried out both monitoring and management projects, and 3 had just carried out management projects for the expressed purpose of

addressing climate change and its effects in designated wilderness. Overall 31 park units, or 68% of the respondents, had conducted stewardship projects in wilderness in response to climate change. This amounted to a total of 120 monitoring and 27 management projects happening in wilderness due to climate change.

## NUMBER AND TYPE OF MANAGEMENT ACTIONS

To generate an additional layer of detail about the types of stewardship activities happening in wilderness, respondents were asked to indicate which, from a list of 16, management actions they were carrying out in designated wilderness as they addressed climate change. Climate change-driven management actions were ongoing in 25 of 45

**Chart 5: 4(c) use approval rates for management actions happening in NPS wilderness to address the effects of climate change in wilderness, n = 45**

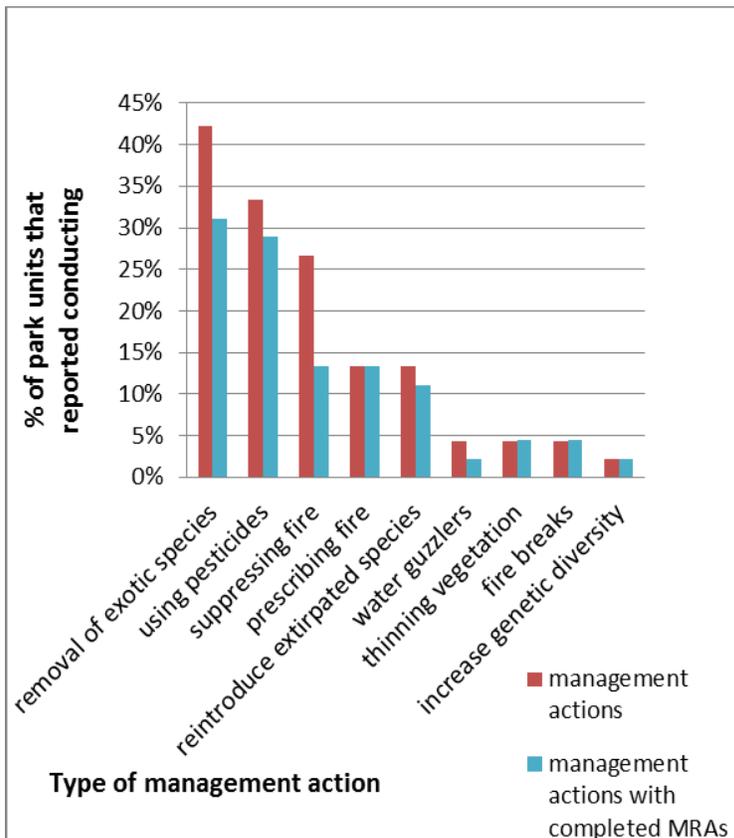


park units responding to this question. Nine of the 16 listed management actions were reported. Actions that were *not* reportedly being carried out in wilderness to address climate change included feeding wildlife, fertilizing vegetation, introducing new species, mitigating nutrients and pH, and thinning trees. Of those that *were* reported to have been carried out in

wilderness, actions that removed undesired species or had to do with fire were among the most common, as illustrated in Chart 5.

The survey also asked respondents whether they had permitted a 4(c) use (motor vehicle, motorized equipment, mechanical transport, structures or installations) to carry out each type of management action. About half of the activities removing undesired species (through a mix of mechanical, manual, and chemical means) had allowed a 4(c) use in the process. Management actions with regards to fire (suppressing and prescribing) were also common. According to NPS policy, “actions taken to suppress wildfires must use the minimum requirements concept unless the on-site decision-maker determines in

**Chart 6: MRA completion rates for management actions happening in NPS wilderness to address the effects of climate change in wilderness, n = 45**



his professional judgment that conditions dictate otherwise”

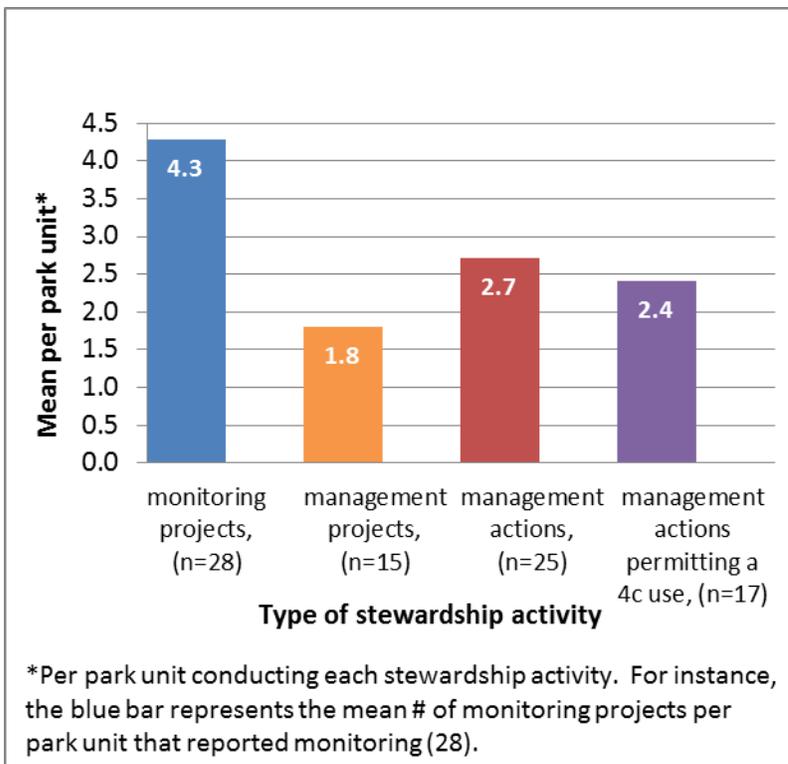
(NPS 2006b). Yet fire-related management actions almost always permitted 4(c) uses (93%). This was in contrast to the overall level of 4(c) use approval for management actions at 60%.

I was also curious about the prevalence of Minimum Requirement Analysis (MRA) completion and how it broke down

according to the list of management actions. Overall, 77% of the reported wilderness management actions designed to address climate change had completed an MRA. As illustrated in Chart 6, fire suppression had the lowest completion rate at 50%. This was in contrast to other fire activities, such as prescribing fire and creating fire breaks, which had 100% completion rates. The most common management actions fell somewhere in between these two extremes.

Given the level of stewardship activity happening in wilderness, I grew curious about the potential for a slippery slope when it came to the active approach to wilderness stewardship—would park units that had approved stewardship activities have approved multiple activities? To get a better sense for whether or not this was the case, I took a

**Chart 7: Mean number of NPS wilderness stewardship activities happening per park unit\* to address the effects of climate change**



closer look at the park units that had permitted each of the four stewardship activities tracked in the survey: monitoring projects, management projects, management activities, and management activities permitting 4(c) uses. For those park units that had approved a monitoring project, I

found the mean number of monitoring projects that they had approved. I did this for all the other stewardship activities as well. As is illustrated by Chart 7, if park units had approved stewardship activities to address climate change in wilderness, they had likely approved multiple activities—particularly when it came to monitoring projects.

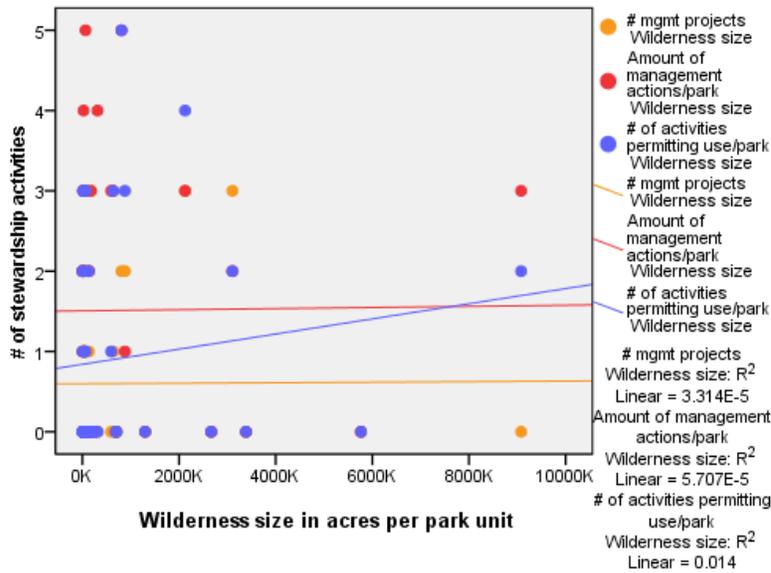
## CONSERVATIVE FINDINGS

The number of monitoring projects, management projects, and management actions are limited to those ongoing activities that have been driven by efforts to address climate change and its effects. Several participants pointed out that their park unit had carried out additional projects that were not reported in their survey responses. These projects went unreported because they had been *related* to climate change but not *driven* by it. A few participants also remarked that they had “just started really looking at climate change impacts to wilderness.” Others stated their intent to ramp up efforts; for instance, one said: “We will soon begin strategies to identify resources at risk, determine their vulnerability to climate change, and begin to develop possible strategies to respond to changing climate. At the very least, our park needs to be monitoring changes from climate change....” Two noted that these efforts were most limited by capacity: “...little can be done without more money and staff.” Given (1) the considerable percentage of park units carrying out active stewardship activities, (2) the fact that these activities represent only a portion of all stewardship responses to climate change in wilderness, and (3) the interest in escalating responses, it seems that few park units strictly adhere to the hands-off approach when addressing climate change in wilderness.

## STEWARDSHIP LEVELS AND WILDERNESS SIZE

The wilderness stewardship debate frames the hands-off approach climate change adaptation as the default approach. This is due to the premise that stewardship responses to climate change are considered less feasible (and thus less likely) in large, remote wildernesses. Indeed NPS wilderness represented in this study ranges from the 1,380 acre one at Fire Island National Seashore just outside New York City to the 9,078,675 acre wilderness in Alaska’s Wrangell-St. Elias National Park and Monument—a park unit the size of Switzerland. Given this diversity and attendant assumptions about the feasibility of adaptation activities, I sought to define how wilderness size (in acres) influenced the number of stewardship activities underway. Climate change-driven monitoring projects, management projects, management activities, and management activities permitting 4(c) uses were used to measure the number of decision-points that permitted climate change adaptation activities. By pitting wilderness size against the number of adaptation activities, the study aimed to clarify whether there were less stewardship responses to climate change in larger wildernesses. In doing so this research sought to verify whether this premise could support a default approach wilderness stewardship in large wildernesses—be it hands-off or otherwise.

**Chart 8: Wilderness size and the number of stewardship activities per park unit to address climate change in wilderness**



**Management projects (n = 46), management actions (n = 28), management activities permitting 4(c) uses (n = 17).**

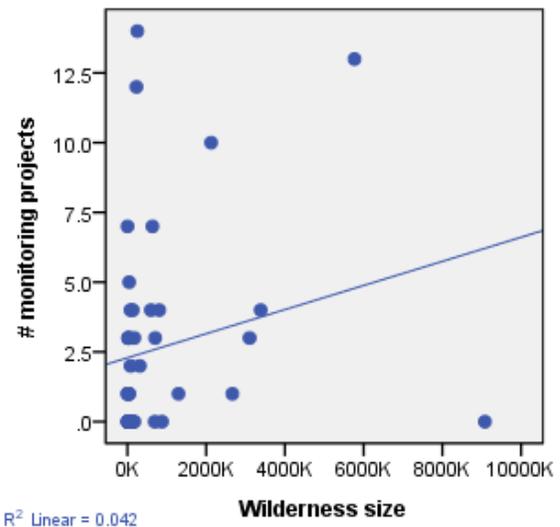
Despite the diversity of wilderness sizes and assumptions in the scholarly literature, wilderness size showed little relationship to the amount stewardship activities happening in wilderness. As shown in Chart 8, there were null

relationships ( $r^2 < 0.014$ ) between wilderness size and the number of management projects and actions. There was a meager positive correlation between wilderness size and 4(c) uses ( $r^2 = 0.014$ ); this relationship hardly warrants characterization above null.

Monitoring, shown in Chart 9, presented only slightly stronger correlations to wilderness size, however these results must also be characterized as very weak. (Knowing the

wilderness size could, with only a 4% accuracy rate, predict the number of monitoring projects.) The null and feeble correlations lead me to think that factors—perhaps funding, staff, management philosophies, geography, for instance—play stronger roles than wilderness size in determining the number of decisions made to

**Chart 9: Wilderness size and the number of monitoring projects per park unit to track climate change and its effects in wilderness, n = 46**

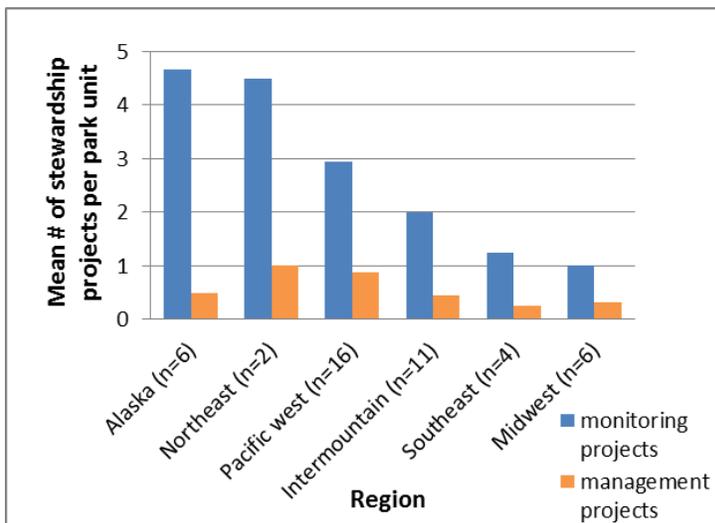


carry out climate change adaptation activities in NPS wilderness.

## WILDERNESS STEWARDSHIP LEVELS BY NPS REGION

The study also examined how the number of monitoring and management projects played out across NPS Regions as is shown in Chart 10. Overall the Alaska, Northeast, and

**Chart 10: Mean number of wilderness stewardship activities happening per park unit in each NPS Region designed to address the effects of climate change**



Pacific West Regions had greater amounts of climate change-driven projects per park unit happening in wilderness. The Intermountain, Southeast, and Midwest Regions had less. Whether these patterns were due to geography or regional management prerogatives warrants additional research.

## Discussion

### INTERPRETATION OF MONITORING

I found it problematic to interpret any correlation from monitoring in wilderness as evidence of an active or hands-off approach to wilderness stewardship. Some have suggested that the hands-off approach to stewardship is an opportunity to observe and learn from the changes (Aplet and Gallo 2012; Landres 2010; Marris 2013). On the other hand, the potential for monitoring to impact wilderness character (through the use of installations, motorized equipment, and personnel) leads others to classify scientific

activity as an active stewardship response (Hood 2011-2012; Landres 2010). Interpreting whether monitoring is evidence of a particular approach to wilderness stewardship would be better ascertained through a more qualitative analysis that reveals, on a case-by-case basis, the duration, frequency, and area affected by monitoring in addition to the type and level of constrained uses permitted in the process. If MRAs for monitoring projects were also housed in a central and standardized database, such analyses would be much more accessible. At the present time, however, qualitative interviews may serve as the best conduit for this type of information.

#### IMPACT OF STEWARDSHIP ACTIVITIES ON WILDERNESS

Based on these results it is difficult to say what proportion of the wilderness had been impacted by these stewardship activities. To get a better idea of the level of stewardship activity, I initially attempted to determine the percent of wilderness monitored and managed by projects reported in this study. Survey questions asked respondents to estimate the percentage of wilderness that had been affected by monitoring and management activities designed to address climate change. From the outset I recognized that these estimations would produce coarse results. However, upon receiving comments from respondents that demonstrated just how “gross” these estimations were, I opted to exclude them from the analyses. As an alternative, I considered dividing the number of projects by the number of wilderness acres in each park unit—giving us a rough project per square acre measurement. However, this calculation also ignored the fact that stewardship projects happen at different scales; some are carried out on a wilderness-wide basis while others may happen at a comparably minute scale—in one watershed, one valley, on one creek, or even at one

crossing. As such I chose to stick with the number of projects and management actions as the primary measures of stewardship levels. Although these measures do not fully characterize the effect of stewardship activities upon wilderness, they do capture the number of decision-points permitting stewardship activities. However the amount of decision-points were most pertinent to the aims of this study.

#### HAND-OFF APPROACH AS THE DEFAULT APPROACH?

These data do demonstrate a considerable and perhaps increasing propensity for decision-makers to opt for active climate change adaptation strategies in NPS wilderness. This level of activity, coupled with its potential to reframe the stewardship debate, warrants a more targeted exploration of how many decisions have been made to pursue an active or hands-off approach to wilderness stewardship.

If the hands-off approach is not necessarily the default approach, then the frame surrounding the stewardship debate must be redrawn. This new frame shifts the active approach from an alluring exception to the norm to a more routine practice. As such the implications of active management cannot be brushed off as too rare or inconsequential to thoughtfully consider. On the other hand, a revised frame also brings attention to whether the hands-off approach is selected intentionally. If the hands-off stewardship is not the default approach, then its merits as a deliberate choice ought to be more heavily considered. Essentially, a redrawn frame would shift the burden of proof from showing that action is warranted to showing that restraint is warranted.

It is tempting to use these findings in ways that may be problematic. Some may jump to the conclusion the hands-off approach is not the default approach. Others may want to claim that the level of stewardship response to climate change muddies the

concept of a pristine wilderness and thus makes the argument for a hands-off approach irrelevant. Yet one notable caveat for these assertions is that the findings in this study only reflect decisions that have been made actively respond. The data do not tell us whether NPS decision-makers rejected other (and perhaps more) stewardship activities in favor of the hands-off approach.

When designing the survey, I considered asking participants to indicate how many monitoring and management projects driven by climate change had been proposed, approved, and rejected over a five year time period. However questions requiring respondents to conduct research, such as sifting through old proposals and MRAs, decrease response rates (Dillman 2007). Accordingly, I demurred from asking these questions in favor of facilitating higher survey response rates and developing a more complete picture overall. In addition, this enabled me to frame survey questions as a snap-shot of current baseline activity and avoided confusion as to whether all questions covered a five year period.

Ideally, testing the premise of a default approach would be as simple as identifying how many and what type of stewardship activities had been proposed in wilderness and how many had been rejected over defined periods of time. The best existing documentation to capture such data would be the Minimum Requirement Analysis or MRA. Because each park unit is responsible for designing, completing, and archiving their own MRAs and because not all park units actually do so, drawing on this information would be difficult, if not impossible, to accomplish at this time.



## Chapter 6

### Wilderness visitation

The academic discussion of climate change adaptation in wilderness has given little consideration to the impact that these activities may have on wilderness visitation. Given this void, I developed open-ended questions to target whether and what climate-driven changes in wilderness visitor use have been noticed. Respondents were invited to share changes they noticed in wilderness visitation “amount, frequency, seasonality, and other use-patterns” that they also attribute to climate change (see Appendix 1 for question phrasing). Respondents were also asked whether and how wilderness stewards are reacting to the changes that they have observed.

### Results

Nearly half of the responding park units reported noticing differences in wilderness visitor use due to climate change. About a quarter of the park units that participated in this study reported altering visitor management in response to noticed changes. Yet only one park unit reported monitoring visitor use in the context of climate change. Thus these responses are likely personal observations from professionals in the field.

Almost half of the respondents reporting climate-driven changes in visitor use described longer visitation seasons. Respondents associated these extended periods of visitation with milder shoulder seasons, milder winters, early snow pack melt, and longer open water cycles. Several respondents observed more visitors at these times. One noted

that visitation had been compressed into key areas during the shoulder seasons. In response to a longer use season, a couple of park units reported that they had added more patrols to interact with visitors at these times.

Other park units experienced decreases in visitation that they attributed to climate change. A couple had closed areas because of dangerous conditions wrought by hurricane debris, fire, and severe storms. In one instance, drought conditions had compressed visitation into a river corridor. Access problems had also resulted from low river levels, severe floods, road washouts, and hurricane damage to visitor facilities. One park unit renovated a hurricane damaged facility; another repaired washed out roads.

Though these the effects of climate change likely impacted visitor experience, only two respondents described them as doing so. One respondent expressed the difficulty that visitors faced during the traditional hunting season. Another considered how chainsaw use after a heavy windfall event would impact sound experience. A couple of others were considering climate-driven effects on visitation as they undertook planning processes.

## **Discussion**

Only a few park units linked their own stewardship activities with shifts in wilderness visitor use. Examples of these include closing areas in the wilderness due to dangerous conditions and using chainsaws to address a heavy windfall event. Yet these findings cannot be said to represent all instances of stewardship activities impacting visitor experience in wilderness. The open-ended question eliciting these responses only asked participants to describe changes in visitor use as they relate to climate change and its effects. Already in this question respondents are asked to make two jumps—from

climate change to (1) its effects to (2) changes in wilderness visitation. It may be that respondents did not consider adding an additional jump—from climate change to (1) its effects, (2) to wilderness stewardship response, (3) to changes in wilderness visitation.

Our data do indicate that NPS employees are noticing shifts in wilderness visitor use that they attribute to climate change. In particular, the potential for longer visitation seasons could impact budgets and staff allocations. Given the lack of academic discussion about these shifts, the findings portend that these issues are ripe for research and scholarly deliberation.

To set the stage for this deliberation, it will be important to first clarify how to interpret the solitude and recreation quality of wilderness character as being affected by climate change adaptation activities. The wilderness stewardship debate tends to pit the hands-off approach against the active approach and thus the natural quality against the untrammelled quality of wilderness. Yet it is unclear whether the solitude and recreation quality fits into this academic debate. Our data seem to reflect a tendency for the active approach to degrade the solitude and recreation quality (see Chapter 7 for more on qualities of wilderness character). Indeed the perceived tension between visitor experience and active wilderness stewardship frustrates those on either side of the debate.

As one respondent declared:

The wilderness program is visitor management oriented to a fault. The natural quality mandate and the core mission of the NPS to conserve natural and cultural resource values needs more attention. The entire program should be reorganized under the natural and cultural resource program directorates. Until this is done, the recreation purpose of wilderness will dominate to the detriment of the other purposes.

I endeavored to delve more deeply into and clarify these tensions by asking respondents how they perceived their stewardship activities as affecting wilderness character. These findings are explored in the next chapter.

## Chapter 7

### Wilderness character

Wilderness coordinators and scientists sort through a tangle of competing, converging, and seceding factors when making wilderness stewardship decisions. This process is further complicated by the increasingly apparent challenge of making those decisions in an uncertain and evolving world that lacks a true baseline. As decision makers combine these considerations with structural matters (such as funding, capacity, feasibility, and need), they must also keep in mind the context of wilderness character and interpret this character in light of new climatic circumstances.

To develop a sense for how wilderness coordinators and scientists interpret wilderness character under these circumstances, I asked respondents to describe how wilderness character is affected by the stewardship activities they are undertaking to address climate change in their park unit's wilderness. In two open-ended questions, respondents reported on whether and how they see these activities improving or degrading wilderness character. Respondents were prompted with a list of the five qualities of wilderness character that had been defined in interagency recommendations to guide appropriate wilderness stewardship (Landres, Vagias, and Stutzman 2012). This included the natural, untrammeled, undeveloped, and other features of value qualities, as well as the solitude and/or primitive and unconfined recreation quality (the latter of which is hereafter referred to as the "solitude and recreation quality"). See question phrasing in Appendix 1.

The findings that follow first contextualize the response rates for each wilderness character question. Responses have been classified according to whether they specifically name a quality of wilderness character as expressed in the Wilderness Act and prompted in the wilderness character questions. I share these findings as they have interpreted the defined qualities and as they have considered additional factors. The analyses explore what these findings mean for NPS administrators as well as for the debate about appropriate approaches to climate change adaptation in designated wilderness.

## **Results**

### IMPROVING WILDERNESS CHARACTER

One of the open-ended questions asked respondents to describe how wilderness character had been improved by climate change-driven monitoring and management projects. Twenty-two of the 44 respondents indicated that they had seen no improvements to wilderness character from these projects. Eleven respondents, who, according to responses they provided in this survey, had carried out climate change adaptation activities in wilderness, reported that these activities had not improved wilderness character. The other eleven respondents reporting no improvements to wilderness character likely saw no improvements from climate change adaptation activities because they had not carried out any—these respondents did not report carrying out monitoring or management projects in designated wilderness to address climate change and its effects.

Of those offering other responses, clear patterns emerged. Twenty two respondents reported that wilderness stewardship activities to address the effects of climate change had improved wilderness character. Fifteen of these respondents referenced qualities of wilderness character defined in the Wilderness Act and included in

the survey question. Overwhelmingly, respondents cited improvements in the natural quality of wilderness character.

#### DEGRADING WILDERNESS CHARACTER

Nearly half of the respondents to this question (22 of 44) reported that they had seen no degradations to wilderness character from activities happening in their park unit's wilderness to address the effects of climate change. Among those reporting no degradations were 11 park units that had not conducted such activities. Nine park units that had carried out climate change-driven stewardship activities in wilderness reported that their activities had not degraded wilderness character. One respondent indicated that the impacts to wilderness character were simply "unknown."

Just over half, 24 of 44 park units responding to this question, reported that stewardship activities driven to address climate change had degraded wilderness character. Eight respondents qualified their reports of degradations to wilderness character as either "minor" or "temporary." Eighteen of the respondents reporting degradations referenced qualities of wilderness prompted in the survey question. Those describing degradations to wilderness character commonly referred to several of these qualities. These findings contrast to the responses given in the "improvements question," which had so heavily referenced the natural quality. Only one quality defined in the Wilderness Act, the other features of value quality, went un-discussed.

## RESPONSES BY QUALITY OF WILDERNESS CHARACTER

### *Natural quality*

Respondents overwhelmingly reported that the natural quality had been both improved and degraded by stewardship activities happening in wilderness to address the effects of climate change. Twelve respondents described improvements to wilderness character in terms of the natural quality. Three respondents specified that scientific activity had improved the natural quality of wilderness character. As one respondent explained, the “study of yellow-cedar decline in relationship to declining snow pack helps us understand more about the natural quality of... wilderness character.” Another said: “scientific studies... are improving our ability to understand where, when and how to intervene to maintain and improve natural qualities.”

Only one respondent framed improvements to the natural quality of wilderness character as a trade-off with the untrammeled quality: “generally, projects that are implemented to improve ‘naturalness’ ...are considered degrading to the ‘untrammeled’ quality...” The findings indicate, however, that a mere trade-off may not be so straightforward. Four respondents reported that stewardship activities had degraded the natural quality of wilderness character by using installations, aircraft, and bridges.

### *Untrammeled quality*

One respondent linked climate change adaptation activities in wilderness with improvements to the untrammeled quality of wilderness character. This respondent explained that prescribing fire now would, in the long run, prevent greater trammeling caused by otherwise inevitable fire management efforts. In doing so, this respondent

characterized efforts to minimize impacts to the untrammelled quality as an improvement of wilderness character.

The untrammelled quality was the quality most often reported as being degraded in wilderness due to climate change-driven stewardship activities. Half of those reporting any degradations at all (11 of 22 respondents) remarked that the untrammelled quality had been degraded by climate change-driven stewardship activities in NPS wilderness. Some respondents went on to describe which activities had caused the trammeling: the installation of bridges, removal of invasive and exotic species, planting, re-routing trails, control of fire, monitoring stations, and the use of helicopters.

### *Undeveloped quality*

No respondents reported that the undeveloped quality had been improved by climate change-driven stewardship activities. In seven parks, however, the undeveloped quality was reported to have been degraded by these activities. Frequently, this quality was listed in a string alongside the untrammelled quality, but on the two occasions it was mentioned alone. In these instances, respondents commented that the undeveloped quality had been degraded by monitoring and monitoring installations.

### *Other features of value quality*

The only respondent who specifically named the other features of value quality declared that monitoring would improve this quality. The respondent explained that, “scientific activity is one of the other features of value described in the Wilderness Act that is important in the Saguaro Wilderness... and climate change monitoring improves this quality.” This response drew a connection between the other features of value and

“scientific activity.” Though several other responses regarded scientific activity as benefitting wilderness character (see below), the above respondent was the only one to overtly draw a connection between science and the other features of value quality. Therefore, it is unclear whether others may have made this connection and just neglected to explicitly express it.

### ***Solitude and/or primitive and unconfined recreation***

Respondents reported that, in 9 park units, the solitude and recreation quality had been degraded by stewardship activities driven by climate change. Some of the stewardship activities impacting the solitude and recreation quality included planting, monitoring, flying helicopters, constructing bridges, installing climate change detection equipment, and restricting the use of or closing areas due to severe storms. One respondent demonstrated that these qualities could be impacted in conflicting ways: “Depending on one’s perspective, the loss of access to trailheads via roads either improves solitude opportunities due to fewer people or degrades opportunities for visitors to experience wilderness in general if they can’t access it.”

## **OTHER FACTORS**

### ***Scientific activity***

Overall, ten respondents framed climate change-driven scientific activity as improving wilderness character. Seven described science as improving wilderness character without referencing qualities expressed in the Wilderness Act. Most of these responses characterized greater scientific understanding itself as improving wilderness character. Another respondent valued scientific activity for its ability to inform

stewardship responses. It is unclear whether these respondents did not understand the qualities expressed in the Wilderness Act, or whether they instead ignored them or simply found them unnecessary to convey their response.

### ***Enabling legislation***

A couple of respondents discussed their efforts to preserve features that had been identified by enabling legislation as improving wilderness character. In one instance, management projects had been undertaken to protect the “cultural sites and settings for which the monument was established.” Another respondent valued climate change monitoring in his park unit’s wilderness in part because “the park was established for its scientific interest.”

### ***Managing change***

Another theme that arose on three occasions was management of change as an improvement to wilderness character. Respondents described how their stewardship activities could improve wilderness character by stabilizing change, improving resilience, and facilitating ecosystem adaptation.

## **Discussion**

The natural quality is said to be improved by active management and the untrammeled quality by the hands-off approach. As this study describes activities happening in wilderness to address climate change, it also describes the active approach. Thus one would expect this study’s findings to show that respondents perceived climate change activities as improving the natural quality of wilderness character and degrading the untrammeled quality. To some degree, the data do show this. The natural quality was

the quality of wilderness character most often reported as being improved by climate change adaptation activities happening in wilderness. Likewise, the untrammeled quality of wilderness character was the quality most often reported as being degraded by these activities. However, the findings also complicate these trade-off assumptions. In a few circumstances, respondents reported that the natural quality had been degraded by stewardship activities. They also reported that other qualities of wilderness character had been degraded as well.

Clearly, wilderness qualities are interpreted in multiple, complex, and even conflicting ways. Friskics (2008) unravels several definitions of the word “untrammeled” that have been used in conversations about wilderness stewardship. For instance, he explains that untrammeled and pristine are not synonyms. Yet problematic interpretations of the word untrammeled have led to divergent paths of logic regarding appropriate wilderness stewardship responses. To complicate matters further, untrammeled is conflated with the concept of wildness. Wilderness has itself been interpreted in a variety of ways. Some of these interpretations have been critiqued for separating humans from nature. There may have been evidence of this in at least two responses to the questions about wilderness character which described degradations as stemming from increases in “human activity.” The broad concept of wildness may also blanket other qualities of wilderness character.

It is unclear if the untrammeled quality serves as an umbrella for the undeveloped, other features and solitude and recreation qualities of wilderness character. The debate so often pits the natural quality against the untrammeled quality without reference to these other qualities. If the untrammeled quality serves as an umbrella, it warrants clarification

within the academic debate. If the untrammelled quality is not an umbrella, then the other qualities warrant consideration as well—especially because the data show that some of the qualities ignored in this discussion are being impacted by stewardship activities. This disconnect calls attention to the need for a more common understanding of wilderness characteristics as they are used in legal, administrative, and scholarly lexicon. Without such clarification, discussions about wilderness stewardship goals and approaches may remain trapped within flawed frames.

The other features of value quality stands out as requiring a more commonly understood definition in this context. Only one of the 46 respondents mentioned it anywhere in the survey. This respondent characterized the quality in a way that has been critiqued by Chris Barns of the interagency Arthur Carhart National Wilderness Training Center (2013). Barns contends that wilderness uses are frequently (and mistakenly) conflated with wilderness values when it comes to defining the other features of value quality of wilderness character. He maintains that protecting the scientific value of a wilderness does not necessarily endorse any and all scientific activities. Vice versa, the presence of scientific activities in wilderness cannot necessarily demonstrate that the scientific value is being protected. If otherwise, then scientific activities may be misconstrued as being immune from Minimum Requirement Analyses. Although the connection between science and the other features of value quality can be made, it must be made in terms of the scientific value of a wilderness and not in terms of the scientific activities happening in that wilderness.

Similarly, NPS decision-makers may need greater clarification about how to weight scientific activity as they consider whether a monitoring project is appropriate in

designated wilderness. It seemed that many respondents valued scientific activity as an end in itself—to be considered alongside other qualities of wilderness character. If this is indeed the case, and it will take more research to determine whether it is, then monitoring may disproportionately affect other qualities. Wilderness administrators may also have their work cut out for them when it comes to clarifying the nuances surrounding the appropriate role of scientific activity in a conversation about wilderness character.

The protection of features identified in enabling legislation also warrants greater legal consideration. As resources named within these laws are impacted by climate change, the question is raised: How should wilderness coordinators weigh yet another layer of potentially conflicting legal obligations? Does preserving these named resources trump consideration of other wilderness qualities under climate change? Or does complying with the Wilderness Act supersede the preservation of resources named in other acts of Congress?

## **Chapter 8**

### **Conclusions**

As the first baseline study documenting climate change adaptation activities happening in National Park Service (NPS) wilderness, this study serves several purposes. It informs NPS administrators about what is happening in the field with regards to climate change. It also explores how park unit representatives perceive these activities as impacting wilderness character. In doing so it sheds light upon active and hands-off approaches to wilderness stewardship vis-à-vis climate change. Finally, it uses the case of wilderness to teach us about decision-making frameworks that could be applied to climate change adaptation activities happening elsewhere. In this final chapter, I clarify how this study relates to these larger questions. As I do so, I offer recommendations for future research and more effective policy. (See additional departures for research in Appendix 3). The data and analyses inspired a few thought experiments that I use to conclude the study. These vignettes are ripe for exploration, deliberation, and future research.

#### **Informing NPS Administrators**

This study demonstrates extent of our knowledge about how park managers respond to climate change in NPS wilderness. Beyond providing basic information to NPS administrators about what is happening on the ground, it highlights climate change related budget and staffing challenges, policy considerations. It also demonstrates the need for enhanced accountability and transparency with regards to Minimum Requirement Analyses (MRAs) and existing databases.

The findings in Chapter 6 draw attention to the need for seasonal employees to be present during extending visitation seasons. As more visitors come to wilderness during these traditional shoulder seasons, there will be a greater need for visitor services (interpretation, facilities maintenance at wilderness access-points, trail maintenance, and patrols) that may push time-honored field season and seasonal funding end-dates. Chapter 6 also highlights how a changing climate is impacting facilities and infrastructure that exists both within and providing access to wilderness. Park administrators will need to decide if repairing these structures falls within the bounds set by the Wilderness Act. If so, they will also need to allocate budgets and staff-time in order to do so. As park budgets bundle funding for climate change adaptation, it may be prudent to consider the needs of adapting wilderness programs.

This study also calls attention to NPS policies that may need to be designed or clarified when it comes to climate change impacts on wilderness. In particular, NPS administrators ought to consider the confusion over whether to prioritize compliance with the Wilderness Act or protecting features and resources named in park unit or wilderness enabling legislation. Although only three respondents discussed the challenge of balancing stewardship obligations established in the Wilderness Act with obligations to preserve features identified in enabling legislation, it seemed provocative enough to highlight here. Enabling legislation warrants attention as valued features identified in the enabling legislation change, move, or decline due to climate change. The dual obligation to protect these features while also protecting wilderness character may present legal, logistical, and ethical conundrums for wilderness stewardship in an era of climate change. The management dilemma posed here ought to spur wilderness coordinators and park

officials to, at minimum, familiarize themselves with the legislation that established their park units and wildernesses. In particular they may need to consider and define how to approach managing the resources named in enabling legislation. Given the potential for legal challenges on these grounds, the NPS and other agencies administering designated wilderness ought to also consider developing policies that establish administrative priorities.

In addition, this study also highlights topics like fire and invasive species that receive a good deal of stewardship attention. Were NPS wilderness administrators wishing to guide wilderness stewardship, they could tailor policy around these topics. These findings may also encourage NPS Wilderness Stewardship Division to network with other divisions (the Fire Division or the Climate Change Program) in order to cooperatively and most ethically tackle topics of concern in designated wilderness.

The findings also highlight the needs for greater transparency and accountability with regard to stewardship decisions. This project was intended to fill information gaps that had been ignored in existing NPS databases that track monitoring and management activities. While the study sketches a preliminary perspective on the extent and type of these activities, it also calls attention to the need for more comprehensive documentation and oversight—especially in regards to activities that degrade wilderness character. One strategy to ensure enhanced transparency and accountability would be to improve data collection requirements for existing databases. Databases that already track what is happening in the Park Service include the Inventory and Monitoring Program’s Protocol and Vital Signs Databases, the Facility Management Software System, and the Research Permit and Reporting System’s Investigator Annual Reports. These databases could

document whether or not activities are happening within designated wilderness. If so, they could ask whether MRAs had been completed for activities happening in wilderness. These additional fields could serve as educational tools to teach park unit employees about appropriate MRA considerations required by the Wilderness Act.

Beyond these measures the NPS Wilderness Stewardship Program ought to also consider collecting and cataloguing MRAs into a centralized database. These documents would provide NPS administrators with up-to-date information about the degree and type of stewardship activities happening in NPS wilderness. A database would also enable a more robust characterization of the active approach to wilderness stewardship. By documenting projects that had been approved and rejected through these analyses, cataloged MRAs would provide greater transparency, more accountability, and a better sense for how park-level administrators approach wilderness stewardship. It should be recognized that this documentation would not give voice to the number of projects or ideas that wilderness coordinators abandoned prior to reaching the MRA stage of consideration. Yet despite this limitation, MRAs could indicate whether and how wilderness coordinators are considering impacts to wilderness character from proposed stewardship activities. This information could demonstrate whether efforts had been taken to recommend alternatives, minimum tools, and accommodations in compliance with prohibitions stated in the Wilderness Act. It could also demonstrate the level of understanding about and consideration of wilderness character qualities. When making decisions about management and monitoring in wilderness, MRAs have the potential to indicate whether and to what extent wilderness coordinators consider impacts to wilderness character. Ideally an NPS MRA database would be compatible with other

federal agencies administering designated wilderness so as to enable comparison and facilitate the coordination of stewardship activities at the regional scales.

From legal conundrums to actions on the ground, this study provides NPS administrators with a rich glimpse into what is on the minds of park-level respondents as they react to the effects of climate change in NPS wilderness.

## **Grounding the Wilderness Stewardship Debate**

As these findings reiterate, designated wilderness is not the wilderness portrayed in story book legends. As is asserted by proponents on both sides of the wilderness stewardship debate, these findings once again demonstrate that designated wilderness is neither pristine nor free from human activity. Participants in this study consistently voiced concern about climate change impacts to invasive, native, and endangered species, as well as fire and fuel dynamics. More than two thirds of the park units surveyed had carried out stewardship projects designed to address climate change and its effects. These findings demonstrate that decision-makers recognize the effects of human-induced climate change in the field and that they respond in ways that they deem appropriate. As such, this study describes the existing relationship between people and wilderness. It brings hypothetical scenarios, which so often form the basis of arguments in this debate, to reality. Fundamentally this study more fully characterizes the active approach to wilderness stewardship.

These findings demonstrate that there is not a simple trade off between the natural and untrammled qualities of wilderness character. The natural quality had been both improved and degraded by active approaches to wilderness stewardship. The untrammled quality was expectedly degraded, but so too was the undeveloped quality

and the solitude and/or primitive and unconfined recreation quality. These findings acknowledge, but complicate, the dualistic notion that stewardship activities tend to harm the untrammeled quality of wilderness character while improving the natural one. As such, contributors to the discussion about appropriate wilderness stewardship activities ought to consider widening the conversation beyond an oversimplified dichotomy between the natural and untrammeled qualities of wilderness character. Because other qualities are also impacted by stewardship activities, it seems practical and responsible for the conversation to consider them. If advocates in the debate open the untrammeled quality as an umbrella and stow other qualities of wilderness character underneath, it may be prudent for them to clarify their logic as such. Beyond that, some of the qualities (and in particular, the other features of value quality) may need greater clarification. Without a common understanding for each quality of wilderness character, discussions about wilderness stewardship approaches may speak past one another.

This study characterizes what is happening on the ground: in some cases what these actions are attempting to achieve, to an extent how the actions are being carried out, and whether they are interpreted as impacting wilderness character. Through these findings we can more fully describe the active approach to wilderness stewardship in an era of climate change. The data show that a majority of park units have approved stewardship activities to address climate change in wilderness. Such findings highlight the need to test the assumption whether or not the default approach to wilderness stewardship is indeed the hands-off approach. To test this assumption, improve accountability, and facilitate oversight, it would be helpful to more fully characterize stewardship activities' impacts to wilderness character, especially with regards to project

duration, intervention frequency, area impacted, and type of 4(c) uses approved. MRAs could best capture and archive this information.

A limitation of these findings is that they were unable to characterize the hands-off approach—and indeed they were not designed to. The aim of this study was to understand what was happening in NPS wilderness as park unit administrators respond to the effects of climate change. However, through the process of collecting data and conducting analyses—the void begged, how do you measure the hands-off approach to wilderness stewardship? How does one measure options that are not taken? How does one gauge restraint? Negative data is unusable data. But if this is the case then how does one describe a negative approach to wilderness stewardship?

Without an adequate description or measure for the hands-off approach, the discussion surrounding the appropriate approaches to wilderness stewardship will remain lopsided. The active approach can be described and measured with relative ease. The hands-off approach can similarly be measured and described, but it may be more difficult—for it is often easier to describe what is different than what has stayed the same.

## **Inspiring Ethical Climate Change Adaptation**

One of the most precious values of the national parks is their ability to teach us about ourselves and how we relate to the natural world. This important role may prove invaluable in the near future as we strive to understand and adapt to a changing climate.

— Jon Jarvis, National Park Service Director (NPS 2012*b*)

The experience of conducting this study has inspired a number of through experiments that I introduce here. I intend these ideas to be fodder for future experimentation and for further development.

The Wilderness Act was written long before greenhouse gas emissions were well known to impact global climate. However, its prohibition of 4(c) uses limits the use of equipment that so often produces or is produced by the emission of greenhouse gases. Instead of using chainsaws to cut out trees that fall across trails, crews instead use axes, 50 to 100 year old cross-cut saws, and human energy to do so. These prohibitions require wilderness coordinators and visitors alike to think creatively about how to tackle common problems without greenhouse gas using and produced mechanisms. This is not to say that the prohibition of 4(c) use ought to be the law outside of wilderness, however, it does provide a framework to think about alternative ways of doing things. In many cases these alternative ways may provide more jobs, improve human health, and decrease the exacerbation of climate change.

The wilderness stewardship debate extracts climate change from its persuasion rut and goes on to demand, how should we respond? As the ensuing discussion matures the climate change narrative, this study applies wilderness stewardship as a lens through which to examine appropriate adaptation responses to climate change. Before asking what NPS administrators should do, wilderness obligates them to ask whether they should do anything at all. At the current stage in the debate, arguments start from the assumption that the hands-off approach to wilderness stewardship is the default approach. Thus, the fundamental question asks whether stewardship responses are warranted. However, if the assumption proves false and the active approach is instead, the default, this frame may flip. The fundamental question may instead need to ask: is management restraint warranted? Regardless of whether this happens, both frames value and consider

the alternative of non-action. Indeed, even advocates of climate change adaptation in wilderness concede that there is value in considering management restraint (Stephenson and Millar 2011-2012).

Wilderness character gives us an inclusive framework within which to characterize the relationship between humans and nature. It enables us to more comprehensively evaluate whether or not and which climate change adaptation activities are appropriate. Some have argued that the concept of wilderness serves as a wedge that widens an artificial distinction between humans and nature (Cronon 1995; Jordan 1994; 2003). The concept of wilderness is said to place greater value on nature as it characterizes human action as inherently harmful. However, by breaking wilderness down into different qualities, wilderness character enables us to recognize the real and complicated relationship that humans have with wilderness. Wilderness character gives us the ability to articulate how climate change adaptation activities may harm some qualities of wilderness while improving others. It also enables us to distinguish how management restraint may harm some qualities while improving others. In doing so, wilderness character empowers us to recognize restraint is as much a valid and deliberate approach to the human-nature relationship as is action. Wilderness character also enables us to move beyond generalizing human actions as “good” or “bad” with respect to nature. Rather wilderness character provides us the framework through which to recognize, articulate, and study the real and complex relationship that humans have with nature and wilderness—especially as we are all impacted by climate change.

In thinking more broadly about climate change adaptation and wilderness stewardship, I have come to an analogy that may help define ethical approaches for both endeavors. Recall what I have described as the appropriate role for climate change adaptation; that it ought to serve as a tool to be used on the occasions when it can build momentum toward the ultimate goal of climate change mitigation. The end goal is to prevent further harm and allow nature, wildness, and the planet to heal itself. In many ways, I also see this as the ultimate goal of wilderness stewardship. The 1964 Wilderness Act describes wilderness as a place “affected primarily by the forces of nature,” “where the earth and its community of life are untrammelled.” The act even permits 4(c) uses so long as the actions they help carry out are intended to achieve the goal of wilderness. In this way, wilderness stewardship is a tool, to be used in appropriate occasions where it can enable nature and wildness to heal itself. In order for climate change adaptation and wilderness stewardship to achieve the ultimate goal of untrammelledness, they must foster a sense of agency while being effective and appropriate.

Given these goals, I have defined a set of recommendations to help define ethical climate change adaptation and wilderness stewardship. The recommendations are as follows:

1. **Restraint is a valid alternative.** Although we may want to do something to address climate change, adaptation may not always be the most appropriate response. Wilderness teaches us that restraint is also a valid and valued response.
2. **Minimize greenhouse gas emissions.** If an ultimate goal of adaptation is to build the momentum toward mitigation, then climate change adaptation activities ought to refrain from exacerbating greenhouse gas emissions. Wilderness teaches us that we can often achieve stewardship objectives by thinking creatively to avoid 4(c) uses and thus minimally emit greenhouse gases.

3. **Maximize public engagement.** By maximizing public engagement, adaptation activities can more fully realize their potential to build momentum toward mitigation.
4. **Ensure a temporary intervention.** Ensuring a sense of agency is a vital factor in building that momentum. A sense of agency can be realized through accomplishment; accomplishment by a goal achieved.
5. **Monitor the outcome.** To ensure that the goals are indeed accomplished and that agency is truly attained, project managers must comprehensively monitor project outcomes.
6. **The predictability of the outcome must be high.** Also, to ensure this sense of agency, it is vital that the projects achieve their intended outcome.
7. **The chance for unintended consequences must be low.** At the same time, undesired outcomes must not undercut this sense of agency.
8. **Recognize complex implications of adaptation actions.** The findings presented in this study teach us that a simple trade-off between values and approaches may not be so straightforward. Unanticipated or ignored values can become caught up in the wake.
9. **Transparently disclose values considered and prioritized.** Thus project managers must transparently disclose the values that they considered and prioritized in the decision-making process, while also minimally meeting the aforementioned criteria.

I intend these thoughts and recommendations to recognize and honor the very real crises that climate change has for people and for the landscapes they inhabit. It is my ultimate aim to enrich the climate change narrative in a thoughtful and provocative way that engenders fruitful deliberations and effective responses. The lens of wilderness stewardship teaches us to recognize the complex, messy, flexible, and adaptable natures of the world we live in. It also teaches us, that when warranted, we can tackle its crises with thoughtful resolve. And, when warranted, we can exercise a deliberate restraint that accepts, mourns, values, and celebrates the world's ability to adapt.



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# Appendix 1

## Survey Questions

### Climate Change Response in NPS Wilderness

As climate change influences NPS wilderness, your input will help us understand how managers and ecologists respond to changes on the ground. This project is being done in partnership between the NPS Wilderness Stewardship Division, the Aldo Leopold Institute, and the University of Montana.

This survey neither recommends nor discourages activities related to climate change in wilderness. It is understood that some parks will have many climate change-related projects and others have none. Even still, input from each NPS unit is vital to help develop a comprehensive and accurate picture for how climate change is (or is not) influencing wilderness stewardship.

Reports, papers, and articles that publish the results of this study could refer to the answers you provide. These answers could be associated with your NPS unit. However your name and/or contact information will NOT be used.

If you have questions, concerns, or comments about the survey itself, please contact Katie Nelson of the University of Montana (the project lead) at [katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu) or at 760-920-9961.

Direct any questions about wilderness stewardship to Erin Drake of the NPS Wilderness Stewardship Division at [erin\\_drake@nps.gov](mailto:erin_drake@nps.gov) or at 202-513-7130.

Thank you again for taking the time to thoughtfully respond to this study. Your response is important.

1) Which National Park Service unit do you represent? \*

Answer the following questions only as they related to the single park unit you indicate here. Please fill out additional surveys to provide information about other park units.

- |   |  |
|---|--|
| <input type="checkbox"/> Apostle Islands National Lakeshore                 | <input type="checkbox"/> Joshua Tree National Park                     |
| <input type="checkbox"/> Badlands National Park                             | <input type="checkbox"/> Katmai National Park and Preserve             |
| <input type="checkbox"/> Bandelier National Monument                        | <input type="checkbox"/> Kobuk Valley National Park                    |
| <input type="checkbox"/> Black Canyon of the Gunnison National Park         | <input type="checkbox"/> Lake Clark National Park and Preserve         |
| <input type="checkbox"/> Buffalo National River                             | <input type="checkbox"/> Lake Mead National Recreation Area            |
| <input type="checkbox"/> Carlsbad Caverns National Park                     | <input type="checkbox"/> Lassen Volcanic National Park                 |
| <input type="checkbox"/> Chiricahua National Monument                       | <input type="checkbox"/> Lava Beds National Monument                   |
| <input type="checkbox"/> Congaree National Park                             | <input type="checkbox"/> Mesa Verde National Park                      |
| <input type="checkbox"/> Craters of the Moon National Monument and Preserve | <input type="checkbox"/> Mojave National Preserve                      |
| <input type="checkbox"/> Cumberland Island National Seashore                | <input type="checkbox"/> Mount Rainier National Park                   |
| <input type="checkbox"/> Death Valley National Park                         | <input type="checkbox"/> Noatak National Preserve                      |
| <input type="checkbox"/> Denali National Park and Preserve                  | <input type="checkbox"/> North Cascades National Park                  |
| <input type="checkbox"/> Devils Postpile National Monument                  | <input type="checkbox"/> Olympic National Park                         |
| <input type="checkbox"/> Everglades National Park                           | <input type="checkbox"/> Organ Pipe Cactus National Monument           |
| <input type="checkbox"/> Fire Island National Seashore                      | <input type="checkbox"/> Petrified Forest National Park                |
| <input type="checkbox"/> Gates of the Arctic National Park and Preserve     | <input type="checkbox"/> Pictured Rocks National Lakeshore             |
| <input type="checkbox"/> Glacier Bay National Park and Preserve             | <input type="checkbox"/> Pinnacles National Monument                   |
| <input type="checkbox"/> Great Sand Dunes National Park and Preserve        | <input type="checkbox"/> Point Reyes National Seashore                 |
| <input type="checkbox"/> Guadalupe Mountains National Park                  | <input type="checkbox"/> Rocky Mountain National Park                  |
| <input type="checkbox"/> Gulf Islands National Seashore                     | <input type="checkbox"/> Saguaro National Park                         |
| <input type="checkbox"/> Haleakala National Park                            | <input type="checkbox"/> Sequoia-Kings Canyon National Park            |
| <input type="checkbox"/> Hawaii Volcanoes National Park                     | <input type="checkbox"/> Shenandoah National Park                      |
| <input type="checkbox"/> Isle Royale National Park                          | <input type="checkbox"/> Theodore Roosevelt National Park              |
|   | <input type="checkbox"/> Wrangell-St. Elias National Park and Preserve |
|   | <input type="checkbox"/> Yosemite National Park                        |
|   | <input type="checkbox"/> Zion National Park                            |

2) What is your work email address?\*

\_\_\_\_\_

3) Are you the wilderness coordinator for this park unit?

- Yes  
 No

4) How many YEARS have you worked in this park unit?

Round to the nearest whole number. If less than one year, enter "0".

\_\_\_\_\_

5) How many YEARS have you been involved in wilderness management?

Round to the nearest whole number. If less than one year, please enter "0".

\_\_\_\_\_

6) Please rank your top five concerns for how climate change will impact this unit's designated wilderness.

"1" indicates the topic of HIGHEST concern, "2" the second-highest concern, etc.

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Archeological and cultural sites	<input type="radio"/>				
Air quality	<input type="radio"/>				
Endangered species	<input type="radio"/>				
Fire and fuel dynamics	<input type="radio"/>				
Glaciation	<input type="radio"/>				
Habitat connectivity	<input type="radio"/>				
Invasive species	<input type="radio"/>				
Nutrient cycling	<input type="radio"/>				
Native species	<input type="radio"/>				
Pathogens	<input type="radio"/>				
Pest species	<input type="radio"/>				
Soil dynamics	<input type="radio"/>				
Sea-level	<input type="radio"/>				
Snow-pack	<input type="radio"/>				
Spring runoff	<input type="radio"/>				
Severe storms	<input type="radio"/>				
Water quality	<input type="radio"/>				

7) Please list other concerns you may have for how climate change could impact your wilderness:

8) Please place a check mark next to ANY of the following that are being monitored or managed in any way BECAUSE OF CLIMATE CHANGE and its impacts to this park unit's designated WILDERNESS. Check all that apply.

	Being MONITORED in wilderness due to climate change	Being MANAGED in wilderness due to climate change
Fire regime	<input type="checkbox"/>	<input type="checkbox"/>
Nutrient cycling	<input type="checkbox"/>	<input type="checkbox"/>
Soil dynamics	<input type="checkbox"/>	<input type="checkbox"/>
Air quality	<input type="checkbox"/>	<input type="checkbox"/>
Habitat connectivity	<input type="checkbox"/>	<input type="checkbox"/>
Snow-pack	<input type="checkbox"/>	<input type="checkbox"/>
Glaciation	<input type="checkbox"/>	<input type="checkbox"/>
Springtime runoff	<input type="checkbox"/>	<input type="checkbox"/>
Water quality	<input type="checkbox"/>	<input type="checkbox"/>
Sea-level	<input type="checkbox"/>	<input type="checkbox"/>
Severe storms	<input type="checkbox"/>	<input type="checkbox"/>
Archaeological and cultural sites	<input type="checkbox"/>	<input type="checkbox"/>
Native species	<input type="checkbox"/>	<input type="checkbox"/>
Endangered species	<input type="checkbox"/>	<input type="checkbox"/>
Invasive and/or exotic species	<input type="checkbox"/>	<input type="checkbox"/>
Pest species	<input type="checkbox"/>	<input type="checkbox"/>
Pathogens	<input type="checkbox"/>	<input type="checkbox"/>

9) Please list any other characteristics that are being MONITORED in your wilderness due to climate change:

10) Please list any other characteristics that are being MANAGED in your wilderness due to climate change:

11) How many ONGOING MONITORING projects are happening in your designated WILDERNESS for the expressed purpose of tracking CLIMATE CHANGE AND ITS IMPACTS?

This includes BOTH external and NPS-led monitoring. We understand that these projects can be complex--monitoring a variety of variables using a variety of methods. This question is asking about the NUMBER OF PROJECTS allowing such activities.

If none, please enter "0".

\_\_\_\_\_

12) Climate change-driven MONITORING projects are happening in what PERCENTAGE of this unit's wilderness LAND AREA? Please provide an estimate.

If none, please enter "0%".

\_\_\_\_\_

13) How many ONGOING MANAGEMENT projects are happening in your designated WILDERNESS for the expressed purpose of responding to CLIMATE CHANGE AND ITS IMPACTS?

This includes BOTH external and NPS-led management projects. We understand that these projects can be complex--managing a variety of characteristics using a variety of methods. This question is asking about the NUMBER OF PROJECTS allowing such activities.

If none, please enter "0".

\_\_\_\_\_

14) Climate change-driven MANAGEMENT projects are happening in what PERCENTAGE of this unit's wilderness LAND AREA? Please provide an estimate.

If none, please enter "0%".

\_\_\_\_\_

15) Please put a check mark next to any ONGOING management activities being conducted in your park unit's designated WILDERNESS to respond to the impacts of CLIMATE CHANGE. Add any management activities missing from the list to the bottom of the left-hand column.

Have any 4(c) uses been permitted for activities checked in the column at left? According to the Wilderness Act, 4(c) uses include temporary roads, motor vehicles, motorized equipment, mechanical transport, structures, and installations.

Have Minimum Requirement Analyses (MRA) been undertaken for climate change-driven management activities happening in designated wilderness?

	Management activities being conducted in wilderness due to climate change	4(c) use permitted for management activity	MRA undertaken for activity
Introducing new species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reintroducing extirpated species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mechanically or manually removing invasive/exotic species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increasing genetic diversity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Installing, maintaining, replacing water guzzlers for wildlife	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suppressing naturally ignited fire	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fertilizing vegetation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeding wildlife	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thinning trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thinning vegetation (trees, shrubs, grasses, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using prescribed fire	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creating fire-breaks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mitigating pH level changes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mitigating nutrient changes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using pesticides (herbicide, insecticide, piscicide, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using bio-controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16) Describe any CHANGES IN WILDERNESS-USE (its amount, frequency, seasonality, other use-patterns) happening in your park unit. Please ONLY describe those that have been driven by CLIMATE CHANGE. This can include use by wilderness visitors or commercial permittees.

If no change, please write "none".

17) Please describe how your park unit's USE-MANAGEMENT has RESPONDED to wilderness-use patterns driven by climate change.

If there has not been a response, please write "none".

18) How do climate change-driven monitoring and management activities IMPROVE qualities of WILDERNESS CHARACTER in your park unit? Wilderness character is defined by a natural quality, an untrammelled quality, an undeveloped quality, an other-features-of-value quality, and by solitude and/or primitive and unconfined recreation. If wilderness character has not been improved by these actions, please write "none."

19) How do climate change-driven monitoring and management activities DEGRADE qualities of WILDERNESS CHARACTER in your park unit? Wilderness character is defined by a natural quality, an untrammelled quality, an undeveloped quality, an other-features-of-value quality, and by solitude and/or primitive and unconfined recreation. If wilderness character has not been degraded by these actions, please write "none."

20) Those are all of our questions. Would you like to add anything?

Thank you!

Again please contact Katie Nelson (the project lead) with survey-specific questions at [katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu) or at 760-920-9961. Direct questions about wilderness stewardship to Erin Drake of the NPS Wilderness Stewardship Division at [erin.drake@nps.gov](mailto:erin.drake@nps.gov) or at 202-513-7130.

Thank you again for taking the time to thoughtfully respond to this study. We appreciate your input.

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## Appendix 2

### Participant Recruitment

#### 2.1. Email Seeking Permission from NPS Regional Director

Dear First name of the Regional Director,

The Wilderness Stewardship Division is interested in determining whether and how climate change is influencing the management of wilderness areas under NPS jurisdiction. This information will help the division better understand the relationship between climate change and wilderness management, while informing future management decisions based on precedence and regional dynamics. To gather this information, we are planning to survey a representative in each of the NPS units listed below (in addition to wilderness park representatives in the other regions). Park Superintendents will be asked to designate an appropriate employee as the point of contact for the study. Contacts will then receive the survey via email. The survey is being developed with input from Peter Landres of the Aldo Leopold Center, Tim Devine of the Carhart Center, and Cat Hawkins Hoffman of the NPS Climate Change Response Program.

This email is intended to check in with you before contacting the Park Superintendents in the Intermountain Region directly. If you have any questions, concerns, or suggestions, please contact me or the project lead, Katie Nelson, ([katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu)). Otherwise, we will plan to introduce Park Superintendents to the study via email on Friday, June 29th.

Thank you for your time and assistance with this study.

Best,  
Garry Oye  
Chief of Wilderness Stewardship

## **2.2. Email to Park Superintendents to Solicit the Names of Potential Survey Participants**

### **FIRST CONTACT**

[Occasionally beginning this email with a personal note if the Chief of Wilderness Stewardship knows the Park Superintendent....]

The Wilderness Stewardship Division is interested in determining whether and how climate change is influencing the management of Wilderness under NPS jurisdiction. To gather this information, we will survey a representative in each NPS unit that administers wilderness. Please designate an appropriate employee who can best serve as a contact for the survey. Ideal representatives will have a background in wilderness stewardship and/or climate change-related activities.

Our project lead is Katie Nelson, a Wyss Scholar in the Environmental Studies program at the University of Montana. To date, she's been focusing her research efforts on climate change and federal agency planning in the Greater Yellowstone Ecosystem. She has also been an AmeriCorps member and a Wilderness Ranger in the Eastern Sierra.

Please email the project lead, Katie Nelson, ([katherine3.nelson@montana.edu](mailto:katherine3.nelson@montana.edu)), with the name and email address of an employee who can best speak to either wilderness or climate change issues within your NPS unit—and preferably both.

Thank you,  
Garry

### **SECOND CONTACT**

Hello First name of Park Superintendent,

The Wilderness Stewardship Division is working to determine whether and how climate change is influencing the management of Wilderness under NPS jurisdiction. To gather this information, we are surveying a representative in each NPS unit that administers wilderness. Ideal representatives will have a background in wilderness stewardship and/or climate change-related activities.

We are appreciative for the many NPS units who have designated representatives for this survey (reference the attached spreadsheet). You are receiving this email because we have not yet received a response from your NPS unit. Note: We discovered the reply-address sent out in an earlier email was not working. Please reference the new email address below.

Our project lead is Katie Nelson, a Wyss Scholar in the Environmental Studies program at the University of Montana. To date, she's focused her research efforts on climate change and federal agency planning in the Greater Yellowstone Ecosystem. She has also been an AmeriCorps member and a Wilderness Ranger in the Eastern Sierra.

Please respond to both the project lead, Katie Nelson (katherine3.nelson@umconnect.umt.edu), and Chief of the NPS Wilderness Stewardship Division, Garry Oye (Garry\_Oye@nps.gov), with the name and email address of an employee who can best speak to wilderness or climate change issues within your NPS unit.

Please reply by this Friday, July 13th.

Thank you,  
Garry Oye

Background Information and Contacts:

PR Number: R2462120023

Award Number: P12AC10837

Project Number: UMT-281

Park/NPS Unit: WASO – Wilderness Program

Title of Project: Climate Change and National Parks Wilderness Review

Administered through the: Rocky Mountains Cooperative Ecosystem Studies

Unit Cooperative Agreement Number H1200-09-0004

RM-CESU Partner: University of Montana

Project Contacts

Principal Investigator: Len Broberg, EVST, University of Montana,

Missoula, MT 59812, 406-243-5209; len.broberg@umontana.edu

Student Intern: Katie Nelson, EVST, University of Montana, Missoula, MT 59812, kt.nelson02@gmail.com

Partner Administrative Contact: Joe Rasmussen, ORSP, Main Hall, University of Montana, Missoula, MT 59812; 406-243-5078; joe.rasmussen@umontana.edu

NPS Certified ATR: Ashley Adams, National Park Service, Wilderness Stewardship Division, Washington Office, PO Box 577 Yosemite CA 95389;

209-379-2038, fax: (209) 379-1853; Ashley\_adams@nps.gov

NPS Technical Expert: Garry Oye, National Park Service, Wilderness Stewardship Division, 702-895-4893, garry\_oye@nps.gov

THIRD CONTACT

Hello First name of Park Superintendent,

I wanted to check back with you to see if we could get a point of contact for common name for park unit that can respond to Katie's survey on Wilderness & Climate Change.

We are thinking it would take about 30 minutes. Let us know.

Thank you. Garry

## 2.3 Recruitment Email to Potential Participants

### FIRST CONTACT

Dear First name of participant,

In the next few days you will receive an email containing a link to an online questionnaire for a study being conducted by the NPS Wilderness Stewardship Division, The Aldo Leopold Institute, and the University of Montana.

As climate change alters designated wilderness, this study will help us understand how the National Park Service is responding on the ground.

This study is an important one. Only by identifying how park-units are dealing with these changes can we improve our ability to support work to sustain and nurture wilderness character.

You have been identified by your NPS unit's Supervisor as someone who could best represent your park unit in our survey. Each of the forty-nine NPS Superintendents who administer designated wilderness has identified representatives to take part in the survey. Each NPS Regional Director has also been contacted to ensure their approval for this project.

Thank you for your time and consideration. It is only with your help that our research can be successful.

Sincerely,  
Katie Nelson  
Project Lead  
NPS Wilderness and Climate Change Response  
University of Montana

P.S. Please direct questions about the study to Katie Nelson of the University of Montana at [katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu) or [760-920-9961](tel:760-920-9961). Direct any questions regarding wilderness stewardship to Erin Drake of the NPS Wilderness Stewardship Division at [erin\\_drake@nps.gov](mailto:erin_drake@nps.gov) or at [202-513-7130](tel:202-513-7130).

### SECOND CONTACT

Dear First name of participant,

Here is the brief survey on climate change in wilderness that we notified you about a few days ago. The partners working on this study (NPS Wilderness Stewardship Division, The Aldo Leopold Institute, and the University of Montana) have found that NPS

databases contain little information about which climate change activities are happening in designated wilderness. You have been identified by your NPS unit's supervisor as someone to represent your park unit in this survey. Your thoughts and experiences will help us understand how climate change is influencing wilderness stewardship on a system-wide basis.

Complete the survey by following this [link](#).

Please direct questions about the study to Katie Nelson of the University of Montana at [katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu) or 760-920-9961. Direct any questions regarding wilderness stewardship to Erin Drake of the NPS Wilderness Stewardship Division at [erin\\_drake@nps.gov](mailto:erin_drake@nps.gov) or at 202-513-7130.

Thank you for your response.

Sincerely,

Katie Nelson

Project Lead

Climate change in NPS wilderness study

University of Montana

### THIRD CONTACT

Thank you for participating in the climate change and NPS wilderness study. By voluntarily sharing your thoughts and experiences, you are helping us understand how climate change is influencing wilderness stewardship throughout the Park Service. We hope to have a response from you by the end of this week. If we do not hear from you by then, you can expect us to follow up with you again after the new year. Only with your generous participation can our research be successful.

You can complete the survey by following this [link](#).

Please direct questions about the study to Katie Nelson of the University of Montana at [katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu) or 760-920-9961. Direct any questions regarding wilderness stewardship to Erin Drake of the NPS Wilderness Stewardship Division at [erin\\_drake@nps.gov](mailto:erin_drake@nps.gov) or at 202-513-7130.

### FORTH CONTACT

Dear First name of participant,

A few weeks ago I emailed a survey to you that asked about how climate change is affecting wilderness stewardship in name of respondent's park unit. As of today we have not received a completed survey from you. The comments from those who have already responded indicate a wide range and degree of climate change concerns and related

stewardship activities. We think that the results are going to be very useful to NPS wilderness stewards and others.

I realize this has been a busy time of year. However, we are contacting you and others in hopes of obtaining the insights that only NPS employees in your position can provide. In an effort to protect your privacy, we will never attach to your name to your in any of our publications. Your response will ensure that name of respondent's park unit is represented in this system-wide survey.

To complete the survey, [click here](#).

Thank you for your participation.

Katie Nelson  
Climate change and NPS wilderness study  
University of Montana

P.S. If you have any questions or concerns about the study, feel free to contact me (Katie Nelson) at [katherine3.nelson@umontana.edu](mailto:katherine3.nelson@umontana.edu) or 760-920-9961. Please direct any questions regarding wilderness stewardship to Erin Drake of the NPS Wilderness Stewardship Division at [erin\\_drake@nps.gov](mailto:erin_drake@nps.gov) or at 202-513-7130.

## FIFTH CONTACT

### ***Telephone script for potential participants who had not yet contacted survey administrators***

Hey First name of participant,

This is Katie Nelson and I'm working on the climate change and wilderness study. You've probably gotten a few emails about it. At this point we've gotten pretty good response and we're *really* just trying to wrap things up. I wanted to make sure you get a chance to participate and to represent Name of respondent's park unit.

If you like, I can re-*email* you a link to the survey. The survey is fairly brief *but* it will help us get a sense for what, if any *climate change* activities are happening in NPS wilderness. We think your voluntary input *will be helpful* and we just want to give you this *one last chance to respond*. So thanks for considering it. We won't be contacting you anymore. But if you have any questions you can get in touch with me at 760.920.9961. We look forward to your response.

Thanks and have a good day.

*Telephone script for potential participants who had contacted survey administrators*

Hey First name of participant,

This is Katie Nelson and I'm working on the climate change and wilderness study. I know you've said that you guys will get to it, so that's great. I'm just following-up with my final reminders. (can pause here) We're really just trying to wrap up the study at this point. So let me know if you have questions. My phone number is 7609209961. Looking forward to your response. Hope you have a good day. Thanks and take care.



## **Appendix 3**

### Recommendations for future research

- What is the level of impact from stewardship activities?
- Qualitative description of stewardship activities
- How can we better articulate the effects of the hands-off approach upon wilderness character?
- How do these findings compare with other agencies?
- Is there a slippery slope toward active management?
- Is the hands-off approach the default approach?
- Is the burden of proof shifting from what warrants response to what warrants restraint?
- How does the carbon output/capture of wilderness compare with other land designations?



## Appendix 4

### Executive Summary

#### Study description

As scholars debate whether climate change warrants more or less active management in wilderness, this baseline study identifies what is happening on the ground. This study focuses attention on National Park Service (NPS) units that administer designated wilderness. Representatives who had been identified by the superintendents from each of these units responded to an online survey (with a 94% response rate). Respondents reported on their concerns, monitoring, and management projects driven by climate change happening in their wilderness. Respondents also discussed whether and how these activities affected wilderness character. This is the first study to characterize the response to climate change in wilderness at a national scale. In doing so it provides basic information to NPS administrators about what is happening in the field, it grounds the debate over appropriate approaches to wilderness stewardship with data about how wilderness coordinators are currently responding to climate change, and it also uses wilderness as a lens through which to examine ethical means for climate change adaptation.

#### Findings

A majority of park units (68%) that administer designated wilderness are conducting stewardship projects in their wilderness that have been designed to address and track the effects of climate change. A third of the park units were conducting management activities, 60% were monitoring, and many were doing both with regards to climate change. Several respondents commented that they were doing additional activities that went unreported in the survey because those activities had been related to climate change and not driven by it. Other park units mentioned that they were just beginning to address climate change. For those park units that were already doing so, invasive species and fire were among the topics most commonly of concern, monitored, and managed, regards to climate change.

Of the management actions addressing climate change, 60% had approved a 4(c) use to complete the task. These uses (motorized equipment, mechanical transport, and structures, for instance) are prohibited in Section 4.c. of the Wilderness Act, except as required to meet the minimum requirements for the administration of the area as wilderness. Yet fire-related activities were most likely to have a 4(c) approved at 93%.

This study also explored completion rates for Minimum Requirement Analyses (MRAs) with regards to management actions addressing climate change. MRAs are required by NPS policy to help wilderness coordinators to comply with the Wilderness Act and to determine appropriate stewardship actions in their wilderness. Overall 76% of the reported management actions had a completed MRA. Fire suppression was the management action least likely to have a completed MRA at 50%. However, prescribing fire, creating fire breaks, and thinning vegetation (unclear if the latter was a fire-driven activity) were actions with a 100% MRA completion rate.

Survey questions also asked respondents to describe changes in visitation frequency, amount, seasonality, and use-patterns happening in their wilderness that they attributed to climate change. A longer visitation season was the most commonly reported visitor use shift. A couple of park units had responded to this shift by extending patrols into traditional shoulder seasons. Decreased visitation was another reported shift, the reasons for which varied greatly—closures due to fire danger and hurricane debris, access issues due to washed out roads and damaged facilities, as well as drought. Park units responded by repairing roads and facilities.

Finally, the survey asked respondents how climate change-driven stewardship activities had impacted wilderness character. As park units respond to climate change in wilderness they cite perceived improvements to the natural quality of wilderness character. They also indicate that these activities harm the natural quality of wilderness character along with the untrammeled, undeveloped, solitude or primitive and unconfined recreation qualities.

## **Discussion and Recommendations**

Although the study succeeds in providing basic information to NPS administrators about what is happening in the field, it also demonstrates the need for greater transparency and accountability as these activities reportedly degrade wilderness character. Existing databases that track activities happening throughout the parks could also indicate which of these activities area happening in wilderness. They could also require that activities happening in designated wilderness have completed MRAs. MRAs themselves could be archived into a centralized database. This would ensure completion, provide accountability and transparency while also serving as an educational tool to teach wilderness coordinators what considerations need to be made to ensure appropriate wilderness stewardship.

The study also demonstrates that wilderness programs consider the financial implications of choosing to repair infrastructure and facilities damaged by the effects of climate change. Beyond that the study demonstrates the need to lengthen seasonal staffing periods in order to cover extending visitation seasons.

These findings give those discussing appropriate stewardship responses the fabric within which to sew their arguments. The wilderness stewardship debate has often framed the active approach as improving the natural quality of wilderness character and the hands-off approach as improving the untrammeled quality. However, these data demonstrate that such decisions are not a simple trade-off between two values.

Finally, this study explores lessons learned from climate change adaptation in wilderness that may be applicable to adaptation activities happening elsewhere. Prohibiting 4(c) uses teaches us that we can creatively avoid uses that emit greenhouse gases as we adapt to climate change. Decisions to act or to refrain from doing so can improve and degrade different qualities of wilderness character. Wilderness character thus demonstrates that the relationship between humans and nature is complex.