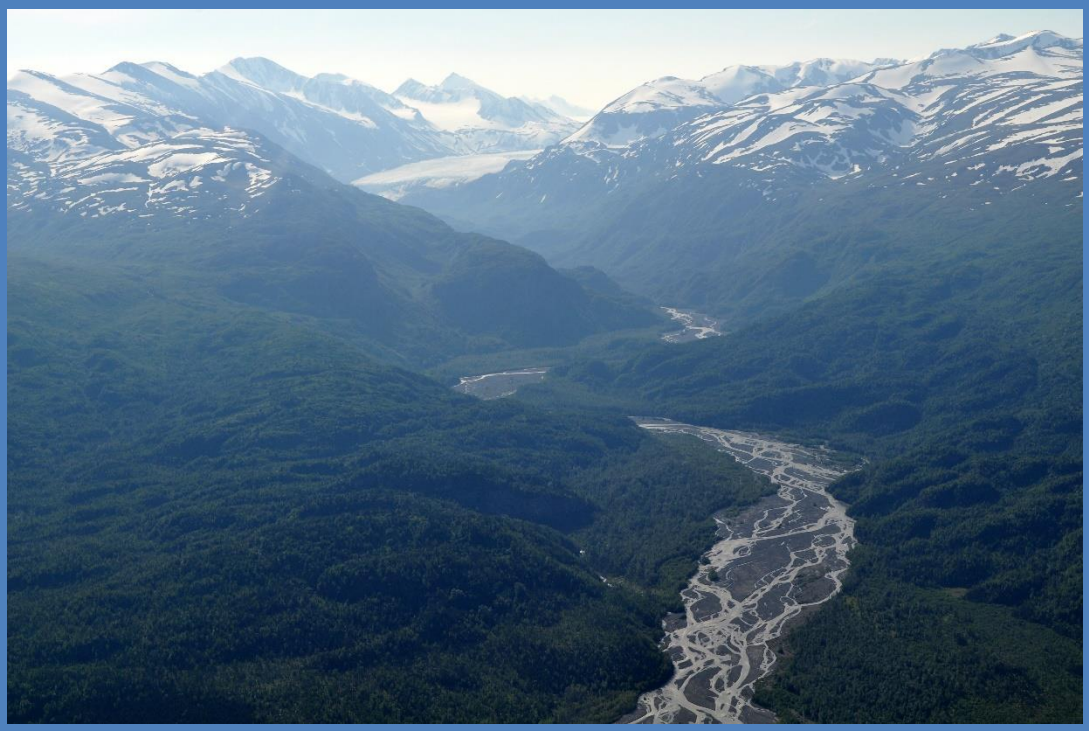

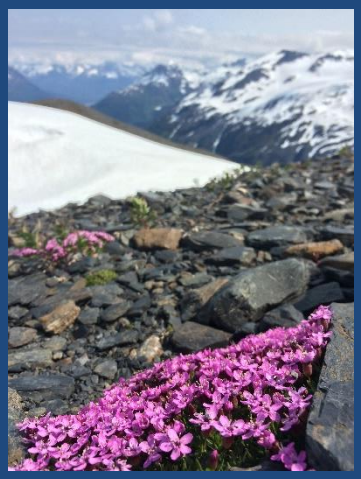

Reframing Climate Change Adaptation

Examining the future of landscape-scale climate change adaptation on the Kenai Peninsula in response to participant identified barriers to implementation.

This report examines barriers to implementing landscape scale climate change adaptation on the Kenai Peninsula as a result of interviews with 13 decision makers. It provides three ways forward for the Kenai National Wildlife Refuge to increase the likelihood of success with its adaptation efforts.

Dylan Beach
Directorate Resource Assistant Fellow, 2015

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Acronym List:

ANILCA – Alaska National Interest Lands Conservation Act
CIRI – Cook Inlet Region, Incorporated
CNF – Chugach National Forest
DOI – Department of the Interior
IPCC - Intergovernmental Panel on Climate Change
KFNP – Kenai Fjords National Park
KNWR – Kenai National Wildlife Refuge
NPS – National Park Service
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service

Skilak Glacier. Photo by Dylan Beach

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Introduction

The need to respond to climate change

According to the most recent Intergovernmental Panel on Climate Change (IPCC) report, climate warming is unequivocal and impacts associated with climate change are occurring across the globe (IPCC, 2014). Alaska has warmed at twice the rate of the rest of the U.S. over the past 60 years (Stewart et al. 2013).

On the Kenai Peninsula changes associated with climate change have been dramatic, and because of this, it was a featured case study in the National Fish, Wildlife and Plants Climate Adaptation Strategy (National Fish, Wildlife and Plants Climate Adaptation Partnership, 2012). Some alarming impacts mentioned in the case study include: over a 15 year period, the spruce bark beetle devastated four million acres of forest in south central Alaska including the Peninsula (Berg et al. 2006b); the treeline has risen 150 feet (Dial et al., 2007); available water has declined 55% and the area of wetlands has decreased by six-11% per decade (Berg et al., 2009). The fire regime has departed from the historical norm (Berg and Anderson, 2006), resulting in the State of Alaska recently moving the start date of its fire season from May 1 to April 1. These changes have already occurred.

Forward looking projections from spatial modeling done at the Kenai National Wildlife Refuge (KNWR) show further changes on the Kenai Peninsula. Biome shifts and change of land cover types on the western side of the Peninsula suggest catastrophic loss of forests in the Kenai lowlands, conversion of alpine tundra to forest, among other changes (Hollingsworth et al., In review). At the same time, the eastern side of the Peninsula is projected to stay relatively stable as a coastal rainforest (Hollingsworth et al., In review), conveying that there may be less conservation need for having planned adaptation on the western side.

The Kenai Peninsula is an ideal laboratory to study climate change effects. The combination of geographic discreteness and intact ecosystems allows researchers to study climate change signals which are not masked by an anthropogenic footprint. As a result, research on the Kenai Peninsula is some of the most comprehensive in all Alaska. These same factors make the Peninsula an ideal laboratory to explore the effectiveness of various adaptation measures.

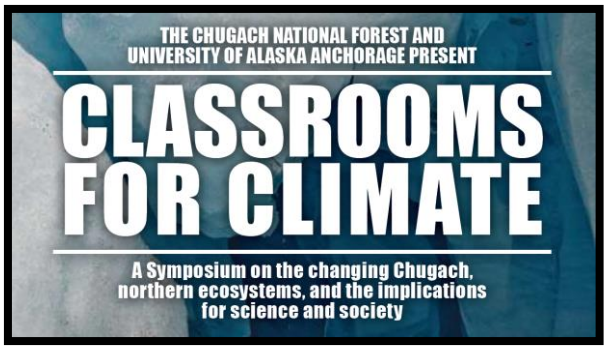
The climate change response to date: a lack of adaptation

Climate adaptation is a means for achieving conservation goals in a rapidly changing environment, not just a goal in and of itself (Game et al. 2010). Now, ecosystems are complex, dynamic systems with multiple possible trajectories (Chapin et al., 2009). Given current trends, conservation will need to be more open to anticipating and actively facilitating ecological transitions and place less emphasis on preservation and historical restoration (Millar et al. 2007, West et al. 2009, Link et al. 2010). In this context of change, some ecologists have begun to question whether managing natural landscapes using a historic reference point as a benchmark is a viable goal (Schroeder et al., 2004).

In this spirit, KNWR biologists are concerned that several vegetative cover types on the Kenai Peninsula are near a tipping point in which they may shift to new system states of lesser ecological diversity and/or function (Hollingsworth et al., In review). When systems are preparing to transition to a new state, there is a window of opportunity in which to steward or guide its trajectory (Olsson et al., 2006). KNWR biologists are exploring prospective versus retrospective options (Magness et al., 2011) to actively facilitate the trajectory of ecological transitions that may be occurring on the Kenai Peninsula. A

critical issue is how to respond coherently across the landscape, and whether the will to respond exists amongst partners that manage land across the Peninsula.

Federal agencies have produced strategy documents in effort to address how to approach conservation in the face of climate change. Some examples include Climate-Smart Conservation (Stein et al. 2014), Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change (USFWS, 2010), Planning for climate change on the National Wildlife Refuge System (Czech et al., 2014), and Climate Change Response Strategy (National Park Service, 2010).



In addition to Federal mitigation and adaptation strategies, Kenai Peninsula based workshops and forums have been held to increase awareness about climate change. One participant in this study said, "Climate change in the header of some kind of a forum is becoming at least an annual occurrence." Examples of these forums are described below. Classrooms for Climate was a symposium sharing implications of a changing climate on northern ecosystems and society. It was led by Chugach National Forest and University of Alaska Anchorage and happened in May 2011 in Anchorage, AK. The Climate Change Café happened in June 2011 in Cooper Landing, AK. This was one of a series of workshops hosted around the country by Colorado State University's Human Dimensions of Natural Resources Department in efforts to improve communication about climate change. Climate Change Planning in Alaska's National Parks occurred in February 2011 in Anchorage, AK. It was led by National Park Service and University of Alaska Fairbanks' Scenarios Network for Alaska Planning. It included other agencies and organizations and discussed how to manage southern region Alaska national parks in the face of climate change. Climate Change in our Backyard was hosted by the Central Peninsula League of Voters and Kenai Peninsula College in March 2015. The Alaska Climate Center (USGS), U.S. Fish and Wildlife Service, and U.S. Natural Resource Conservation Service gave updates about their local findings on climate change.

Despite the apparent need to respond to climate change, the many workshops that have taken place, and the many climate strategies that have been created, no landscape-scale adaptation actions have been implemented to date on the Kenai Peninsula; a fact that was verified by all interview participants from this study, many of whom participated in one or more of the abovementioned workshops. It is true that the Regional Climate Vulnerability Assessment for Chugach National Forest and the Kenai Peninsula grew out of the Classrooms for Climate symposium. This effort, completed in 2014, assessed vulnerability of natural resources and landscapes within the Chugach National Forest and Kenai Peninsula to climate change. It was led by the U.S. Forest Service (Chugach National Forest) and the University of Anchorage, but included many other agencies and organizations, including the U.S. Fish and Wildlife Service. It is a positive step towards enabling adaptation, but is not an example of adaptation itself.

Given the lack of adaptation as a response to climate change, KNWR staff believe that barriers exist to implementing adaptation measures across the Kenai Peninsula landscape. To date, actual response has taken the forms of public outreach and changes in facilities/maintenance to mitigate greenhouse gas emissions, but not on-the-ground adaptation at a landscape scale, and certainly not a coordinated effort. This report examines the barriers to implementing landscape scale climate change adaptation on the Kenai Peninsula. It provides four ways forward for the Kenai National Wildlife Refuge to increase the likelihood of success with its adaptation efforts.

Methods

Study area

The Kenai Peninsula is in south central Alaska and juts into the Gulf of Alaska (Figure 1). It is surrounded on the western side by the Cook Inlet and on the eastern side by the Prince William Sound. The Kenai Mountains, a north-south mountain range, intercepts the generally east to west flow of storm systems and causes a rain shadow on the western side of the Peninsula. Because of this, it experiences substantial differences in climate from east to west. The two main biomes that the Kenai Peninsula currently supports are coastal rainforest along its eastern shores and transitional boreal forest on northwestern lowlands. Montane and alpine habitats occur in between. The Kenai Peninsula is also home to the Harding Icefield, the largest ice field complex in the U.S., as well as the Sargent Icefield and the Wosnesenski–Grewingk Glacier complex.

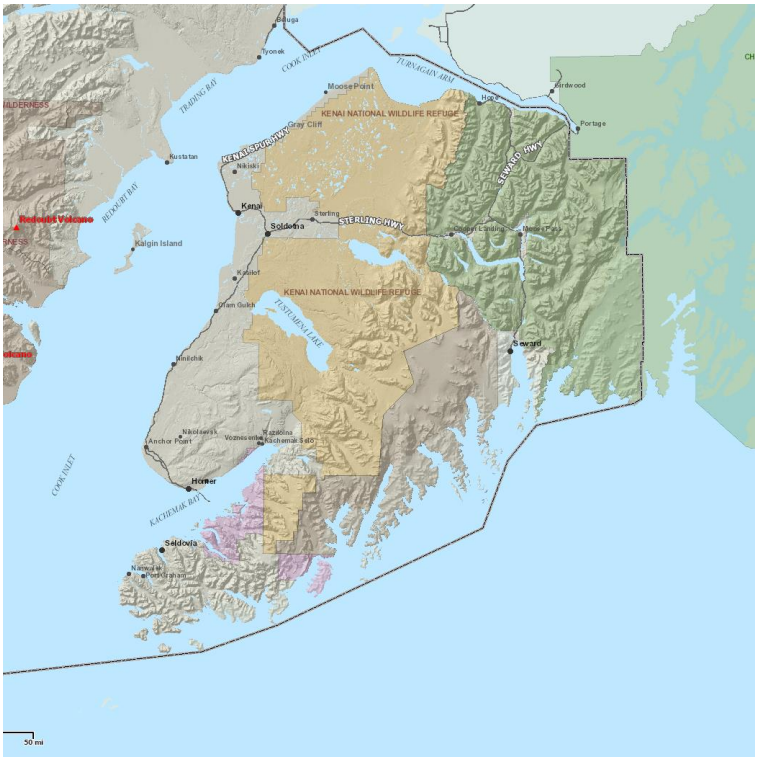


Figure 1. Map of the study area, the Kenai Peninsula. Image captured from the Kenai Peninsula Borough Interactive Parcel Viewer. http://mapserver.borough.kenai.ak.us/kpbmapviewer/

Study design

A total of 12 semi-structured interviews were conducted with 13 participants. One interview was conducted jointly with 2 participants at the request of the participants. Core questions forming the semi-structured interviews can be found in Box 1. Interviews were conducted during July 2015 at the

respective offices of participants. The semi-structured interview is a standard ethnographic method for gathering information in an open-ended format (Briggs, 1986). The interviewer has a uniform question set across participants, but gives the interviewer the discretion to follow conversation topics that deviate from the question set. All participants signed consent forms that detailed how the interview data was to be used and discussed the rights of participants to withdraw in part or in totality from the study.

Wooly lousewort on Skyline Trail hike on the Kenai National Wildlife Refuge. Photo by Dylan Beach

Box 1. Core questions forming the semi-structured interview.

1) **Perceptions of climate change**
   - Does climate change exist?
     - Are humans causing or accelerating change?
       - Does knowing about climate change affect your willingness to adapt?
     - What does climate change mean to you personally?
2) **Unit context**
   - What are the big issues/drivers on [Specific unit lands]?
     - Where does climate change fit?
     - On a scale of 1-10, how do you rank climate change (where 1 is just where CC is just another landscape driver and 10 is the 6th extinction)
   - Has climate change affected your agency's culture? In what ways?
   - What language does your agency use to talk about climate change adaptation?
3) **Adaptation to climate change**
   - What has been the focus of your CC adaptation efforts to date?
     - What is the reason for this focus?
     - To what extent do people/public use inform your climate change adaptation actions?
   - Are CC adaptation decisions affected by your [specific institution's] mission?
   - What is the range of climate change adaptation strategies available to you as a [specific position]?
     - Are some strategies more favored than others by your institution? By your unit?
     - Are there any situations where you might use management intervention to alter the landscape prospectively as a way to adapt to climate change?
4) **Management plan specifics and climate change**
   - Discuss whether [relevant comprehensive plan] discusses climate change
     - Have you revisited any of the plan's goals in light of climate change?
       - Have you adapted these goals since the creation of this strategy?
   - Discuss highlights in [relevant CC strategy documents]
     - Are you aware of [specific strategies within relevant CC strategy documents]
     - Have you encountered any barriers to implementing recommendations from the strategy?
   - What opportunities exist to incorporate other agency/institution information?
     - What opportunities exist for building partnerships for landscape level climate change adaptation?
5) **Monitoring**
   - Are you engaged in an inventory monitoring program?
     - Does information you are collecting allow you to make landscape scale management decisions?
     - Does information you are collecting provide you with enough information to make smart climate choices?
   - Are there plans to collaborate with other existing monitoring processes, such as the FIA?
6) **Internal land classification**
   - Does the way your land holding is classified affect how you think about or implement climate change adaptation?
     - Do your Recommended for Wilderness areas change your perceptions of acceptable management, especially adaptation?
7) **Normative assessment / Rectitude**
   - What do you envision for the Kenai Peninsula/Prince Williams Sound?
   - What can be done here for adaptation to Climate Change?
     - What would you want to do if there were no limiting factors?
8) **Personal involvement**
   - Have you been involved with any of the climate change adaptation planning processes that have taken place on the peninsula, such as the SWAN scenario workshops?
     - Has this process(s) resulted in any adaptation actions that you are aware of or have authorized on your lands or otherwise?

Participant demographics

Participants represented federal, state, and local governments, and one native corporation. Institutions[1] included the National Park Service (NPS) through Kenai Fjords National Park (KNFP); U.S. Fish and Wildlife Service (USFWS) through the Kenai National Wildlife Refuge; U.S. Forest Service (USFS) through the Chugach National Forest (CNF); Alaska Department of Natural Resources (ADNR) through the Division of Mining, Land, and Water and Alaska State Parks; Kenai Peninsula Borough (KPB) through the Mayor's Office, Land Management Division, and the Donald E. Gilman River Center; and the Cook Inlet Region, Incorporated (CIRI).

Table 1. Participant demographics. Shows participant ID, umbrella institution, and the unit or division represented by the participant.

ID	Institution	Unit or Division
1	USFS	Chugach National Forest
2	USFWS	Kenai National Wildlife Refuge
3	NPS	Kenai Fjords National Park
4	NPS	Kenai Fjords National Park
5	USFS	Chugach National Forest
6	NPS	Kenai Fjords National Park
7	USFWS	Kenai National Wildlife Refuge
8	Alaska DNR	Alaska State Parks
9	Alaska DNR	Mining, Land, and Water
10	CIRI	Land and Resources
11	KPB	Land Management Division
12	KPB	Mayor's Office
13	KPB	The Donald E. Gilman River Center

Participant selection parameters

Since this study was about decisions to implement climate change adaptation, level of land ownership was an important selection parameter. On the Kenai Peninsula much of the land is owned by public agencies or tribes, and therefore managed by a small group of stakeholders. By focusing attention on the selected 6 institutions (Table 1), interviews could be conducted with individuals who collectively make management decisions for, or permit use on, over 80% of the land within the KPB (Table 2). While this figure and the data contained within the KPB Parcel Viewer are for the entire Borough, which is slightly larger than the Peninsula as a whole, the claim that the 6 selected institutions manage a large portion of the land still holds when focusing on land only within the Kenai Peninsula.

Consequently, participants were selected based on the organizations they represented. When possible, I sought participation from both senior levels and intermediate levels within institutions. It was hypothesized that the different roles might yield different insight into barriers that their respective institutions faced regarding landscape-scale climate change adaptation. For example, senior leaders might be more connected to the high level arguments for or against adaptation from a policy perspective, while an intermediate level employee might be more connected to day-to-day challenges

[1] Institutions is used throughout the report as a synonym for agencies and organizations.

including familiarity with the ecological data. Having multiple voices would provide a more complete picture of how an institution approaches these issues.

Table 2. Acreage of Kenai Peninsula Borough land by ownership. Shows total land acreage and % of land managed by institutions represented by participants. Acreage and % information taken from the Kenai Peninsula Borough Parcel Viewer (citation) and therefore reflect the acreage of the entire Borough, as opposed to exclusively the Peninsula. Acreage numbers reflect surface rights to ownership. For example, native village corporation and/or regional native corporations own surface rights to much of the land within KFNP. Acreage of KFNP as reported in this table is smaller than numbers reported elsewhere as a result.

Land Owner	Total Acreage	% of Total Land
FEDERAL	**3,773,739.98**	**68.90%**
KENAI FJORDS NATIONAL PARK	288,642.94	5.27%
KENAI NATIONAL WILDLIFE REFUGE	1,803,035.77	32.92%
CHUGACH NATIONAL FOREST	1,280,944.38	23.39%
STATE	**896,599.69**	**16.37%**
ALASKA STATE DNR (INCLUDES PARKS)	859,003.69	15.68%
NATIVE	**477,764.15**	**8.72%**
COOK INLET REGION INC	117,997.14	2.15%
BOROUGH	**61,959.42**	**1.13%**
KENAI PENINSULA BOROUGH	61,934.51	1.13%
Total lands managed by study participants	**4,411,558.43**	**80.55%**
Total lands in the Kenai Peninsula Borough	**5,476,798.79**	**100.00%**

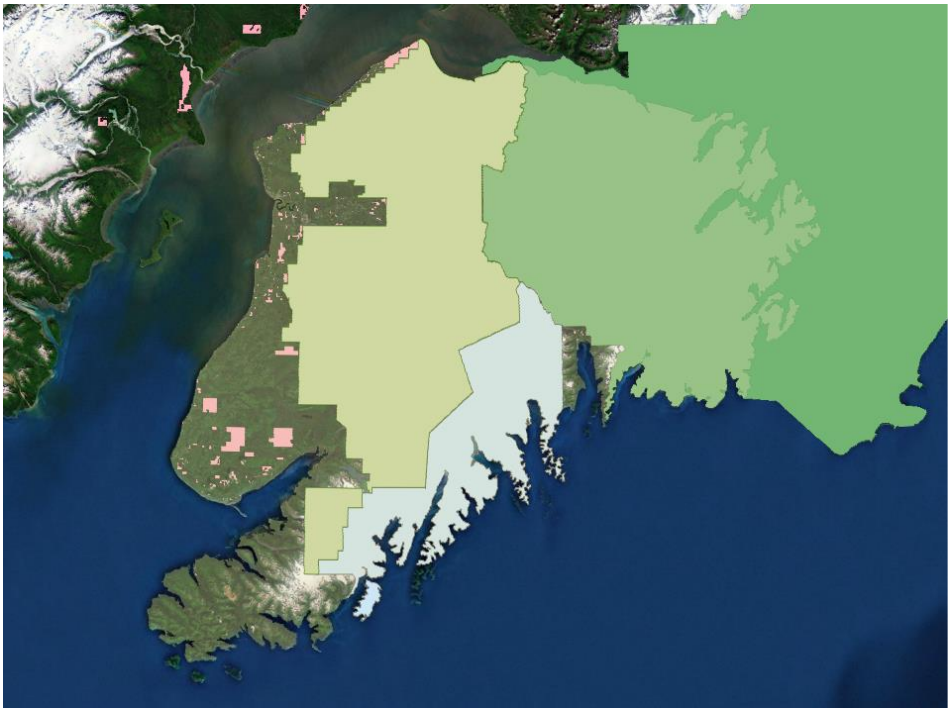


Figure 2. Shows the land responsible for management by institutions represented in this study. KNWR land shown in yellow, CNF land shown in green, KFNP land shown in white, and KPB land shown in pink. CIRI and ADNR did not provide shape files and are not shown.

Results

Climate change perceptions

Interview participants recognized that the climate is changing. Of 13 participants, 12 said that climate change exists, 10 said that it is being accelerated by humans, and 9 cited a moral obligation to address climate changes (Table 3). Participants also ranked climate change as a driver of change on his/her land management unit, where a ranking of 1 meant climate change is a non-issue and 10 meant that climate change is the next extinction great event (Figure 3). Where climate change rankings were given, there is a trend of higher rankings from participants at federal agencies relative to participants at other institutions. Several caveats, or subtleties, to participant responses to these questions are presented below Table 3.

Beyond acknowledgement, interview participants were also able to cite specific events linked to climate change. A few examples are, “Insect outbreaks like the spruce bark beetle have also been linked to a warming climate,” or “Glaciers are declining, snow levels are going up,” and also, “We are seeing more weather extremes.”

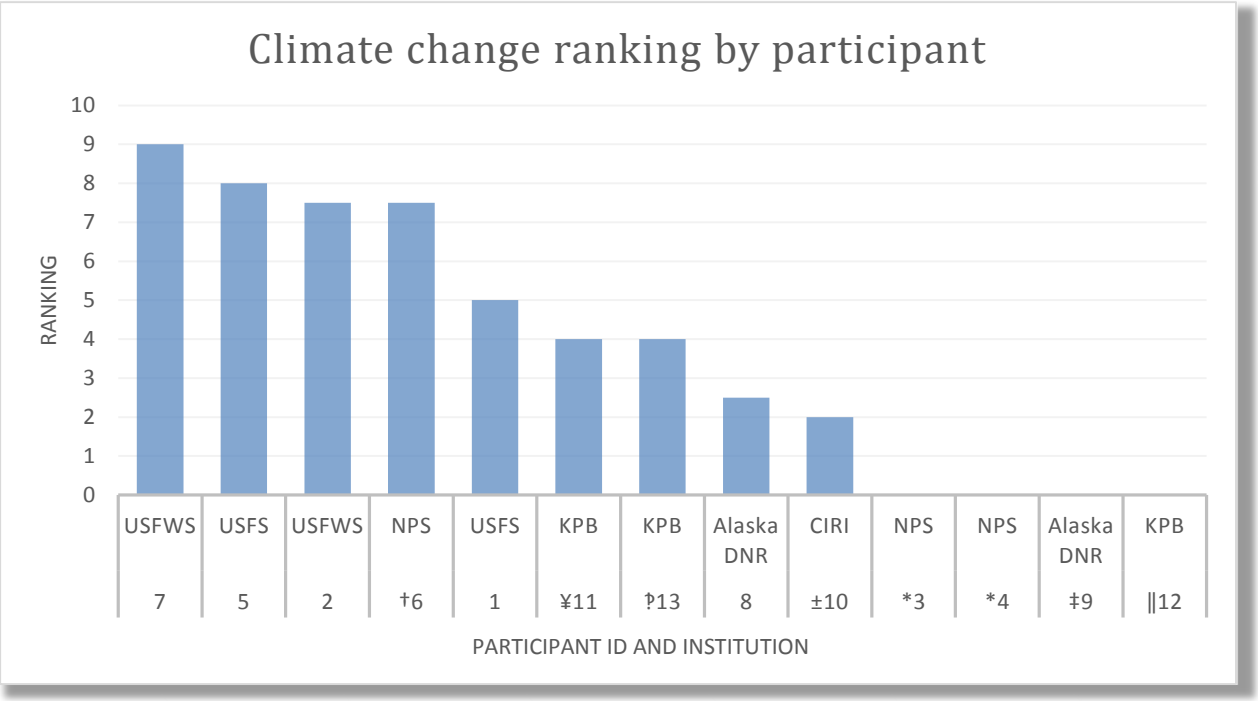


Figure 3. Shows how participants ranked climate change as a driver of change on his/her respective land management units. Rankings were based on a range of 1-10, where a ranking of 1 meant climate change is a non-issue and 10 meant climate change is the next extinction event. Several participants did not provide a ranking. Explanations of non-ranking are given below Table 3. Where climate change rankings were given, there is a trend of higher rankings from participants at federal agencies relative to participants at other institutions.

Table 3. Shows participant responses to questions about climate change perceptions. Several caveats, or subtleties, to participant responses to these questions are presented below.

Perceptions of Climate Change						
ID	Institution	Unit or Division	Climate change ranking	Does climate change exist?	Is climate change being accelerated by humans?	Do humans have a moral obligation to adapt?
1	USFS	Chugach National Forest	5	Yes	Yes	No
2	USFWS	Kenai National Wildlife Refuge	7.5	Yes	Yes	Yes
*3	*NPS	Kenai Fjords National Park	-	Yes	Yes	Yes
*4	*NPS	Kenai Fjords National Park	-	Yes	Yes	Yes
5	USFS	Chugach National Forest	8	Yes	Yes	Yes
†6	NPS	Kenai Fjords National Park	7.5	Yes	Yes	-
7	USFWS	Kenai National Wildlife Refuge	9	Yes	Yes	Yes
8	Alaska DNR	Alaska State Parks	2.5	Yes	Yes	Yes
‡9	‡Alaska DNR	Mining, Land, and Water	-	-	-	-
±10	CIRI	Land and Resources	2	Yes	-	Yes
¥11	KPB	Land Management Division	4	Yes	-	Yes
‖12	‖KPB	Mayor's Office	-	Yes	Yes	Yes
⁈13	KPB	The Donald E. Gilman River Center	4	Yes	Yes	-

*Participants did not provide a ranking, though they explained that they recognize its importance and can see the effects of it happening
†Participant explained that morality is not applicable to the individual's position nor is it appropriate for federal agencies to discuss
‡Participant explained that the division does not have a stance on climate change
±Participant explained that CIRI does not have a specific position on whether or not it is anthropogenic causes or natural causes
¥Participant recognizes impacts and unknowns without being conclusive as to causation
‖Participant did not provide a ranking but recognized climate change as a growing issue
⁈Participant said climate change encourages more long-term thinking but did not comment on a moral obligation

Table 4. Shows participant responses to questions about his/her institution's management plan.

ID	Institution	Unit or Division	Name and date of current comprehensive plan	Does current comprehensive plan has climate change language?	Is there consistent use of climate change language in your institution?
1	USFS	Chugach National Forest	2002 Forest Plan	*No	Yes
2	USFWS	Kenai National Wildlife Refuge	2010 Comprehensive Conservation Plan	Yes	Yes
3	NPS	Kenai Fjords National Park	1984 General Plan	†No	Yes
4	NPS	Kenai Fjords National Park	1984 General Plan	†No	Yes
5	USFS	Chugach National Forest	2002 Forest Plan	*No	¥Yes
6	NPS	Kenai Fjords National Park	1984 General Plan	†No	Yes
7	USFWS	Kenai National Wildlife Refuge	2010 Comprehensive Conservation Plan	Yes	¥Yes
8	Alaska DNR	Alaska State Parks	Alaska State Parks Strategic Plan 2007-2017	No	No
9	Alaska DNR	Mining, Land, and Water	2000 Kenai Area Plan	No	No
10	CIRI	Land and Resources	X‖	No	No
11	KPB	Land Management Division	X⁞	‡No	No
12	KPB	Mayor's Office	2005 Comprehensive Plan	‡No	No
13	KPB	The Donald E. Gilman River Center	2008 Coastal Management Plan	‡No	No

* Chugach National Forest is currently revising the Forest Plan and will reportedly include climate change language
† Kenai Fjords National Park has a Foundation Statement (2013) that has reportedly replaced the General Plan, and which includes climate change language
‡ The Kenai Peninsula Borough has reportedly flagged the 2005 Comprehensive Plan for revision and may include climate change language
¥ Participants from both the USFS and USFWS commented that although climate change language is established and consistent, highly specific terms like the division of approaches within adaptation are not understood outside of biologist and senior level employees
‖ CIRI reportedly has a land management plan that is followed. It was not shared however, as CIRI is a privately held corporation.
⁞ The Land Management Division within KPB has no plan. There is a section within the overarching Borough Comprehensive Plan that addresses some land management issues.

Table 5. Mission statements at the institution and unit levels.

Mission Statements by Institution		
Institution	Institutional Mission	Unit Mission or Vision
NPS - KFNP	The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations.	Kenai Fjords National Park preserves the scenic and environmental integrity of an interconnected icefield, glacier, and coastal fjord ecosystem.
USFS - CNF	The mission of the USDA Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.	X
USFWS - KNWR	Working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.	The Kenai National Wildlife Refuge will serve as an anchor for biodiversity on the Kenai Peninsula despite global climate change, increasing development, and competing demands for Refuge resources.
ADNR - Mining, Land, and Water	Develop, conserve, and maximize the use of Alaska's natural resources consistent with the public interest.	To provide for the appropriate use and management of Alaska's state owned land and water, aiming toward maximum use consistent with the public interest.
ADNR - State Parks	Develop, conserve, and maximize the use of Alaska's natural resources consistent with the public interest.	The Division of Parks and Outdoor Recreation provides outdoor recreation opportunities and conserves and interprets natural, cultural, and historic resources for the use, enjoyment, and welfare of the people.
KPB - Mayor's Office	X	X
KPB - Land Management Division	X	Serve the Borough through the acquisition, management and classification of Borough lands, as well as the disposal of real property and resources owned by the Borough
KPB - Donald E. Gilman River Center	X	Work cooperatively to protect the rivers of the Kenai Peninsula, its watersheds, and its fish and wildlife resources.
CIRI	The mission of CIRI is to promote the economic and social well-being and Alaska Native heritage of our shareholders, now and into the future, through prudent stewardship of the company's resources, while furthering self-sufficiency among CIRI shareholders and their families.	N/A

Barriers to implementing landscape-scale climate change adaptation

From the interviews, participants identified what was grouped into 12 themes, or barriers (Table 6). The barriers were communication, complexity, data, mission/mandates, money, organizational culture or structure, personnel, policies, priorities, public perception, remoteness, and time (Table 6). Each barrier is defined below.

Communication

Communication, as a barrier, referred to either consistency of language used to discuss climate change within the participant's institution, whether climate was in fact communicated throughout the institution or not, and/or whether climate change language is featured in the institution's overarching planning document. Only the KNWR has climate change language 10/13 participants, or 77% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Complexity

Complexity referred to whether a participant mentioned that his/her decision to implement adaptation was affected by the ability to measure success, see/feel tangible results, and/or have a feeling of control over the issue. 7/13 participants, or 54% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Data

Data referred to information that would allow the participant to make informed resource management decisions about climate change and how to adapt to it at a landscape-scale, such as peer-reviewed research or government reports. 8/13 participants, or 62% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Mission or mandates

Mission or mandates referred to whether the participant believed that a section(s) of the institution's mission statement, Alaska National Interest Lands Conservation Act (ANILCA) purposes, or other mandates made it difficult for the participant or institution to implement adaptation. 2/13 participants, or 15% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Money

Money referred to whether the participant perceived that financial resources were sufficient to implement adaptation. 9/13 participants, or 69% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Organizational culture or structure

Organizational culture or structure referred to whether or not a participant perceived that some aspect of his/her respective institution's culture or structure made it difficult to implement adaptation. 5/13 participants, or 38% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Personnel

Personnel referred to whether or not the participant perceived that human resources, or staffing, were sufficient to implement adaptation. 4/13 participants, or 31% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Policies

Policies referred to whether or not the participant perceived that an institutional policy or policies prohibited him/her from discussing climate change and/or implementing adaptation. 8/13 participants, or 62% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Priorities

Priorities referred to whether or not the participant perceived that other priorities prevented him/her from implementing adaptation, or that the issue of climate change had not become a priority to that particular institution and so was not being addressed. 9/13 participants, or 69% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Public perception

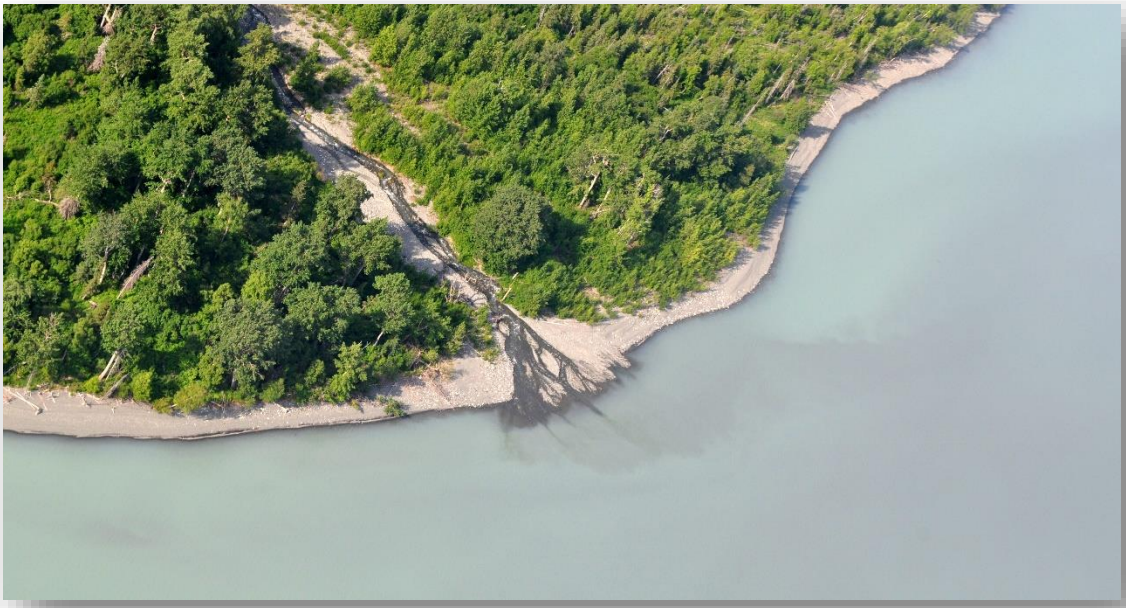
Public perception referred to whether or not the participant perceived that the public's views towards climate change influenced his/her ability to implement adaptation. 8/13 participants, or 62% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Remoteness

Remoteness referred to whether or not the participant perceived that the degree of remoteness of the land unit that he/she managed made it difficult to adapt to climate change. 5/13 participants, or 38% of participants found this to be a barrier to implementing climate change adaptation (Table 6).

Time

Time referred to whether or not the participant perceived having sufficient time to address climate change adaptation was an issue. 2/13 participants, or 15% of participants found this to be a barrier to implementing climate change adaptation (Table 6).



Fresh water meets glacial at Tustumena Lake. Photo by Dylan Beach

Table 6. Barriers to adaptation. Shows 12 barriers to implementing landscape-scale climate change adaptation and which participants identified each barrier during his/her interview. Also shows the percentage of participants that identified each barrier.

ID	Institution	Unit or Division	Communication	Complexity	Data	Mission or Mandate(s)	Money	Organizational culture or structure	Personnel	Policies	Priorities	Public Perception	Remoteness	Time
1	USFS	Chugach National Forest	X	X		X	X		X	X	X		X	X
2	USFWS	Kenai National Wildlife Refuge	X	X	X		X		X	X		X		X
3	NPS	Kenai Fjords National Park		X	X		X				X	X	X	
4	NPS	Kenai Fjords National Park		X	X		X				X	X	X	
5	USFS	Chugach National Forest	X								X		X	
6	NPS	Kenai Fjords National Park		X			X				X		X	
7	USFWS	Kenai National Wildlife Refuge	X	X	X			X						
8	Alaska DNR	Alaska State Parks	X				X		X	X	X	X		
9	Alaska DNR	Mining, Land, and Water	X					X	X	X	X	X		
10	CIRI	Land and Resources	X		X	X	X	X		X	X			
11	KPB	Land Management Division	X	X	X			X		X	X	X		
12	KPB	Mayor's Office	X		X		X	X		X	X	X		
13	KPB	The Donald E. Gilman River Center	X		X		X			X		X		
		Total	**77%**	**54%**	**62%**	**15%**	**69%**	**38%**	**31%**	**62%**	**77%**	**62%**	**38%**	**15%**

Table 7. Issues for reframing climate change. Shows participant identified issues that are of significance on the Kenai Peninsula and have a relationship with climate change.

Issues of importance on the Kenai Peninsula								
ID	Institution	Unit or Division	Coastal erosion	Fire	Infrastructure	Invasives	Population pressures	Salmon/Fisheries
1	USFS	Chugach National Forest		X	X	X	X	X
2	USFWS	Kenai National Wildlife Refuge		X		X	X	X
3	NPS	Kenai Fjords National Park			X	X		
4	NPS	Kenai Fjords National Park			X	X		
5	USFS	Chugach National Forest		X	X	X		X
6	NPS	Kenai Fjords National Park			X	X		X
7	USFWS	Kenai National Wildlife Refuge		X		X	X	X
8	Alaska DNR	Alaska State Parks	X	X	X		X	X
9	Alaska DNR	Mining, Land, and Water				X		X
10	CIRI	Land and Resources	X	X	X			X
11	KPB	Land Management Division		X			X	X
12	KPB	Mayor's Office	X	X	X		X	X
13	KPB	The Donald E. Gilman River Center	X	X	X	X		X
		Total	31%	69%	69%	69%	46%	85%

DISCUSSION
Why Adaptation is a Hard Seed to Sow: Implications of Select Barriers to Landscape-scale Climate Change Adaptation

Priorities

There are two parts to priorities as a barrier. The first concerns immediate needs as a priority over long-term planning and action. A USFWS participant commented that, "The challenges posed by climate change perhaps emphasize the need for long range planning and thinking." Despite a recognized need for long-term planning, a USFS participant said, "You are looking at the here and now. What's on my plate this fiscal year and what's coming up next fiscal year, which makes it difficult to do some long range, or medium range, thinking." Other comments reinforced this idea, "[Climate change] is important, but how do I get today's job done?" indicating that day-to-day tasks associated with his/her job took priority to thinking about longer-term adaptation issues. A participant from ADNR cited the division's budget and staffing cuts saying, "I'm having a hard time looking into the future dealing with future management issues. My focus right now is operations."

Sometimes large, urgent projects take priority. A participant from NPS said, "I think we have to prioritize what our needs are in the Park. We have had some pretty compelling needs such as the flooding of Exit Glacier Road." Issues that threaten safety or use of the particular land unit being managed often take priority over climate change adaptation as well. Although, in some cases, use and safety might be impacted by climate change.

Sometimes because of complexity, or else because of differing opinions of what constitutes an effective response to climate change, mitigation and engagement response strategies are prioritized over adaptation. This issue is discussed further in the section on complexity.

In the cases above, climate change is recognized as an issue, but other issues are being addressed instead. Another side of priorities is revealed in this comment from ADNR: "[Climate change] hasn't become a priority for the State." Here, climate change is not on the radar as a priority, which is another issue entirely and will be addressed in why engaging the public is important.

Policy challenges

Lack of climate change focus within existing policy and/or management plans

Table 4 shows that most comprehensive land management plans at the unit level are out of date. The most recent comprehensive plan that participants can use to make decisions is KNWR's 2010 Comprehensive Conservation Plan. Coincidentally, this same plan is the only to include climate change language. KFNP's General Plan is from 1984, though NPS reportedly have replaced slower general planning with more flexible foundation statements. KFNP has a 2013 Foundation Statement. CNF is currently revising the 2002 Forest Plan. The KPB does not have a comprehensive land management plan that deals exclusively with land management issues.

Some represented institutions did not have policies in place that discussed climate change. In fact, only the Comprehensive Plan for the KNWR currently has any language discussing climate change objectives (Table 4). However, there are some caveats to that statement. NPS has reportedly replaced General Plans with Foundation Statements which are broader and allow for more agile, flexible planning. KFNP's Foundation Statement (2013) includes climate change language. CNF will reportedly include climate

change language in the revised Forest Plan. KPB may include climate change language in the revised Comprehensive Plan.

Non-federal agencies also have policy challenges that limit consideration on climate change in decision making. The Division of Mining, Land, and Water within ADNR permits use on DNR land. When adjudicating acceptable use, "climate change, or possible effects, are not one of those sections of a multi-page decision document." State DNR employees cannot make a land use decision based on reasoning related to climate change. Likewise, CIRI, and KPB have no policies requiring, or even advocating for, consideration of climate change. Participants from CIRI and KPB said that their institutions would engage in climate change related projects provided they made sense economically. For CIRI, the project should go further and also demonstrate a return for shareholders. Evaluating an economic argument for climate change adaptation becomes important as the KNWR looks for partners with which to collaborate.

Wilderness policy

Congressionally-designated Wilderness (KNWR), Wilderness Study Areas (CNF), and Eligible Wilderness (KFNP) on the three federal estates on the Peninsula pose both logistical and policy challenges for adaptation.

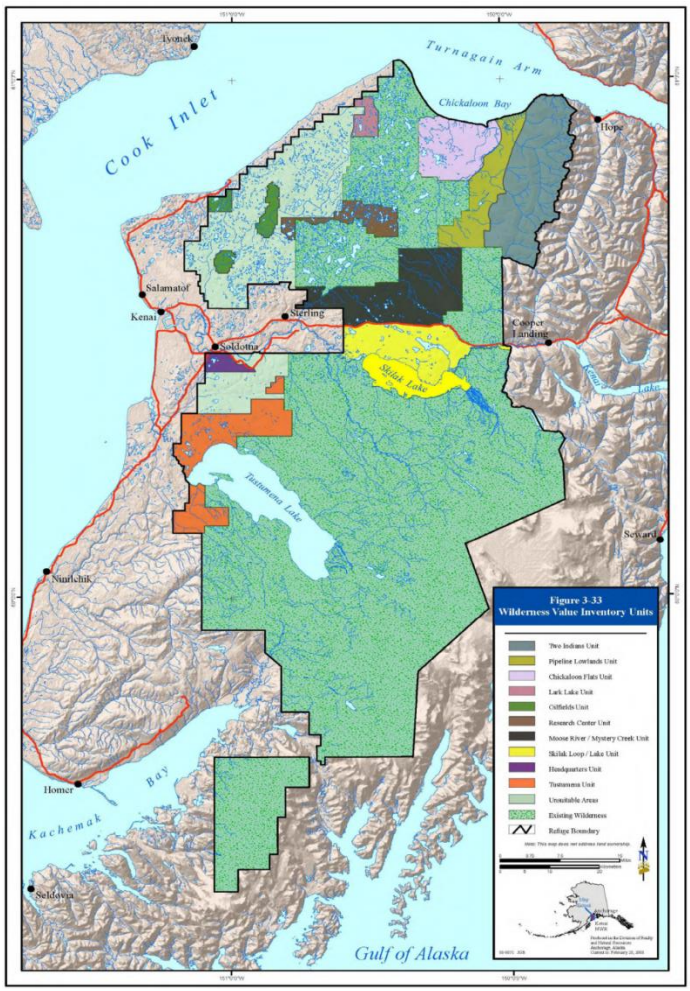


Figure 4. Map showing Kenai National Wildlife Refuge Designated Wilderness Areas.

KNWR has 1.4 million acres of congressionally designated Wilderness (Figure 4). A USFWS participant said in regards to implementing climate change adaptation in Wilderness that, “it's a policy barrier, but I think we *need* to think about whether trammeling in Wilderness in an attempt to maintain or restore natural value, or the natural quality of wilderness character, is actually an acceptable trade-off.” Currently, there are not clear guidelines in place to help conservation decision makers assess trade-offs between trammeling Wilderness for adaptation and restoring wilderness character. This policy challenge adds complexity when decision makers look for strategies to adapt to climate change on Wilderness lands.

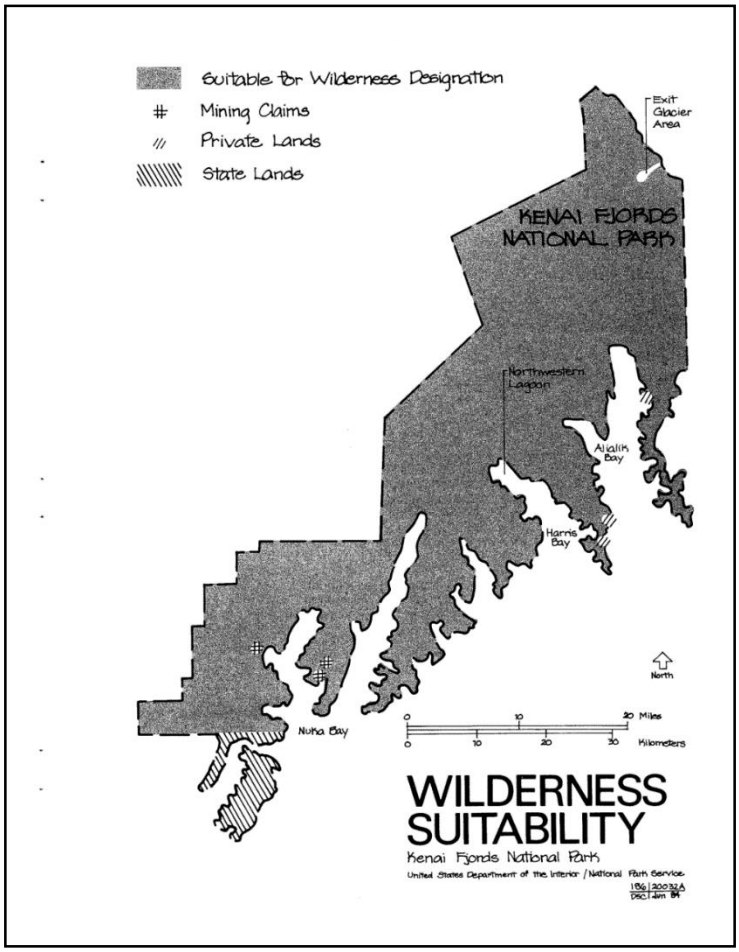


Figure 5. Map showing Kenai Fjords National Park areas eligible for Wilderness.

KFNP determined that 570,000 acres of the park is eligible for Wilderness designation (Figure 5). By policy, lands that are determined to be eligible for wilderness are to be managed to preserve their wilderness character, or managed as though they are designated wilderness with protections afforded by the Wilderness Act. In accordance with policy and according to a NPS participant, "outside of one area in Exit Glacier, everything is treated as Wilderness. Everything." This means that Minimum Tools Analysis is conducted prior to every project done outside of Exit Glacier. While adding additional steps to a project does not render it impossible, it can change the feasibility from a cost or time perspective. Much of the land is also incredibly remote, making it difficult to access.

CNF has a 2.2 million acre Nellie Juan-Fiord Wilderness Study Area designated under ANILCA. The 2002 Revised Chugach Forest Plan actually recommends that 1.4 million acres of this WSA be designated as wilderness (Figure 6). Like eligible wilderness, WSAs are managed to maintain their wilderness character. According to USFS participants, that the Wilderness Act mediates the allowable actions the USFS can take on large portions of the Forest is less important than the actual state of the land itself. Chugach National Forest's Wilderness areas and "de facto areas of low management potential, such as snow and ice, leave very little of the landscape iteself that can be managed in an active way which would influence outcomes in terms of adaptation." Also, "[adaptation] is less economically available because you don't have the infrastructure." In fact, it's still 98% roadless. Perhaps most importantly from a climate change perspective, though, is that much of the eastern side of the Peninsula is coastal rainforest and is projected to remain a coastal rainforest. This reduces the need to adapt from a Forest Service perspective.

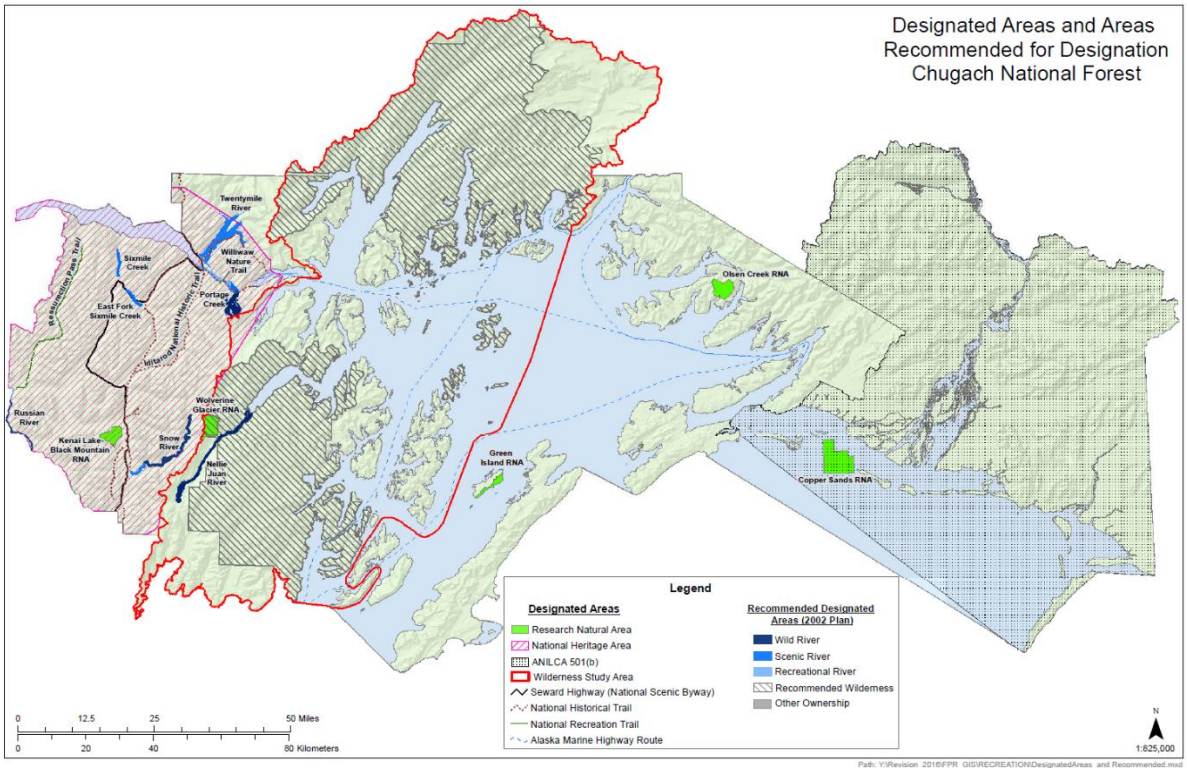


Figure 6. Map showing Chugach National Forest Wilderness Study Areas

The data is in its infancy

Successful landscape-scale climate change adaptation will be complicated endeavors. Data is problematic for two reasons. First, there is currently not enough data to act. A USFWS participant said, "Reducing uncertainty at the end of the day is going to be very important to successful adaptation," and that "It is a waste of tax payer money to start doing adaptation until you understand the range of outcomes from climate change so you can prioritize where adaptation should be focused." In that respect, "We're still a ways out there from really being able to get to the point where we're comfortable, and we may never be comfortable."

Second, a concern is that most data is not collected in a way that is useful for landscape-scale understanding. A USFWS participant said, "Climate change is forcing people to realize that…we need data that are spatial, that is scaleable, and most people don't collect data that way." As research continues to be conducted to advance the collective understanding of landscape-scale changes on the Peninsula, sampling techniques should be used that actually allow for landscape-scale understanding. Collaboration around what this looks like in practice will be important.

These two insights about the state of the data offer one explanation for why, within KFNP, "most of the historical focus thus far has been on the science, the mitigation, and the communication," rather than proactive, adaptive management.

Climate change response mediated by complexity

One possible explanation for the lack of implemented landscape-scale adaptation is that adaptation options are highly complex. As a result, employees within institutions that have climate change response plans tend to favor actions in which he/she has control and can see tangible outcomes. Many of these actions fall outside of adaptation as a strategic response to climate change.

Controlled and tangible

When asked about adaptation that their respective institutions had undertaken, many participants focused their responses around highly tangible past actions. A USFS participant even said, "I like to look at more of the tangible sort of things." This mostly involved adapting infrastructure, such as moving trailheads and parking lots, in response to projected climate change impacts. The effort required to do and the resulting outcome from these types of actions are tangible. They can be measured and easily planned for. In a resource constrained world, particularly financially constrained, "How much effort goes into how much progress?" is a common question to be considered. If success is measured, and funding is tied to success, a long-term and large scale adaptation effort might not fit the same success factors.

With climate change being a highly complex issue, it is easy to feel a lack of control over actually changing the outcomes, an insight gleaned through several participant comments such as, "People want to have an effect. People want to do things at their scale," and "I think it's the control part. If you don't have much control over something, there's only so much you can do." This desire to control and have an effect seems to be one possible explanation for pursuing non-adaptation climate change response strategies. This quote, "The only way we kind of can control [climate change] is through education and outreach," from a NPS participant supports this explanation. In regards to NPS, it is important to note that education and outreach is part of the NPS mission ("…for the enjoyment, education, and inspiration of this and future generations.") and the ANILCA purposes for KFNP ("We serve residents and visitors who seek inspiration, recreation and education..."). While this validates pursuing education and outreach as important, it should not be considered a reason for not pursuing adaptation.

Mitigation vs. adaptation

The question of doing what is controllable and measurable potentially has a large impact on what climate change response strategy institutions pursue. For example, a USFWS participant said, "Things like the Agency's own carbon footprint we perhaps have more immediate control of than some of our adaptation challenges." There is a distinct tension within the represented institutions about whether it is more effective to pursue mitigation or adaptation.

There are several possible explanations for a mitigation strategy. A NPS participant said that, "With mitigation we can help to try and slow that, we're setting an example for other people." Another explanation from a USFS participant is that, "Right now is the time to act on the mitigation side. Acting on mitigation in 100 years is quite late." A third explanation is that "it is a waste of tax payer money to start doing adaptation until you understand the range of outcomes from climate change so you can prioritize where adaptation should be focused," said a USFS participant. The IPCC (2014) validates all of these explanations. It says, for example, "Substantial emissions reductions over the next few decades can reduce climate risks in the 21st century and beyond, increasing prospects for effective adaptation" (IPCC, 2014).

A risk to consider and to caution against is if an institution pursues mitigation as a convenient justification to do what is manageable. That said, mitigation is important in the global solution to curb climate change impacts. It should not however, be undertaken in isolation (IPCC, 2014).

Why engagement is important
Engagement, as a climate change response strategy, is important for several reasons which differ depending on the particular institution. A KPB representative said, "[Climate change] needs to be driven by a recognition from citizens and the public. That will lead to policy makers who can affect that type of change and make it a priority." ADNR participants said that adaptation is only possible if it is a priority and priorities come from the people.

The NPS stance is that engagement leads to behavior change which leads to increased mitigation. A KFNP participant said, "Park Service's perspective is that climate change is happening and what can we do to assist in at least slowing it down from a one person at a time perspective. This is a park where you can see that it is happening first hand." With annual visitation averaging 295,979 between 2010 and 2014 they see an opportunity to change behaviors, building mitigation from the ground up. Regardless of the reasoning to pursue public engagement, the interviews conducted show a relationship between involving the public and perceived climate change outcomes.

At the end of the day, each institution is accountable to its stakeholders. Federal agencies are accountable to American citizens. State departments are accountable to Alaskans residents. KPB government is accountable to residents of the Borough. CIRI is accountable to its shareholders throughout the world. It is important to have the necessary support when it's time to act.

Choosing words carefully
The State, Borough, and CIRI don't have consistent language identified to talk about climate change (Table 4). A KPB participant said "climate change seems to be a loaded term that means different things to different people…I find it a hard word to use in communication because it is taken in so many different ways." Because of this, the same KPB participant said, "I would not put legislation forward to our governing bodies that had the words 'climate change' in it unless it was required by the primary nature of the legislation." When searching for strategies to involve state and borough partners in climate change adaptation, perhaps speaking directly of climate change is not the most effective approach.

Despite the existence of climate change response strategy documents among the federal land management agencies, according to participants there is a wide degree of understanding of the response strategies within the agencies. Participants from both the USFS and USFWS commented that although climate change language is established and consistent, highly specific terms like the division of approaches within adaptation (resistance, resilience, and transition) are not understood outside of research community. "Once you get down the organization level to the Forest or district they disappear," said a USFS participant. "Communication in all directions, up, down and latterally is a big challenge when it comes to [climate change]," said a USFWS participant. If employees do not have the same level of understanding when talking about adaptation, it could affect the institutions ability to properly navigate the available adaptation options.

The perceived need for landscape-scale adaptation
As has been mentioned elsewhere in this document, uniform change is not projected across the Kenai Peninsula. The western side of the Peninsula (occupied by KNWR) is projected to have changes to land cover types, while the eastern side (occupied by CNF and KFNP) is projected to be relatively stable (Hollingsworth et al., In review). How, then, does this difference in geographical impacts of climate change affect agency responses, particularly when viewed through the lens of the agency's mission?

A USFS participant corroborated the study, saying "[Dawn Magness'] modeling shows that [CNF] is rainforest now and it will be rainforest then." For that reason the same participant saw "the adaptation need, for conservation reasons, here being extremely low relative to other places on the planet."
In discussing whether the USFS would facilitate land cover change prospectively, the same participant said that on the CNF they "likely won't given that objectives for vegetation condition, outside of fire protection, aren't such that there is a recognized need to influence the trajectory." The meaning of this is described by another USFS participant who commented on the mission of the Forest Service and the context in which CNF operates. "We're a different national forest than the other models, because we're not out there doing silvicultural prescriptions to try to get it back to some production class so we can recruit or something like that. We're looking at natural processes and ecological functions." Taken altogether, the USFS plans to allow natural processes to unfold without actively managing them. Since the projections for change do not threaten the diversity of CNF, they perceive themselves to be acting within the mandates of the USFS mission (Table 5).

A NPS participant commented that at KFNP "we're letting the natural course of action take place." KFNP is not resisting climate change effects, but neither is it actively managing what transition may be occurring. A resistance strategy is most closely aligned with the NPS mission of "preserve unimpaired" (Table 5). Saying that KFNP will not resist climate change effects seems like a departure from preserving the park using a historic baseline. Allowing the changes to happen helps KFNP accomplish other aspects of its mission, namely education of this and future generations. Not going so far as actively managing the change is consistent with the NPS mission (Table 5).

Given that projected changes are more pronounced on the western side of the Peninsula, the perception of adaptation need is higher from participants at KNWR. The bulk of the USFWS mission is to "conserve, protect, and enhance fish, wildlife, plants, and their habitats" (Table 5). Additionally, the ANILCA purposes for KNWR stipulate that the Refuge maintain diversity. In the face of rapid climate changes, the KNWR is concerned that once land cover changes occur, the reshuffling of species could be ecologically less diverse than in the existing systems. For this reason the KNWR is exploring active facilitation options, such as species translocation, and whether those options would enhance the diversity of transitioning systems.

On the western side of the Peninsula, retrospective adaptation is not viable. This is not necessarily the case for the eastern side of the Peninsula. Therefore, amongst the federal agencies on the Peninsula, there is a difference in opinion in how to adapt to climate change, which is brought on in part by differing agency missions and geographic climate variability.

RECOMMENDATIONS
Ways Forward: Our Collaborative Future

Reasons to collaborate
There are many reasons why increased collaboration will be a way of the future in terms of landscape-scale climate change adaptation. First, as one USFWS participant said, "[Climate change] research is at such a scale that it almost demands that you do it collaboratively." A USFS participant also noted that because of the broad scale, "the adaptation will be more effective if done collaborateively across agencies," since "systems are running right from one boundary into another."

Other important reasons to collaborate according to a USFS participant is that, “by bringing multiple together you get a better understanding of the range of consequences. Also, pools resources and so is more efficient with those resources so you're not duplicating evaluations that are redundant.” A NPS participant also said, “Partnerships are always going to be funded more.”

Important for individuals from different institutions to consider, collaborative partnerships do not necessarily mean the specific actions need to be the same on both sides. Coordination of the goals and outcomes, though, would be more efficient. Collaborative partnerships do not require individuals to abandon his/her institution’s mission and mandates.

Reframing the issue

If collaborative partnerships are increasingly necessary to implement landscape-scale climate change adaptation, what are important considerations when partnering? Incentives for partnership, including and how the proposed partnership can specifically help the partnering institutions, should be considered when approaching different partners to collaborate.

Climate change, despite the first-hand impacts that have been seen on the Kenai Peninsula, is still a hard issue to feel personally attached to. A crucial early step is for the issue to be personalized so that people understand how climate changes might affect their lifestyle, and so that institutions understand how it might affect their goals.

Focus on needs not climate change

Effectiveness of partnerships may increase if potential outcomes align with particular institution’s needs. Given some of the challenges surrounding climate change, for example the collective understanding of terminology, acceptance by state and local governments and their constituents, and the more static state of the eastern Peninsula, speaking directly of climate change is not the most effective approach to build collaborations around climate change adaptation.

Rather than discuss climate change explicitly the issues should be reframed. Participants mentioned salmon, coastal erosion, and fire as examples of unifying issues tied to climate change (Table 7). Salmon fisheries, for example, was described by 11/13 or 85% of participants as an issue with high relevance to the local economy and lifestyles. The same issue also has associated climate change concerns with a need consider adaptation. Approaching adaptation from the perspective of addressing one of these challenges might be a way to foster broader receptiveness from a broader audience.

Redirecting the conversation towards economics and risk would give climate change impacts, and the need to prioritize adaptation, broader receptiveness. CIRI, for one, would have a higher level of interest. Gaining broader public support could make climate change a priority for the Borough and the State, potentially rendering them more willing partners in collaborative adaptation.

For KFNP, which is more focused on gathering data, mitigation, and engaging the public, KNWR should look towards data collection as a way to collaborate. Improving the understanding of climate change impacts and projected impacts could render KFNP as more willing partners in adaptation in the future. From a KNWR perspective, at the very least the Refuge would have a broader dataset, potentially based on the same sampling technique.

Reduce complexity
If one possible explanation for a lack of implemented adaptation is high complexity of the task, reducing complexity is key for success. Identifying and taking the first step to solve a large, complex problem can be the hardest part. This can be especially true when it is unclear how an individual or group's actions contribute to a tangible product and/or that visibly affects an outcome.

One aspect of complexity of considering adaptation over the entire Kenai Peninsula is the scale. "There is a great need to do inventory and monitoring at a landscape-scale that is bigger than most people's jurisdictional boundaries," said a USFWS participant. "Having a sampling frame that we did collaboratively over the larger Kenai Peninsula," says the same participant, could reduce the feeling of uncertainty and complexity felt by any one institution.

Breaking adaptation down into smaller, more manageable steps is a crucial step forward. One USFWS participant explained that, "At the end of the day, as long as we could agree on the trajectory [of forecasts] we could begin the process of taking baby steps." Another US Fish and Wildlife participant said, "There is a need to start putting some of this stuff in black and white, documenting where we're at, what we're thinking, why we're thinking it, and what possible solutions exist. We need to this in a cohesive and comprehensive way." Then, said a Park Service participant, "The key is building on successes. You keep pushing off from the last successful work that you did."

KNWR staff should identify past collaborative efforts that were successful and use those successes to build momentum for future partnerships. A USFS participant "you could see [the Regional Climate Change Vulnerability Assessment] as a first step in adaptation of learning where the change is going to be biophysically as well as socioeconomically." This inventory exercise could be considered a successful collaborative effort from which to move forward.

A Conservation Blueprint to redirect conservation thinking to broad landscape issues
As this study shows, framing issues around climate change may not be the best tact. As a wicked problem, climate change is both a singular issue and one that affects others. Therefore addressing landscape-scale conservation challenges could, in effect, result in climate change adaptation. A conservation blueprint is a process and product that could identify landscape-scale conservation challenges that require collaborative partnerships to address. It would redirect and focus conservation thinking to these broad landscape issues that have relevance to all parties involved in the partnership.

During the interviews in this study, participants identified several concerns (Table 7) around which a conservation blueprint could be created. Salmon fisheries and wildfire received a lot of attention during the summer of 2015, providing a unique opportunity for multiple parties to come together and discuss future management. Over time, once more data is in place and effective, trusting partnerships are developed, a cohesive and coherent climate change adaptation plan may have better traction than it appears to have today.

Conclusion

"The [climate change] dialogue is revolutionary within our generation that we can look at things at a space-time scale and say, 'There's probably going to be changes.'" This KPB participant is foreseeing that tackling challenges relating to climate change adaptation will require different thinking. Not only do "the challenges posed by climate change perhaps emphasize the need for long range planning and thinking,"

as a USFWS participant said, climate change requires transboundary thinking. Climate change touches all issues and eschews man-made jurisdictional boundaries. The six institutions represented in this study need to think this way too, which necessitates identifying collaborative efforts and partnerships that enable them to act according to ecological boundaries, at scales beyond their mandates. This is only possible if individuals at the institutions examined in this study have the capacity to act. That is why, if the KNWR wants to engage with other institutions around implementing adaptation, it needs to understand the respective needs of each and engage in ways that help the institution in question address its needs.

Bald eagle flying over Skilak Lake and the Kenai River. Photo by Dylan Beach

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