

Challenges and Opportunities in Alaska Fire Management: Adapting to Climate Change

A Practitioner's Report on Interview Findings by Tait Rutherford and Courtney Schultz (PI)

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Firefighters on a prescribed burn fuel break at Fort Richardson Army Base. *Photo: R. Jandt*

Executive Summary

Under projected patterns of climate change, models predict an increase in wildland fire activity in Alaska, which is likely to strain the capacity of the fire governance system under current arrangements (Melvin et al., 2017; Pastick et al., 2017). The Alaska wildland fire governance system consists of the actors, networks, and institutions, including policies and laws, that influence wildland fire management. This system is already adjusting to the effects of a changing climate, but future climate change presents significant uncertainties, with possible higher interannual variability for fire extent and severity that may necessitate new approaches to fire management (Kasischke et al., 2010; Rupp et al., 2016).

This report presents the results of interviews that we conducted as part of a broader Joint Fire Science Program (JFSP) project on the future impacts of climate change on fire management in Alaska. Our team assessed fire regime projections using the Alaska Frame-Based Ecosystem Code (ALFRESCO) model and interviewed fire managers to understand perceptions of challenges and strategies in the governance system, specifically regarding anticipated changes to fire regimes as a result of climate change. We synthesized our interview data to create future fire governance alternatives, which we will later input into the ALFRESCO model to project fire regime scenarios. Throughout this process, we are working iteratively with the fire management community, with the primary goal of understanding the implications of future management alternatives for fire regimes and whether changes to current management approaches may be desirable.

In interviews, our research objectives were to understand:

1. Current priorities for fire management and how these might change in the future;
2. Advantages and challenges associated with the current fire governance system, particularly in regard to adapting to climate change; and
3. Future needs, opportunities, and potential avenues for improving fire management and fire governance in Alaska.

We conducted 41 hour-long interviews with individuals from the fire and land management agencies, Alaska Native consortia, and boroughs. We then used standard qualitative methods to organize and analyze the data according to our research objectives. We are delivering these findings to our interviewees and the broader fire management community to gather feedback and refine our recommendations for facets of fire governance that may require change or policy attention in the years to come. We also used interview data to assess and characterize two future management alternatives, including (1) extending full and critical management option buffers around communities and known sites and (2) implementing large-scale fuel breaks, which correspond to reduced flammability for areas of treatment. We will evaluate these management alternatives in contrast to a baseline management approach that depicts a continuation of current management options. We will perform this evaluation using the ALFRESCO model to determine potential impacts of different management approaches on fire regimes and vegetation.

Interviewees indicated multiple management priorities to protect a variety of values held by the public, politicians, and ANCSA Corporations. We classified these values into three broad categories as follows:

1. Values requiring fire protection: human life and property, infrastructure, cultural sites, natural resources (e.g. timber), and carbon sequestration;
2. Values reliant on the occurrence of fire: maintenance of natural, fire-dependent ecological processes and conditions and the enhancement of wildlife habitat, especially for subsistence use, although agencies also may protect certain areas of

old-growth habitat from fire to preserve subsistence opportunities (e.g. caribou winter range); and

3. Broader values not directly related to fire management: efficiency with the use of public funds for fire management and fire management as a source of employment.

Interviewees explained that the diverse values may conflict, and that during times of high fire activity, the agencies sometimes must prioritize suppression resources because not all values can be protected.

According to interviewees, the advantages of the current system include the strong relationships and communication among agencies, annual interagency meetings sponsored by the Alaska Wildland Fire Coordinating Group (AWFCG) to discuss needed changes to fire management, collaborative arrangements among the agencies and local governments and stakeholders, and the agencies' use of research and science to improve management.

Despite the advantages to the current interagency arrangements, interviewees also saw potential for improvement in some specific areas of communication among actors in the governance system. For example, interviewees mentioned the opportunity for more involvement with and education of the public, politicians, and ANCSA Corporations to improve communication of values and understanding of agency limitations. To improve planning and the communication of land management goals, interviewees said the jurisdictional agencies could be more involved in fire management planning, while the protection agencies could be more involved in land management planning. Interviewees also discussed two challenges associated with periods of high fire activity, including lack of capacity to protect values that rely on suppression and the potential for more frequent extraordinarily large and high severity fires that may present too much risk to allow them to burn without the use of suppression tactics. Almost all interviewees focused primarily on the immediate challenges of limited staff and funding, which strain their capacity for all aspects of fire management.

Interviewees mentioned some possible changes in fire management policy and approaches that might be necessary to address anticipated challenges associated with climate change. These changes include: the minimization of conflicting and overlapping policies between agencies, broad changes in fire management option designations, and increased use of fuels reduction work. Interviewees discussed incongruence and inefficiencies among agencies in cabin protection policies and certification and permitting policies. Regarding future management approaches, interviewees explained that agencies may consider expansion of full and critical management option buffers around communities to mitigate elevated risk from extraordinarily large fires under climate change. Interviewees also discussed many potential benefits of increased use of fuel breaks and fuel treatments in a scenario of increased fire activity under climate change, including easing suppression around communities, being able to allow more natural burning on the landscape relatively near communities, and enhancing wildlife habitat.

In summary, our interview data shows that the fire governance system in Alaska is adaptive to change but faces some capacity limitations that may require changes in interagency policy, structure, or management goals. Based on the challenges and suggestions most commonly mentioned by interviewees, we recommend a focus on four key issues to address going forward: (1) budget processes and allocations; (2) staffing strategies to build capacity; (3) values for protection that may present controversy or challenges; and (4) considerations of climate change adaptation and mitigation in fire management.

1. Introduction

Alaska's boreal forests and tundra ecosystems rely on the regular return of wildland fire to maintain ecological integrity (Kasischke et al., 2010). Rising temperatures and drying soils have recently caused an increase in the frequency of fires, average annual area burned, and average length of the fire season (Kasischke & Turetsky, 2006; Kelly et al., 2013). Fire regime models project these increases will continue with future climate change (Young et al., 2016; Pastick et al., 2017). Higher severity fires will likely cause transitions in vegetation regimes, resulting in loss of ecosystem services to human communities (Chapin et al., 2008; Rupp et al., 2016). More frequent large fire years, with high numbers of ignitions and area burned, may strain the ability of Alaska's fire management agencies to protect properties, cultural sites, infrastructure, and valued natural resources (Kasischke et al., 2010). Federal and state funding for fire suppression will need to increase to sustain current management approaches if fire activity increases under climate change (Melvin et al., 2017).

To manage wildland fire, the land managers, land owners, and stakeholders participate in a fire governance system, consisting of the actors, networks, and institutions—including the rules, laws, regulations, policies, and social norms—that influence how fire is managed. In Alaska, the actors involved in fire management include federal and state land management agencies and Alaska Native Corporations (collectively called “jurisdictional” agencies), three separate suppression agencies (called “protection” agencies), Alaska's boroughs, and municipalities and other private landowners (Alaska Wildland Fire Coordinating Group, 2016). In addition to these individual agencies, several interagency organizations and agreements coordinate fire management policies and operations, such as the Alaska Interagency Wildland Fire Management Plan, written and overseen by the Alaska Wildland Fire Coordinating Group (AWFCG) (U.S. Department of the Interior, Bureau of Indian Affairs, et al., 2016). While the fire governance system in Alaska has been facing a changing climate and adapting to the demands of more frequent large fire years over the past few decades, future climate change presents major uncertainties regarding fire extent and effects, with possible greater interannual variability and more years with high fire activity compared to the past (Kasischke et al., 2010; Pastick et al., 2017). To continue to protect key values, managers will likely

require increased resources and workforce capacity (Melvin et al., 2017).

This report summarizes interviews we conducted as part of a larger Joint Fire Science Program project to understand how the fire governance system in Alaska will respond to the challenges of climate change. Our goals were to understand the following:

1. Current priorities for fire management and how these might change in the future;
2. Advantages and challenges associated with the current fire governance system, particularly in regard to adapting to climate change; and
3. Future needs, opportunities, and potential avenues for improving fire management and fire governance in Alaska.

This report presents our findings and offers some draft recommendations, based on interviews, in an effort to contribute to the interagency dialogue about preparing for the future of fire management in Alaska. We are also using the information gleaned from interviews to complete the next step of our project, which involves building different management alternatives into modeled fire regime projections using the ALFRESCO model to explore implications for operations and resources into the future.

2. Project Overview and Methods

This paper is a product of a Joint Fire Science Program (JFSP) project entitled *Impacts of Climate and Management Options on Wildland Fire Fighting in Alaska: Implications for Operational Costs and Complexity under Future Scenarios*. Principal Investigators include Courtney Schultz (Colorado State University [CSU]), Paul Duffy (Neptune, Inc.), and Nancy Fresco (University of Alaska, Fairbanks); Randi Jandt (Alaska Fire Science Consortium [AFSC]) is a project collaborator, and Tait Rutherford, who conducted the interviews, is a master's student in Forest Sciences at CSU. The project's broader objectives are to assess current fire regime projections, develop future management alternatives, and use these alternatives to create fire regime scenarios and explore their implications for management costs and decision making. We are using the Alaska Frame-Based Ecosystem Code (ALFRESCO) model to develop the fire regime projections (Rupp et al., 2000). The project involves several steps and products (see *Table 1*).

For the interviews that are the basis of this report, we recruited participants from AFSC general contact

lists and the 2017 Interagency Spring Fire Operations Meeting attendee lists. We began by contacting individuals who our team believed could inform our research objectives, and we conducted additional interviews based on interviewee recommendations until we reached information saturation. We strove to obtain a diverse a set of perspectives and information. Data collection began with an online pilot questionnaire targeted to individuals who had participated in a February 2017, AFSC-sponsored webinar to introduce our project and the beta-version of our fire regime projections website; the questionnaire consisted of seven open-ended questions about current challenges in fire management and the usefulness of our fire regime projections website (see *Table 1*). We received 20 responses to the questionnaire, and we used this information to develop and improve the website and to help structure our interview protocol.

Interviews were confidential and conducted in accordance with requirements and approval from CSU’s Institutional Review Board. Since March of 2017, we have conducted 41 interviews with individuals from the following organizations:¹

- Alaska Department of Fish & Game (ADF&G)
- Alaska Department of Natural Resources, Division of Forestry (DOF)
- Alaska Native consortia
- Borough emergency services departments

- U.S. Department of Agriculture (USDA), Forest Service (USFS)
- USDA, USFS, State & Private Forestry
- U.S. Department of Defense military bases, fire operations
- U.S. Department of the Interior (DOI), Bureau of Indian Affairs (BIA)
- DOI, Bureau of Land Management (BLM)
- DOI, BLM, Alaska Fire Service (AFS)
- DOI, Fish & Wildlife Service (FWS)
- DOI, National Park Service (NPS)

We recorded and transcribed interviews, then systematically analyzed them using coding software that allows us to assign codes (i.e. labels) to excerpts of text and view all excerpts under each code and in context. Coding allows us to identify and analyze themes in the data. We also wrote brief summaries of each interview. We then created memos according to codes (e.g. “management priorities” or “capacity challenges”) and associated excerpts. This process allowed us to collate and analyze the large amount of interview data to understand the fire governance system and reflect on what interviewees told us. We derived the results that follow entirely from interview analysis and interviewees’ own statements.

Table 1: Project milestones and delivery dates

Project Milestone	Description	Delivery Date
Introduction of project	Present project overview at the Interagency Fall Fire Review.	Oct. 2016
Introduction of initial fire regime projections website	Present webinar of beta-version of fire regime projections website. Available at https://www.frames.gov/partner-sites/afsc/events/previous-events/previous-webinars/duffy-schultz-feb-2017/	Feb. 2017
Online pilot questionnaire	Gather initial response to the fire regime projections website and perceptions of current challenges in fire management through an online questionnaire.	Feb.-Mar. 2017
Interviews	Conduct interviews with fire managers.	Mar.-Sep. 2017
Presentation of interview data	Present to the fire management community this practitioner’s report summarizing our interview findings.	Oct. 2017 Interagency Fall Fire Review
Workshop: presentation and analysis of management alternatives	Present outputs of the fire regime projections model under future management alternatives in a workshop setting to explore implications of management alternatives.	Spring 2018 Interagency Spring Operations Meetings
Synthetic analysis and additional science delivery	Synthesize findings from all phases of our project for publications, policy briefings, and science delivery at conferences and via webinars.	Spring and Summer 2018

¹ Some specifics omitted for confidentiality

3. Results

In this section, we summarize our interview findings. First, we identify constraints, pressures, and values that shape priorities and drive decision making for “the agencies,” meaning the federal and state jurisdictional and protection agencies. In the second section, we discuss advantages and challenges associated with current governance structure and policy. Finally, we examine strategies for the future that managers suggested to meet potential challenges posed by projected capacity limitations and climate change.

I. Current Fire Management Priorities

Interviewees explained that the agencies set priorities based on state and federal law and external pressure from the public and politicians. Jurisdictional agencies manage fire in accordance with their mandates and missions under a variety of laws.² These laws include mandates to consider and balance public interests.³ Within these laws, the agencies have some discretion over planning and prioritization, but as one interviewee explained, the laws and agency rules put significant limits on agency priorities:

Yeah, it's not really what [the agency] wants. [The agency] has some direction that has been established through the Department of the Interior, Congress, and the president. ... We have a mission and we get a certain amount of ability to do things the way we think is best, but we're kind of held to the sideboards of various laws and public land orders and processes that are over our heads.

Interviewees also emphasized two federal acts that set parameters on prioritizing specific valued resources. The Alaska Native Claims Settlement Act of 1971 (ANCSA) requires that the federal government provide fire suppression to all Native Corporation land and all Native allotments. Under ANCSA, “So long as there are no substantial revenues from such lands they shall continue to receive wildland fire protection services from the

United States at no cost” (43 USC 1620(e)). Native Corporations communicate directly with the protection agencies as jurisdictional agencies via ANCSA authority. The second federal law affecting fire management is the Alaska National Interest Lands Conservation Act of 1980 (ANILCA), which requires that federal agencies prioritize subsistence use of natural resources by rural Alaskans over non-subsistence use (16 USC 3114). ANILCA also states that public lands use, consistent with existing land management principles, including fire management, should have as little impact on rural Alaskans dependent on subsistence uses as possible (16 USC 3112(1)).

Interviewees mentioned a wide array of values that influence fire management priorities. We have organized these values into three categories (see Table 2). **The first category of values is reliant on protection from wildland fire, provided by a combination of suppression tactics and the use of fuel breaks and preparedness measures.** Virtually all the actors within the governance system agree that protection of human life is the primary priority in fire management; the agencies value firefighter safety and the protection of communities and primary residences above all else. Interviewees consistently said that remote cabins or undeveloped Native allotments will sometimes receive lower priority than other property during periods of high fire activity because remote sites draw heavily on response resources relative to road-accessible areas. The agencies may suppress fires for various other reasons, including preservation of cultural sites, protection of tourist sites, or prevention of smoke pollution. ANCSA Corporations may protect swaths of forest as greenhouse gas pollution offset credits⁴ or as timber for biomass.⁵ Finally, a few interviewees mentioned the future potential for placing value on the protection of permafrost for carbon sequestration. As with the protection of carbon offset credits, interviewees expressed concern that protecting large areas of permafrost would entail a suppression capacity that currently does not exist.

While maintenance of life, property, cultural sites, and tourist sites requires suppression, the

² See, e.g.: 16 USC 668dd; 16 USC 1600 et seq.; 43 USC 1701 et seq.; 54 USC 100101 et seq.; AS 16.05.010 et seq.; AS 41.17.010 et seq.

³ See, e.g.: 16 USC 1612(a); 16 USC 3191(d); 43 USC 1712(c)(9); AS 30.04.065(d)

⁴ See: Tribal Carbon Partners (2017)

⁵ The protection of forest for economic reasons has sparked discussion among the agencies about invoking the “substantial revenue” limitation written into ANCSA (43 USC 1620(e)) due to the high cost of protecting large areas of timber. This would move protection of the land under state fiscal responsibility, however, which would fail to resolve the fundamental challenge associated with limited resources to protect values-at-risk.

Table 2: Interests and values that drive Alaska fire management

Relationship to fire	Values
Values that require protection from fire	<ul style="list-style-type: none"> · <i>Cultural and paleontological sites</i> · <i>Human life</i> · <i>Permafrost or timber for carbon sequestration</i> · <i>Property</i> · <i>Reduction of smoke pollution for health</i> · <i>Subsistence hunting opportunities (e.g. caribou winter range)</i> · <i>Timber as carbon emissions offset credits</i> · <i>Timber for biomass or other commercial purposes</i> · <i>Tourist sites and viewshed</i>
Values that rely on fire	<ul style="list-style-type: none"> · <i>Natural ecological processes</i> · <i>Subsistence hunting opportunities (e.g. moose browse)</i> · <i>Wildlife habitat enhancement</i>
General fire management priorities	<ul style="list-style-type: none"> · <i>Efficiency with taxpayer money</i> · <i>Employment opportunities in fire management</i>

agencies otherwise allow natural fire ignitions to burn. As most interviewees agree, Alaska offers a unique opportunity to allow natural fires to burn for ecological benefit due to the low population density relative to the conterminous United States. One interviewee explained, “*Kind of the glory thing about Alaska is really across the board ... [the agencies] have kind of the same vision on fire management and fire [being] good on the landscape.*” While climate change has increased fire activity, the agencies still try to allow fire on the landscape as often as they can. One interviewee said,

We don't seem to have gotten into the situation where we're trying to manage for some landscape that would occur in the absence of climate change. ... Even though we may be experiencing more fires ... we haven't said, well, our goal is to have this many acres burn over a ten-year period but then not some other number because this other number is inflated as a result of climate change.

Two agencies specifically manage for enhancement of wildlife habitat.⁶ Interviewees mentioned that the U.S. Fish and Wildlife Service (FWS) and Alaska Department of Fish & Game (ADF&G) prefer to see natural fires burn when possible to create a diversity of habitat on the landscape. Where this is not possible, ADF&G would like to see increased use of prescribed fire to enhance wildlife habitat. On the other hand, while habitat enhancement usually implicates allowing fires to burn, the subsistence mandate in ANILCA

complicates habitat management by requiring agencies to consider protecting habitat through suppression in certain areas. In particular, the ANILCA subsistence mandate has recently prompted the protection of caribou winter browse in old-growth black spruce forest in the Kanuti National Wildlife Refuge to maintain hunting grounds for nearby rural villages due to extensive loss of old-growth stands in that refuge in 2004 and 2005.⁷ According to a few interviewees, this has created some value conflicts for the wildlife management agencies because it contradicts the natural processes paradigm and inhibits moose habitat enhancement.

Some interests are unrelated to increases or decreases in suppression, including careful use of resources and employment opportunities. Agencies said they try to spend public dollars efficiently; similarly, a few interviewees from the protection agencies said suppression operations must identify acceptable amounts of risk to be more efficient with resources. A second interest relatively unrelated to suppression is the desire for fire crew employment opportunities among rural Alaskans, especially Alaska Natives. Interviewees said Alaska Native non-profit consortia try to maintain Type 2 Initial Attack crews or Emergency Firefighter (EFF) crews with Native preference hiring to create local employment opportunities. As part of this, the consortia or the villages will often push for suppression or for more fuels projects to create work for the villages.

⁶ See: 16 USC 668dd(2); AS 16.05.020(2)

⁷ See: U.S. Department of the Interior, Fish & Wildlife Service (2012)

Prioritizing among values is a critical part of fire management and underlies many of the challenges that the agencies currently face, because they have not had the capacity to satisfy all interests and meet all requirements during recent large fire years. Large fire years may force agencies to balance protection of remote sites against saving resources for anticipated ignitions closer to inhabited areas. The agencies also cannot allow unbridled burning for natural processes; sometimes they must balance allowing a fire to burn on public land against risk of it spreading toward adjacent communities.

II. Advantages and challenges within the current fire governance system

a) Current advantages: adaptability and efficiency

According to interviewees, the effectiveness of the current fire governance system in Alaska lies in the strong relationships among the agencies. While interviewees mentioned several areas in which communication within the governance system could be improved, as we show in the following section, interviewees explained that the separation of the protection agencies from the jurisdictional agencies forces them to maintain constant lines of interagency communication. Protection agency fire management officers (FMOs) work hard to build good relationships with the jurisdictional agencies and landowners to constantly be aware of how they should respond to a fire in any location or situation. An interviewee explained,

Having that need for communication between the jurisdictional and the protection agencies, we have a pretty good working relationship with all the other agencies. ... It's not one of those, 'I haven't talked to that individual in a couple of months.' It's, 'I haven't talked to that individual in a couple hours' about something.

In general, interviewees said that interagency coordination in Alaska is very healthy. Documents such as the *Master Agreement* and the *Alaska Interagency Wildland Fire Management Plan* codify the interagency system by clearly defining agency responsibilities. In the words of one interviewee,

The way the document is written, the Master Agreement that is, it clearly defines who is responsible for what. And that right there sets the stage for a successful relationship between the agencies. It's clearly defining who does what and who is responsible.

In addition, interviewees noted that the biannual interagency meetings sponsored by interagency organizations such as the Alaska Wildland Fire Coordinating Group (AWFCG) allow the agencies to refine planning and operations.

Outside of the interagency system, interviewees said that the agencies benefit from collaboration with local governments and the public. The agencies make strong efforts to communicate to communities and private landowners how preparedness measures can help with protection. Prevention officers for Alaska Division of Forestry (DOF) host public education programs on fire preparedness and prevention throughout the state. In addition, local collaborative initiatives coordinate large-scale, cross-jurisdictional fuel breaks, preparedness, and recovery projects. Many interviewees cited the Kenai Peninsula's All Lands/All Hands group, which coordinates planning and resource sharing for fuels projects between federal, state, Alaska Native, and local governments, as an ideal example of collaborative fire management.⁸ A few interviewees also said that some of the agencies would like to set up groups like the Kenai All Lands/All Hands group in other areas, but that such collaborative work is often not feasible outside of the more densely populated regions of the state such as the Kenai Peninsula or the Fairbanks area.

Interviewees mentioned a few mechanisms in the current governance system that enable adaptability to change. For example, the biannual interagency meetings allow agencies to continually refine fire management based on current circumstances and values. The agencies also try to use science and research to inform management decisions. An interviewee explained this effort to continually improve:

We're always preparing and trying to do forecasting of what we need and what we need to be doing to do our jobs correctly, safely, and then also looking at ways to do it better. Trying to stay aware of innovation, new tools, tools that maybe

⁸ See: U.S. Department of Agriculture, Forest Service, et al. (2004)

fire [management] hasn't used before, but bringing them into fire [management] to increase our abilities to be responsive and do our jobs better.

In part, this effort to improve operations and communication has resulted from a widespread realization among the agencies that they must anticipate climate change and the need to better understand its effects. One interviewee mentioned that *“climate change and such is causing the [jurisdictional agencies] to have to sit down and have more conversations with the [protection agencies] and look at fire science.”*

b) Current challenges I: Improving communication for planning

Despite the strong interagency relationships and collaborative arrangements that interviewees described as advantages to the current governance system, many interviewees identified specific areas in which lines of communication among various groups in the governance system could improve. **Interviewees suggested including a broader array of actors in the governance system will improve communication regarding values and limitations.** For example, a few interviewees mentioned that the inclusion of Department of Defense (DOD) agencies in the *Master Agreement* would facilitate billing between the protection agencies and DOD. Interviewees also explained that despite current agency efforts, there is a need for more education and outreach. Interviewees said this would help with communication of values and priorities between the agencies and other groups in the governance system, including ANCSA Corporations, communities, and politicians. According to one interviewee, *“[The agencies] need to be the conduit to provide some of the information. People, grants, and stuff like that, opportunities for people, to give them an incentive to do that kind of [preparedness] work. That is a challenge.”* At the same time, some agency interviewees suggested that the public and the ANCSA Corporations may have opportunities to involve themselves to a greater extent in fire management to improve preparedness and their understanding of the limits and priorities of the agencies.

Within the governance system, interviewees felt that some groups of agency personnel could become better involved in fire management to improve the system. Some interviewees, for

example, suggested that the state jurisdictional agencies could consider fire risks when zoning and selling or leasing land. Many interviewees felt that the jurisdictional agency administrators could also be more involved in fire management. The agency administrators manage public lands resources and write the land and resource management plans that inform fire management planning. Involving agency administrators more directly in fire management would improve the communication of landscape goals to the protection agencies so that they could tailor suppression decisions and implement more targeted fuels work. Interviewees felt both that agency administrators need to work to involve themselves in fire management more and that the protection agencies need to reach out more to the agency administrators. One interviewee said,

We're having to consciously integrate between the Alaska Fire Service and [the] field and district offices, push them together basically to have those conversations. And I think as fire regimes are changing ... the resources side [has] to sit down and have more conversations with the fire side and [look] at fire science.

An interviewee explained that some agency administrators have begun to attend the annual interagency fire management meetings in order to become more involved in fire management.

Many interviewees also felt that the jurisdictional agency FMOs need to become more involved in the annual review of management option designations in the Alaska Interagency Wildland Fire Management Plan (AIWFMP). Some of the protection agency interviewees believed that significant inconsistencies in the management options map need to be addressed. For example, one interviewee explained that the agencies have not holistically reviewed the original management option designations:

And that's the problem with our fire plan, is that it was a product of ANILCA and that was the driving force in the funding to get these groups together to initiate the plan. ... But there really hasn't been a mechanism to bring that same group together, the current participants, and review the management options.

A few interviewees from the protection agencies suggested the creation of an interagency, interdisciplinary team that would work exclusively on management option changes. Such a team would review the current management options map in detail,

replacing the current annual review system, to fix any inconsistencies across management areas or needed changes based on changes in valued resources. As one interviewee described,

[I]t could be a multi-agency group. That's their task, to re-look at the fire plan and protection level. ... They fully understand all the procedures they need to follow ... and I think if you had a group that did that, it would get pretty good at going through that process.

On the other hand, interviewees from several agencies, including AFS, felt the protection agencies could focus more on fuels work and land management considerations. Several interviewees noted that the protection agencies are relatively specialized in suppression activity. In the words of one interviewee,

[AFS] is built to put everything out. That's changed over the years and we've tried to adjust a lot of our thinking and adapt to ... science and jurisdictional management resource requests. We could do a better job at that.

Many of the jurisdictional agencies would like to allow more fire on the landscape, but the protection agencies may not want to accept the risk of allowing natural fires to burn. An interviewee explained:

[The jurisdictional agencies try] to convince the suppression resources what the intent is there. What [the protection agencies] see when they arrive is the large fuel column next to a town. So just automatically they're trained to put fires out. ... [I]t's really hard to get strategy to the boots on the ground in a timely manner. So, action was taken on the fire; perhaps less action would have been okay. But what would have happened in a no action? So, it's a balance.

c) Current challenges II: Capacity and resources

Interviewees emphasized that challenges in fire suppression arise in particular during large fire years,⁹ which pose a threat to multiple types of values, and models indicate they may become more frequent.¹⁰ On the one hand, large fire years strain the capacity of the protecting agencies. The agencies are accustomed to dealing with these events about once per decade, but interviewees expressed

concern that if the frequency of large fire years increases under climate change, the agencies will more often not be able to protect the valued resources that they intend to be protecting. One interviewee explained,

That's something you see in larger fire seasons up here is that resources become thin, and incidents are prioritized so you can figure out where to allocate limited resources, because it's not possible to give every incident what it may need or what it may want.

On the other hand, even if the agencies were to have unlimited suppression resources, they worry that they might lose the ability to allow fire on the landscape, due to ecosystem transitions and risk to communities as a result of unusually large and severe “megafires.”¹¹ As one interviewee said, “*If we start seeing huge megafires going on all the time, you know there's going to be resistance to allowing any fires to burn naturally because there's too much risk in it.*”

Most interviewees focused on challenges stemming from limited capacity; interviewees said that insufficient funding has affected operations, fuels projects, and hiring. During large fire years, agencies in Alaska borrow equipment and staff from their counterparts in the conterminous United States, but borrowing will not be available if fire seasons lengthen in both the Lower 48 and in Alaska. An interviewee explained,

We're bringing resources up from the Lower 48 to supplement our resources. At some point in time, that pipeline's going to slow down [due] to the fact that they're having increasing [fire] activity, as well, and they're not going to be readily available.

The protection agencies also are concerned that changes in shared interagency equipment and staffing policies under nationwide federal agency regulations will reduce operations capacity in Alaska. DOF and Alaska Fire Service (AFS), for example, want to make sure that fuel-efficient air tankers suited to the long-distance flights common in Alaska suppression operations remain available for use. It is also becoming more difficult for the protection agencies to afford EFF crews, due to requirements for increased training and growth in crew size. These specific issues are symptomatic of broader capacity challenges affecting Alaska as a result of nationwide regulations. An interviewee stated,

⁹ For an explanation of large fire years as a result of annual variation in Alaska fire activity, see: Duffy et al. (2005).

¹⁰ See: Rupp et al. (2016)

¹¹ See: Stephens et al. (2014)

Nationally, there's been reductions in overall work force and an increase in number of technical positions and whatnot. We've made things more complex, in other words. And so, you need more people to do the same job and with reduced numbers of people, it's making it more and more difficult to attain what our intent is and what we said we would do.

Interviewees mentioned that many of the agencies would like to implement more fuel breaks to ease potential suppression or enhance habitat, but funding for fuels projects is limited, especially in Alaska, where fuels projects are unusually expensive and unlikely to encounter a natural ignition before regrowth. In remote areas, suppression is often cheaper than implementing a fuel break. An interviewee explained, “[I]n general, I think I could say that fires, especially in Alaska suppression-wise, are a lot cheaper than fuels work.”

To ease funding challenges, interviewees suggested possible changes in budgeting processes or more pooling of funding sources among agencies. For example, many interviewees explained that fire budgeting for the Department of the Interior (DOI) and the Bureau of Land Management (BLM) uses risk-based statistical models designed for suppression operations in the conterminous United States; those model do not always apply well in Alaska where values to protect are different, the interagency governance structure is different, and suppression operations often focus on protection of sites rather than minimization of acreage burned. Other interviewees suggested consideration of innovative funding structures used by other states, such as purchasing insurance for the state suppression agency or implementing a flat annual tax on property located in the wildland-urban interface (WUI). Interviewees also explained that collaborative governance arrangements may help agencies and communities obtain money from federal grant pools, such as Cohesive Strategy funding, for fuels projects. For example, municipalities and villages with Community Wildfire Protection Plans are more likely to be able to win federal grants. Interagency organizations such as the Kenai Peninsula All Lands/All Hands group have been able to pool money from various sources: while communities in the Kenai Borough can get federal grants, ADF&G can use Federal Aid in Wildlife Restoration (Pittman-Robertson) Act funding for fuels projects as habitat enhancement, the Chugachmiut Alaska Native non-profit organization can use Reserve Treaty Rights

Lands (RTRL) program funding from the Bureau of Indian Affairs (BIA), and FWS and DOF can use their own operating budgets.

Limited funding is interrelated with staffing challenges. **Interviewees expressed that funding directly affects the ability of agencies to retain staff and hire new staff.** Many interviewees mentioned several other issues associated with staffing at multiple levels, including: lack of competitive pay in firefighting jobs relative to similar types of work; workforce demographic shifts toward white-collar careers, resulting in fewer recruits for firefighting jobs; consolidation of jurisdictional agency fire offices and closing of protection agency outstations; lack of experience among fire managers; a need for more flexibility in staffing regulations; limits on the sharing of staff across agencies; and lack of fire-related positions in jurisdictional agencies.

With the scarcity of personnel at many levels, interviewees said the agencies lose capacity for suppression operations and fuels projects. A protection agency interviewee explained,

I think right now really [our primary challenge is] just the numbers of staff for the positions we've got. We're very, very lean. I think we were before we had budget cuts and even more so now. So, the lack of resources in terms of just people. And then also, we have a fairly high turnover rate so I think a lot of the experience that we had at one time, we don't have anymore. ... I guess what that means ... is we're in a never-ending training cycle.

To solve staffing issues, interviewees suggested more localized decision making on staffing levels, longer staffing seasons for seasonal employees, and easier processes for interagency hiring and staff sharing for projects.

III. Future Management Strategies

To improve on the current situation and address challenges associated with anticipated climate change, interviewees suggested some changes in fire management policy and approaches going forward. Interviewees explained that coalescing interagency policy in a few areas to prevent policy gaps, conflicts, or redundancies could improve the efficiency of the governance system. **Interviewees emphasized two primary types of policy incongruence in the governance system, including remote cabin protection policy and the agency certification and permitting processes.** Protection policy for remote

cabins is not uniform across jurisdictional units. In addition, when the jurisdictional agencies do not have cabin protection policies (e.g. BLM), the protection agencies have their own policy on whether they should protect a remote structure. One interviewee explained cabin protection policy:

The issue with cabins, and it's constantly an issue up here, is whether or not a cabin is going to receive protection or not. ... Each agency has a cabin protection policy, and not all the agencies are aligned with their cabin protection policies. Each agency is a little bit different. ... Regardless, if it's inhabited, and even if it's in a no-protect area, [the protection agency] typically will take action on that. If it's not inhabited, and it's not in an area that receives protection, then [the protection agency] typically [doesn't] take action. ... I mean, it gets to be pretty expensive, pretty fast if you protect cabins. I understand both sides of the coin. It's just, it's always going to be an issue for us.

The protection agency FMOs are often reluctant to allow any structure to burn, but agency policy may dictate that they should not protect certain structures, such as an uninhabited trespass cabin.

The second area of policy incongruence is agency certification and permitting. **Overlaps in administrative requirements create significant inefficiencies and delays in projects.** For example, when agencies share air resources, they may not recognize each other's certification and safety inspections, and similar inspections may occur multiple times for a single use of an aircraft. The agencies also do not recognize each other's personnel training certifications, such as ATV/UTV use training. As one interviewee mentioned,

I think one of the worst things is that we don't accept each other's training. That hampers us so much. ... [A]s long as these policies are built for not for the intent but for the convenience and the risk management of something else other than intent, we're wasting time and energy and money.

Interviewees also discussed two broad ideas for changes in management approaches to address anticipated challenges associated with climate change, including broad changes in management options and increased use of fuels work. These two ideas formed the basis for our future management alternatives with which we will modify our fire

regime projections outputs using the ALFRESCO model. **We talked with many interviewees about the possibility of broad management option changes in response to either higher risk or limited resources.** These interviewees generally explained that the expansion of critical, full, and modified management option designations to avoid risk is much more likely than their reduction to avoid expense. On the other hand, interviewees also explained that expanding management option buffers around communities to reduce hazard to those communities during increasingly frequent times of high fire danger¹² is much more likely than designating wide swaths of forest under the full or modified management option to protect carbon sinks and avoid the occurrence of unusually large and devastating fires. Many interviewees expressed concern that excessive suppression would lead to fuel buildup and exacerbate future fire severity.

An additional fire management approach interviewees discussed was an increased use of large-scale, cross-jurisdictional fuel breaks to address increased fire activity anticipated with climate change. These would facilitate potential suppression around communities and allow some natural burning relatively closer to communities. While fuels work is prohibitively expensive around many of the more remote sites and communities in Alaska, many interviewees said that the creation of fuel breaks around road-accessible communities and in more densely populated areas would make future suppression operations easier. Many interviewees cited recent successes of large-scale, cross-jurisdictional fuel breaks created by the Kenai All Lands/All Hands group on the Kenai Peninsula as evidence to support greater funding and collaboration for fuel breaks.

A few interviewees also explained the perceived benefits of increasing prescribed fire application in the future to accomplish both fuels reduction and habitat enhancement. As one interviewee said,

I see potential because habitat enhancement, prescribed fires, these two things can be paired with wildland fire mitigation for communities. We've got a lot of tiny communities or little groups of parcels that have structures on them that would otherwise have to be protected, so if we work with those allotments or other private landowners to protect them and then use prescribed fire near them, then prescribed fires will eventually add that

¹² See: Flannigan et al. (2016)

fire protection on a larger scale. I think there is great potential to expand the use of fire.

One interviewee suggested that fuels work should be funded through the resource management budgets in the jurisdictional agencies in addition to through the protection agency budgets, because fuels work is currently underfunded through the protection agency budgets. Interviewees explained that while protection agencies possess the expertise to execute fuel treatments, jurisdictional agencies set landscape goals supported by specific fire-related outcomes. Many interviewees cautioned that although changing the agencies' approach toward fuels work in Alaska has potential benefits to many values, it must be balanced with the large expense that it may entail.

4. Discussion and Key Issues to Address

The Alaska wildland fire governance system's interagency arrangements favor adaptability and responsiveness to changing circumstances, including current resource limitations, but transformations in fire regimes may cause unsustainable capacity failures that would necessitate changes in fire governance. These could include changes in the values and priorities for management, interagency structure, or internal or external policy. To prepare for possible needed changes, the agencies will benefit from continuing to utilize their adaptive mechanisms, such as regular interagency communications, annual interagency meetings, and collaborative arrangements to review and improve the policies, structure, and management goals that are not working or may not work in the future. The agencies must continually maintain good relationships within the system and with the public and use the best equipment and science available to be able to respond to the challenges of a constantly changing environment.

We have identified four broad policy areas to address going forward based on the issues consistently discussed by interviewees:

1) Budgeting and funding. Funding already limits the protection agencies' ability to meet all of their protection obligations. Interviewees stated that the tendency for legislatures to prefer to allocate emergency supplemental funding, rather than increase annual budgets, makes it difficult for them to

plan and prepare resources effectively. Interviewees noted, however, that Alaska's wide swings in fire activity from year to year make it difficult to avoid either over-allocation or under-allocation on a rolling average. Some suggested that a separate DOI funding prioritization model needs to be tailored to Alaska, rather than following that of the conterminous United States, because of the differences in values and suppression tactics between the two regions. Interviewees consistently mentioned limited funding as an issue for staffing, training, preparedness, fuels, and suppression. As fire extent and severity is expected to increase,¹³ this problem will only become exacerbated. Managers either need more money or a review of value prioritization, because increasingly they may not be able to meet all of their protection obligations. Additional exploration of how to improve upon current budgeting strategies is also warranted.

2) Addressing staffing challenges. Interviewees discussed several capacity challenges resulting from lack of staff and lack of expertise among managers. Some of the primary challenges mentioned by interviewees were needing more recruits, needing to hire staff for a period that matches the lengthening fire season, needing easier interagency hiring processes to share staff between agencies, and needing more localized discretion over staffing regulations in order to tailor capacity to expected needs.

3) Protection of remote sites and caribou habitat. Interviewees mentioned that some values generate controversy due to the high cost of protection. These are most often sites under the full or modified protection option that may receive lower priority for protection during large fire years when resources are limited. A few of the more controversial values listed by interviewees include remote uninhabited sites, such as cabins or Native allotments, and large areas of land, such as caribou winter range. At the same time, interviewees indicated the significant natural resource and subsistence use value of protecting cabins, Native allotments, and caribou habitat. This issue may benefit from some additional dialogue.

4) Climate change adaptation and mitigation. Interviewees discussed the possible need for broad changes in fire management approaches in the future to adapt the system to the challenges posed by climate change, including broader use of the full and critical

¹³ See: Flannigan et al. (2016); Rupp et al. (2016)

management option designation to diminish risk and increased use of fuel breaks to facilitate suppression and natural burning under scenarios of increased fire activity. Interviewees also described increasing concern among the fire management community regarding mitigation of greenhouse gas emissions caused by wildland fire. For example, ANCSA Corporations have recently begun asking the agencies to protect some areas of forest as greenhouse gas emissions offset credits. Interviewees mentioned that people within the agencies have begun to discuss the possibility of protecting permafrost as a carbon sink. Despite the benefits of emissions mitigation, interviewees explained that protecting timber and permafrost from fire would require significant risk monitoring efforts to determine which areas must be protected in full at any given time and significant expenditure for remote suppression operations. Considering the expected effects of climate change and the magnitude of Alaska's timber and permafrost carbon sinks, agencies have an opportunity to discuss critical climate change adaptation and mitigation measures in fire management.

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