Kenai National Wildlife Refuge

John Morton
Kenai National Wildlife Refuge

Kenai National Bison Range?

The Case for Stewarding Ecological Transformation

John Morton
Kenai National Wildlife Refuge

ALASKA REFUGE PURPOSES

1980 ANILCA

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

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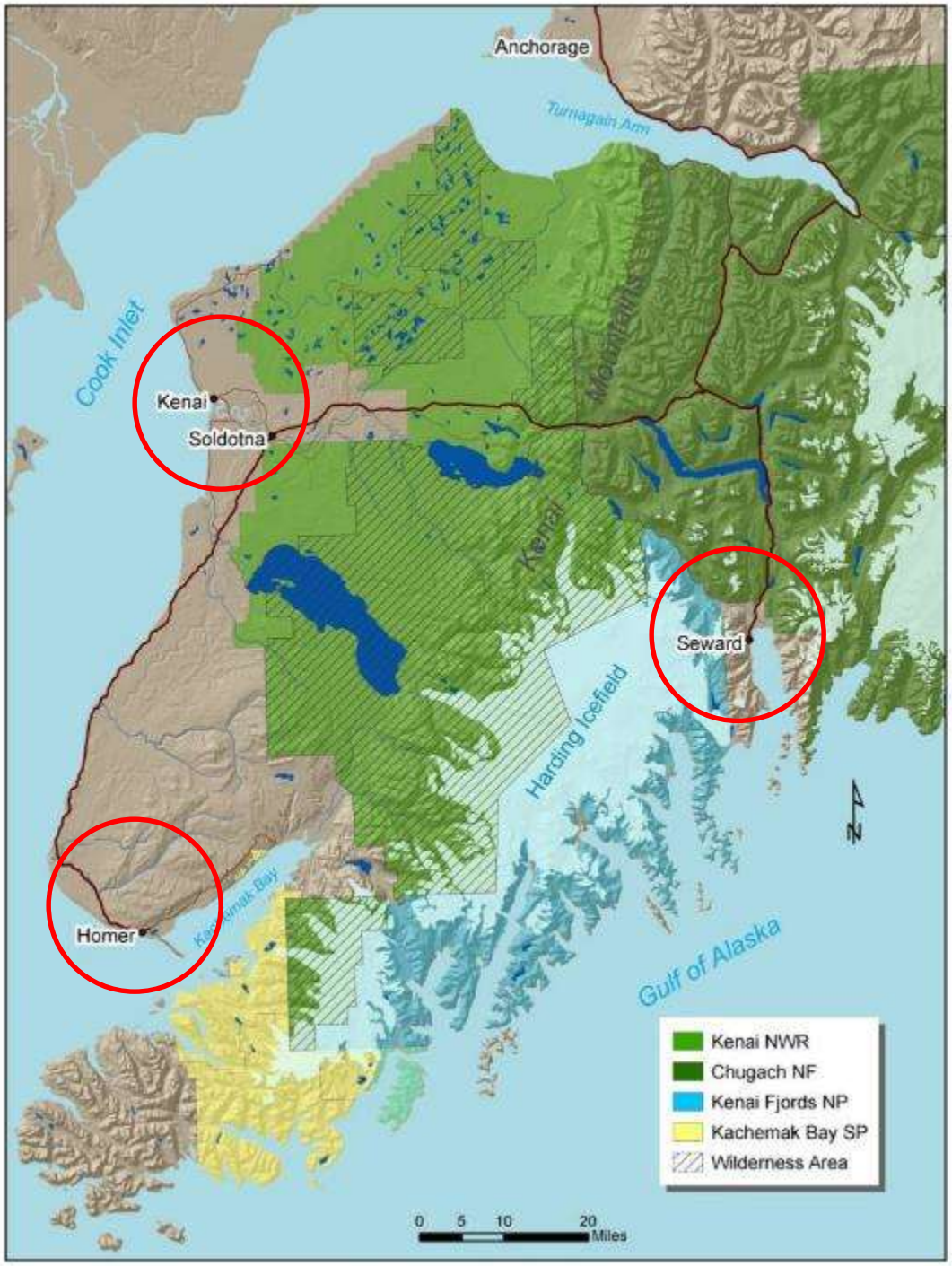
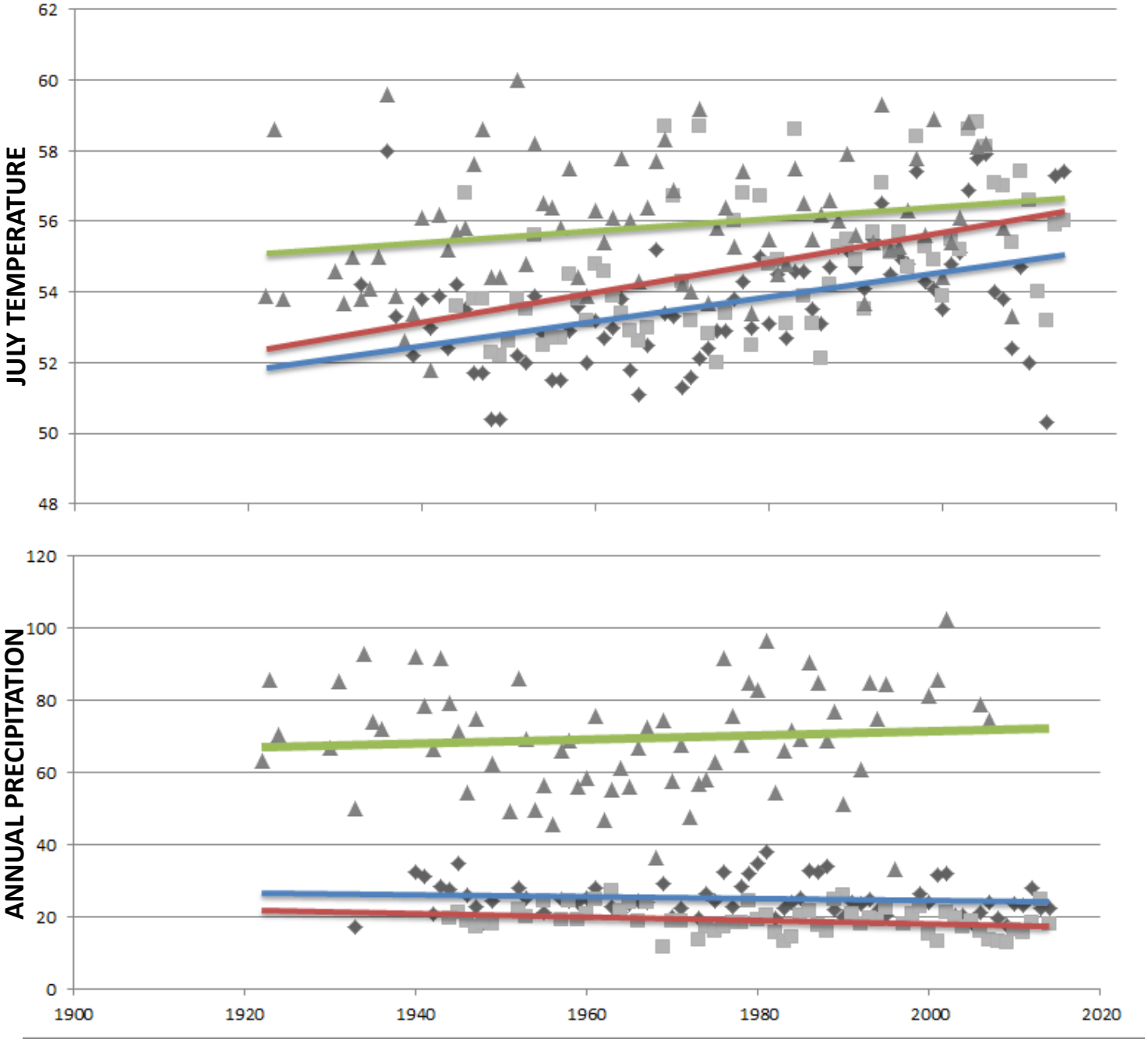
1980 ANILCA

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

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



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

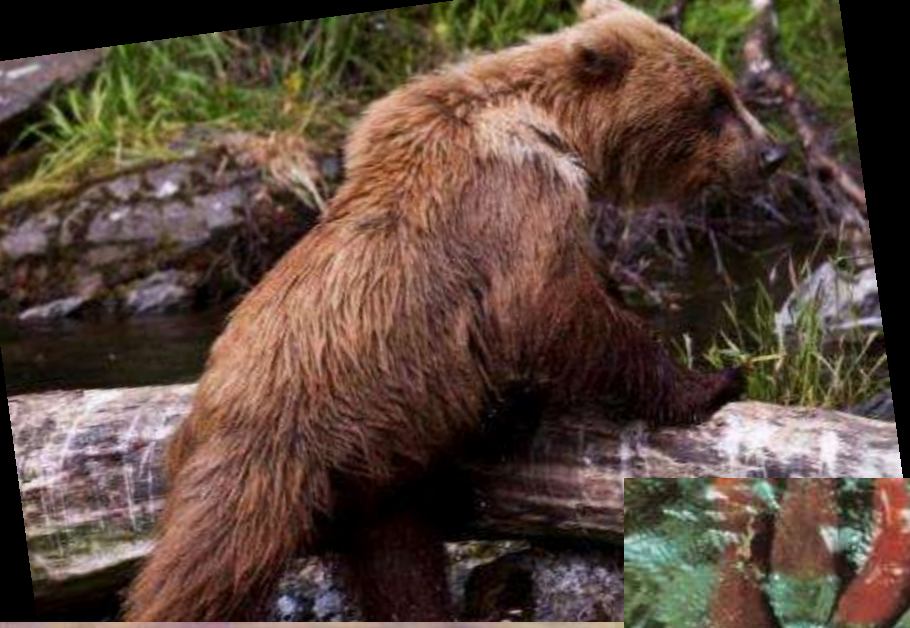
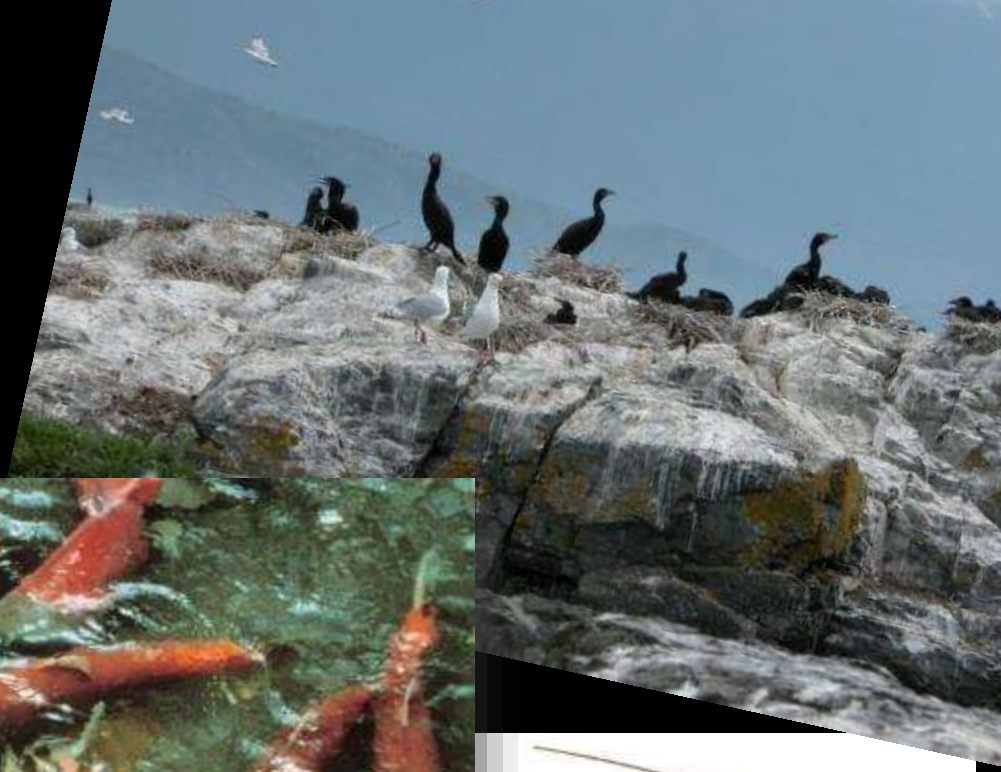


SEWARD

KENAI

HOMER

Biomes - 2005
Aleutian Islands
Arctic
Boreal
Boreal Transition
North Pacific Maritim
Western Tundra
Arctic Ocean
Chukchi Sea
Beaufort Sea
Anadyr Gulf
Kotzebue Sound
Norton Sound
Bering Sea
Kuskokwim Bay
Bristol Bay
Gulf of Alaska
Pacific Ocean
Arctic
Boreal
Boreal Transition
Western Tundra
North Pacific Maritime
Aleutians

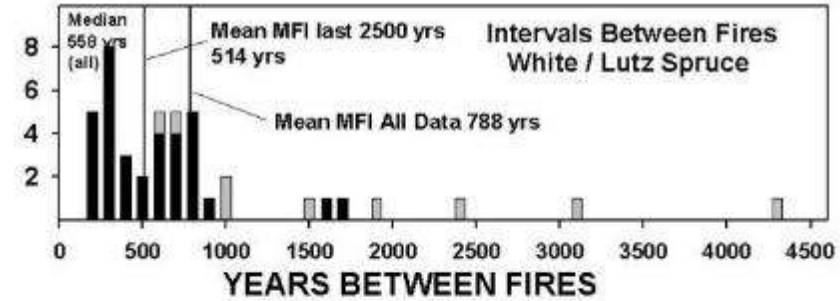



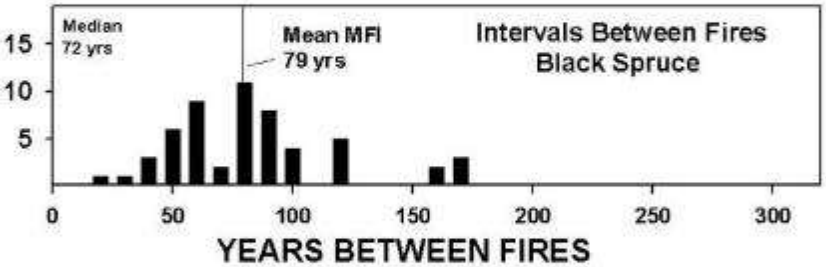
Dramatic changes in last 50 years in response to warming and drying

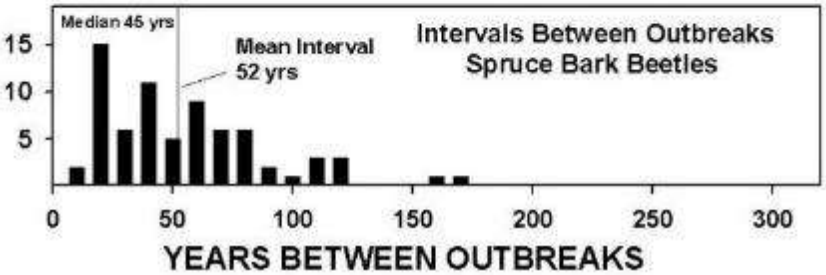
- – available water declines (60% loss since 1968)
- – wetlands dry (6 – 11% per decade)
- – glaciers recede (-11% surface area, -21 m elevation, +55% thinning rate)
- + afforestation (trees~1 m per yr, shrubs~2.8 m per yr)
- + SB beetle outbreaks (triggered by 2 consecutive warm summers)

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

Official fire season is now April 1 instead of May 1







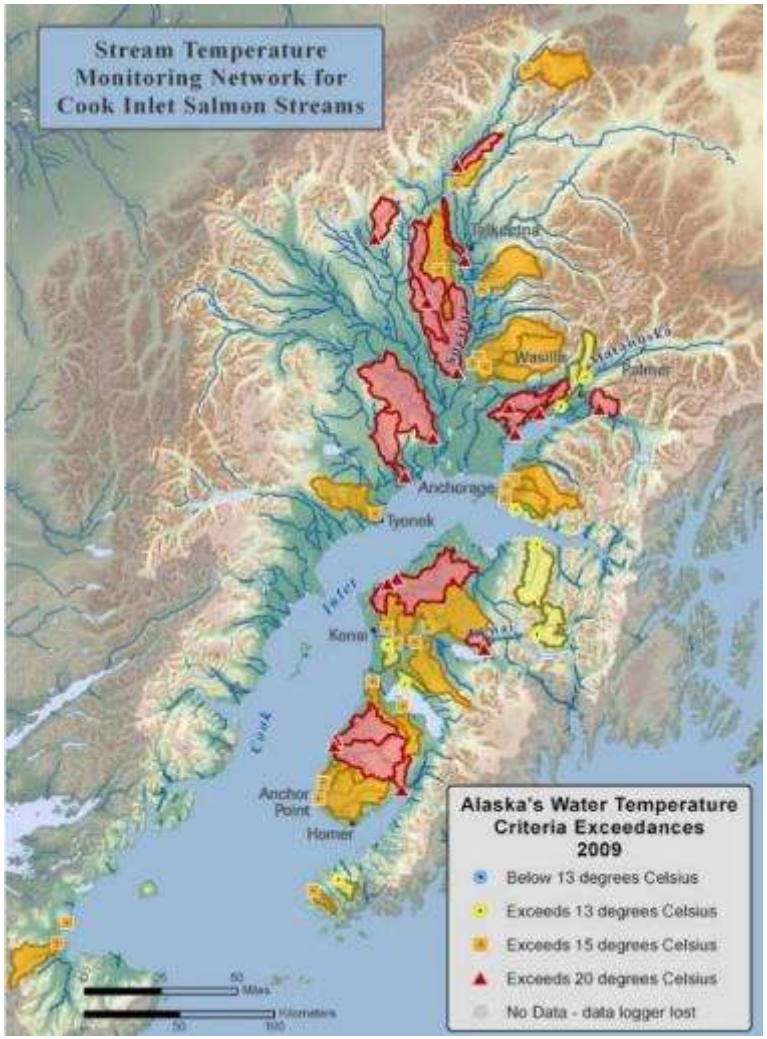
Woody shrub encroachment into 8000 year old Spagnum peatlands

Berg et al. 2009

Conversion of white/Lutz spruce forests to Calamagrostis savannah

Boucher and Mead 2006

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



Maximum temperatures not to be exceeded:

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

Mauger 2011

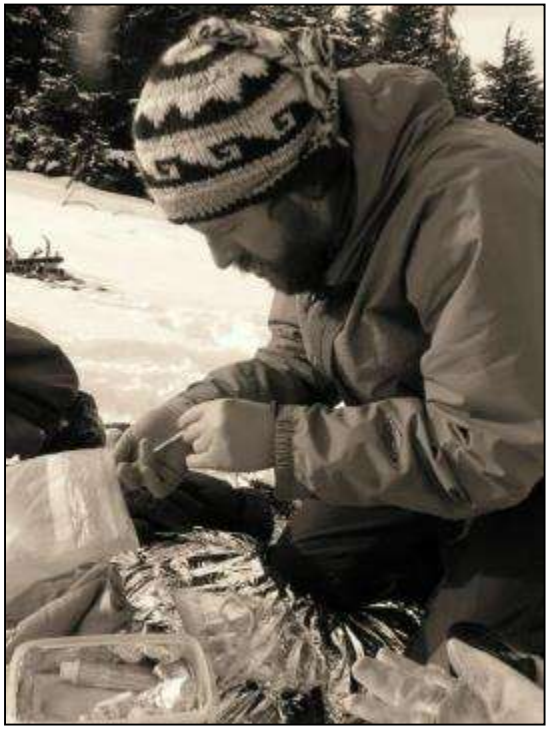
Changing migration window in last decade

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

American marten colonized Kenai Lowlands ~2002

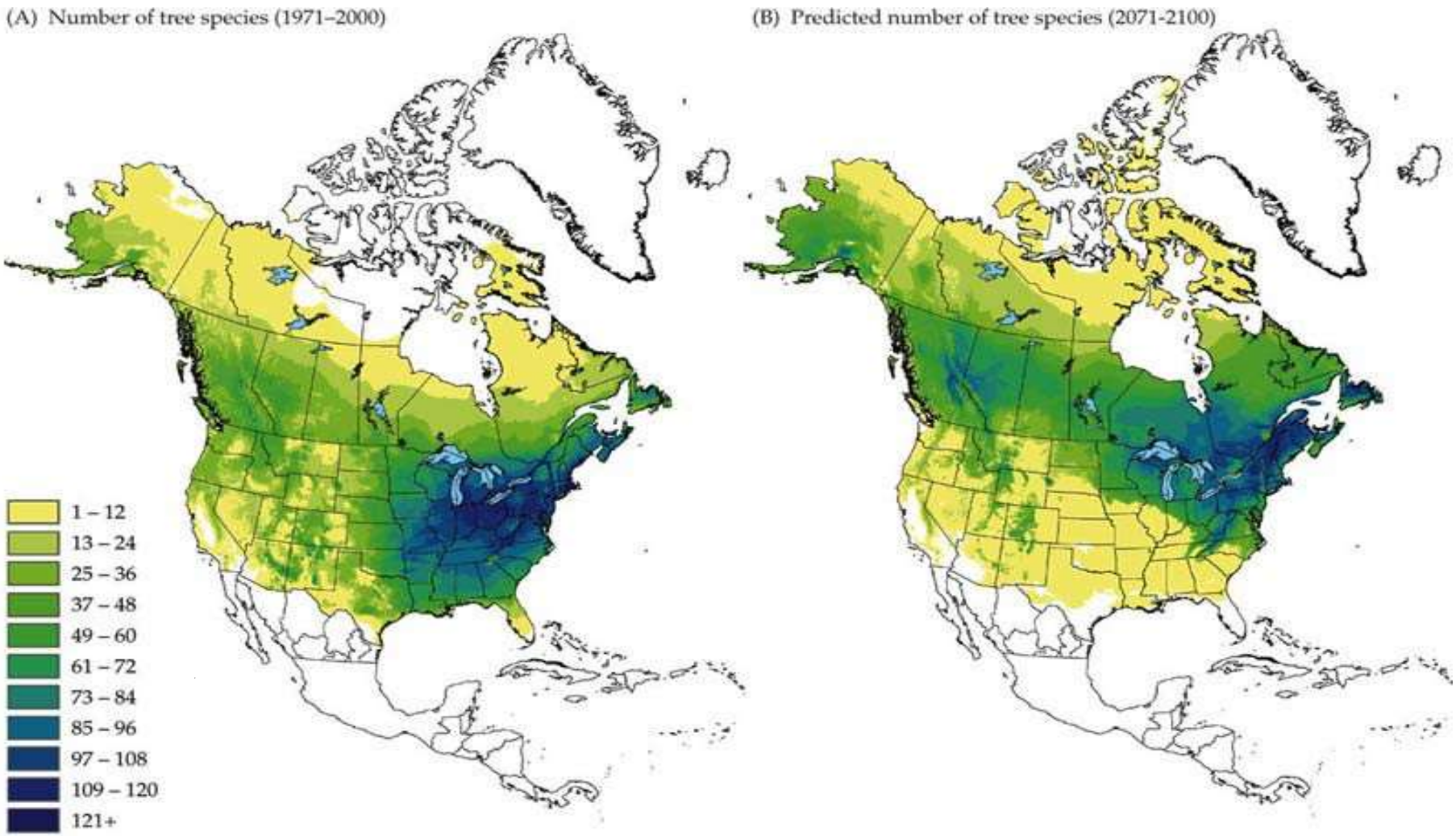


Alpine rest sites

Lowland rest sites

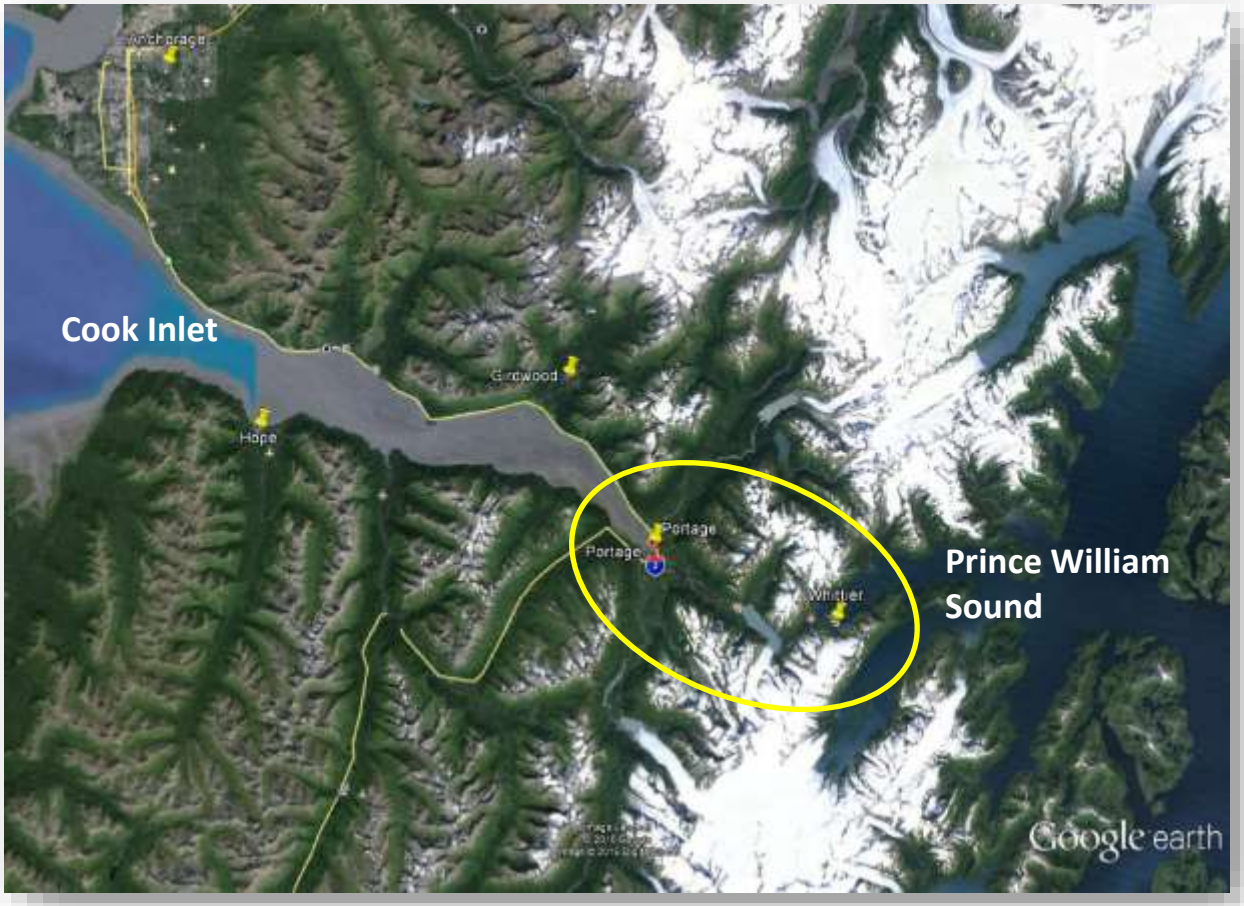
Baltensperger, Morton & Huettmann 2009

Northward migration of tree distributions



McKenney et al. 2011

10-mile wide isthmus is a migration barrier

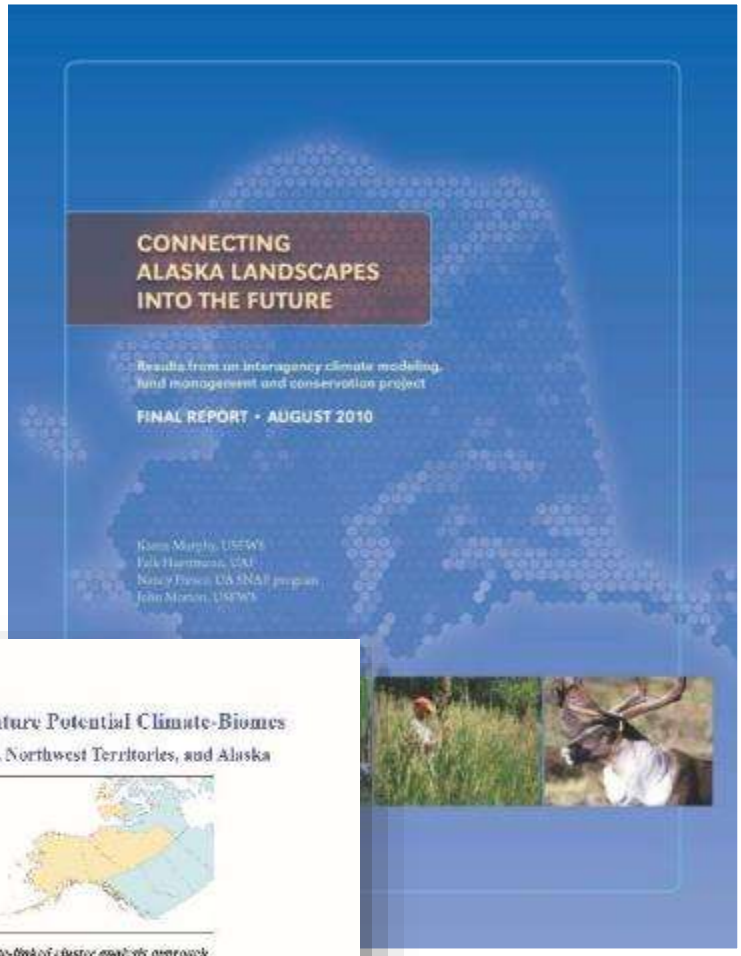


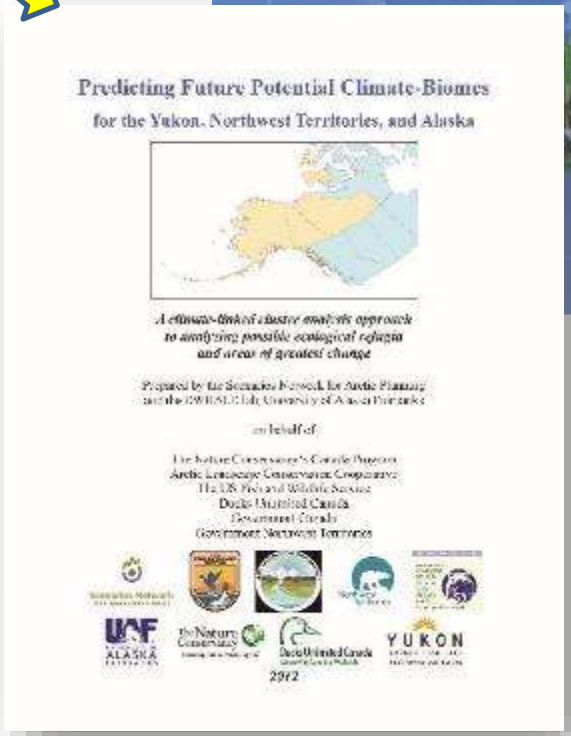
Wilson et al. 2015

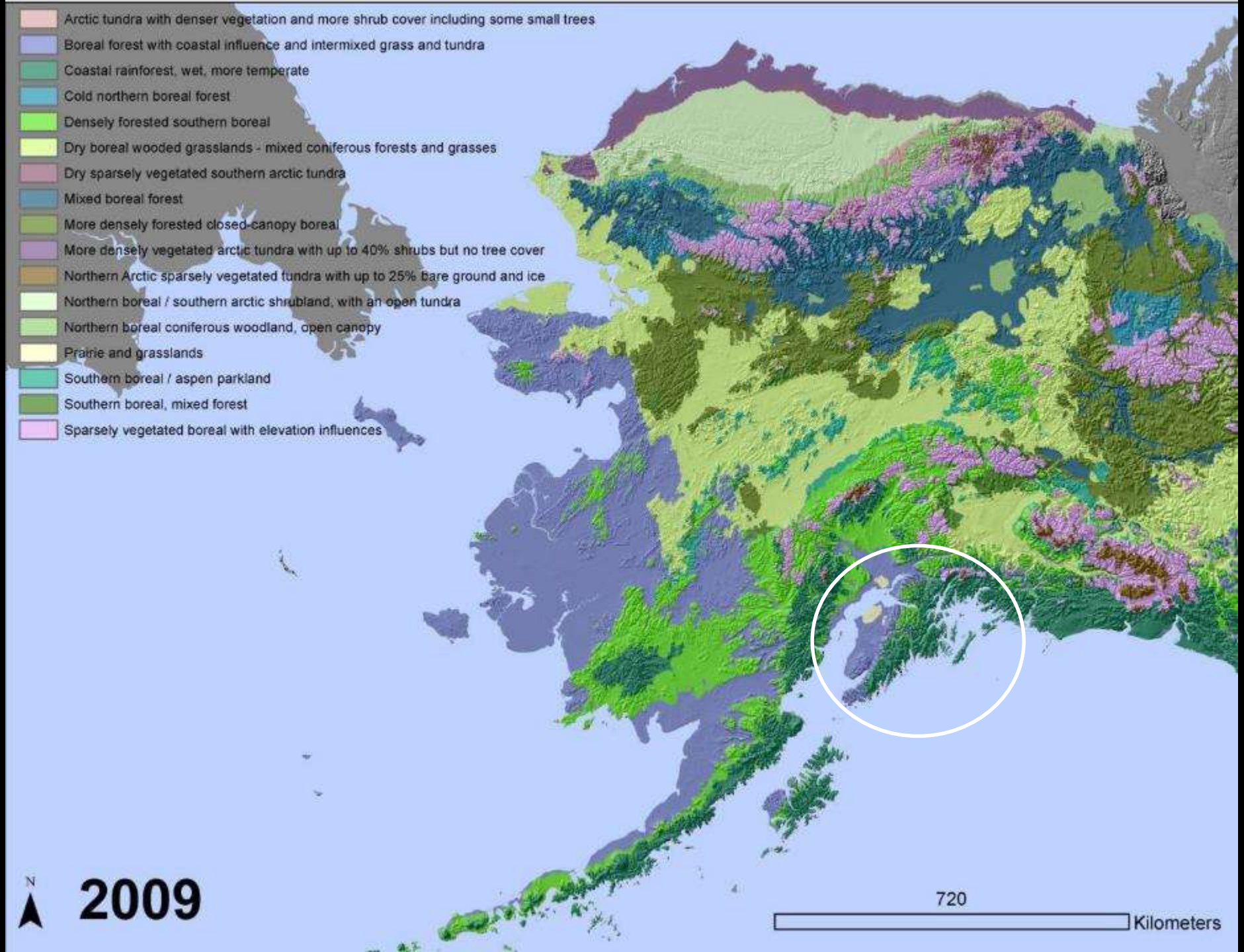
Tomasik and Cook 2005

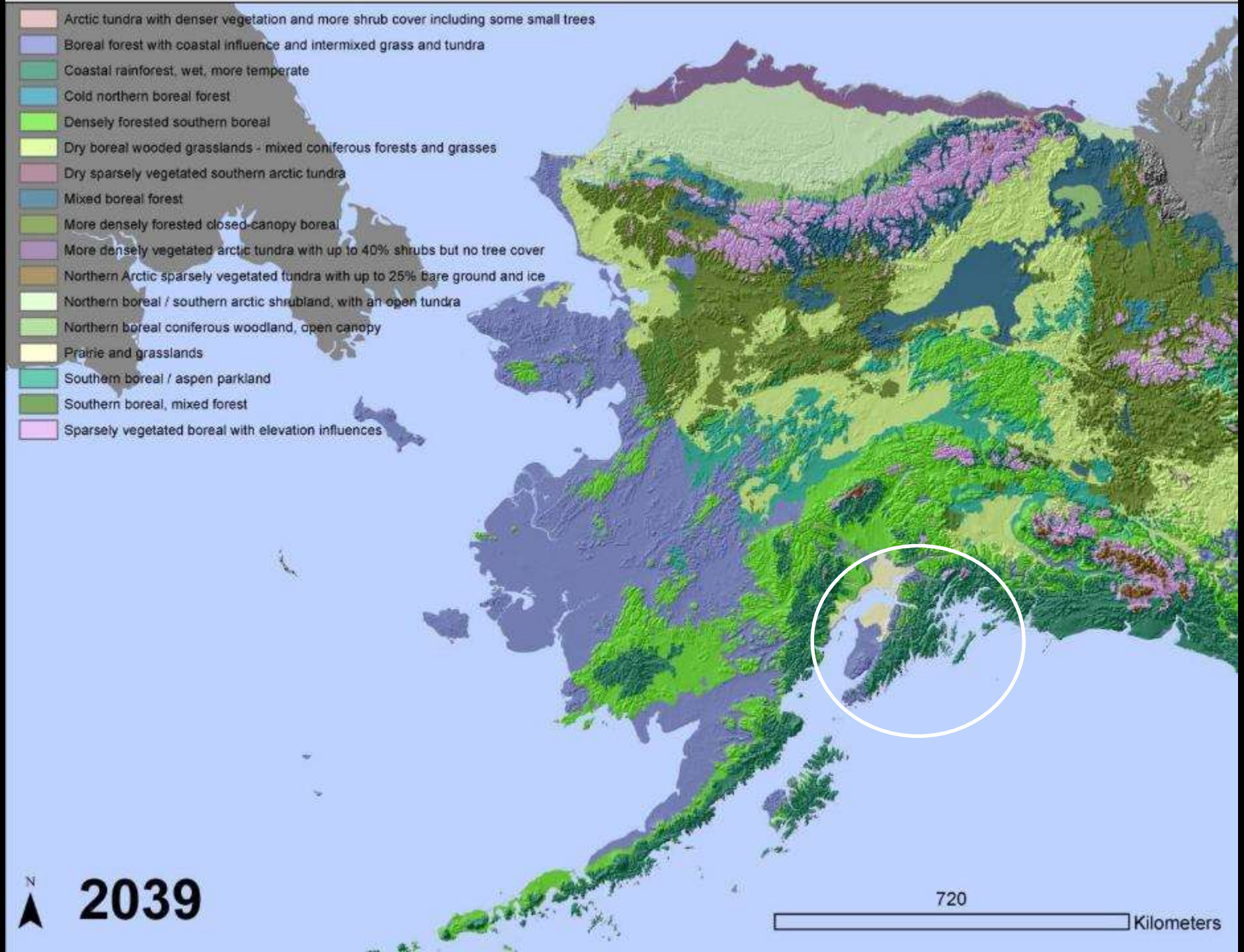
Jackson et al. 2008

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






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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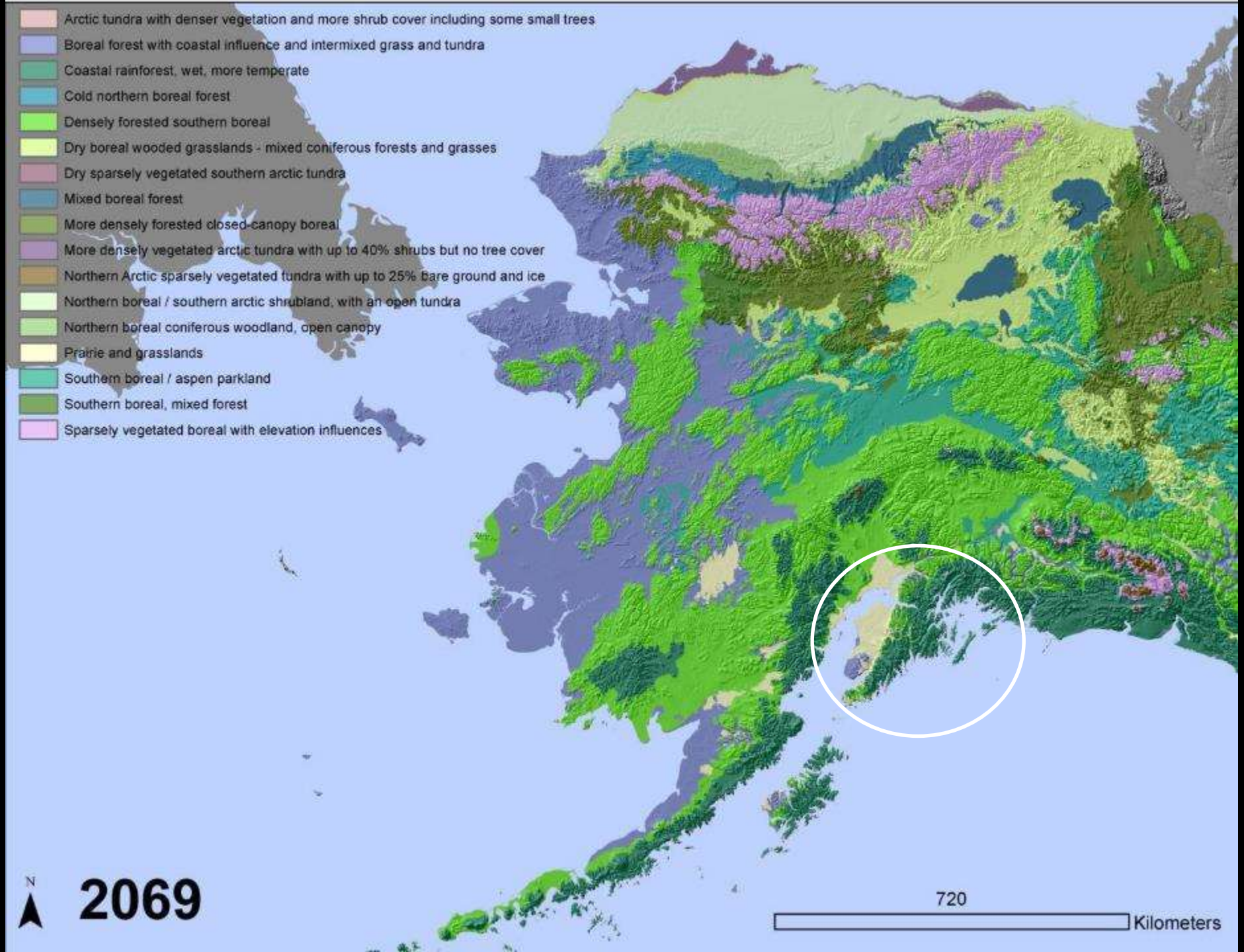
N
2039
720
Kilometers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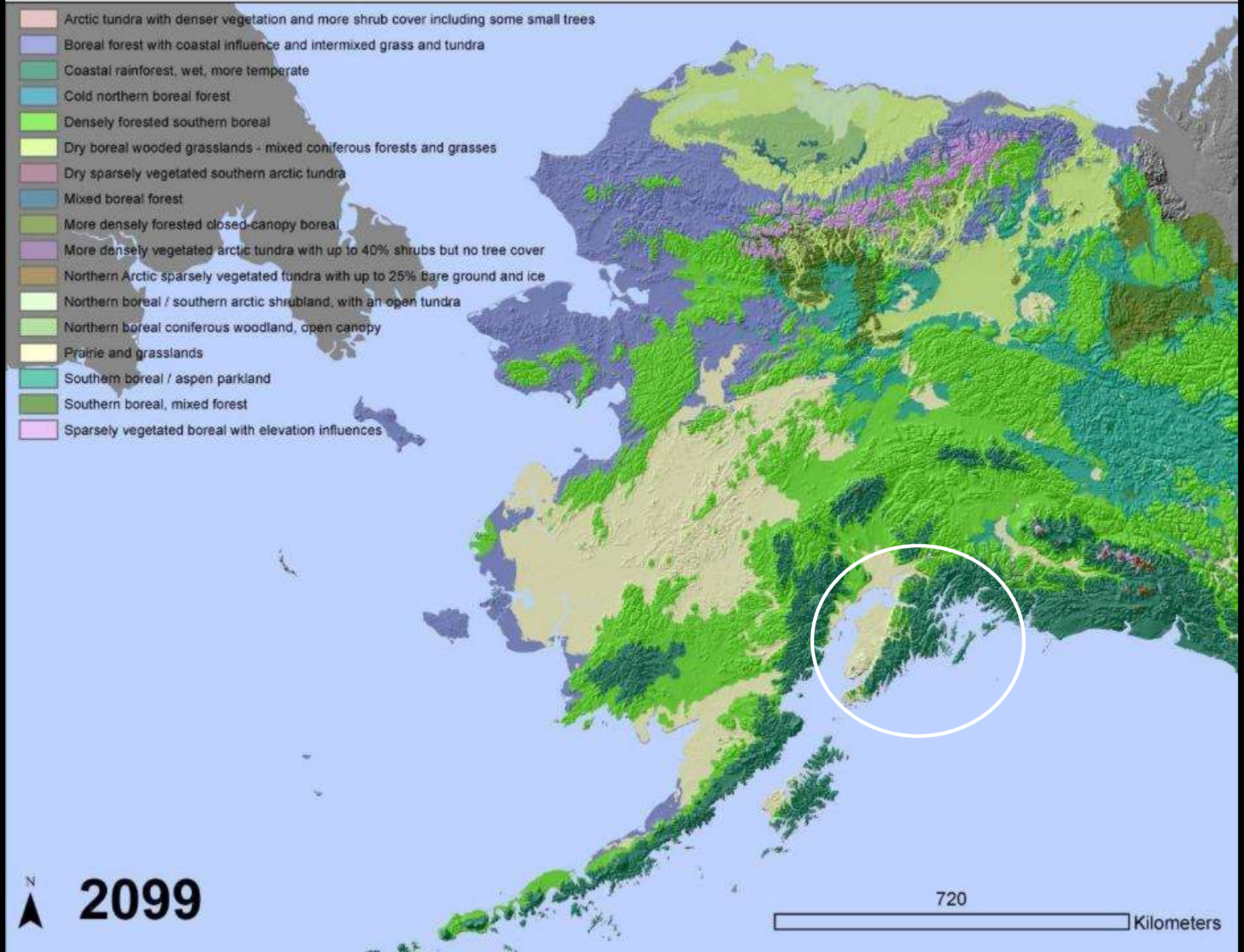
N
2069
720
Kilometers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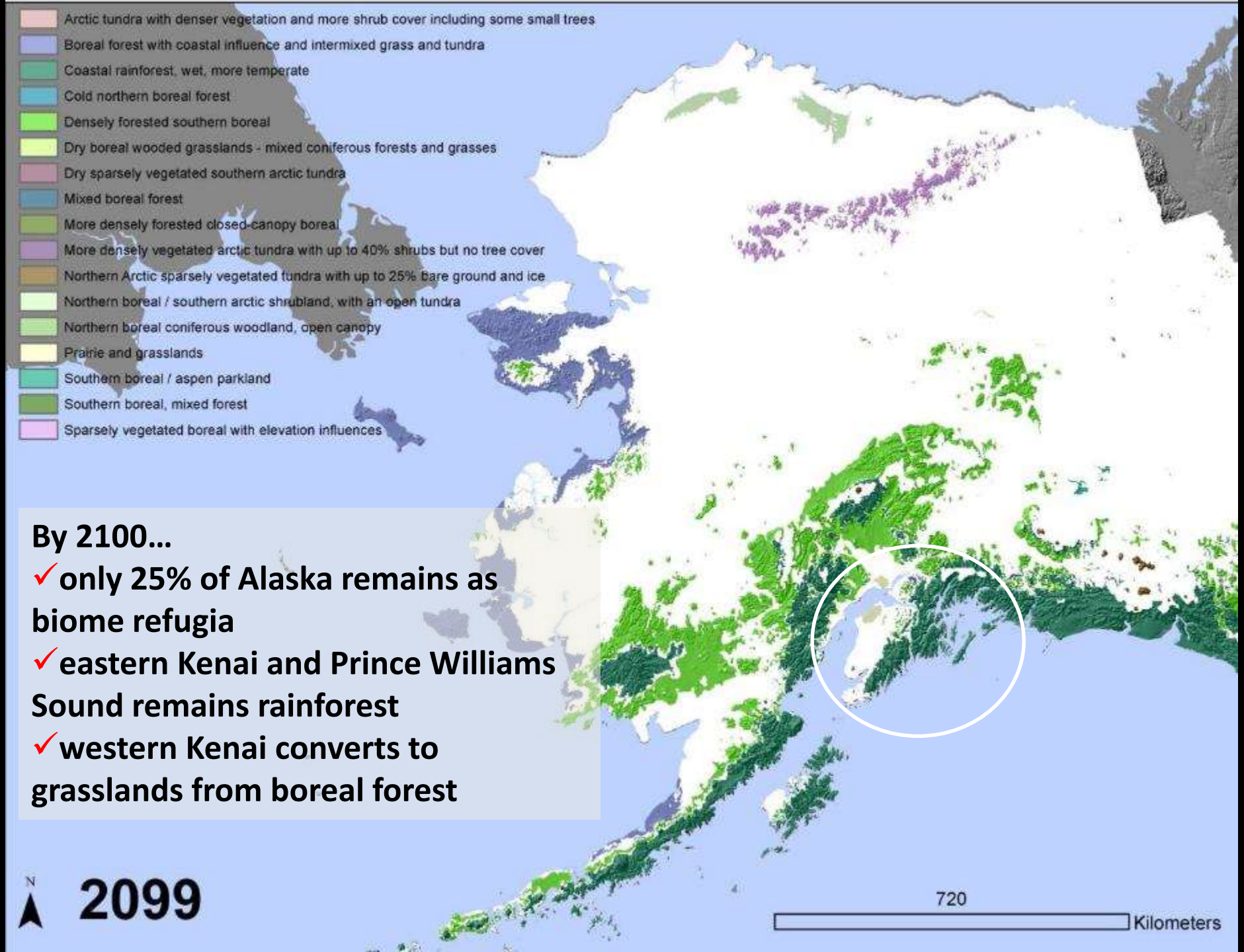
N
2099
720
Kilometers



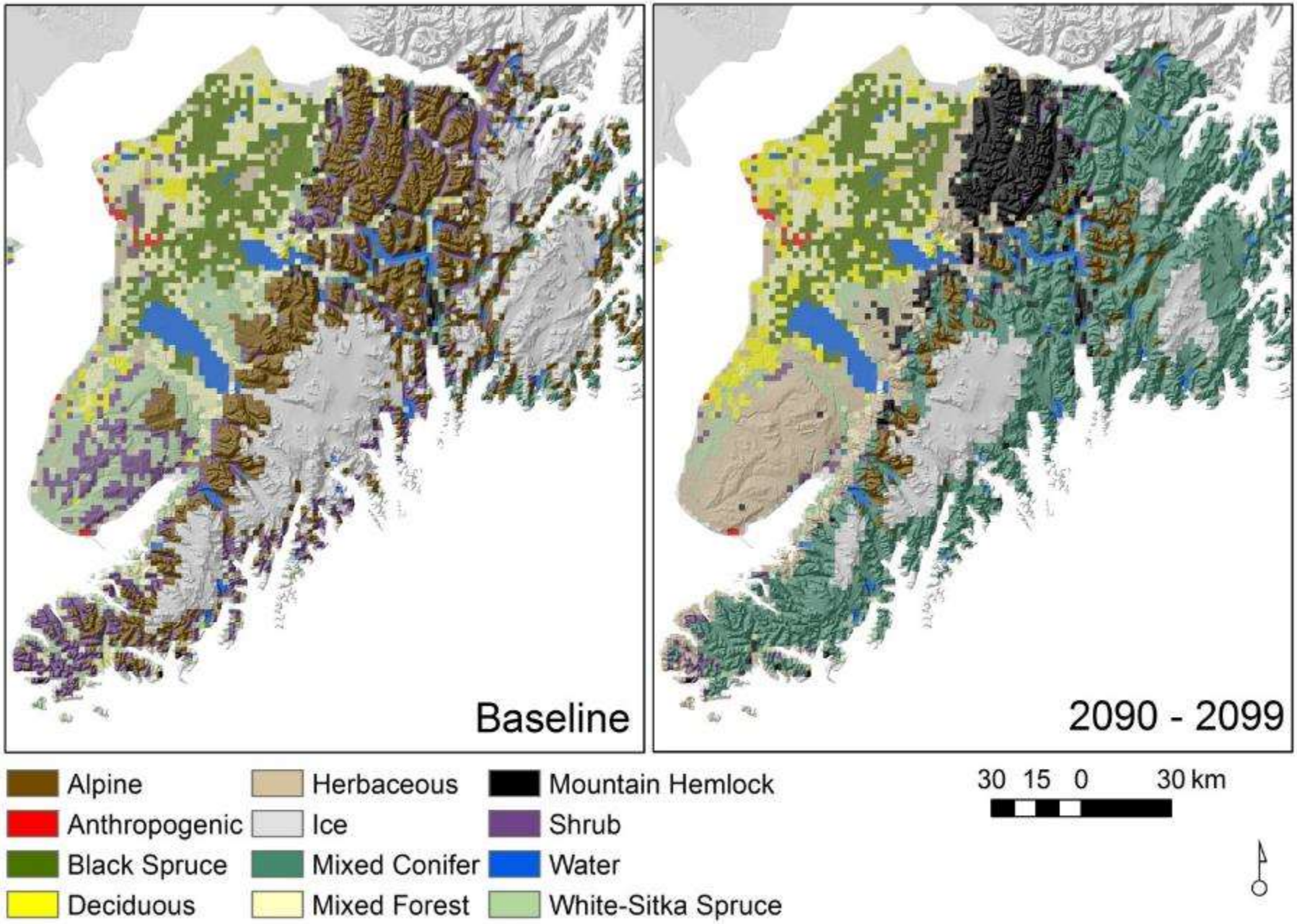
By 2100…

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

Forecasting the Kenai Peninsula's landscape through 2100

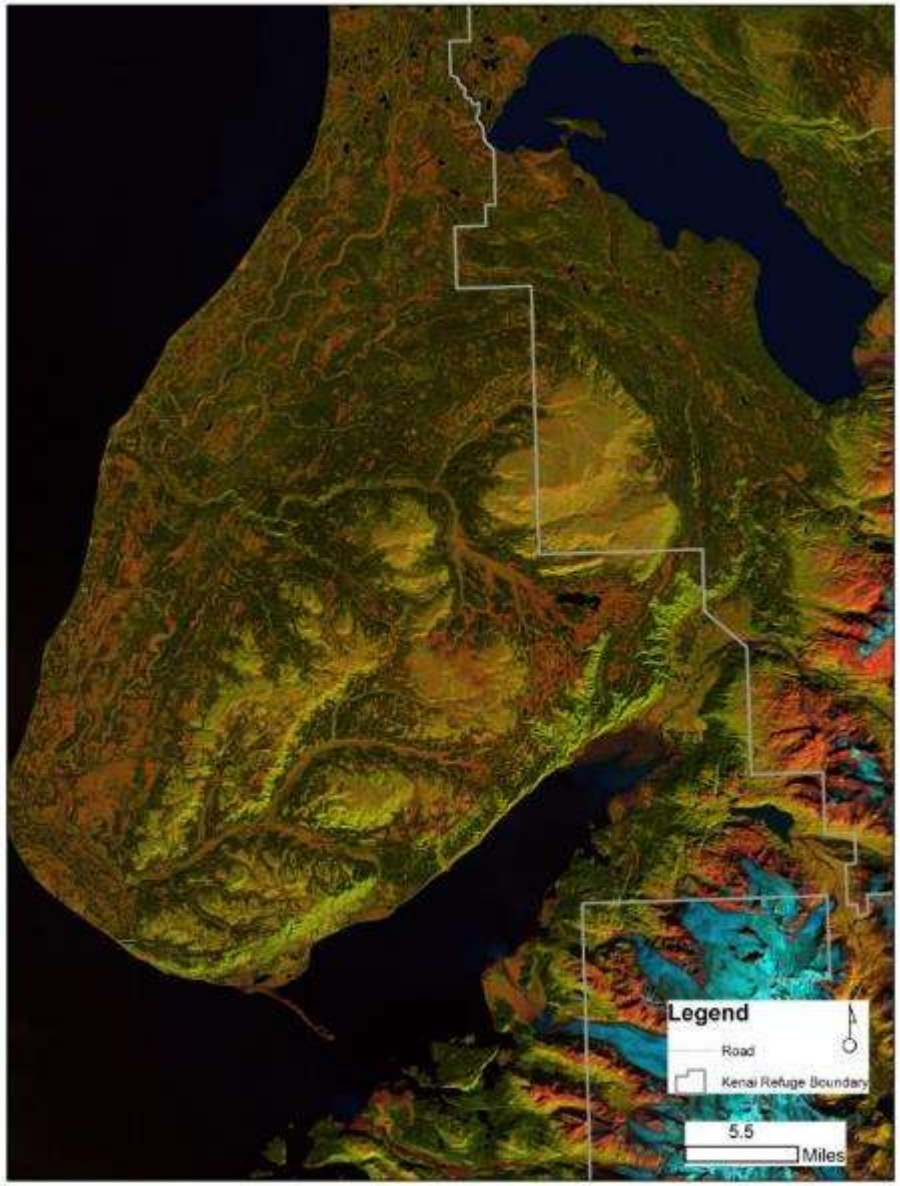
- ✓ Climate envelope modeling using Random Forests™
- ✓ A1B scenario decadal averages for temperature, precipitation (SNAP)
- ✓ landcover type with greatest % cover in 2km pixels
- ✓ if previous landcover type for each timestep (2039, 2069, 2099) P >0.5 then stay; if P <0.5 then landcover type with highest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

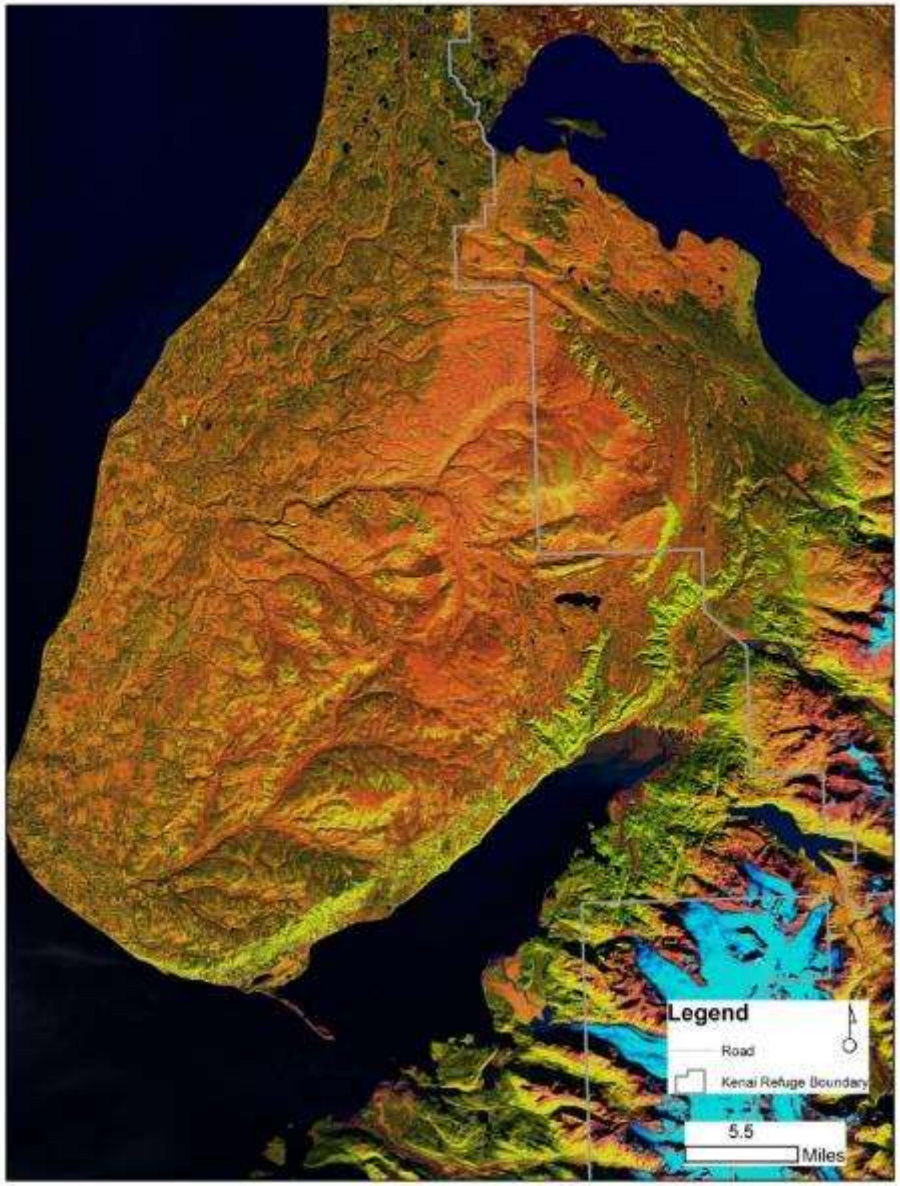
Magness and Morton 2018


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

37% of Kenai Peninsula landcover types are forecasted to change by 2099!

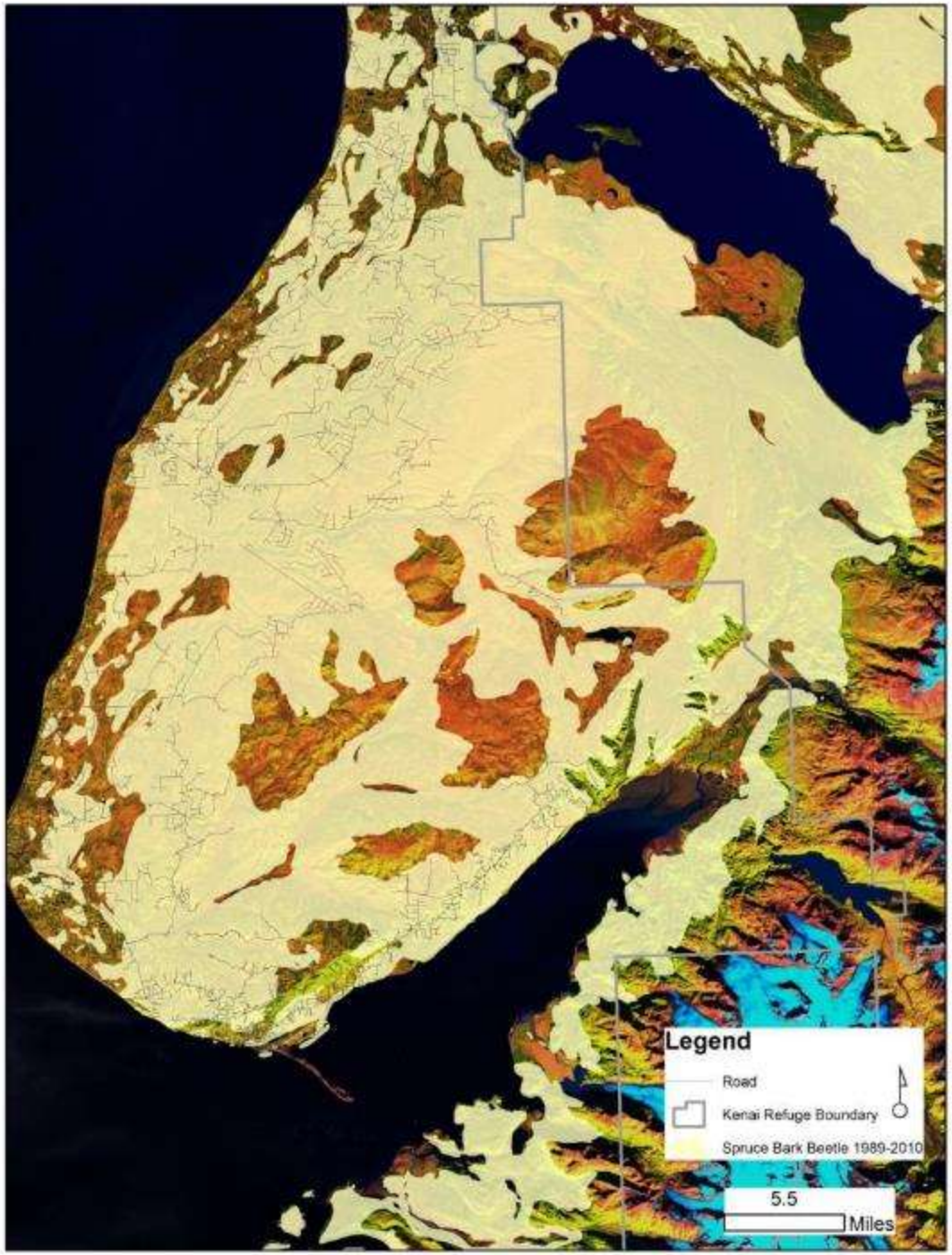
- ✓ Eastern side shows **afforestation** of alpine (hemlock) and coast (Sitka spruce)
- ✓ Western side shows **deforestation** (white and black spruce), expanding grasslands



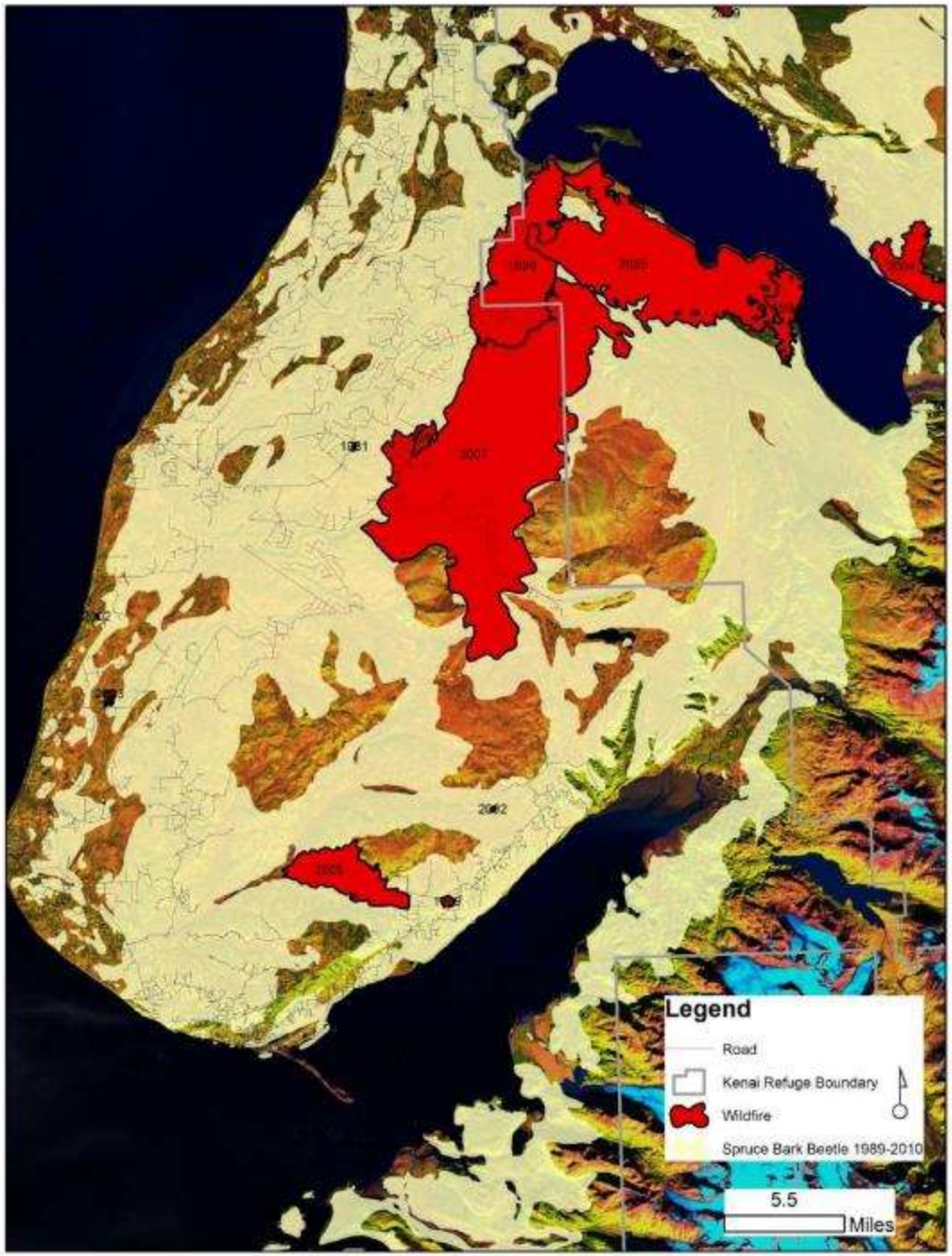


SEPT 1985

SEPT 2014

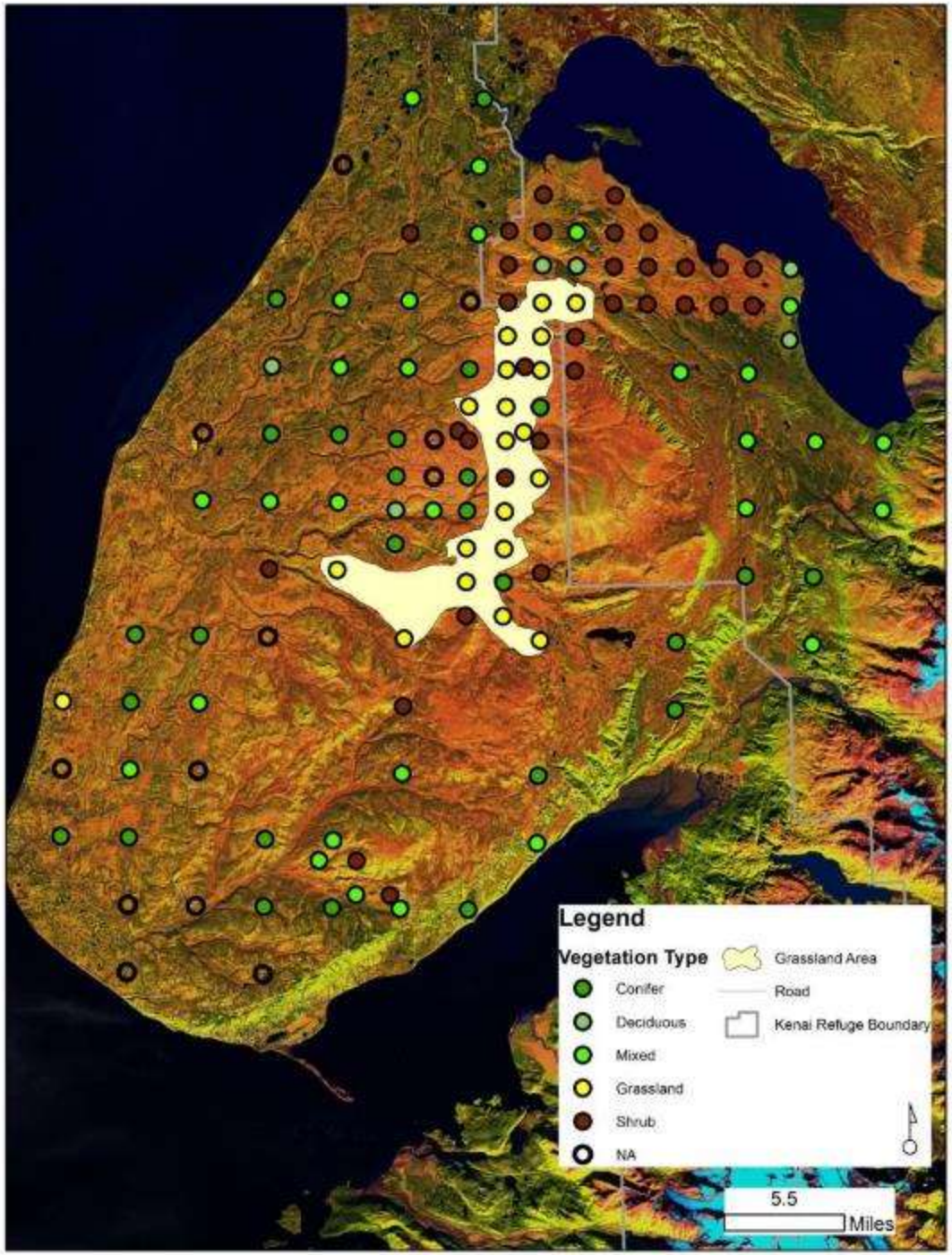


Spruce Bark Beetle Mortality (1989-2010)



Wildfires (1994–2007)

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

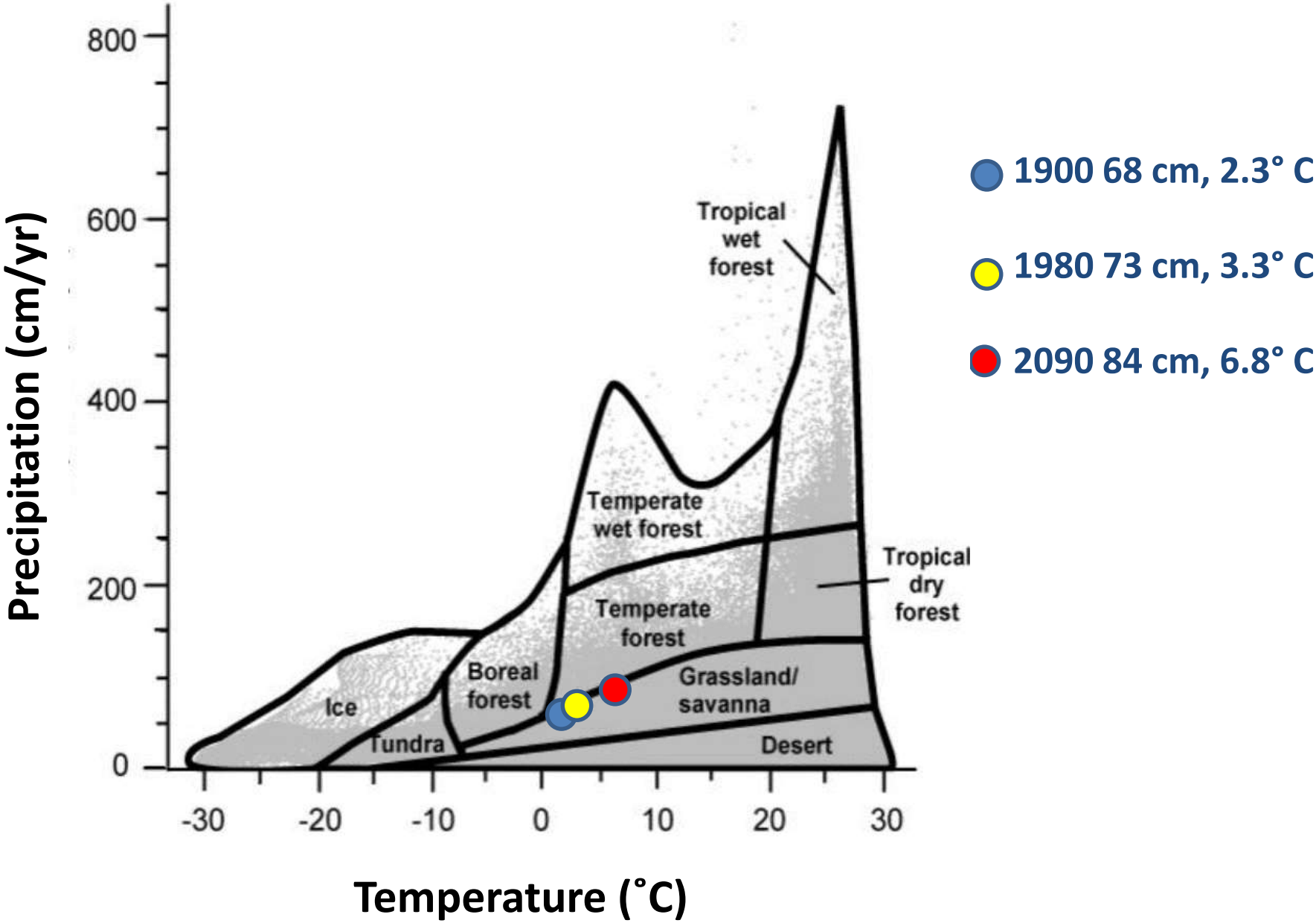


40,000-acre contiguous grassland polygon in 2015

2002 imagery

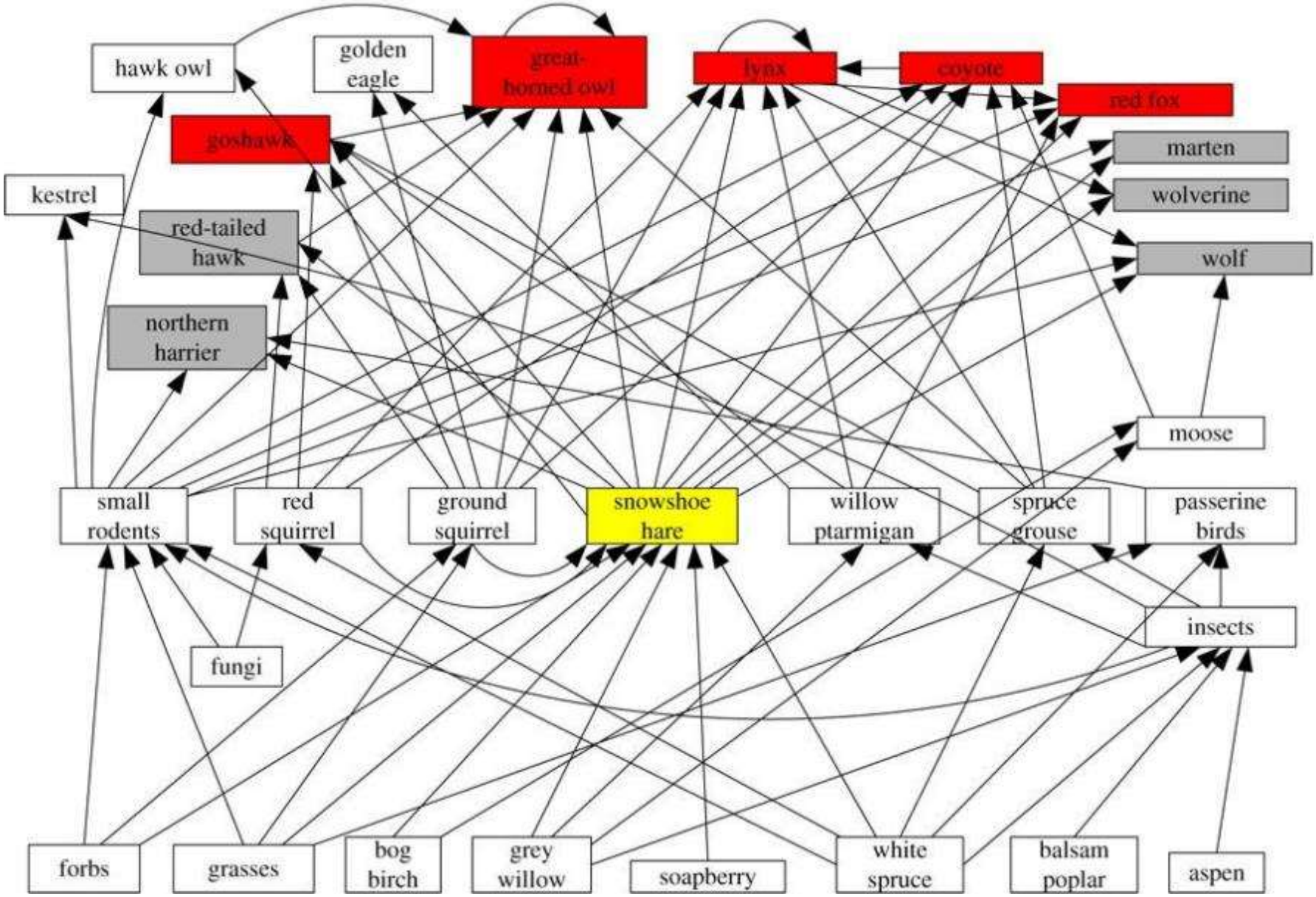
- **Forest 55%**
- **Other 40%**
- **Herbaceous 5%**

2015/07/19



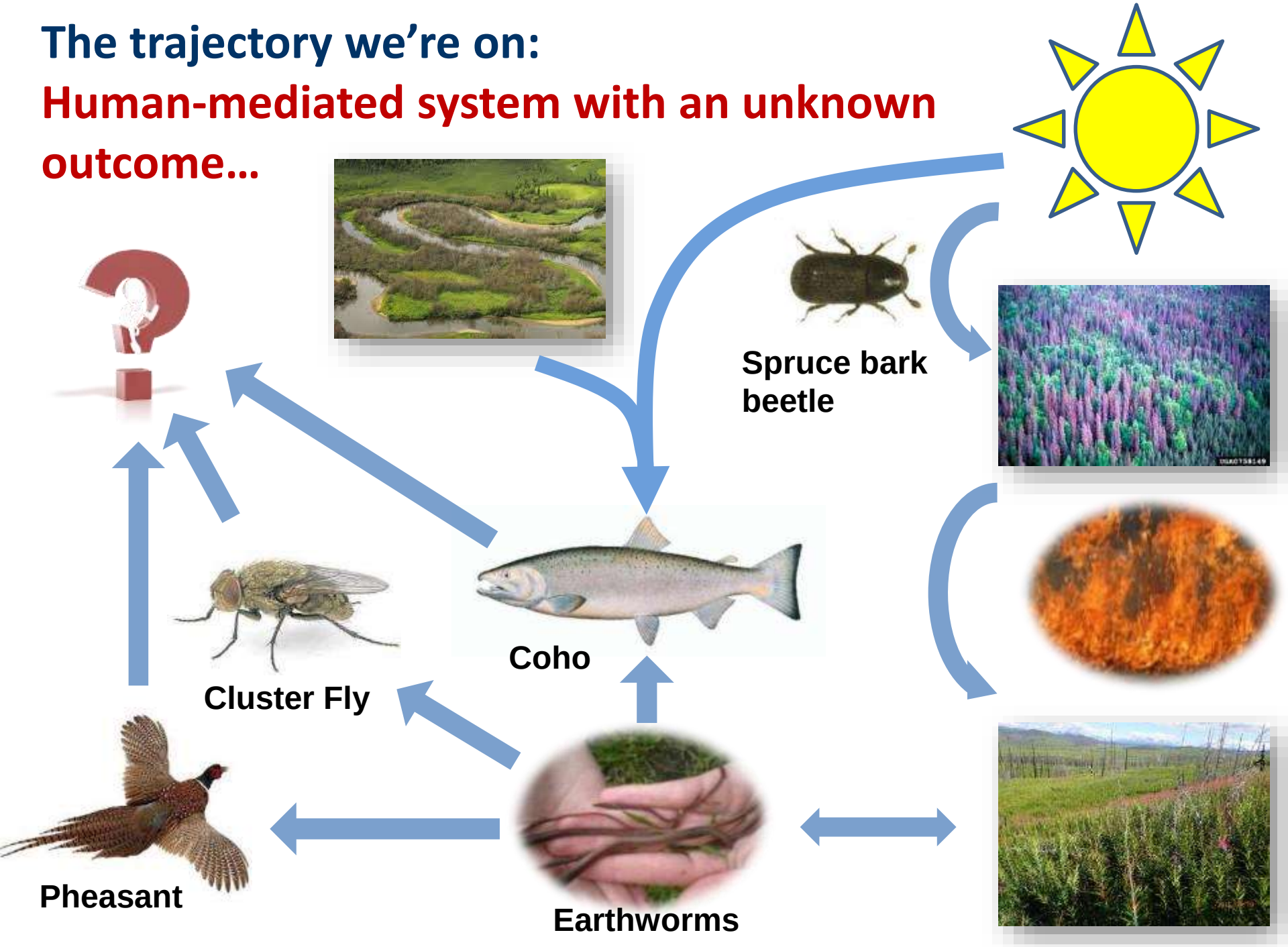
Staudinger et al. (2012). Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment

The boreal system as we're taught…



The trajectory we're on:

Human-mediated system with an unknown outcome…



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

Hardwoods

- Ash (green)
- Birch (Rocky Mountain white, weeping)
- Elm (Siberian)
- Linden (big leaf, little leaf)
- Maple (Amur, Norway, red, silver, Tatarian)
- Mountain ash (European/S. aucuparia)
- Oak (Burr, Red)
- Russian olive
- Poplar (Norway)
- Willows (11 species)
- Many fruit tree varieties (e.g., Bird's cherry)

Softwoods

- Cedar (Western red, white)
- Dawn redwood (Metasequoia)
- Fir (balsam, Douglas, grand, Korean, Sakhalin, Shasta red, silver, subalpine, white)
- Hemlock (Eastern)
- Juniper
- Larch (Alaska, Dahurian, Siberian, Western)
- Pine (Austrian, bristlecone, Eastern white, lodgepole, limber, Manchurian, Mugo, Ponderosa, Scotch, Siberian, Western white)
- Spruce (Black Hills, blue, dwarf Alberta, Englemann, Norway)

2 questions we need to ask ourselves….

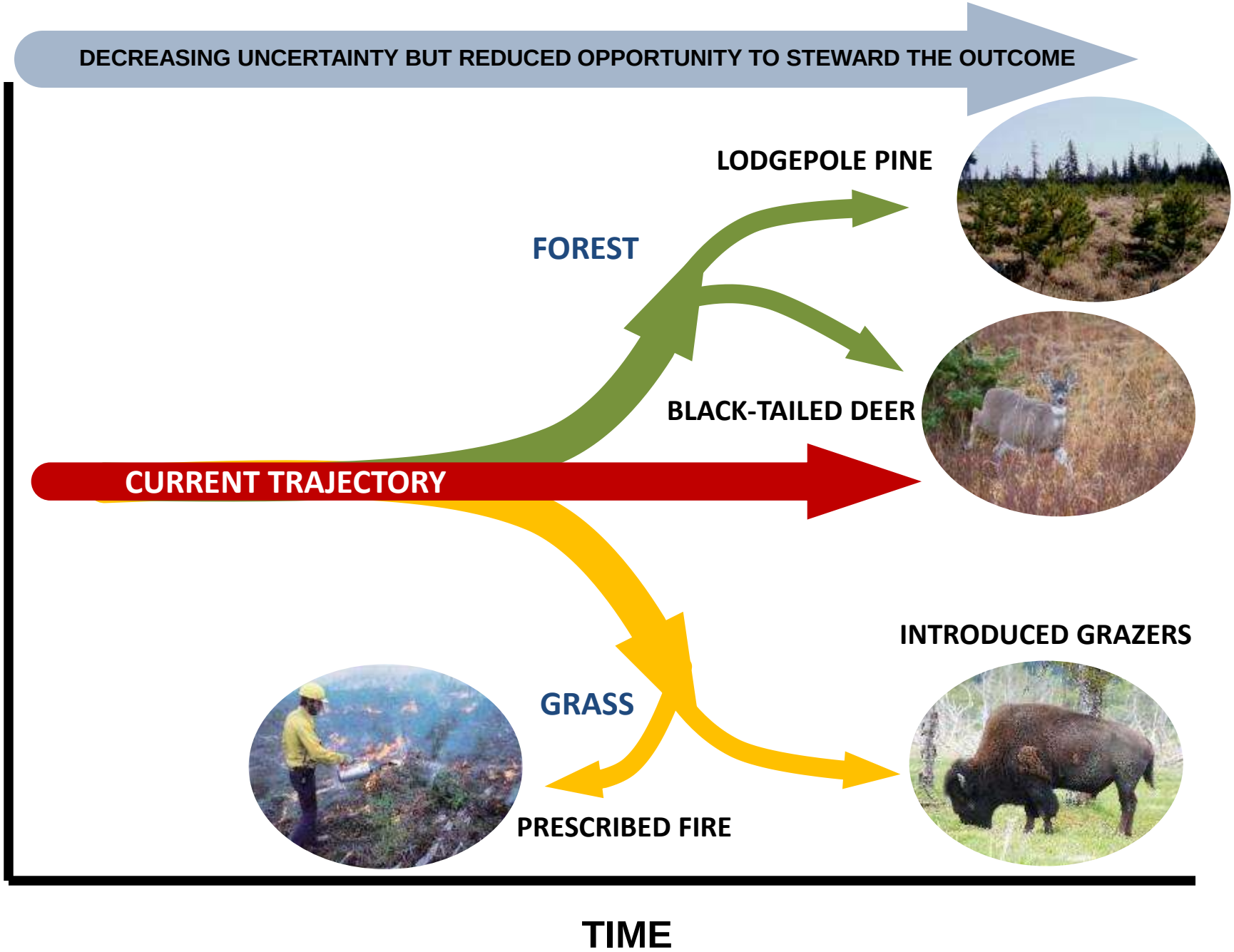
What's the risk of doing nothing?

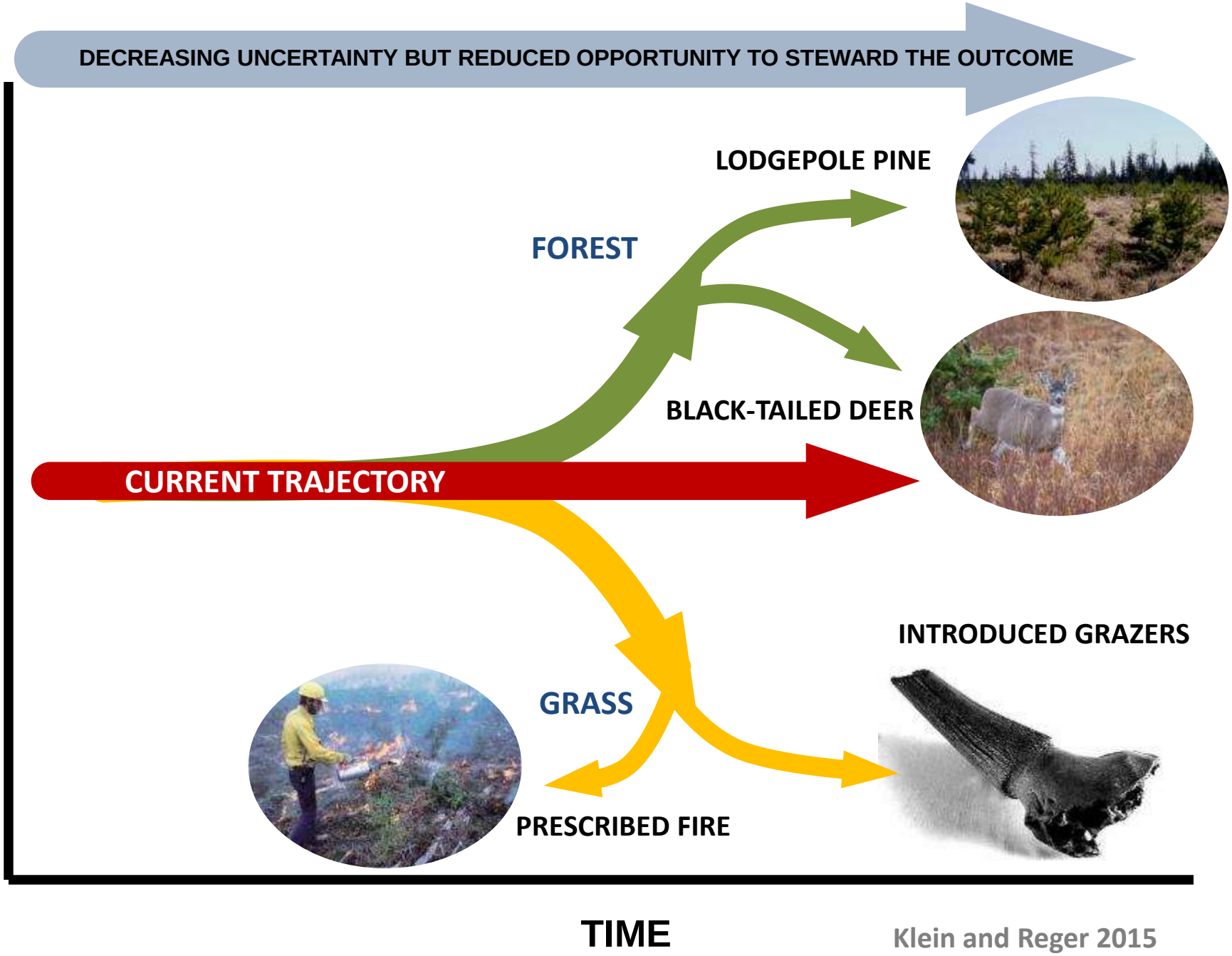
What's the risk of doing something wrong?

----Rosa Meehan
10 Feb 2010

Doing nothing is really doing something… just incoherently and haphazardly

- ✓ **Kenai Peninsula is already responding to a changing climate 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***
- ✓ **And we squander our early opportunities to steward outcomes!**


DECREASING UNCERTAINTY BUT REDUCED OPPORTUNITY TO STEWARD THE OUTCOME
LODGEPOLE PINE
FOREST
BLACK-TAILED DEER
CURRENT TRAJECTORY
INTRODUCED GRAZERS
GRASS
PRESCRIBED FIRE
TIME

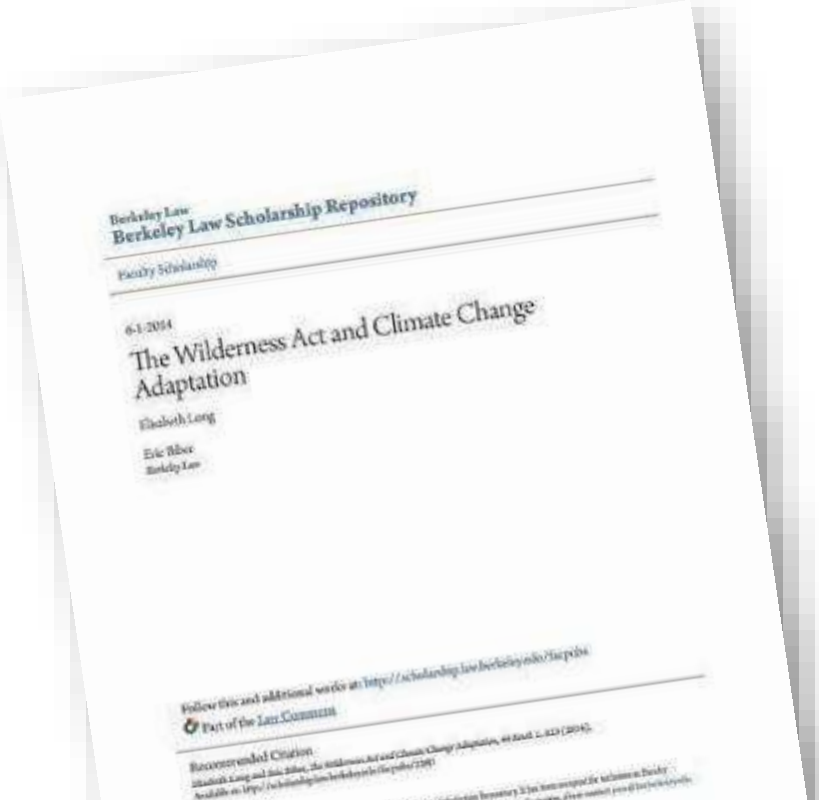


Klein and Reger 2015

We have tools for stewarding ecological transformation

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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Elizabeth Long

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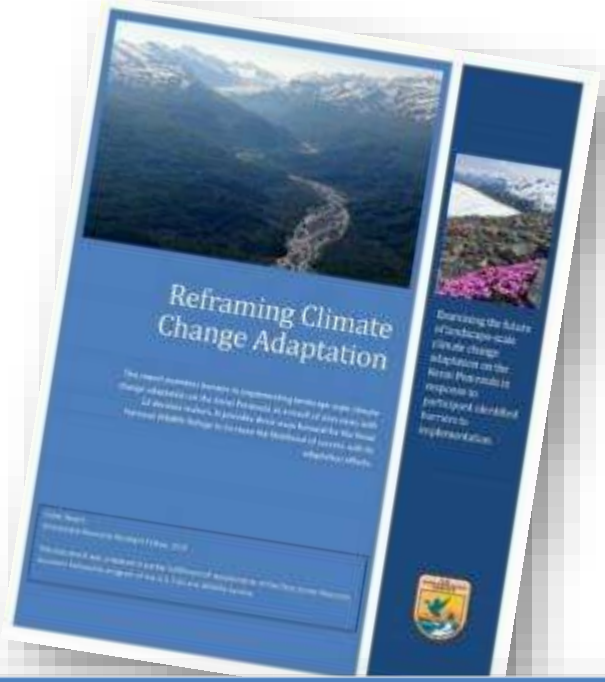

Perceptions of Climate Change					
Institution	Unit or Division	Climate change ranking	Does climate change exist?	Is climate change being accelerated by humans?	Do humans have a moral obligation to adapt?
USFS	Chugach National Forest	5	Yes	Yes	No
USFWS	Kenai National Wildlife Refuge	7.5	Yes	Yes	Yes
*NPS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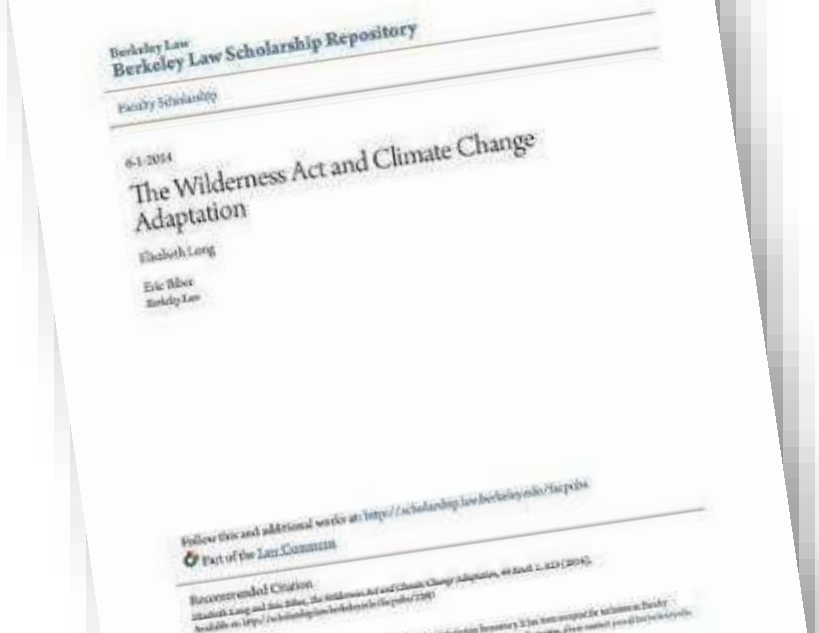
USFS	Chugach National Forest	8	Yes	Yes	Yes
NPS	Kenai Fjords National Park	7.5	Yes	Yes	-
USFWS	Kenai National Wildlife Refuge	9	Yes	Yes	Yes
Alaska DNR	Alaska State Parks	2.5	Yes	Yes	Yes
‡Alaska DNR	Mining, Land, and Water	-	-	-	-
CIRI	Land and Resources	2	Yes	-	Yes
KPB	Land Management Division	4	Yes	-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

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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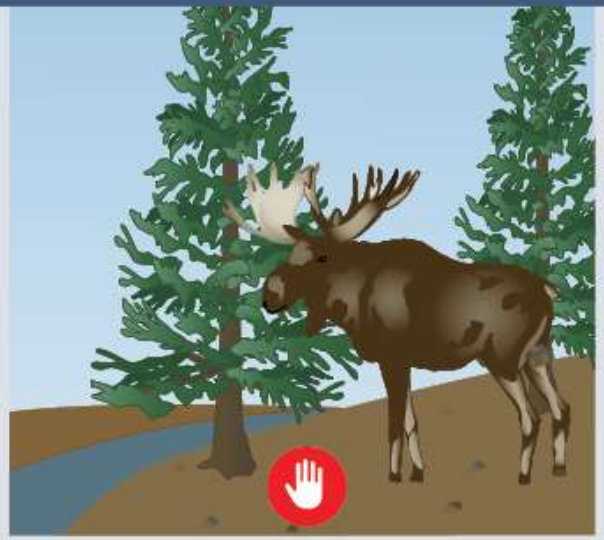
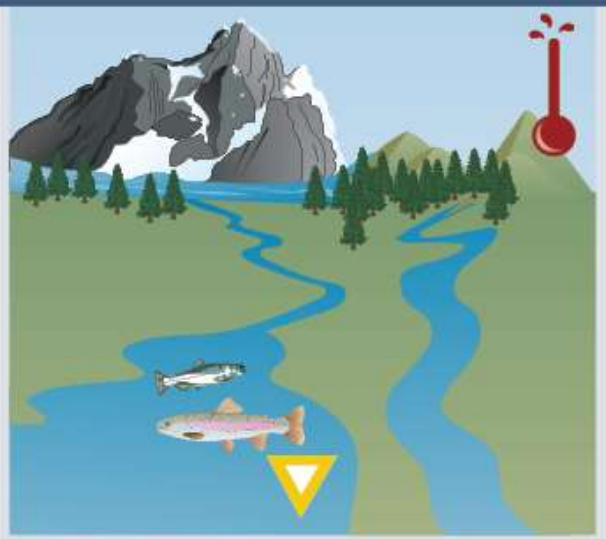
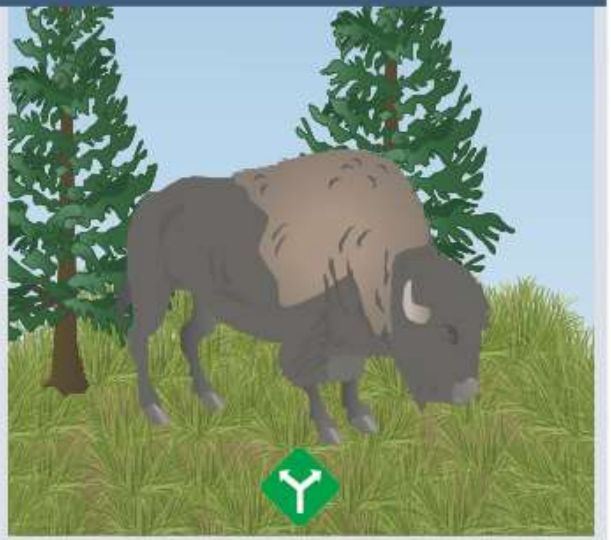


Stream banks are restored, some invasive species are eradicated, fire is managed progressively, and landscape connectivity is maintained through fish and wildlife passages under or over highways. Many invasives are not managed either due to infeasibility or lack of perceived threat.

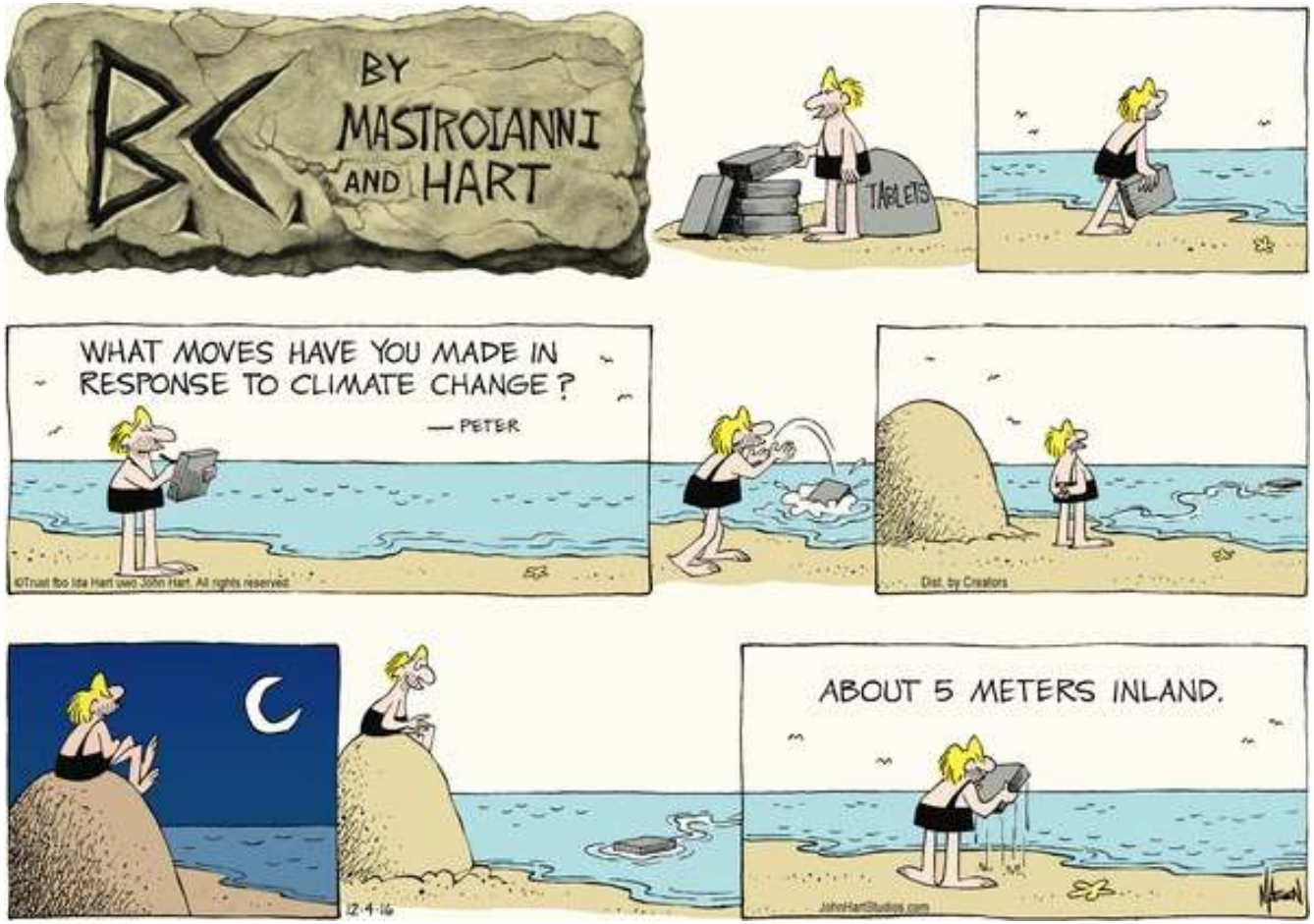


Glaciers are melting, non-glacial streams are warming, tree line is rising, and wetlands are drying. Yet, the effects have not been severe enough to prompt a management response. Society has accepted the changes in fish and wildlife communities, even with higher costs to ecosystem services.



A spruce bark beetle epidemic and human-caused fire have shifted white spruce forests into a novel grassland ecosystem. Non-native trees are being planted, and the introduction of large grazers is being considered to stabilize the new grasslands and related communities.

Questions????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