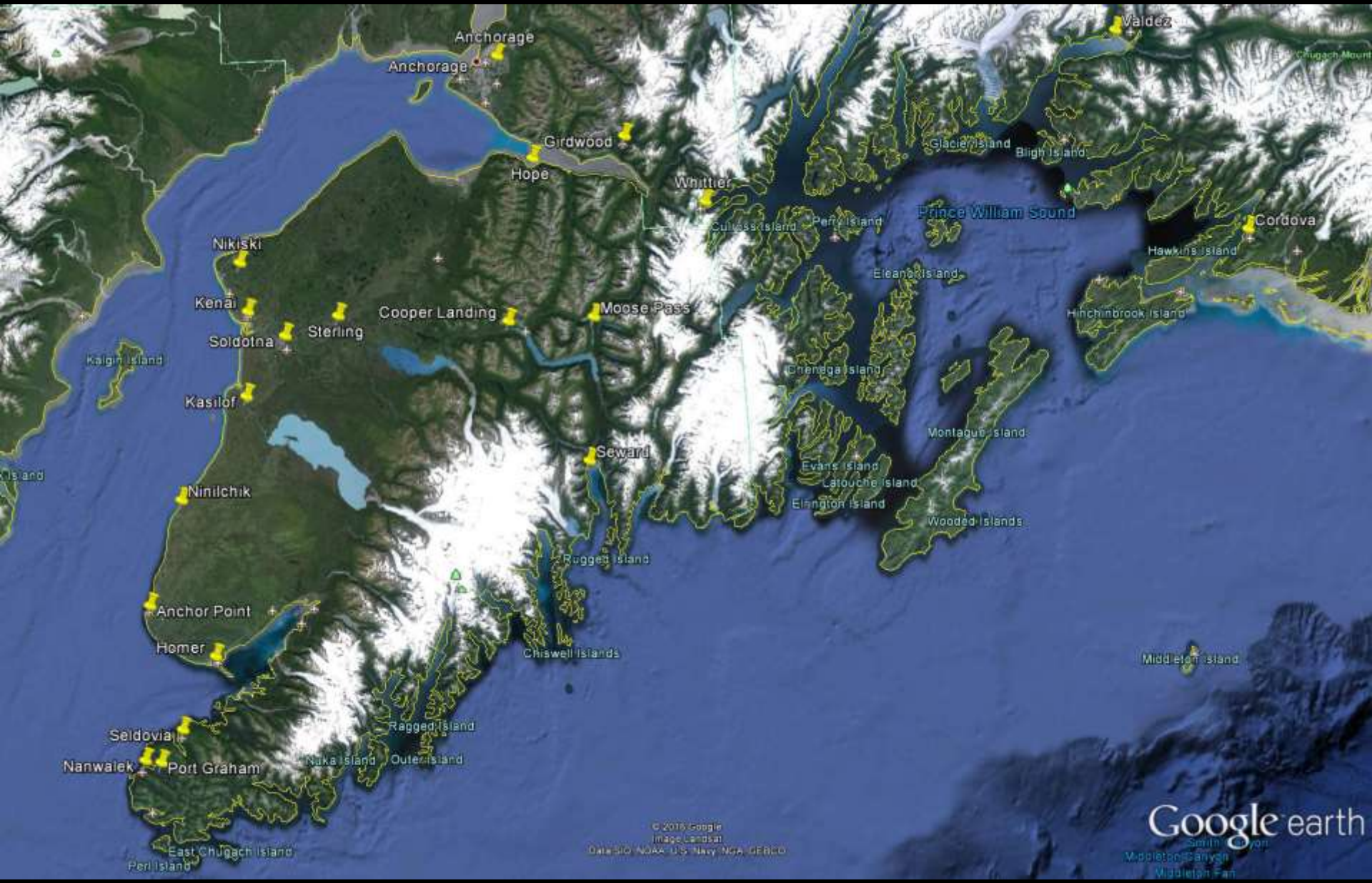
Early responses of Kenai's wildlife and vegetation to rapid climate change

What we know…
and what we think we know

John Morton
Kenai National Wildlife Refuge


Anchorage
Anchorage
Girdwood
Hope
Whittier
Valdez
Glacier Island
Bligh Island
Prince William Sound
Cordova
Hawkins Island
Eleanor Island
Hinchinbrook Island
Culross Island
Perry Island
Nikiski
Kenai
Soldotna
Sterling
Cooper Landing
Moose Pass
Kasilof
Kalgin Island
Chenega Island
Montague Island
Seward
Evans Island
Latouche Island
Ellington Island
Wooded Islands
Ninilchik
Rugged Island
Anchor Point
Homer
Chiswell Islands
Middleton Island
Seldovia
Ragged Island
Nanwalek
Port Graham
Nuka Island
Outer Island
East Chugach Island
Perl Island
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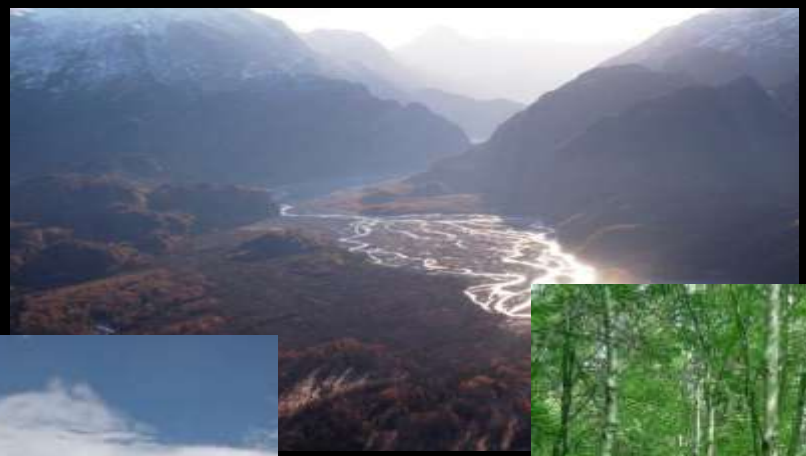
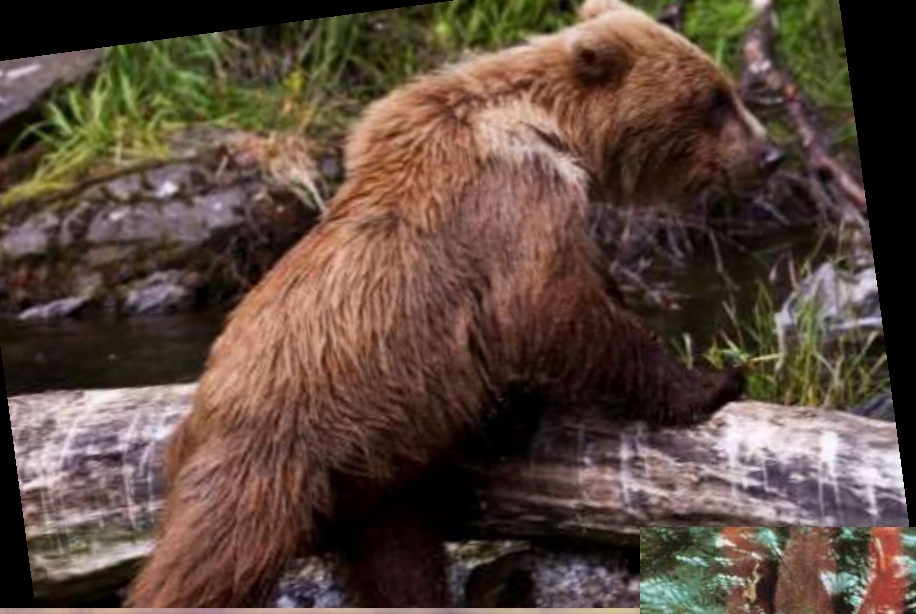




Early January 2016

In the news

Winter warmer-land: U.S. breaks record for hottest winter

WASHINGTON (AP) — Federal meteorologists say the winter that has just ended was the hottest in U.S. records, thanks to the combination of El Nino and man-made global warming.

The average temperature for the Lower 48 from December through February — known as meteorological winter — was 36.8 degrees, 4.6 degrees above normal. It breaks the record set in 1999-2000.

Last month was the seventh warmest February. National Oceanic and Atmospheric Administration climate scientist Jake Crouch said a super-hot December pushed the winter to record territory. The fall of 2015 also was a U.S. record.

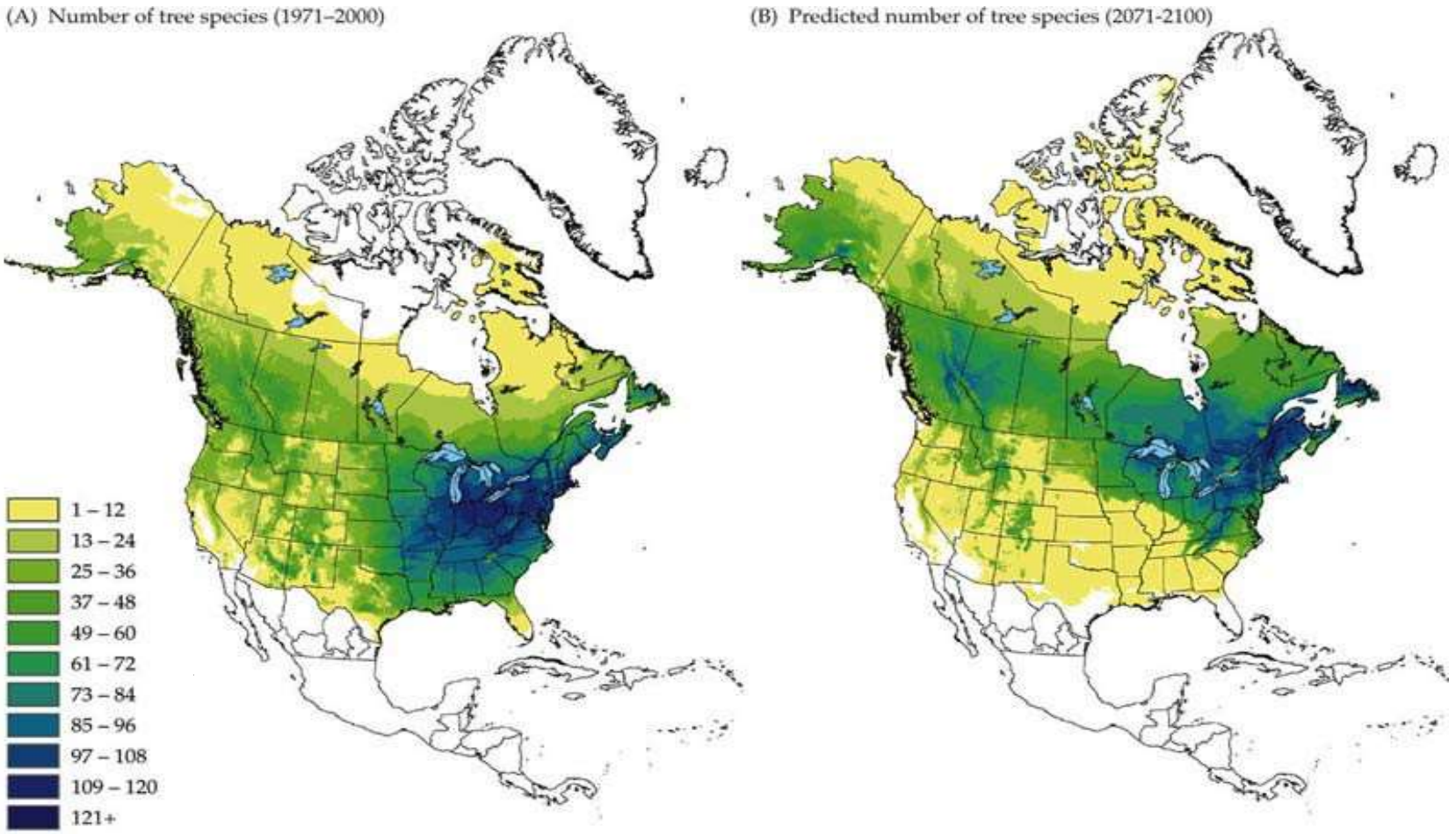
All six New England states had their warmest winters. Every state in the Lower 48 had winters at least 1.7 degrees warmer than normal. Alaska was 10.6 degrees warmer than normal.

Records go back to 1895.

Kenai is ground zero for climate change

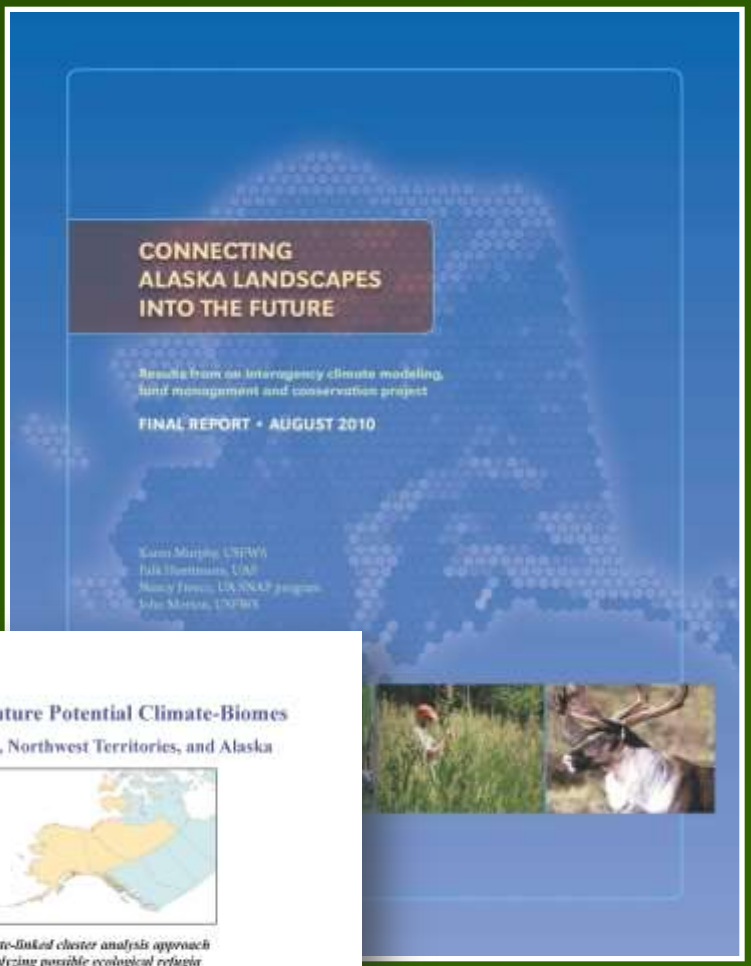
- ✓ Alaska is warming at twice the rate of Lower 48
- ✓ Kenai winters have warmed more than summers
- ✓ Kenai nights have warmed more than days
- ✓ Homer has jumped 2 USDA plant zones
- ✓ Biggest future uncertainty on Kenai is form and variation of increasing precipitation
  - ✓ Extreme events likely
  - ✓ Snow may increase at higher elevations but decrease along coast

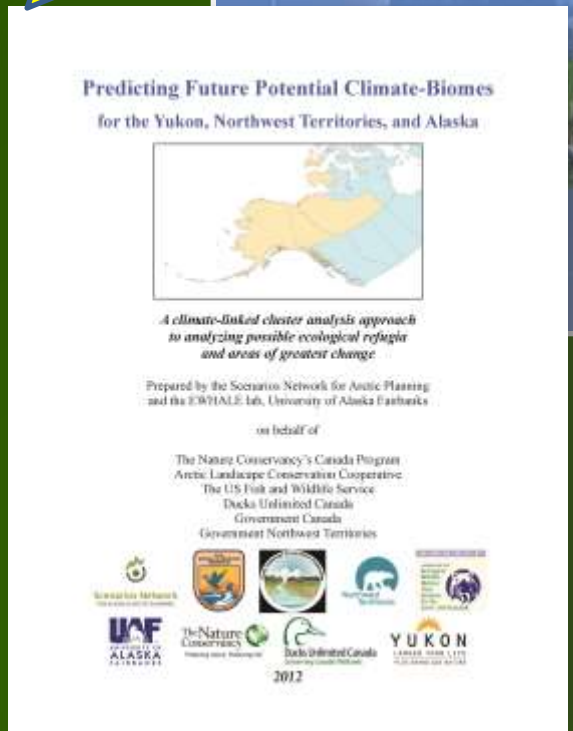
Northward migrations of tree distributions

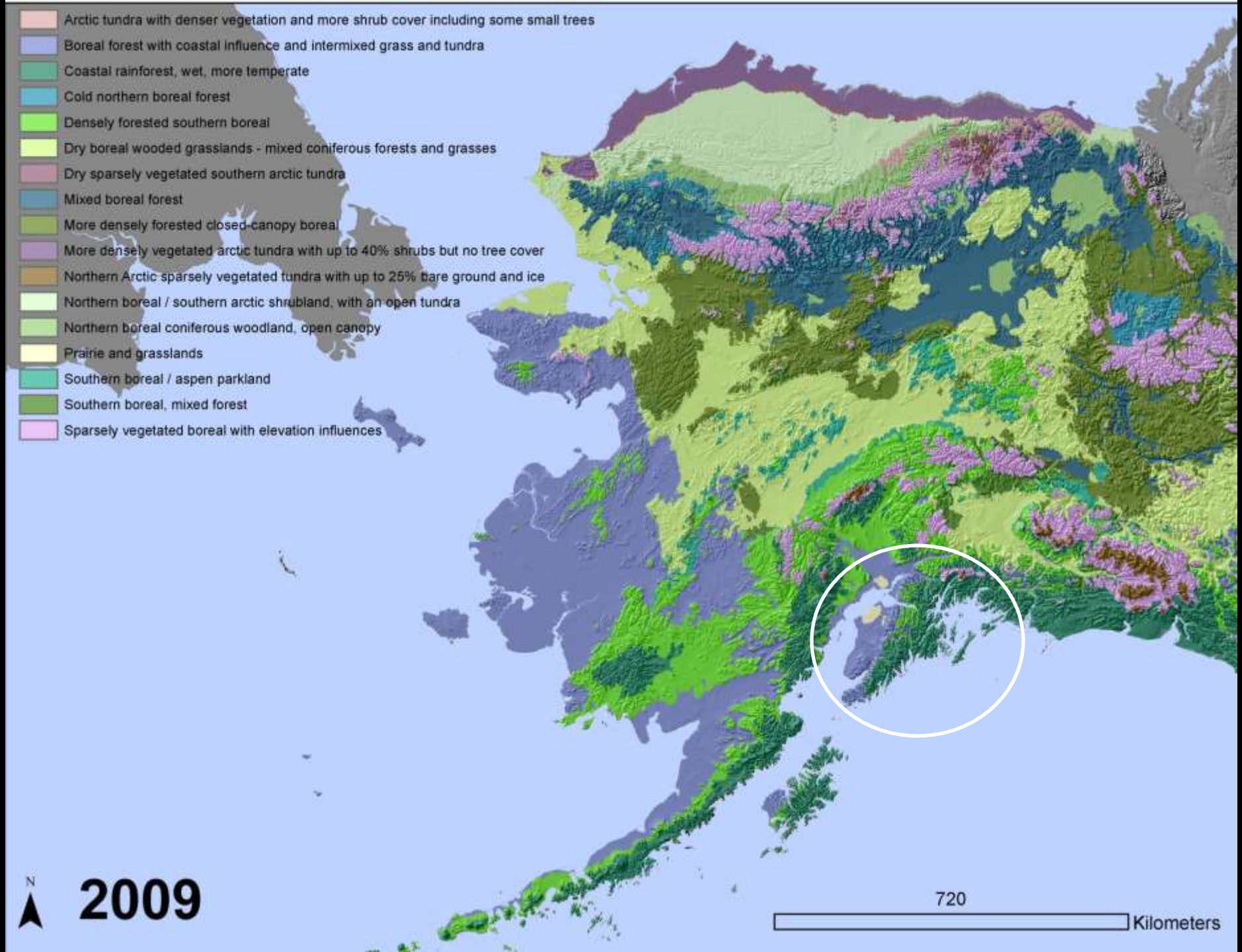


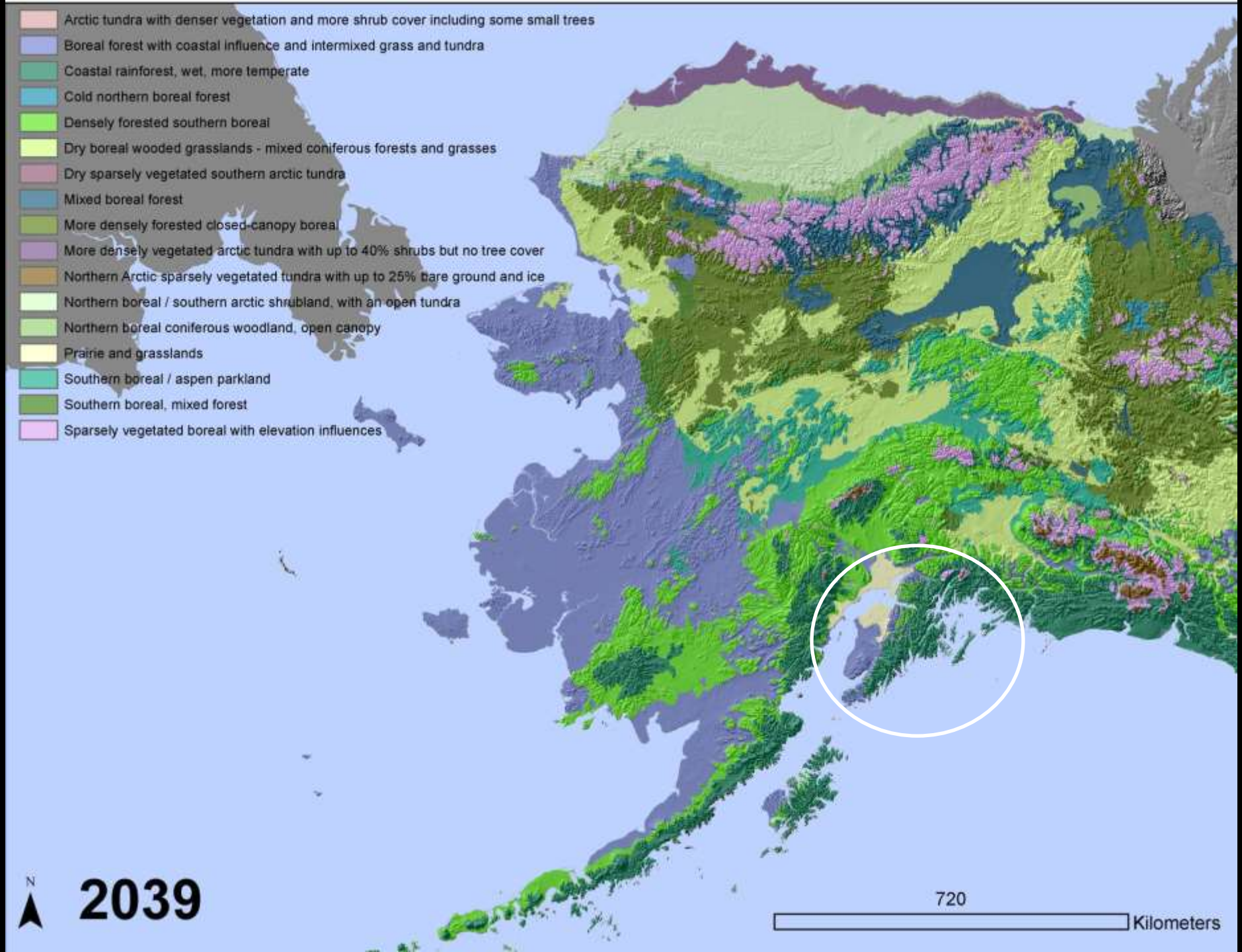
(McKenney et al. 2011)

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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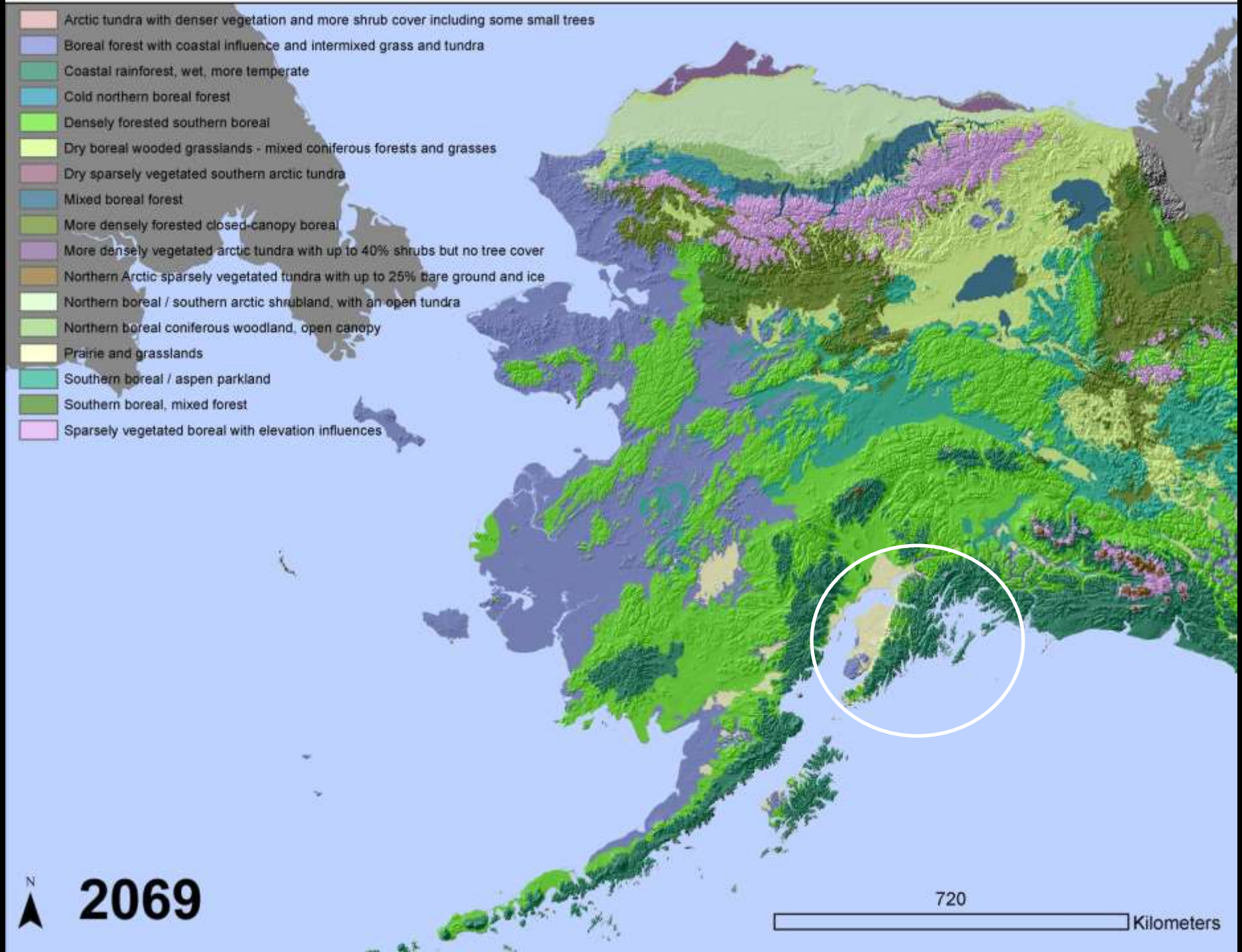
N
2039
720
Kilometers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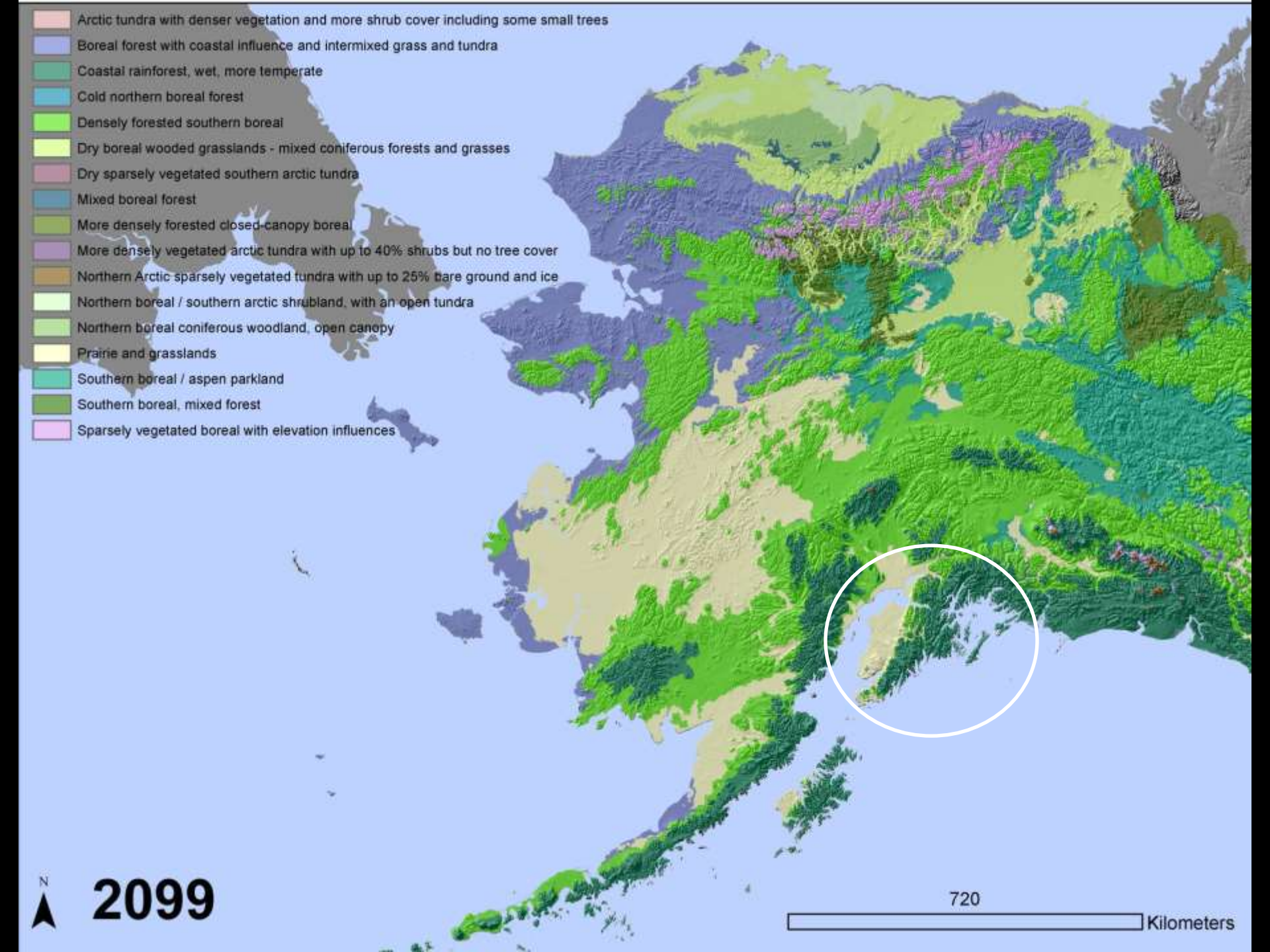
2069
720
Kilometers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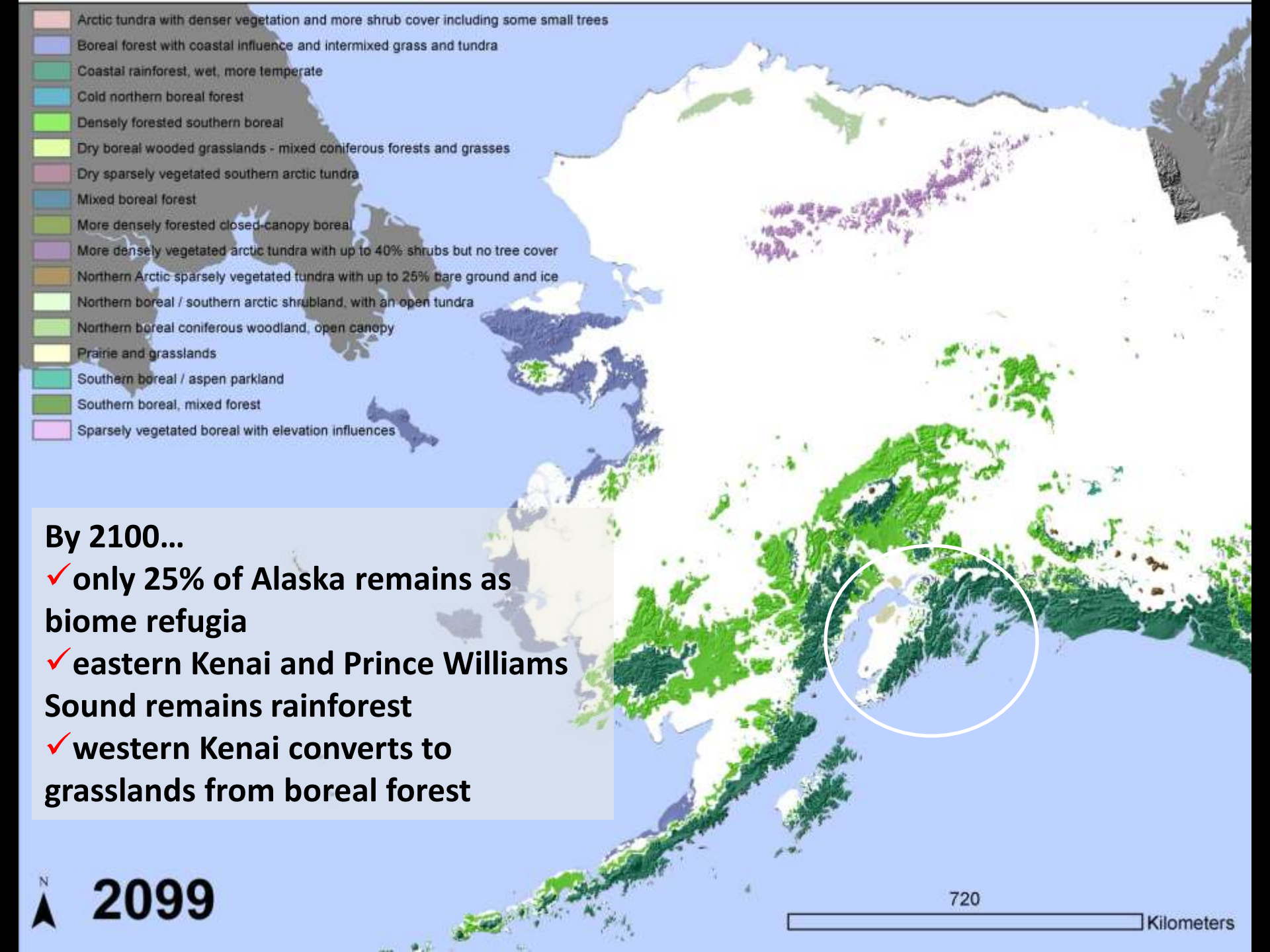
2099
720
Kilometers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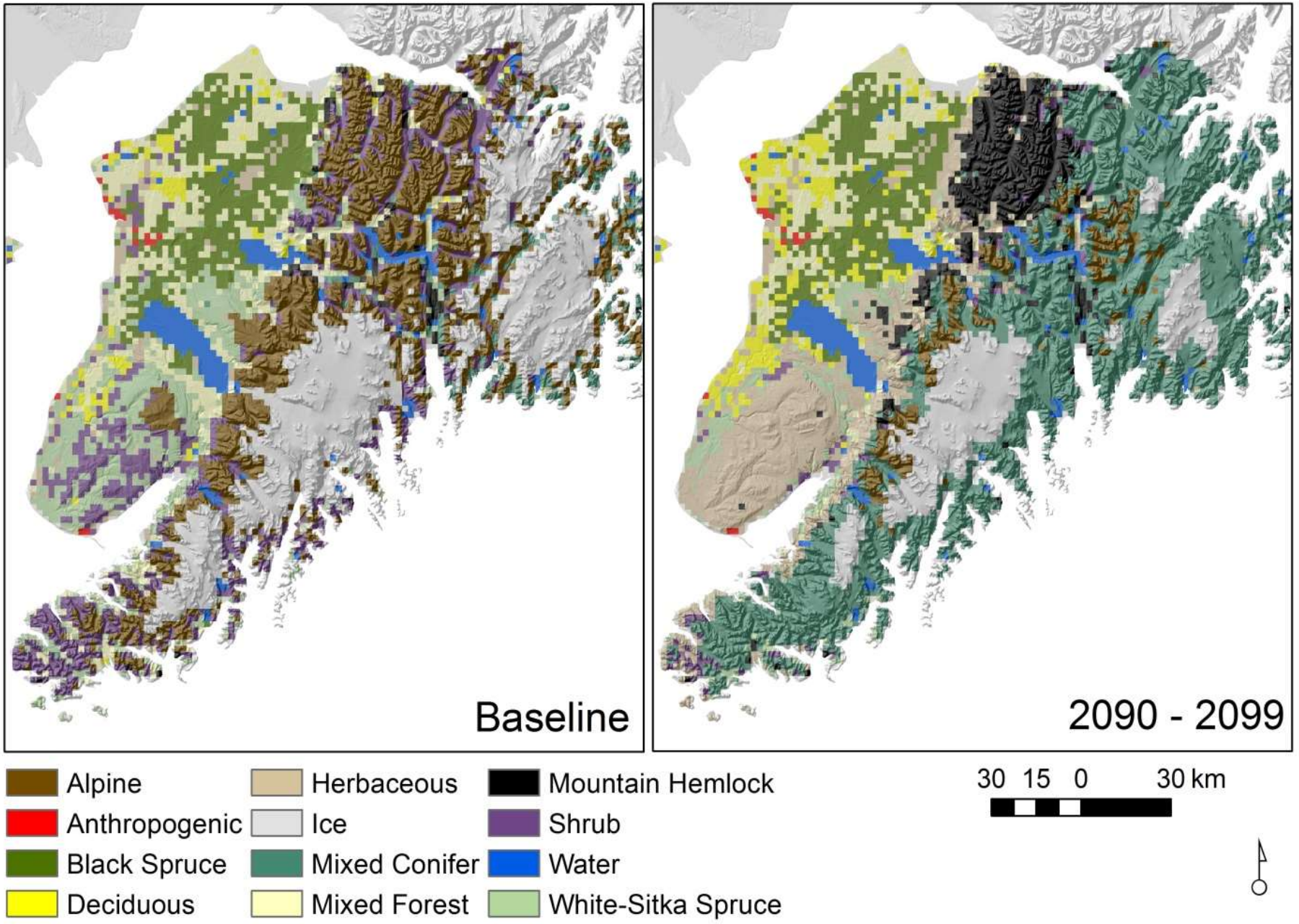
By 2100…
✓only 25% of Alaska remains as biome refugia
✓eastern Kenai and Prince Williams Sound remains rainforest
✓western Kenai converts to grasslands from boreal forest
N
2099
720
Kilometers

Take this with a grain of salt….

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 the 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


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

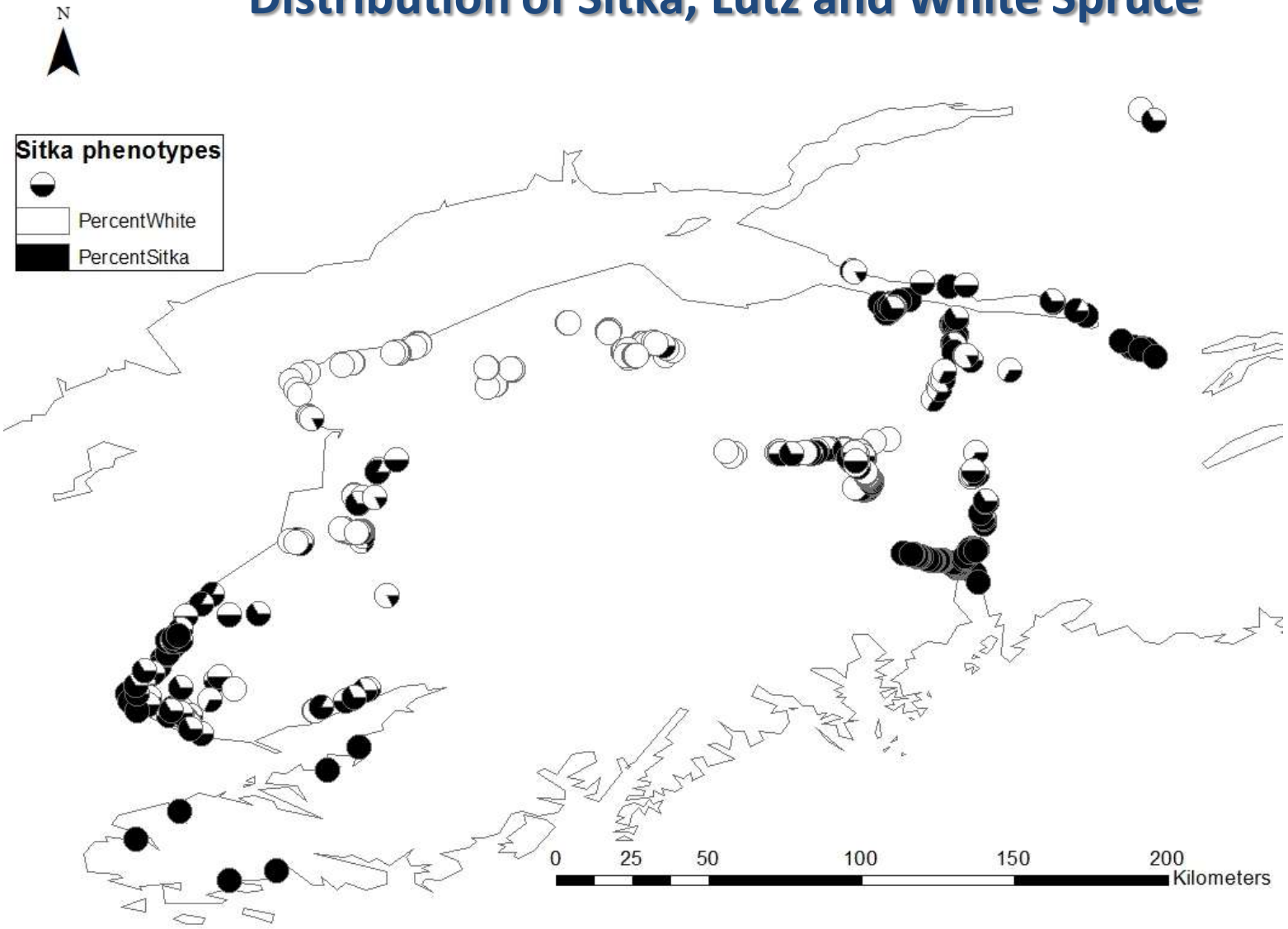
37% of Kenai Peninsula landcover types are forecasted to change by 2099!

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

SEPT 1985

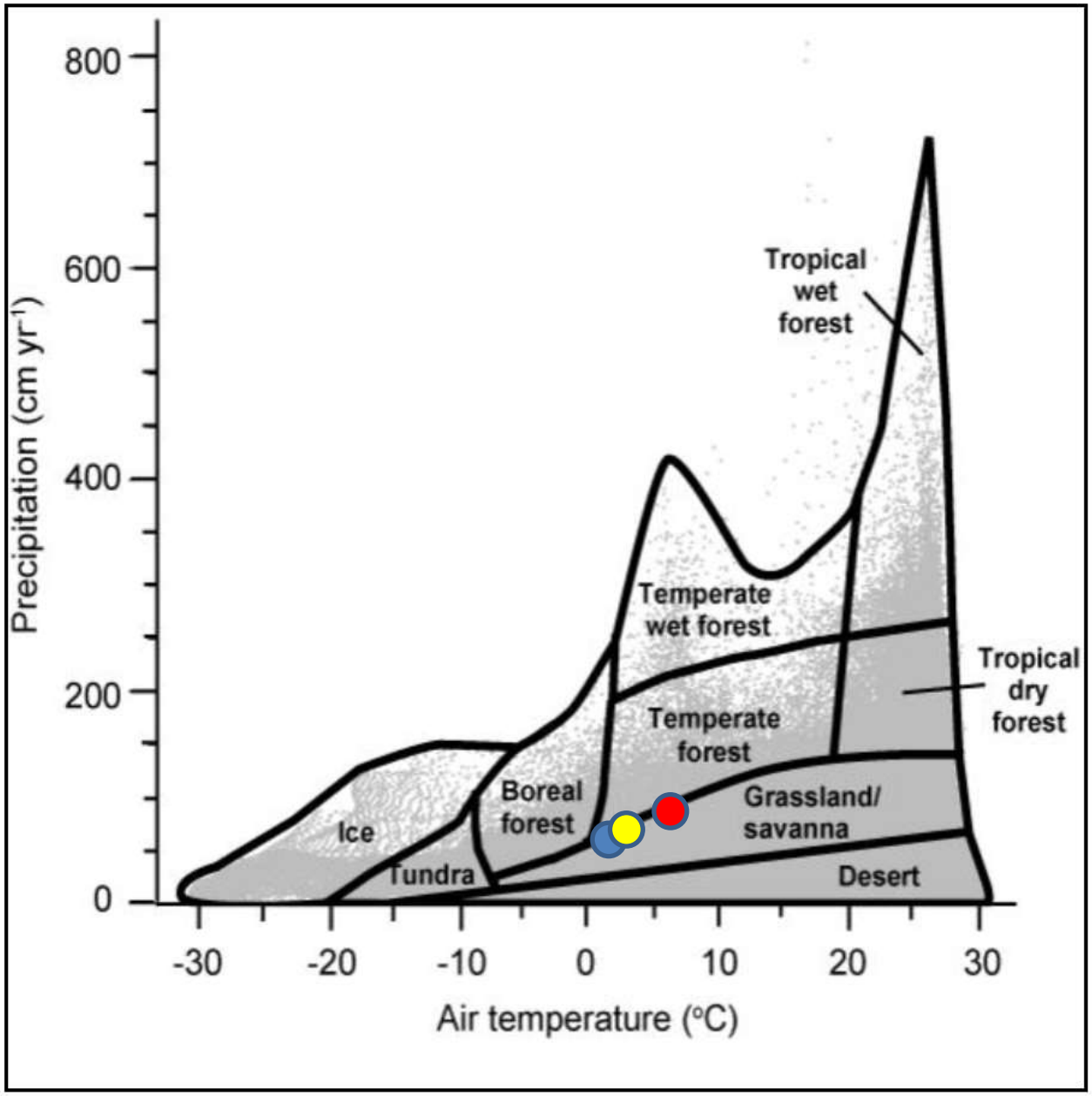
SEPT 2014

Distribution of Sitka, Lutz and White Spruce



John Alden's introgression scale (1-7)


2015/07/19



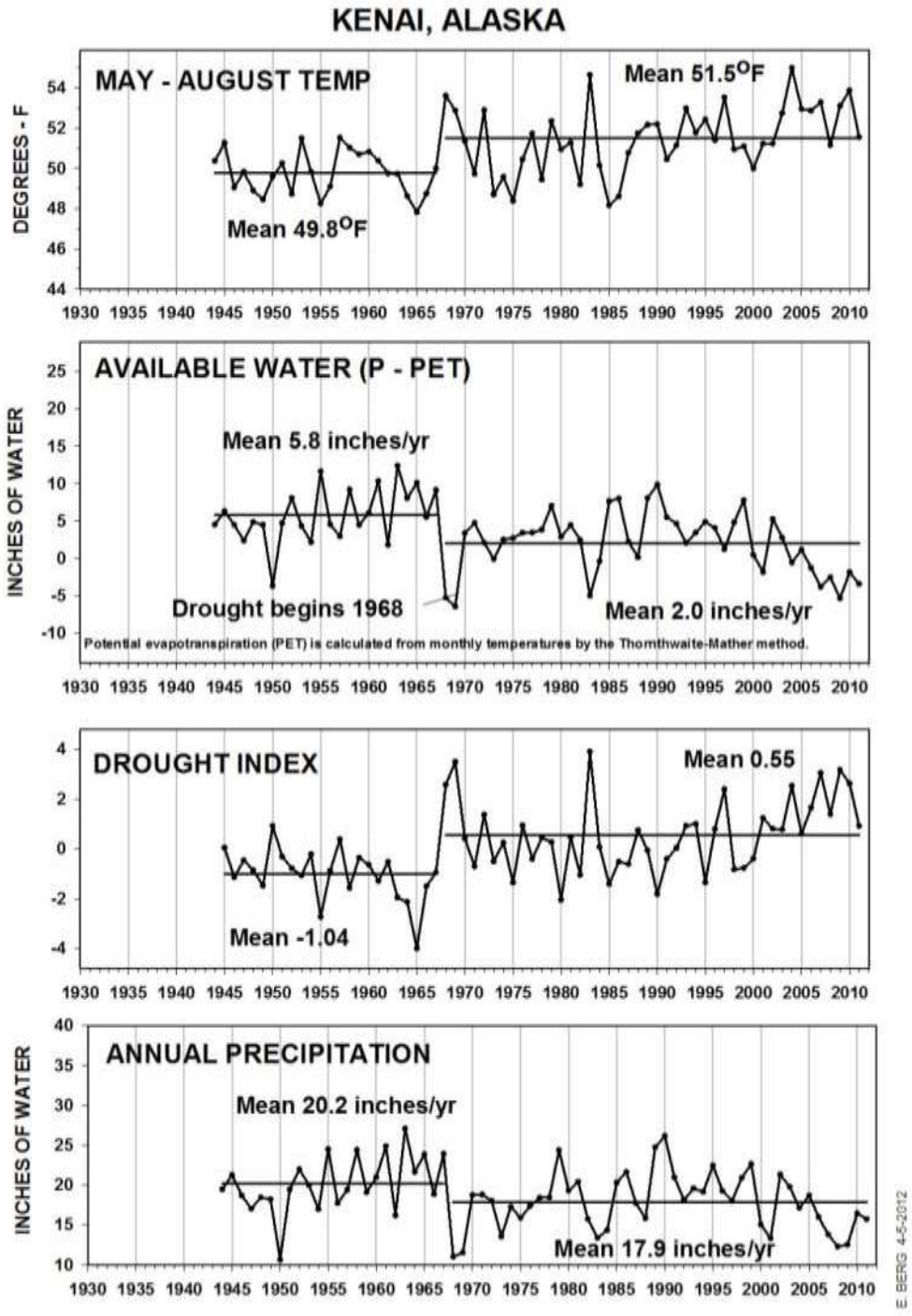
1900 68 cm, 2.3° C

1980 73 cm, 3.3° C

2090 84 cm, 6.8° C

Staudinger, M.D., N. B. Grimm, A. Staudt, S. L. Carter, F. S. Chapin III, P. Kareiva, M. Ruckelshaus, B. A. Stein. 2012. Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment. Cooperative Report to the 2013 National Climate Assessment.

Take this with a grain of salt….

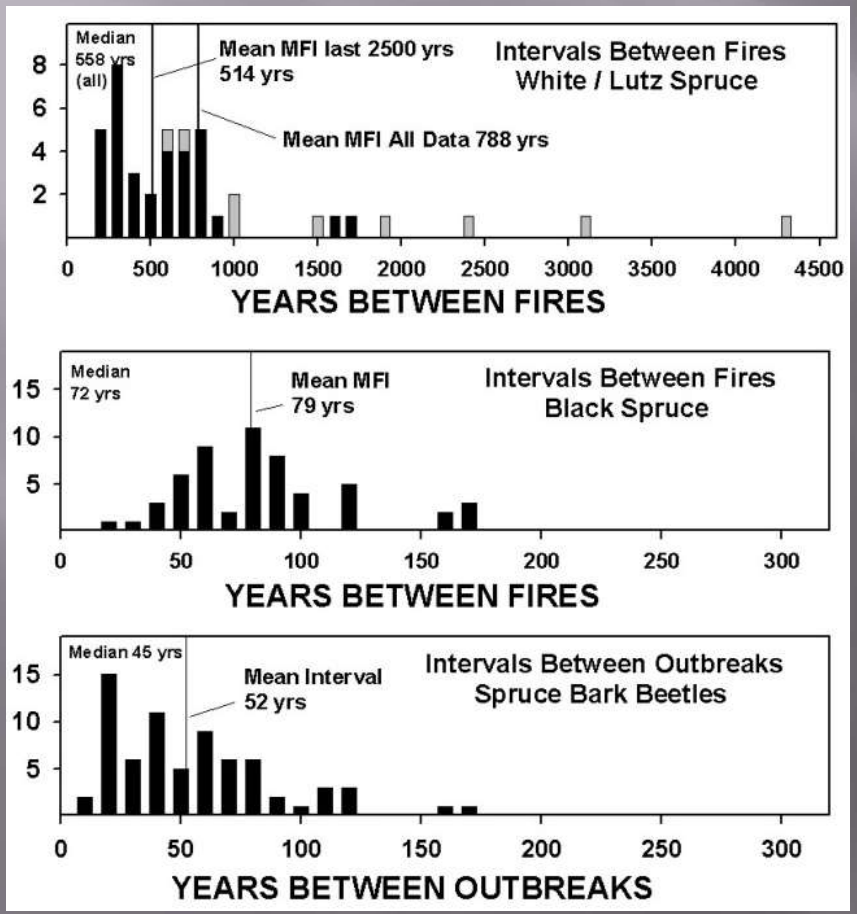


The western Kenai has warmed and dried in last 50 years

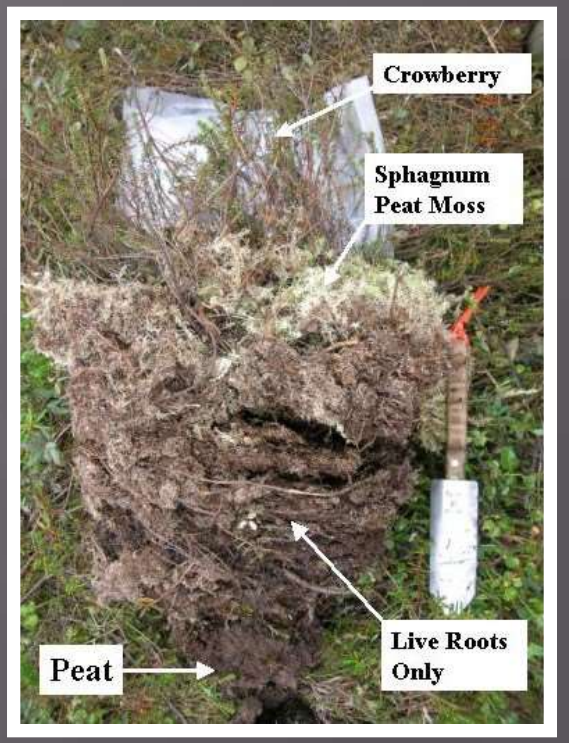
Our landscape has changed dramatically in last 50 years

- – available water (60% loss since 1968)
- – wetlands (6 – 11% per decade)
- – glaciers (5% surface area, 21 m elevation)
- \+ treeline (10 m per decade)
- \+ SB beetle outbreaks (triggered by 2 consecutive warm summers)

Official fire season is now April 1 instead of May 1



Woody shrub encroachment into 8000 year old Spagnum peatlands



Conversion of white/Lutz spruce forests to Calamagrostis savannah

Changing migration window

- eBird records for the Kenai Peninsula in 2007-12

- ✓ 13 new species in last 5 years
- ✓ Earlier arrival records for 33 species
- ✓ Later departure records for 38 species

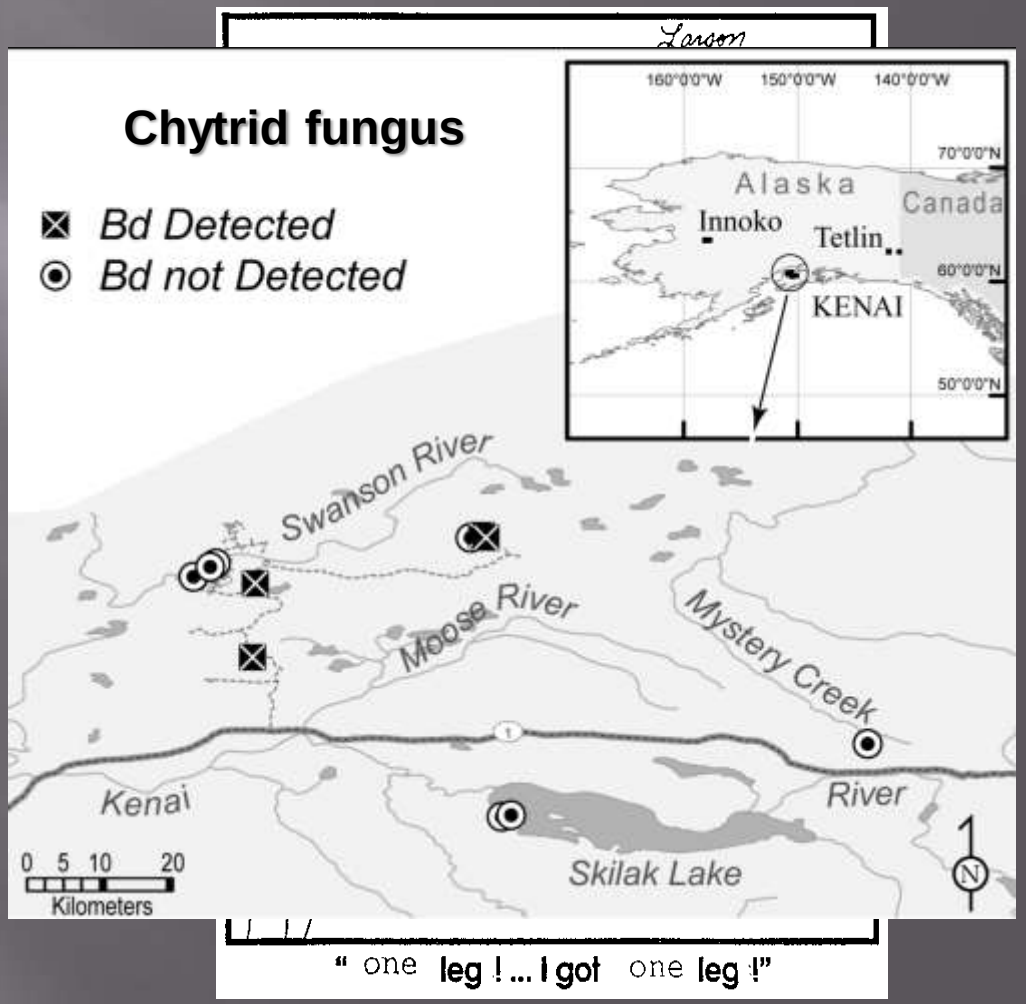
Eurasian-collared dove
Heerman's gull
Jack snipe
Lesser black-backed gull
Long-billed murrelet
Northern Mockingbird
Redwing
Spotted towhee
Turkey vulture
Western Kingbird
Western meadowlark
Willow flycatcher
Wilson's phalarope

Birds that are more common in winter

Horned lark
Lapland longspur
McKay's bunting
Rusty blackbird
White-throated sparrow
Gray -crowned rosy finch
Cedar waxwing
American robin
Red-breasted nuthatch
Northwestern crow
Steller's jay
Northern saw-whet owl
Short-eared owl
Dunlin
Sanderling
Iceland gull
Slaty-backed gull

CBC data

Abnormal wood frogs



American marten colonized Kenai Lowlands ~2002

Alpine rest sites

Lowland rest sites

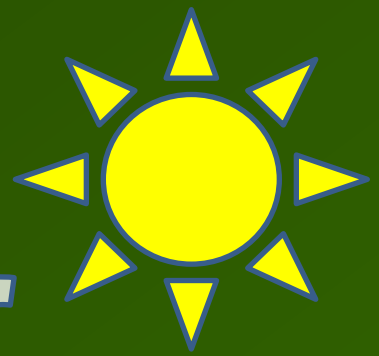
Baltensperger, 2009, Behavior and distribution of American marten in relation to snow and forest cover on the Kenai Peninsula, AK, MS thesis, Colorado State University

Game likely to diminish in abundance

Take this with a grain of salt….

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

A human-mediated system on the Kenai with an unknown outcome….



Spruce bark beetle

Pheasant

Cluster Fly

Earthworms

Questions????