

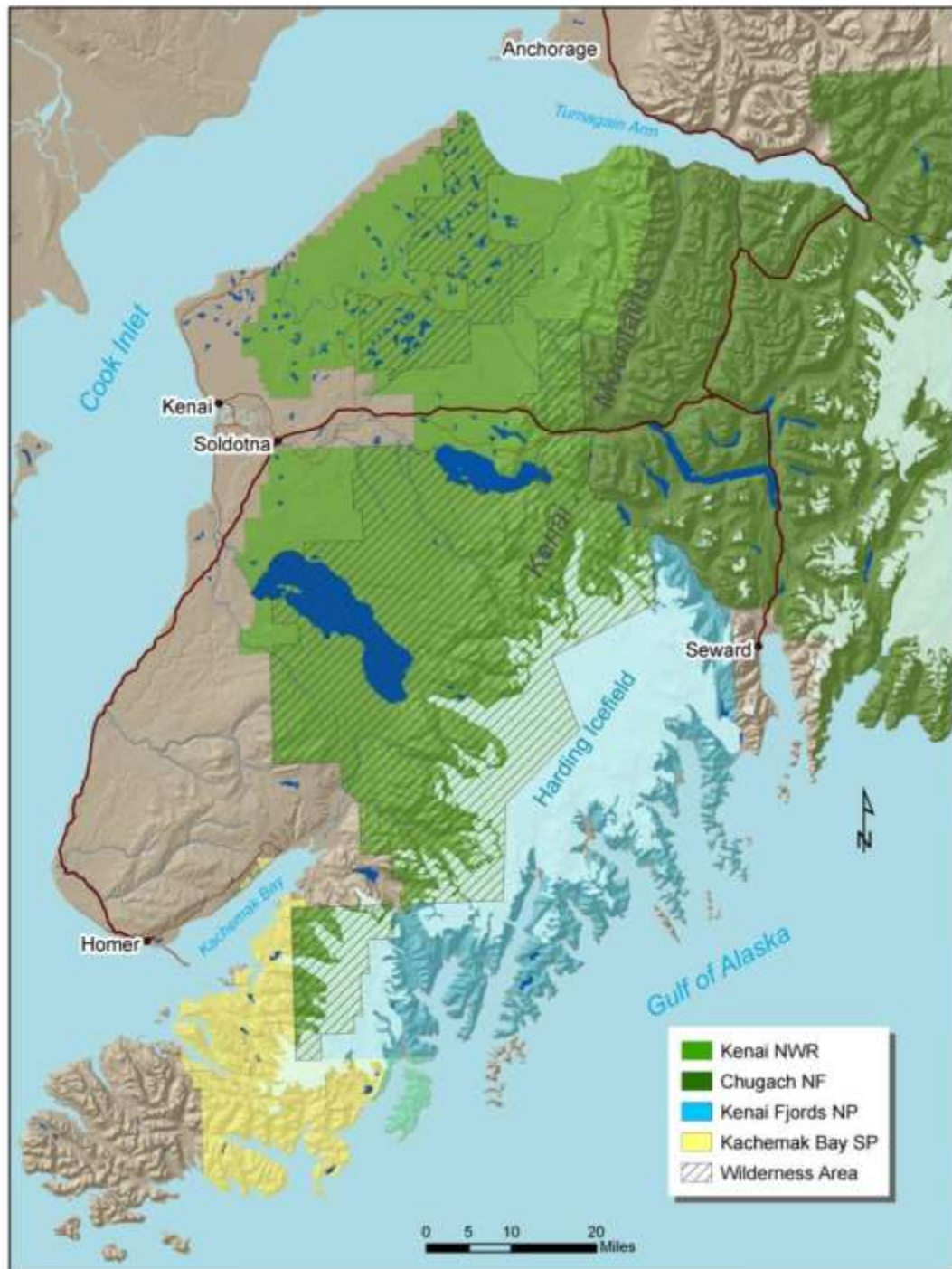
Which Kenai Peninsula?

The case for doing nothing versus doing something



John Morton





- ✓ Alaska is warming at 2-3X Lower 48 rate
- ✓ Climate change effects are not masked by other anthropogenic drivers
- ✓ Kenai Peninsula may be best studied locale in AK outside of high arctic

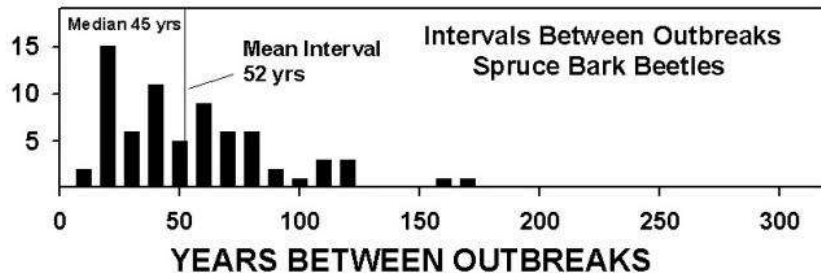
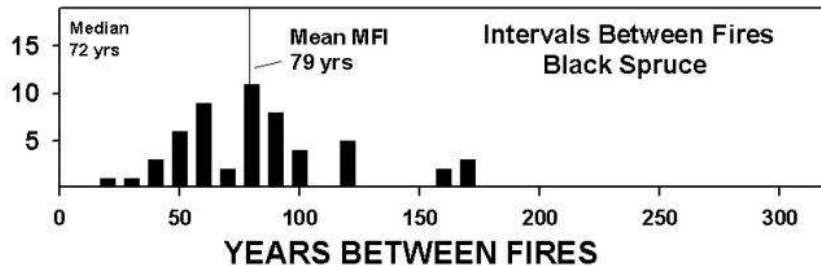
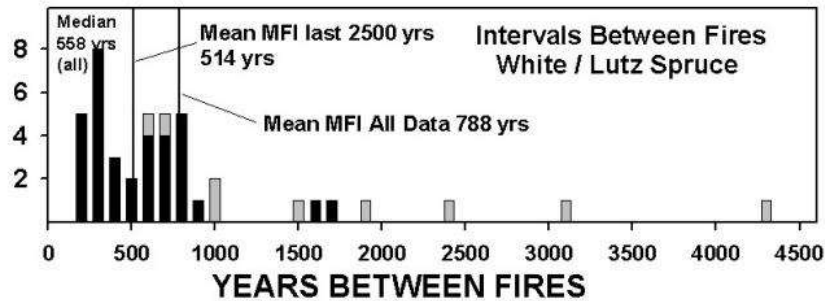
Dramatic changes in last 50 years in response to warming and drying



- decreasing available water (62% loss since 1968)
- drying wetlands (6 – 11% per decade)
- receding glaciers (11% surface area, 21m elevation)
- + rising treeline (1m/yr) and shrubline (2.8m/yr)
- + unprecedented SB beetle outbreak (triggered by 2 consecutive warm summers)

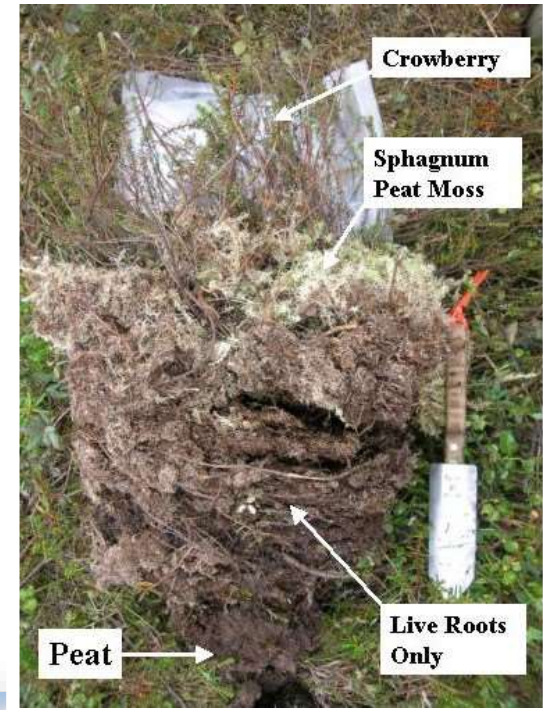


Official fire season now April 1 instead of May 1





Woody shrub encroachment into 8000 year old Sphagnum peatlands



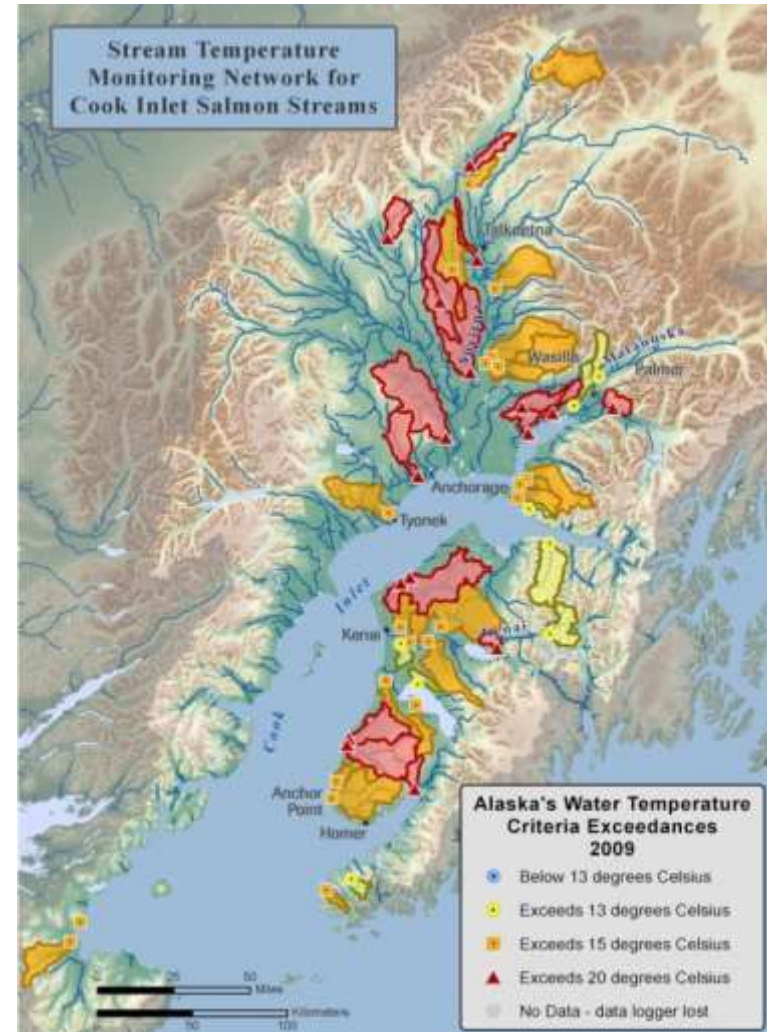
Salmon in 47 of 48 non-glacial streams experience thermal stress in July



47 > 13°C
39 > 15°C
17 > 20°C

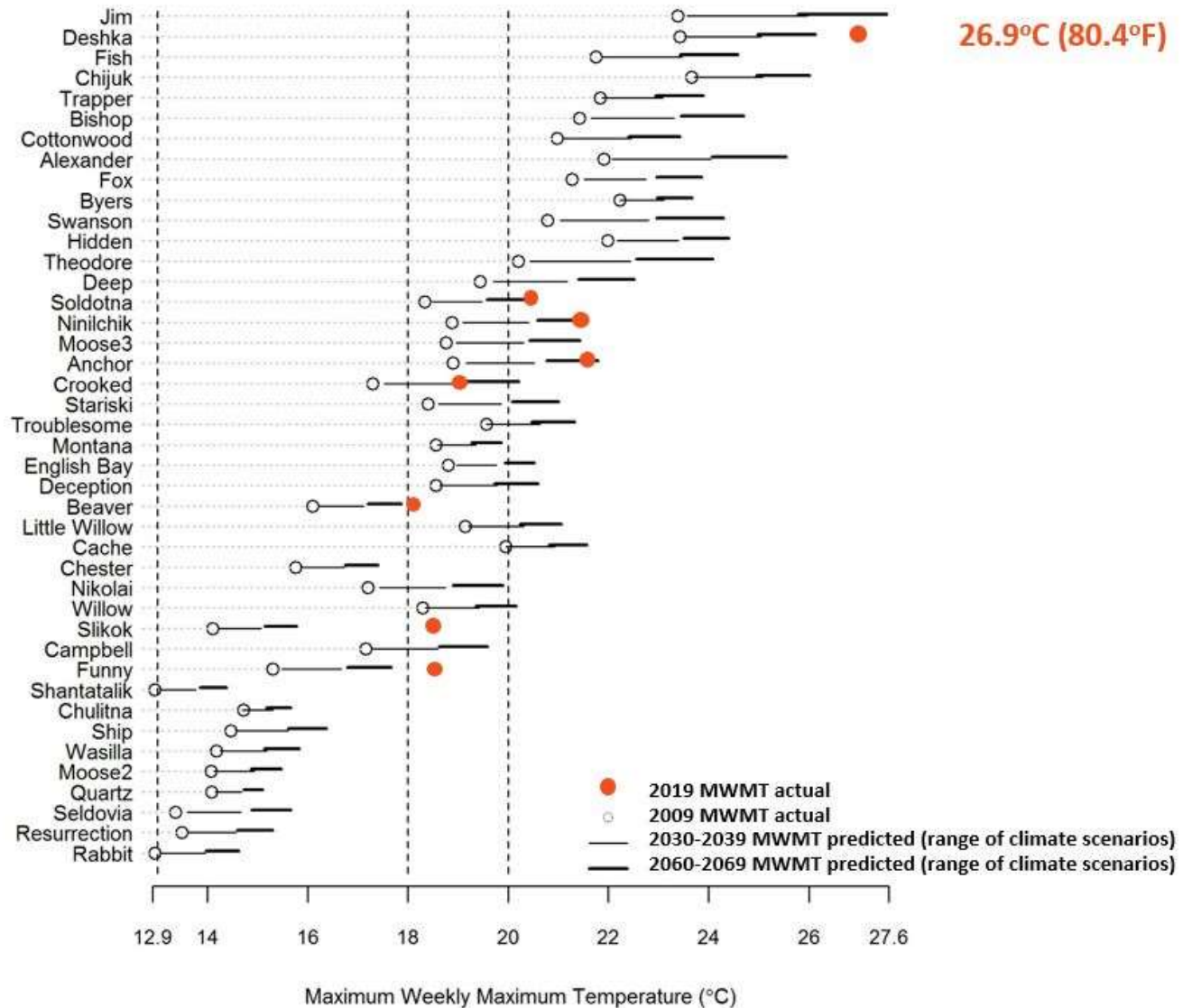
Maximum temperatures not to exceed:

- egg & fry incubation = 13°C
- spawning areas = 13°C
- migration routes = 15°C
- rearing areas = 15°C
- and not exceed 20°C at any time



Mauger 2011

Stream temperatures in 2019 exceeded 2069 forecasts!



Changing migration window in last decade

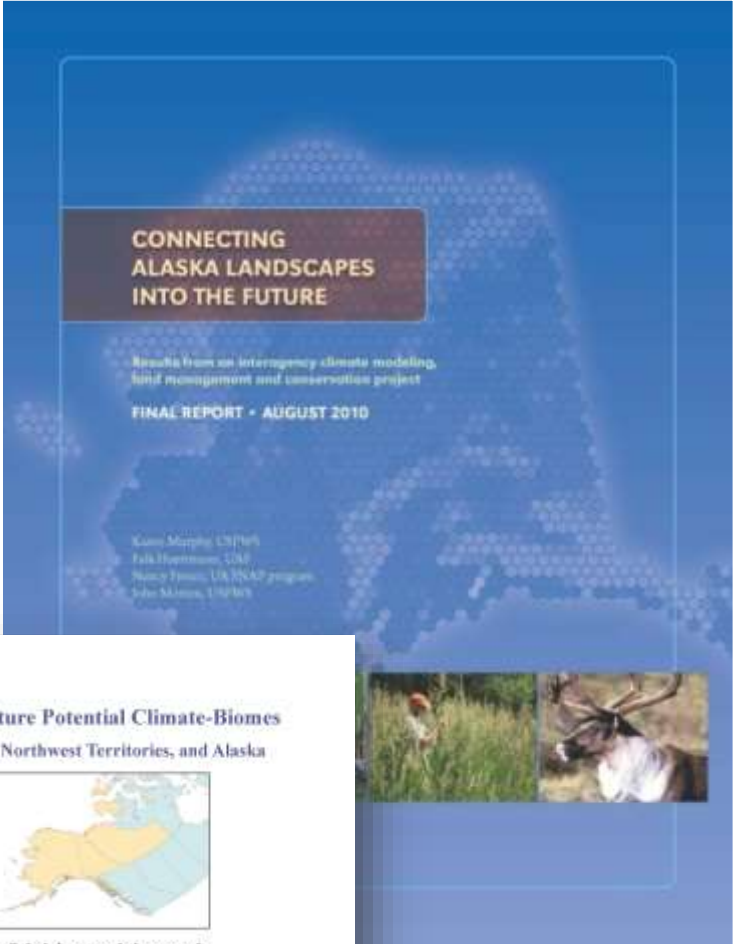


eBird data

- ✓ Earlier arrival records for 33 species
- ✓ Later departure records for 38 species
- ✓ 27 new species since 2007

Eurasian-collared dove*
Redwing*
Jack snipe*
Skylark*
Long-billed murrelet*
Black-tailed godwit*
Northern mockingbird
Spotted towhee
Turkey vulture
Western kingbird
Western meadowlark
Willow flycatcher
Northern wheatear
Western tanager
Yellow-bellied sapsucker
Warbling vireo
Swamp sparrow
Tennessee warbler
Cape May warbler
Nashville warbler
Wilson's phalarope
Great egret
Willet
Red-footed booby
Black guillemot
Heerman's gull
Lesser black-backed gull

Interagency effort to pioneer assessment of climate change effects on biome and species distributions using climate envelope models



Predicting Future Potential Climate-Biomes for the Yukon, Northwest Territories, and Alaska



A climate-linked cluster analysis approach to analyzing possible ecological refugia and areas of greatest change

Prepared by the Scenario Network for Arctic Planning and the ESWHALE lab, University of Alaska Fairbanks on behalf of

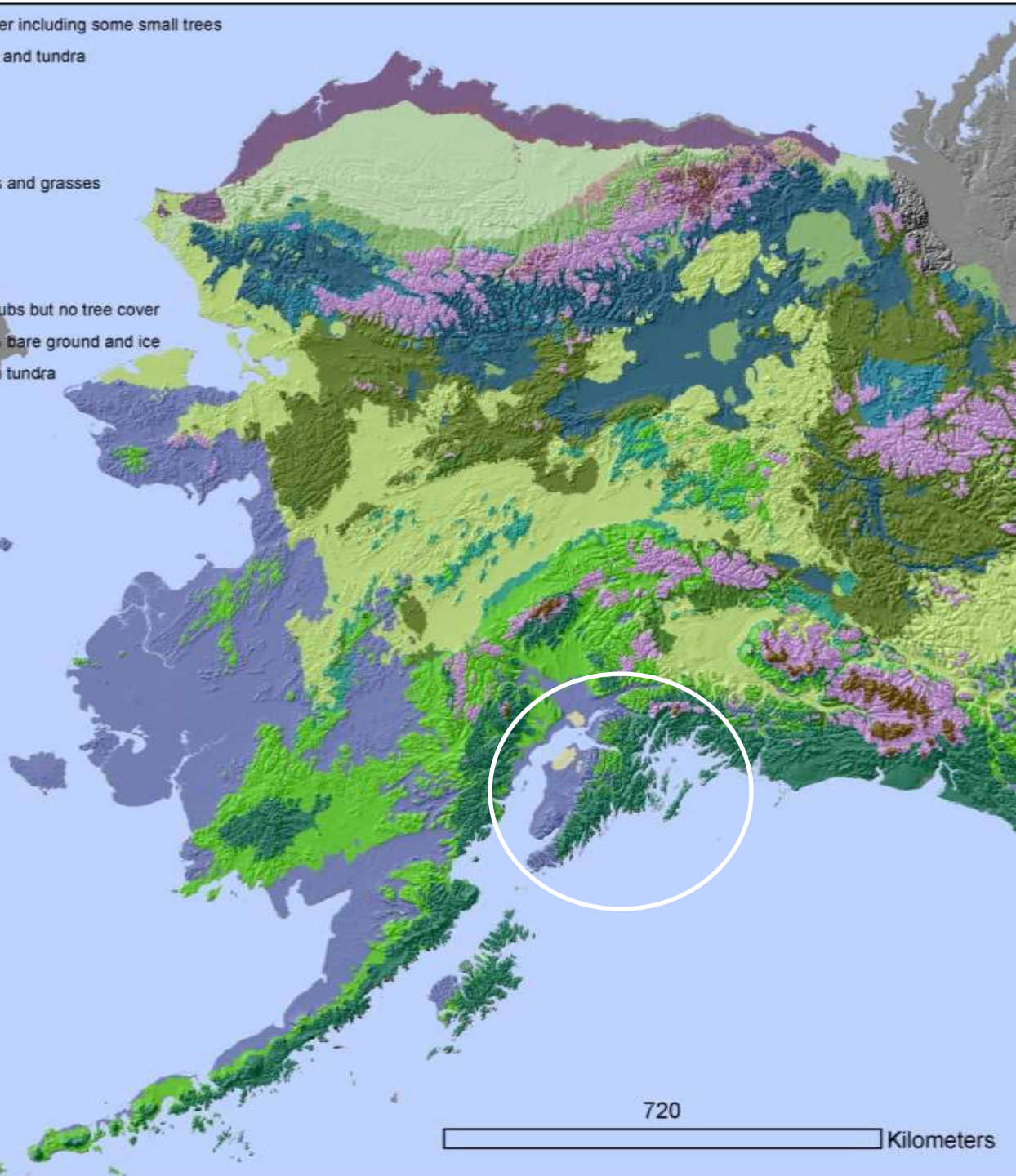
The Nature Conservancy's Canada Program
Arctic Landscape Conservation Cooperative
The US Fish and Wildlife Service
Ducks Unlimited Canada
Government Canada
Government Northwest Territories



- Arctic tundra with denser vegetation and more shrub cover including some small trees
- Boreal forest with coastal influence and intermixed grass and tundra
- Coastal rainforest, wet, more temperate
- Cold northern boreal forest
- Densely forested southern boreal
- Dry boreal wooded grasslands - mixed coniferous forests and grasses
- Dry sparsely vegetated southern arctic tundra
- Mixed boreal forest
- More densely forested closed-canopy boreal
- More densely vegetated arctic tundra with up to 40% shrubs but no tree cover
- Northern Arctic sparsely vegetated tundra with up to 25% bare ground and ice
- Northern boreal / southern arctic shrubland, with an open tundra
- Northern boreal coniferous woodland, open canopy
- Prairie and grasslands
- Southern boreal / aspen parkland
- Southern boreal, mixed forest
- Sparsely vegetated boreal with elevation influences

2009

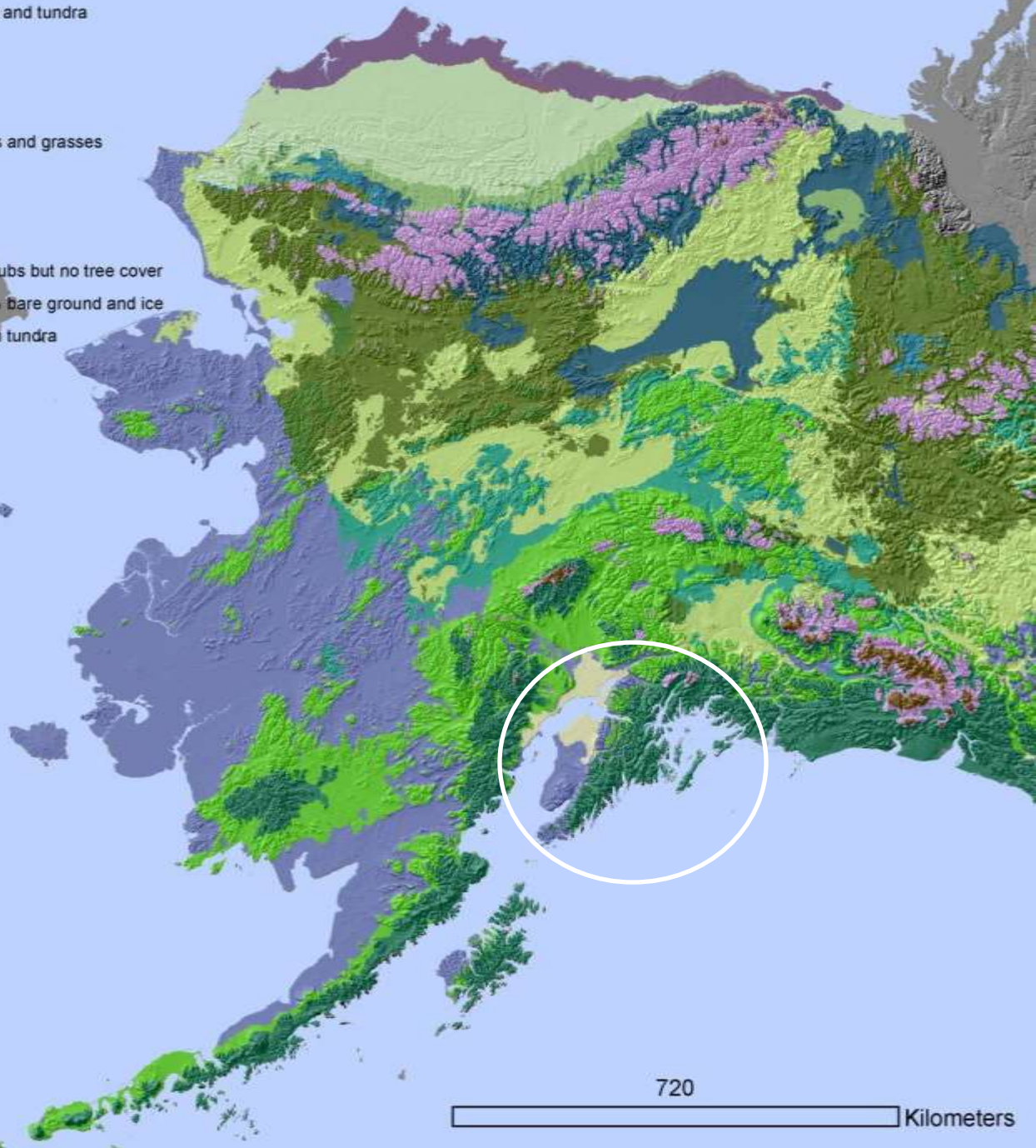
720 Kilometers



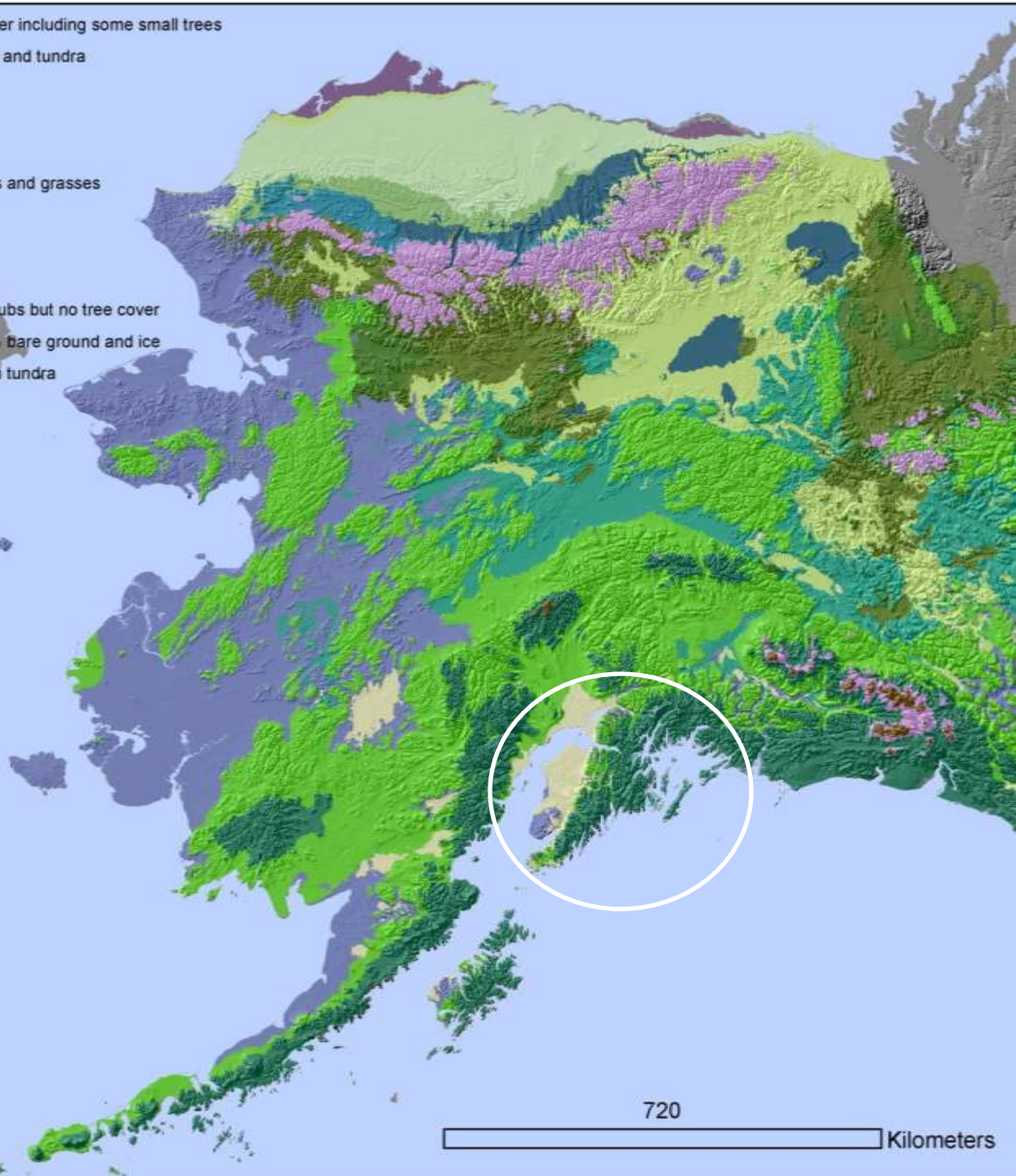
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2039

720 Kilometers



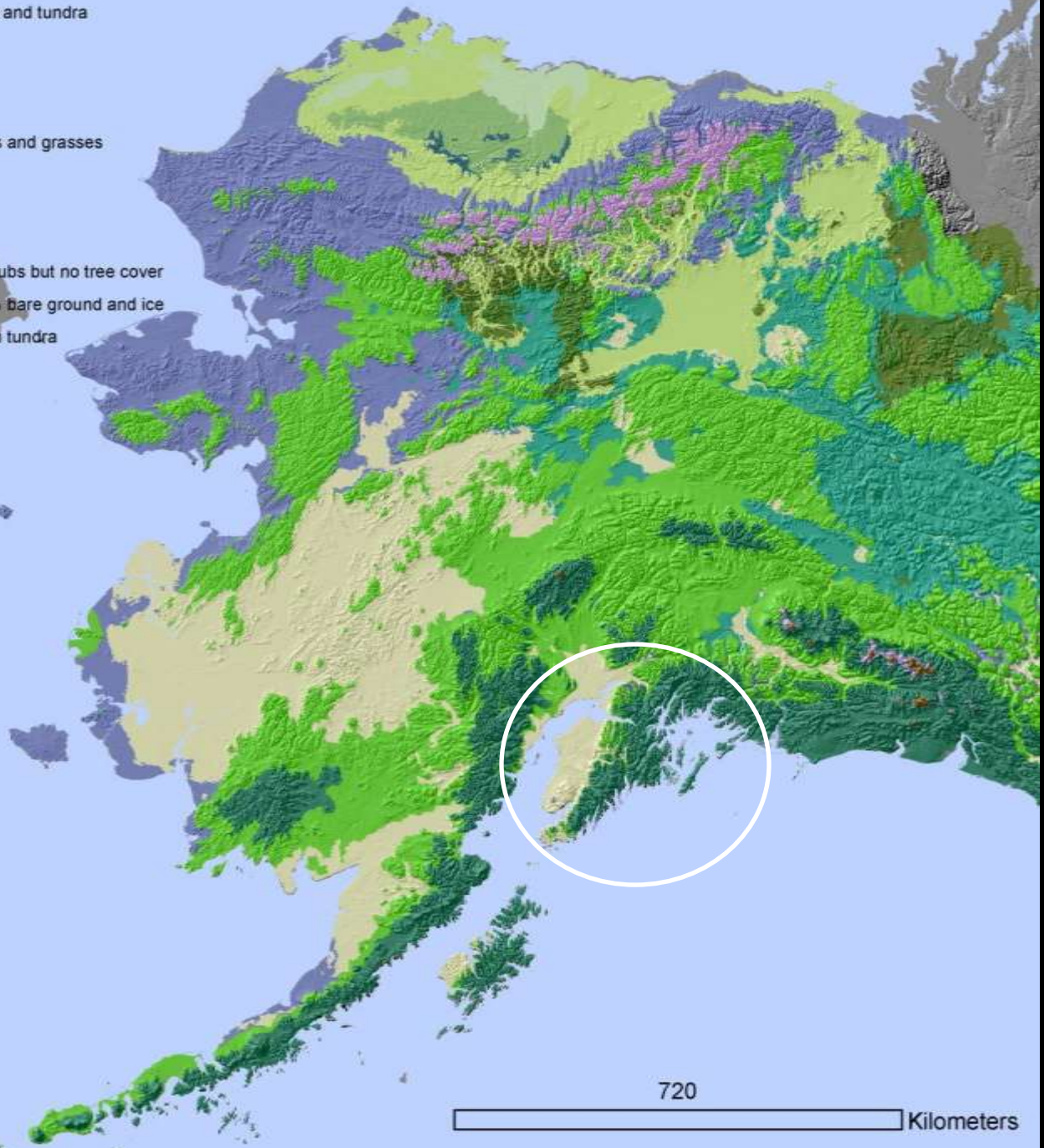
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2069

720 Kilometers

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2099

720 Kilometers

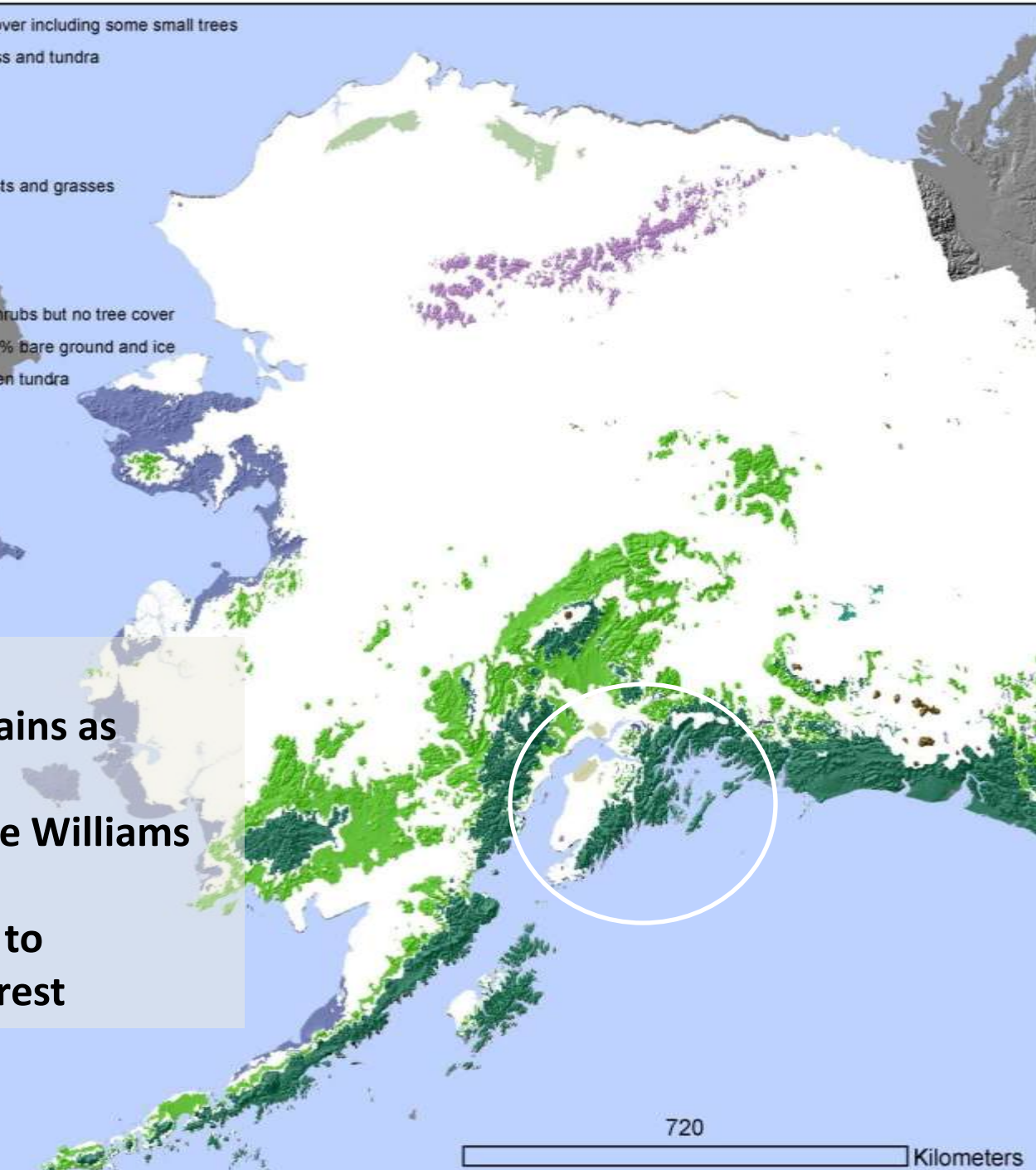
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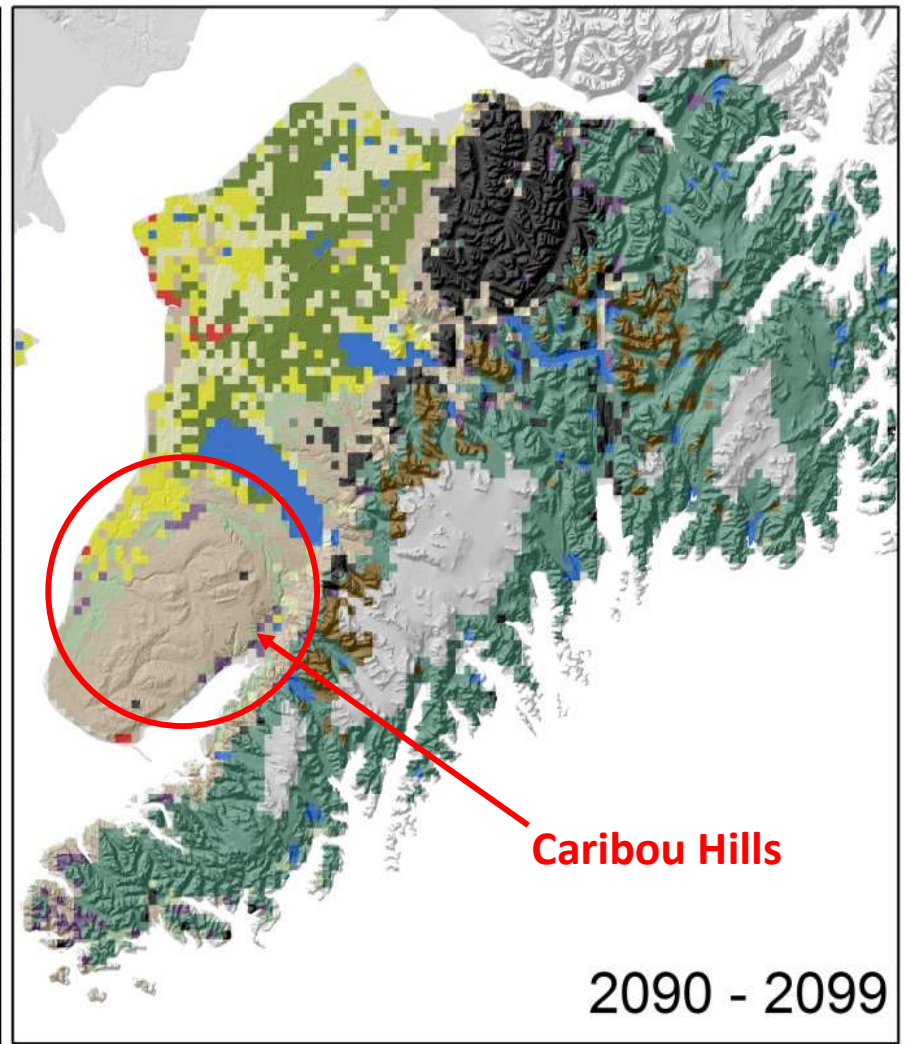
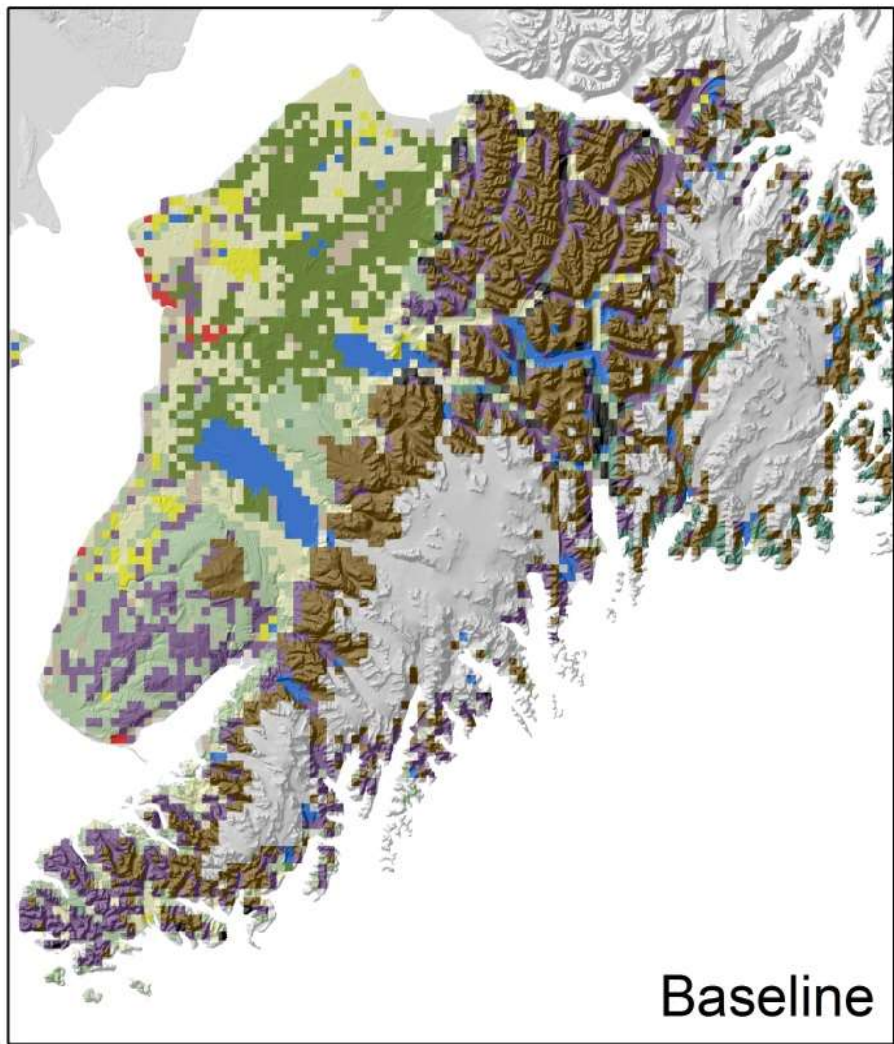
By 2100...

- ✓ **only 25% of Alaska remains as biome refugia**
- ✓ **eastern Kenai and Prince Williams Sound remains rainforest**
- ✓ **western Kenai converts to grasslands from boreal forest**

2099

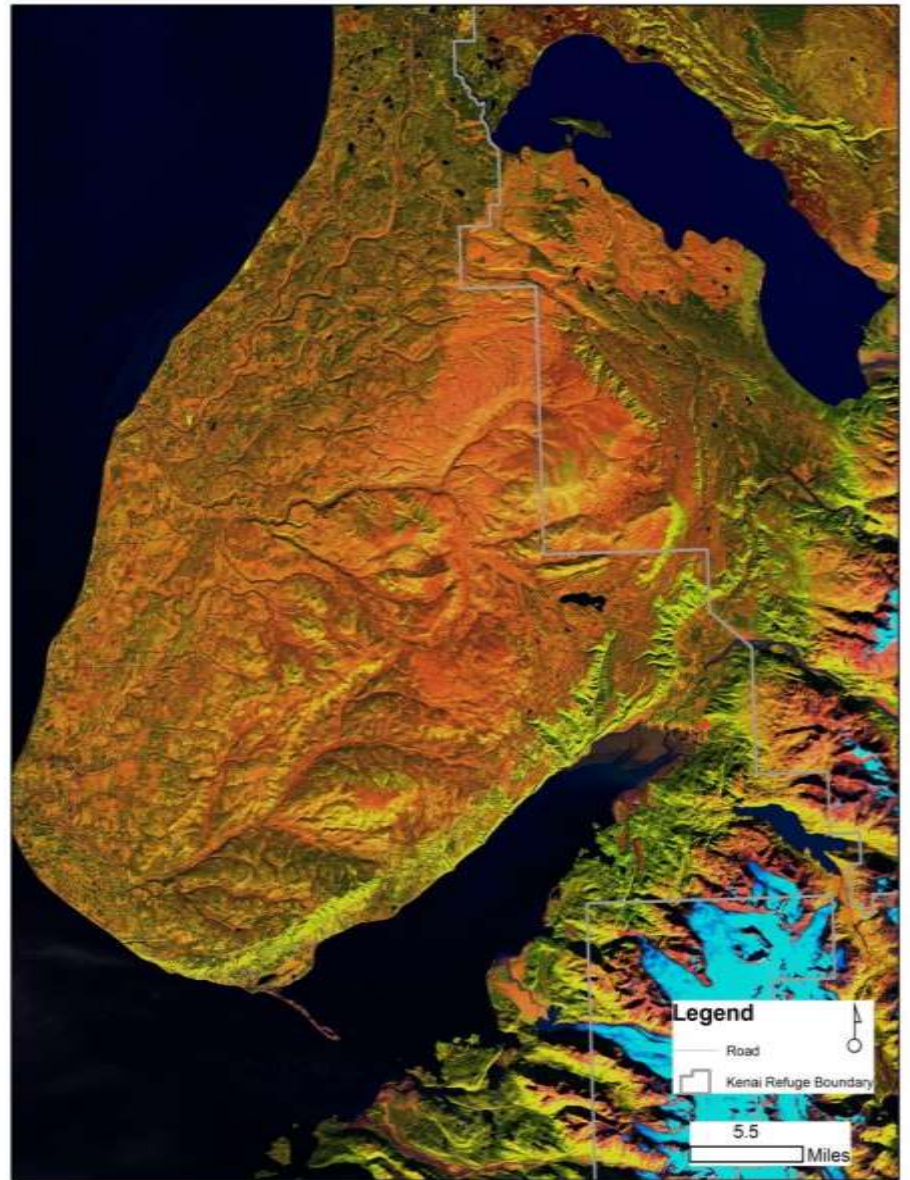
720 Kilometers



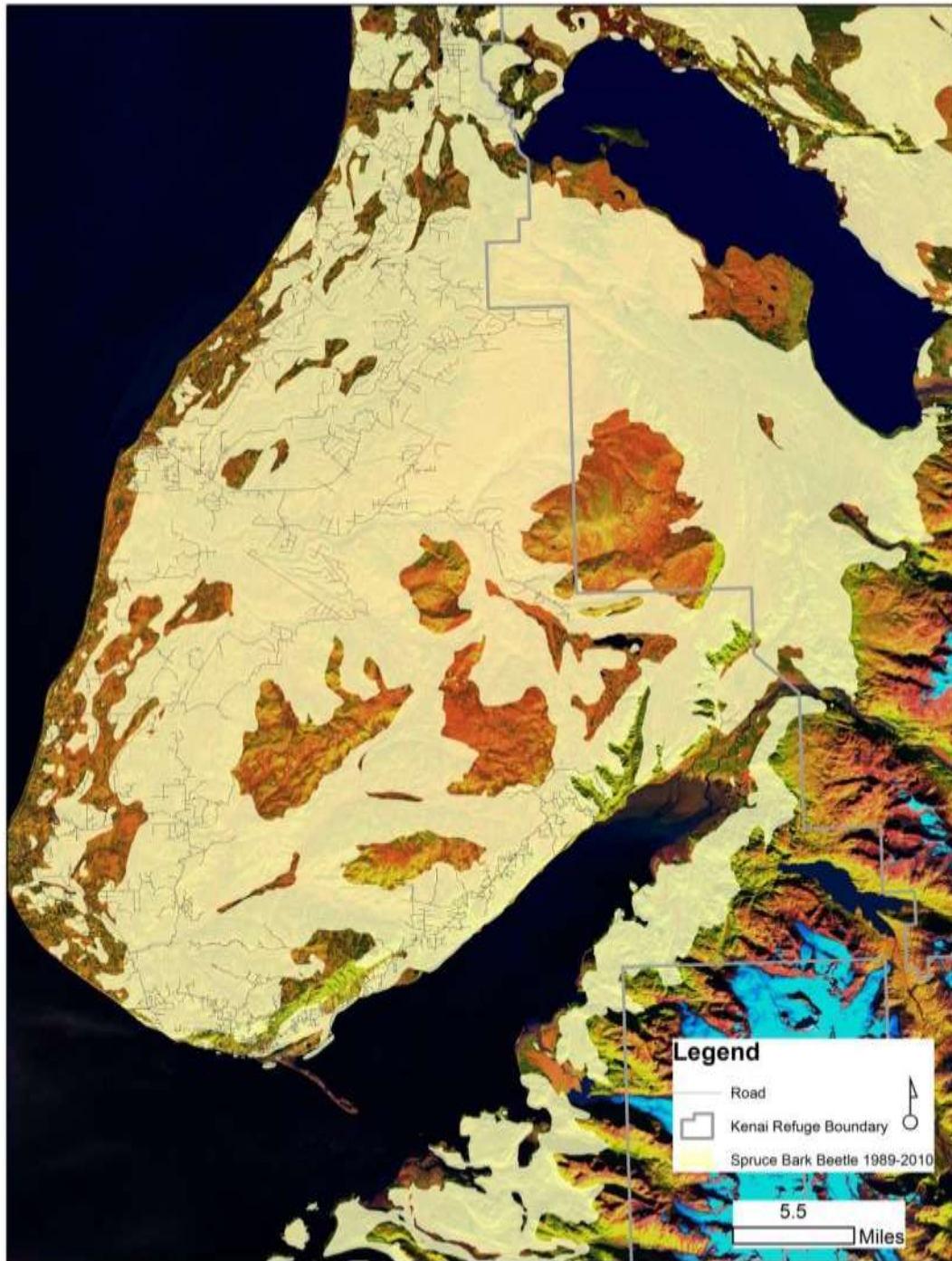




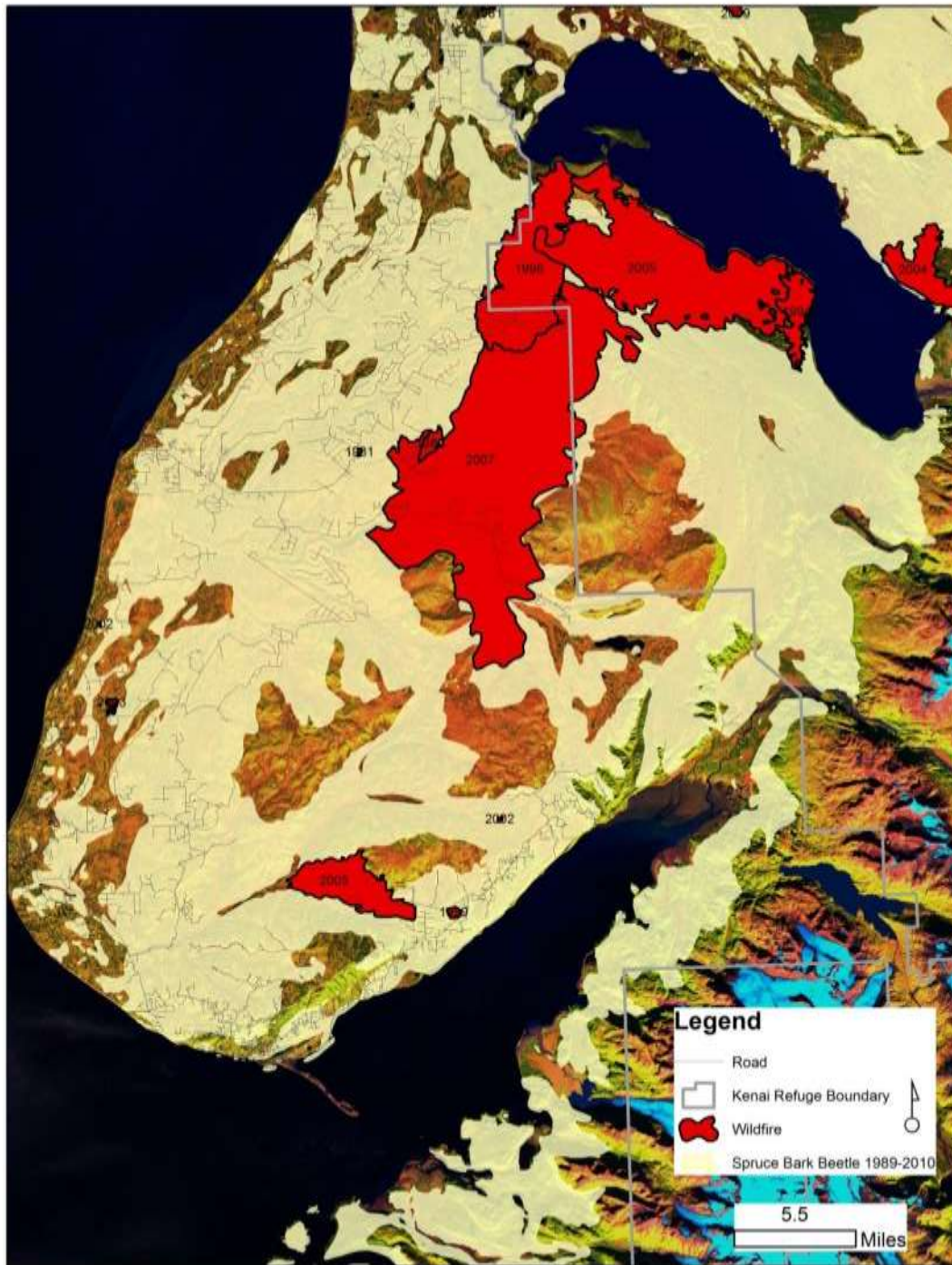
SEPT 1985



SEPT 2014



Spruce Bark Beetle Mortality (1989-2010)



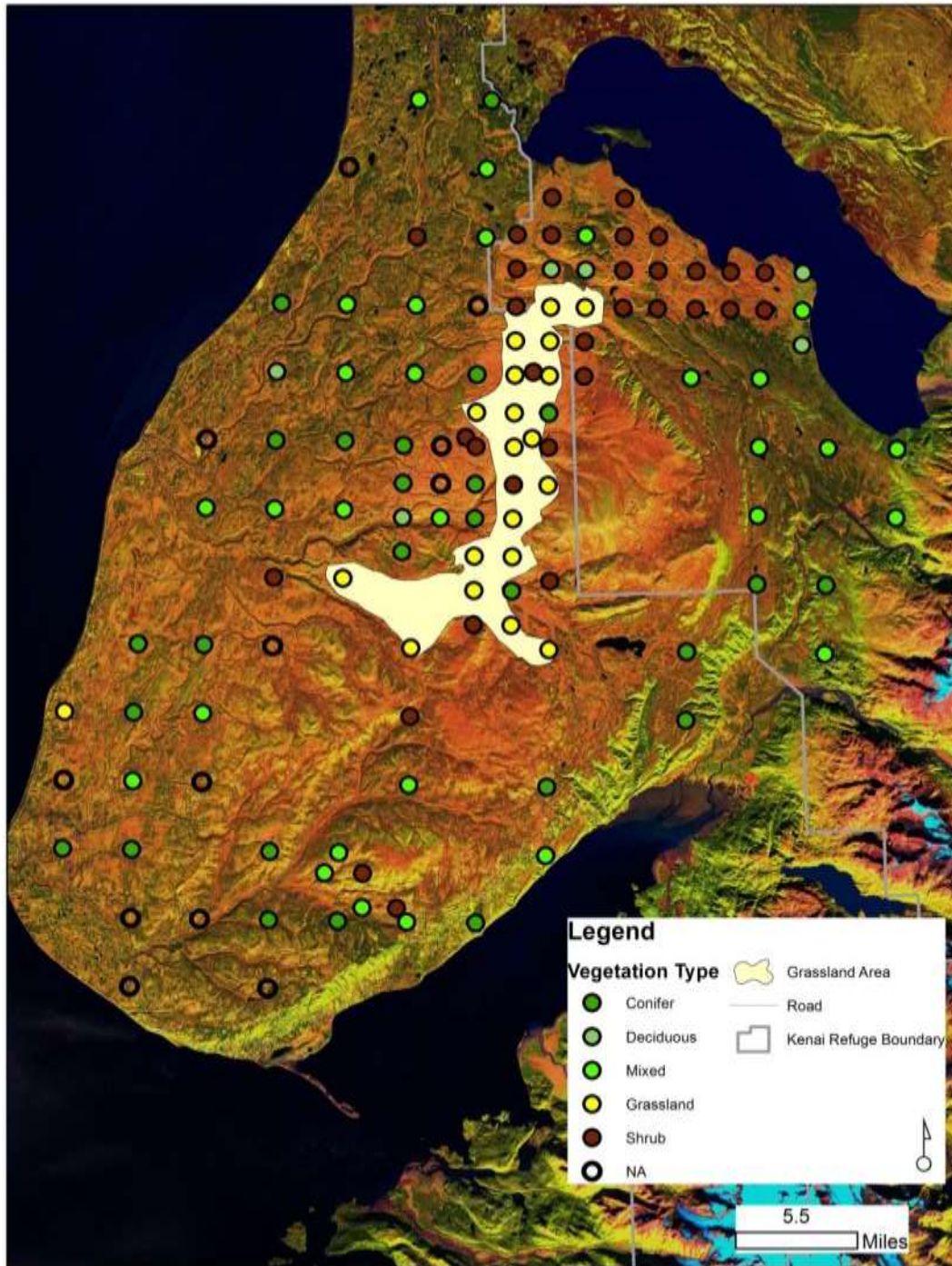
Wildfires (1994–2007)

- 1994 Windy Point
- 1996 Crooked Creek
- 2005 Glacier Creek
- 2005 Fox Creek
- 2005 Tracy Avenue
- 2007 Caribou Hills

40,000-acre contiguous grassland polygon in 2015

2002 imagery

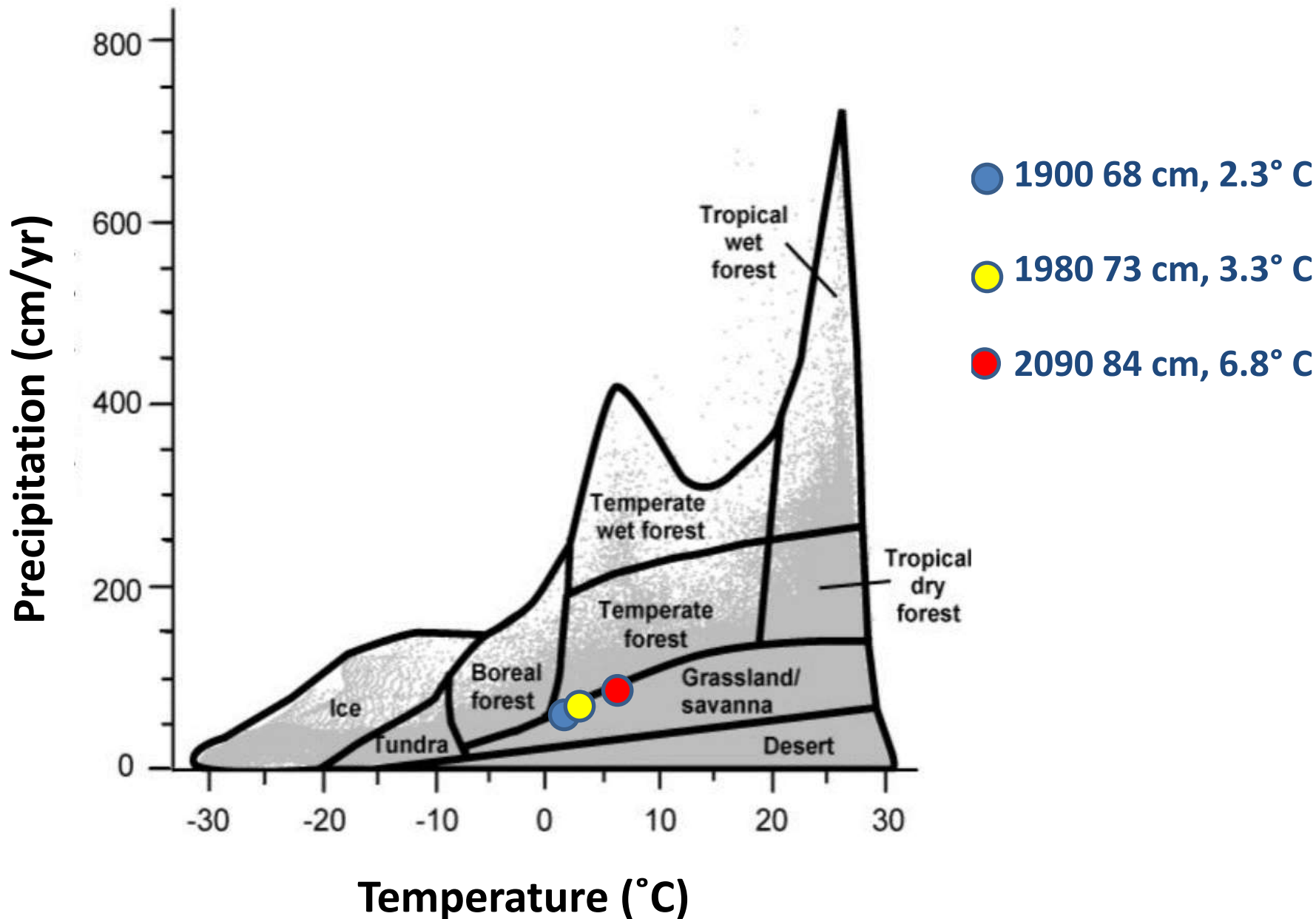
- Forest 55%
- Other 40%
- Herbaceous 5%








2015/07/19



Staudinger et al. 2012. Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment.

A photograph of a beach at sunset. The sky is a mix of blue, purple, and orange. The ocean is calm and reflects the sky. In the foreground, there is a dark, sandy beach. In the middle ground, several polar bears are wading in the shallow water. They are surrounded by many seagulls. One seagull is flying in the upper left corner of the image.

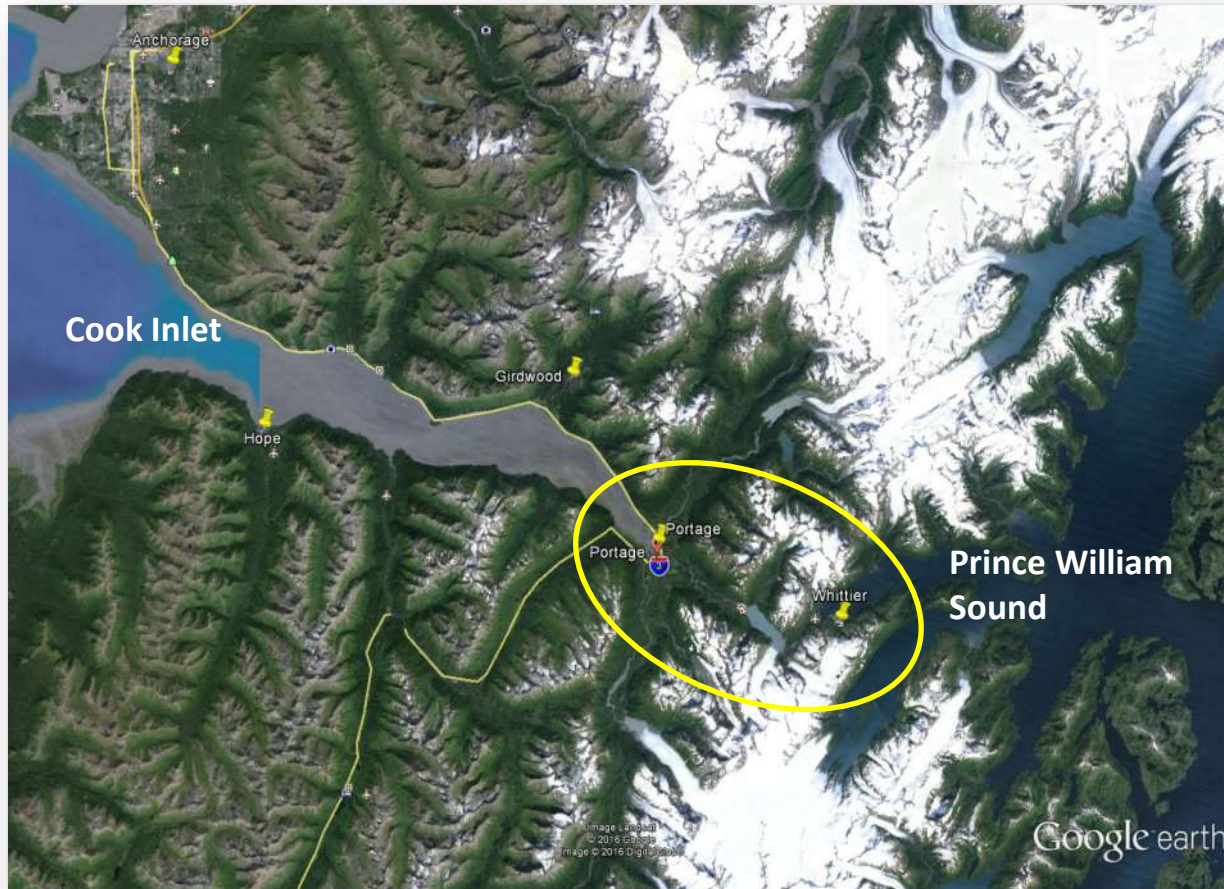
2 questions we need to ask ourselves....

What's the risk of doing nothing?

What's the risk of doing something wrong?

----Rosa Meehan
10 Feb 2010

10-mile wide isthmus is a migration barrier



Wilson et al. 2015



Tomasik and Cook 2005



Jackson et al. 2008

Novel climates, no-analog communities, and ecological surprises

John W Williams^{1*} and Stephen T Jackson²

No-analog communities (communities that are compositionally unlike any found today) occurred frequently in the past and will develop in the greenhouse world of the future. The well documented no-analog plant communities of late-glacial North America are closely linked to "novel" climates also lacking modern analogs, characterized by high seasonality of temperature. In climate simulations for the Intergovernmental Panel on Climate Change A2 and B1 emission scenarios, novel climates arise by 2100 AD, primarily in tropical and subtropical regions. These future novel climates are warmer than any present climates globally, with spatially variable shifts in precipitation, and increase the risk of species reshuffling into future no-analog communities and other ecological surprises. Most ecological models are at least partially parameterized from modern observations and so may fail to accurately predict ecological responses to these novel climates. There is an urgent need to test the robustness of ecological models to climate conditions outside modern experience.

Front Ecol Environ 2007; 5(12): 475–482, doi:10.1890/0959577

How do you study an ecosystem no ecologist has even seen? This is a problem for both paleoecologists and global-change ecologists, who seek to understand ecological systems for time periods outside the realm of modern observations. One group looks to the past and the other to the future, but both use our understanding of extant ecosystems and processes as a common starting point for scientific inference. This is familiar to paleoecologists as the principle of uniformitarianism (ie "the present is the key to the past"), whereby understanding modern processes aids interpretation of fossil records. Similarly, global-change ecologists apply a forward-projected form of uniformitarianism using models based on present-day ecological patterns and processes to forecast ecological responses to future change. Thus, both paleoecology and global-change ecology are inextricably rooted in the current, and research into long-term ecological dynamics,

past or future, is heavily conditioned by our current observations and personal experience.

The further our explorations carry us from the present, the unlikelier our vision becomes. This is not just because the fossil archives become sparser as we look deeper into the past, nor because the chains of future contingency become increasingly long. Rather, the further we move from the present, the more it becomes an inadequate model for past and future system behavior. The current state of the Earth system, and its constituent ecosystems, is just one of many possible states, and both past and future system states may differ fundamentally from the present. The more that environments, past or future, differ from the present, the more our understanding of ecological patterns and processes will be incomplete and the less accurately will our models predict key ecological phenomena such as species distributions, community composition, species interactions, and biogeochemical process rates.

Here, we focus on "no-analog" plant communities (Panel 1), their relationship to climate, and the challenges they pose to predictive ecological models. We briefly summarize a niche-based, conceptual framework explaining how no-analog communities arise (Jackson and Coverack 2000). We discuss past no-analog communities using the well documented late-glacial communities as a detailed case study (Jackson and Williams 2004), and argue that these communities were shaped by environmental conditions also without modern counterpart (Williams et al. 2001). We then turn to the future, identifying regions of the world at risk of developing future novel climates (Williams et al. 2007). Finally, we discuss the implications for global-change ecology, including the risk of future novel ecosystems (Hobbs et al. 2000) and the challenges posed for ecological forecasting.

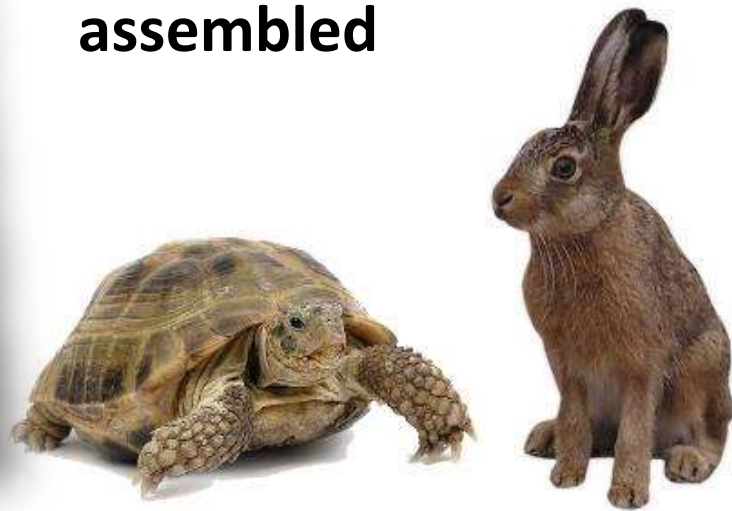
In a nutshell:

- Many past ecological communities were compositionally unlike modern communities
- The formation and distribution of these past "no-analog" communities appear to be climatically driven and linked to climates that are also without modern analogs
- Late Holocene greenhouse gas increases resulted in many future climates well probably lacking modern analogs, with tropical regions at greatest risk
- Regions over much of the globe are likely to develop novel communities and other ecological surprises in a future greenhouse world

¹Department of Geography and Center for Climate Research, University of Wisconsin, Madison, WI 53706. [jwilliams@geography.wisc.edu]
²Department of Geology and Program in Biology, University of Wyoming, Laramie, WY 82071

So which species will compose novel assemblages in dynamic systems?

The ones that are there when its being assembled



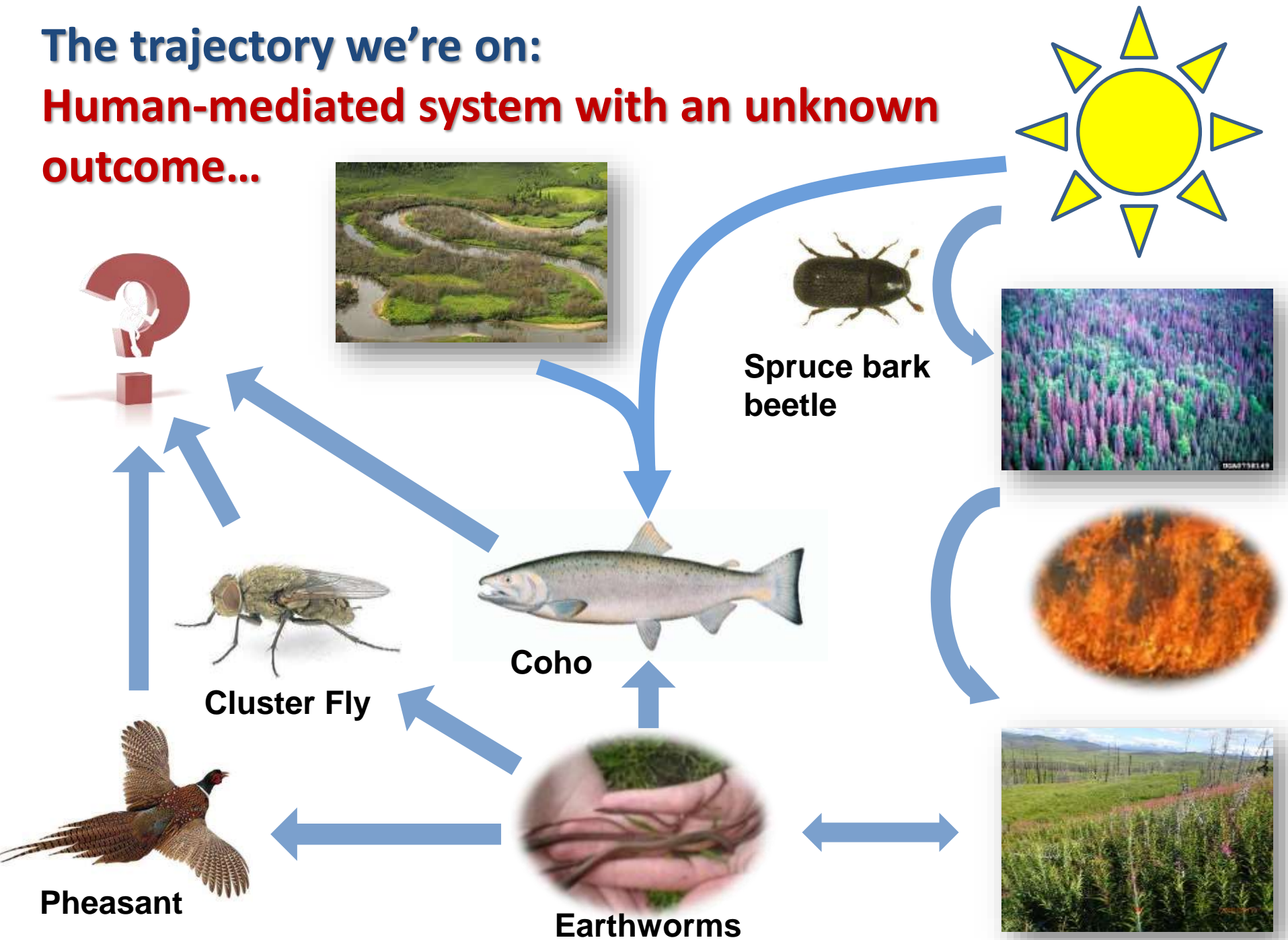


> 138 exotic species of flora (108) and fauna (30) occur on the Kenai Peninsula and are poised to fill novel assemblages



The trajectory we're on:

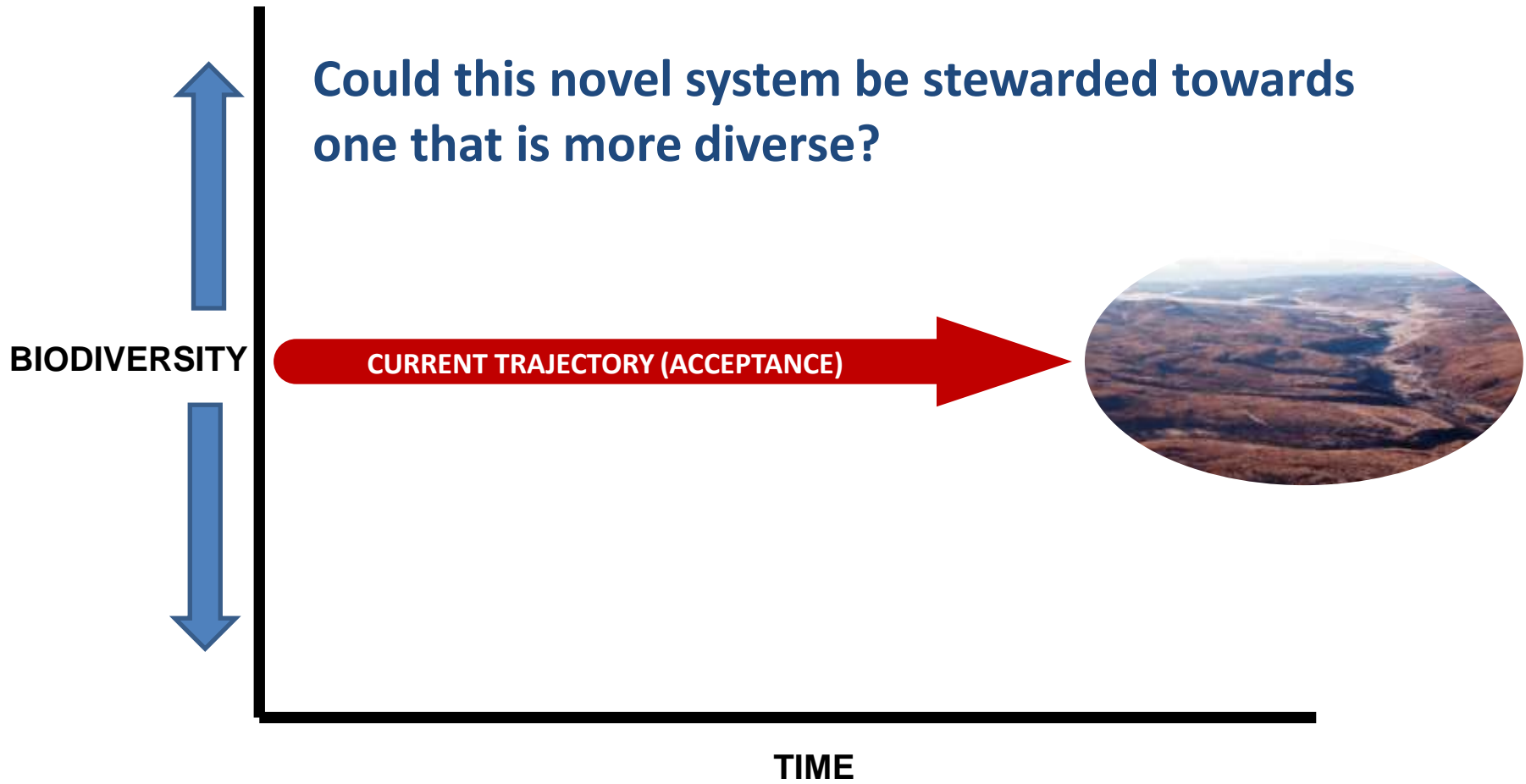
Human-mediated system with an unknown outcome...

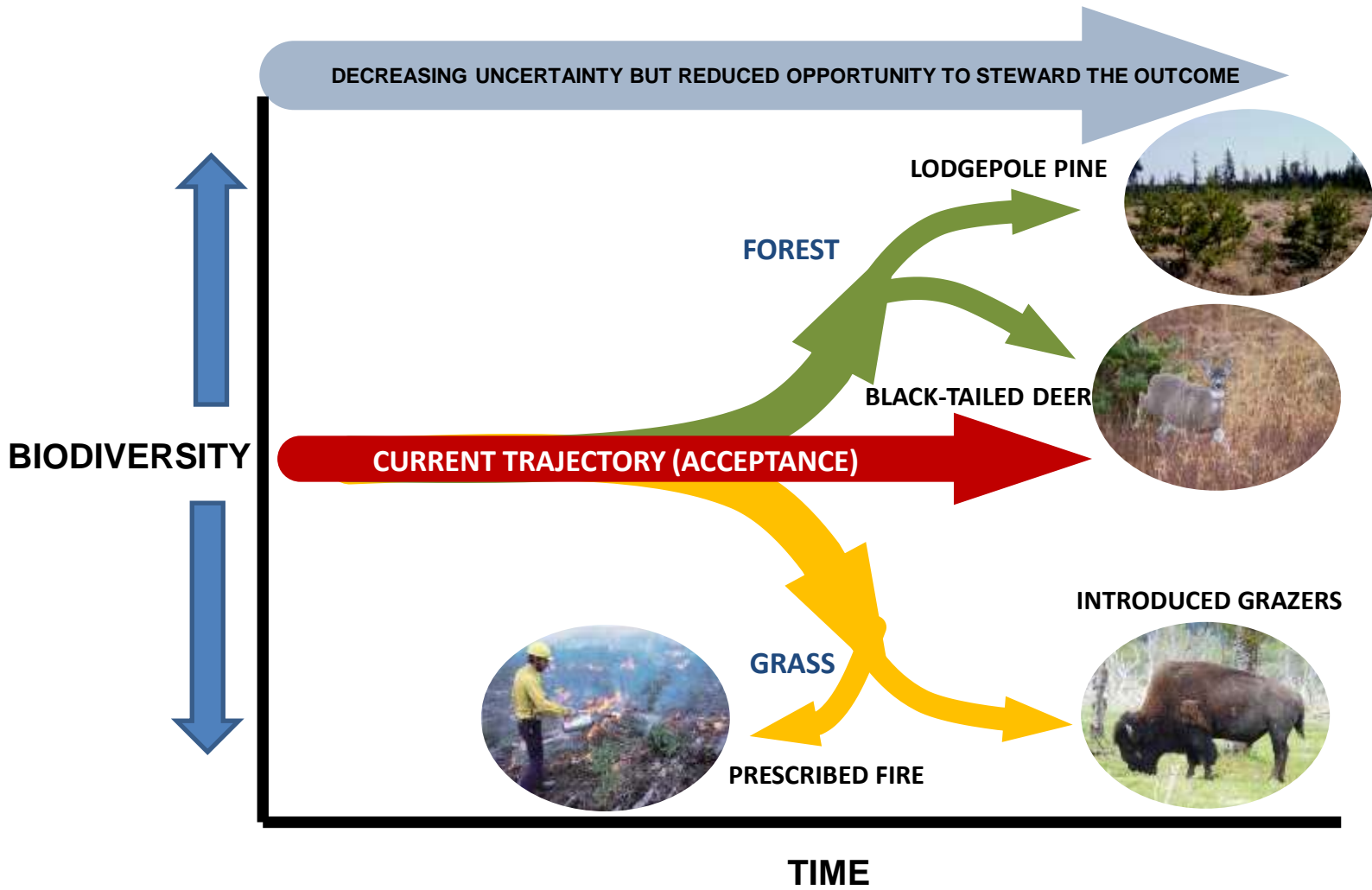


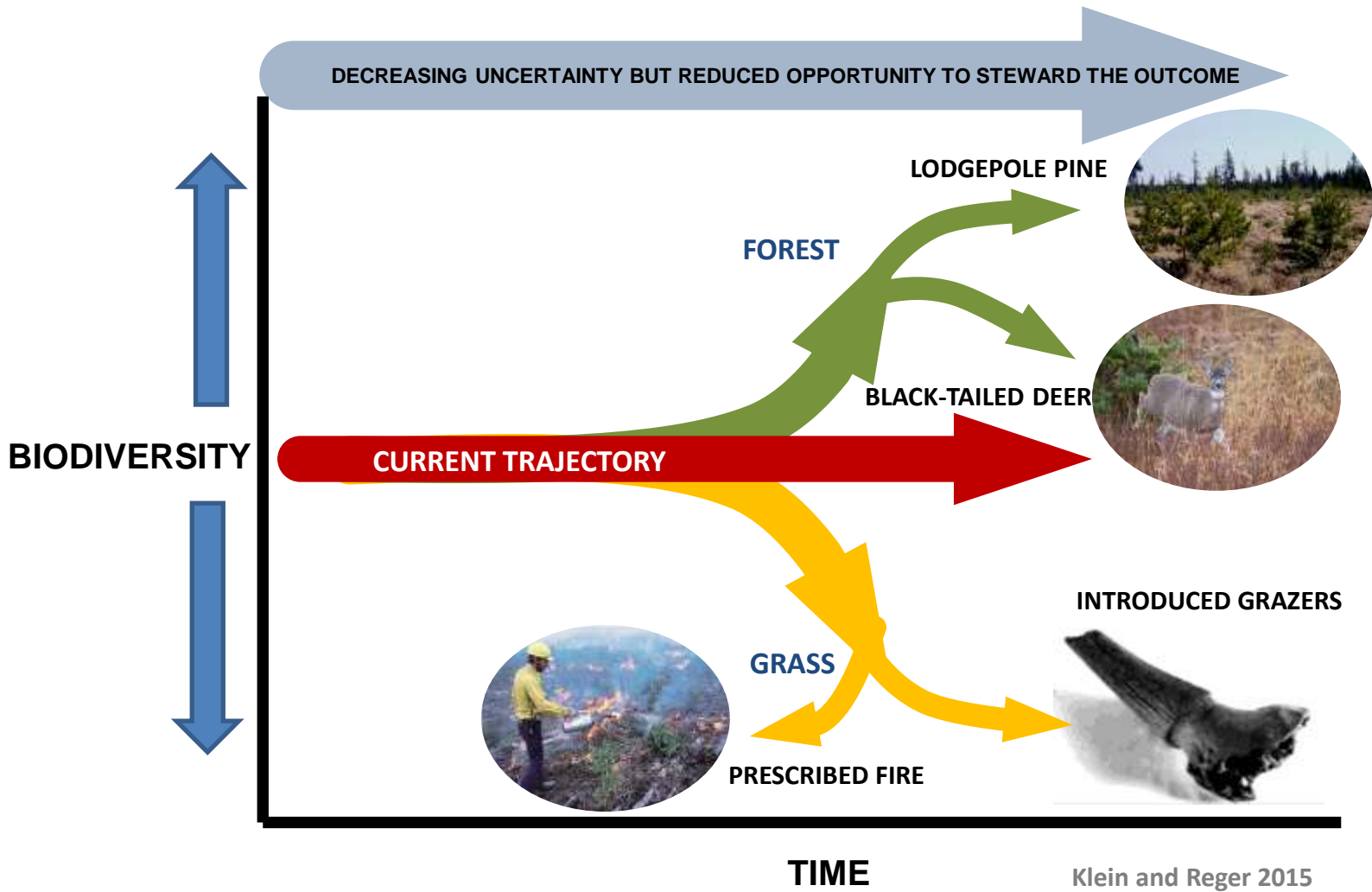


Doing nothing is really doing something... just incoherently and haphazardly

- ✓ **Kenai Peninsula is already responding to a changing climate and forecasted to continue doing so**
- ✓ **Latitudinal migration is constrained by the isthmus and rainshadow of Kenai Mountains**
- ✓ **Novel assemblages ≠ simple re-shuffling of native flora and fauna**
- ✓ **Many exotic species already introduced and more enroute**
- ✓ **And we squander our early opportunities to steward outcomes!**







Constraints on moving forward...

- There is still some uncertainty about the ecological trajectory
- But...scientific uncertainty is NOT the deterrent to adaptation that many think
- We need different goals (but who is the authority?)
- We need more exploratory manipulative field studies
- We need different data, not necessarily more data
- We need to challenge existing policy constraints
- Personal values of “-ologists” are constraining novel approaches
- Decisions are being made by agencies and private citizens...
sometimes without climate change as context,
but always without a comprehensive and coherent strategy

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6-1-2014

The Wilderness Act and Climate Change
Adaptation

Elisabeth Long

Eric Bloor
Berkeley Law



Questions????

