

Plants and animals on the move: the borealization of a rapidly warming Alaska



Krill dieoff near Shishmaref in 2019





Horned puffin carcasses near Nome in 2020

Crab crisis in Bering Sea a sign of 'borealization' and big changes in the future, scientists warn

By Yereth Rosen, Alaska Beacon
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Climate change seen as suspected factor in Western Arctic Caribou Herd decline

December 30, 2022 by Yereth Rosen, Alaska Beacon

North

Walrus on packed Alaska beach may have died in a stampede

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Dead walrus, most under a year old, were found Monday near village of Point Barrow, Alaska. Photo by AP/Wide World

Associated Press · Posted: Sep 14, 2017 5:08 PM EDT | Last Updated: September 14, 2017

A remote camera captures walrus on the beach at Point Lay, Alaska, on Sept. 7. The U.S. Fish and Wildlife Service says the walrus population is declining.

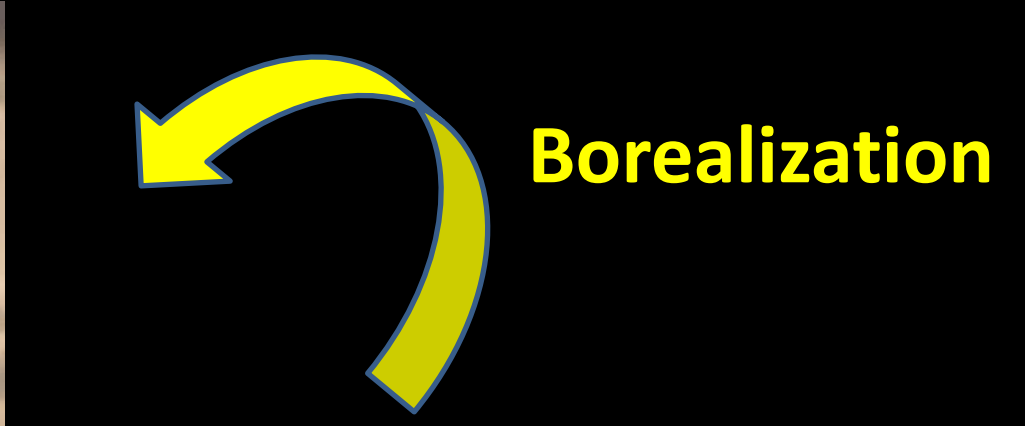
Plants and animals generally move northwards in latitude and upwards in elevation as the climate warms



- Species-specific dispersal rates create mismatch and even extinction
 - Predator-prey
 - Host-pathogen
 - Habitat specialists
- Mountains, oceans, rivers can prevent migration
- Wrong soil or water chemistry can prevent colonization



Arctic tundra biome

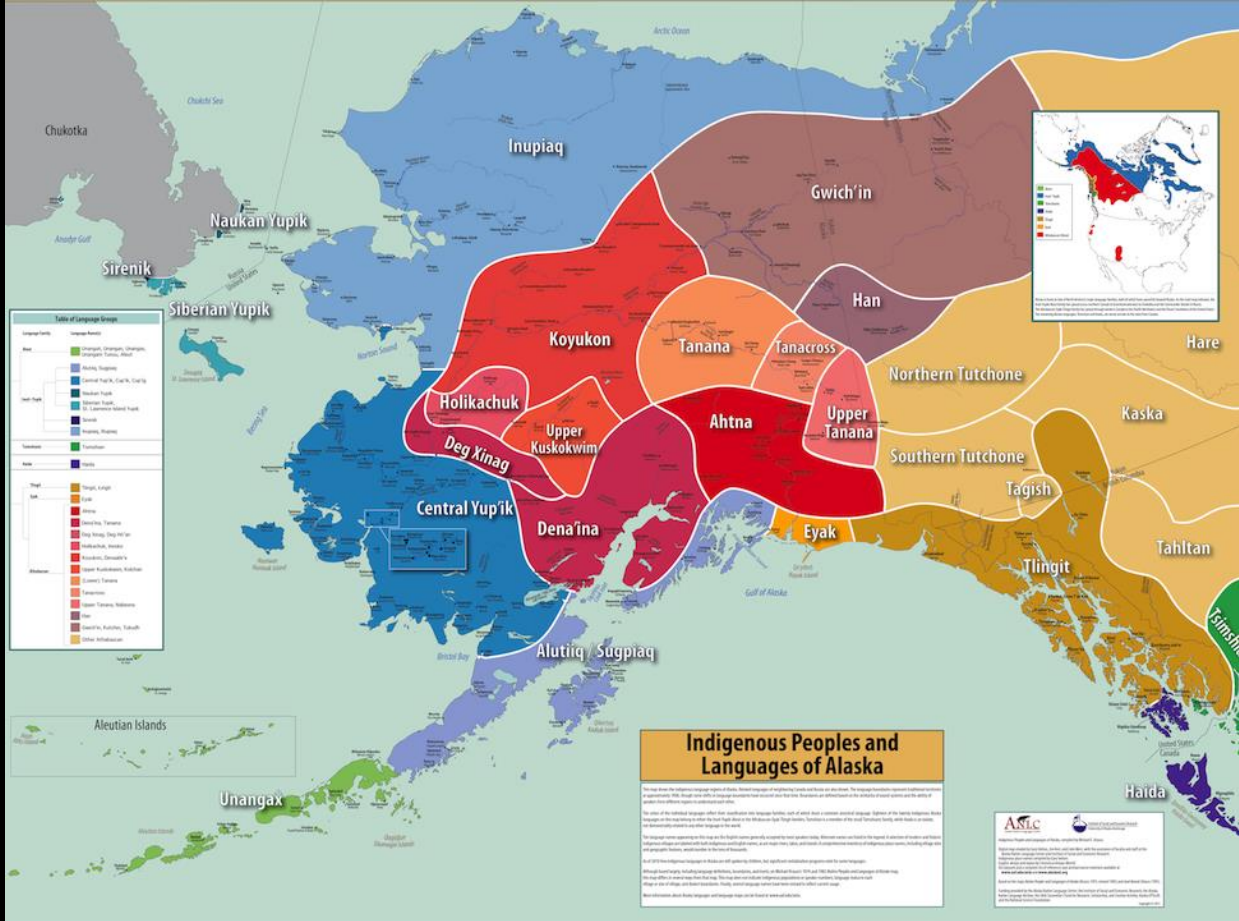
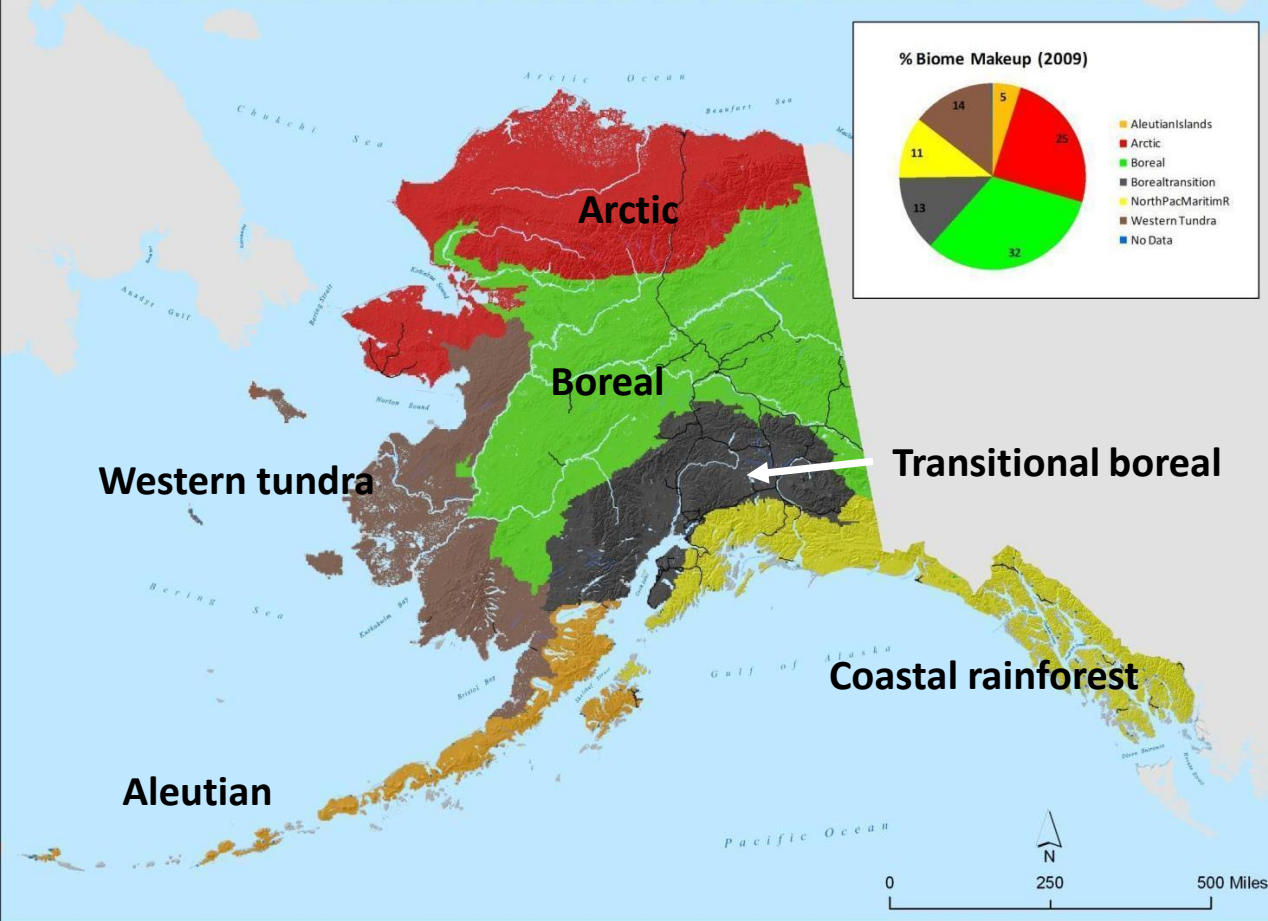


Borealization

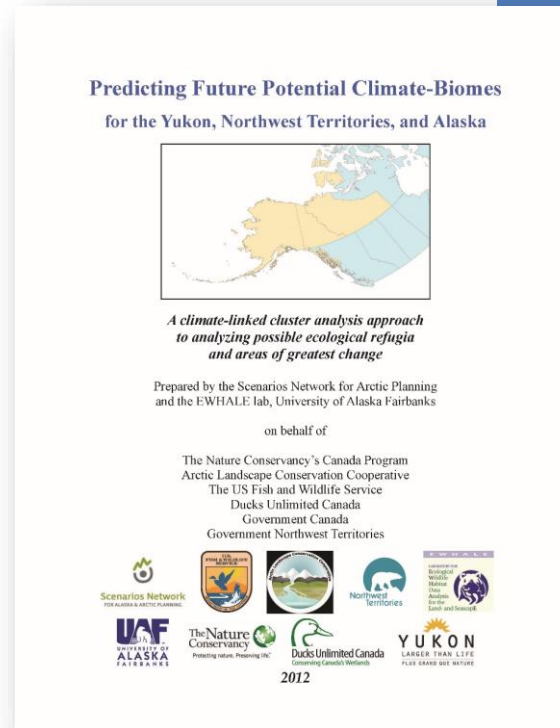
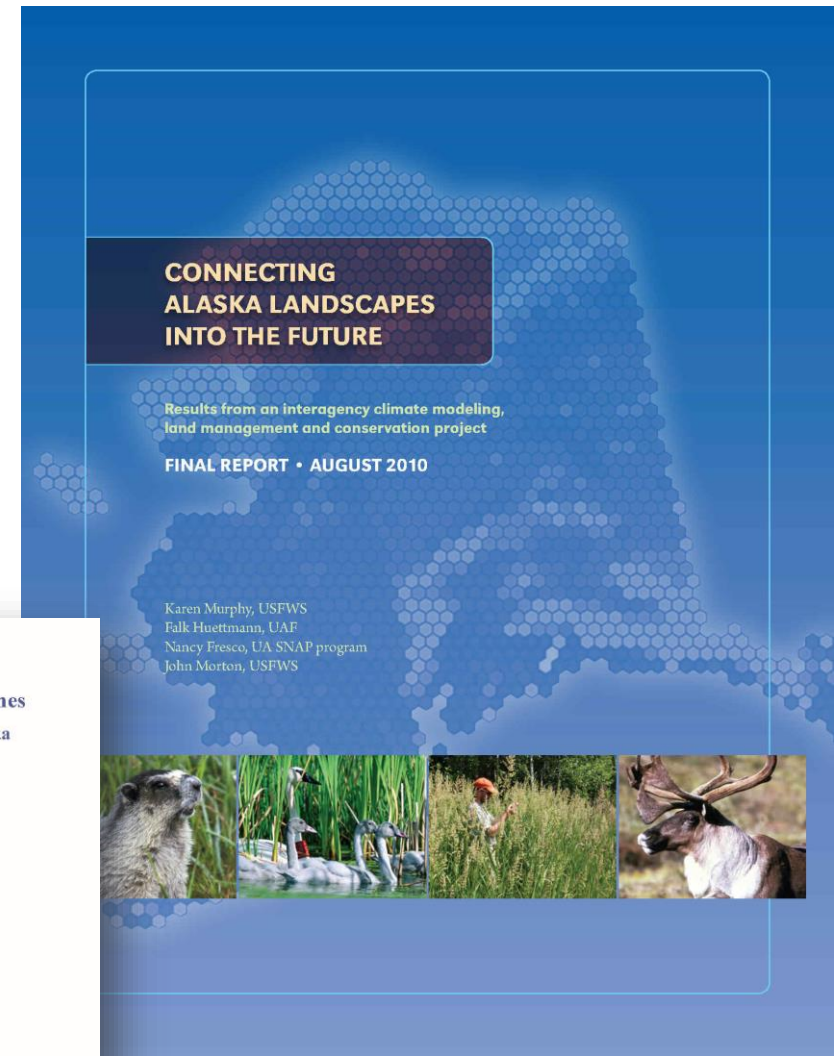
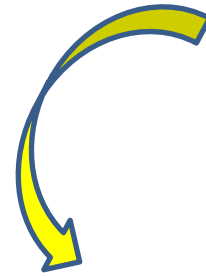


Boreal forest biome

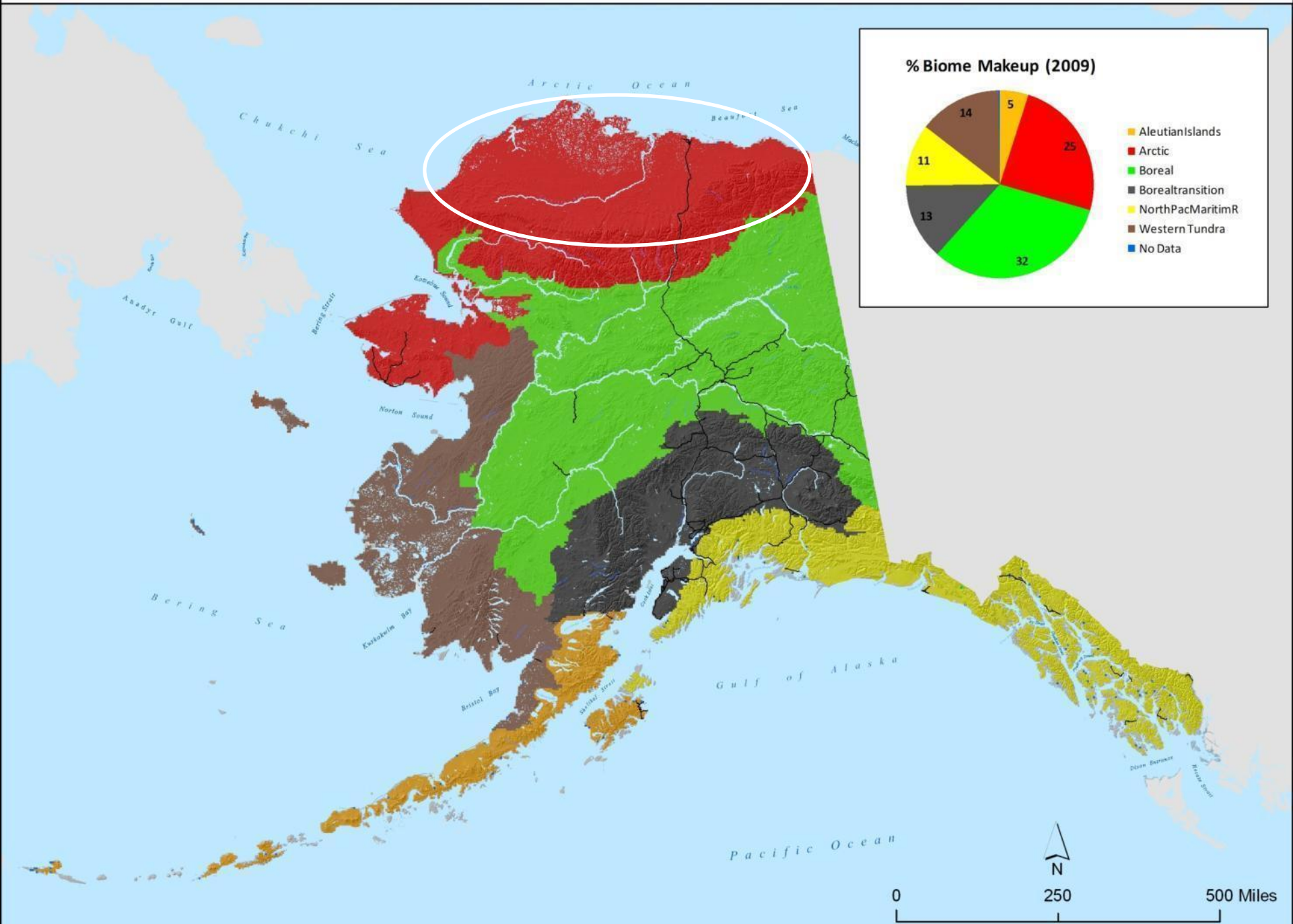
Alaskan Natives co-occur with biomes because they've both been around for a LONG time



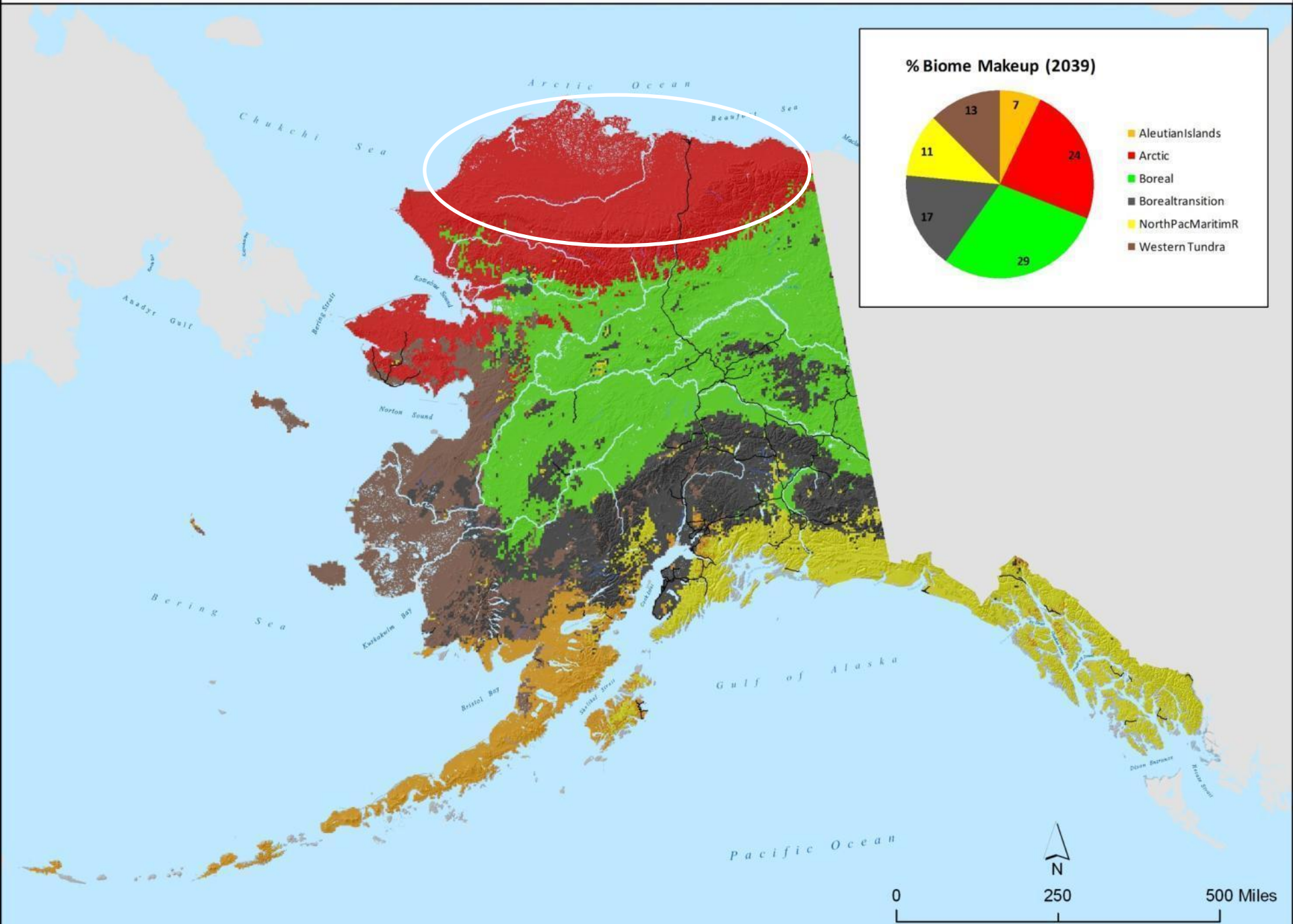
Interagency efforts to pioneer assessment of climate change effects on biome and species distributions using climate envelope models



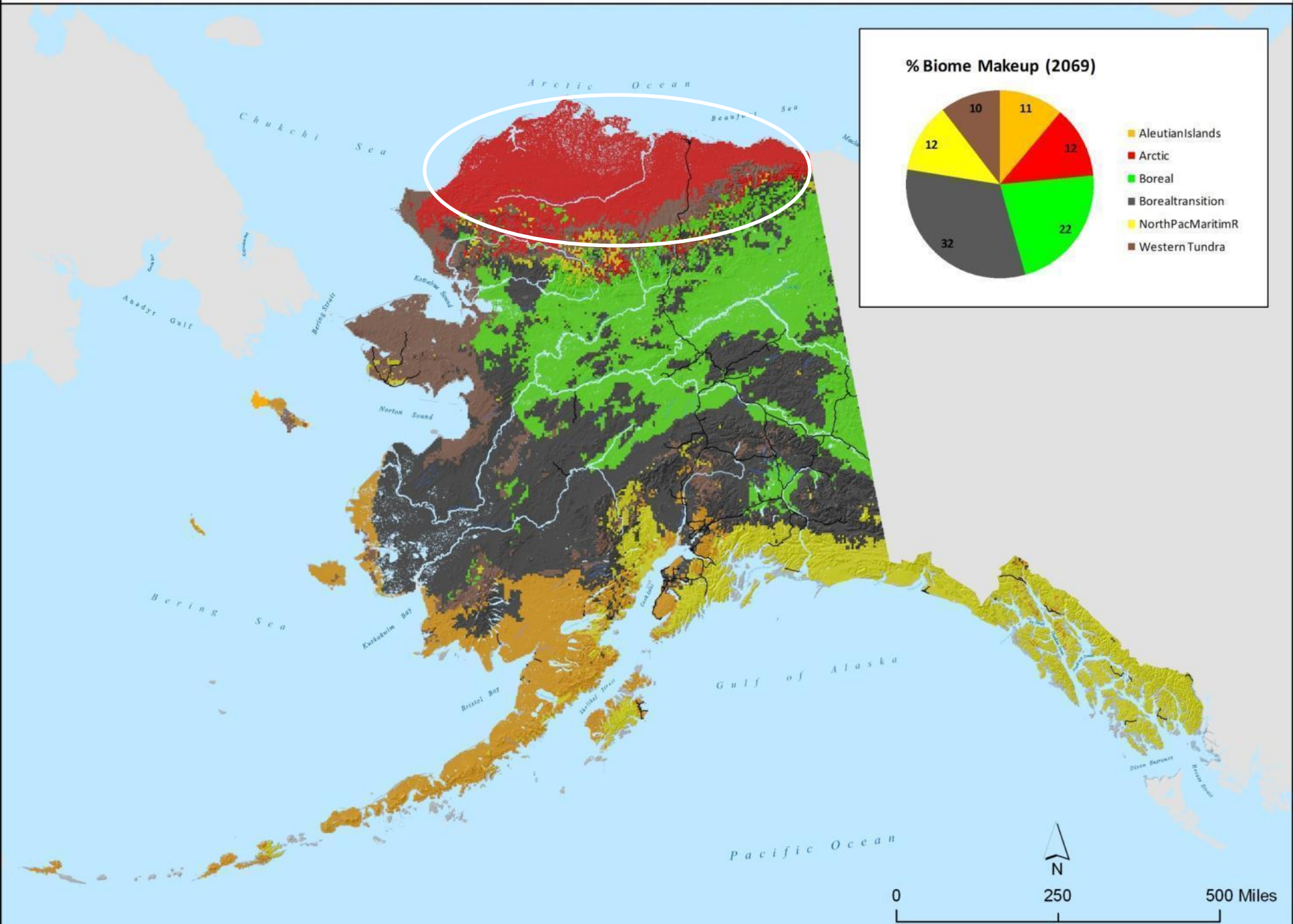
Biome in 2009



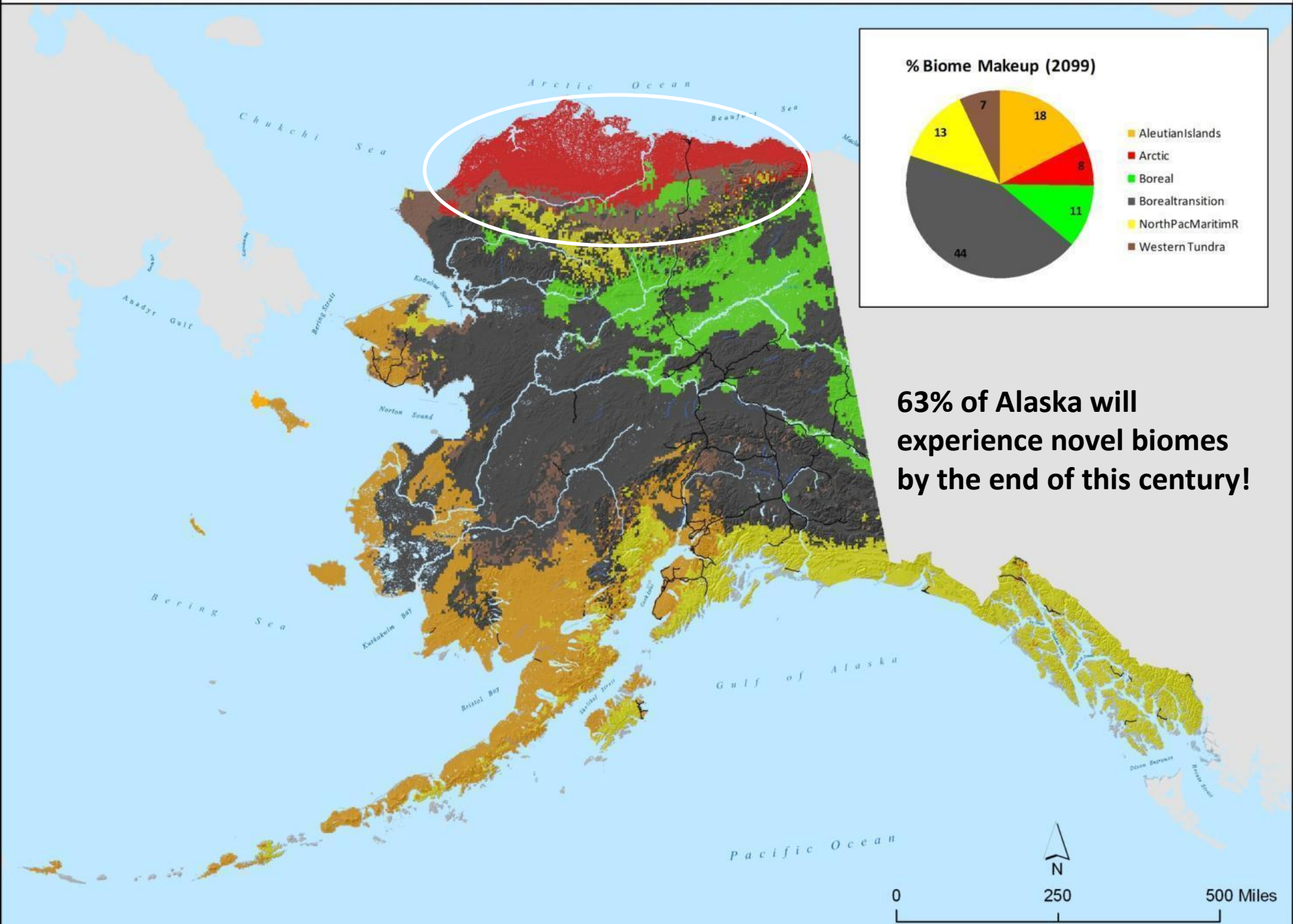
Biome in 2039



Biome in 2069

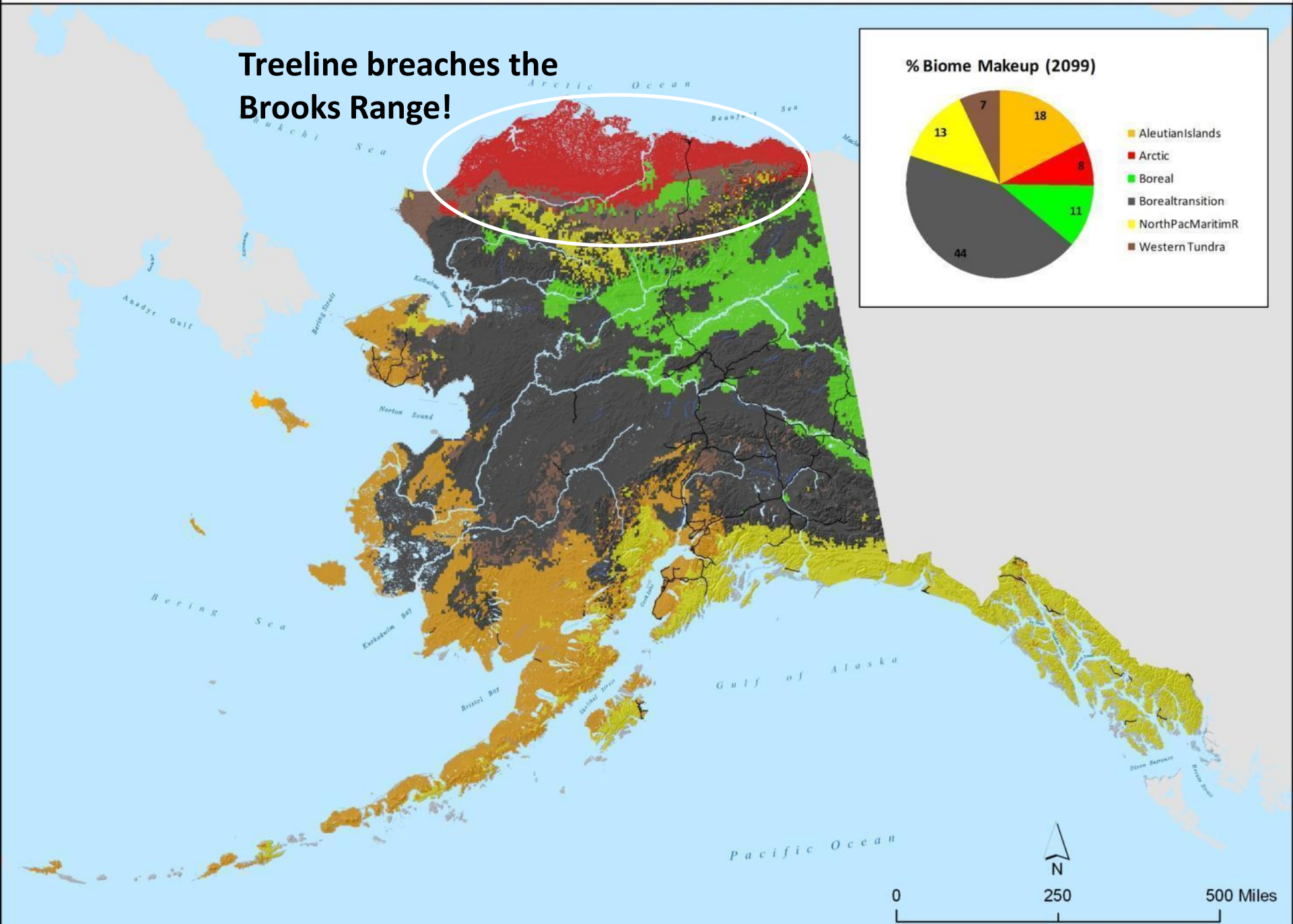


Biome in 2099

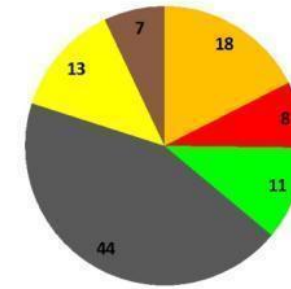


Biome in 2099

Treeline breaches the
Brooks Range!

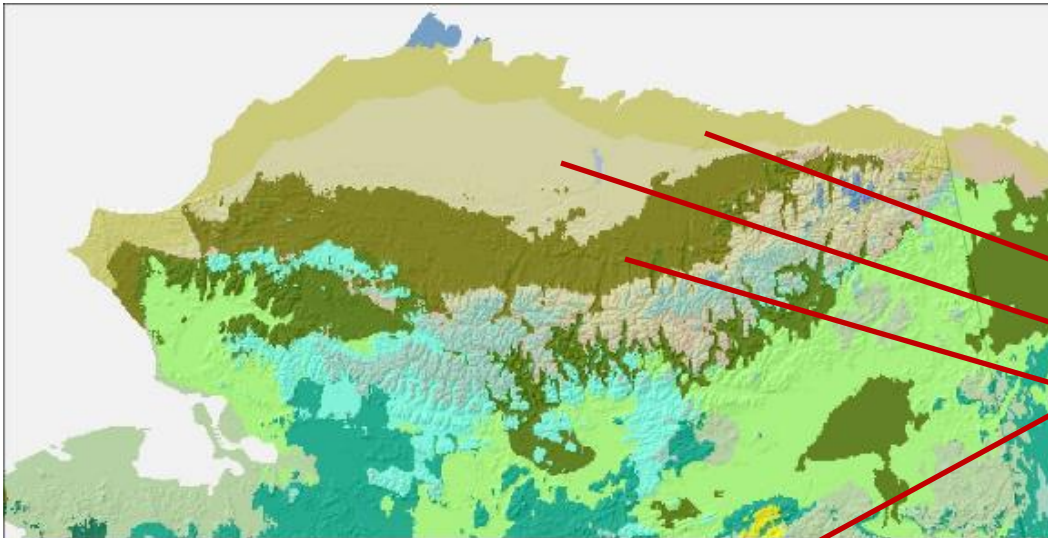


% Biome Makeup (2099)



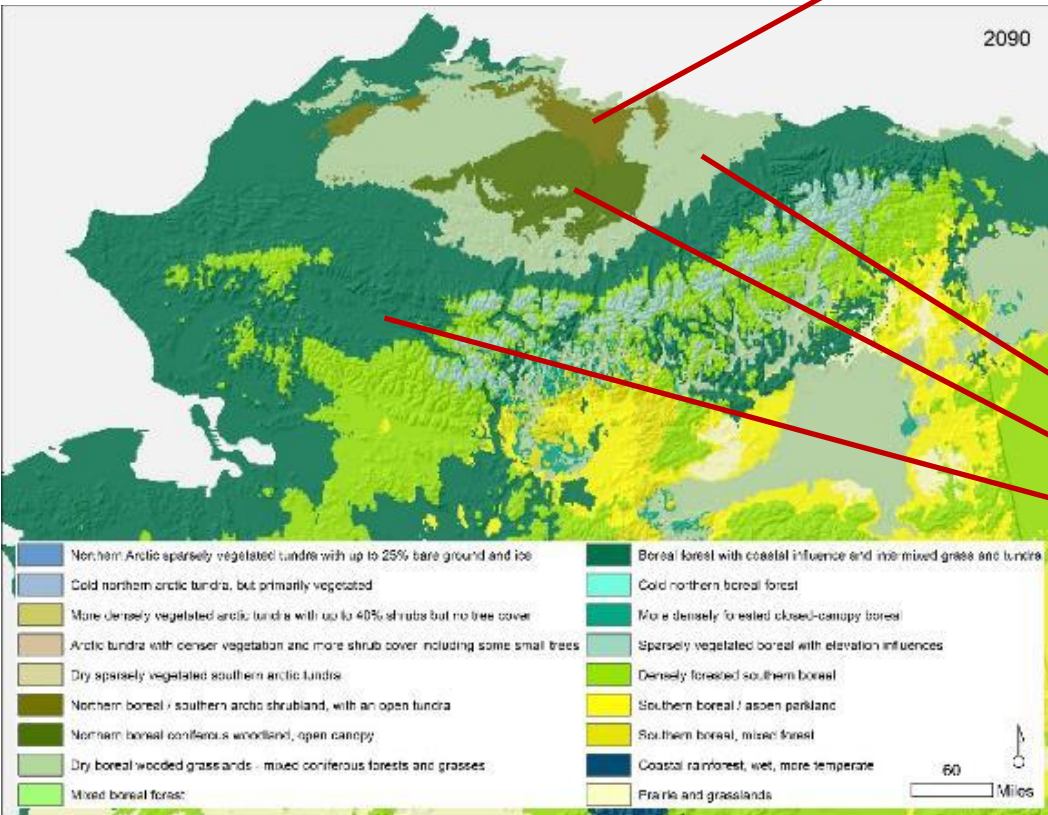
- AleutianIslands
- Arctic
- Boreal
- Borealtransition
- NorthPacMaritimR
- WesternTundra





In 2000, 100% is **TUNDRA**

- tundra < 40% shrubs and no trees (23%)
- tundra but sparsely vegetated (35%)
- shrubland with open tundra (30%)



By 2100, >55% is **CONIFER**

- dry boreal wooded grasslands (28%)
- northern boreal coniferous woodlands (9%)
- mixed boreal forest (46%)

Predicting Future Potential Climate-Biomes for the Yukon, Northwest Territories, and Alaska. 2012. Scenarios Network for Arctic Planning and EWHALE lab, UAF

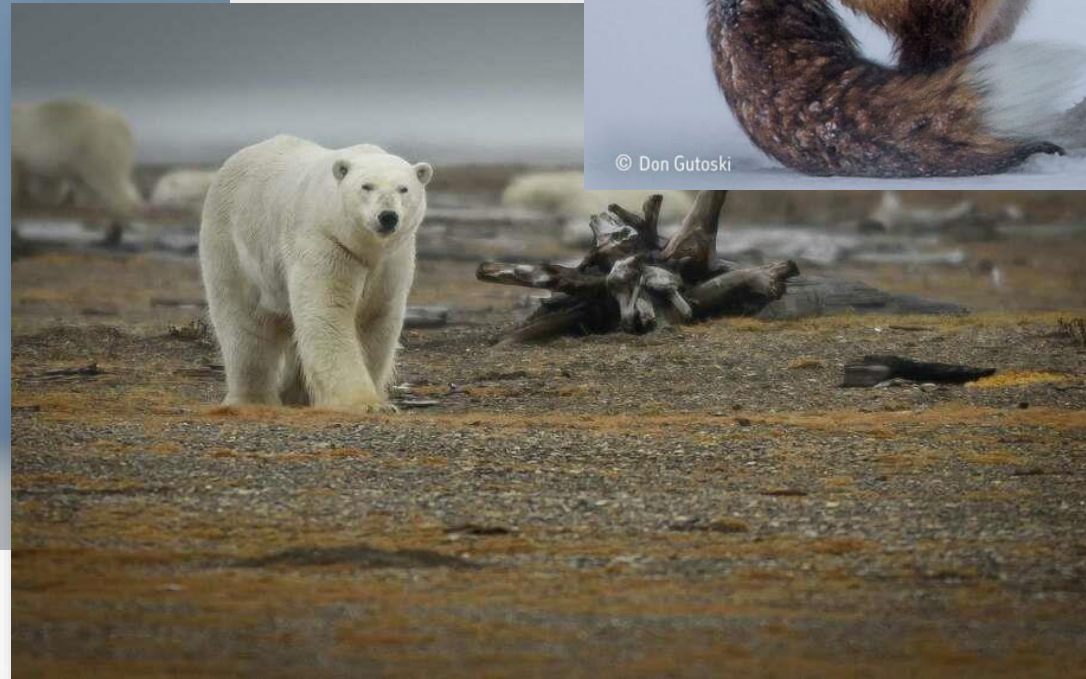
Boreal biome needs to get over the Brooks Range



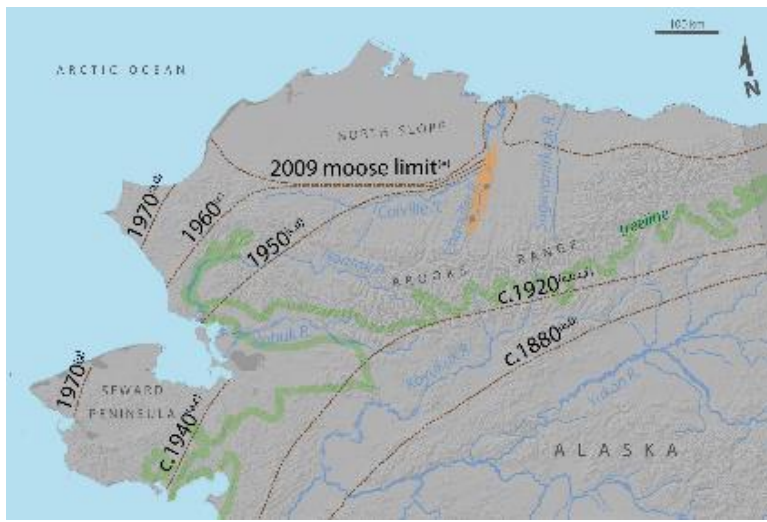
Existing tundra species



Departing tundra species



Arriving boreal species



Tape et al. 2016. Range expansion of **MOOSE** in arctic Alaska linked to warming and increased shrub habitat. PLoS ONE 11(4):e0152636



Tape et al. 2018. Tundra be dammed: **BEAVER** colonization of the Arctic. Global Change Biology 24:4478-4488



Balsam poplar
(*Populus balsamifera*)
well above treeline

Breen. 2014. **BALSAM POPLAR** (*Populus basamifera* L.) on the Arctic Slope of Alaska. Phytocoenologia 44:1-17

Arriving boreal species

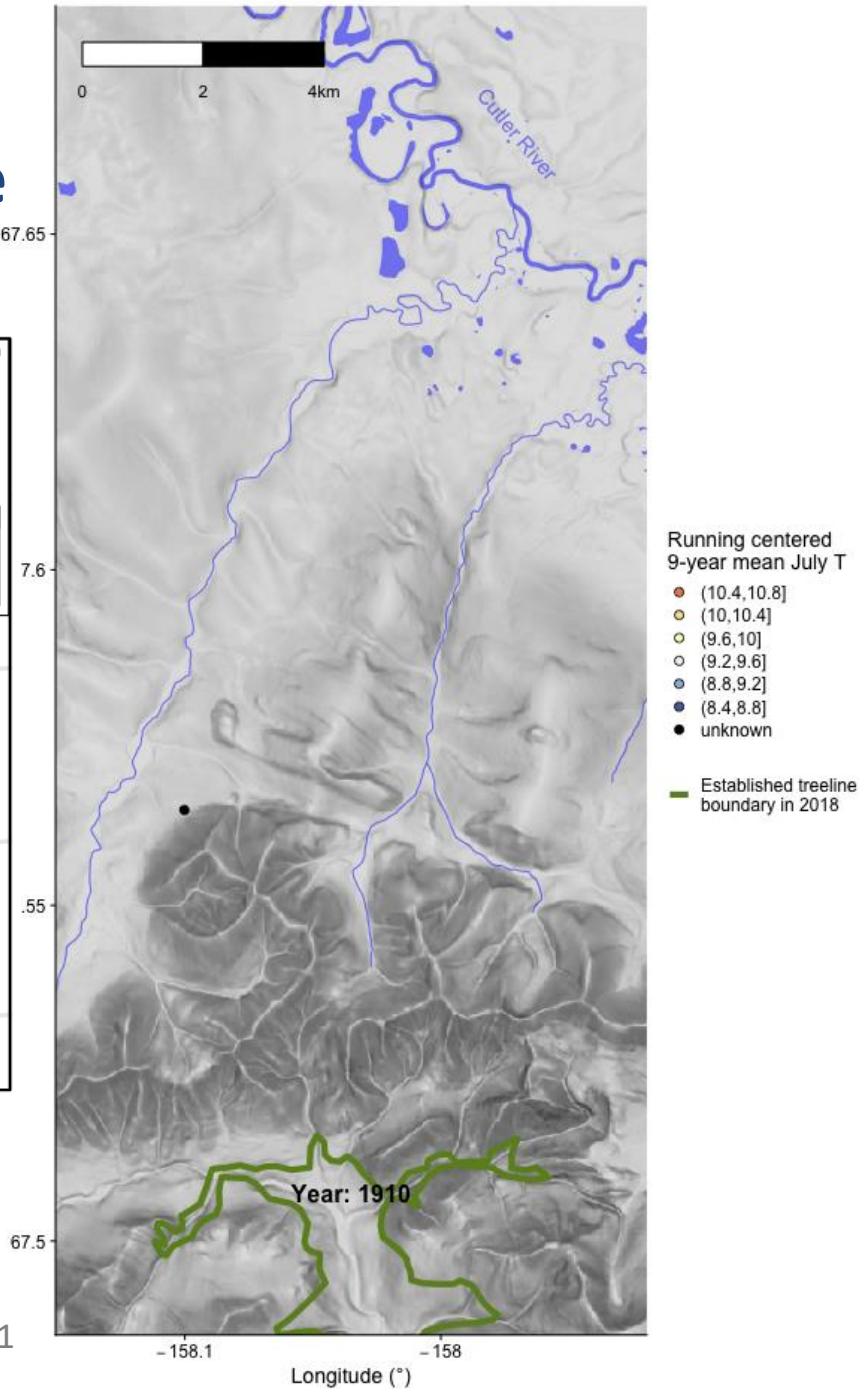
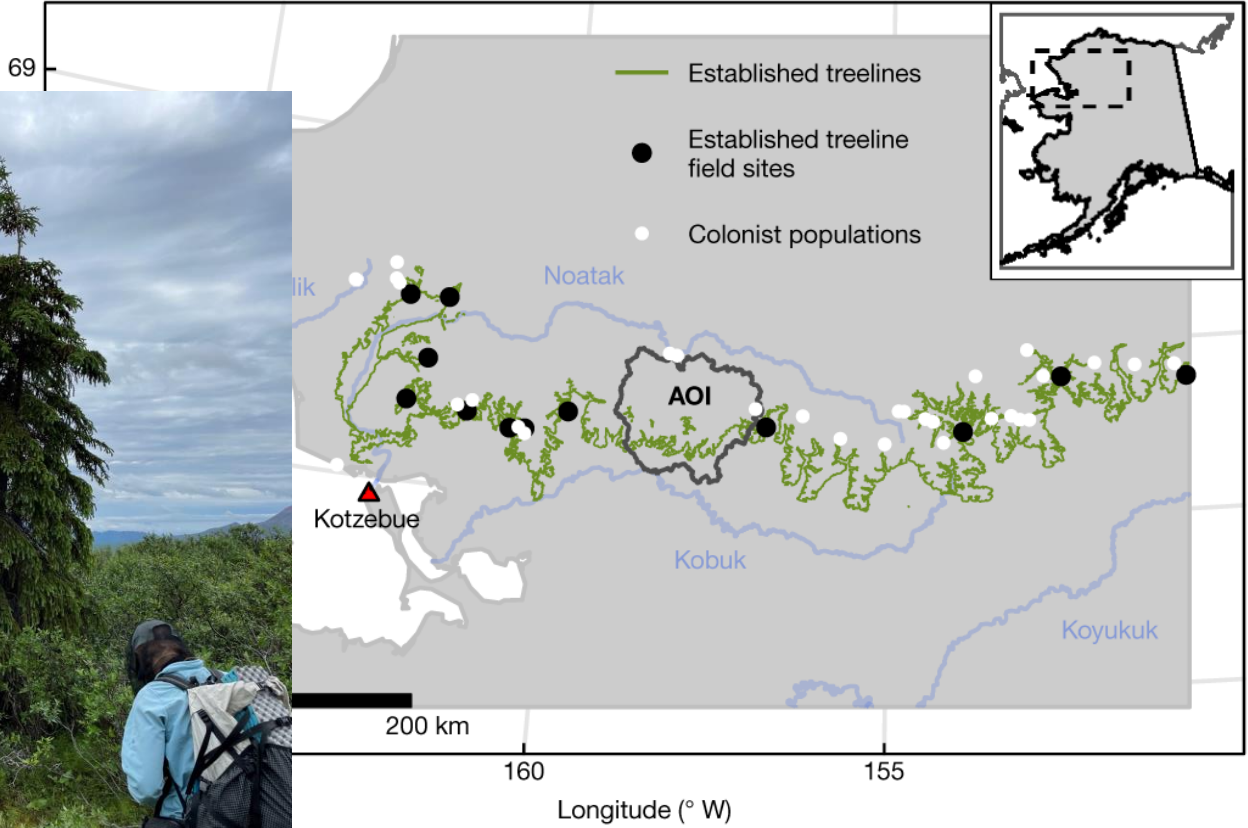


“Topographically mediated climate poses a strong environmental barrier (i.e., the Brooks Range) to species migration, causing a pronounced time lag [**1,000 years**] in forest expansion, or even preventing expansion altogether if temperature increases are $< 6^{\circ} \text{C}$ ”

— Rupp, Chapin & Starfield 2001

Modeling the influence of topographic barriers on treeline advance at the forest-tundra ecotone in northwestern Alaska. *Climatic Change* 48:399–416

In western Brooks Range, white spruce are expanding beyond treeline >2.5 miles per decade



Dial et al. 2022. Sufficient conditions for rapid range expansion of a boreal conifer. Nature 608:546–551

Arriving “boreal” species



Bird vetch



White sweetclover



Creeping thistle



Narrowleaf hawksbeard

Arriving boreal species



Chum salmon captured near Kaktovik in 2017



Arctic char in Kaktovik in the 1980s

“Borealization” as a process



Arctic tundra



Boreal forest



White-tailed deer and mule deer moving from Canada into Alaska



Sitka black-tailed deer

NEW! Deer in Alaska

In response to concerns over mule and white-tailed deer entering Alaska, the Board of Game made it possible for hunters to harvest those deer in **Units 1, 5, 11-13, 20, and 25** (no closed season, no limit, any mule deer or any white-tailed deer). Hunters must contact the nearest ADF&G office prior to harvesting the deer, and must return the entire carcass, including the hide, to ADF&G. Providing the required specimens helps ADF&G learn more about these animals and conduct disease surveillance. See page 4 for office contact information, or go online to <http://hunt.alaska.gov>. More information on mule deer and white-tailed deer is available at <http://alaska.gov/gotCE5V>.

Species	Height at Shoulder
Mule Deer	~4'6"
White-tailed Deer	~5'0"
Sitka Black-tailed Deer	~5'0"

Mule deer

Does: 110-165 lbs
Bucks: 150-250 lbs

Distinguishing characteristics: bifurcated antlers - each beam forks (bucks), antlers are larger when compared to Sitka black-tailed deer, black tipped tail, and large, mule-like ears. Not common in Alaska.

Photo Credits: David Ramirez, Utah Division of Wildlife Resources

White-tailed deer

Does: 100-160 lbs
Bucks: 150-225 lbs

Distinguishing characteristics: antlers that have one main beam with individual tines growing off of it (bucks), outside of tail is brown, and underside of tail is bright white and visible when nervous or fleeing. Not common in Alaska.

Photo Credit: National Park Service

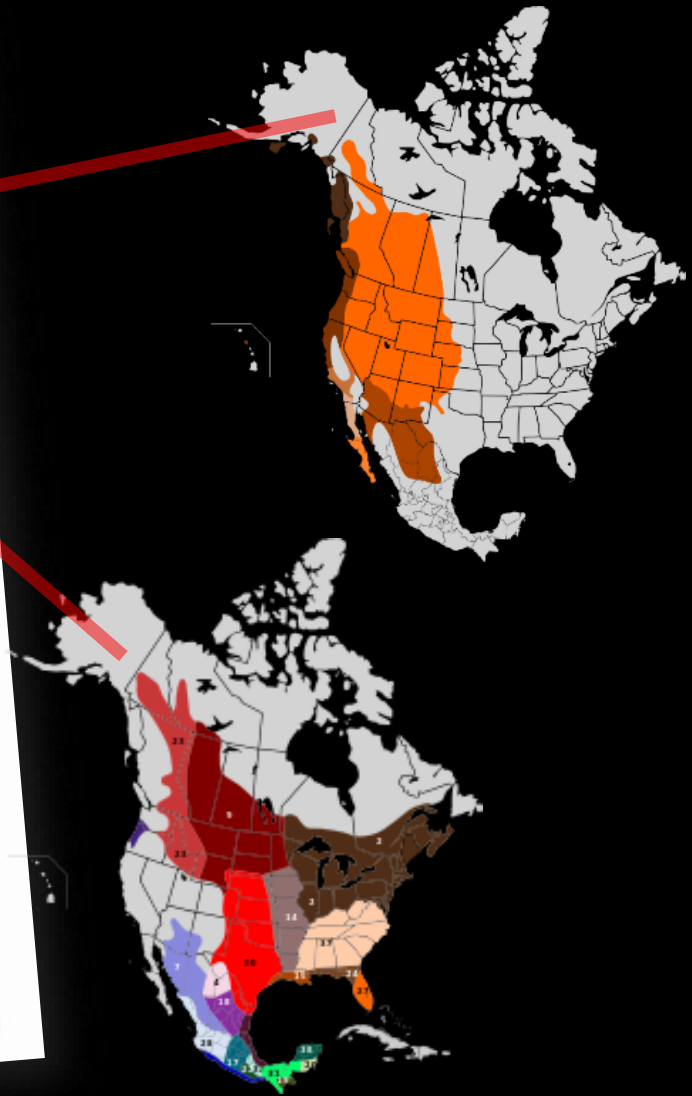
Sitka black-tailed deer

Does: 80 lbs
Bucks: 120-200 lbs

Distinguishing characteristics: bifurcated antlers - each beam forks (bucks), antlers are smaller when compared to mule deer, outside of tail is entirely black or dark brown, and the face is dark.

Common in Southeast Alaska, Prince William Sound, and Kodiak.

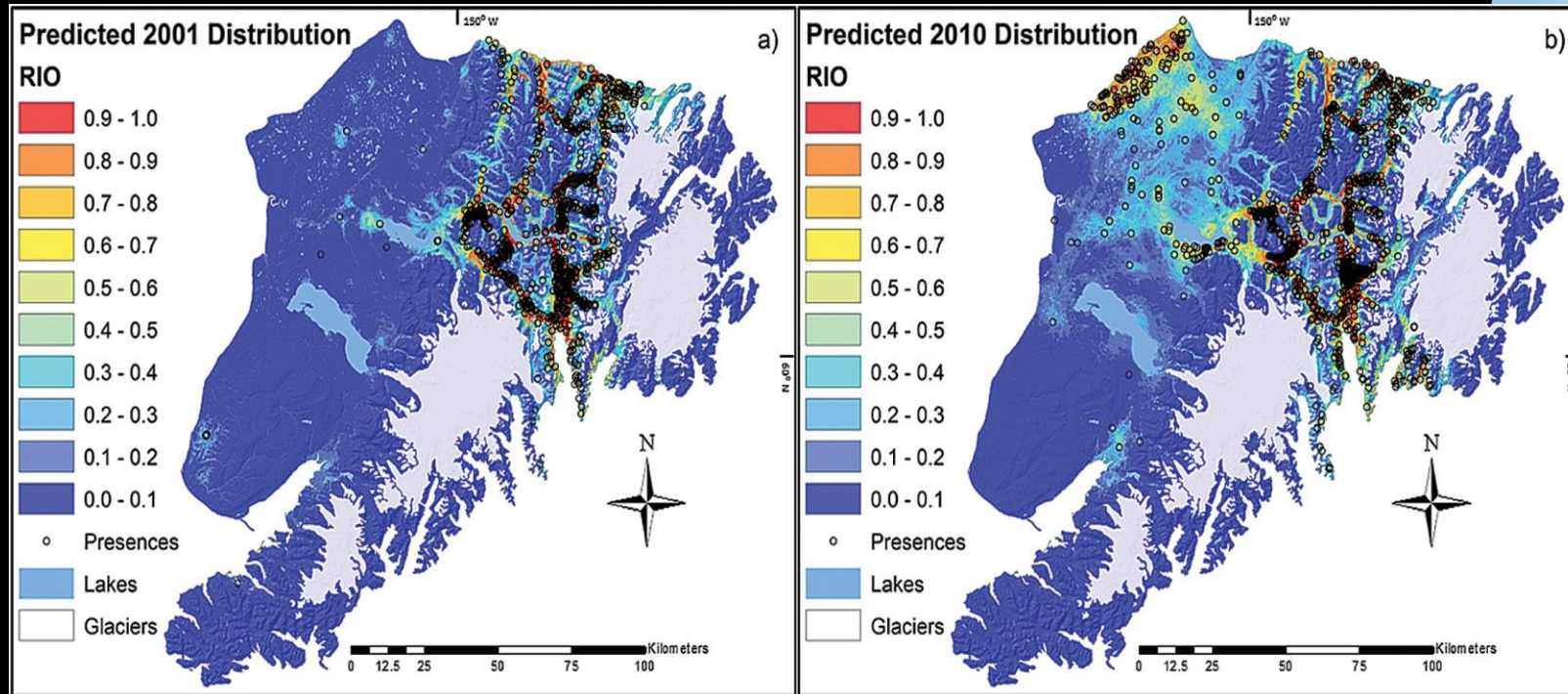
28 2019-2020 Alaska Hunting Regulations effective July 1, 2019 through June 30, 2020



Fishers are colonizing Southeast Alaska from British Columbia



American marten are spreading on to the Kenai Lowlands



Baltensperger, Morton & Huettmann. 2017. Expansion of American marten (*Martes americana*) distribution in response to climate and landscape change on the Kenai Peninsula, Alaska. *J Mammology* 98:703-714

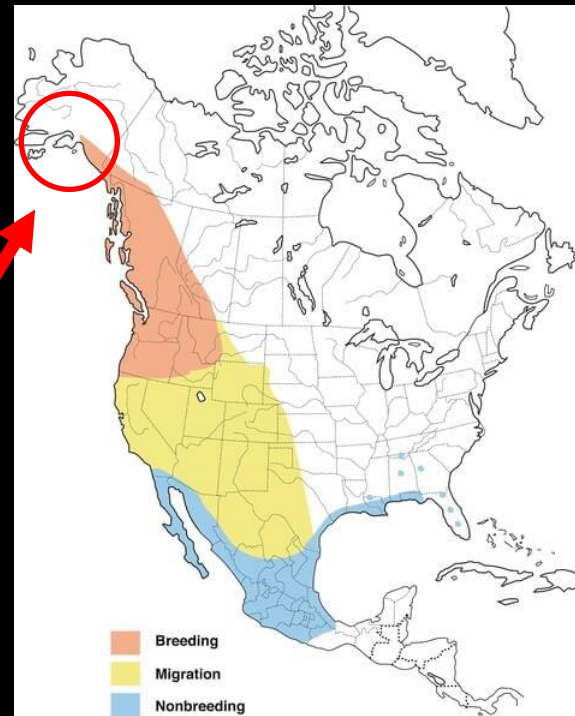
Rufous hummingbird



Anna's hummingbird



Kenai Peninsula



Looking Towards the Future

“Wild foods are an integral component of food security for Alaskans, especially those living in rural areas. Wild food harvest is more than just a way to meet nutritional needs – it is a critical component of Alaskan cultures and ways of life. Traditional wild harvest practices are sustained primarily through local decisions to manage climate change related risks, employing adaptation strategies such as

- finding new hunting areas
- substituting harvest species for other wild foods
- altering processing tactics
- using different modes of transportation

However, additional legal, political, and **managerial actions** have potential to help Alaskans adapt to the impacts of climate change on wild food harvest.”



RAD framework squarely assigns the adaptation response to a managerial/societal/tribal decision

RAD

can help navigate unprecedented ecosystem change



**Re-create ice habitat with
alternative habitat (ACCEPT)**



**Walrus are hauling out on land as
sea ice shrinks in the Bering Sea**



Re-create ice habitat with artificial habitat (RESIST)



Wally the Walrus and his “floating couch” off the coast of Ireland

Walrus are hauling out on land instead of ice in the Bering Sea

Re-create forested habitat with new tree species (DIRECT)



Lodgepole pine plantation near Homer
(Ninilchik Native Association)



Yellow cedar near Port Graham
(Chugachmiut)

Accept until when?



First white spruce north of the Brooks Range not deliberately planted

“The authors welcome comments on whether to protect or pull this likely human-introduced seedling or leave its future to chance...”

—Wendy Elsner and Janet Jorgenson (2009)