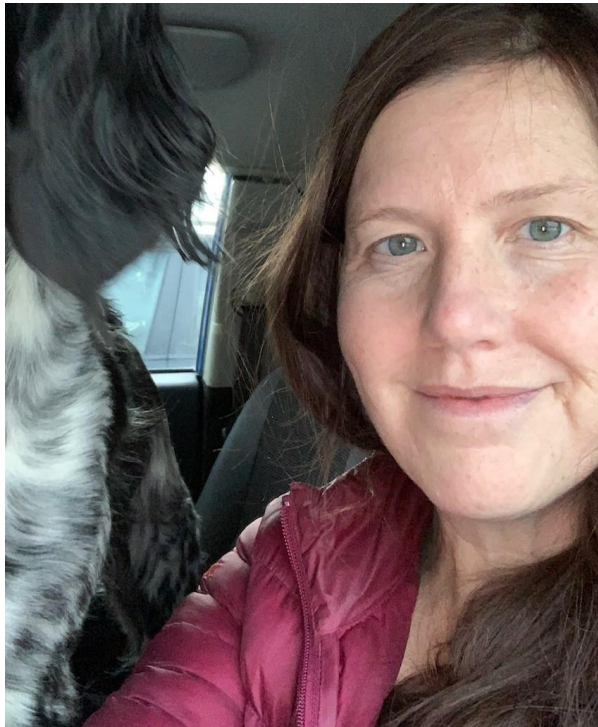


Adaptation in action: How to resist, accept, or direct forest change on the Kenai National Wildlife Refuge, Alaska



Dawn_Magness@fws.gov

Dawn Robin Magness, PhD

Landscape Ecologist

U.S. Fish & Wildlife Service, Kenai National Wildlife Refuge

Education:

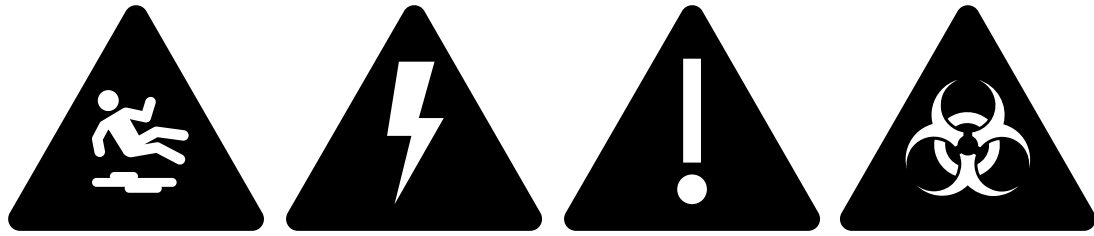
University of Alaska, PhD in Wildlife Biology

Texas A & M University, MS in Fish and Wildlife Science

University of Montana, BA in Biology

Research and Professional Focus:

Dawn has spent the last 20 years working on how the National Wildlife Refuge System can respond to climate change impacts. Most recently, she helped to develop the Resist-Accept-Direct framework and is working with Alaska refuges to help implement climate change adaptation.

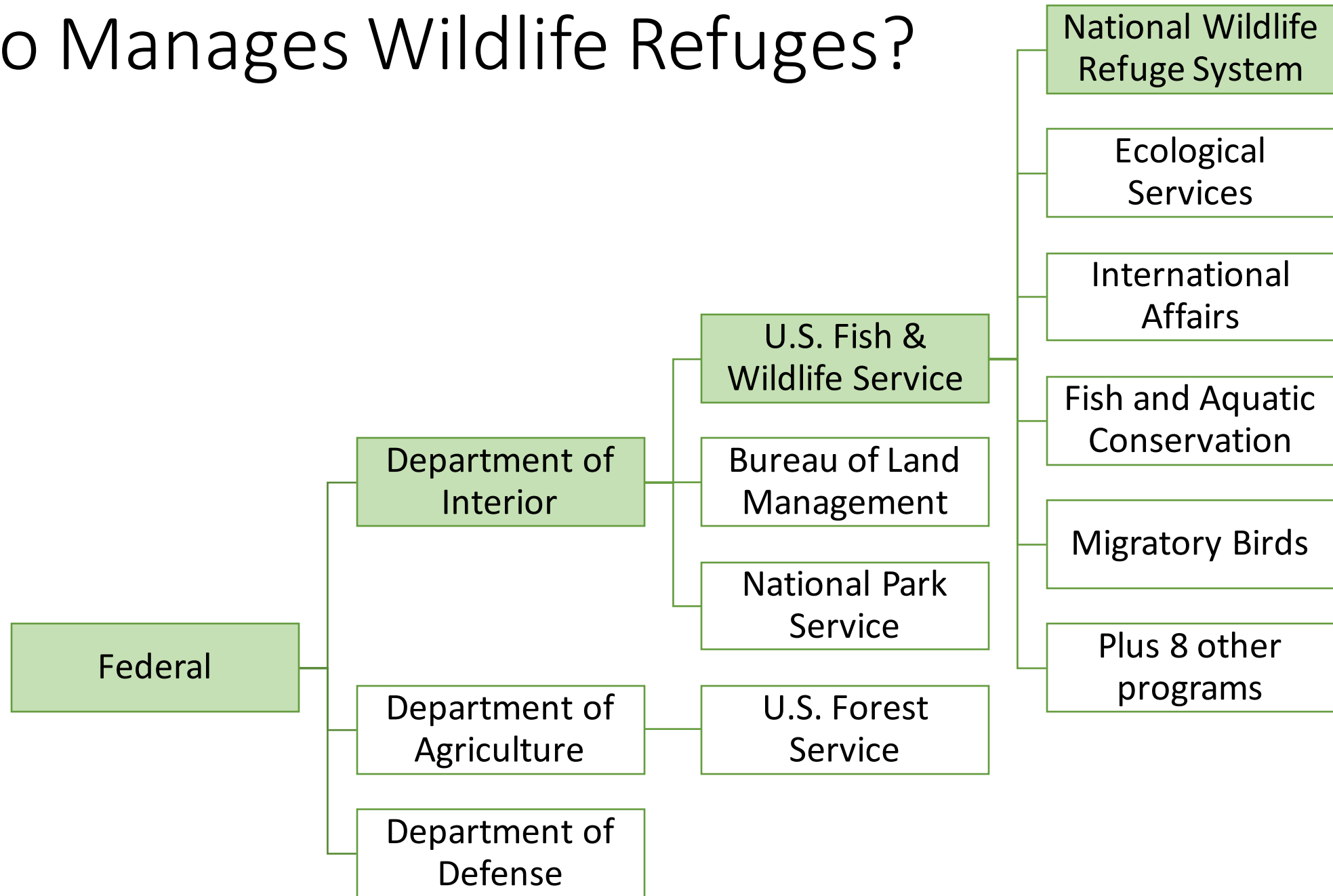


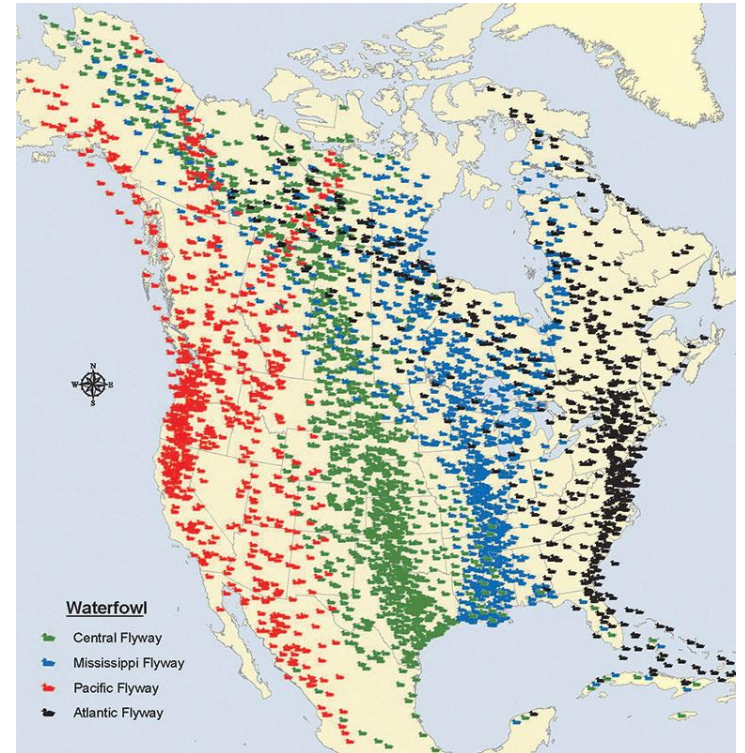
Roadmap

- The National Wildlife Refuge System
- Change on the Kenai
- Reflecting on the Big Whys
 - What does it mean to be a wildlife stronghold in an era of rapid change?
 - How can we steward biodiversity into the future?
- Setting the stage for a discussion of the research and pilots projects needed to move forward



Who Manages Wildlife Refuges?





>560 Refuges – Each with a Purpose



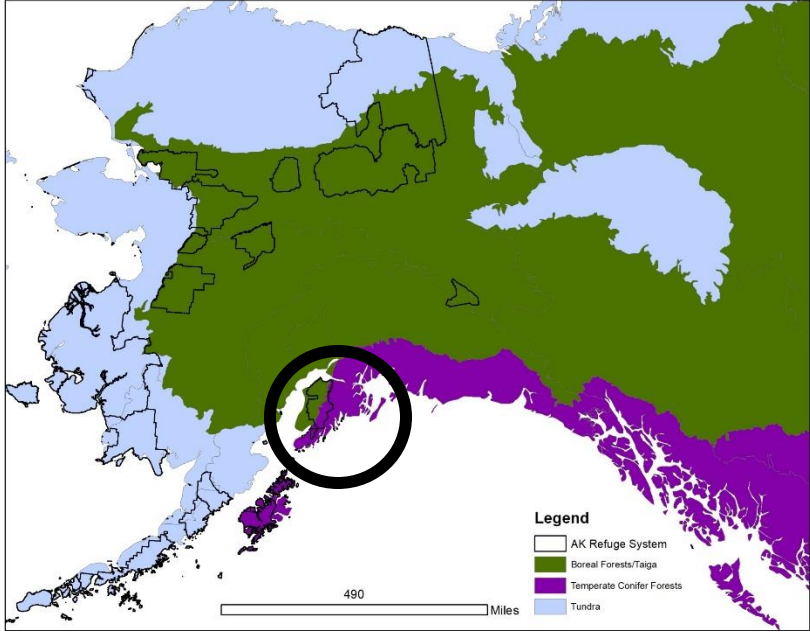
Alaskan Refuges

Established by the Alaska National Interest Lands Conservation Act in 1980

National Wildlife
Refuge System
Improvement Act
of 1997



Kenai National Wildlife Refuge



“small” Alaskan refuge (~ 2 million acres)



Refuges have used historical condition and naturalness to inform management, but....

- Stability is not the norm, change is
- The Anthropocene is human driven; could we be a force for good conservation outcomes?

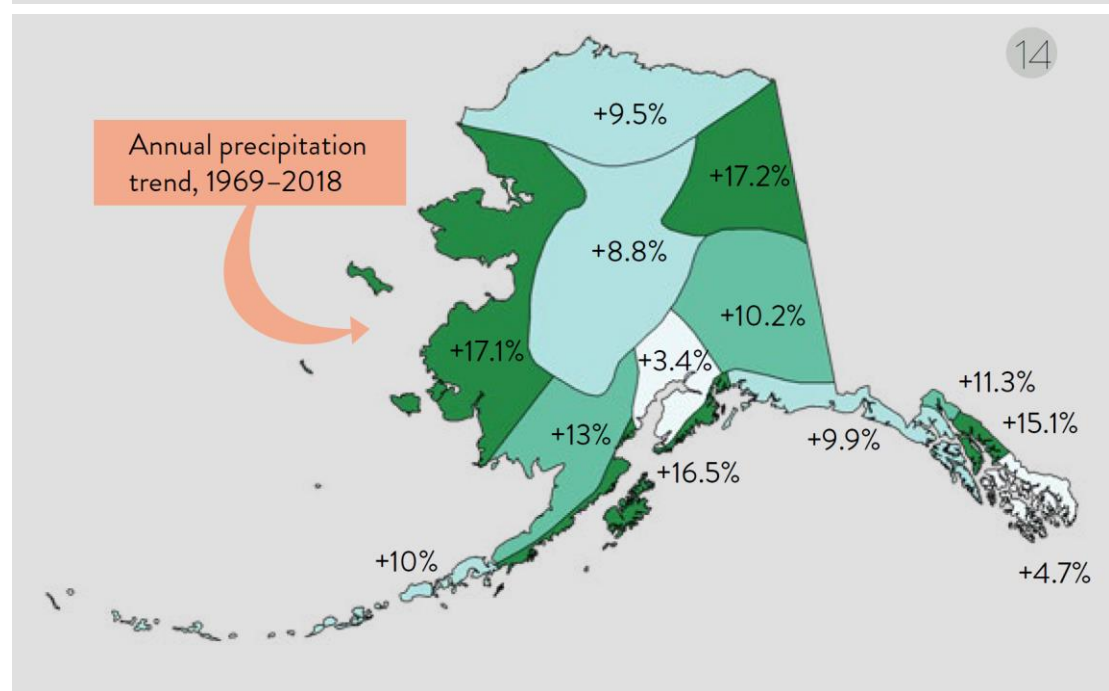
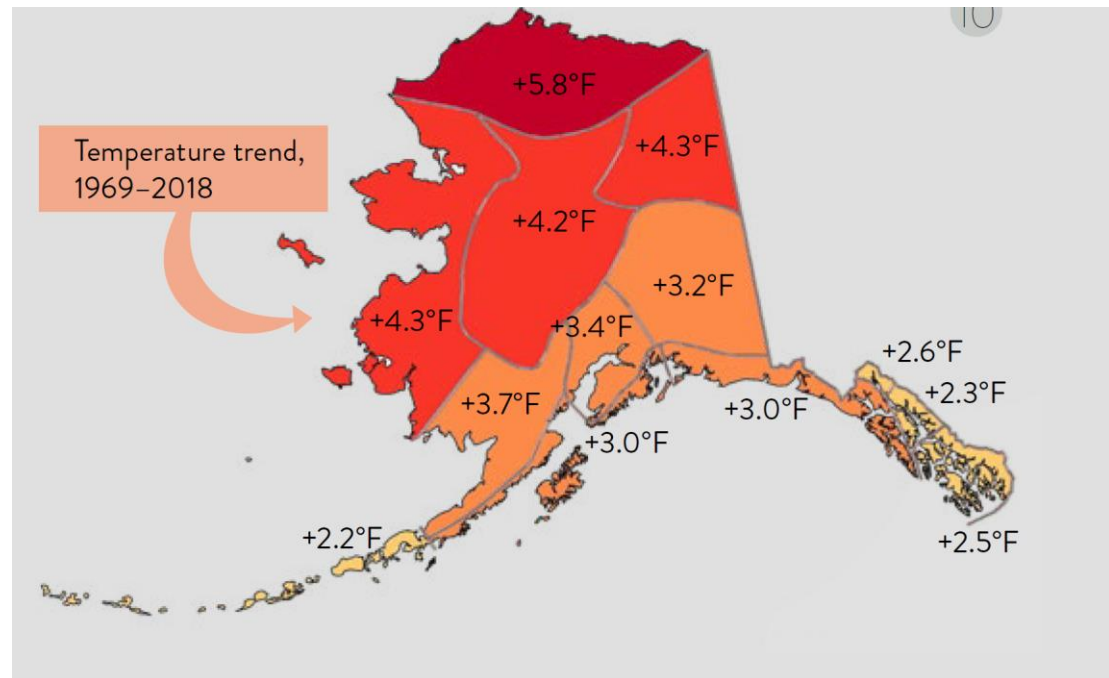


ALASKA'S CHANGING ENVIRONMENT

Documenting Alaska's physical and biological changes through observations



Suggested citations:
Thomson, R. & J. E. Walsh. (2019). Alaska's changing environment: documenting Alaska's physical and biological changes through observations. H. R. McFarland, Ed. International Arctic Research Center, University of Alaska Fairbanks.

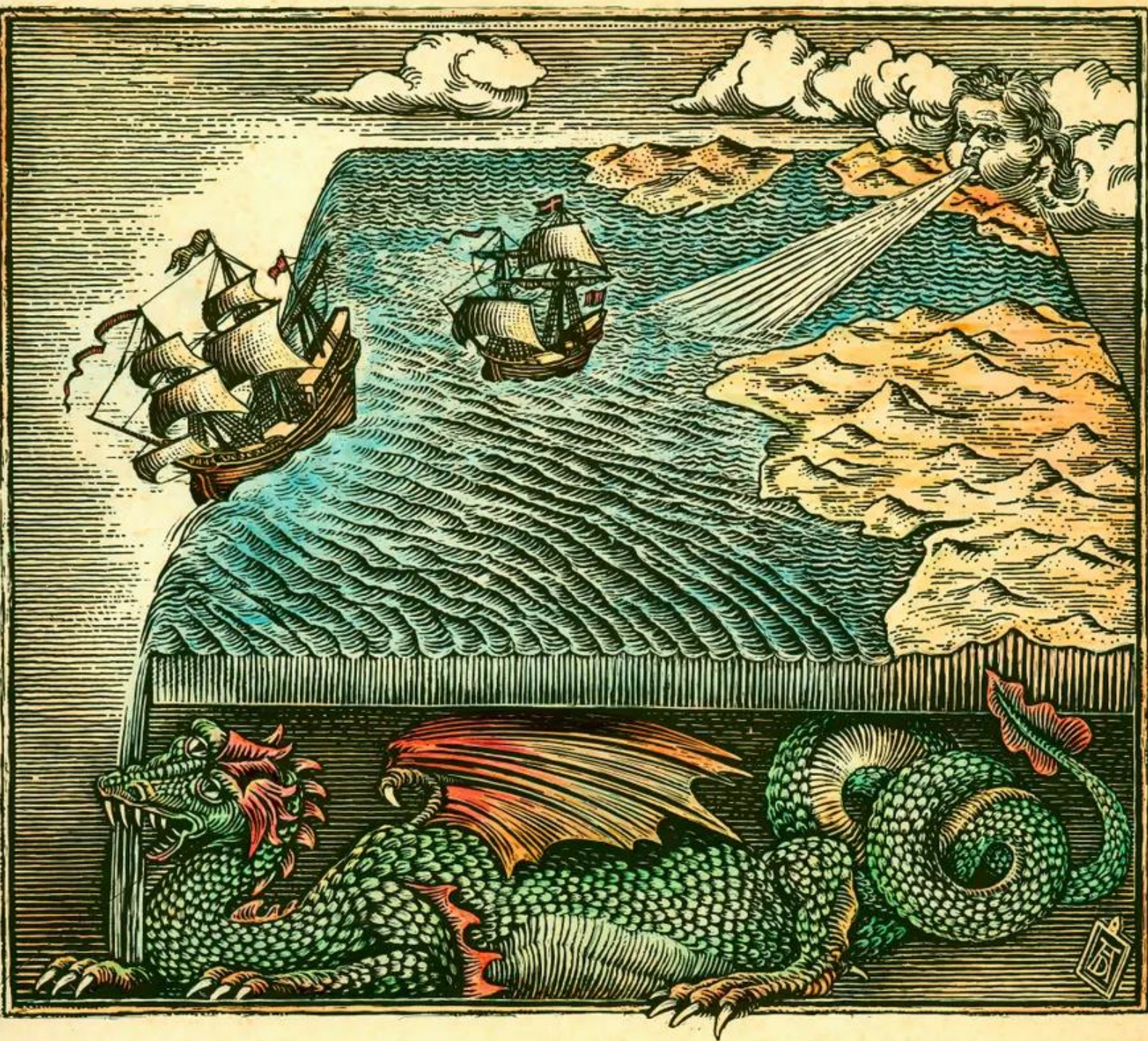


Climate Change Impacts on the Kenai

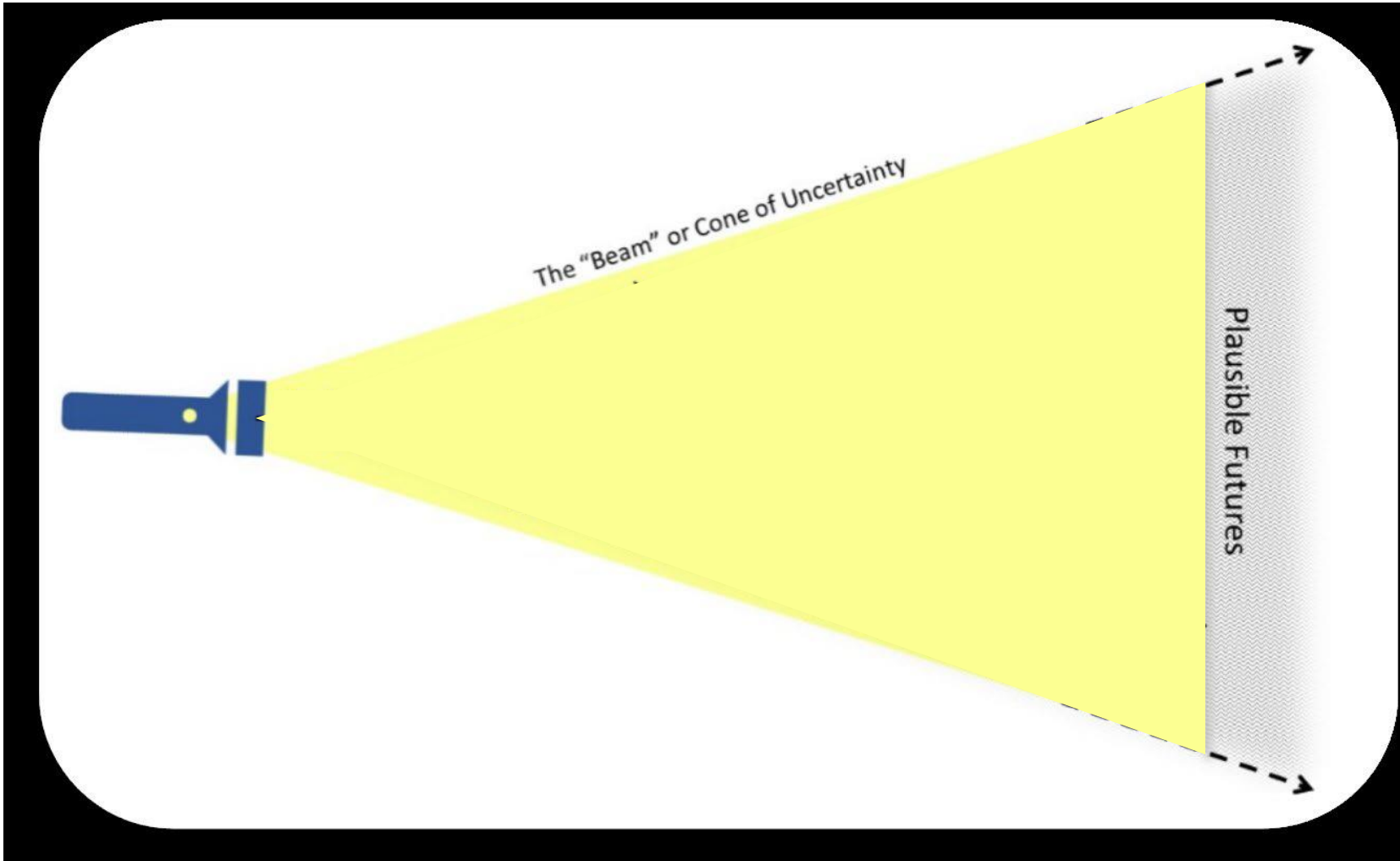
- Less available water (60 % less since 1968)
- Wetland drying and woody encroachment
- Glacier ice melt (11% surface area, 21m in elevation loss of glaciers)
- Non-glacial rivers warming
- Treeline rise 10m per decade
- Regionally synchronized spruce beetle epidemics triggered by 2 consecutive warm summers
- Longer growing season; milder winters
- Earlier fire season, changing fire conditions



Charting a path into novel conditions



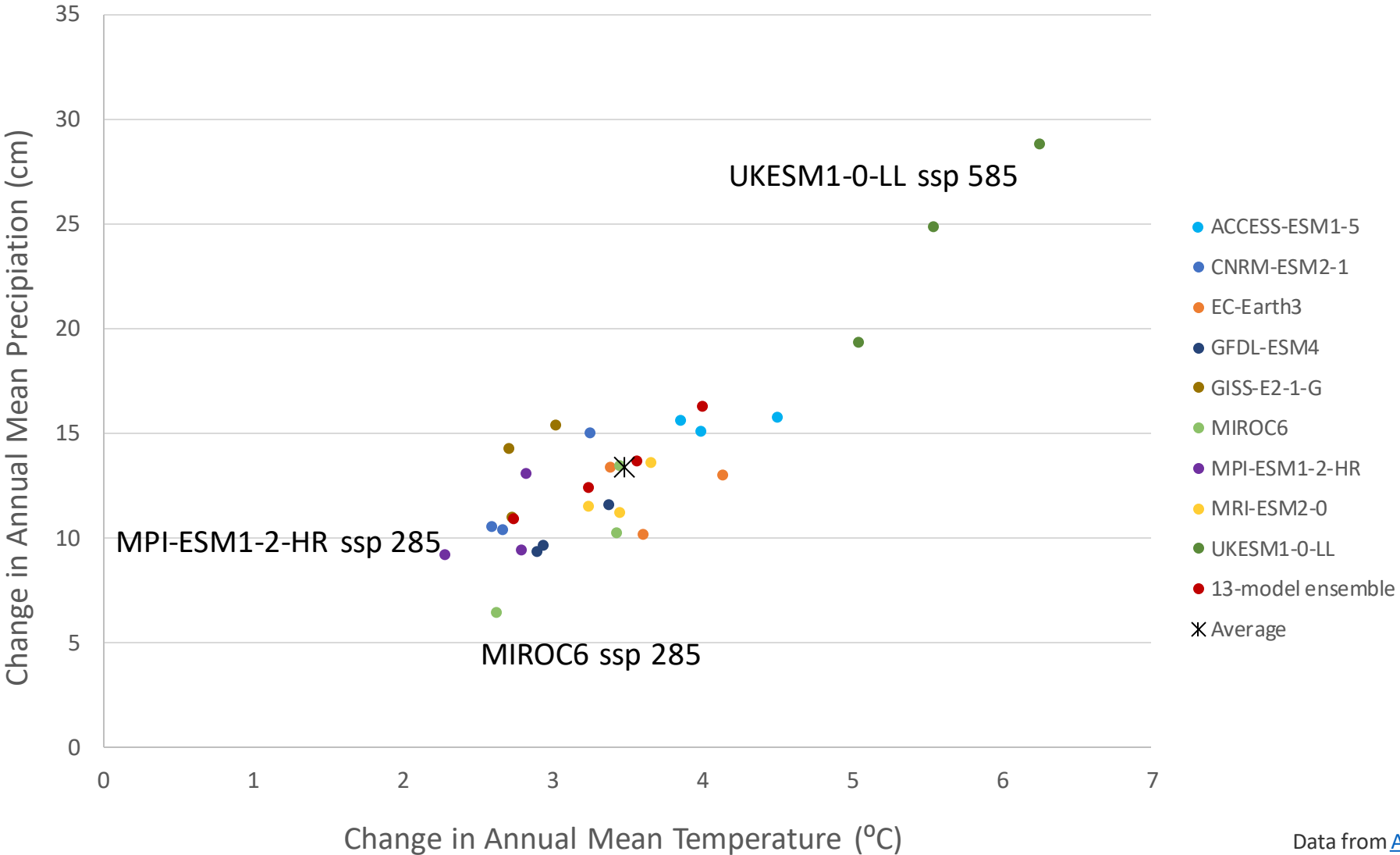
Knowledge about what futures are plausible



“The Beam”

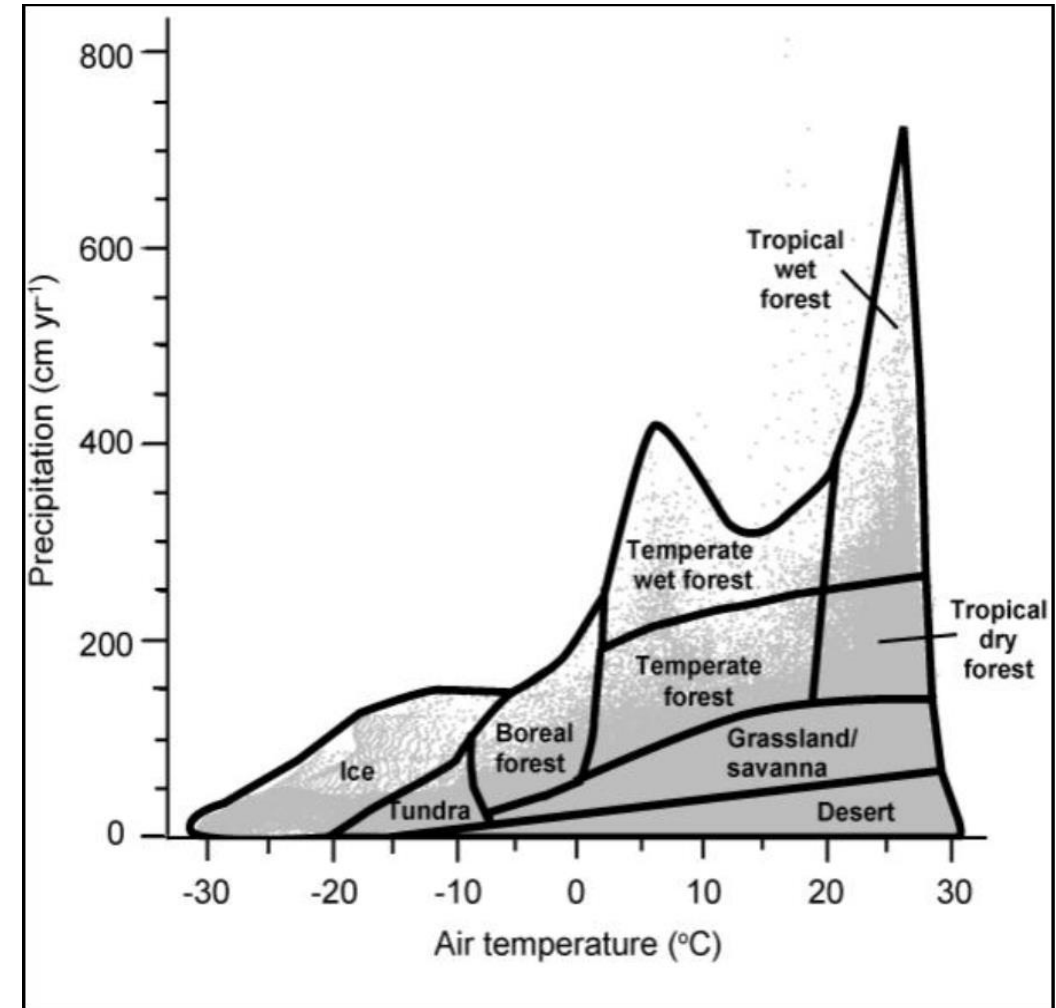
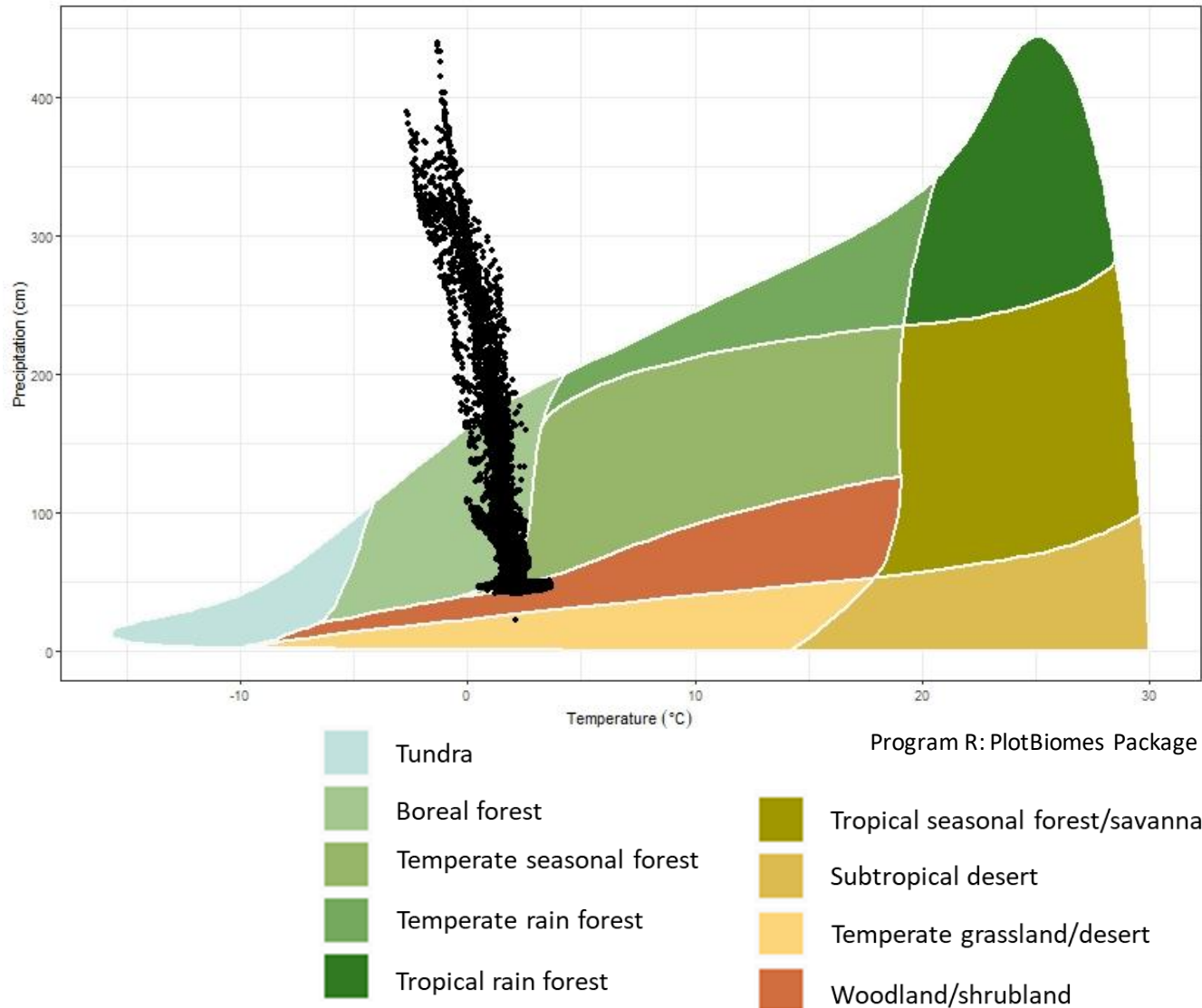
- Bounds the discussion of what could be possible given climate change
- Look across the range of emission scenarios and GCMs.
- Longer time scales (2050, 2070, 2100)
- Builds on:
 - Downscaled climate models
 - Climate analogs
 - Climate envelop models (Species, Ecotype)
 - Climate connectivity

2041-2060 Climate Futures Compared to 1961-1990 by GCM for the Kenai NWR

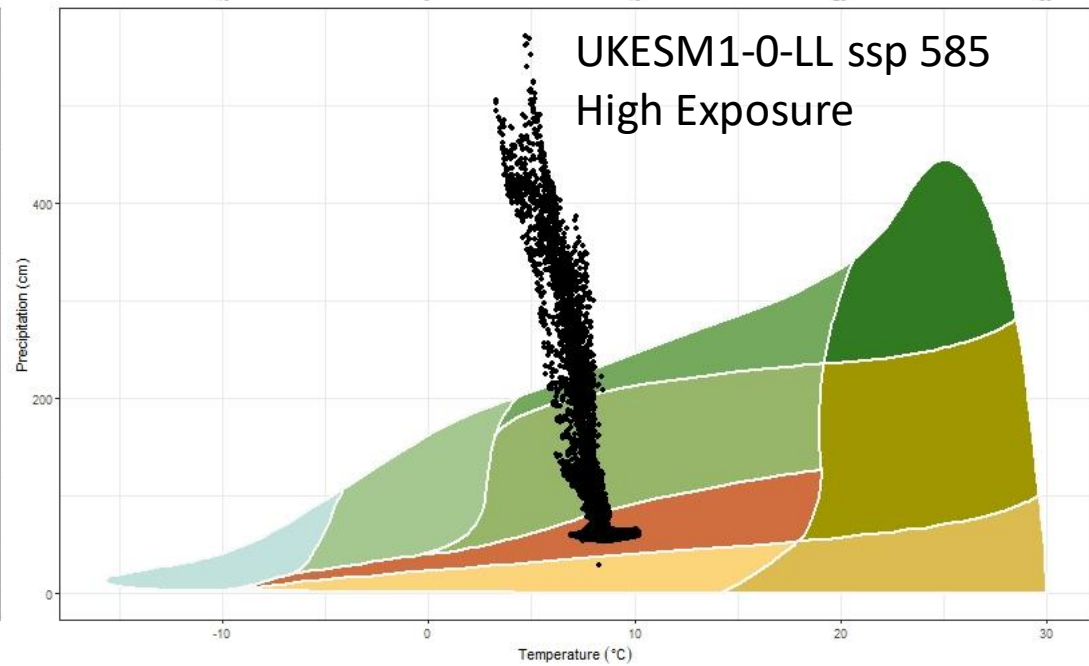
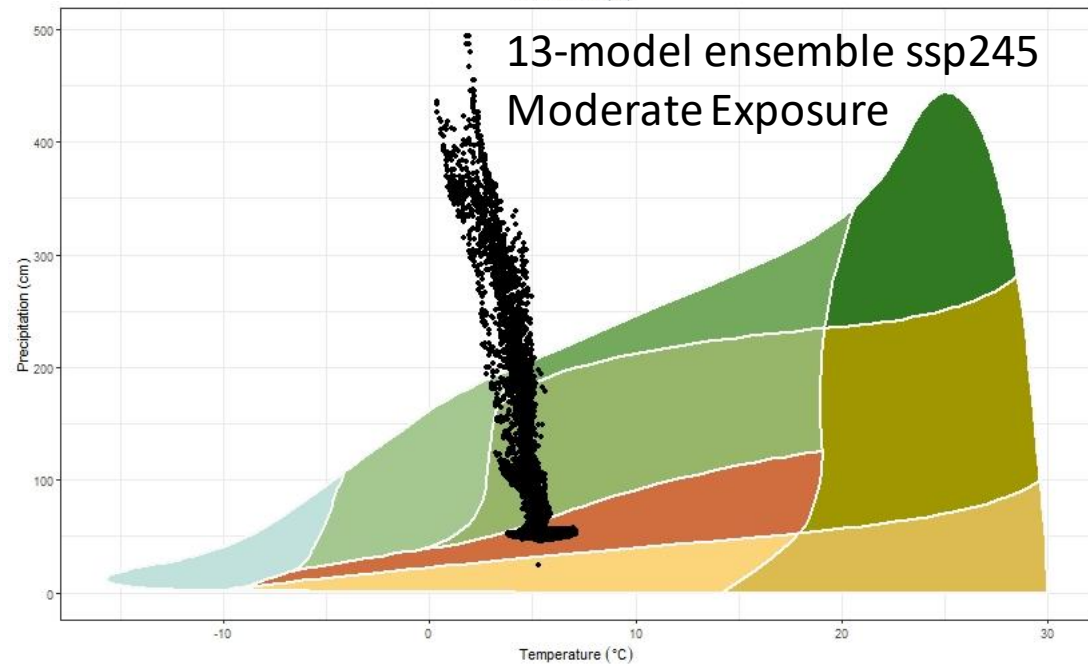
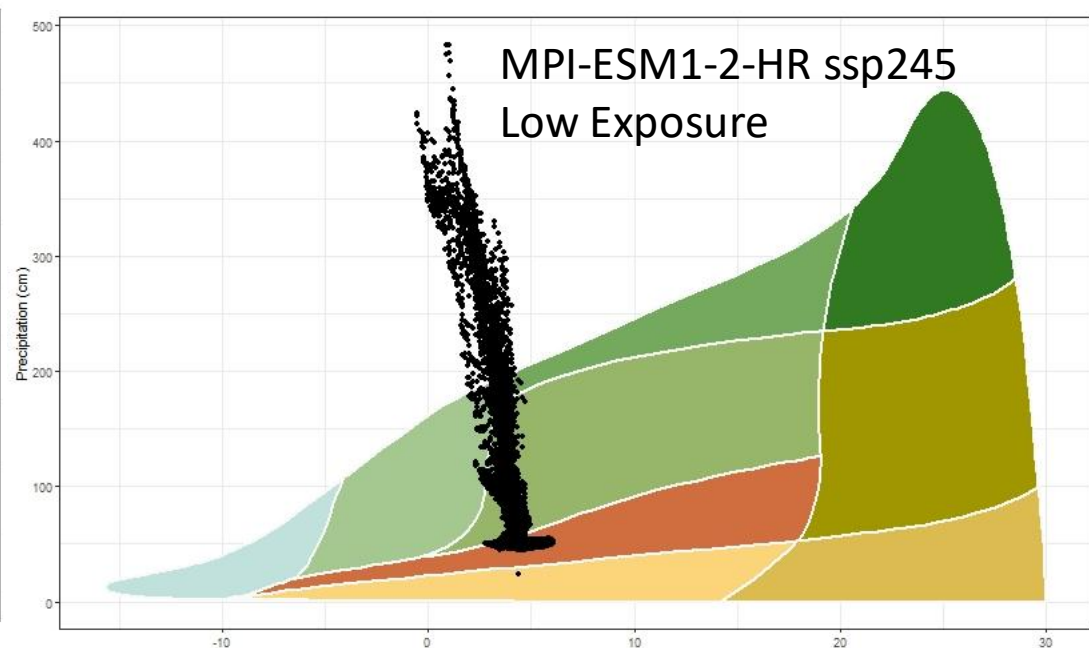
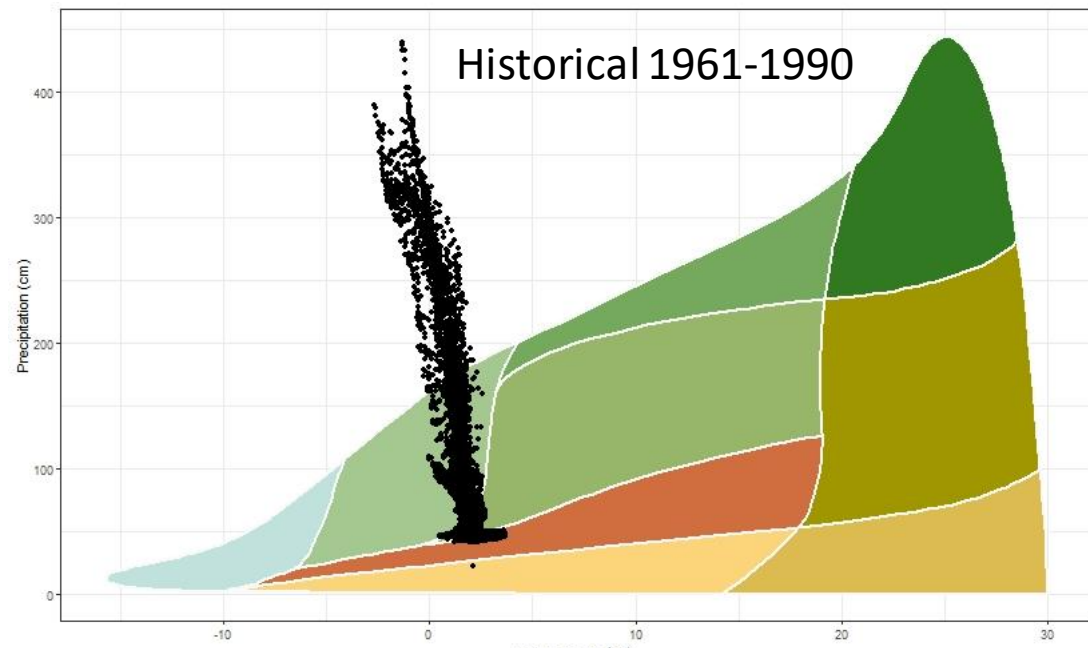


Data from [AdaptWest Project](#). 2022.
Methods adapted from [Lawrence et al. 2021](#).

Whittaker Plots – Link Climate to Biome

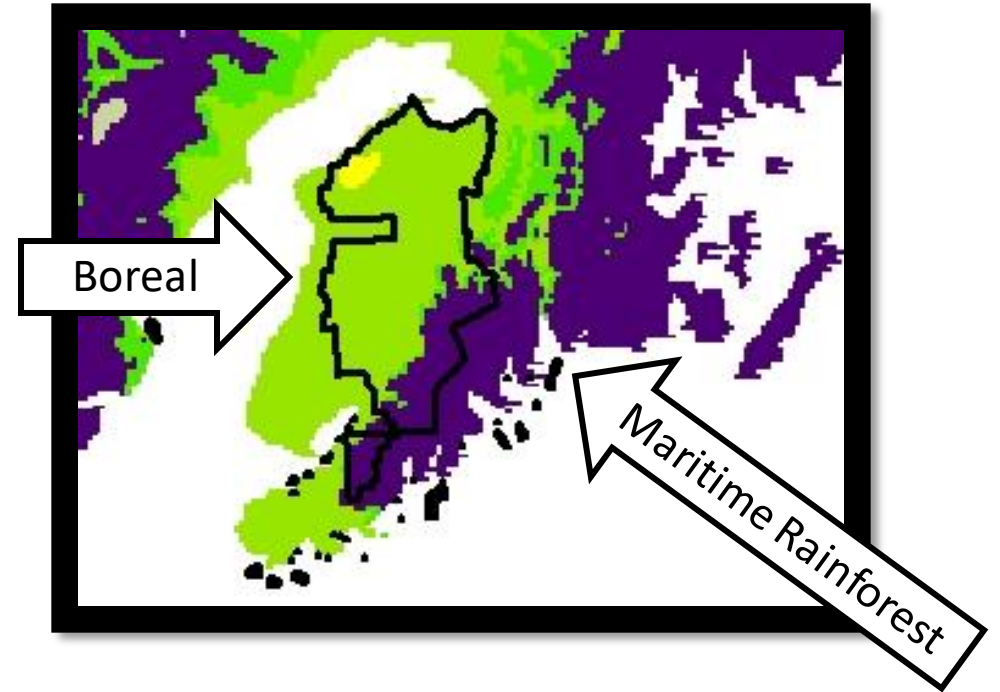
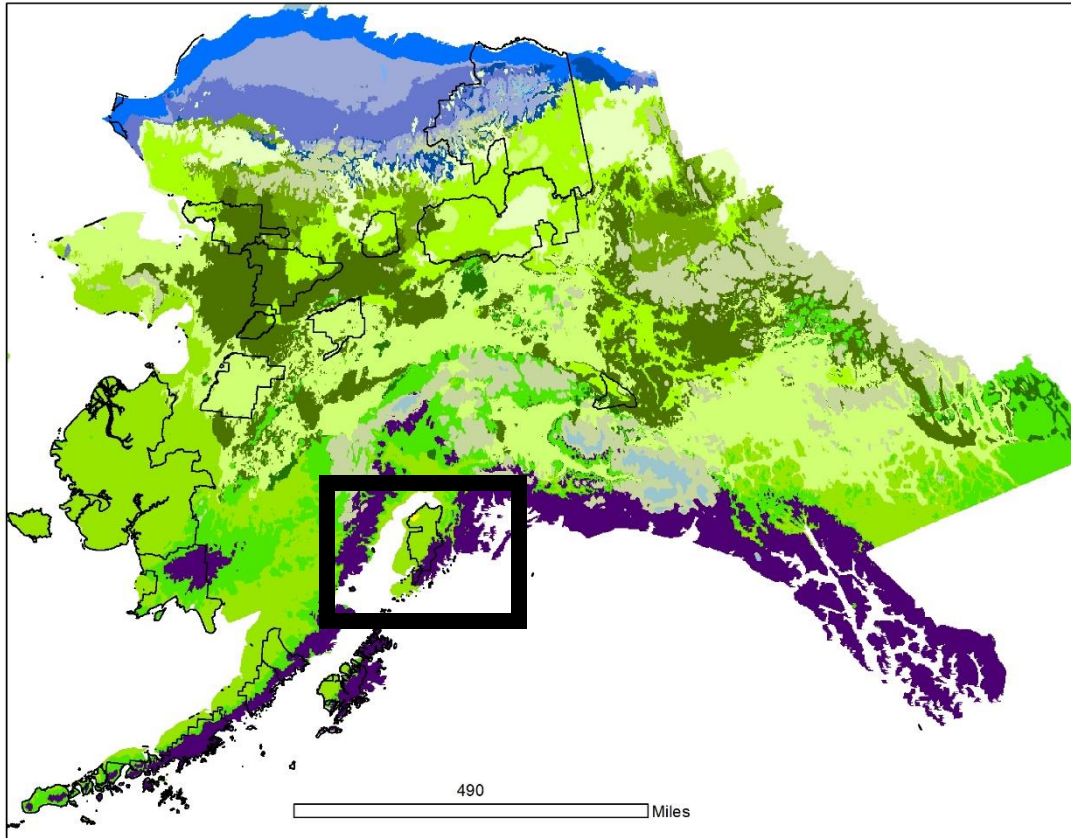


Staudinger et al. 2012. Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment. Cooperative Report to the 2013 National Climate Assessment.



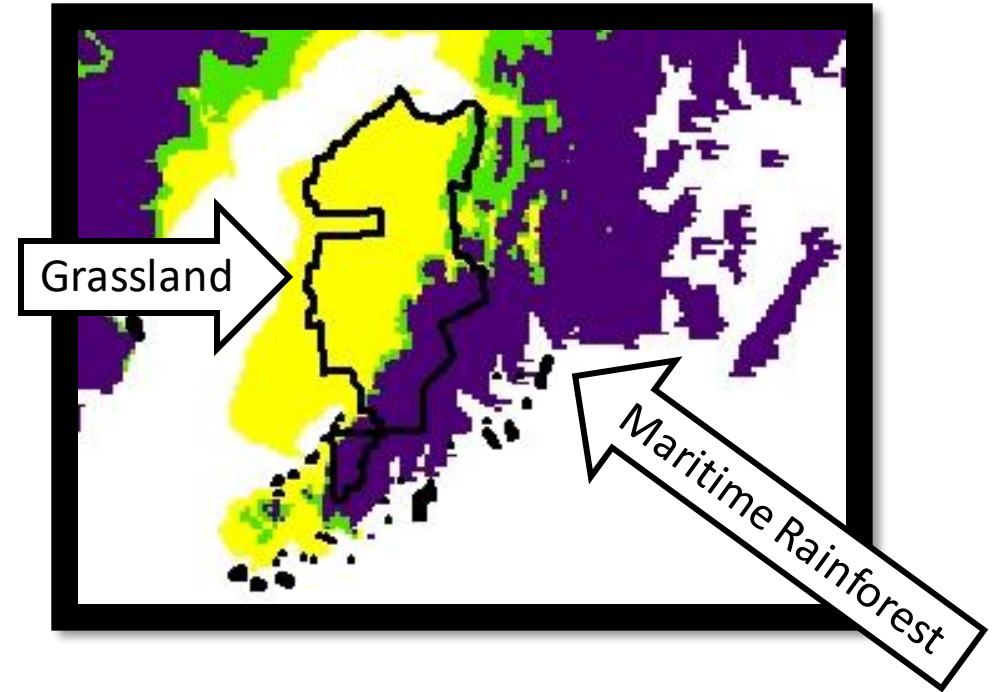
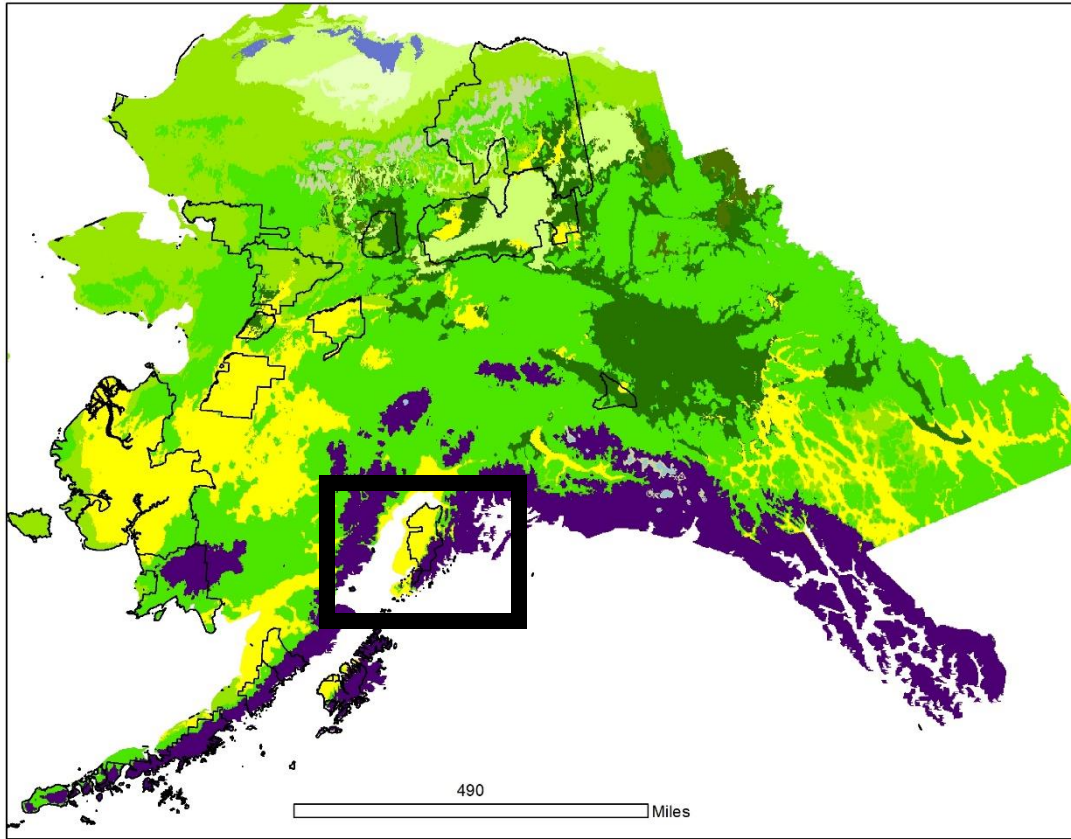
**Kenai NWR
2041-2060**

- Tundra
- Boreal forest
- Temperate seasonal forest
- Temperate rain forest
- Tropical rain forest
- Tropical seasonal forest/savanna
- Subtropical desert
- Temperate grassland/desert
- Woodland/shrubland



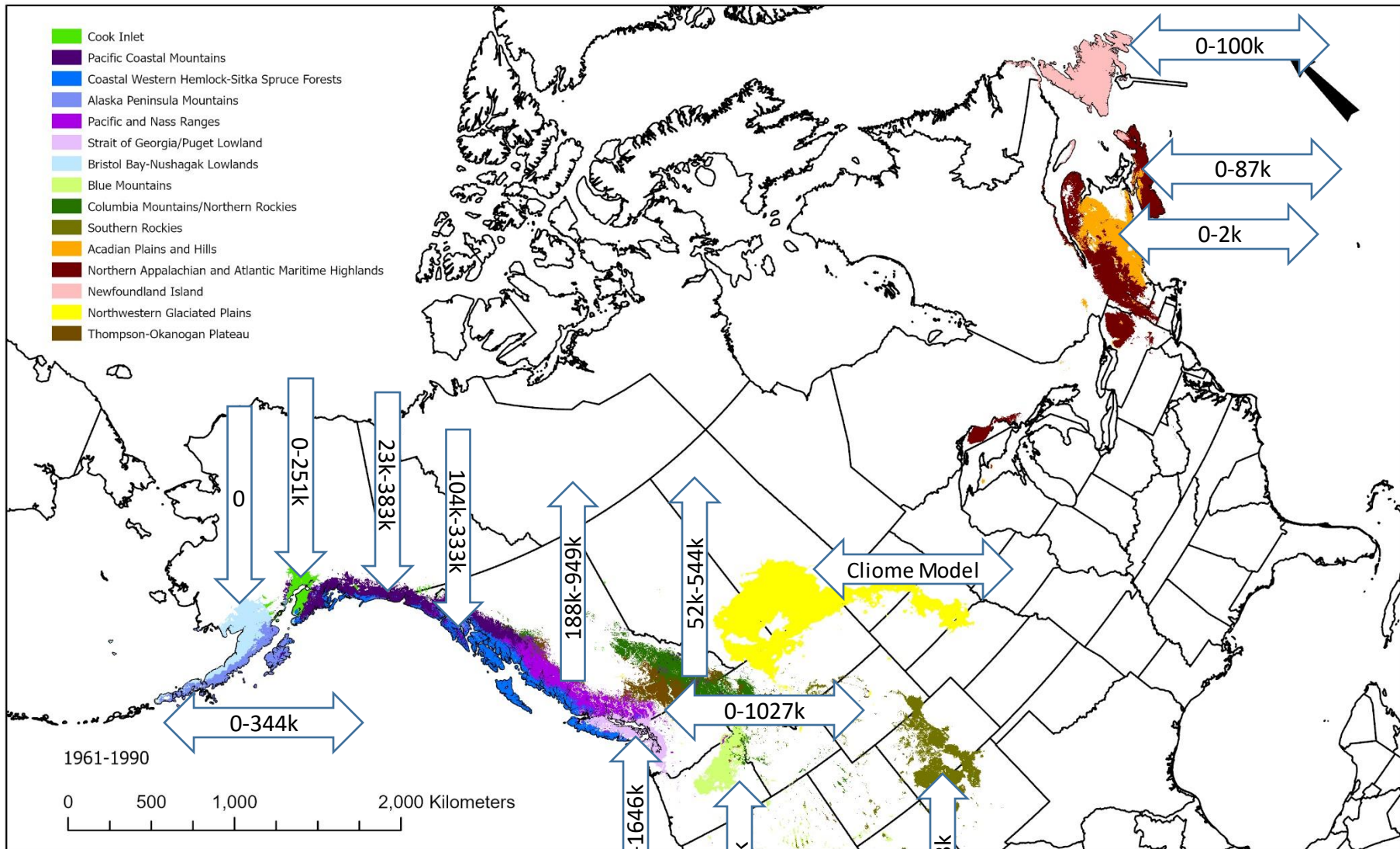
Climate – Biomes 1961-1990

SNAP-EWHALE. Predicting future potential climate-biomes for the Yukon, Northwest Territories and Alaska [Internet]. University of Alaska Fairbanks, Fairbanks: Scenarios Network for Arctic Planning, and Ecological Wildlife Habitat Data Analysis for the Land and Seascape Laboratory; 2012. Available from: <http://www.snap.uaf.edu/attachments/Cliomes-FINAL.pdf>

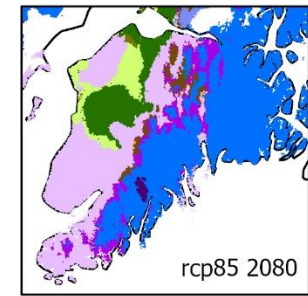
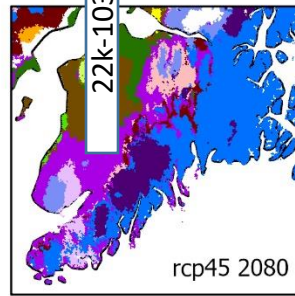
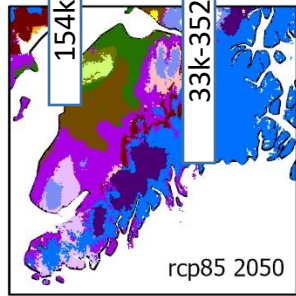
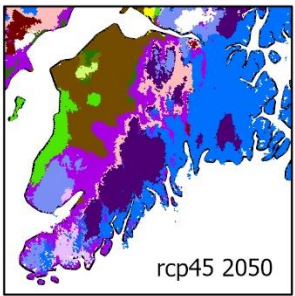
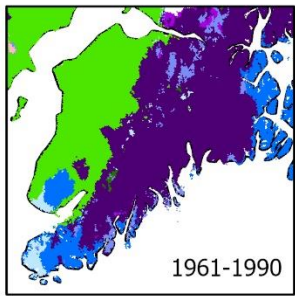
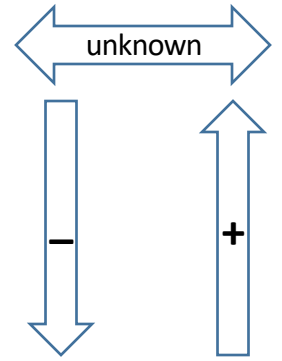


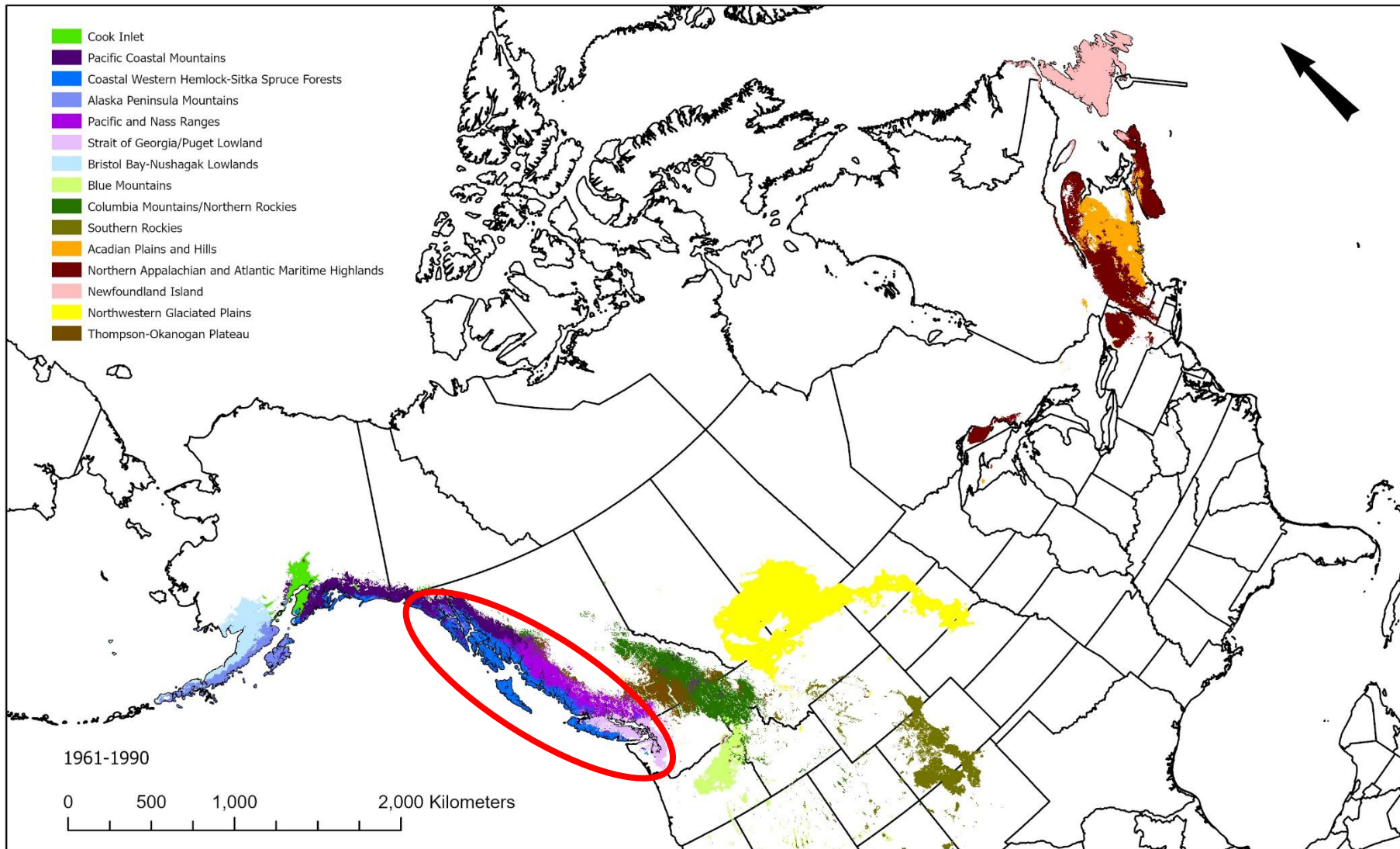
Climate – Biomes 2090

SNAP-EWHALE. Predicting future potential climate-biomes for the Yukon, Northwest Territories and Alaska [Internet]. University of Alaska Fairbanks, Fairbanks: Scenarios Network for Arctic Planning, and Ecological Wildlife Habitat Data Analysis for the Land and Seascape Laboratory; 2012. Available from: <http://www.snap.uaf.edu/attachments/Cliomes-FINAL.pdf>



Trends for the Kenai Lowlands



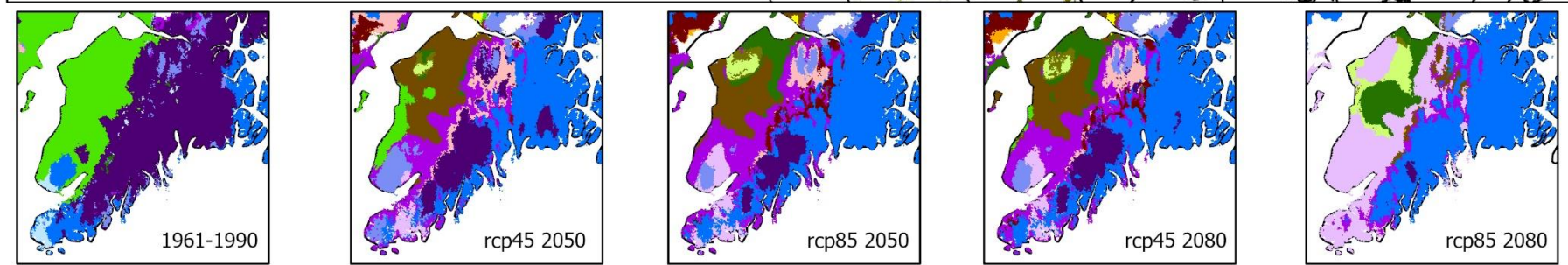


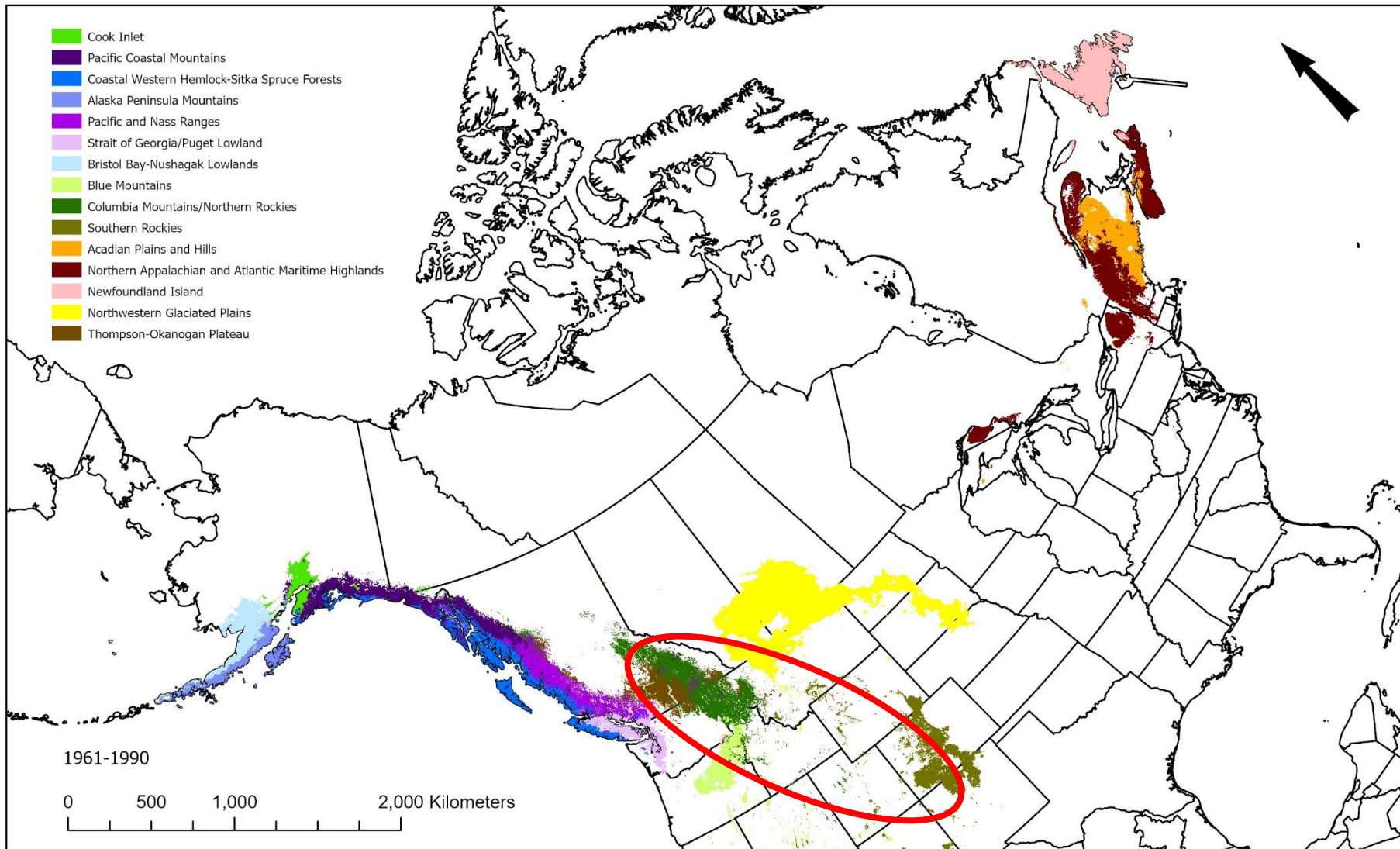
Trends for the Kenai Lowlands

Marine West Coast Forest

Climate: Warmer and much wetter

Plausible



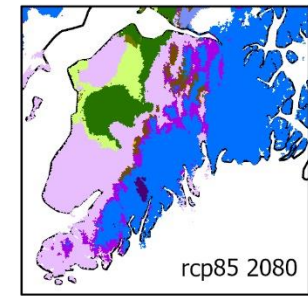
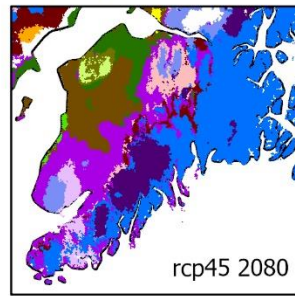
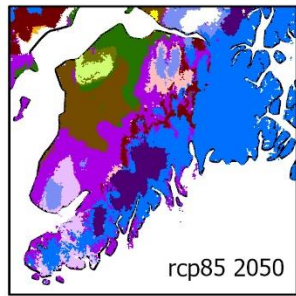
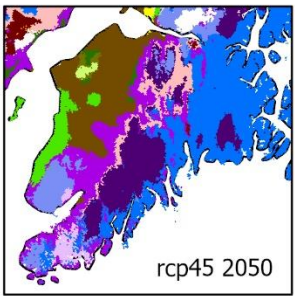
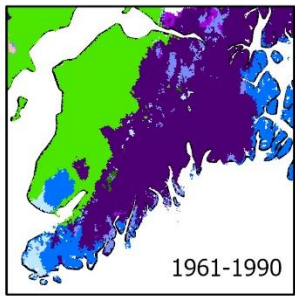


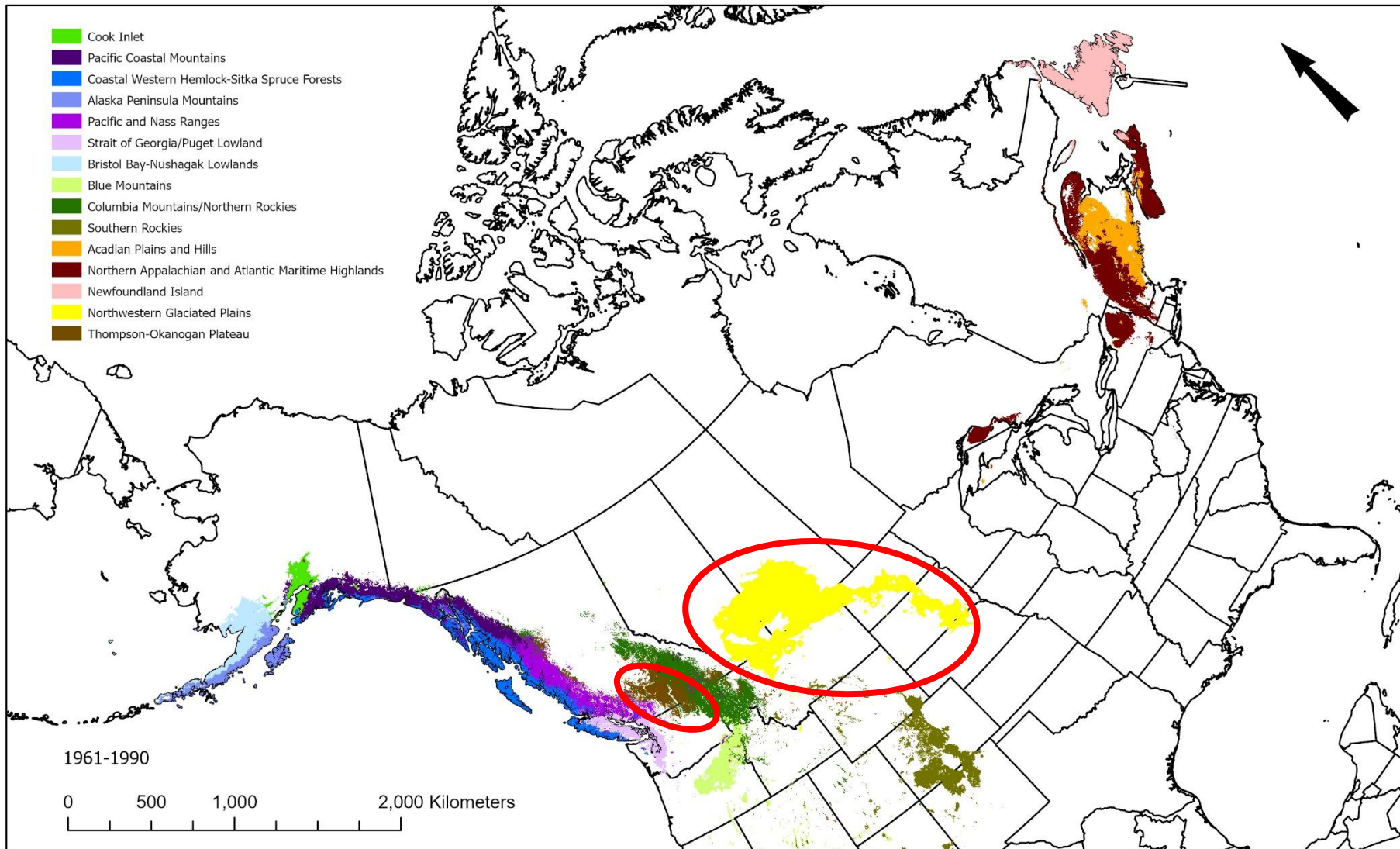
Trends for the Kenai Lowlands

Northwestern Forested Mountains

Climate: Warmer with similar or somewhat more precipitation

Plausible



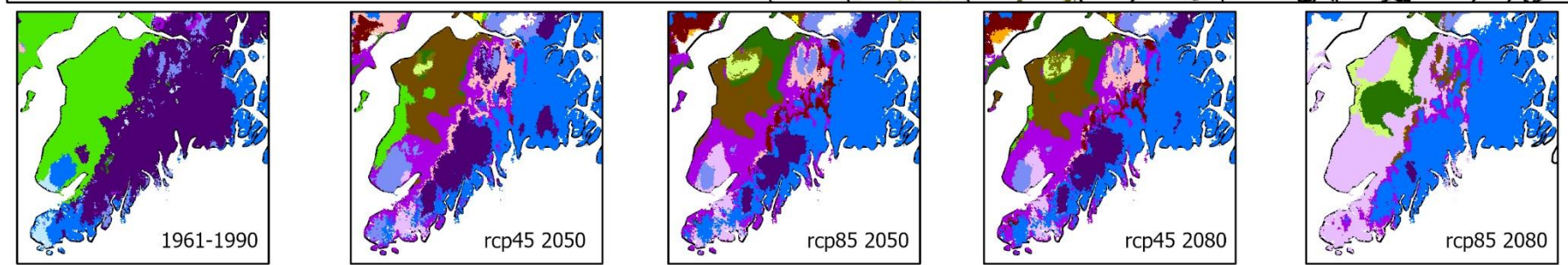


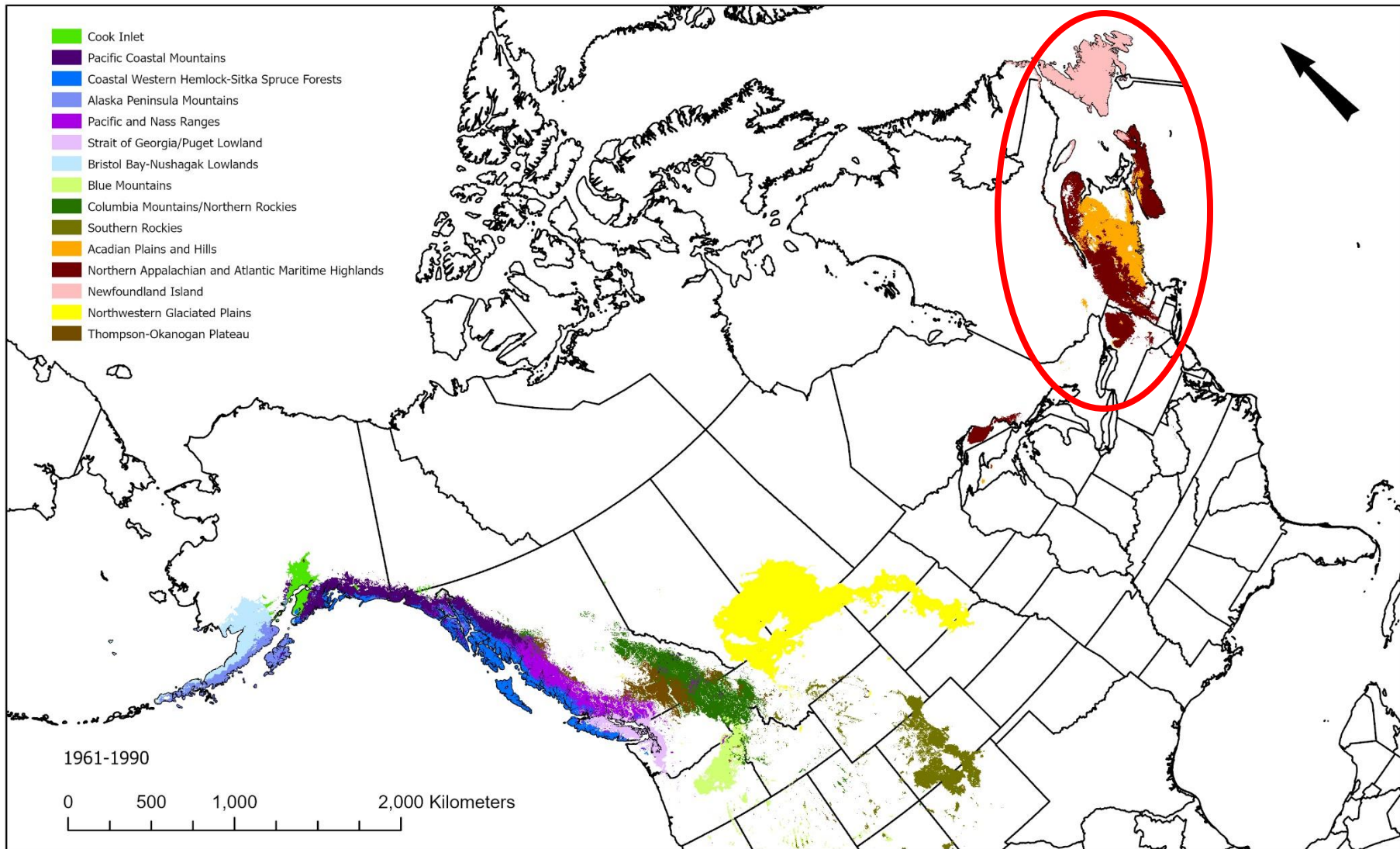
Trends for the Kenai Lowlands

North American Great Plains or Northern Desert

Climate: Warmer with slight precipitation gains lost to evapotranspiration

Plausible



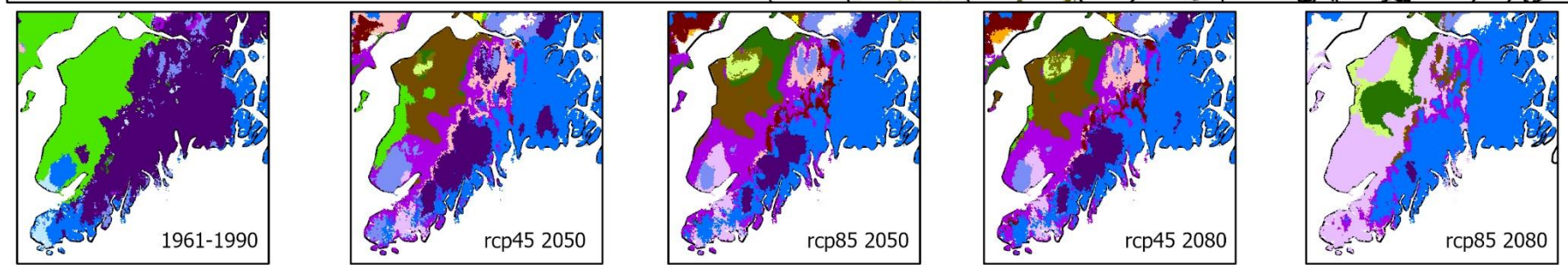


Trends for the Kenai Lowlands

Northern Forest or Eastern Deciduous Forest

Climate: ?

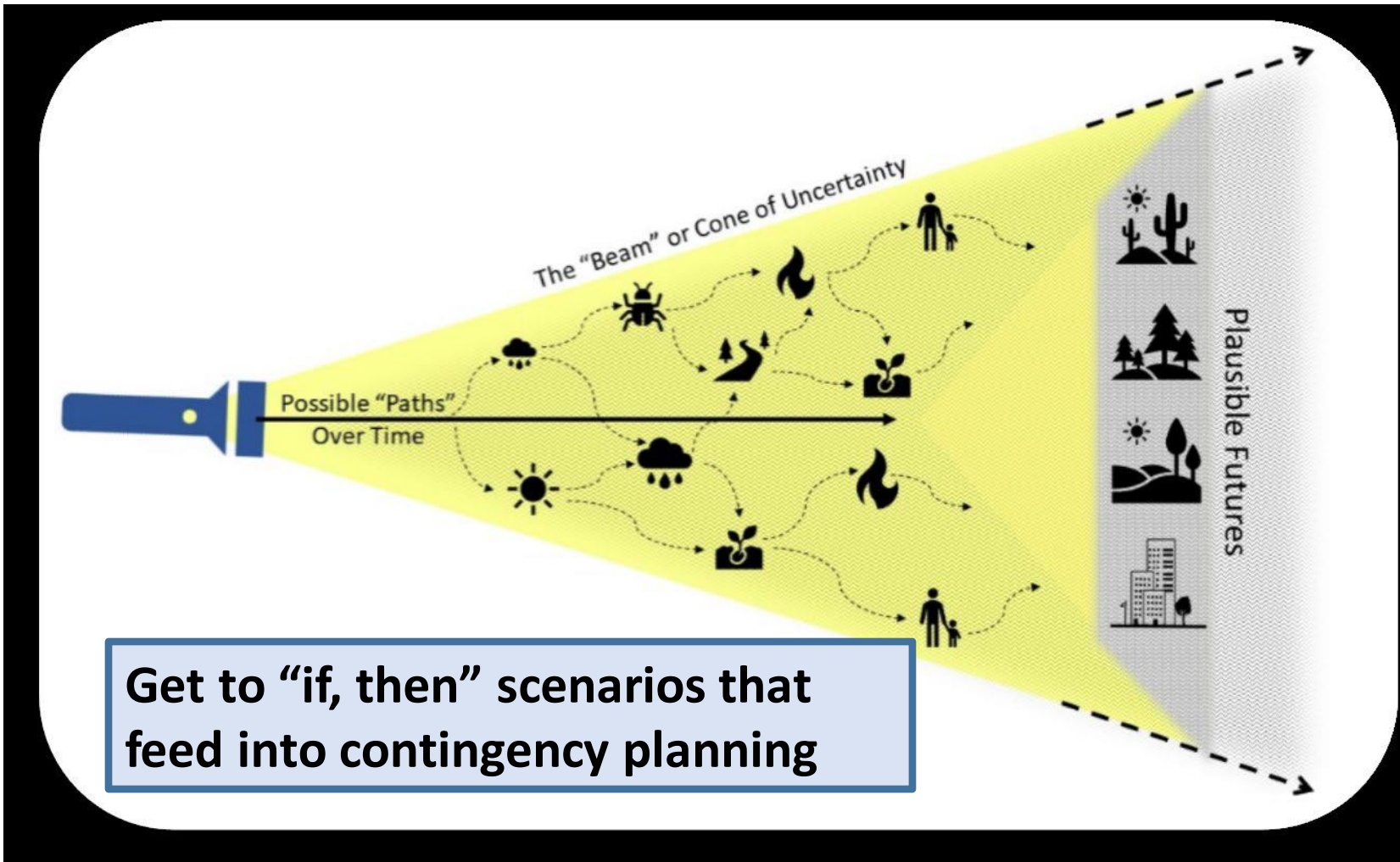
Plausible, but not likely





Kenai Lowlands –An emerging
climate niche with the potential for
dispersal issues

Knowledge about what futures are plausible



The Paths: “Range of plausible trajectories”

- Identify key conditions and events that are highly influential to how change could really unfold
- Includes landscape context and mechanisms
- Shorter timeframes (5-30 years)
- Builds on:
 - [Vulnerability assessment](#) thresholds
 - Extreme events, weather
 - Mechanistic modelling
 - State-and-transition models
 - Spatial PVA



Colonization and Extirpation are Key Contingencies



We Can Resist, Accept, and Direct Colonization and Extirpation

Risks and Challenges



RESIST

Loss of future opportunity
Waste time and money; only delay the inevitable
Failure leads to extinction
Remove species that could be the future assemblage



ACCEPT

Doing nothing is a choice that has consequences.



DIRECT

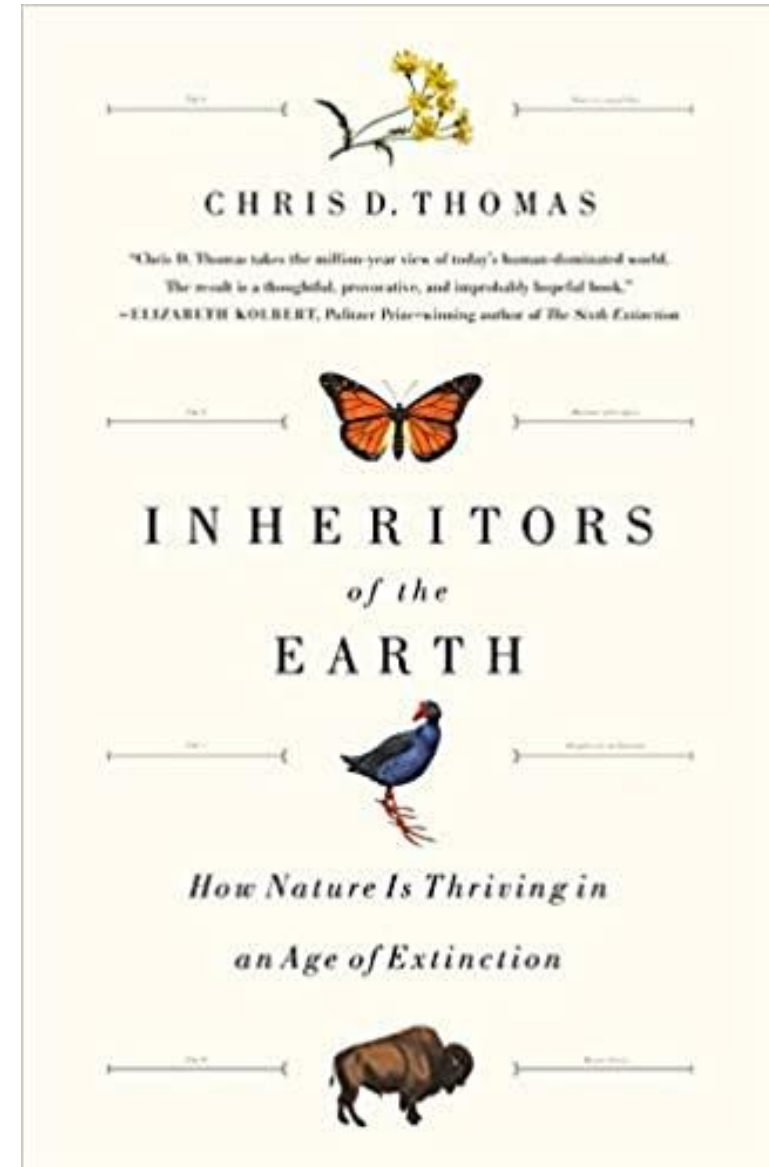
Open question for how to define what assemblage is desired
Trade-offs among future options
Might shoot at the wrong future target

RAD Framework Literature

- Thompson et al. 2021. [Responding to ecosystem transformation: resist, accept, or direct?](#) Fisheries 46: 8-21.
- Lynch et al. 2021. [Managing for RADical ecosystem change: Applying the resist, accept, or direct \(RAD\) framework.](#) Frontiers in Ecology and the Environment 19(8): 461– 469.
- Schuurman et al. 2022. [Navigating Ecological Transformation: Resist–Accept–Direct as a Path to a New Resource Management Paradigm.](#) BioScience 72 (1): 16–29.

Dr. Chris Thomas

- “Life is a process, not a final product”
- The Anthropocene is a selective pressure that will create new species and novel ecosystems
- Managing biodiversity offers a way forward

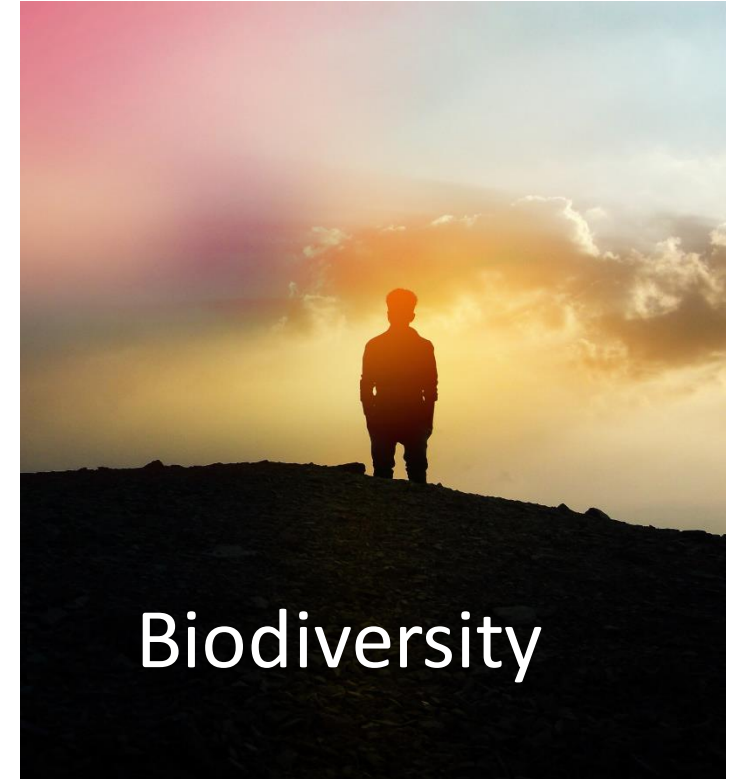


Manage biodiversity while providing other ecological services

Stay within planetary bounds

Create resilient and robust ecosystems

Meet human needs and well-being





**Promote biodiversity
gains, while
minimizing loss**

Chris Thomas



CHRIS D. THOMAS

"Chris D. Thomas takes the million-year view of today's human-dominated world. The result is a thoughtful, provocative, and impressively hopeful book."
—ELIZABETH KOLBERT, Pulitzer Prize-winning author of *The Sixth Extinction*



INHERITORS

of the
EARTH



*How Nature Is Thriving in
an Age of Extinction*



Actions to minimize loss

- Protect where feasible
 - Will efforts make a difference in 100 years?
 - Will people several generations in the future be bothered by the change?
- Move threatened species to new places where they can thrive
- Infuse threatened species with genes (bison-cows)
- Focus on maintaining as much phylogenetic diversity as possible



CHRIS D. THOMAS

"Chris D. Thomas takes the million-year view of today's human-dominated world. The result is a thoughtful, provocative, and improbably hopeful book."
—ELIZABETH KOLBERT, Pulitzer Prize-winning author of *The Sixth Extinction*



INHERITORS
of the
EARTH



*How Nature Is Thriving in
an Age of Extinction*



Biodiversity can increase through

- Hybridization via interactions with new species
- New ecological situations, including interactions with new species, create new niches and opportunities
- Geographic separations - archipelagos as species making machines



Human timescales (15-year refuge planning cycles in a country that is only ~250 years old) are mis-matched with evolutionary time (1 million plus)

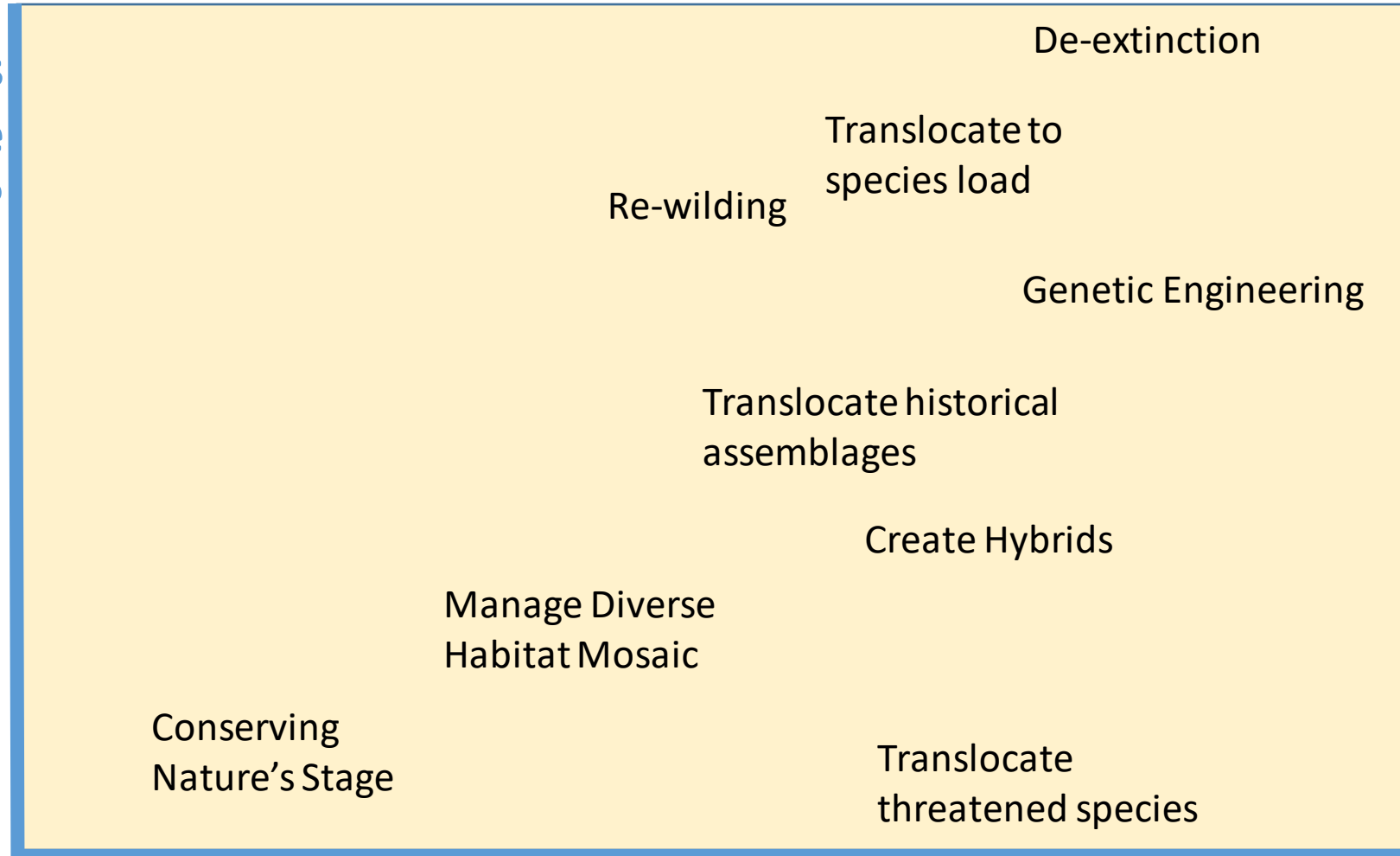
Actions to promote gains can be controversial and novel

Well established is the theory and methods?

Does this even make sense?

How do we do this?

Know how to do it



We Can trust nature

We must help Nature

What is the philosophy about the natural world?



RESIST

- Keep species within their historical range; kill invasives
- Enhance genetic diversity of current species, hybridize or import individuals from other region for species here
- When things show up, decide if we like them



ACCEPT

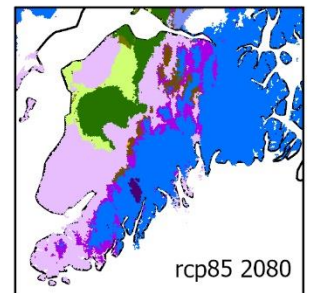
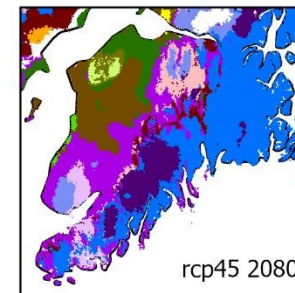
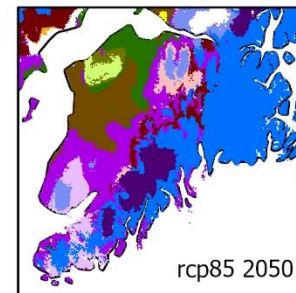
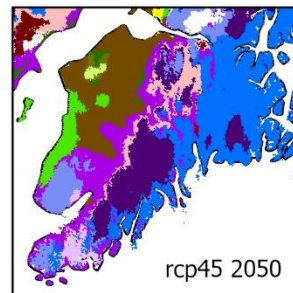
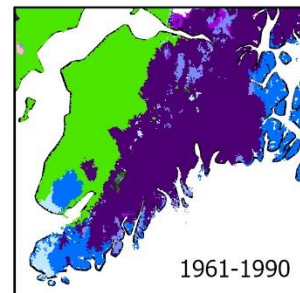
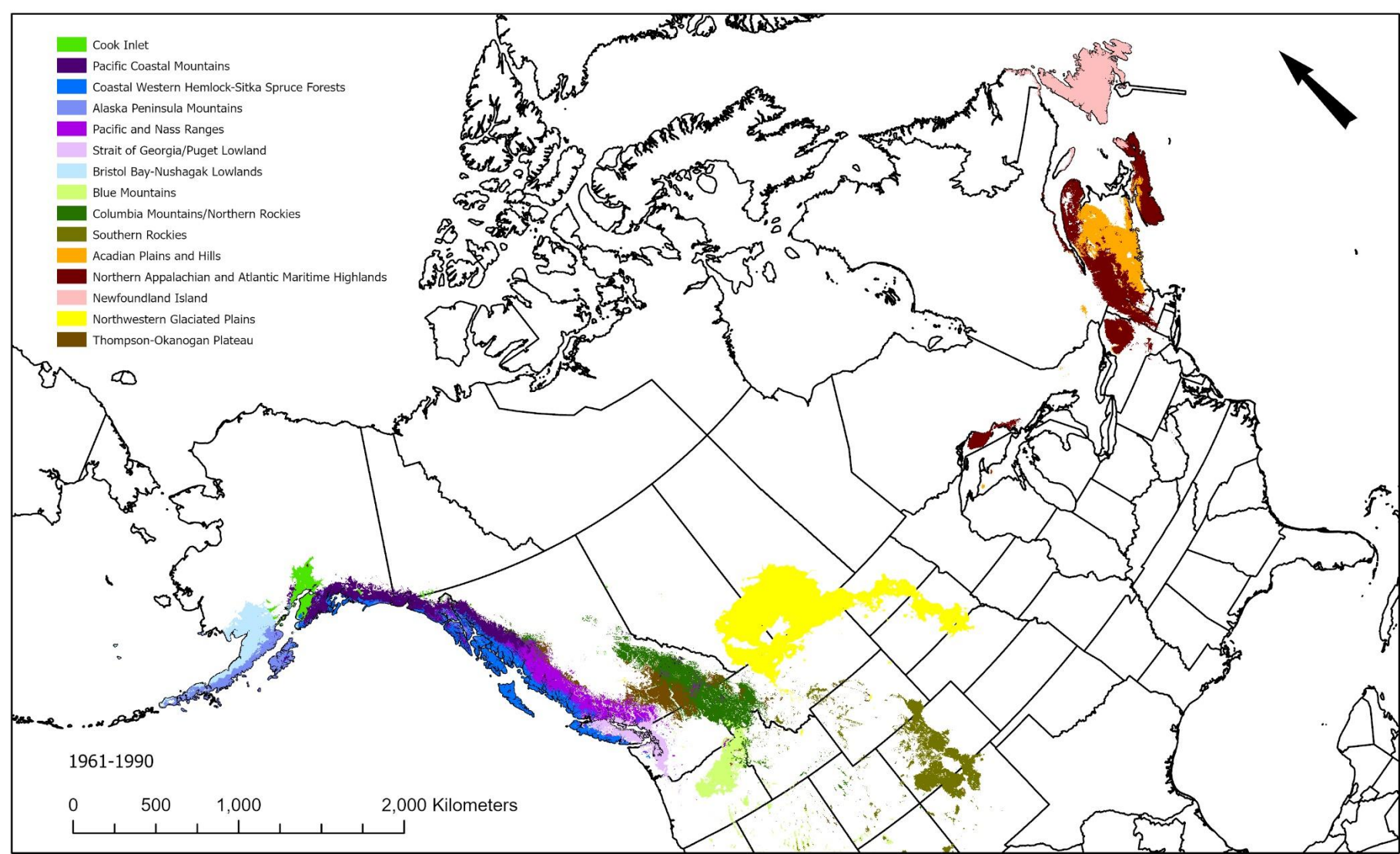
- Allow species to be extirpated and colonize



DIRECT

- Translocate local losers to places they can thrive
- Translocate potential winners to fill functional holes of extirpations
- Enhance species assemblage using translocations/species load to create the novel assemblage

How much overlap is there between the wildlife assemblage of the current and forecast future ecoregions?



Are we a Wildlife Stronghold? Carnivores Present



Black bear – 100% Ecoregions



Marten – 100%



Mink – 93%



Ermine – 93%



Coyote – 93%



River Otter – 93%



Canadian Lynx – 87%



Brown Bear – 67%



Grey Wolf – 67%



Least Weasel – 67%



Wolverine – 67%

What About Carnivores Absent but Possible?



Red Fox (extirpated) – 100% Ecoregions



Raccoon – 67%



Long-tailed Weasel – 60%



Bobcat – 60%



Cougar? – 60%



Striped Skunk – 60%



Fisher – 60%



Arctic Fox – 60%



Grey Fox – 60%



Western Spotted Skunk – 60%



American Badger – 33%



Black-footed Ferret – 20%



Eastern Spotted Skunk – 13%



Kit Fox – 7%



Ringtail – 7%



Swift Fox – 7%

Are we a Wildlife Stronghold? Ruminant Ungulates



Moose



Caribou



Mountain Goat



Dall Sheep



Phase two of the great Alaskan bison roundup was getting the bison in the horse trailer! After much pulling and tugging they both made it in. What's more amazing is that some time during the trip back to Canada the bison were able to switch places in the trailer! 5/89, TNWR 89-28, WKB.

Elk? – 60%

Deer – 60%

40%

Bison – 33%

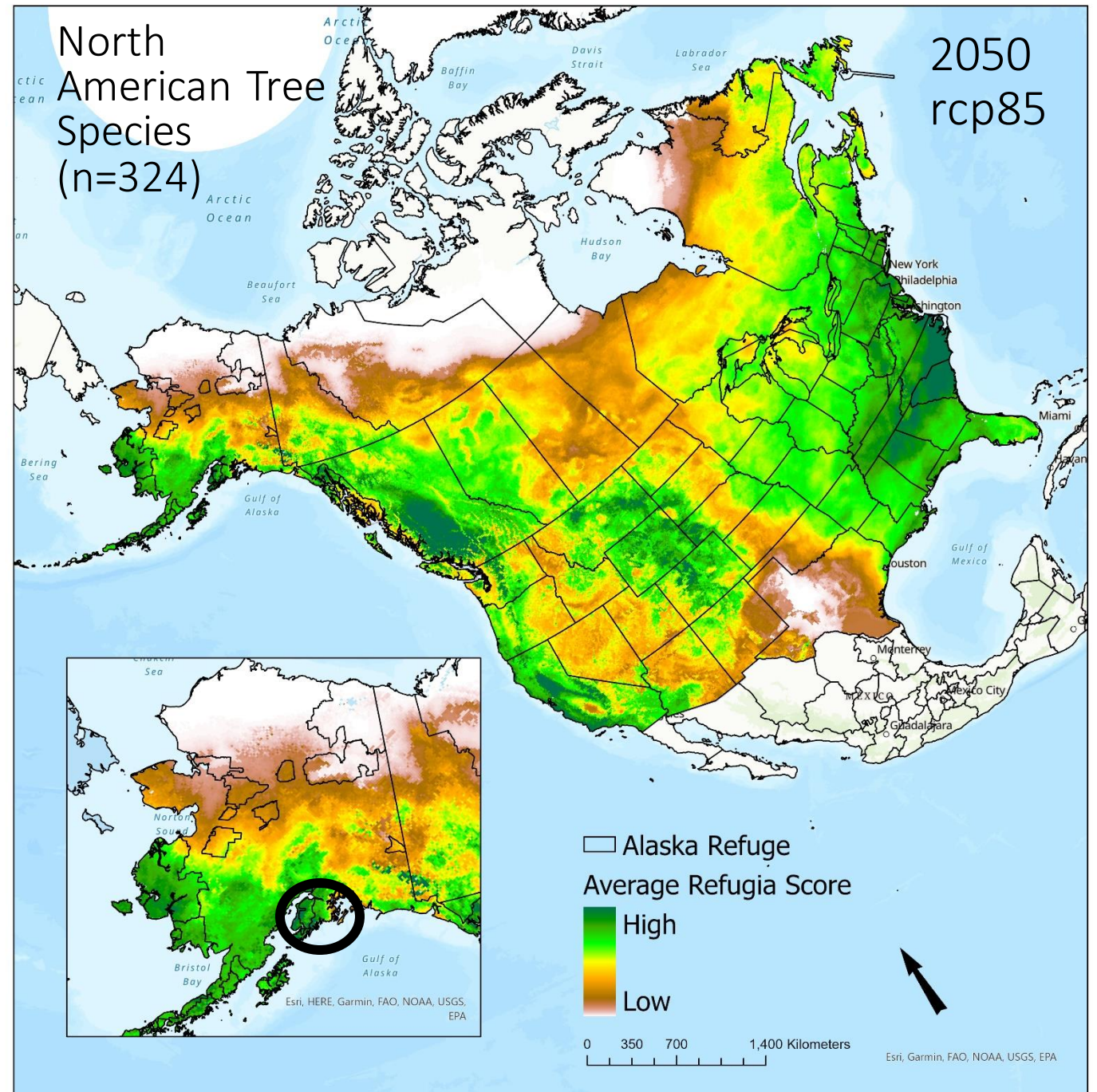
Sheep – 33%

Goat – 20%

Can we maintain forests?

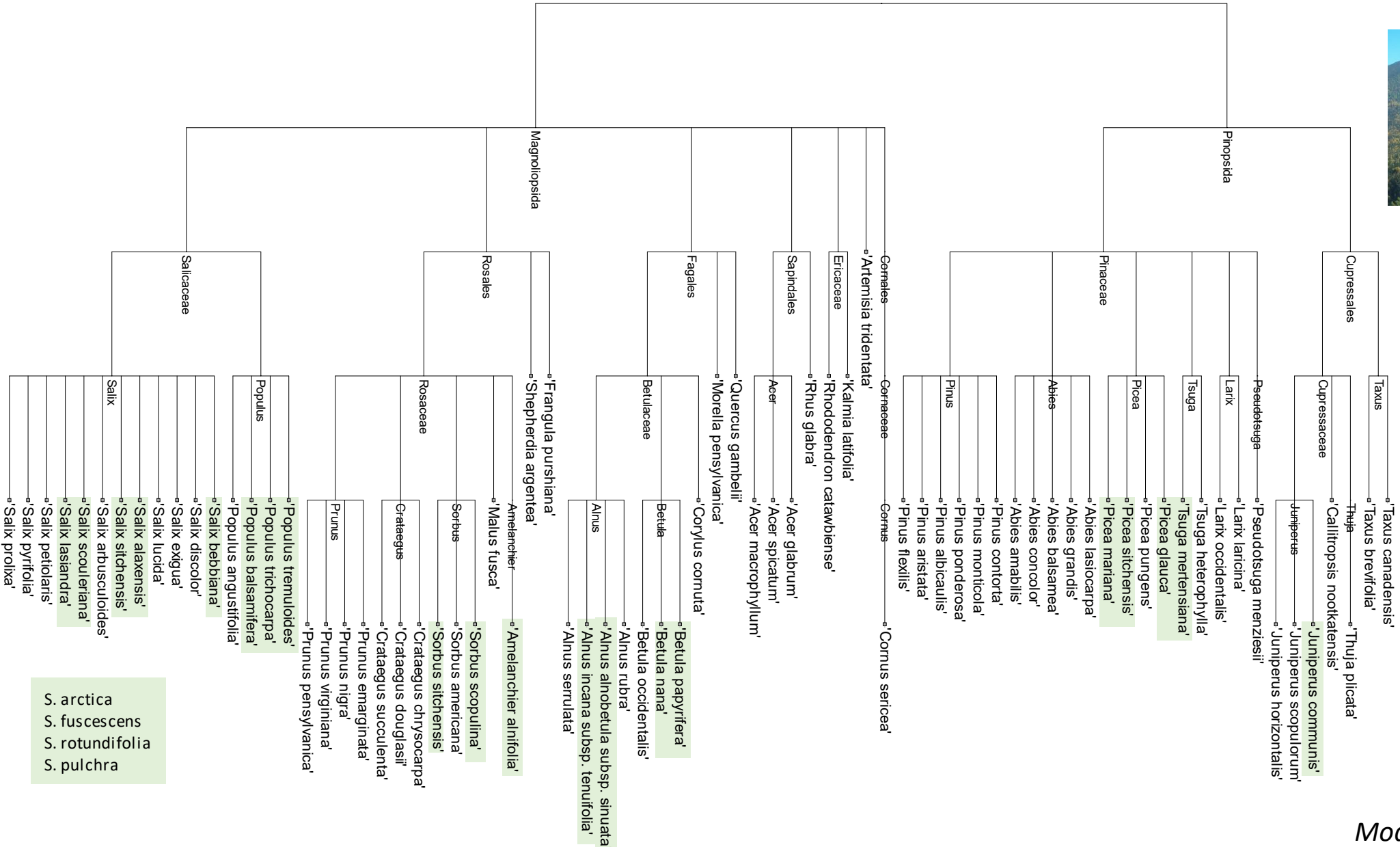
How diverse can these forests be?

Stralberg, D, Carroll, C., Wilsey, C., Pedlar, J., McKenney, D. & Nielsen, S. 2018. "Macrorefugia for North American trees and songbirds: climatic limiting factors and multi-scale topographic influences. *Global Ecology and Biogeography*.
<https://doi.org/10.1111/geb.12731>



76 Trees – Kenai National Wildlife Refuge

Native



- S. arctica
- S. fuscescens
- S. rotundifolia
- S. pulchra

Tree scale: 10

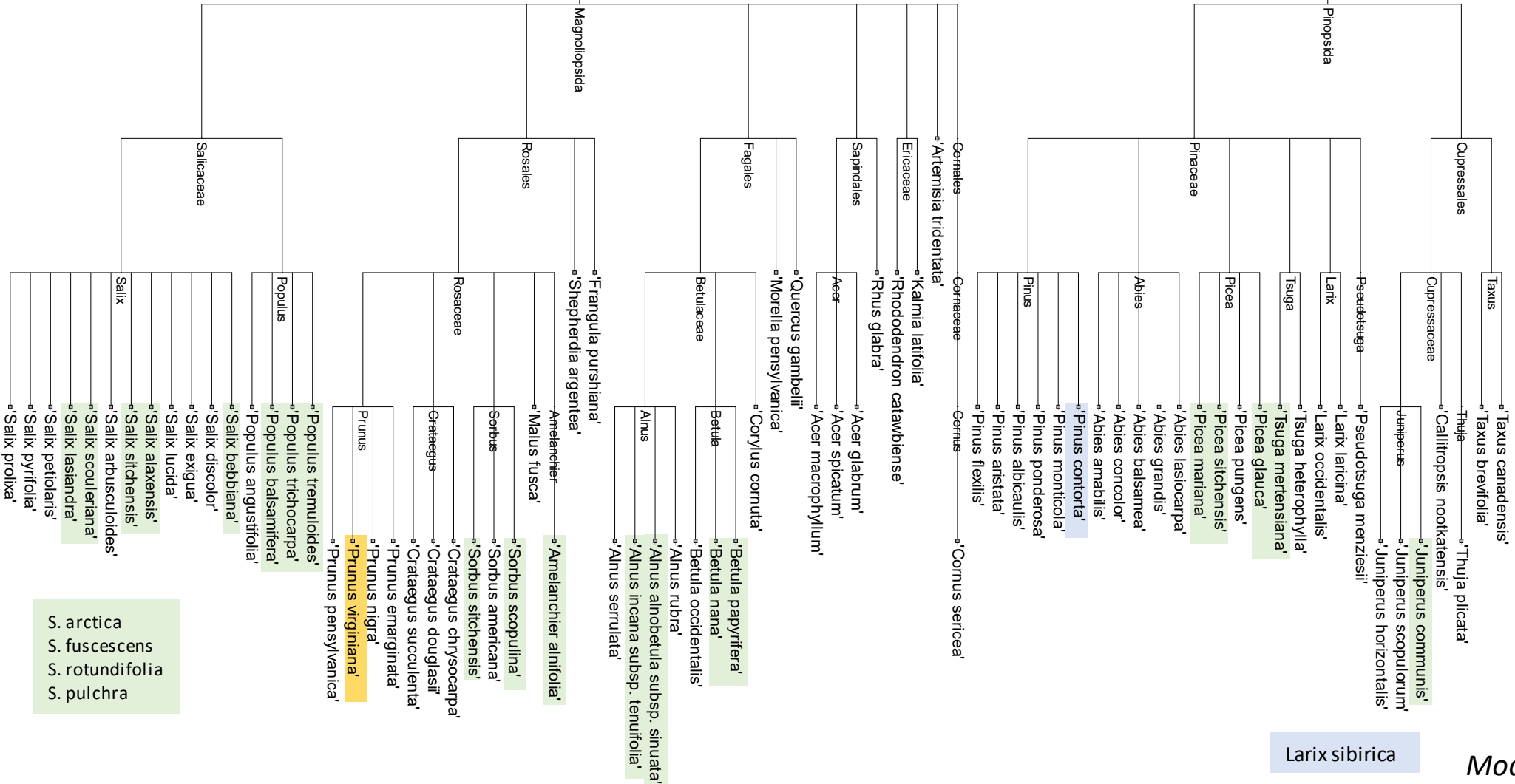
76 Trees – Kenai National Wildlife Refuge



Native

Considered Invasive

Naturalized



- 'S. arctica'
- 'S. fuscescens'
- 'S. rotundifolia'
- 'S. pulchra'

Larix sibirica

Models: Stralberg et al. 2018



What actions should we take to prepare to manage a landscape that will hold current species and be hospitable for many more?

To action: What would be the management trigger points?

- Low population threshold?
- Recruitment failure after disturbance?

What experiments and pilot projects do we need to be prepared?

Pilots and Experiments

- Use human spaces as places as a testing ground and space for species to adapt to the Kenai
- Common gardens
 - Hybrids
 - Individuals from future climate analogs
 - Species that fill phylogenetic holes (from North America)
 - Species loading experiments to allow novel ecosystems to emerge
- Research to understand whether current assemblage have the adaptive capacity to fill opening niches
 - Leverage depauperate small mammals on the Kenai

A scenic landscape featuring a mountain range with patches of snow and green vegetation. In the foreground, a goat with large, curved horns stands in a field of green shrubs, looking towards the mountains. The sky is blue with some clouds.

Questions or Comments?
Dawn_Magness@fws.gov

“When we see land as a community to which we belong, we may begin to use it with love and respect.”

Aldo Leopold Foreword, *A Sand County Almanac*.