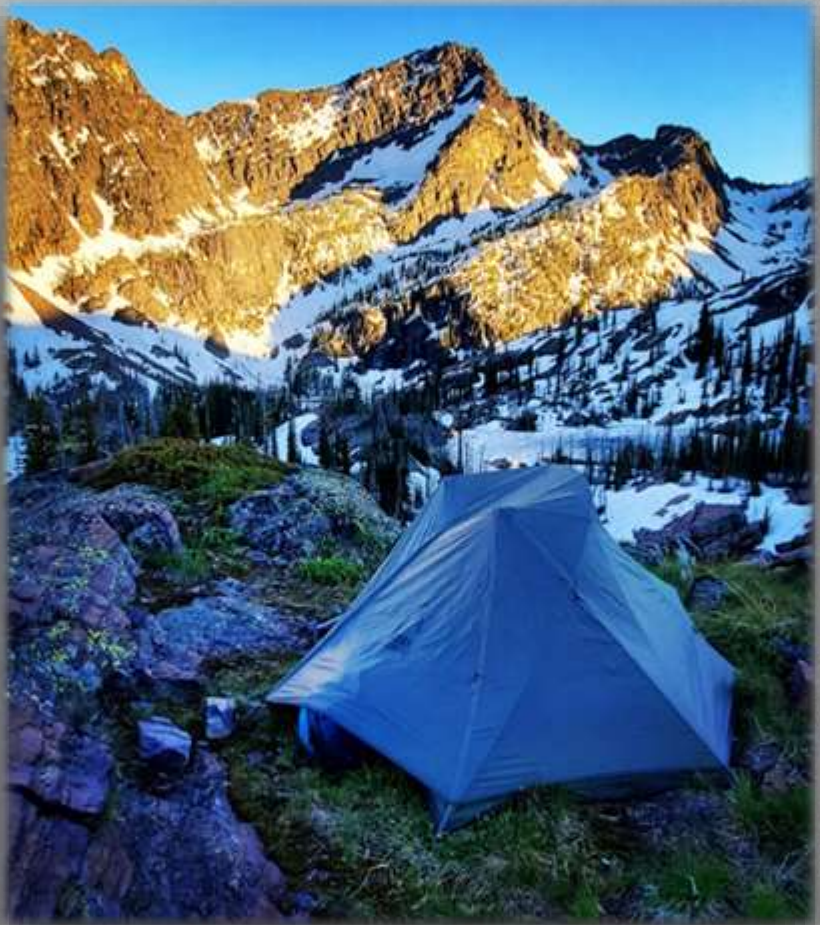
# Virtual Wilderness Information Series

**September 14-17th, 2020**

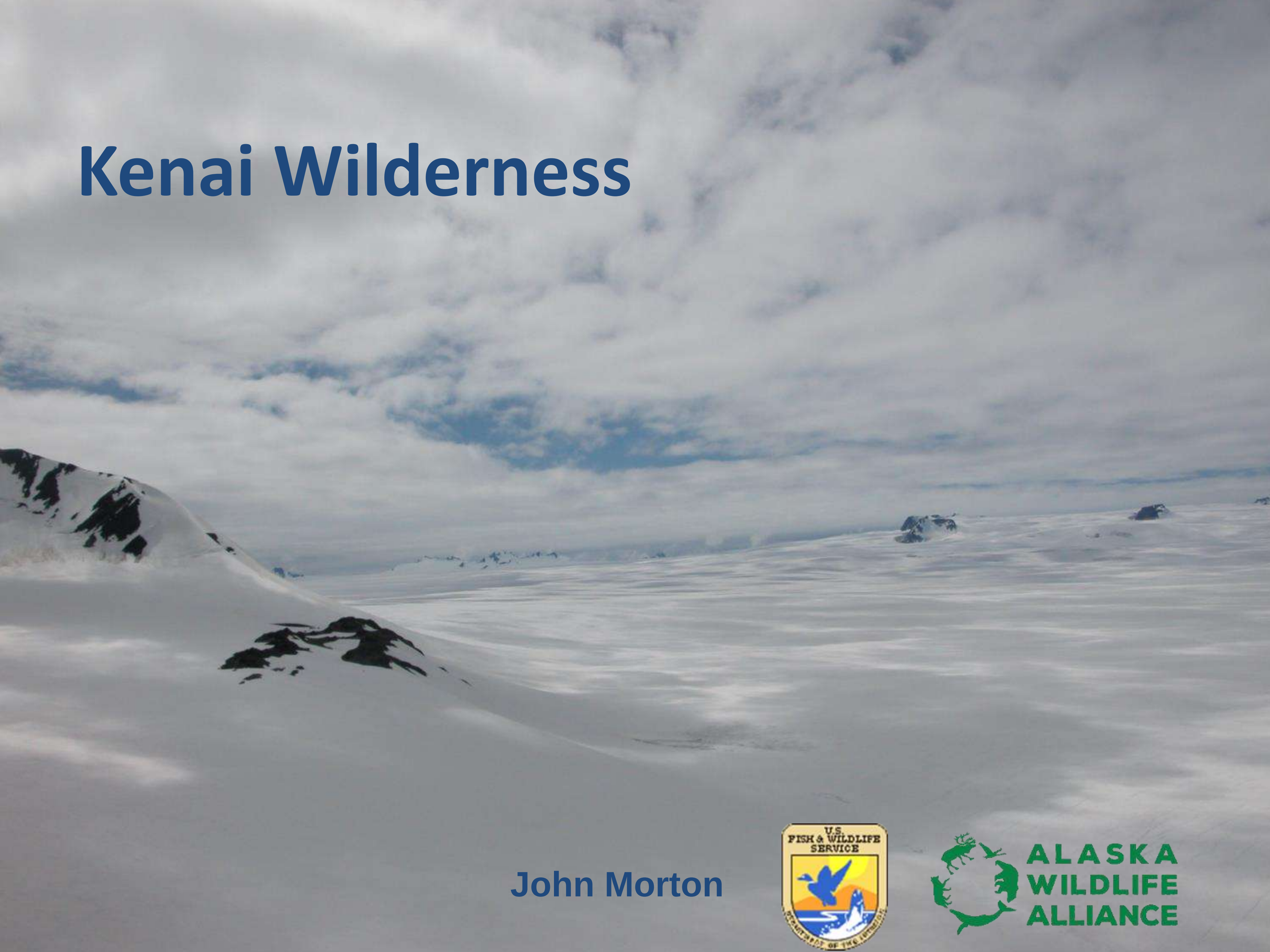
**Hosted by:**

## The Arthur Carhart National Wilderness Training Center

***"Fostering interagency excellence in wilderness stewardship"***



# Kenai Wilderness

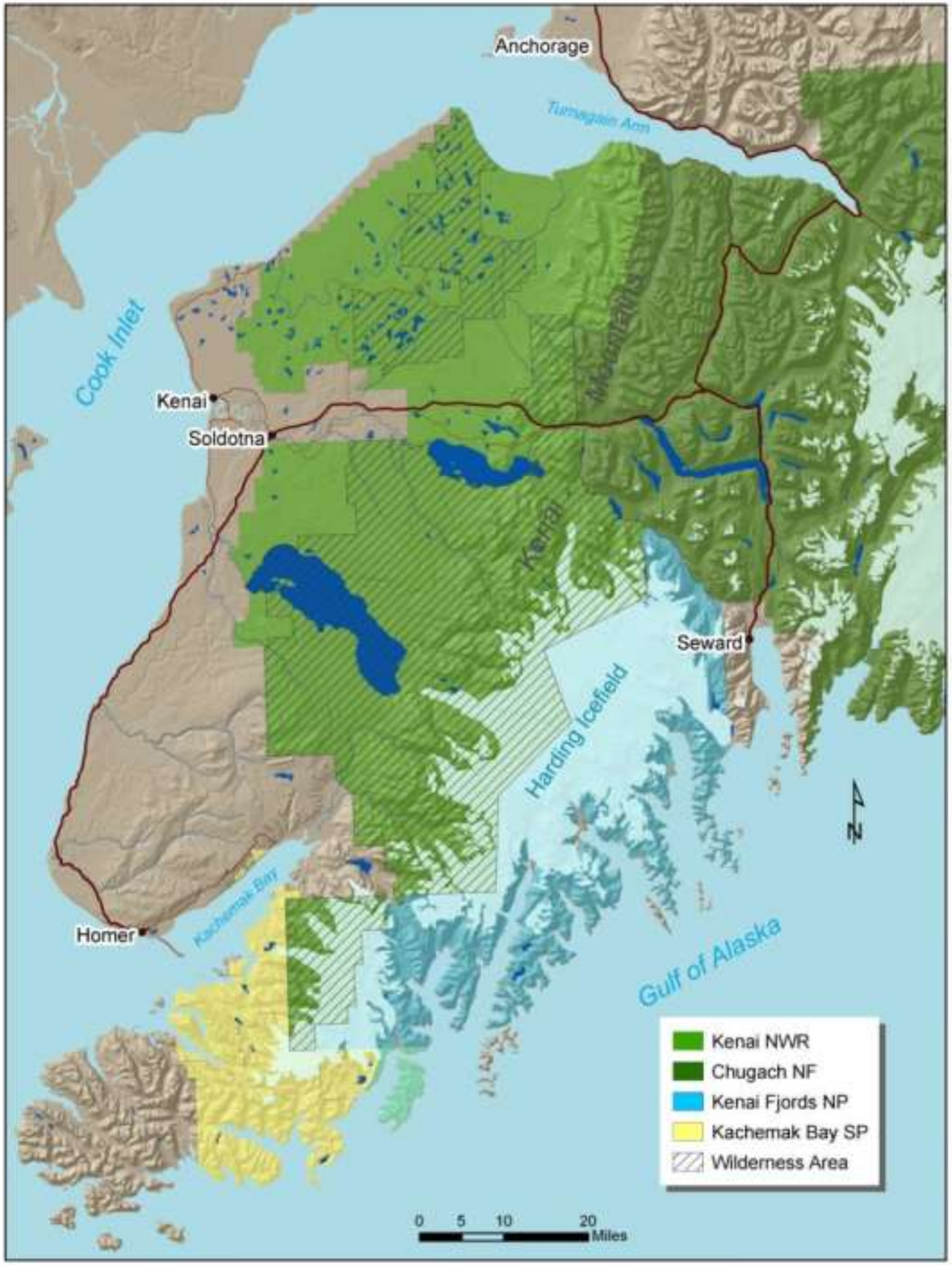


**John Morton**

U.S. FISH & WILDLIFE SERVICE

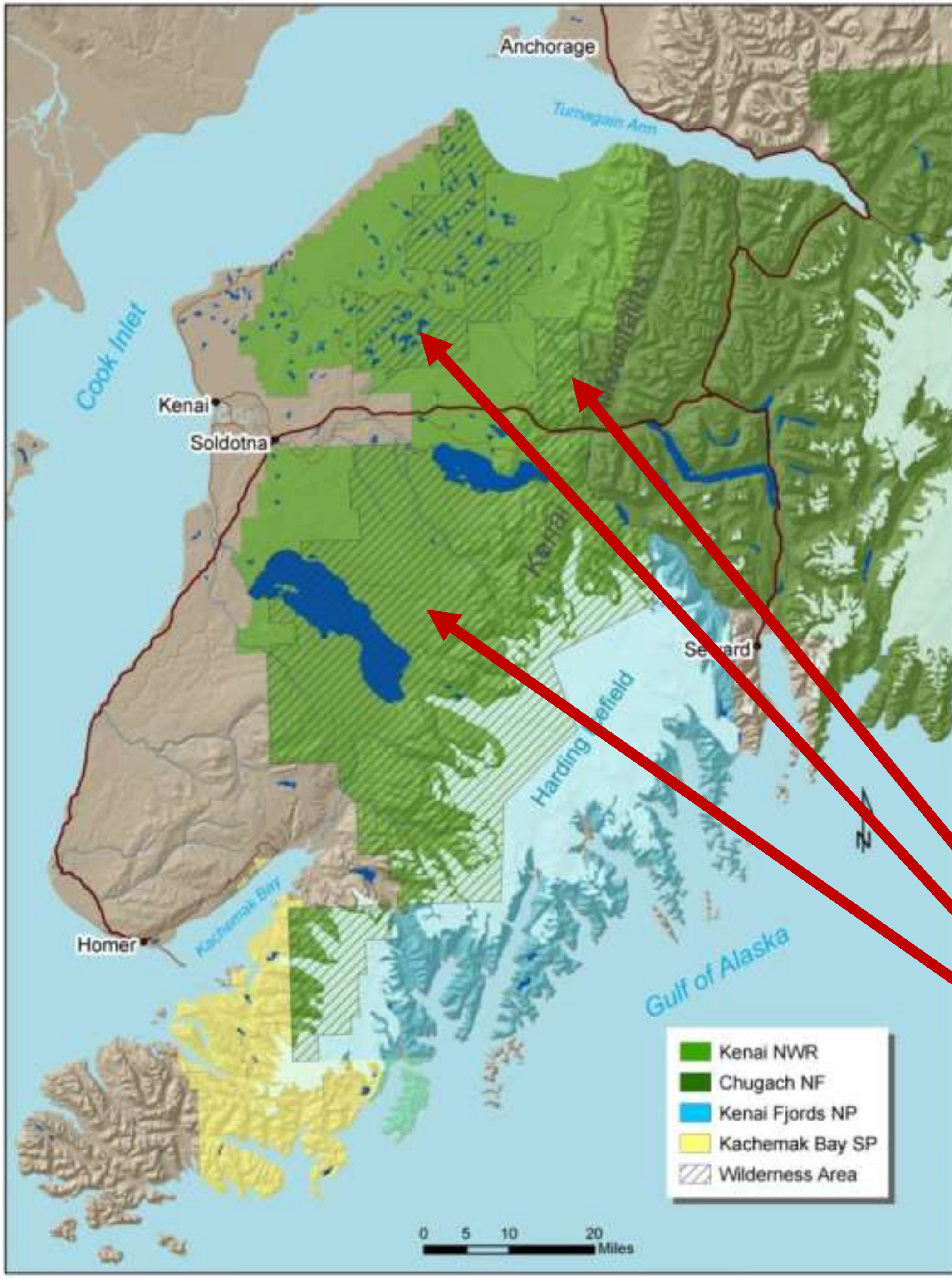
ALASKA WILDLIFE ALLIANCE


Kenai Wilderness
UNIMPAIRED??
UNTRAMMELED??
The ecological effects of a rapidly warming climate





- ✓ **Alaska warming 2 – 3 times faster than Lower 48**
- ✓ **Climate warming effects not masked by other human-caused drivers of change**
- ✓ **Kenai Peninsula may be best studied locale in AK outside of high Arctic**
- ✓ **Nexus of two biomes**

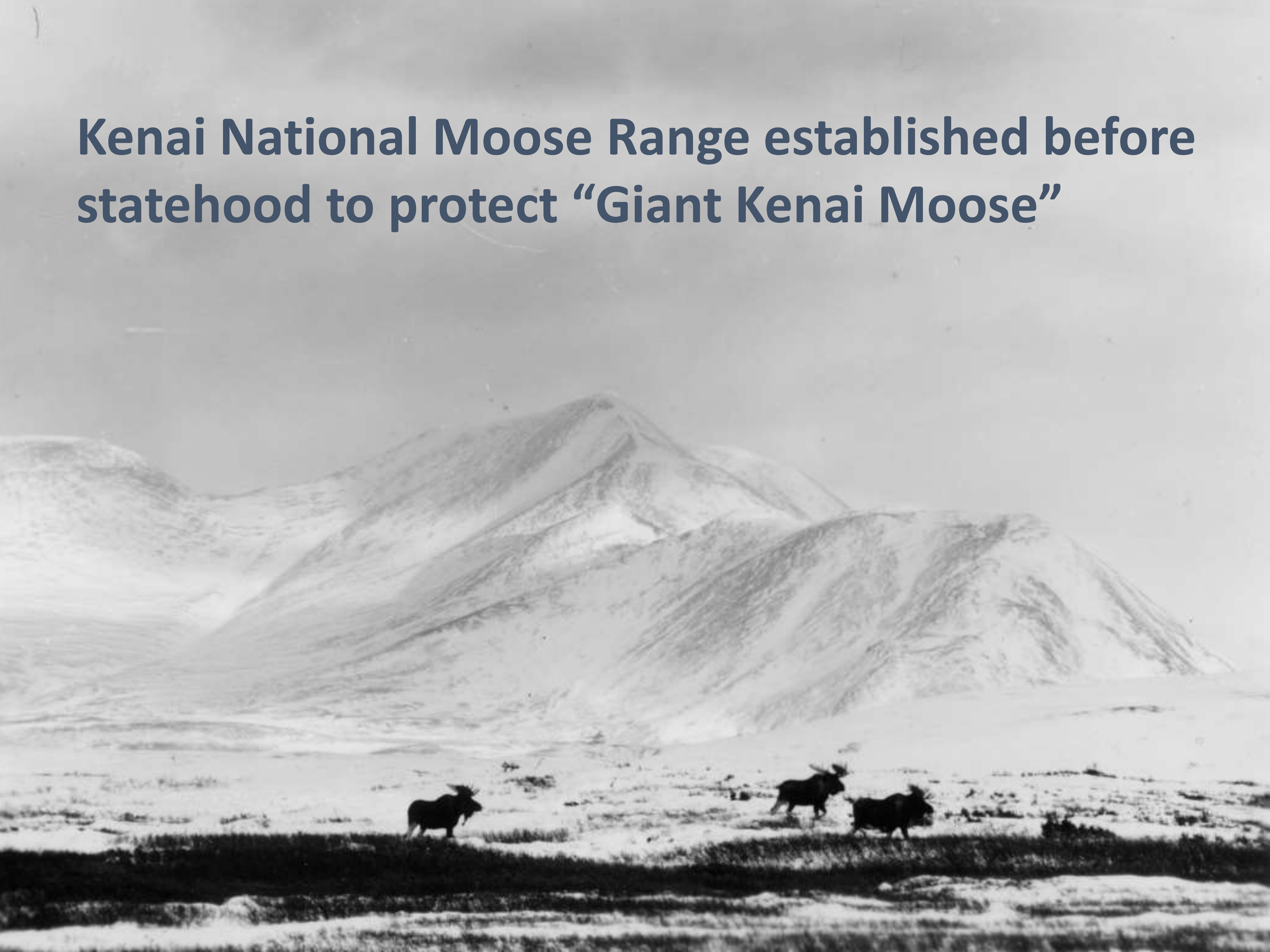




# Kenai Wilderness

**Mystery Hills unit (46K acres)**
**Dave Spencer unit (187K acres)**
**Andrew Simons unit (1087K acres)**

# Kenai National Moose Range established before statehood to protect “Giant Kenai Moose”



# REFGE PURPOSES

## 1980 ANILCA

- conserve fish & wildlife populations and habitats in their **natural diversity** including but not limited to .....
- fulfill international fish & wildlife treaty obligations
  - ensure water quality and quantity
  - opportunities for scientific research, interpretation, EE and land management training
  - compatible fish & wildlife-oriented recreation

# REFUGE PURPOSES

## 1980 ANILCA

- conserve **fish & wildlife** populations and habitats in their natural diversity including but not limited to …..

**fish and wildlife** = any member of the animal kingdom including without limitation any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate…

# OTHER REFUGE PURPOSES

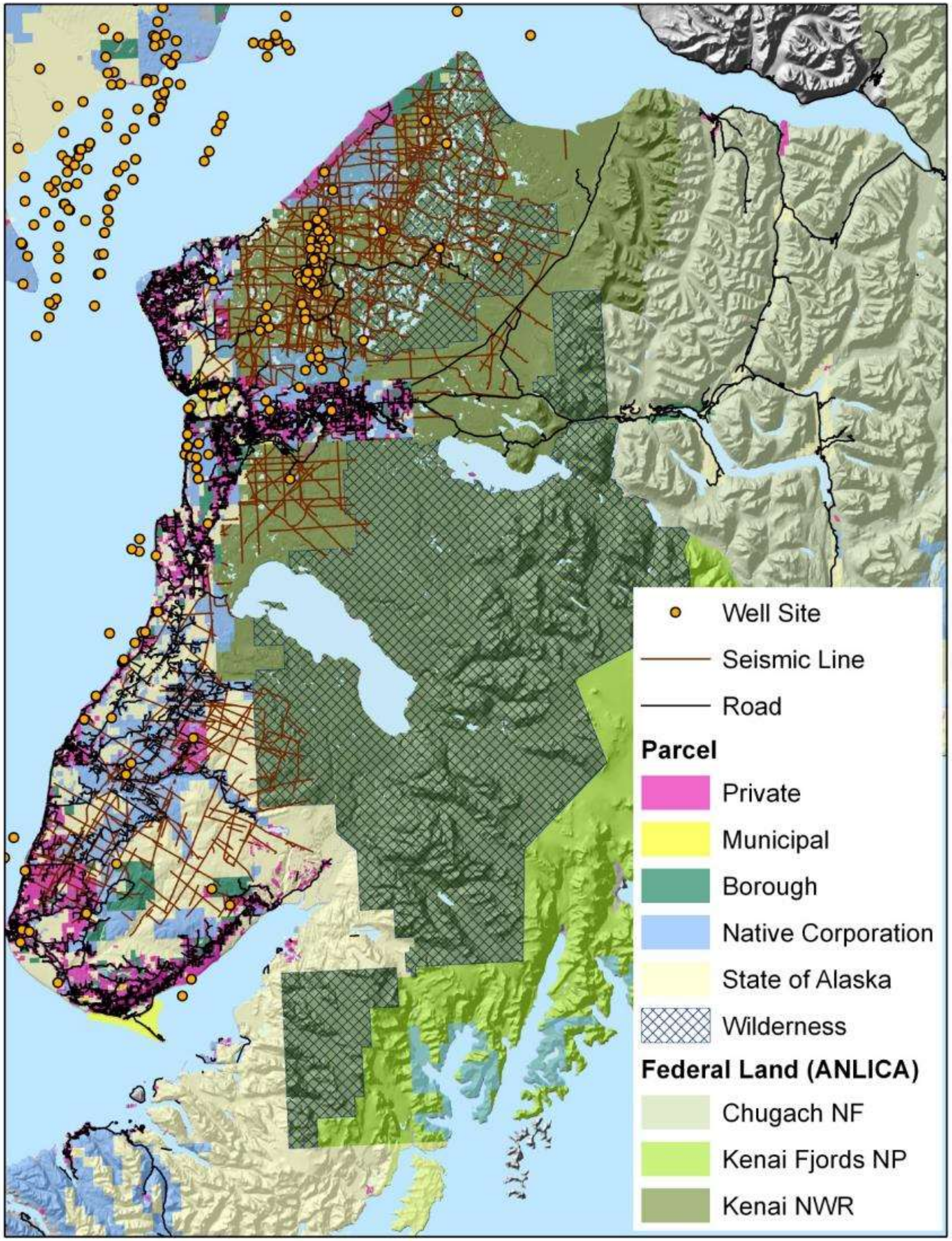
## *1964 Wilderness Act*

- secure an enduring resource of wilderness
- protect and preserve wilderness character
- leave them unimpaired for future use as wilderness

## *1997 Refuge Improvement Act*

- ensure biological integrity, diversity and environmental health

# Alaska’s urban refuge




# Rapid parcelization of non-Federal lands

- ✓ ~56,000 people in Kenai Peninsula Borough
- ✓ 238,800 acres on 55,000 private parcels
- ✓ 2.2% human population growth
  = 1,000 new residents/year
  = 1.5 housing units/day
- ✓ 37 miles of Wilderness along
  175 miles wildland-urban interface

# Stricter management within Kenai Wilderness

- ✓ **Snowmachines: closed in alpine tundra and closed elsewhere when snow cover is inadequate**
- ✓ **Aircraft: closed on >137 float-plane accessible lakes in Wilderness**
- ✓ **Motorboats: closed in Wilderness canoe systems**
- ✓ **Prescribed fire: to protect life/property or to restore, protect or maintain wilderness values**
- ✓ **Hand tools: used to maintain horse-packing and hiking trails**

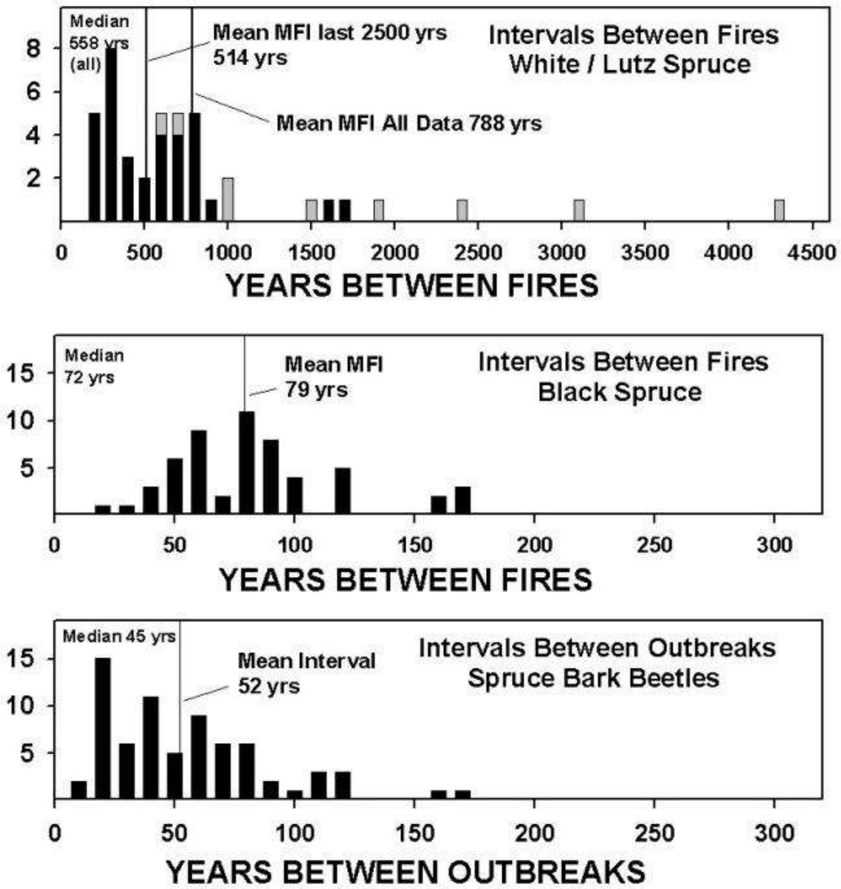
# Aggressive restoration outside Wilderness to maintain naturalness


# Dramatic changes in last 5 decades in response to warming and drying

- – decreasing annual 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)

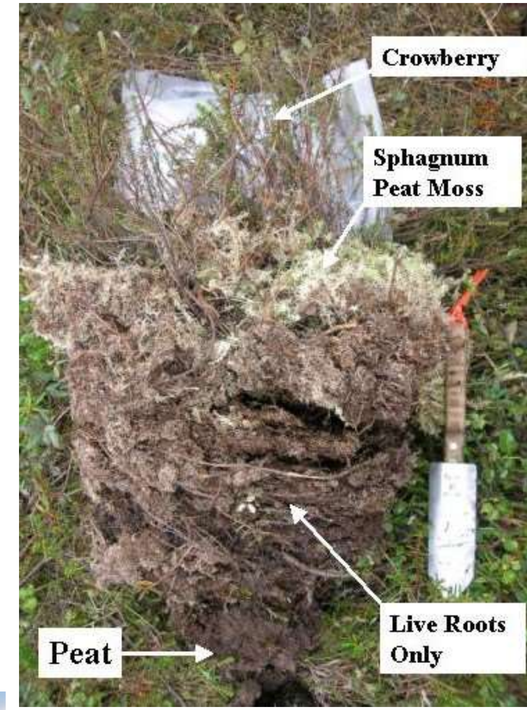
Adageirsdottir et al.1998; Berg et al. 2006,2009; Boucher & Mead 2006; Dial et al. 2007,2016; Klein et al. 2005, Rice 1987, VanLooy et al. 2006

# Official fire season now April 1 instead of May 1




DeVolder 1999, Schoen et al. 2017

# Woody shrub encroachment into 8000 year old Spagnum peatlands

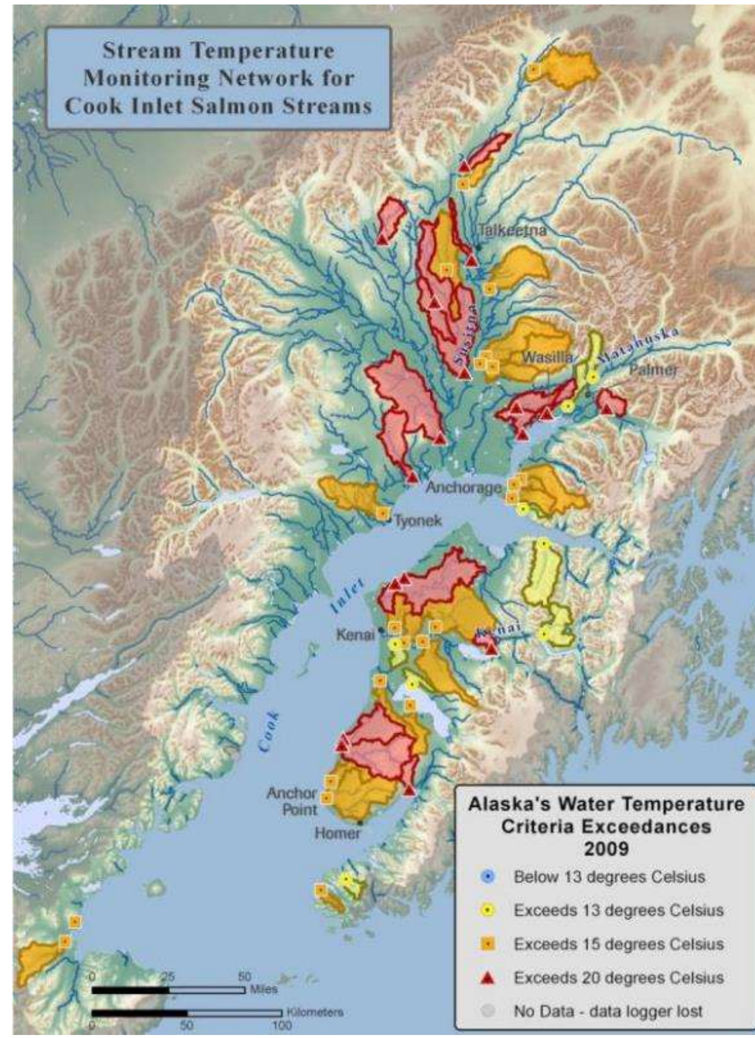



Berg et al. 2009

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

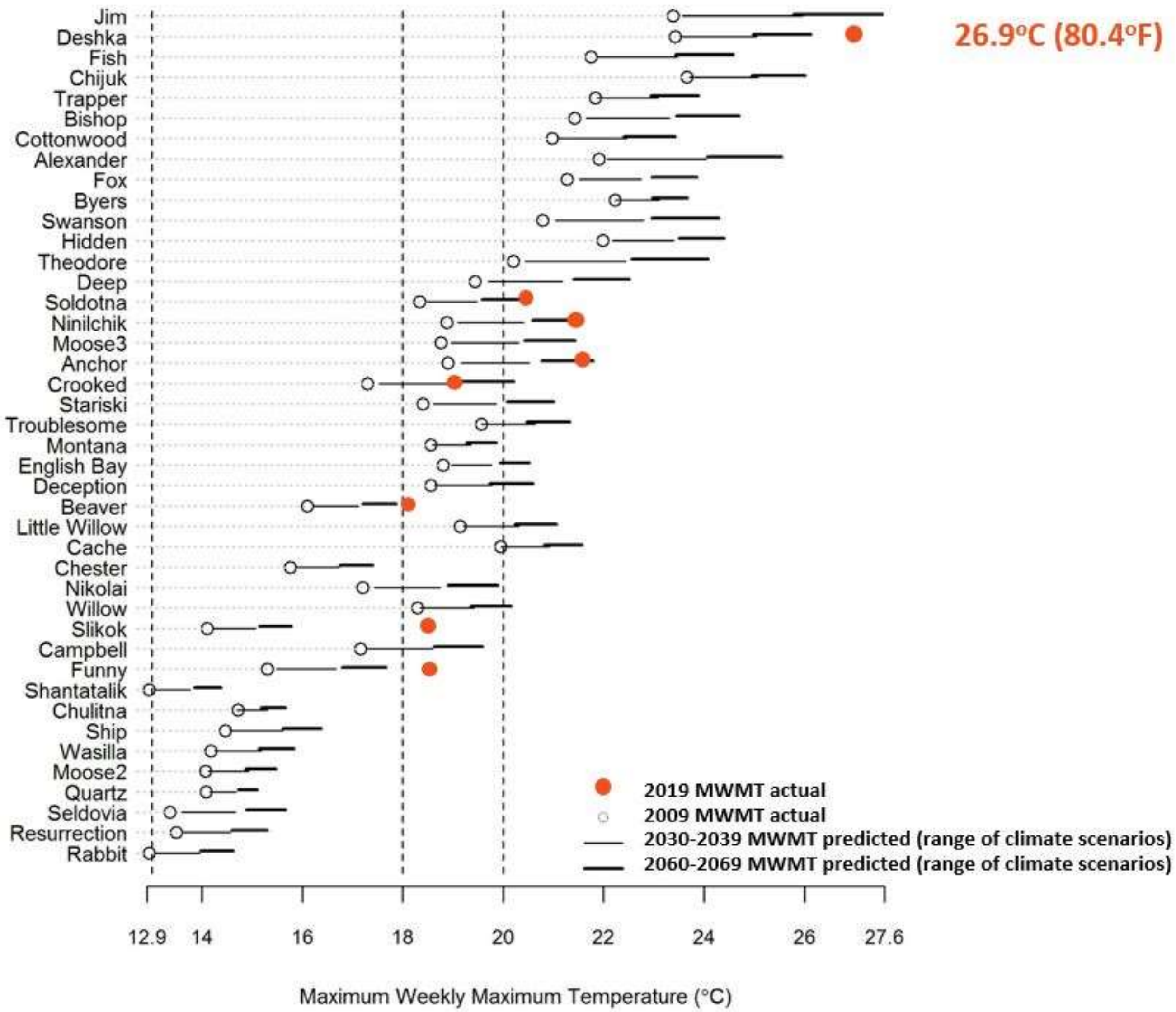

**Maximum temperatures not to exceed:**

- 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!



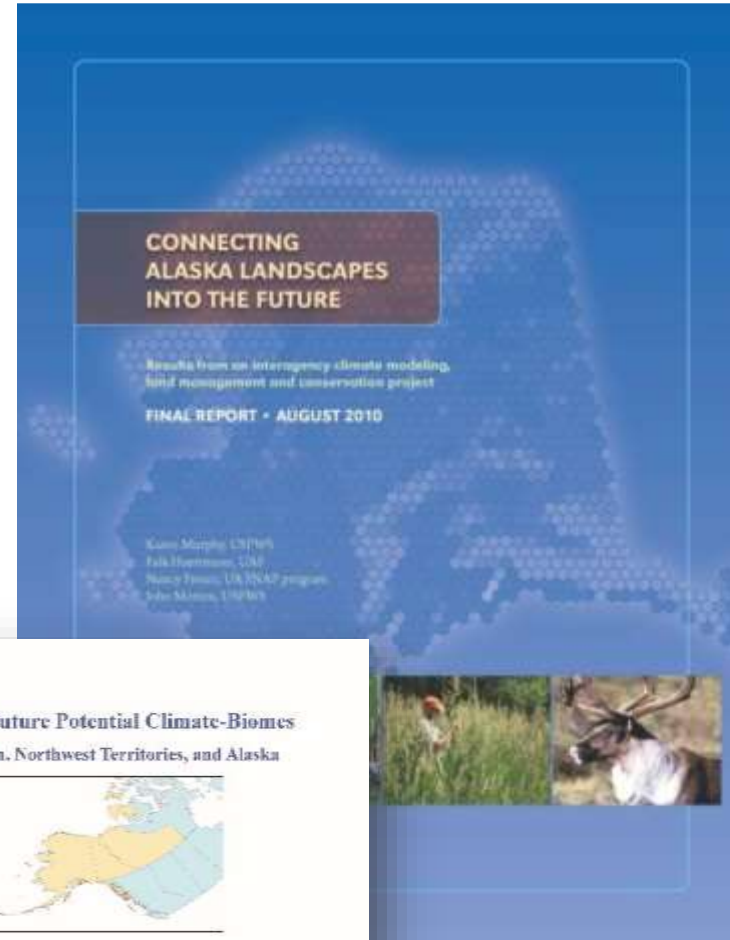
# Changing migration window in last decade

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
Wilsons's phalarope
Great egret
Willet
Red-footed booby
Black guillemot
Heerman's gull
Lesser black-backed gull

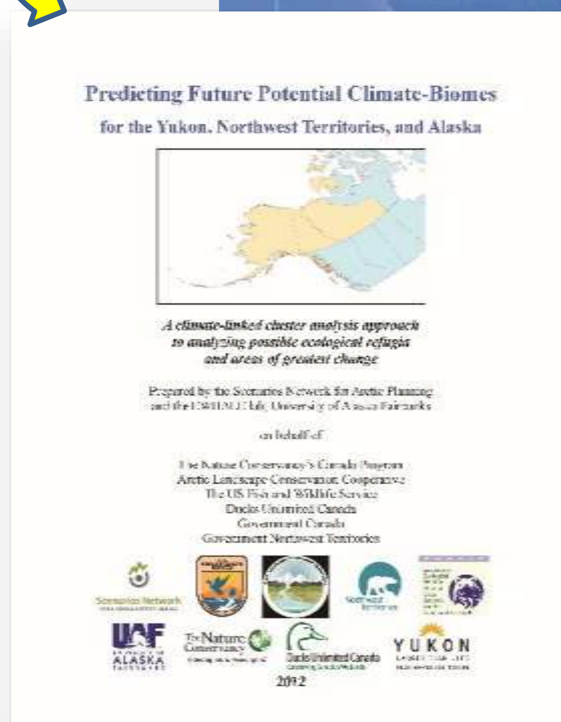
# Interagency effort to assess climate change effects on biome distributions



CONNECTING
ALASKA LANDSCAPES
INTO THE FUTURE

Results from an interagency climate modeling, land management and conservation project

FINAL REPORT • AUGUST 2010



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*

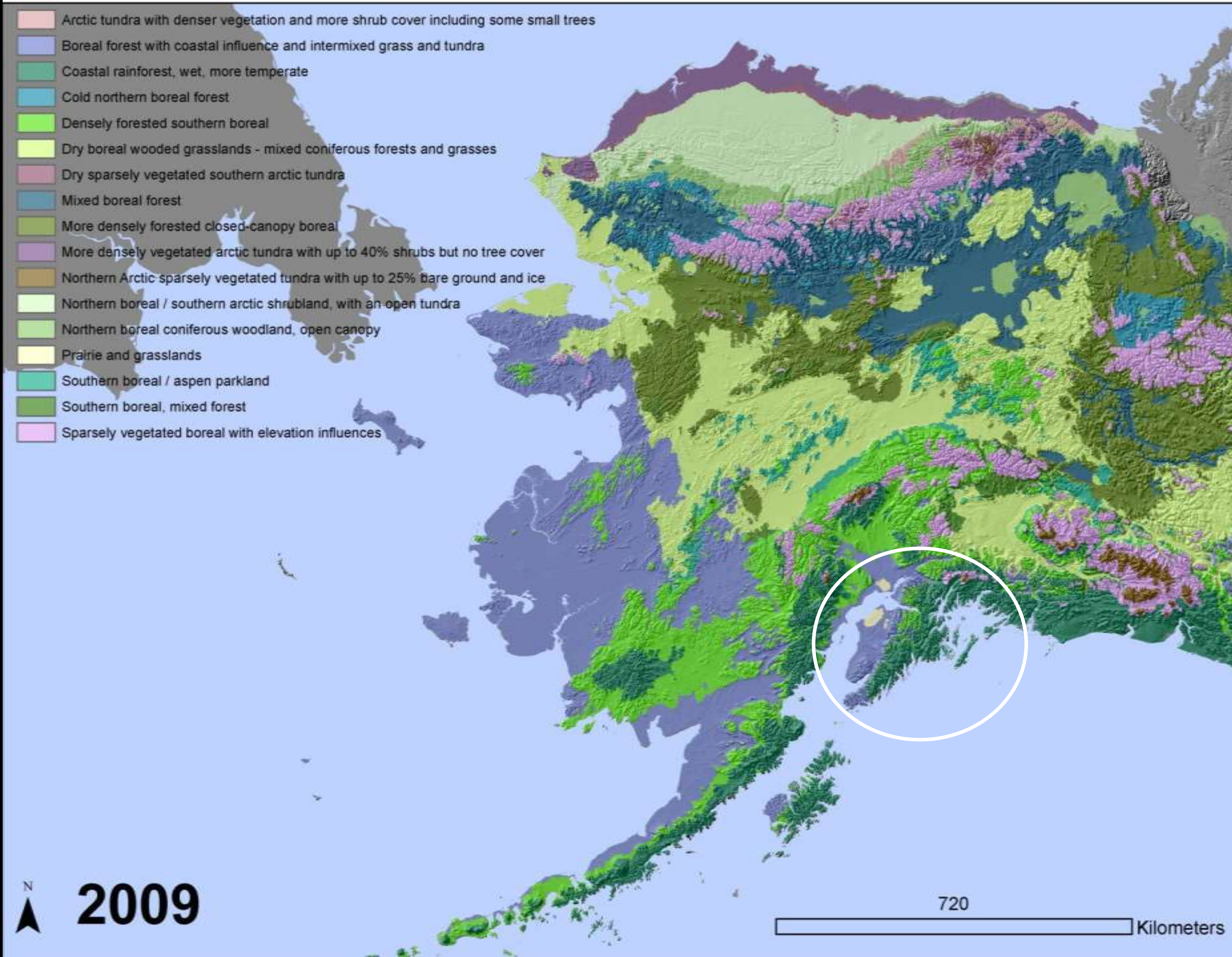
Prepared by the Scenarios Network for Arctic Planning

on behalf of

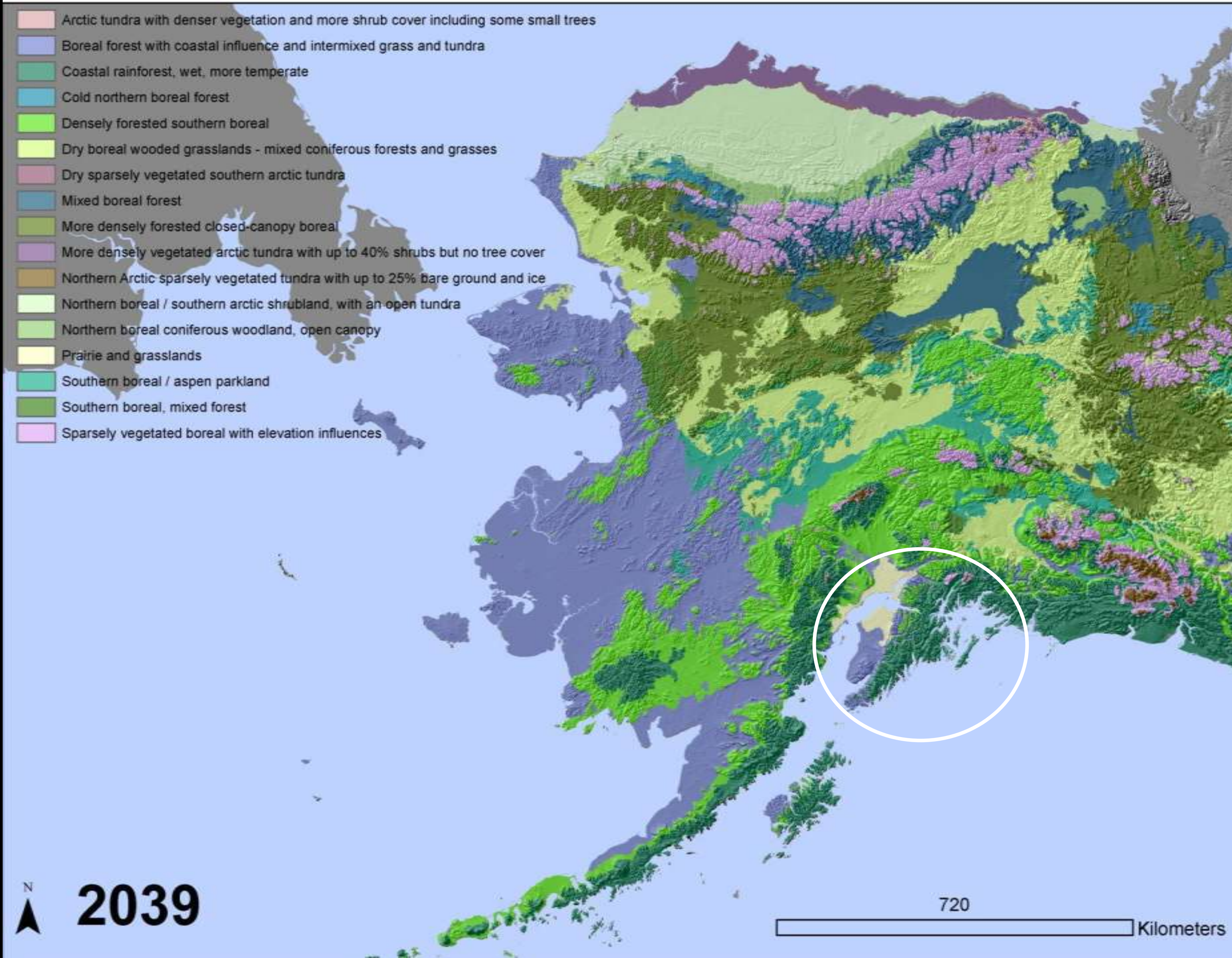
The Nature Conservancy's Canada Program
Arctic Landscape Conservation Cooperative
The US Fish and Wildlife Service
Ducks Unlimited Canada
Government Canada
Government Northwest Territories



2012



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
N
2009
720
Kilometers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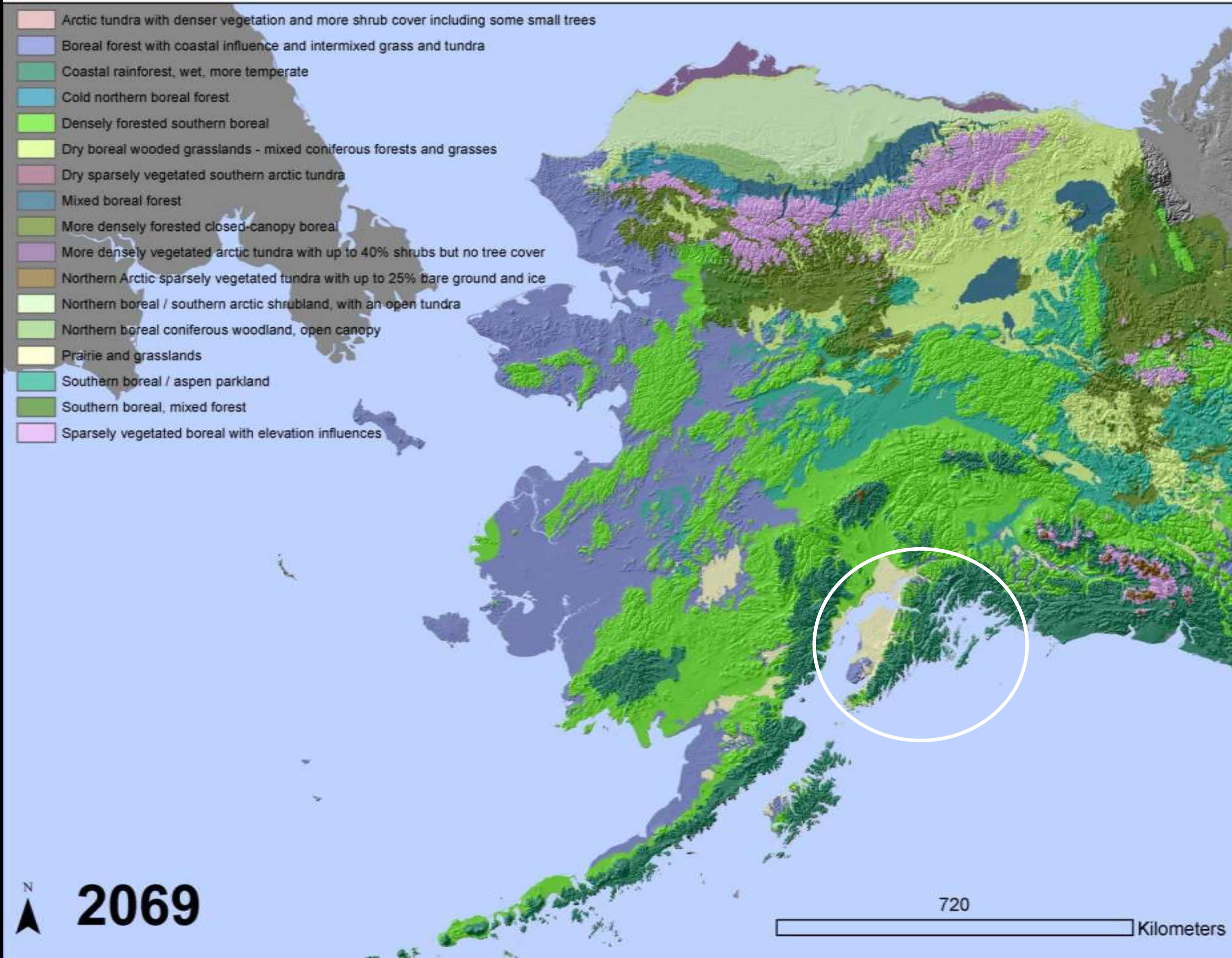
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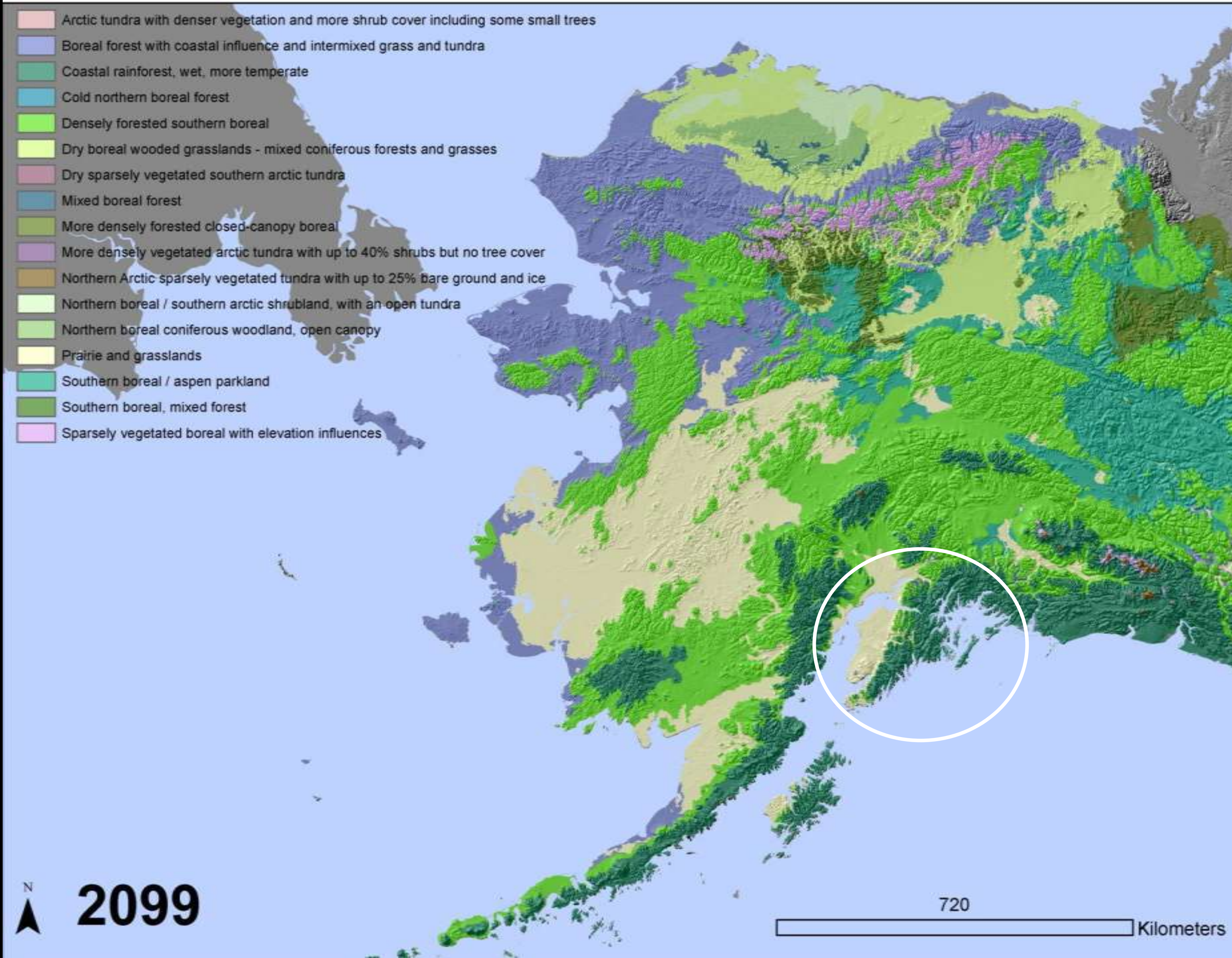

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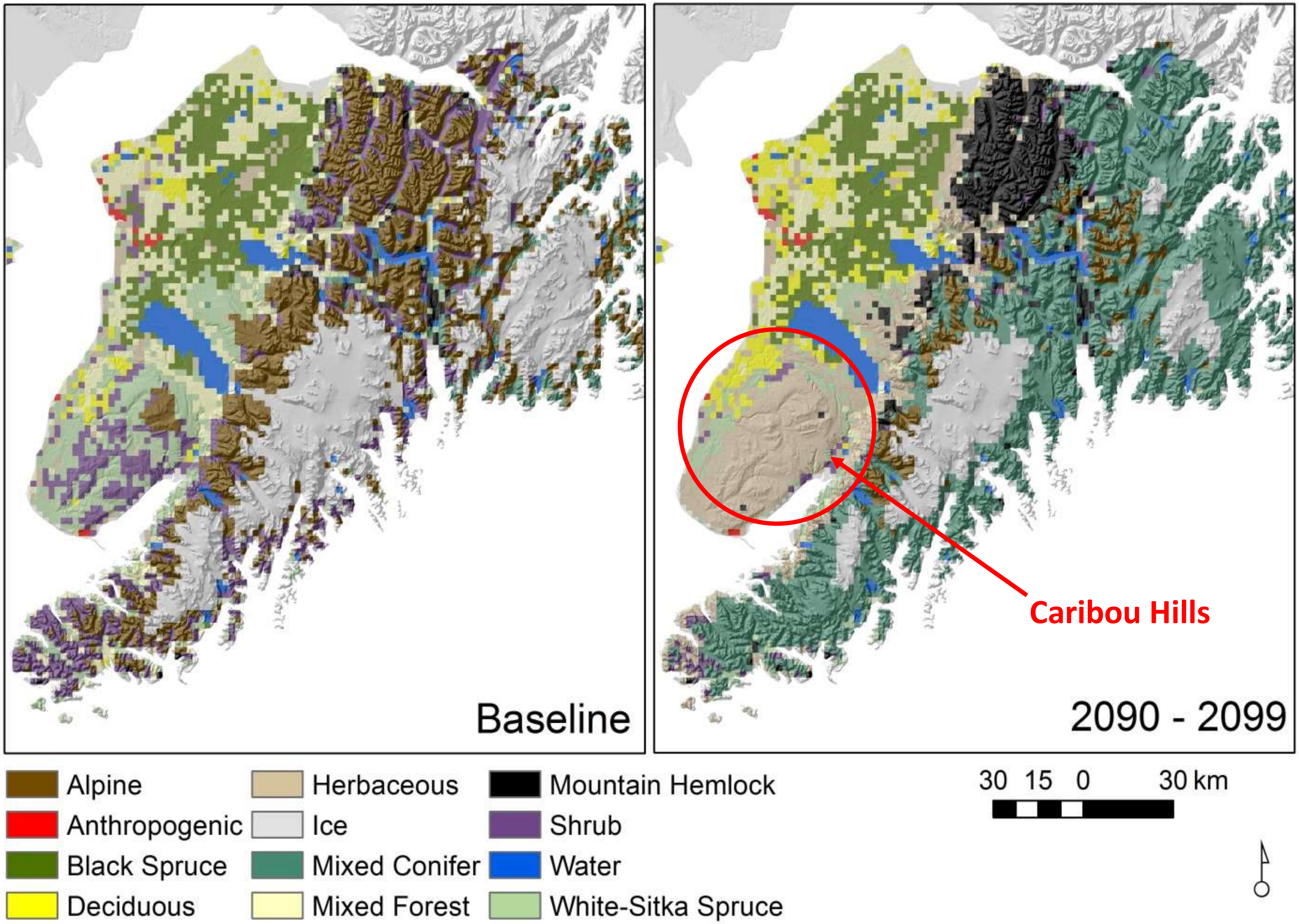
N
2099
720
Kilometers

# Forecasting the Kenai Peninsula's landscape through 2100

- ✓ Climate envelope modeling using Random Forests™
- ✓ A1B scenario decadal averages for temperature, precipitation (SNAP)
- ✓ landcover type with greatest % cover in 2km pixels
- ✓ if previous landcover type for each timestep (2039, 2069, 2099) P >0.5 then stay; if P <0.5 then landcover type with highest probability

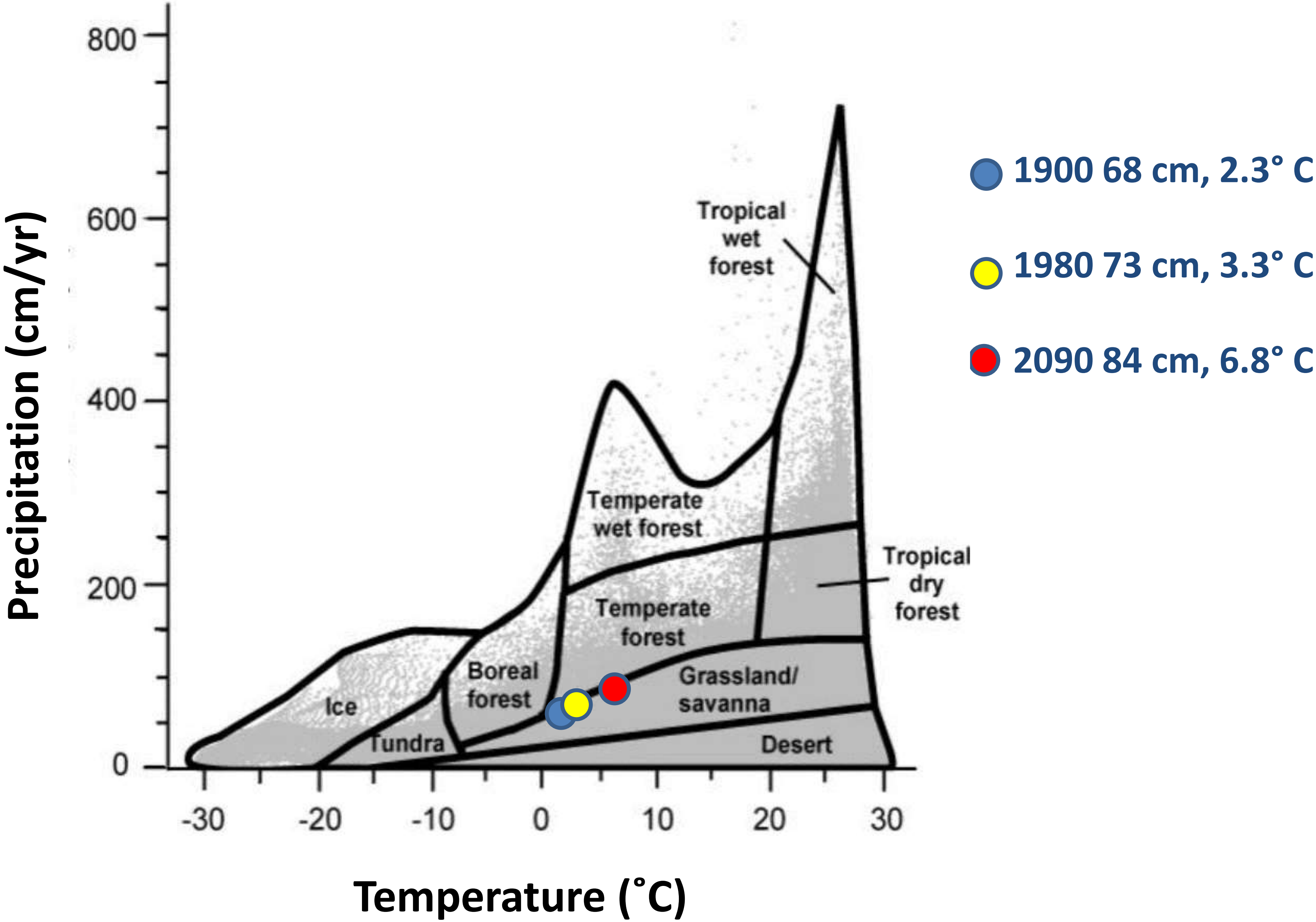
Magness and Morton 2018


Baseline
2090 - 2099
Caribou Hills
Alpine
Anthropogenic
Black Spruce
Deciduous
Herbaceous
Ice
Mixed Conifer
Mixed Forest
Mountain Hemlock
Shrub
Water
White-Sitka Spruce
30 15 0 30 km


SEPT 1985


SEPT 2014


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


# Novel climates, no-analog communities, and ecological surprises

John W Williams[1*] and Stephen T Jackson[2]

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(9): 475–482, doi:10.1890/070037

How do you study an ecosystem no ecologist has ever 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.

### In a nutshell:

- Many past ecological communities were compositionally unlike modern communities
- The formation and dissolution of these past "no-analog" communities appear to be climatically driven and linked to climates that are also without modern analogs
- If anthropogenic greenhouse-gas emissions continue unabated, many future climates will probably lack 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

The further our explorations carry us from the present, the murkier our vision becomes. This is not just because 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.

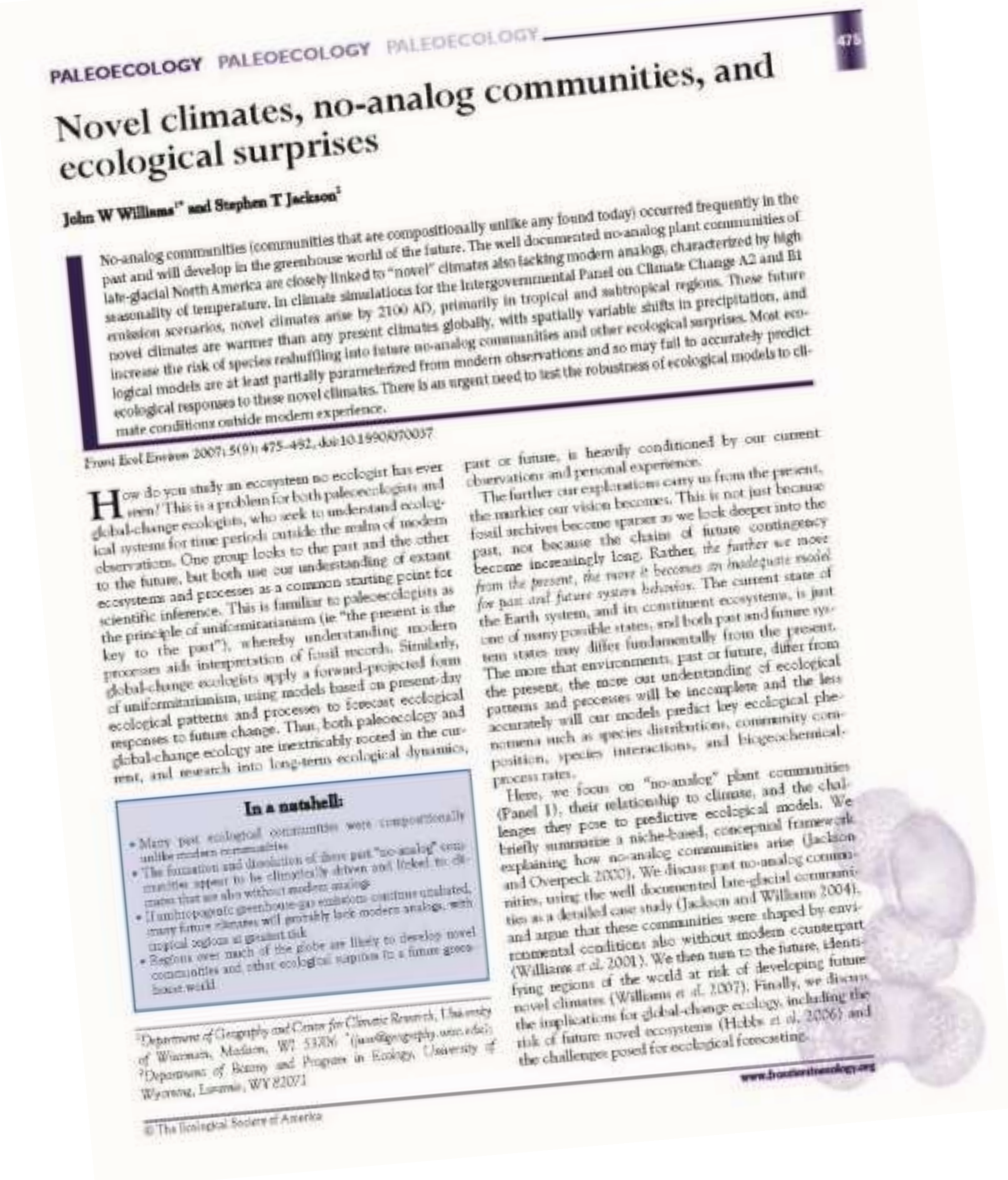
Here, we focus on "no-analog" plant communities (Panel 1), their relationship to climate, and the challenges they pose to predictive ecological models. We briefly summarize a niche-based, conceptual framework explaining how no-analog communities arise (Jackson and Overpeck 2000). We discuss past no-analog 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. 2006) and the challenges posed for ecological forecasting.

[1]Department of Geography and Center for Climatic Research, University of Wisconsin, Madison, WI 53706 *(jww@geography.wisc.edu); [2]Department of Botany and Program in Ecology, University of Wyoming, Laramie, WY 82071





**So which species will compose novel assemblages in the dynamic systems?**


PALEOECOLOGY PALEOECOLOGY PALEOECOLOGY

475

# Novel climates, no-analog communities, and ecological surprises

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In a nutshell:

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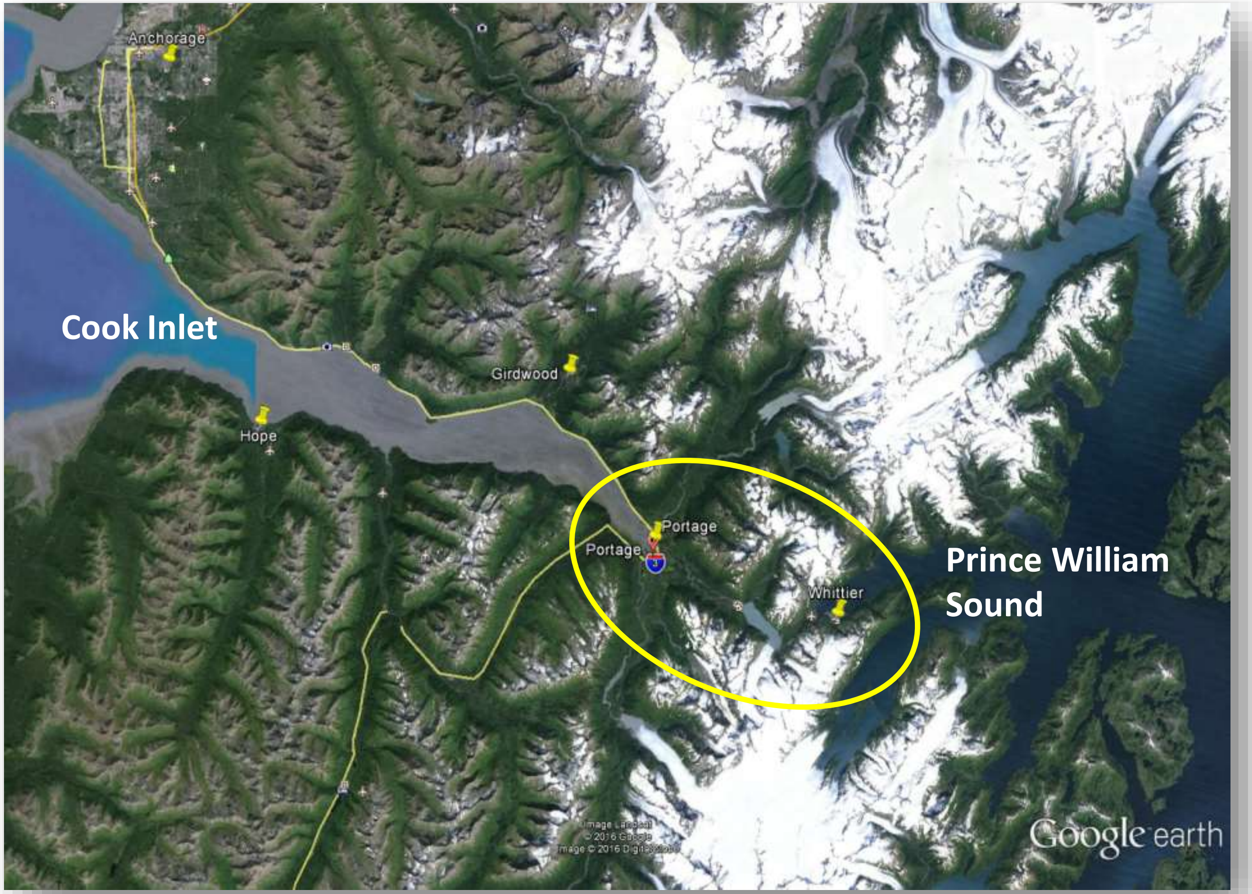
www.frontiersinecology.org

## So which species will compose novel assemblages in the dynamic systems?

**The ones that are there when its being assembled**

# 10-mile wide isthmus is a migration barrier




Wilson et al. 2015

Tomasik and Cook 2005

Jackson et al. 2008

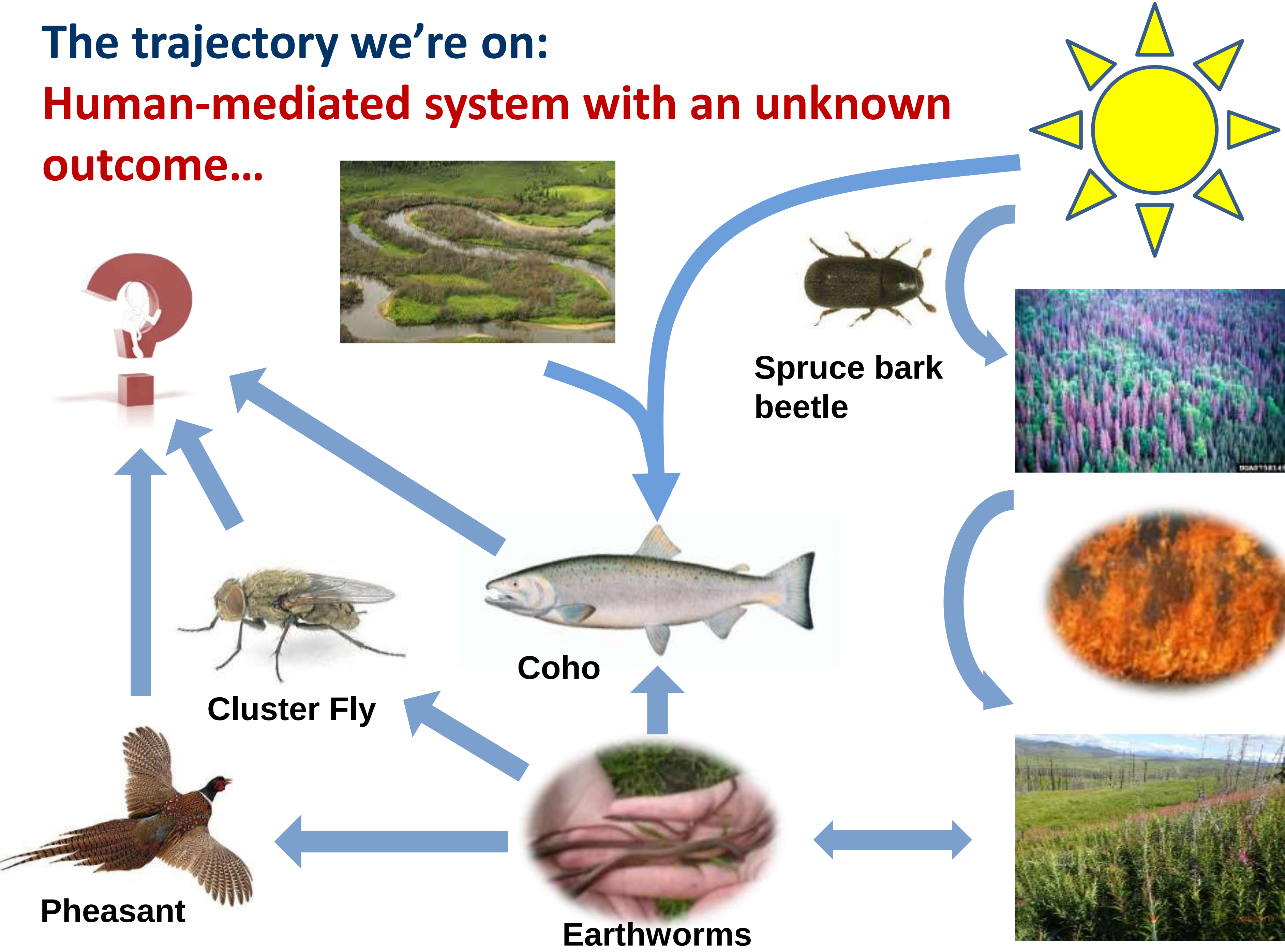


**> 138 exotic species of flora (108) and fauna (30) on Kenai Peninsula are poised to fill novel assemblages…**



# The trajectory we're on:

## Human-mediated system with an unknown outcome…



# Take away…

- ✓ Contemporary climate warming is human-driven
- ✓ Climate change is global and knows no bounds
- ✓ Climate change has cascading ecological effects
- ✓ What is natural?

# 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

# Doing nothing is really doing something… just incoherently and haphazardly

- Kenai Peninsula is already responding to human-driven changing warming and forecasted to continue doing so
- Latitudinal migration is constrained by isthmus and rainshadow of Kenai Mountains
- Novel assemblages ≠ simple re-shuffling of native flora and fauna
- Many exotic species already introduced and more *en route*
- Does doing nothing result in something more “natural”? Unimpaired? Untrammeled?

Could this depauperate novel system be stewarded towards one that is more diverse?

CURRENT TRAJECTORY (WILDERNESS)

**Could this depauperate novel system be stewarded towards one that is more diverse?**

LODGEPOLE PINE

BLACK-TAILED DEER

FOREST

CURRENT TRAJECTORY (WILDERNESS)

## Could this depauperate novel system be stewarded towards one that is more diverse?

LODGEPOLE PINE

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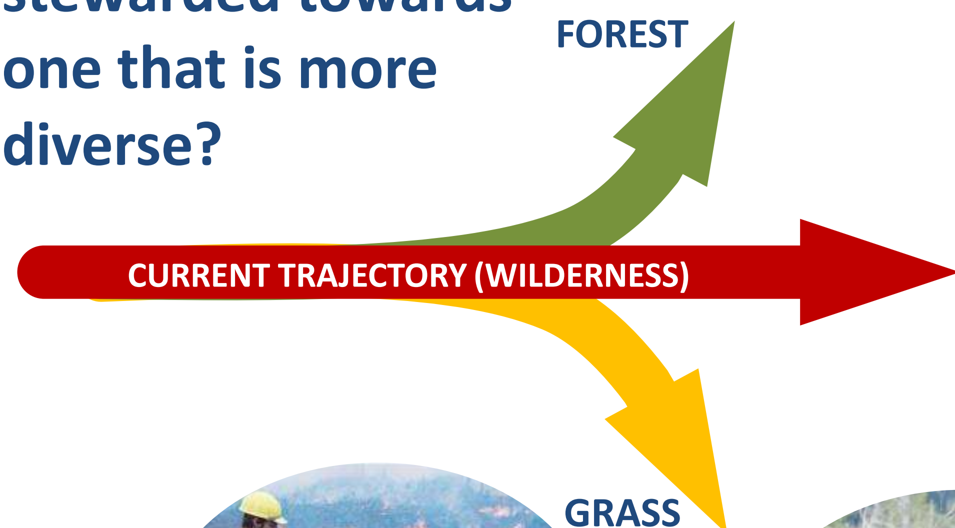


PRESCRIBED FIRE

INTRODUCED GRAZERS

# Could this depauperate novel system be stewarded towards one that is more diverse?

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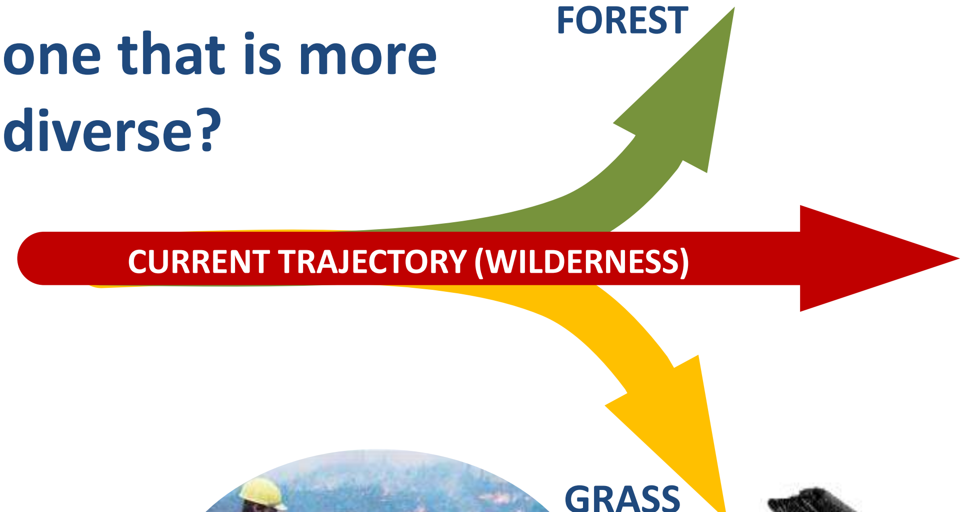


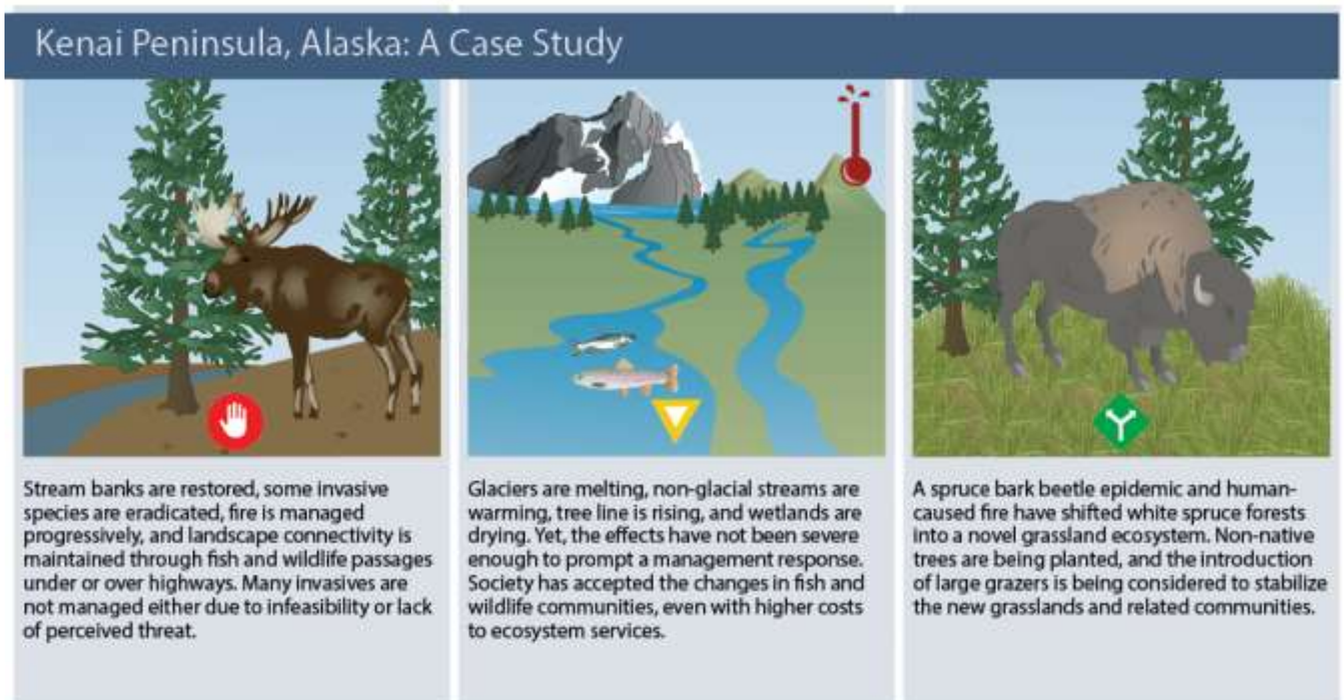

PRESCRIBED FIRE

INTRODUCED GRAZERS

Klein and Reger 2015

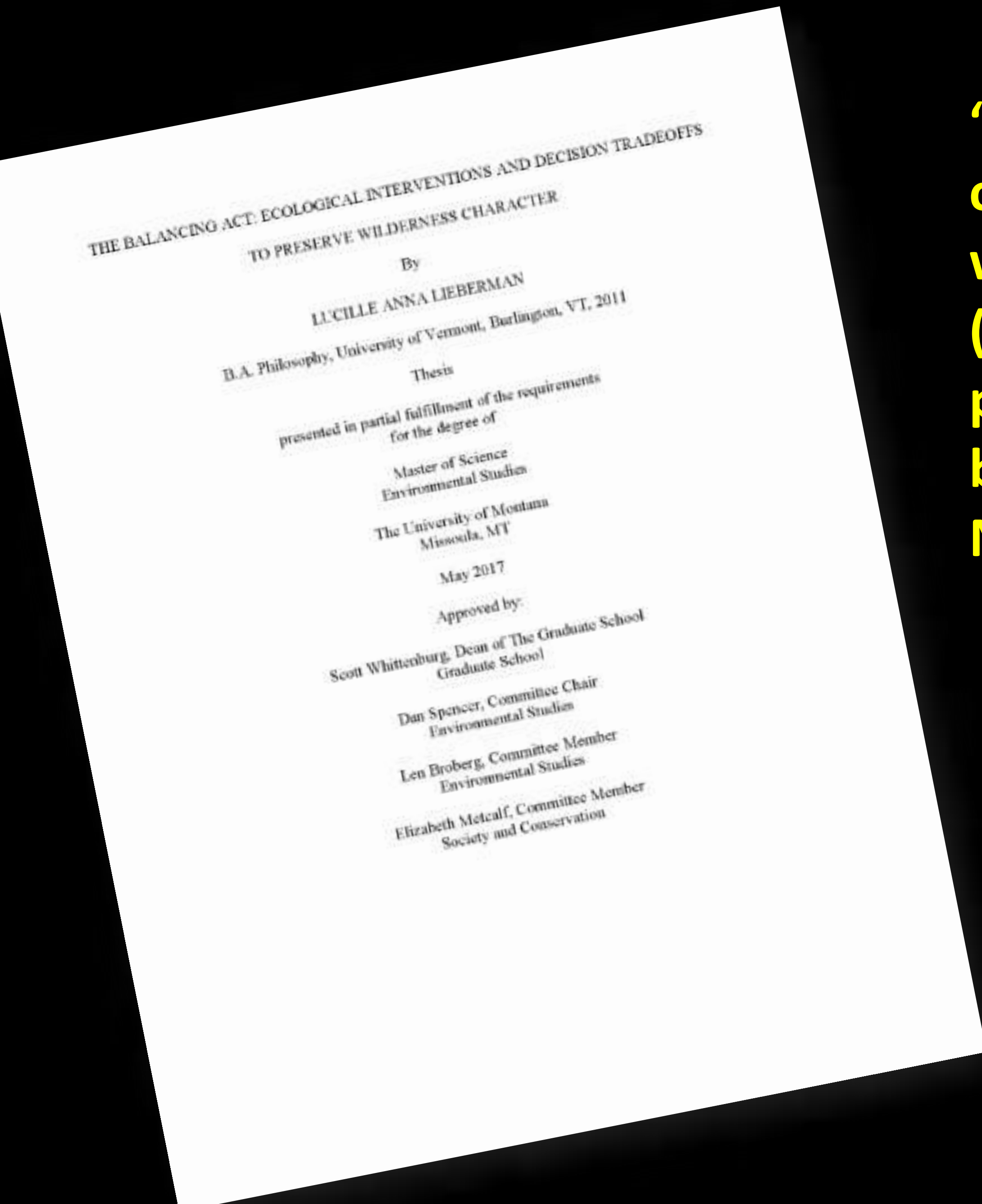
# The RAD Decision Framework

**RESIST** **ACCEPT** **DIRECT**




Lynch et al. 2020. **Managing for R-A-Dical change: resist, accept, or direct ecosystem transformation**. Frontiers in Ecology & the Environment

Thompson et al. 2020. **Responding to ecosystem transformation: Resist, accept or direct**? Fisheries



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

By

LUCILLE ANNA LIEBERMAN

B.A. Philosophy, University of Vermont, Burlington, VT, 2011

Thesis

presented in partial fulfillment of the requirements
for the degree of

Master of Science
Environmental Studies

The University of Montana
Missoula, MT

May 2017

Approved by:

Scott Whittenburg, Dean of The Graduate School
Graduate School

Dan Spencer, Committee Chair
Environmental Studies

Len Broberg, Committee Member
Environmental Studies

Elizabeth Metcalf, Committee Member
Society and Conservation

**“Ecological interventions occurred in 37% of the wilderness units sampled (n ~ 500), with the greatest proportion of interventions by agency from the National Park Service.”**

# Questions?

mortons4@gci.net

# Virtual Wilderness Information Series

**September 14-17th, 2020**

Thank you for attending!

Please join us for the next session in this series.

**Preserving the Untrammeled and Natural Qualities of Wilderness Character**

**Speaker: James Sippel**

**Tuesday, August 15, 2020**
**10:00 am mountain time**

See the series announcement for registration information if you haven't already registered for it.