Yukon Lowlands
Kuskokwim Mountains
Lime Hills
Rapid Ecoregional Assessment
AMT 4 – Summarize Products

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Rapid Ecoregional Assessment

Agenda

REA Overview, Meeting Goals, Schedule

Integrated Products

Conservation Element Product Examples

Change Agent Product Examples

Discussion

Project Team

University of Alaska

- Alaska Natural Heritage Program (AKNHP - UAA)
- Institute of Social and Economic Research (ISER - UAA)
- Scenarios Network for Alaska & Arctic Planning (SNAP - UAF)

Margaret J. King & Associates

community engagement and facilitation

Purpose

To provide an overview of YKL-REA products to the members of the Assessment Management Team and Technical Team.

To provide an opportunity for initial, collective input from the Assessment Management Team and Technical Teams.

Goal

To obtain approval of expected products to allow the UA Team to develop REA documents and materials.

REA Process Overview

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Rapid Ecoregional Assessment

Initiation

Completed

- Establish assessment management team and technical team
- Define preliminary management questions
- Prepare an Assessment Work Plan
- Prepare statements of work
- Establish Contracts and Agreements

Phase I

Completed

Task 1 – 3 Months

- Develop base ecoregional model
- Refine management questions
- Select conservation elements (CEs)
- Select change agents (CAs)

Task 2 – 2 Months

Identify, Evaluate, and Recommend Potential Datasets

Task 3 – 3 Months

Identify, Evaluate, and Recommend Methods, Models, and Tools

Task 4 – 2 Months

Prepare Rapid Ecoregional Assessment Work Plan (REAWP)

Phase II

Oct. 2013 –July 2014

Task 5 – 3 Months

Compile and Generate "Source" Datasets

Task 6 – 5 Months

- Conduct Analyses
- Generate Findings

Task 7 – Completed 18 Mo.

Prepare REA Documents

Task 6 Objectives

Present **primary results***

Describe **issues and concerns** with analyses

Receive **feedback and guidance** from AMT prior to completion

Make **correction or changes using AMT guidance** and incorporate into the work effort

Phase II: Task 6/7 Schedule

Task 6: Conduct Analyses and Generate Findings

AMT 4 Workshop (Dec. 13)
- Workshop summary/Updated memo reflecting technical team comments (Dec. 19)
- AMT Comments (Jan. 10)

Final Memo (Jan. 24)

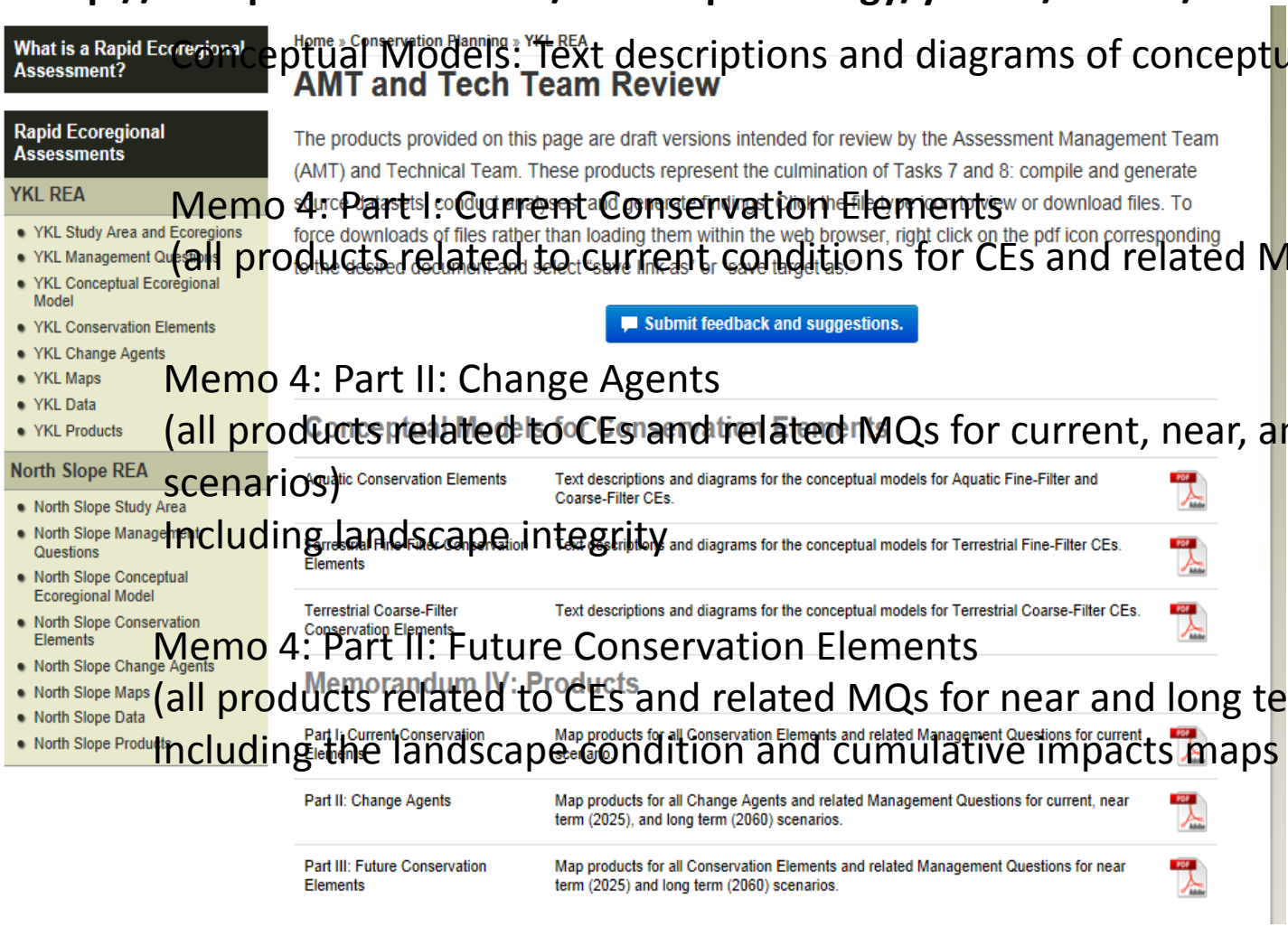
Task 7: Prepare REA Documents
(specific dates provided no later than Feb. 28)

Draft REA documents and materials (beginning May)
Technical team review & comments (middle May)
AMT 5 Workshop (middle May)
- Workshop summary/updated memo reflecting technical team comments (middle May)
- AMT Comments (beginning June)

Final REA Documents, Materials, and Datasets (July 7)

Memo 4 (Map Book): Product Overview

What's on our website:
http://aknhp.uaa.alaska.edu/landscape-ecology/ykl-rea/review/#content



Conceptual Models: Text descriptions and diagrams of conceptual models

Memo 4: Part I: Current Conservation Elements
(all products related to current conditions for CEs and related MQs)

Memo 4: Part II: Change Agents
(all products related to CEs and related MQs for current, near, and long term scenarios)
Including landscape integrity

Memo 4: Part II: Future Conservation Elements
(all products related to CEs and related MQs for near and long term scenarios)
Including the landscape condition and cumulative impacts maps

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Integrated Products

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Landscape Condition Model

Theme	Data Source	Description	Site Impact Score	Est. Relative Stress	Decay Distance (m)
Transportation					
Trails	ADNR	River travel routes, historic non-mechanical trails, winter trails	0.7	Low	500
Dirt roads, 4-wheel drive	DOT	Tractor Trails, Ididarod Trail	0.5	Low	500
Local and connecting roads			0.5	Medium	500
Haul Roads	DOT	Dirt Highways	0.2	High	2500
Primary Highways with limited access	DOT	Secondary Roads	0.05	Very High	5000
Primary Highways w/out limited access	DOT		0.05	Very High	5000

Data Gap

Not Present in YKL

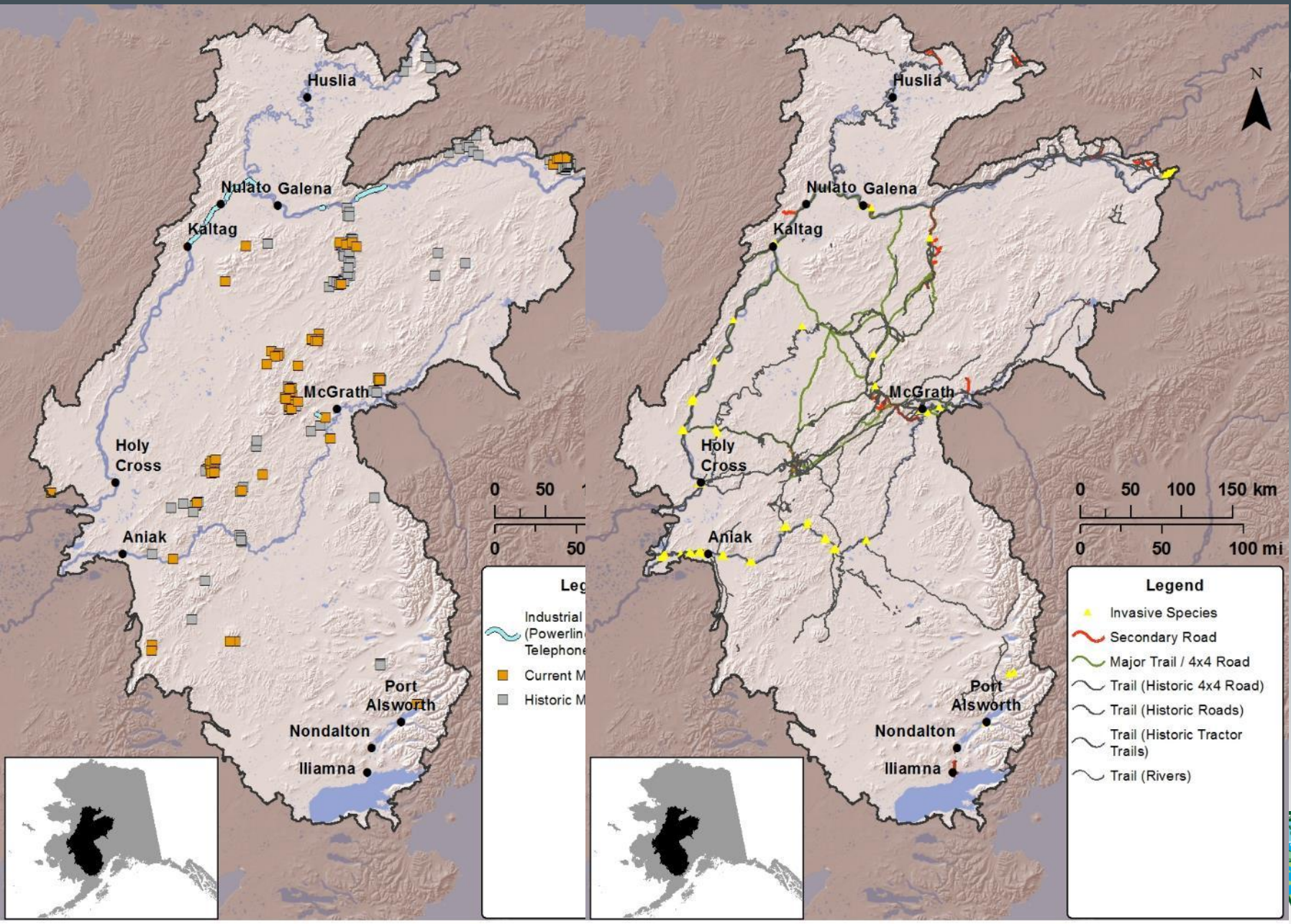
Landscape Condition Model

Theme	Data Source	Site Impact Score	Est. Relative Stress	Decay Distance (m)
Urban and Industrial Development				
Low Density Development	NLCD 2001	0.6	Medium	1000
Medium Density Development	NLCD 2001	0.5	Medium	1000
Powerline/Transmission lines	USGS/AK DNR	0.5	Medium	500
Oil /gas Wells	BLM/AK DNR	0.5	Medium	500
High Density Development	NLCD 2001	0.05	Very High	5000
Historic Mines	ARDF/BLM/ State	0.5	Medium	500
Current Mines	ARDF/BLM/ State	0.05	Very High	1500

Landscape Condition Model

Theme	Data Source	Site Impact Score	Est. Relative Stress	Decay Distance (m)
Managed and Modified Land Cover				
Ruderal Forest & Upland	AK Mosaic	0.9	Very Low	0
Native Veg. with introduced Species	AK Mosaic/AKEPIC	0.9	Very Low	0
Recently Logged	AK Mosaic	0.9	Very Low	200
Managed Tree Plantations	AK Mosaic	0.8	Low	200
Introduced Tree & Shrub	AK Mosaic/AKEPIC	0.5	Medium	200
Introduced Upland grass & forb	AK Mosaic/AKEPIC	0.5	Medium	200
Introduced Wetland	AK Mosaic/AKEPIC	0.3	High	200
Cultivated Agriculture	AK Mosaic	0.3	High	200
Not Present in YKL				

Landscape Condition Model



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Landscape Condition Model

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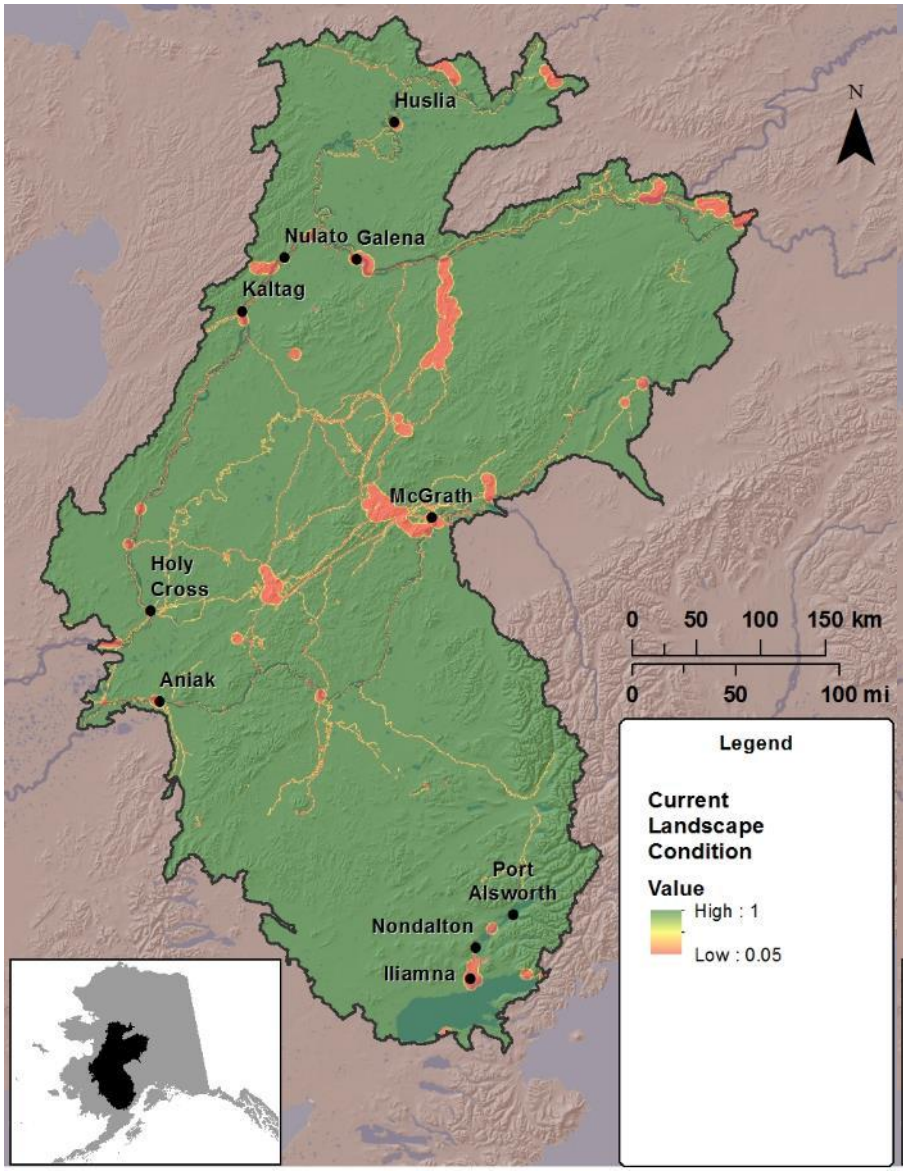

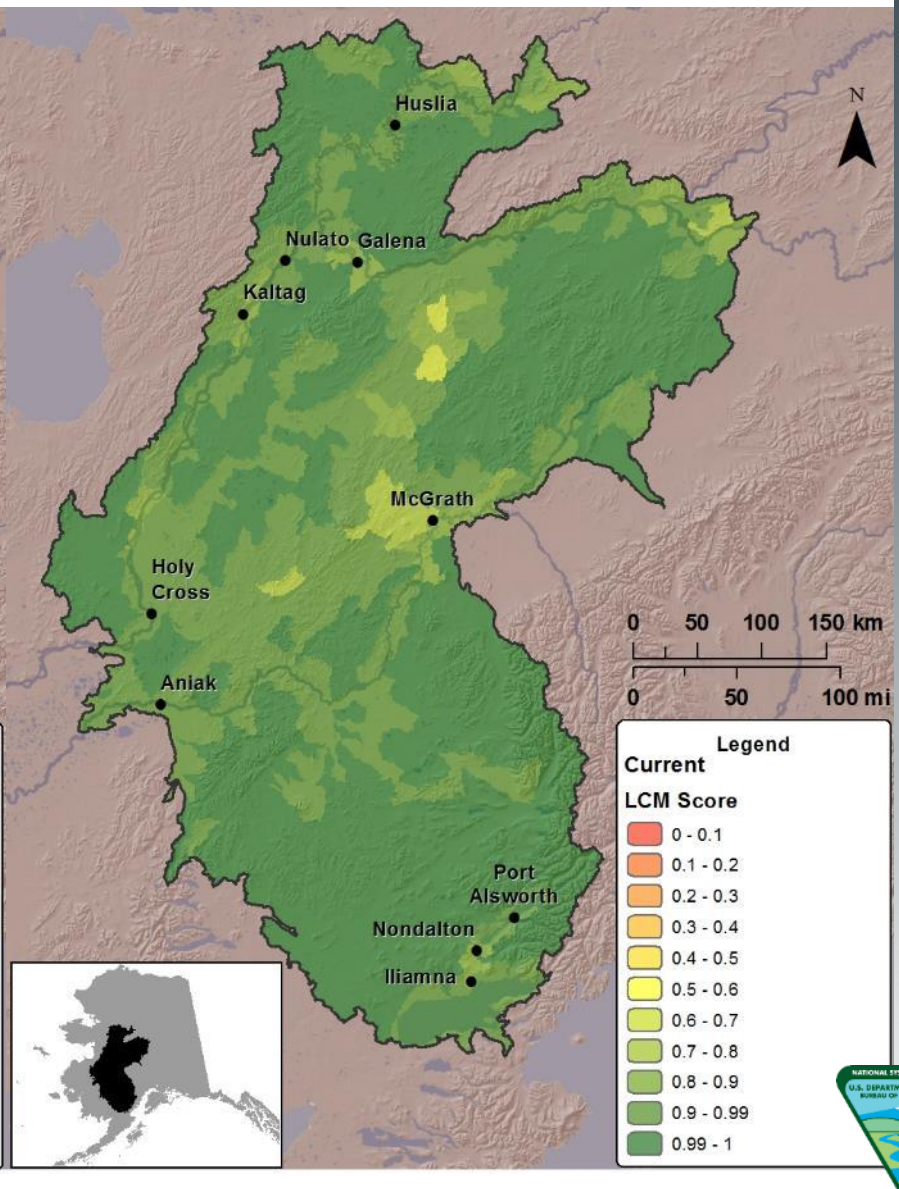

Landscape Condition Model

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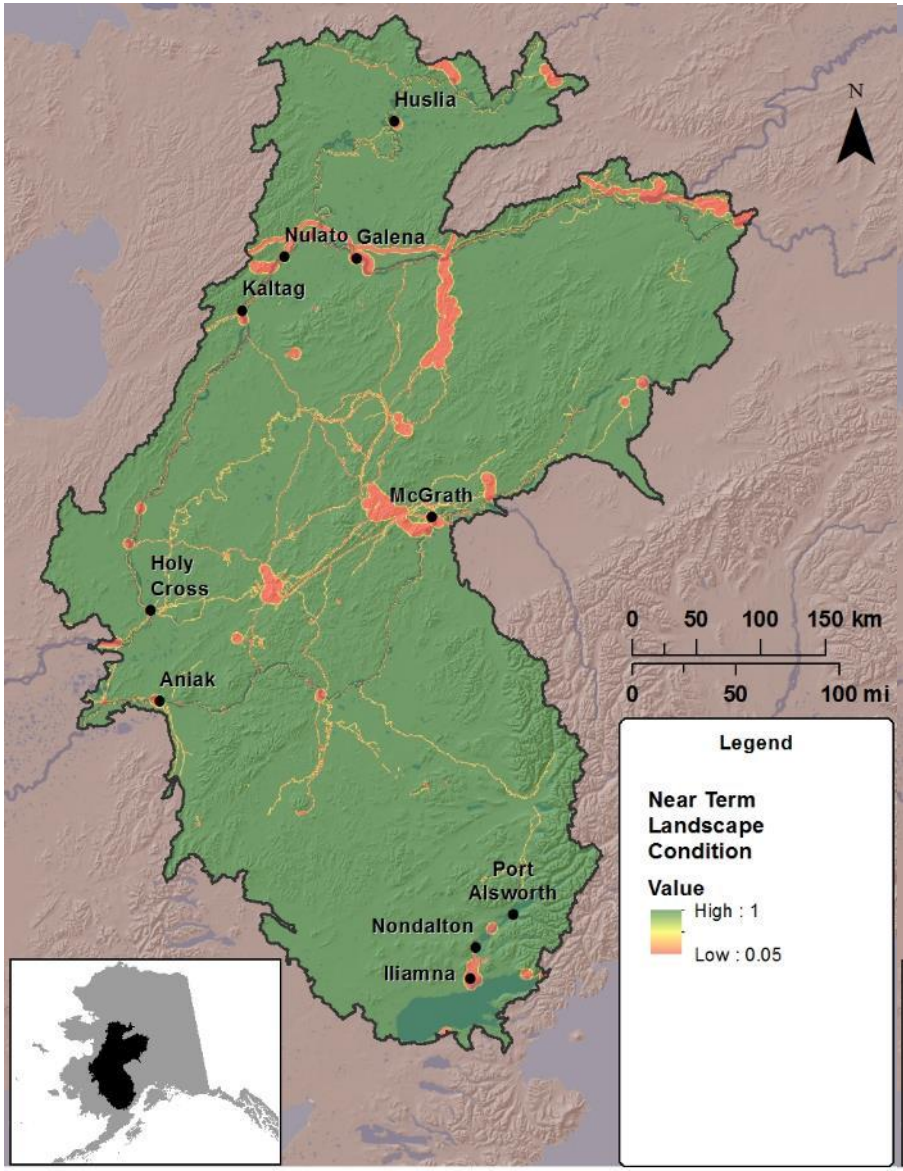
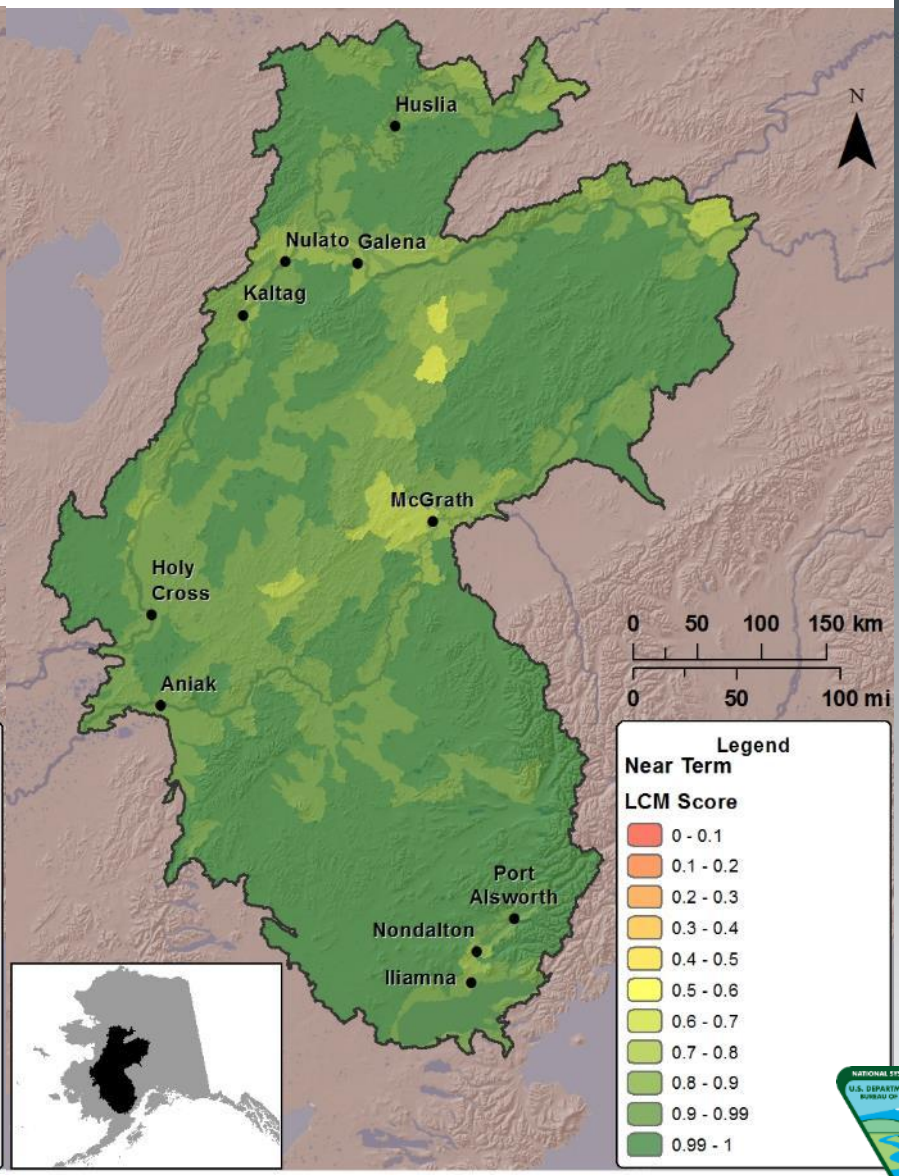
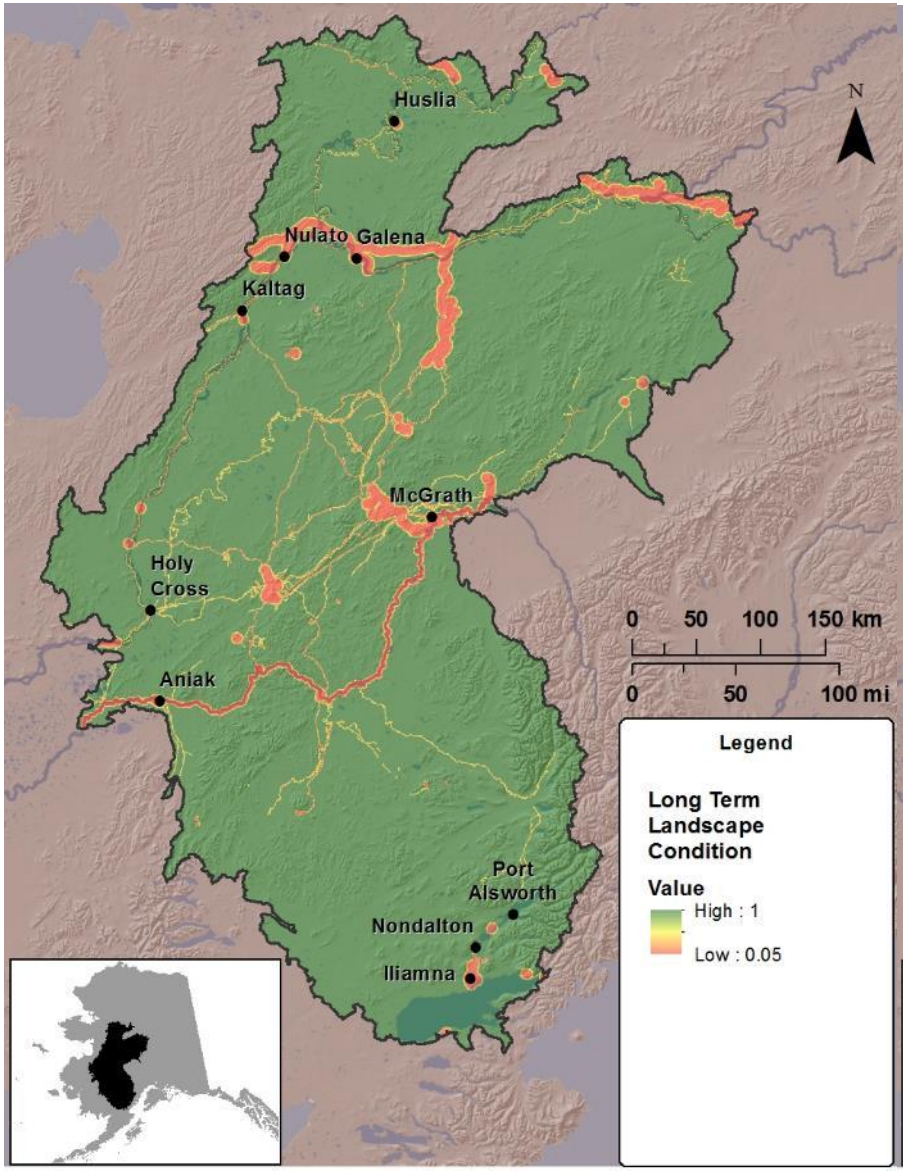
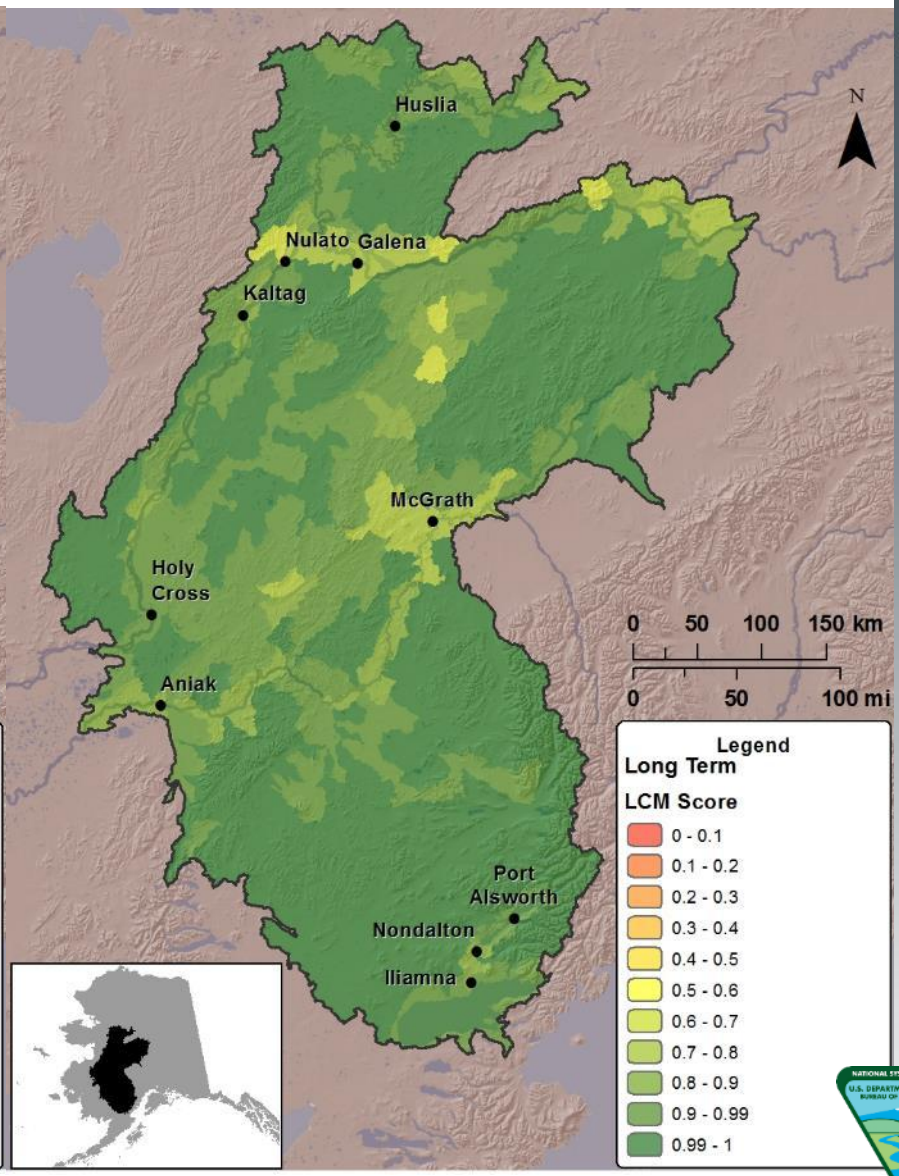
Rapid Ecoregional Assessment



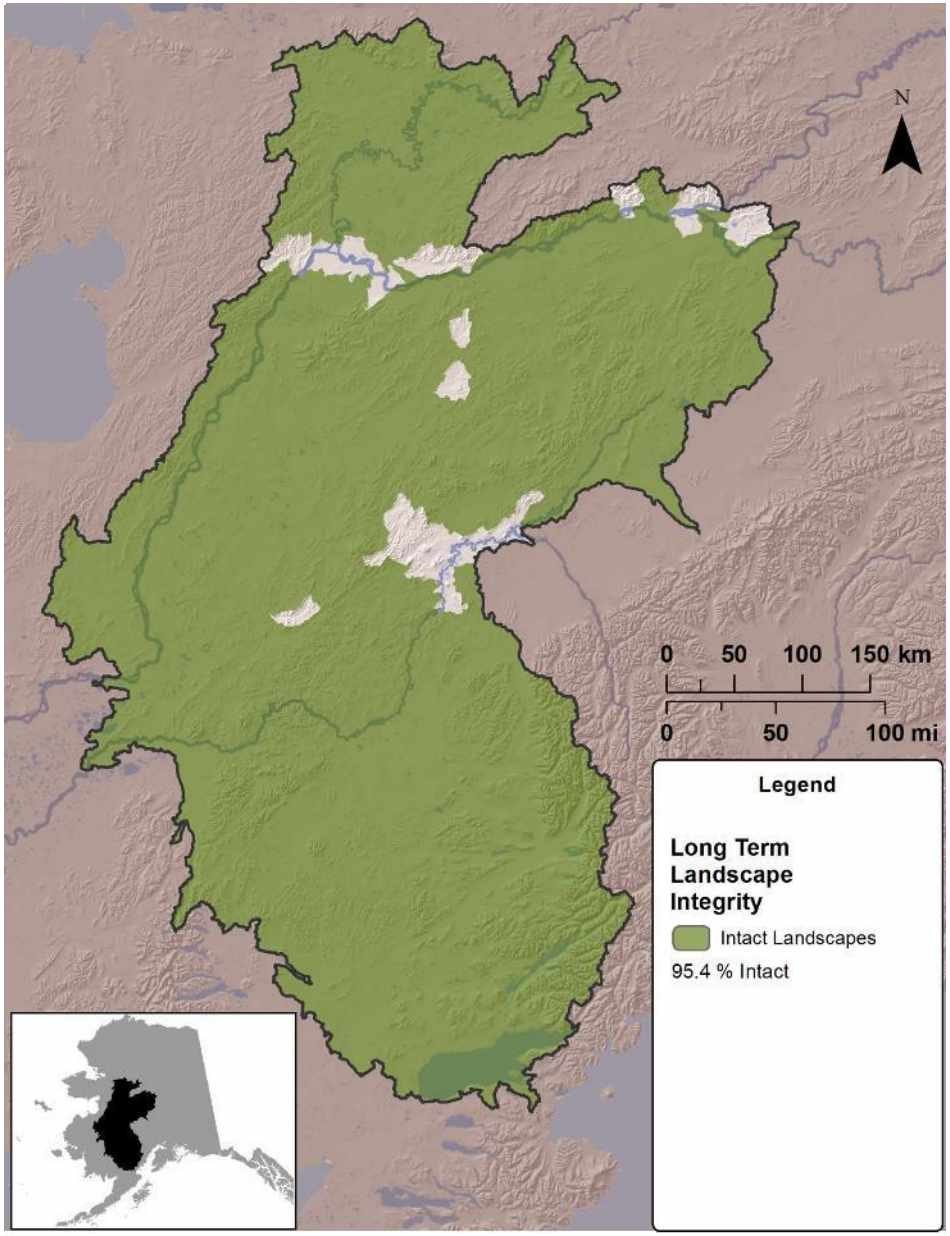


Landscape Condition Model

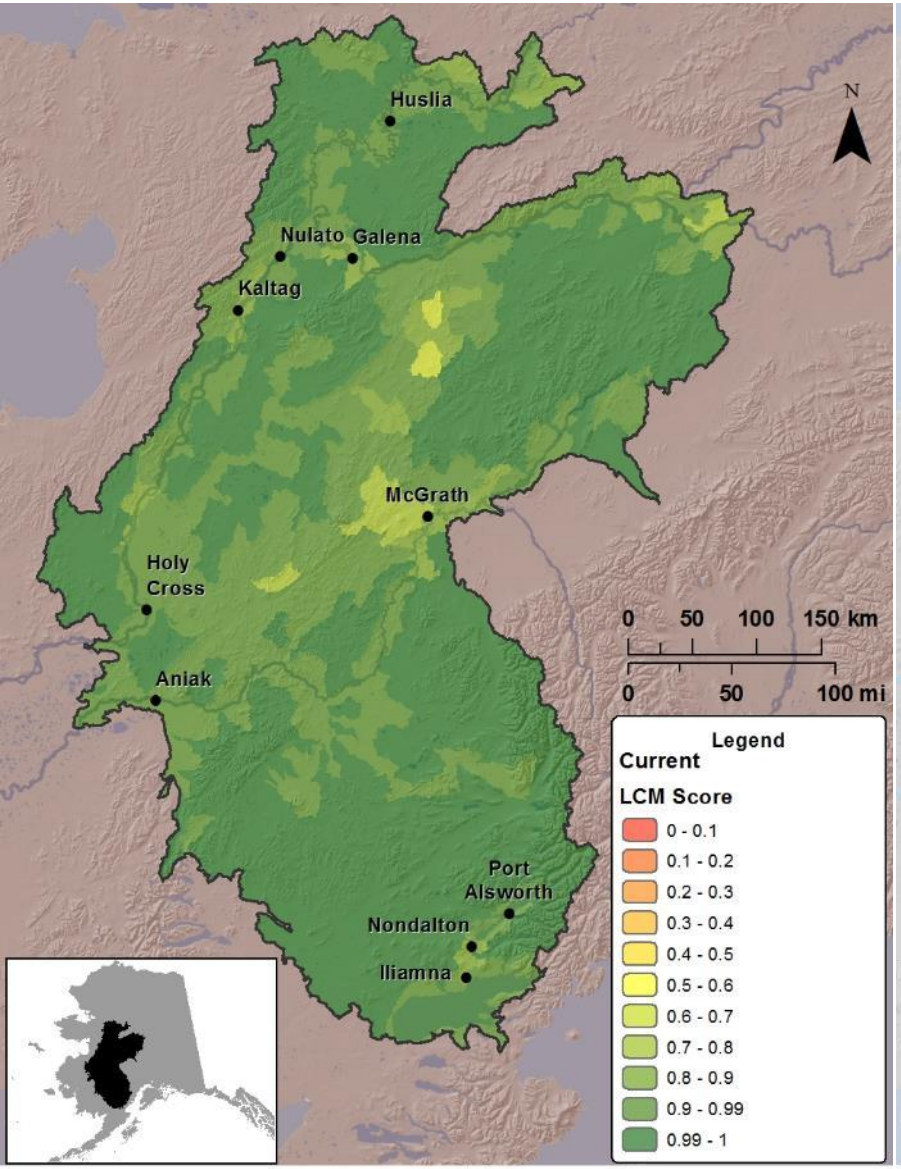


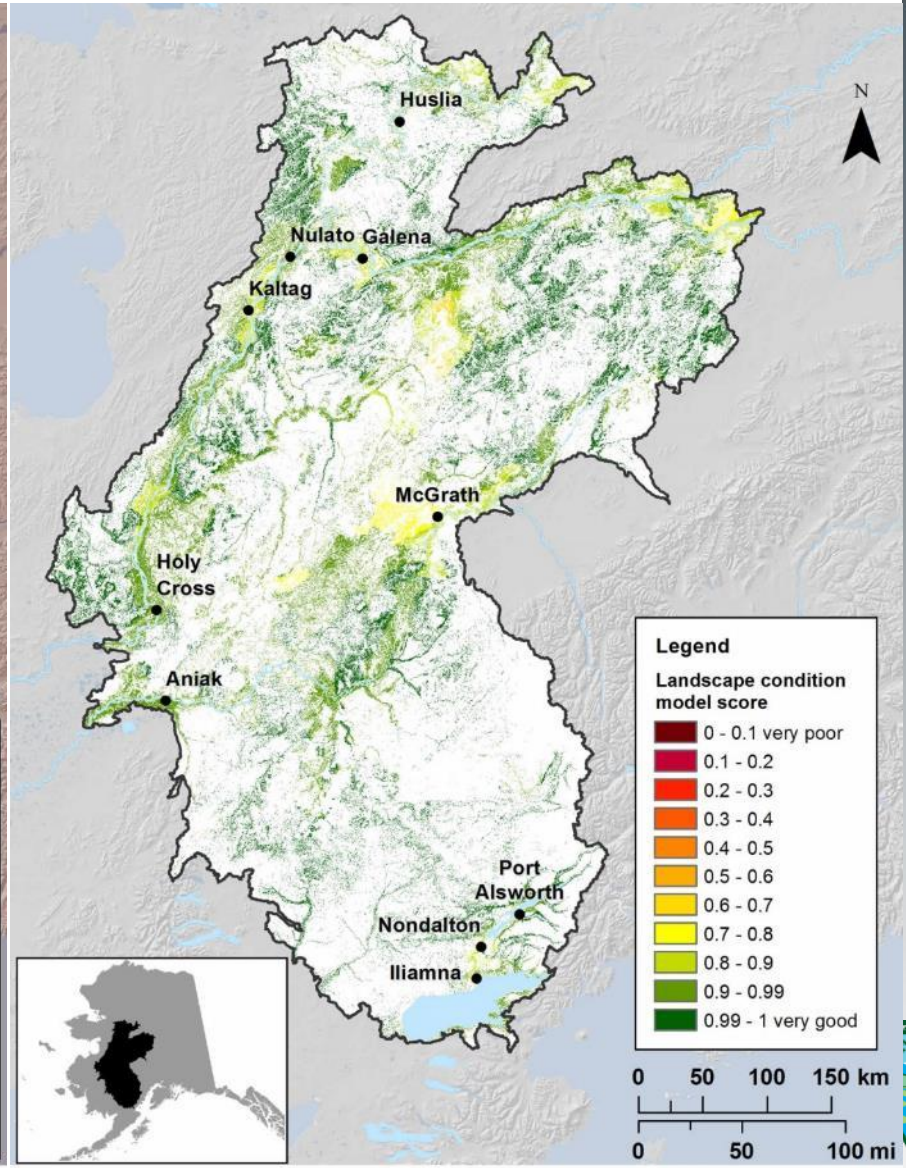


Landscape Integrity



Status Assessments





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Rapid Ecoregional Assessment

Status Assessments

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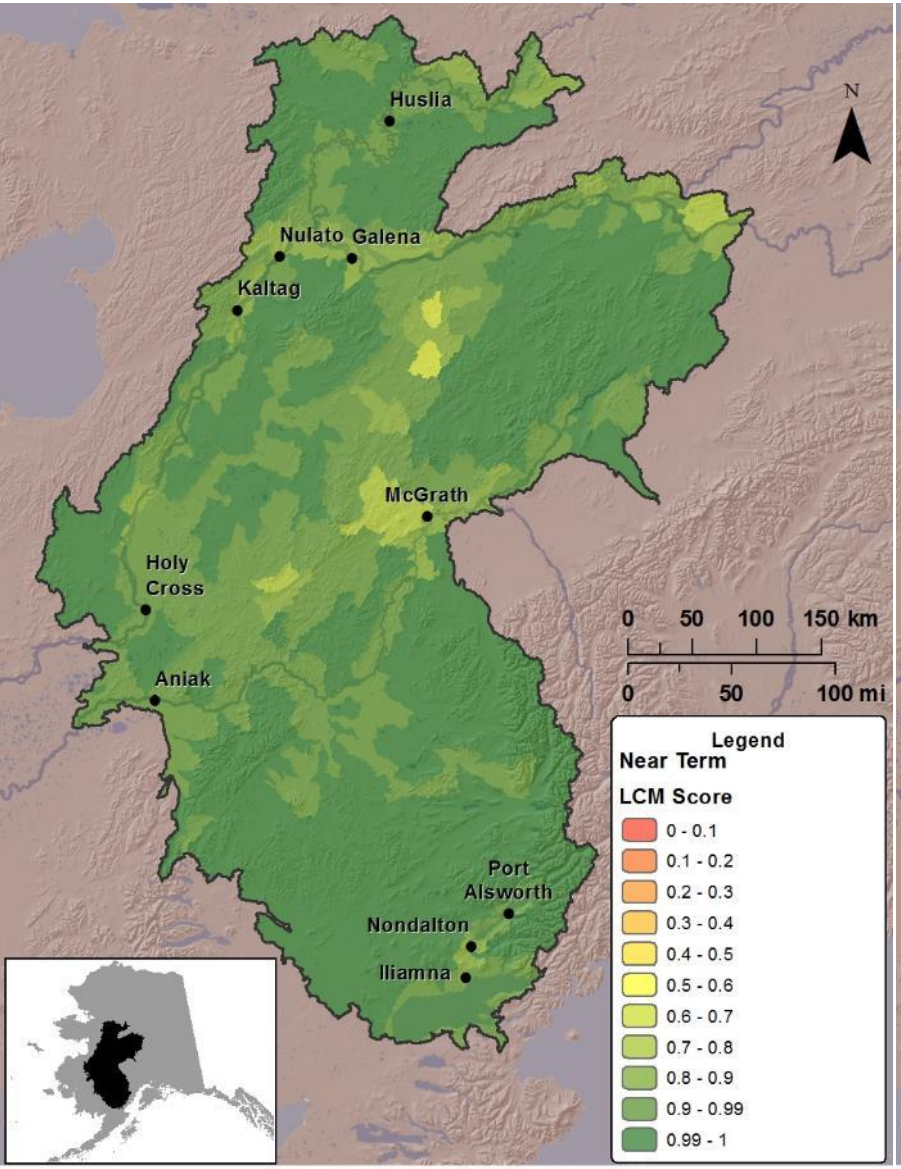
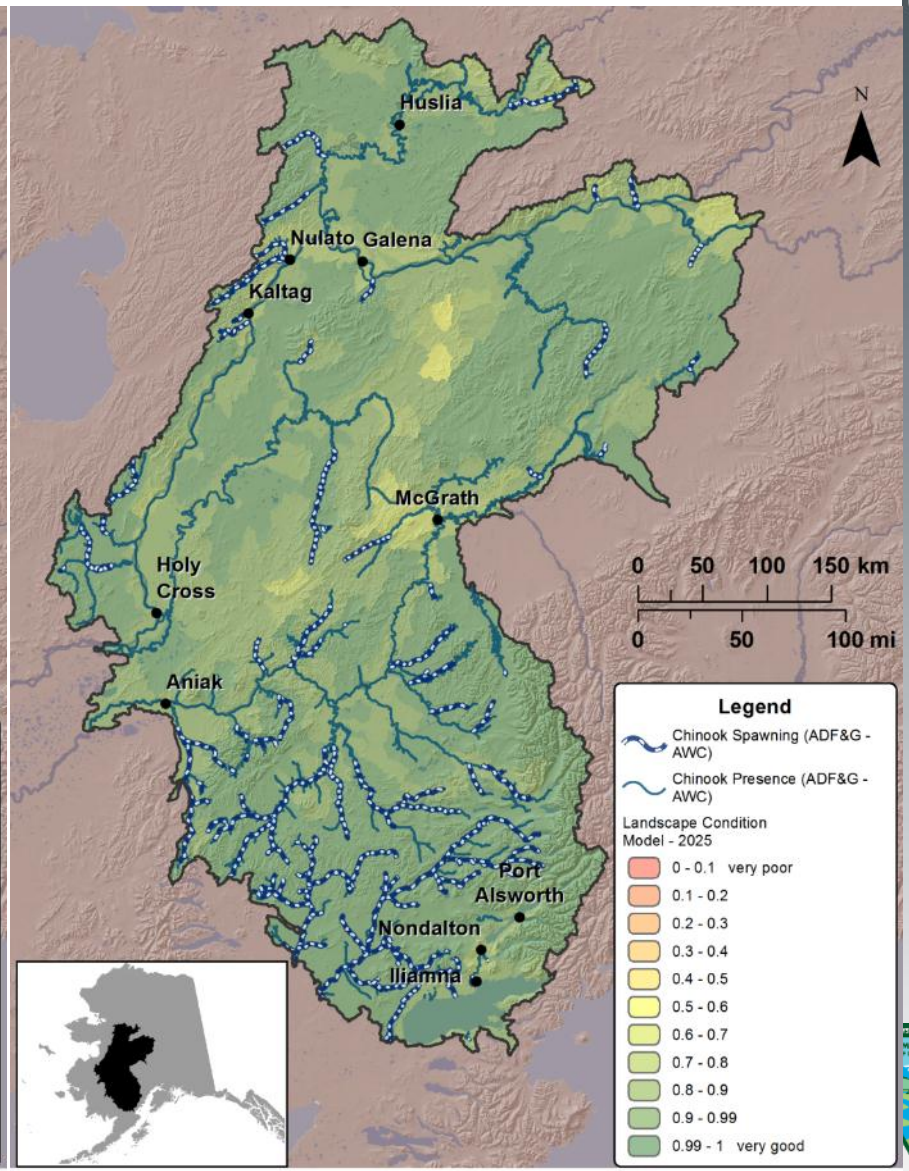
Rapid Ecoregional Assessment





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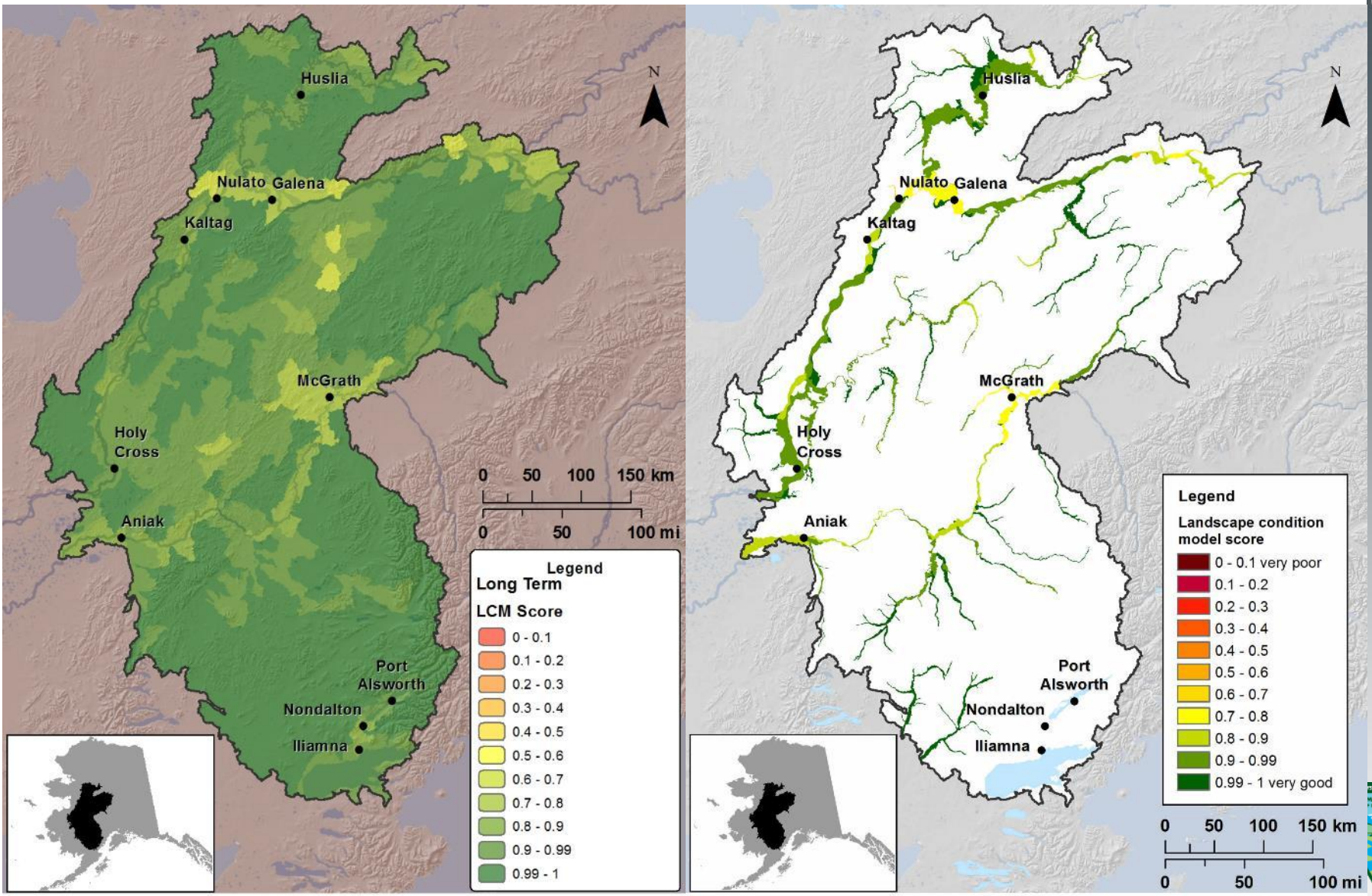

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Rapid Ecoregional Assessment

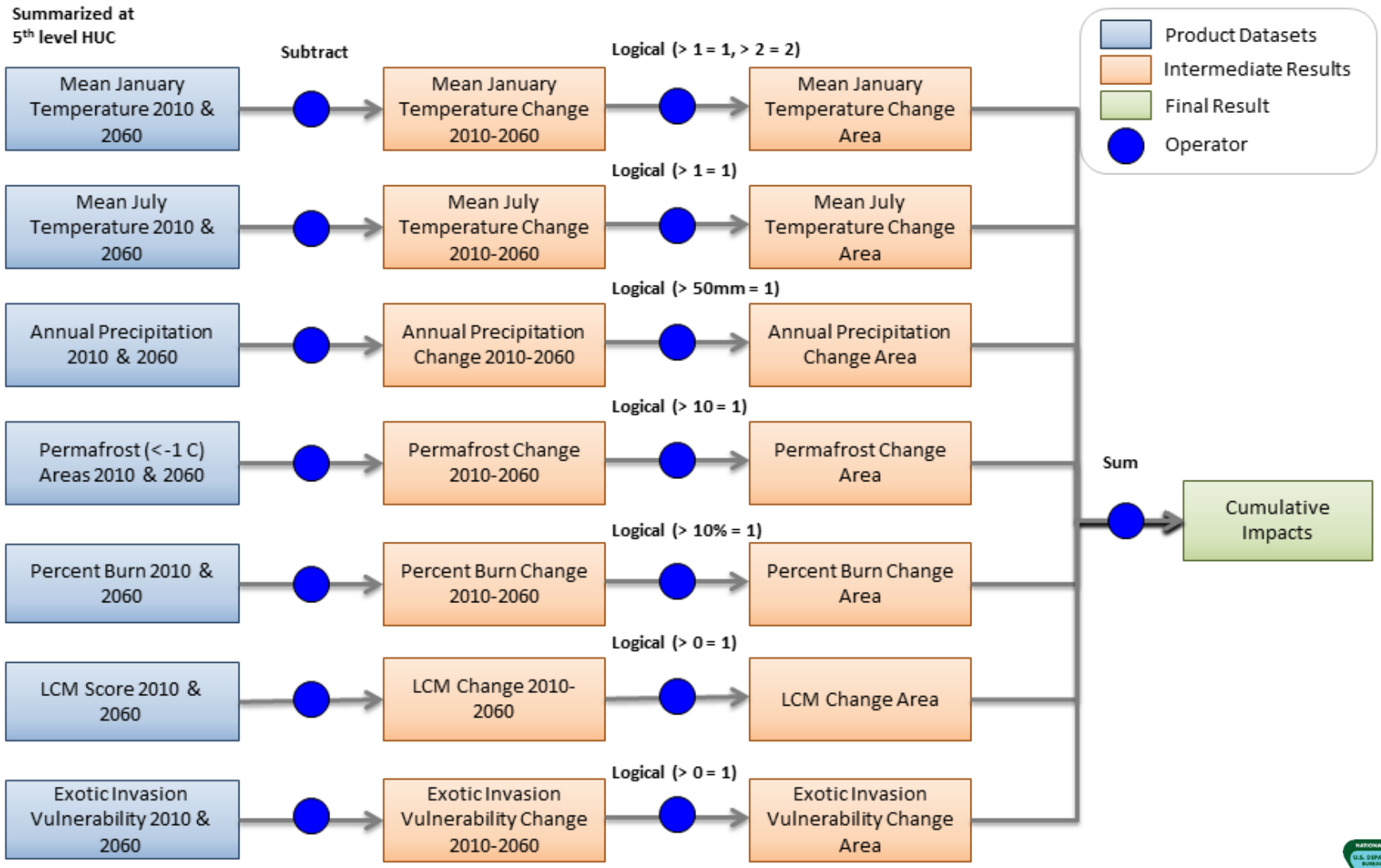
Cumulative Impacts

Summation of all Change Agents

1. Climate
2. Fire
3. Permafrost
4. Invasive Species
5. Land Use and Development

- Identifying *areas* of change
- Quantifying change

Cumulative Impacts



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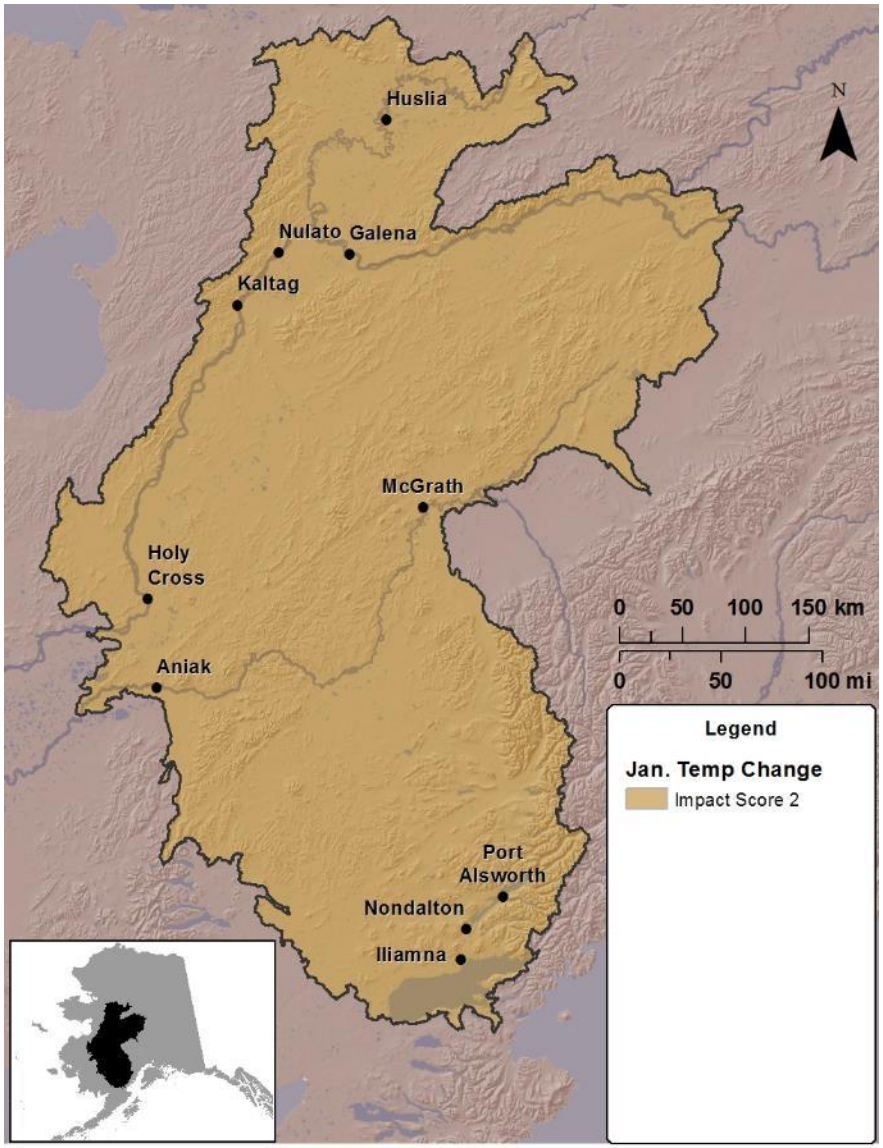
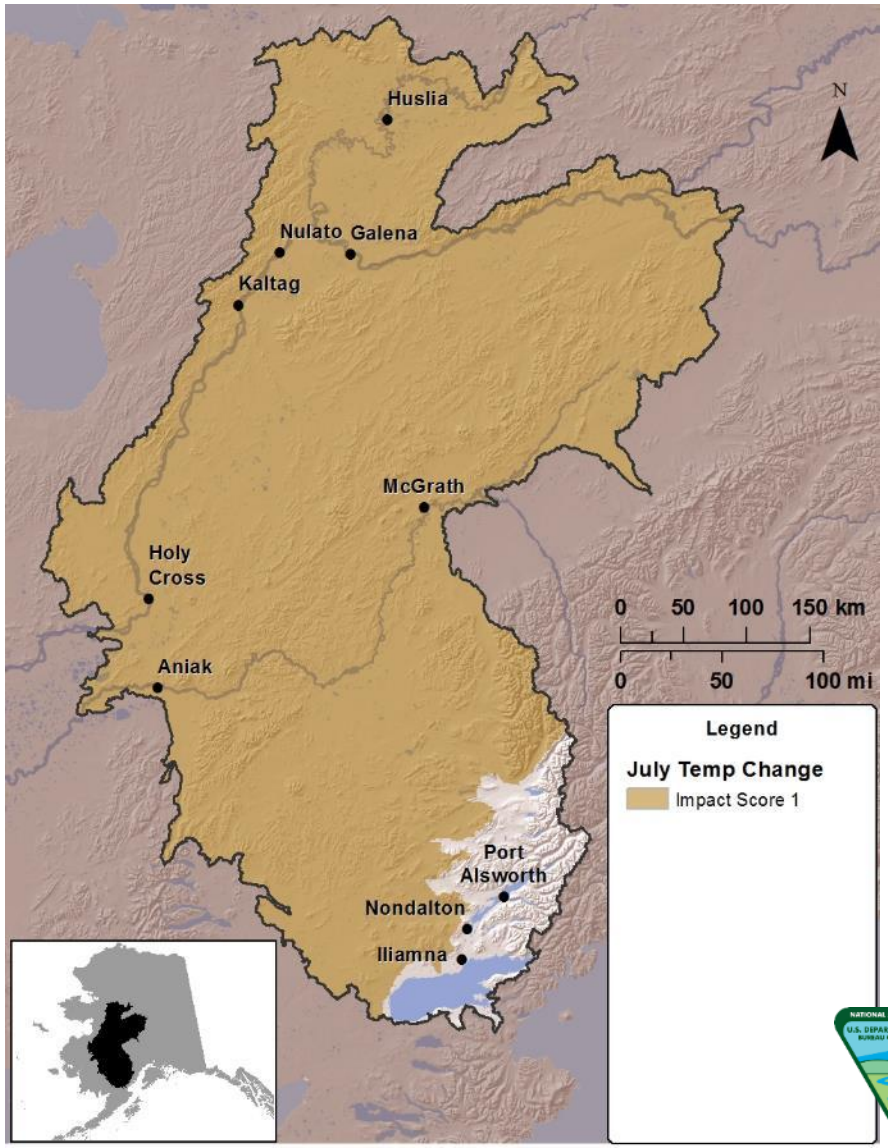
Rapid Ecoregional Assessment

Cumulative Impacts





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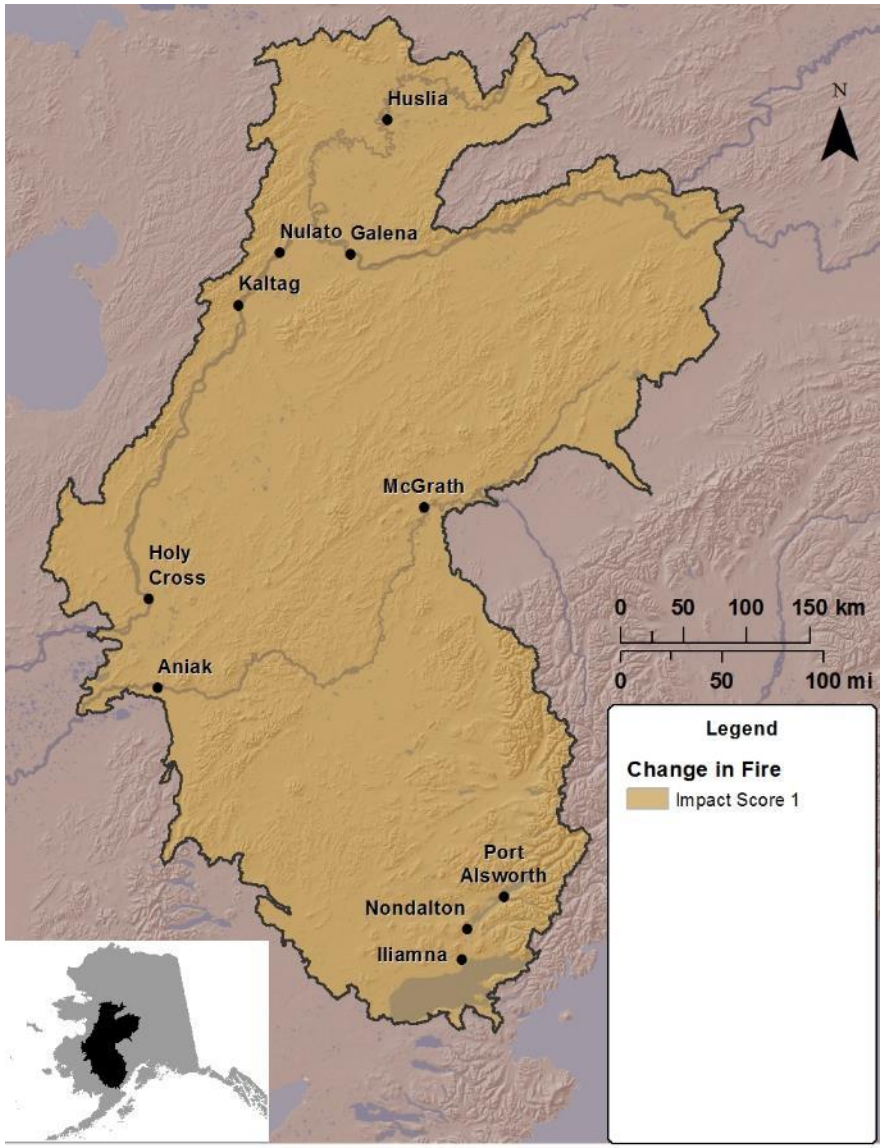

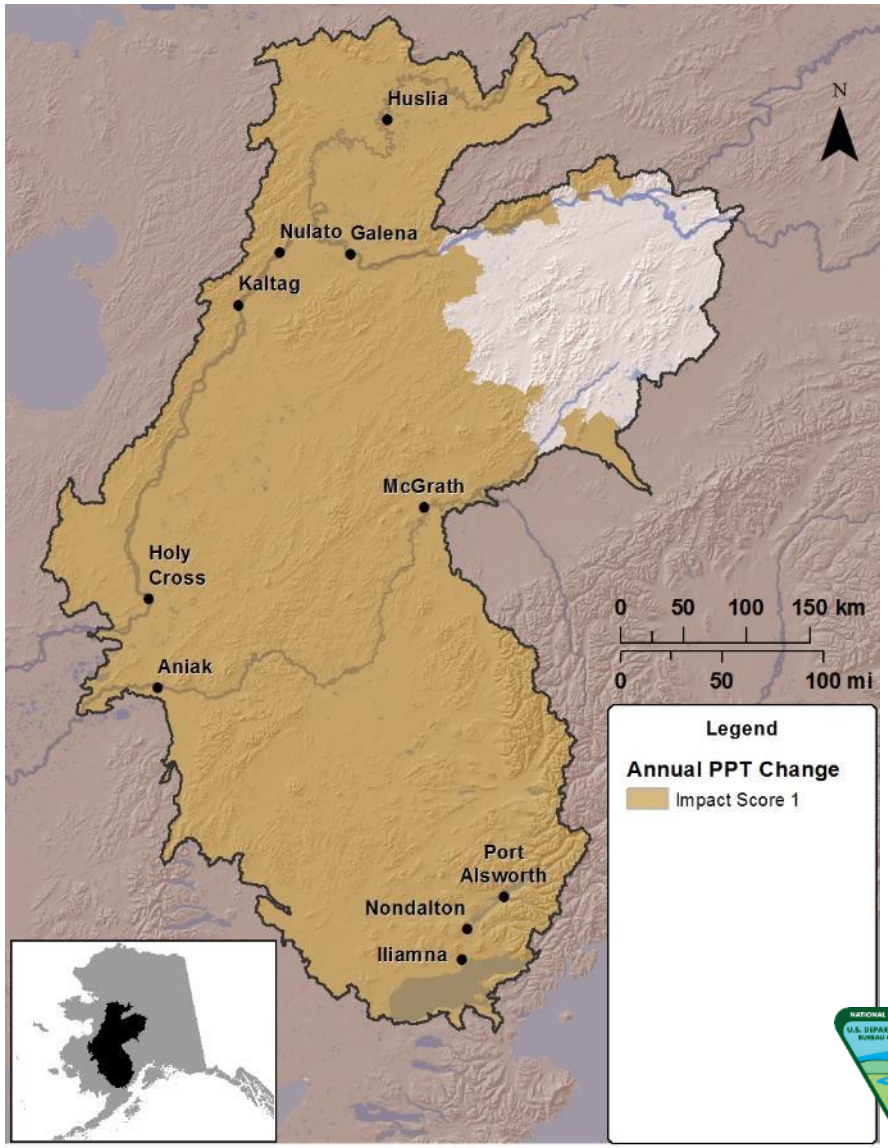

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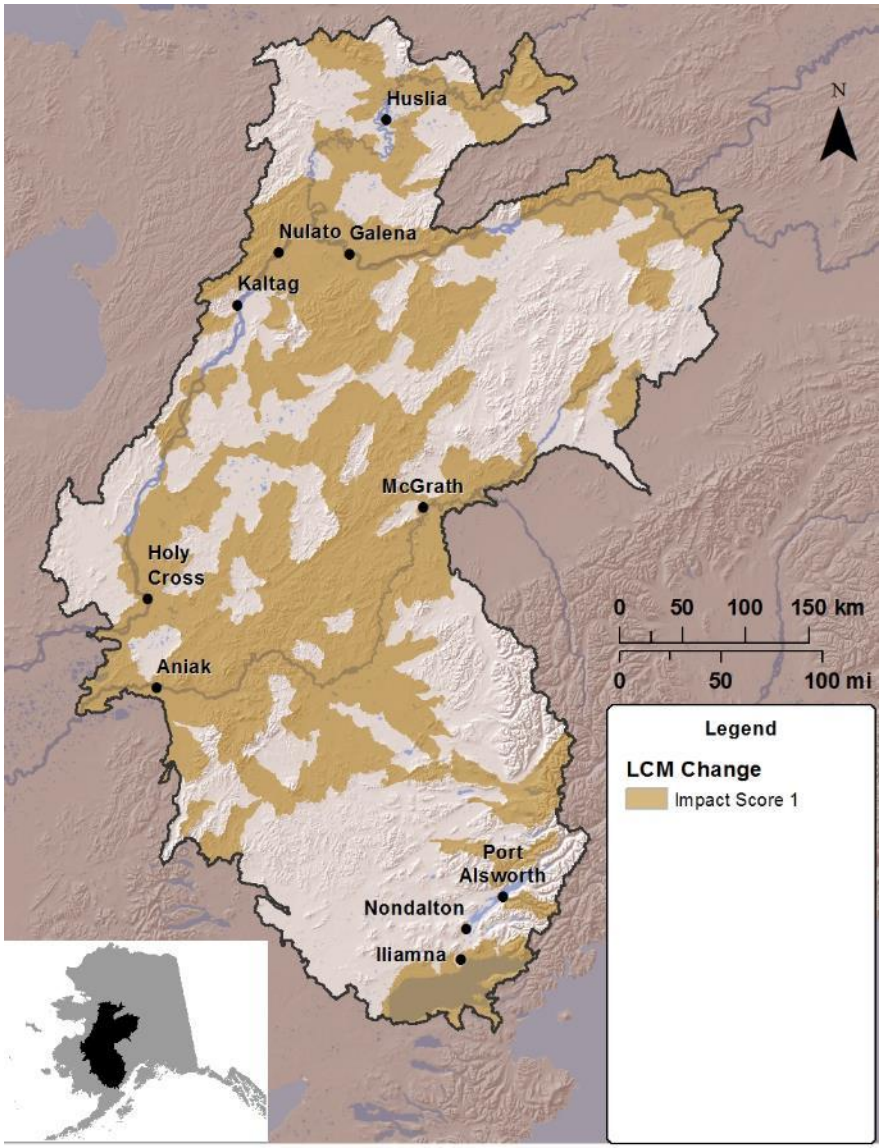

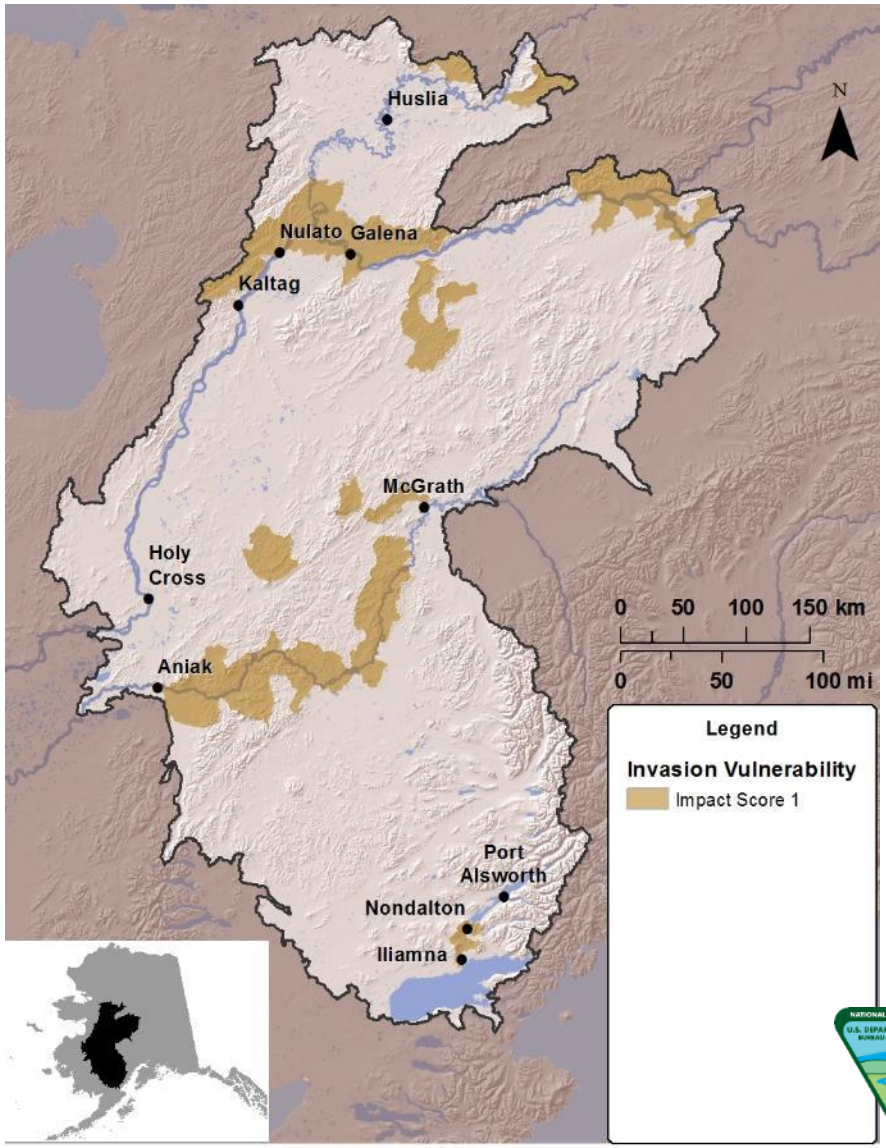

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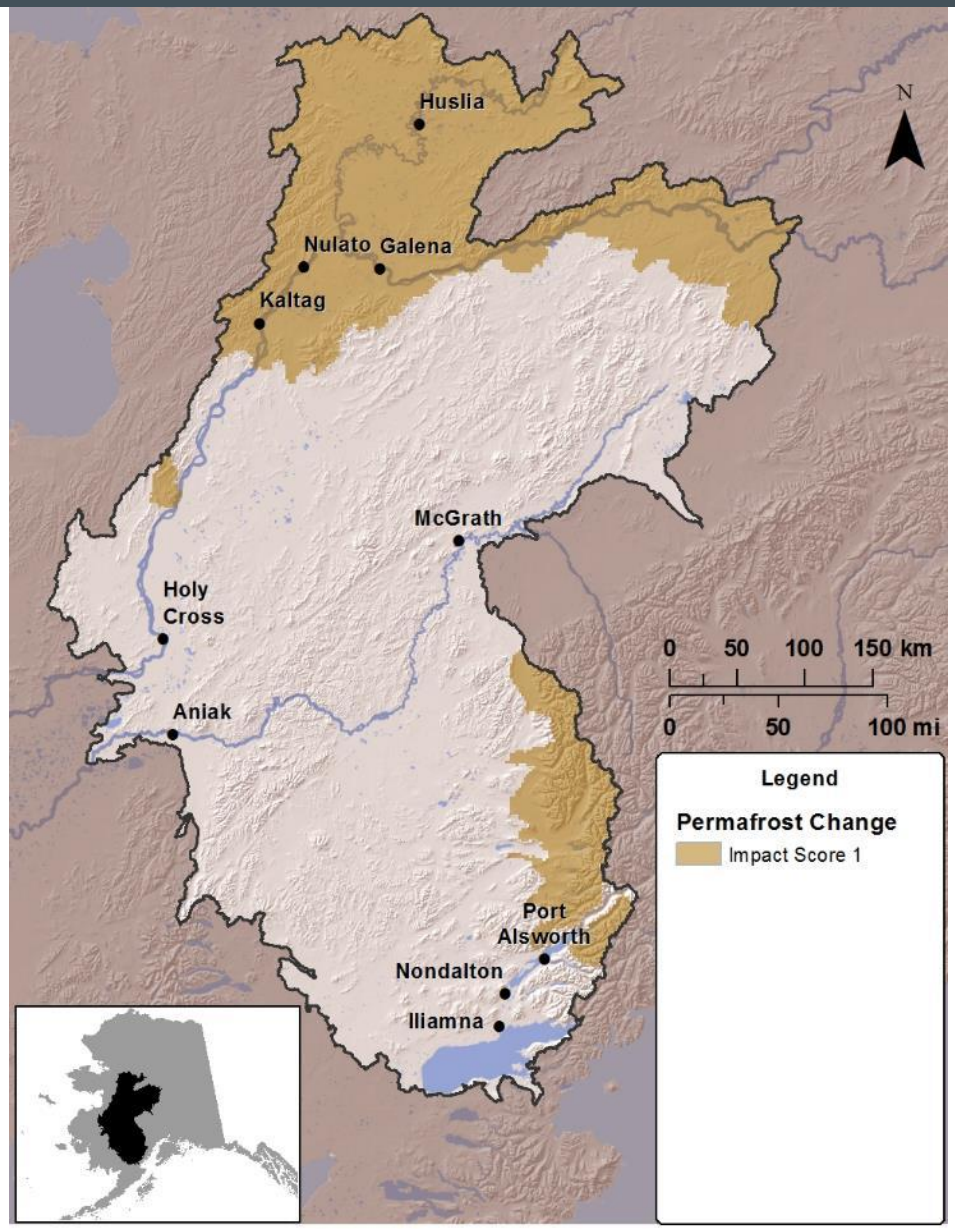

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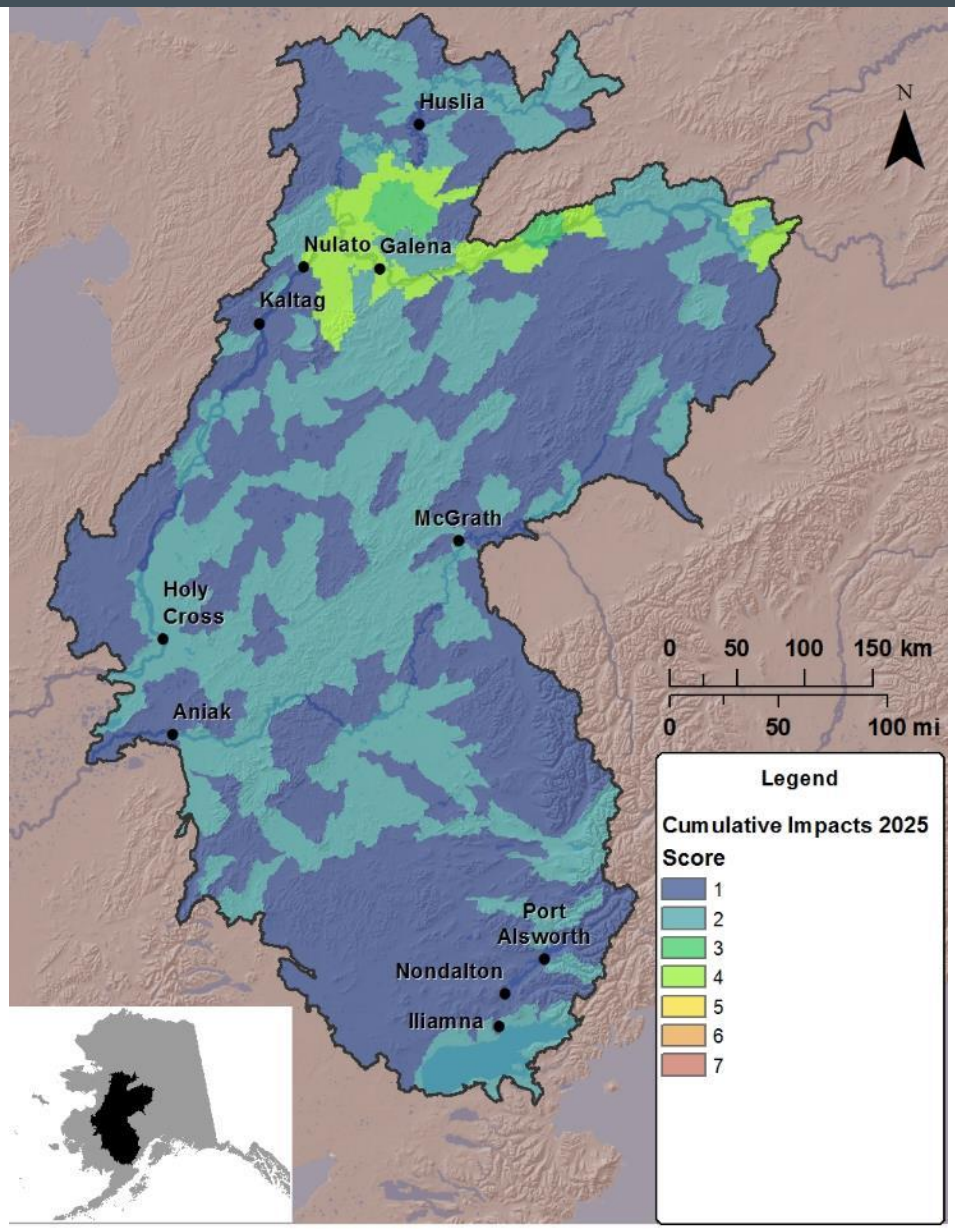

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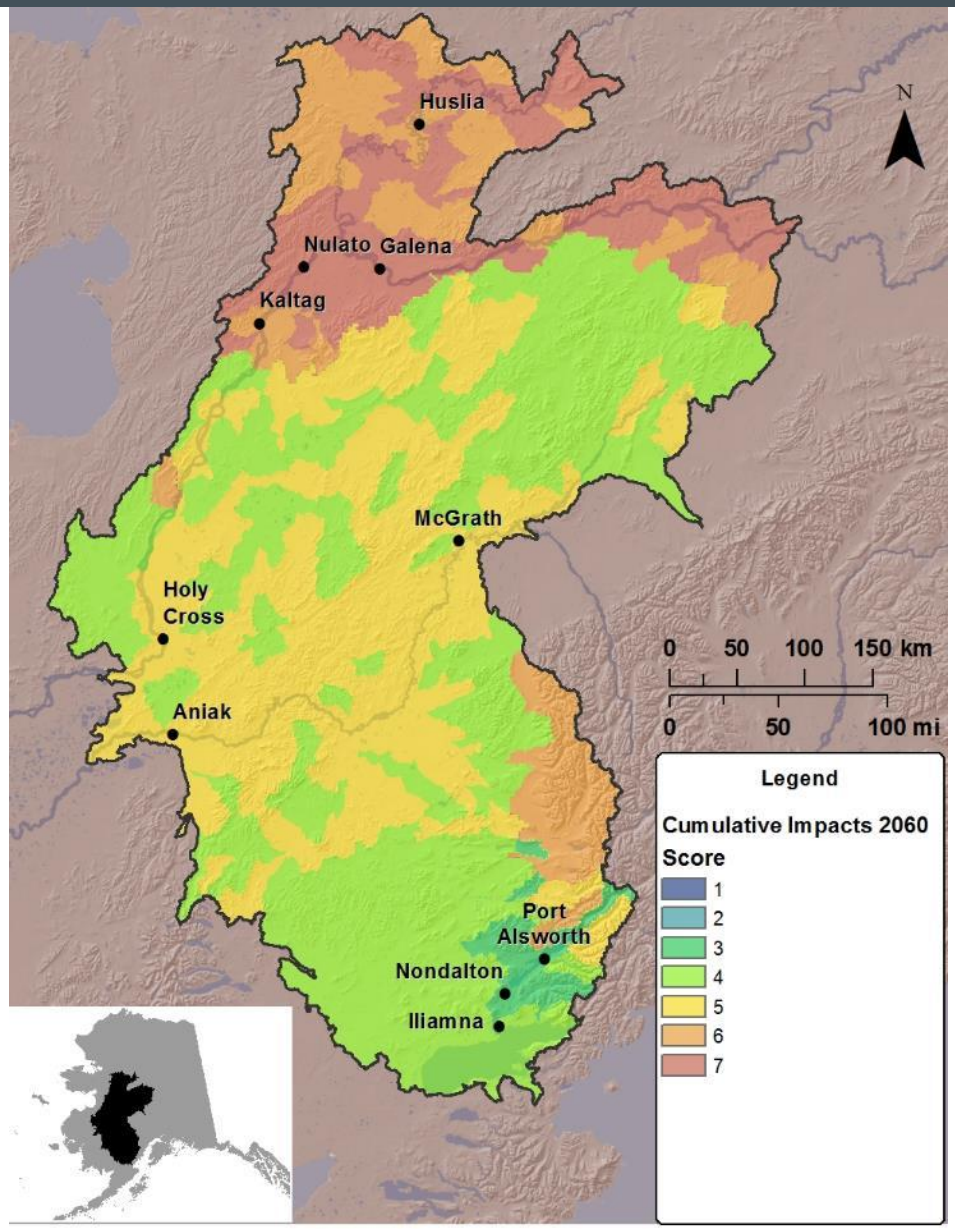
Rapid Ecoregional Assessment

Cumulative Impacts



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Rapid Ecoregional Assessment

Conservation Elements
Wildlife Example

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Rapid Ecoregional Assessment

REA Core Analysis

Where are **CEs currently distributed**?

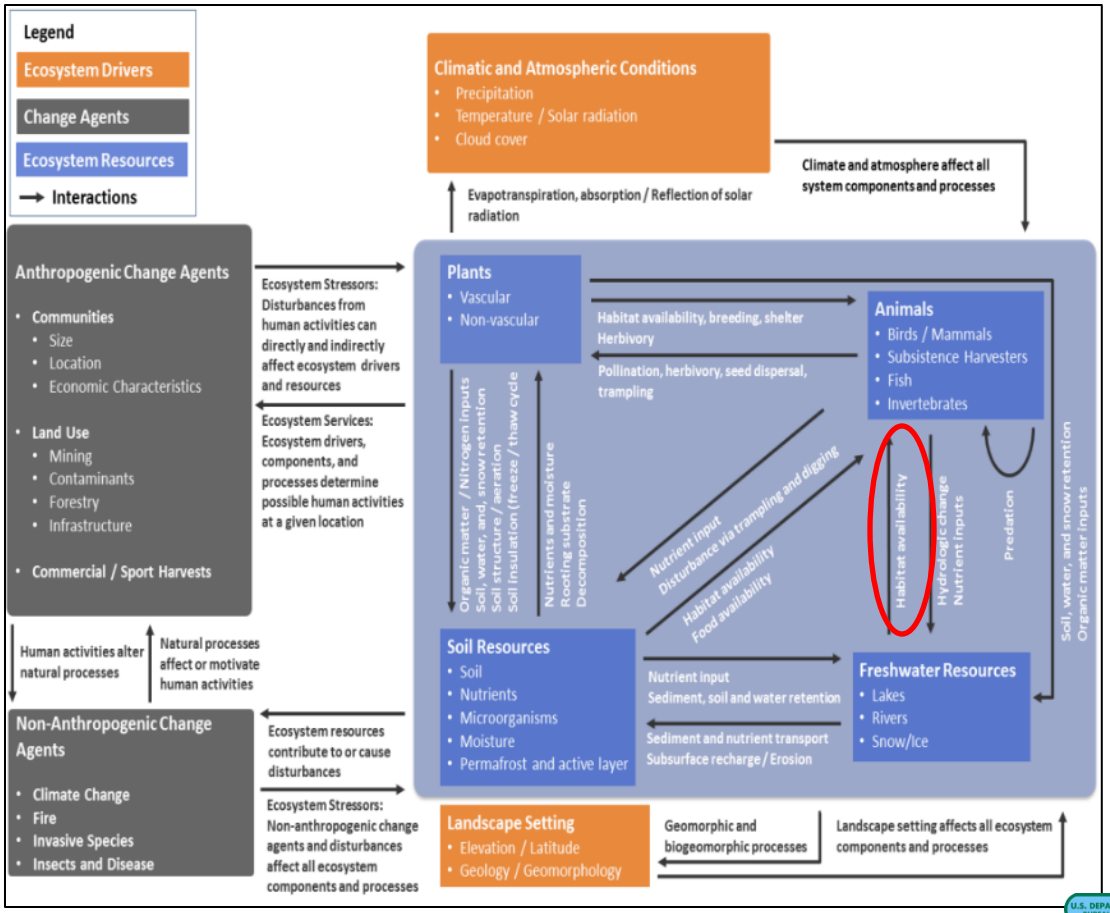
Where are **CAs currently located**?

Where might **CAs differ in the future**, near and long-term?

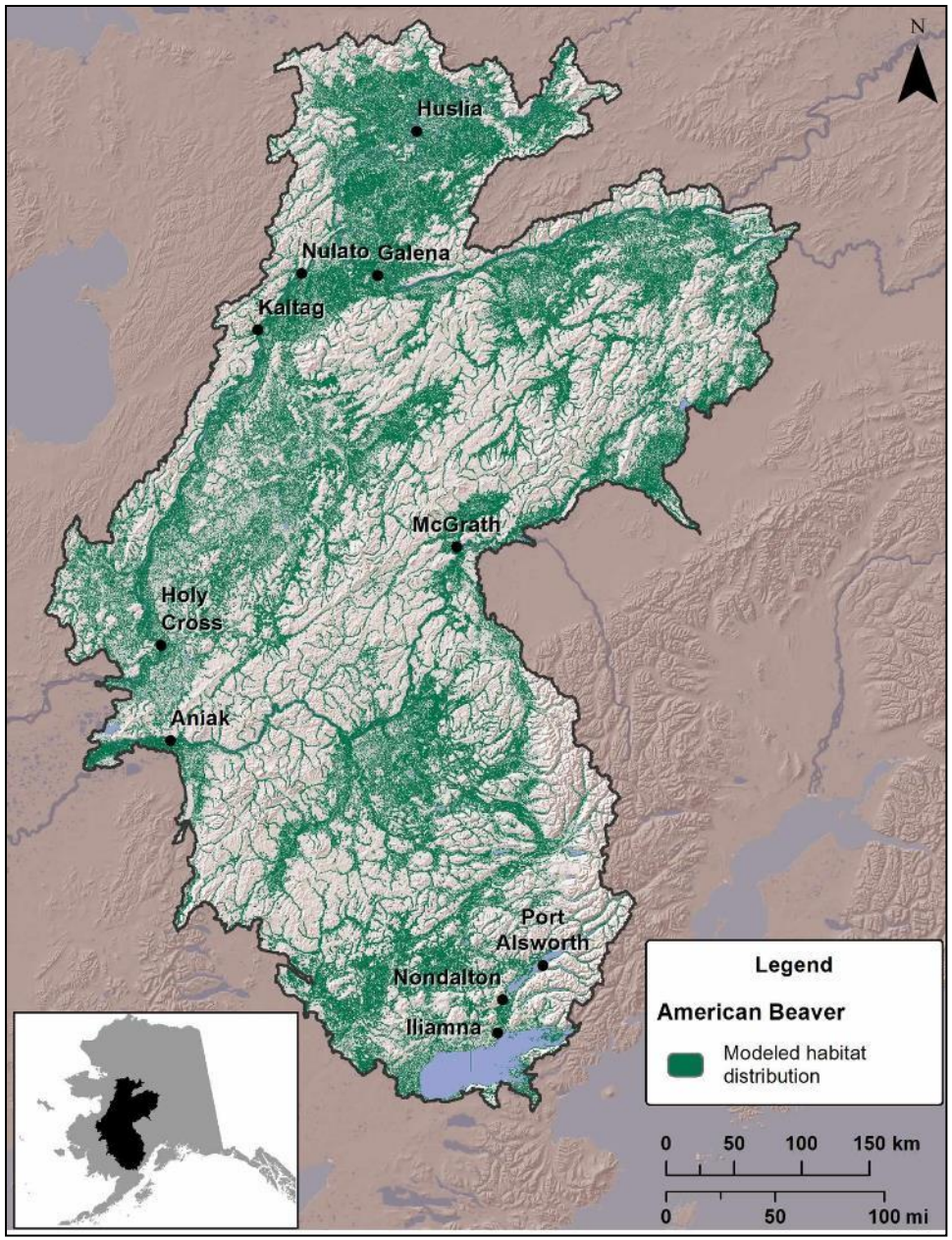
Where do **CEs and CAs overlap** in the near and long-term?

Conservation Elements - American beaver (*Castor canadensis*)

Beaver were identified as a Conservation Element (CE) through the Conceptual Ecoregional Model as a major driver of hydrologic change.



American beaver – Habitat distribution model



American beaver – Conceptual model

Change Agents

Fire

Climate change

Development

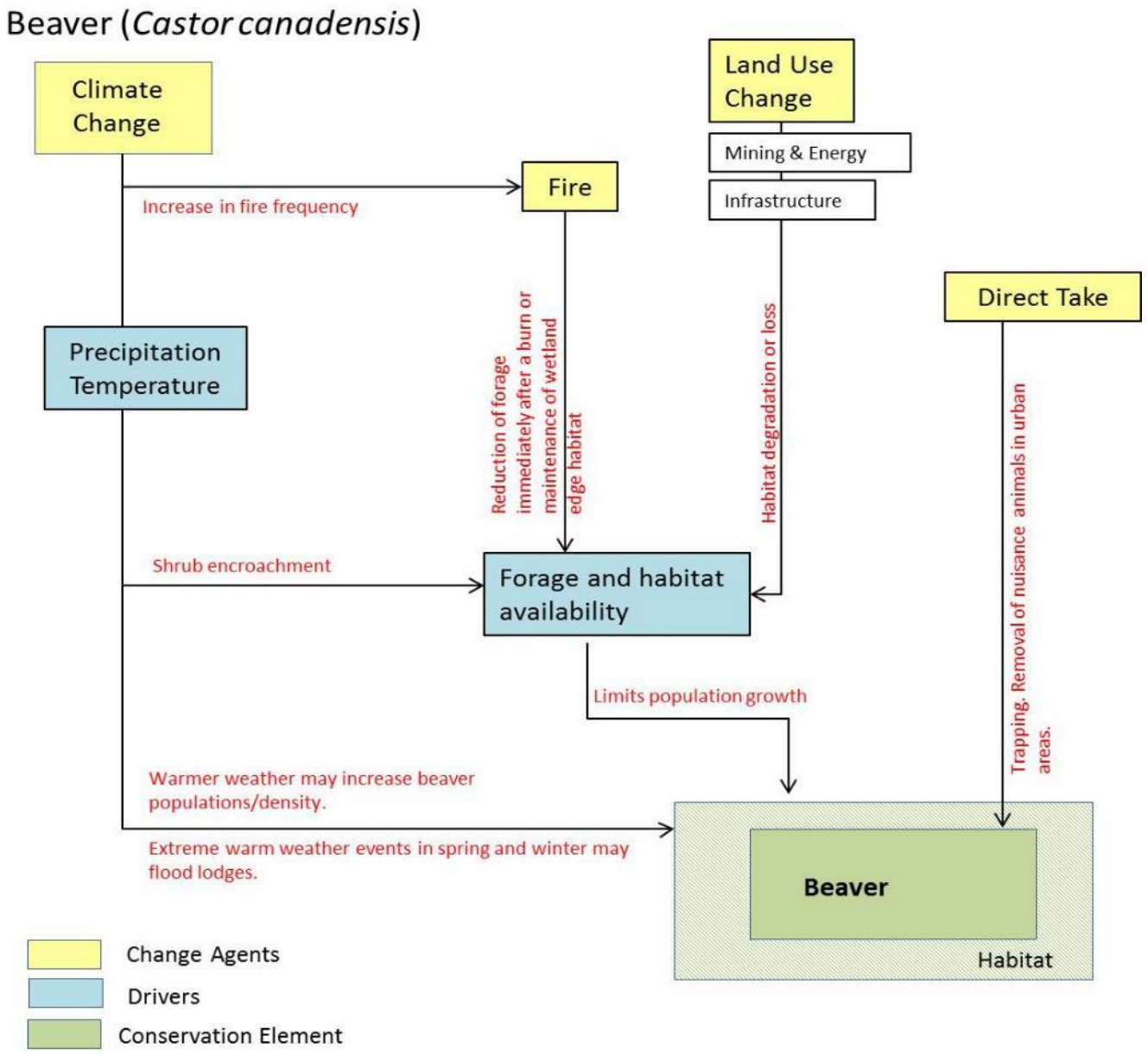
Conceptual Model

In the boreal mixed-forest of central Canada, beaver lodge occupancy was greatly reduced in areas that had been repeatedly burned. The reduction in woody vegetation in areas extensively **burned** reduces forage availability, increases foraging distances, and increases the risk of predation (Hood et al. 2007). However, **fire** does promote the regenerate of many woody plant species used by beaver, but the benefits likely depend on the combination of several factors including fire severity and frequency (Hood et al. 2007). Two other studies in Canada found that **burns** benefitted beaver habitat comprised of disturbance-reliant early successional aspen (Slough and Sadleir 1977, Barnes and Mallik 2001).

Although beaver are resilient and less likely to be impacted by **climate change** compared to other species, extreme warm weather events in winter and spring can cause sudden snowmelt and violent ice breakups that raise water levels and destroy lodges and drown large numbers of beavers (Hakala 1952).**Climate change** is likely to benefit the American beaver by **increasing ambient temperatures** at the northern limits of its current range. Beaver population densities are limited by mean annual temperature, and maximum spring and summer temperatures (Jarema et al. 2009). According to Jarema at al. (2009), beaver densities are greatly reduced (restricted) in locations with a mean annual temperature less than -5.1°C, a maximum spring temperature below -1.4 °C and maximum summer temperature below 15.2°C. Warmer temperatures may allow a northern expansion and increased density of beaver populations near the current northern limits of their range.

Beavers occur in areas with **low to moderate human activity and disturbance** (Slough and Sadleir 1977). **Urban development** causes habitat degradation and loss, often through water storage, diversion, and channelization projects that change stream morphology and hydrology. Development in riparian area can also result in complete loss of habitat or a reduction in food resources (Boyle and Owens 2007). About 1,300 beavers are harvested annually in Alaska (data from 2003-2009)(ADF&G 2013).

American beaver – Conceptual model

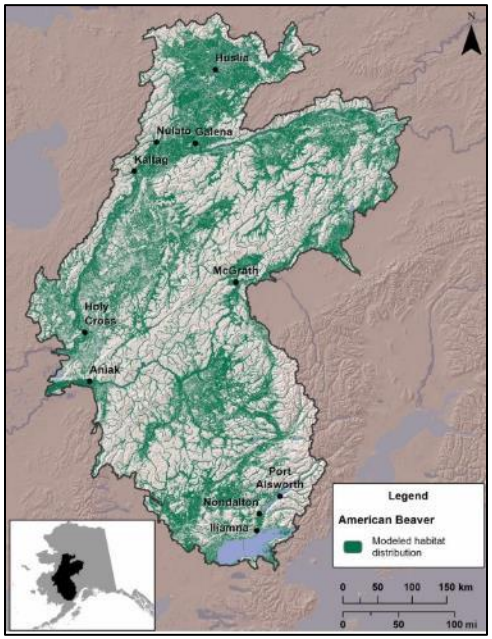


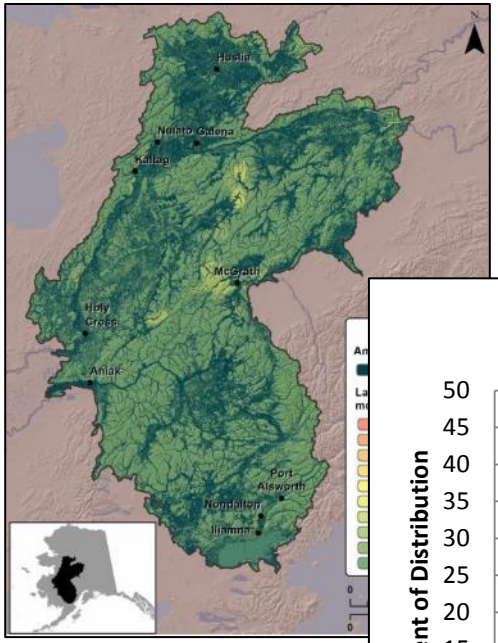
American beaver – Attributes and indicators

Key Ecological Attribute	Indicator	Indicator Rating				Basis for Indicator Rating	Comments
		Poor	Fair	Good	Very Good		
Habitat	Proximity to wetland and riparian areas	No wetland/riparian habitat			Permanent wetland or riparian habitat (buffer by 200 m)	Allen 1983, MacDonald and Cook 2009	Inhabits permanent lakes, ponds, marshes, rivers, and streams. Unsuitable habitat includes lakes and streams with extreme seasonal or annual fluctuations in water level.
Forage	Available food source	Very low to no coverage of tree and/or shrub species	Low (10-39%) or high (61-100%) coverage of deciduous tree or shrub species		Moderate (40-60%) coverage of deciduous tree or shrub species	Allen 1983	Forages on deciduous woody trees/shrubs and herbaceous vegetation usually within 100 m of the water. From late fall to early spring food resources are limited to woody species stored in food caches. Tree/shrub canopy closures between 40 -60% are optimal. Preferred forages include willow, cottonwood, alder, and aspen.
Habitat	Stream gradient	Steep gradient (>15%)	12-15% gradient	6-12% gradient	Less than 6% gradient	Allen 1983, Baker and Hill 2003	Stream channels with a gradient of >6% are optimal. Often prefers wide valleys, which offer more food resources and a lower risk of flooding. Gradients from 6-15% are still suitable, but steep gradients over 15% are unsuitable.
Climate	Annual mean temp; Max. spring temp; Max. summer temp	< - 5.1 °C; < -1.4 °C; < 15.2 °C		- 5.1 °C (mean annual); -1.4 °C (max. spring); 15.2 °C (max. summer)	> - 5.1 °C (mean annual); > -1.4 °C (max. spring); > 15.2 °C (max. summer)	Jarema et al 2009	Mean annual temperature, maximum spring temperature and maximum summer temperature restricts beaver densities. Annual mean temperatures above -5.1 °C, max. spring temperatures above -1.4 °C and max. summer temperatures above 15.2 °C promote higher beaver densities (i.e. larger populations).
Habitat degradation	Human development	High levels of human disturbance/development	Moderate levels of human disturbance/ development	Low levels of human disturbance/development	No human disturbance/development	Slough and Sadleir 1977, Boyle and Owens 2007	Occurs in areas of low to moderate levels of human activity.

American beaver – Status

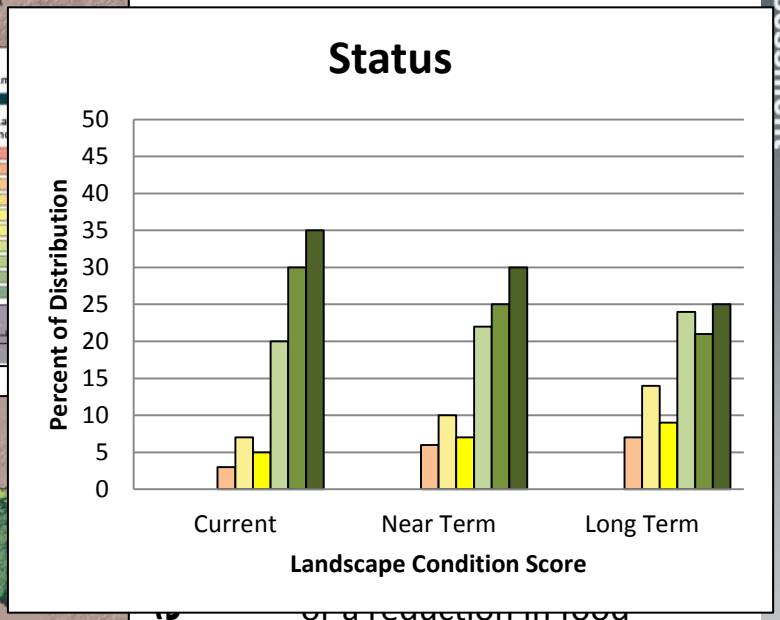
Distribution



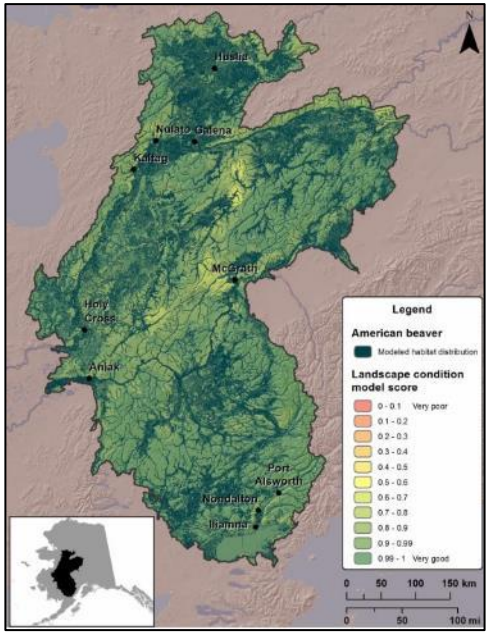


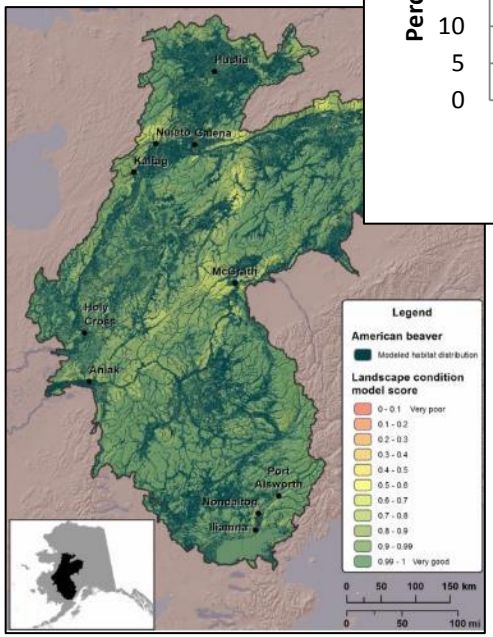
Current

- Habitat = areas with low to moderate human activity and disturbance.



Near Term (2025)





rm (2060)

of a reduction in food resources.

- About 1,300 beavers are harvested annually in Alaska.

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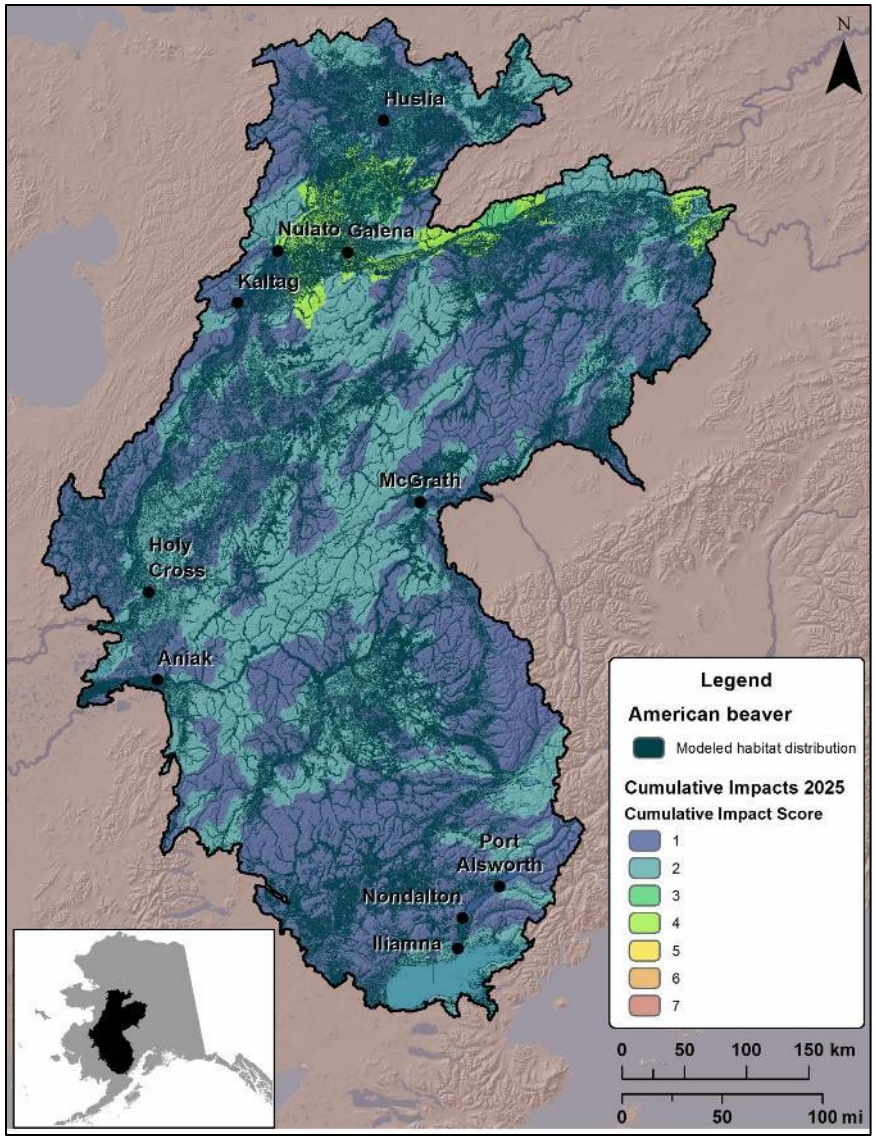
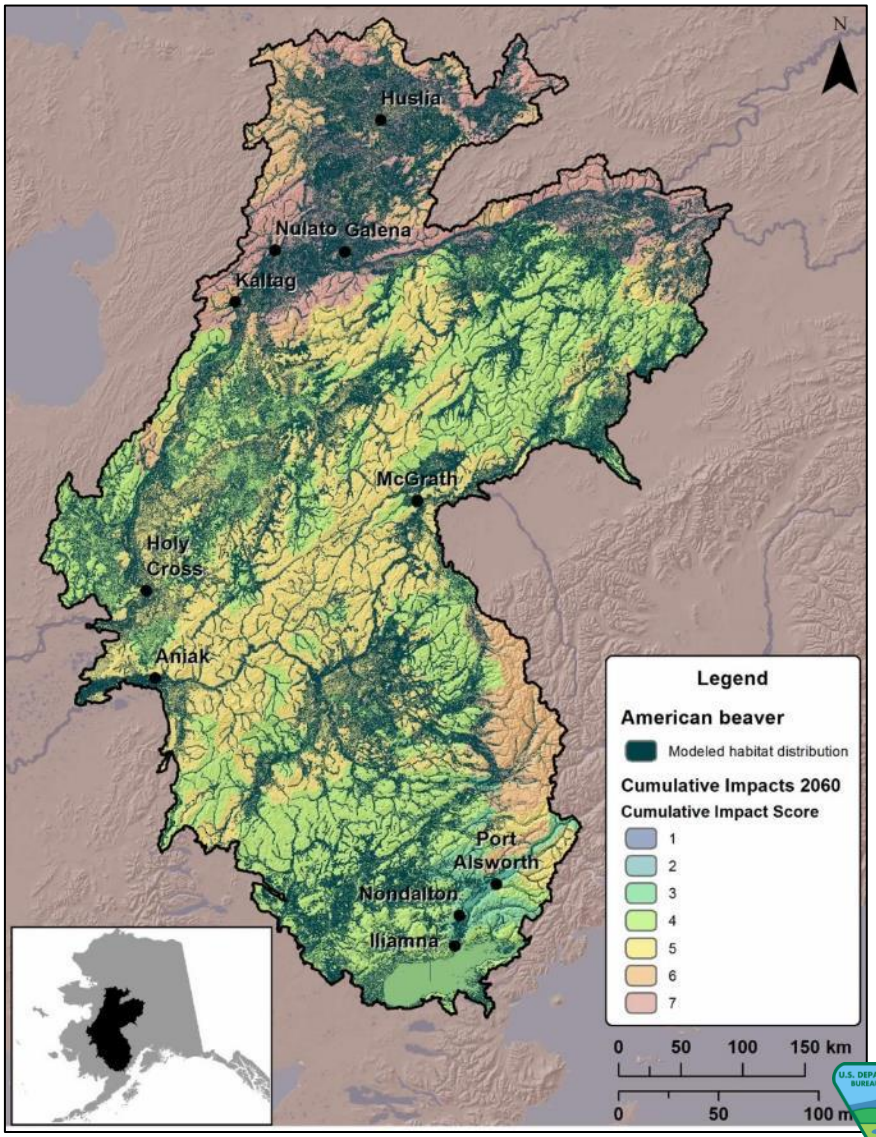
American beaver – Status

Near Term (2025)



Long Term (2060)



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Climate linkages – Additional analysis

1. Change in growing season length
(number of days between thaw and freeze - 2010 and 2060)

2. Mean summer temperature (June, July, August)

3. Mean annual ground temperature

4. Change in annual precipitation (2010 and 2060)

Climate linkages – American beaver

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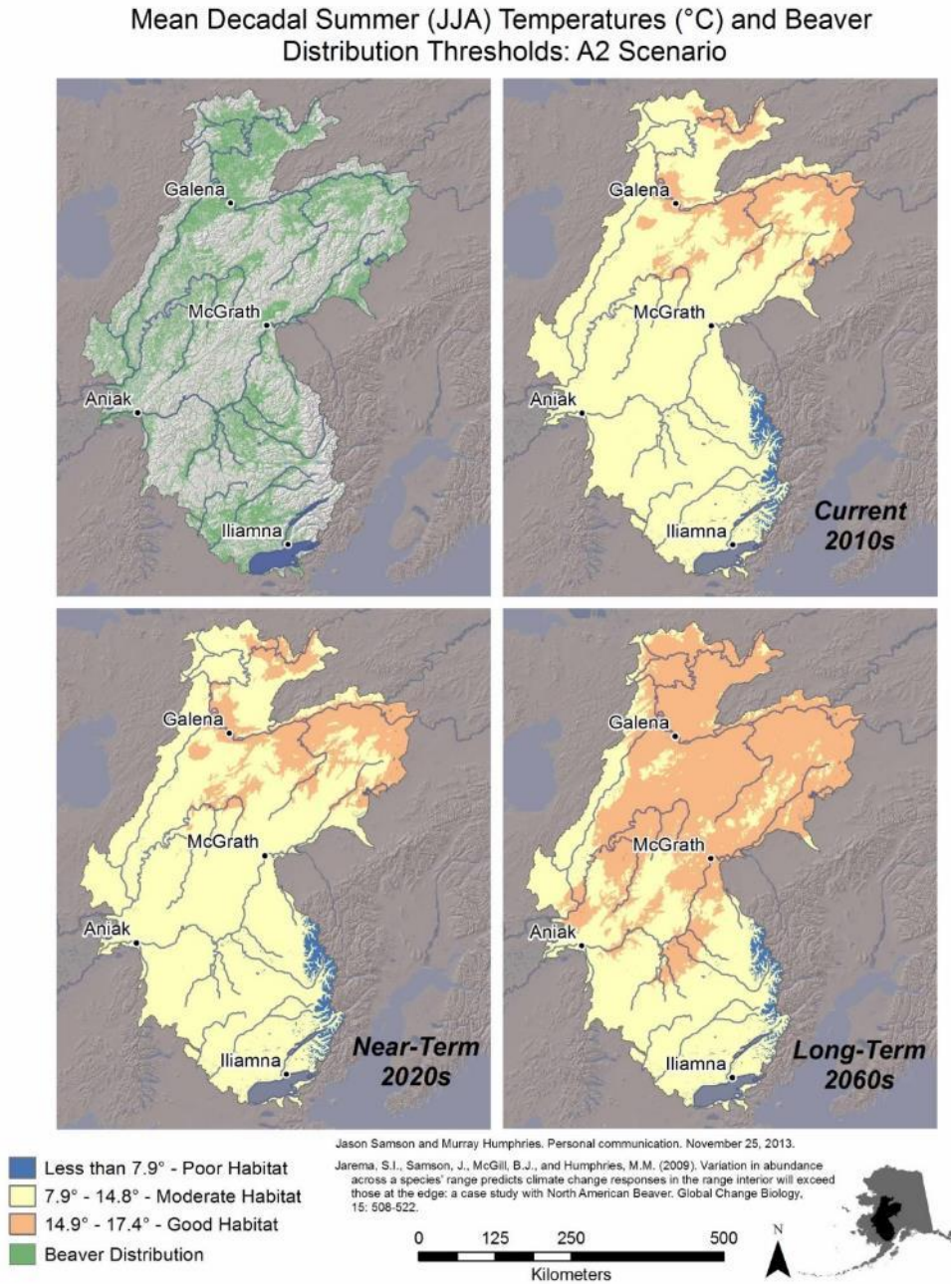
Forage	Available food source	Very low to no coverage of tree and/or shrub species	Low (10-39%) or high (61-100%) coverage of deciduous tree or shrub species		Moderate (40-60%) coverage of deciduous tree or shrub species	Allen 1983	Forages on deciduous woody trees/shrubs and herbaceous vegetation usually within 100 m of the water. From late fall to early spring food resources are limited to woody species stored in food caches. Tree/shrub canopy closures between 40 -60% are optimal. Preferred forages include willow, cottonwood, alder, and aspen.
Habitat	Stream gradient	Steep gradient (>15%)	12-15% gradient	6-12% gradient	Less than 6% gradient	Allen 1983, Baker and Hill 2003	Stream channels with a gradient of >6% are optimal. Often prefers wide valleys, which offer more food resources and a lower risk of flooding. Gradients from 6-15% are still suitable, but steep gradients over 15% are unsuitable.
Climate	Annual mean temp; Max. spring temp; Max. summer temp	< - 5.1 °C; < -1.4 °C; < 15.2 °C		- 5.1 °C (mean annual); -1.4 °C (max. spring); 15.2 °C (max. summer)	> - 5.1 °C (mean annual); > -1.4 °C (max. spring); > 15.2 °C (max. summer)	Jarema et al 2009	Mean annual temperature, maximum spring temperature and maximum summer temperature restricts beaver densities. Annual mean temperatures above -5.1 °C, max. spring temperatures above -1.4 °C and max. summer temperatures above 15.2 °C promote higher beaver densities (i.e. larger populations).
Habitat degradation	Human development	High levels of human disturbance/development	Moderate levels of human disturbance/ development	Low levels of human disturbance/development	No human disturbance/development	Slough and Sadleir 1977, Boyle and Owens 2007	Occurs in areas of low to moderate levels of human activity.

Climate linkages – American beaver

Mean summer temperature

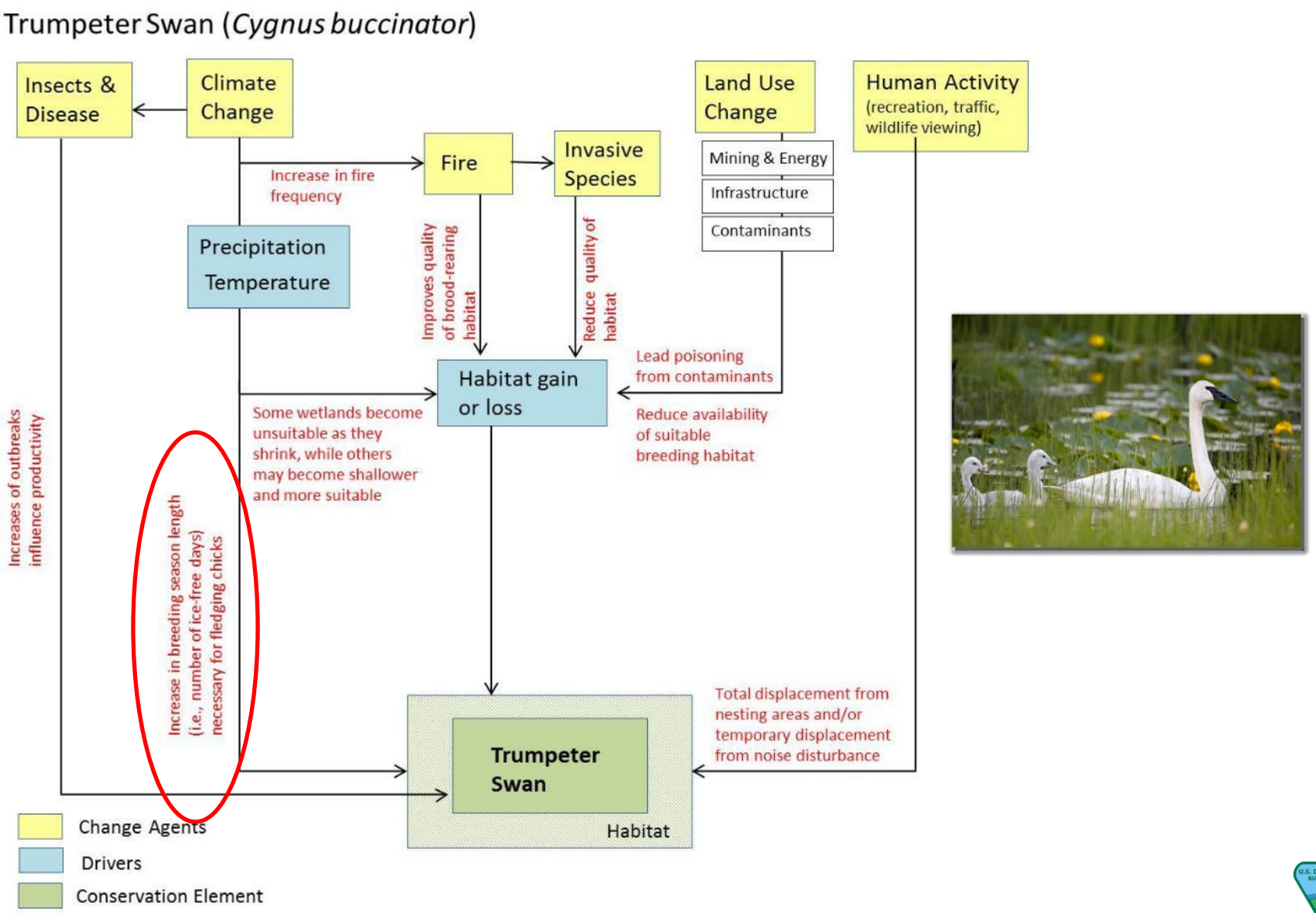
Beaver density

Although beaver presence is possible above a relatively low threshold for mean summer temperature (7.9 C), density increases non-linearly with increasing mean summer temperature



JAREMA, S. I., SAMSON, J., MCGILL, B. J. and HUMPHRIES, M. M. (2009), Variation in abundance across a species' range predicts climate change responses in the range interior will exceed those at the edge: a case study with North American beaver. Global Change Biology, 15: 508–522.

Climate linkages – Trumpeter Swan



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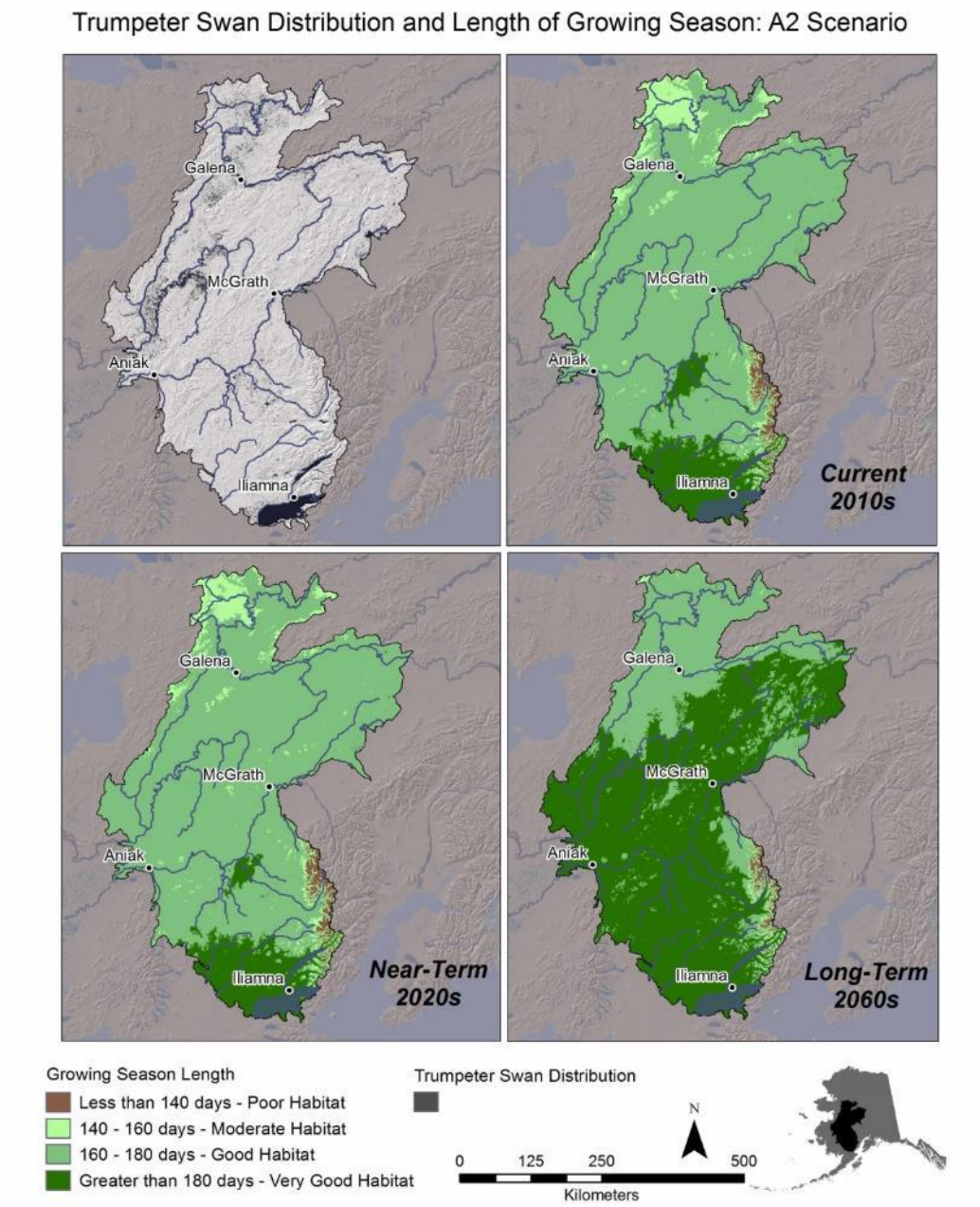
d Ecoregional Assessment

Climate linkages – Trumpeter Swan

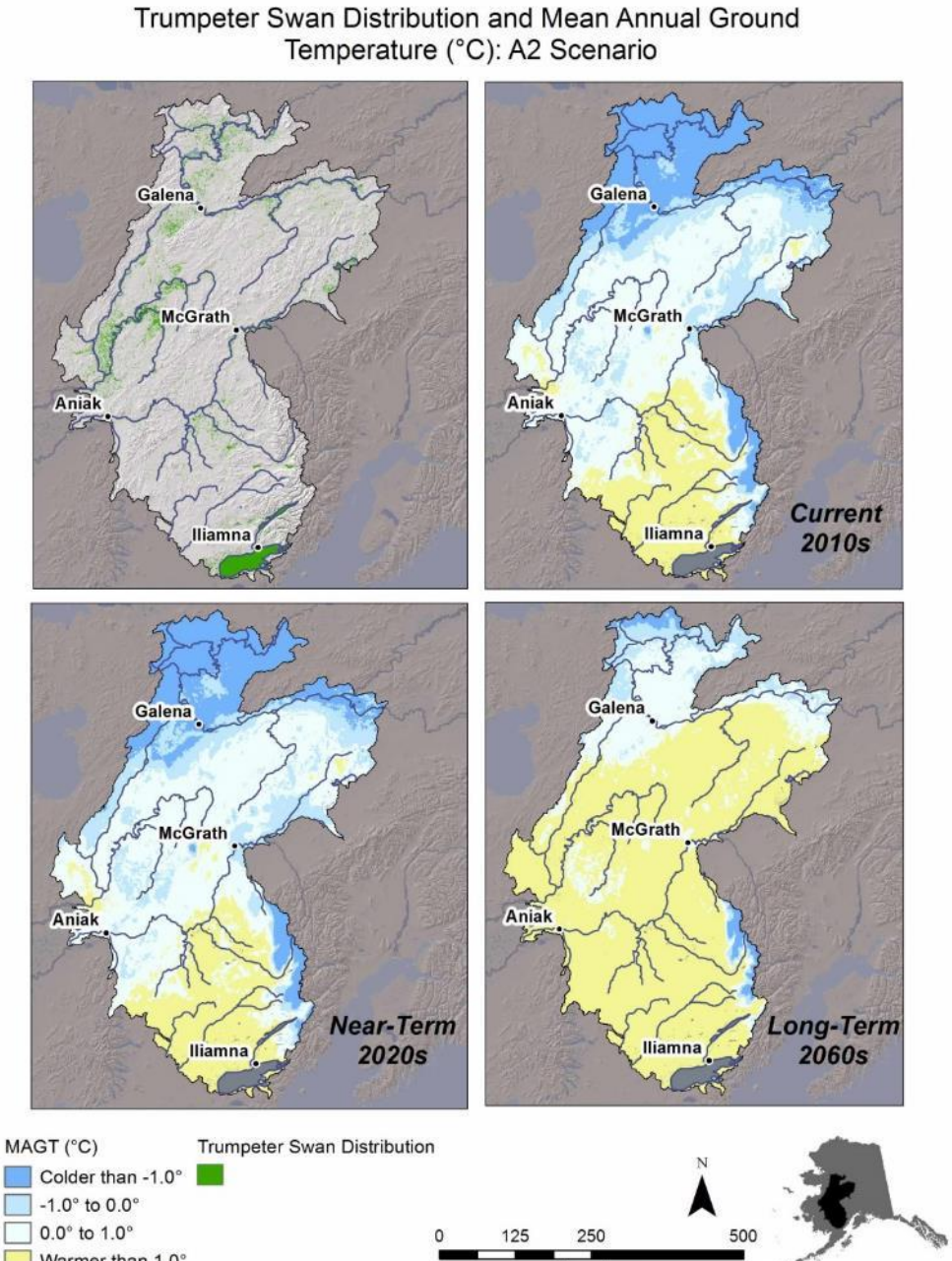


Ice-free days

Swans require a minimum of 140 ice-free days to successfully fledge cygnets. However, ranges significantly higher than this can improve fledging success.

Henry A. Hansen, Peter E. K. Shepherd, James G. King and Willard A. Troyer, The Trumpeter Swan in Alaska, Wildlife Monographs, No. 26, (Oct., 1971), pp. 3-83.

Climate linkages – Trumpeter Swan



Permafrost

Swan habitat includes permafrost and non-permafrost areas.

However, areas projected to undergo significant permafrost thawing may be susceptible to changes in drainage that might affect habitat.

Conservation Elements
Fish Example

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Rapid Ecoregional Assessment

Aquatics Distribution Maps

BLM

Rapid Ecoregional Assessment

Chum Salmon

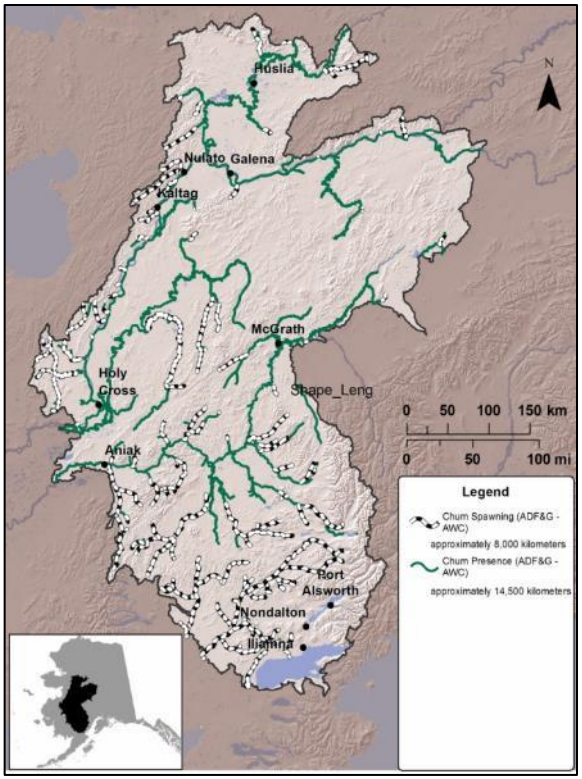


Figure 1. Current known distribution and spawning habitat of Chum Salmon within the YKL study area.

Connected Lakes

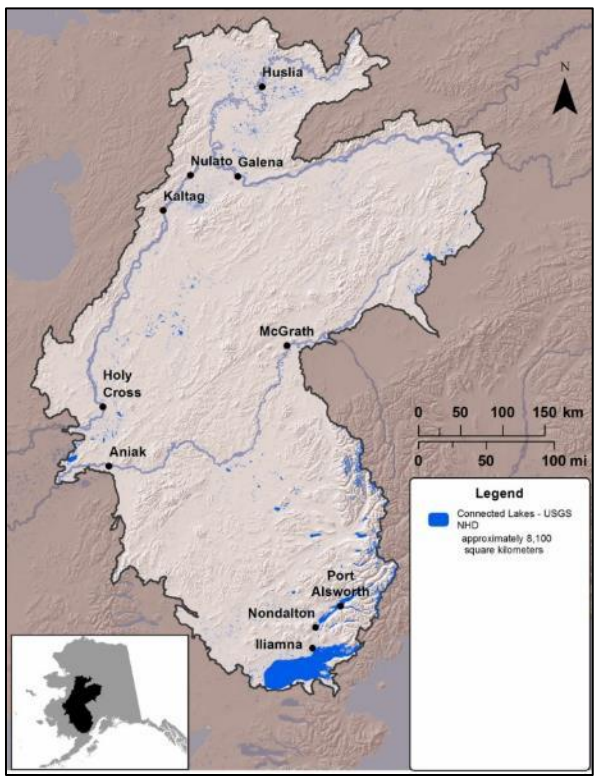


Figure 2. Current known distribution of Connected Lakes within the YKL study area.

Northern Pike

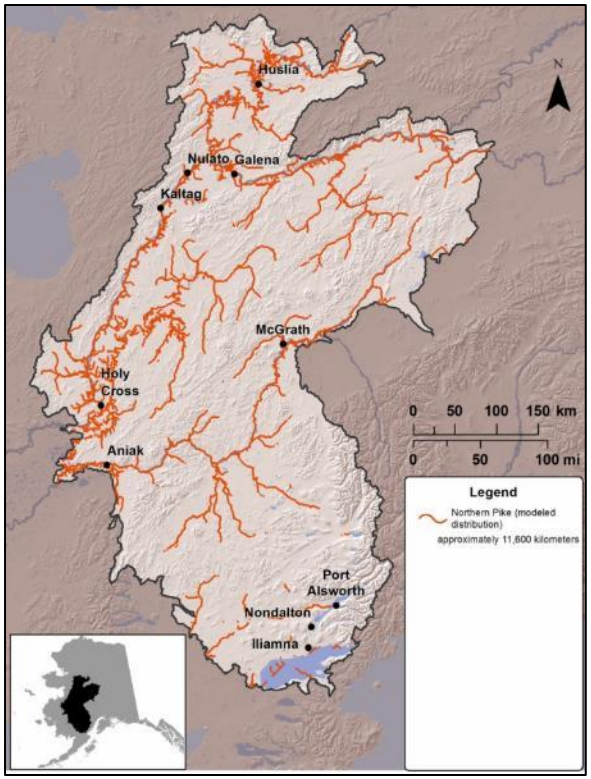
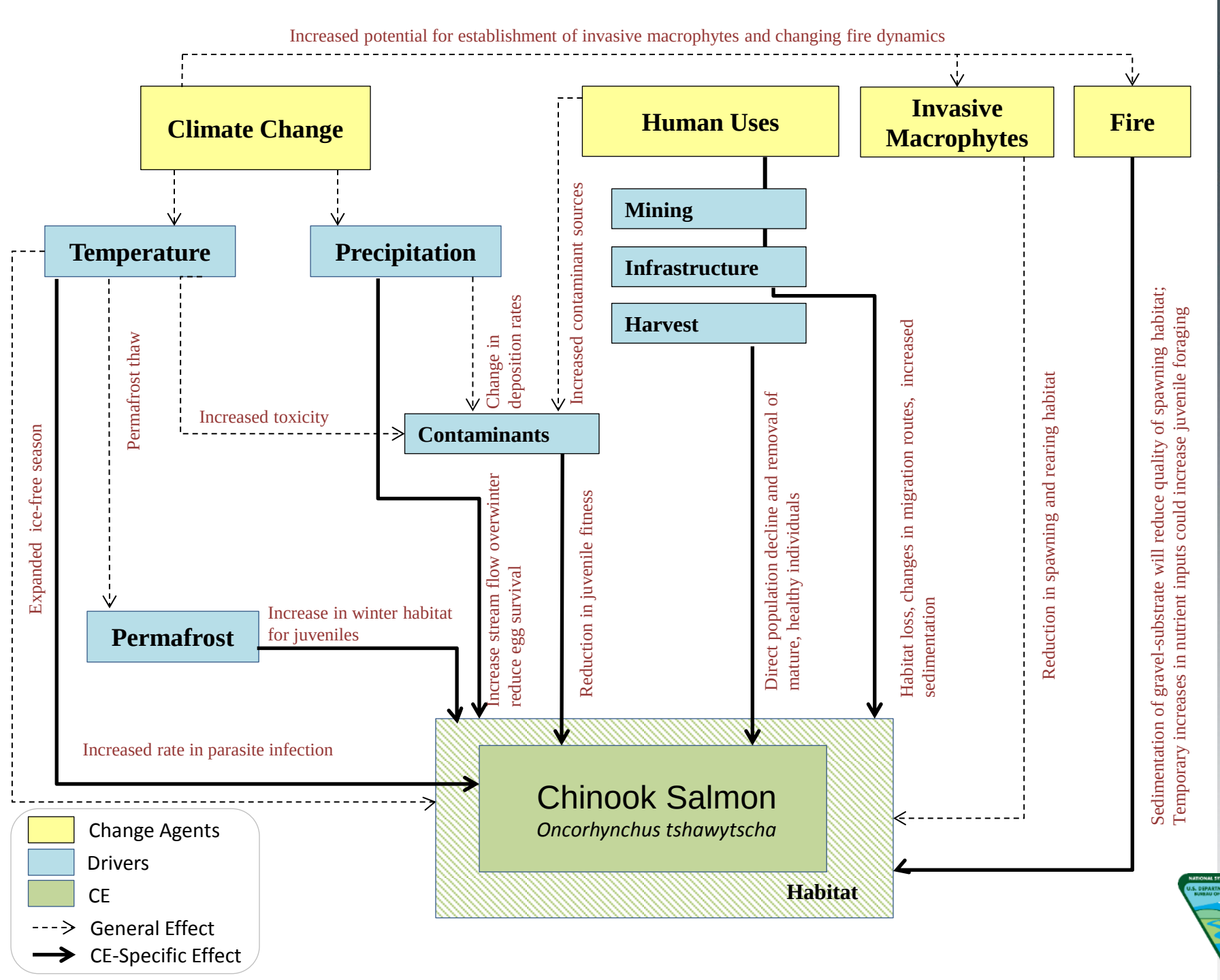
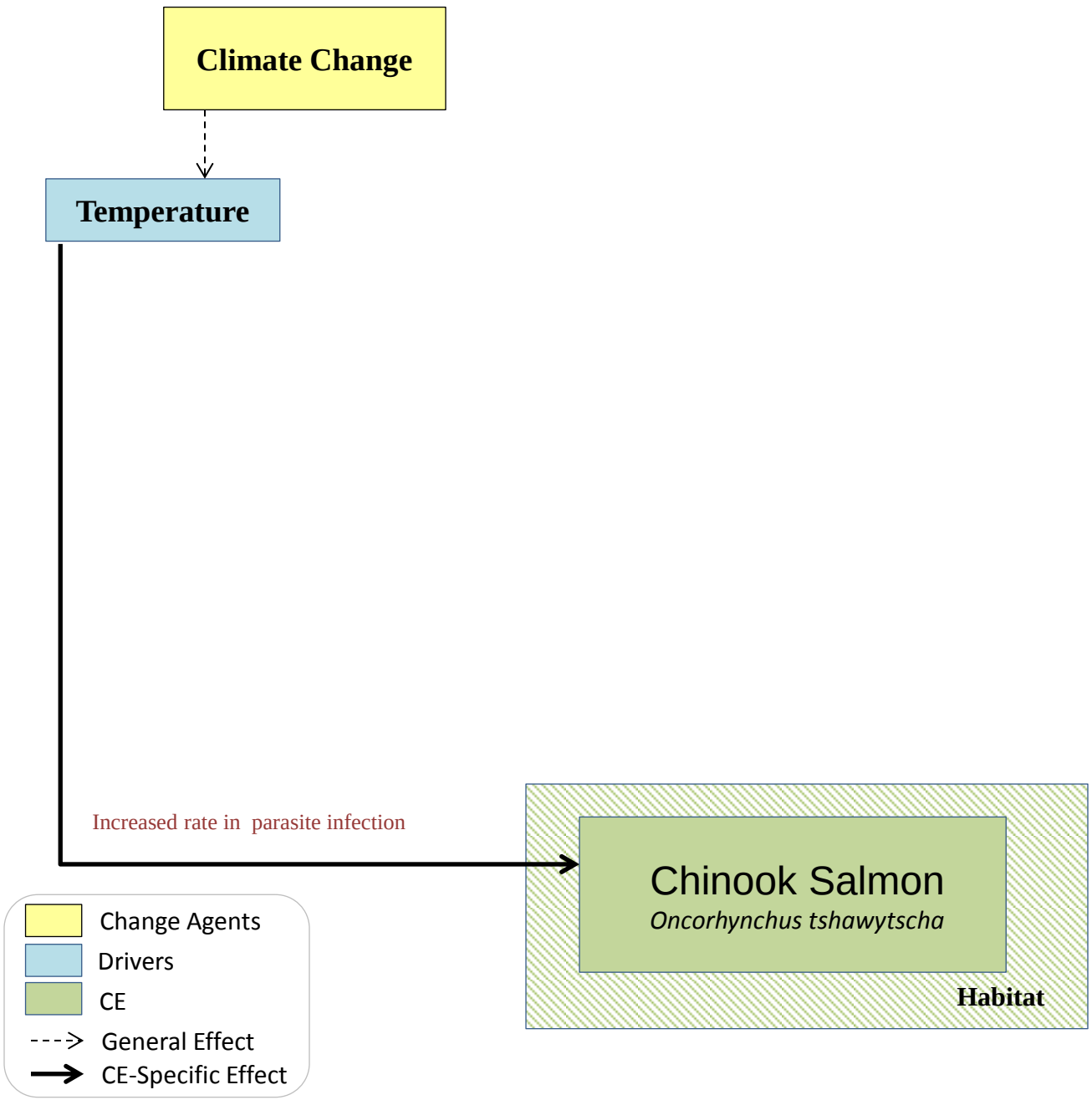


Figure 3. Predicted potential habitat distribution of Northern Pike within the YKL study area.


Increased potential for establishment of invasive macrophytes and changing fire dynamics
Climate Change
Human Uses
Invasive Macrophytes
Fire
Mining
Infrastructure
Harvest
Temperature
Precipitation
Contaminants
Permafrost
Increased contaminant sources
Change in deposition rates
Permafrost thaw
Increased toxicity
Expanded ice-free season
Increase stream flow overwinter reduce egg survival
Reduction in juvenile fitness
Direct population decline and removal of mature, healthy individuals
Habitat loss, changes in migration routes, increased sedimentation
Reduction in spawning and rearing habitat
Sedimentation of gravel-substrate will reduce quality of spawning habitat; Temporary increases in nutrient inputs could increase juvenile foraging
Increase in winter habitat for juveniles
Increased rate in parasite infection
Chinook Salmon
Oncorhynchus tshawytscha
Habitat
Change Agents
Drivers
CE
General Effect
CE-Specific Effect


Climate Change
Temperature
Increased rate in parasite infection
Chinook Salmon
Oncorhynchus tshawytscha
Habitat
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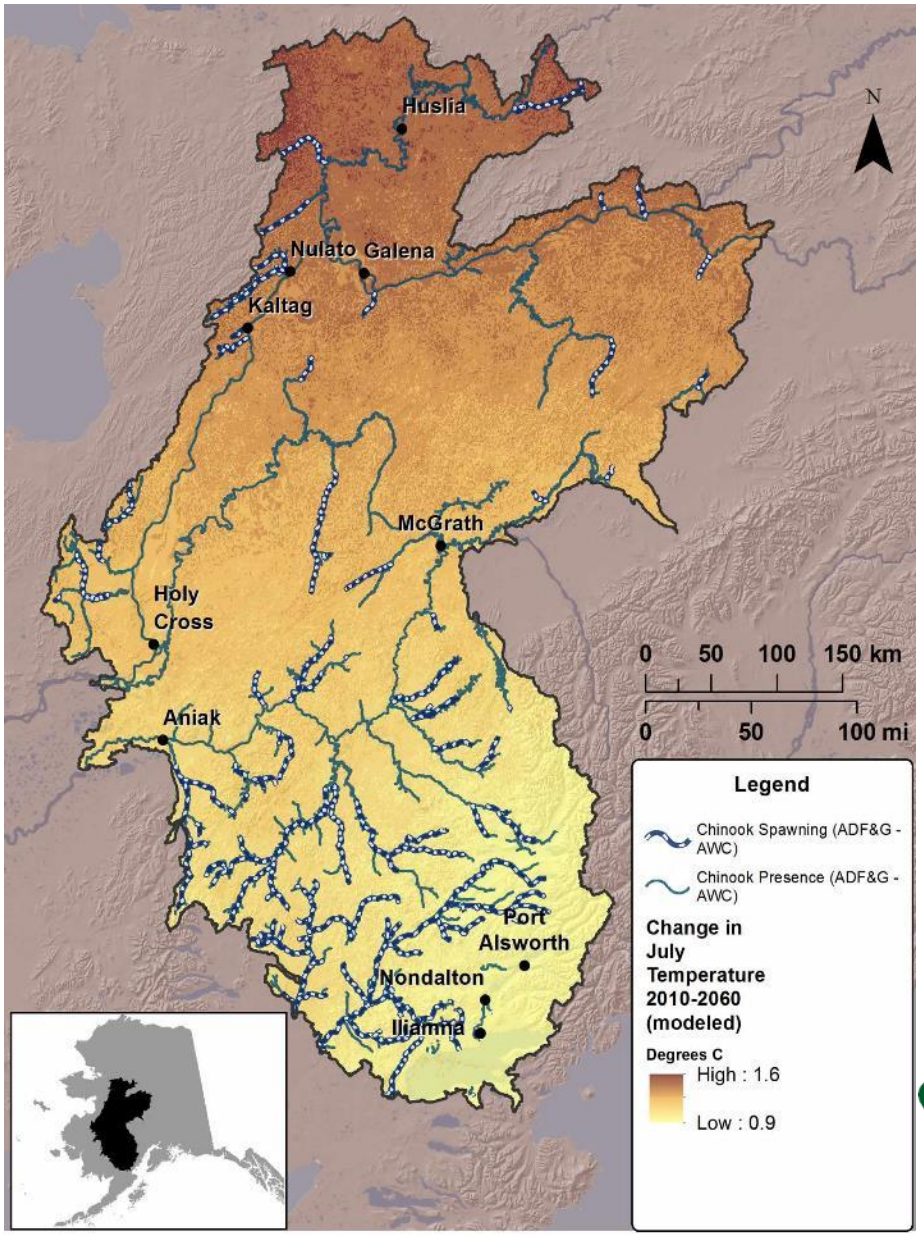
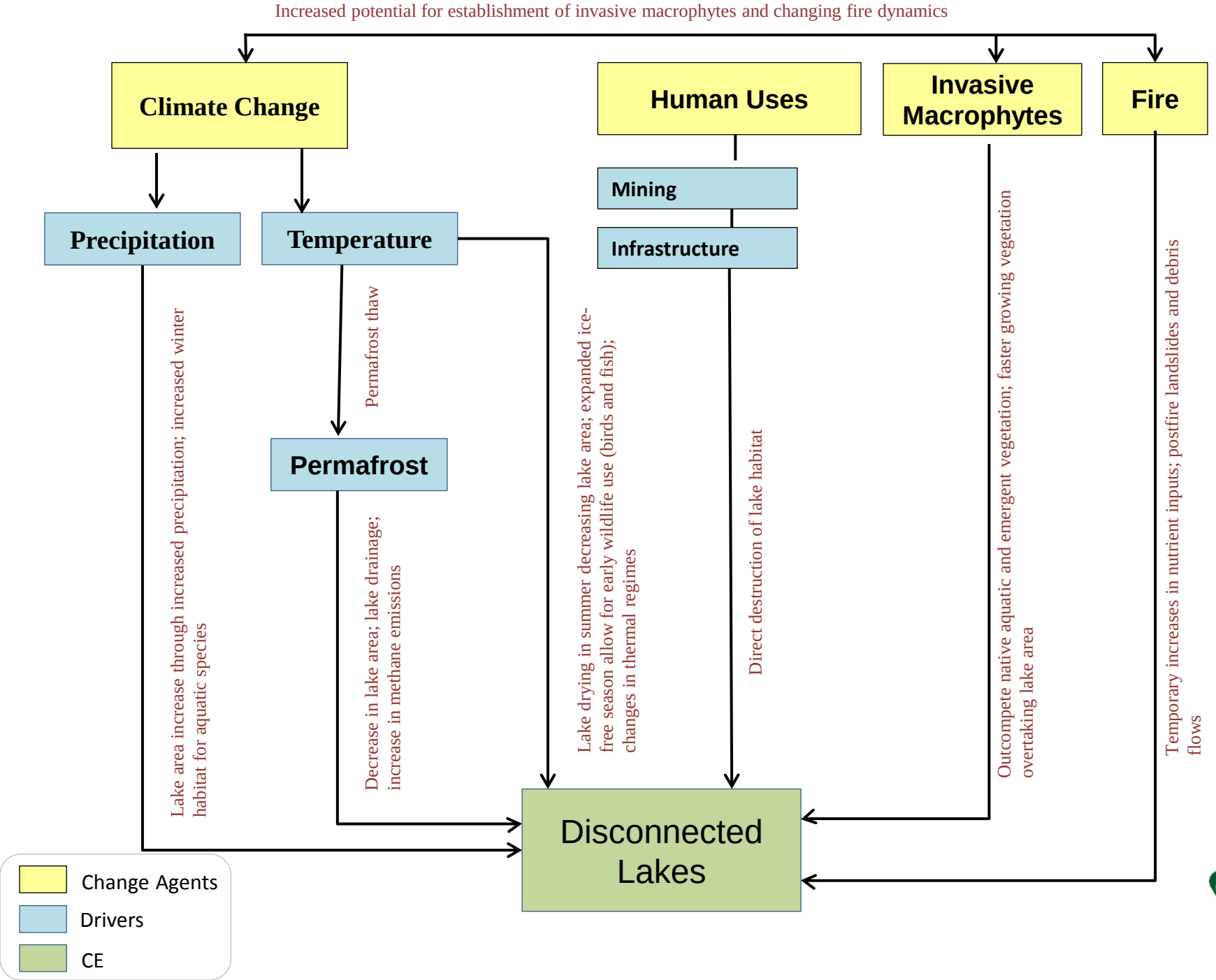
Drivers
CE
General Effect
CE-Specific Effect

Chinook salmon and July Temperature: 2010 to 2060

- Increased temperature correlated with increased rate of infection of *Ichthyophonus hoferi*
  - *Ichthyophonus* causes severe disease in major organs
- Water temperatures above 15ºC appear to be correlated with increased disease.
  - Mean July temperatures since 2002 around 15-18ºC
  - Rising temperatures in the Yukon River may be an important cause of increased disease and pre-spawning mortality
- Potential impacts to subsistence and commercial fisheries

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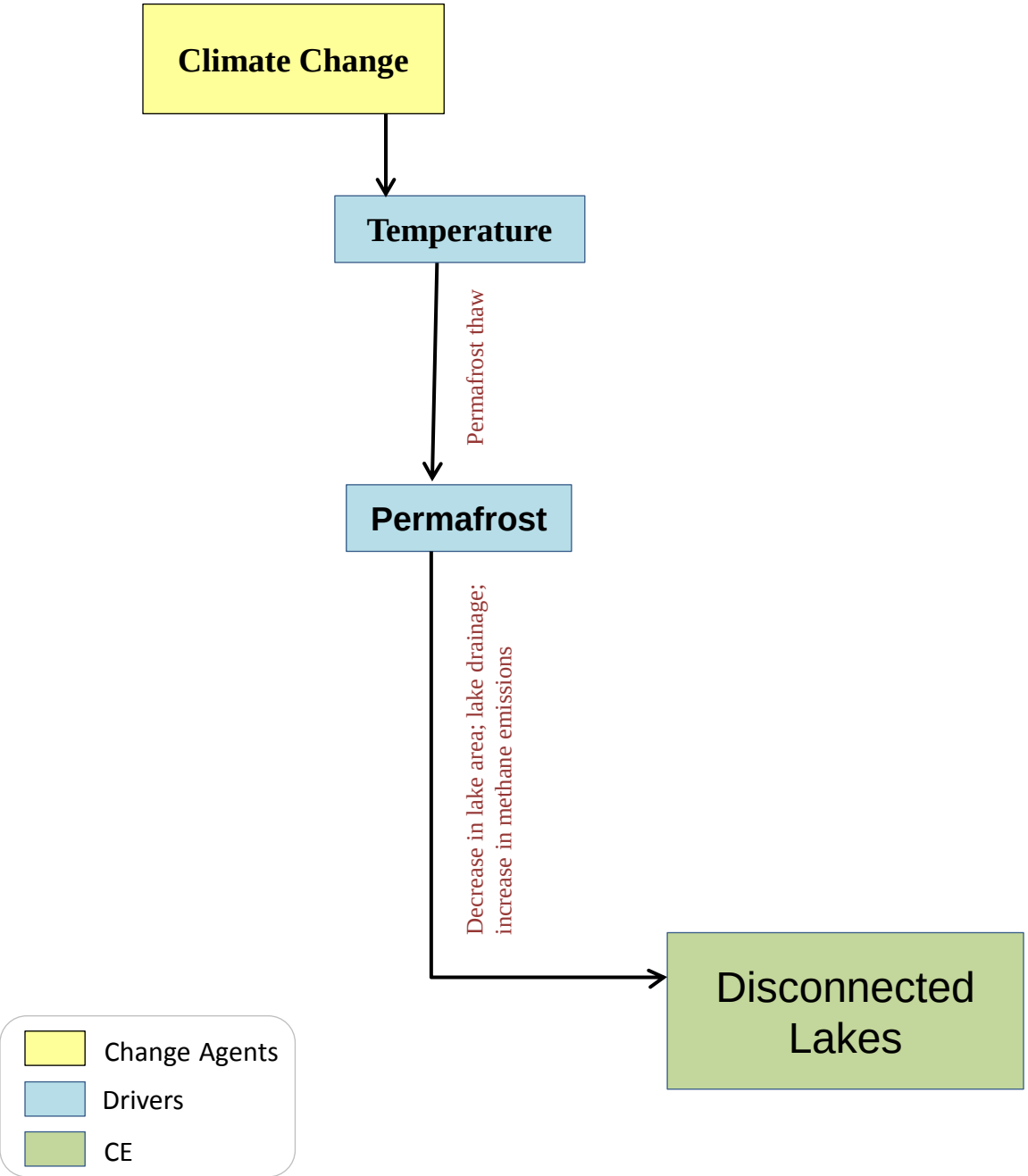
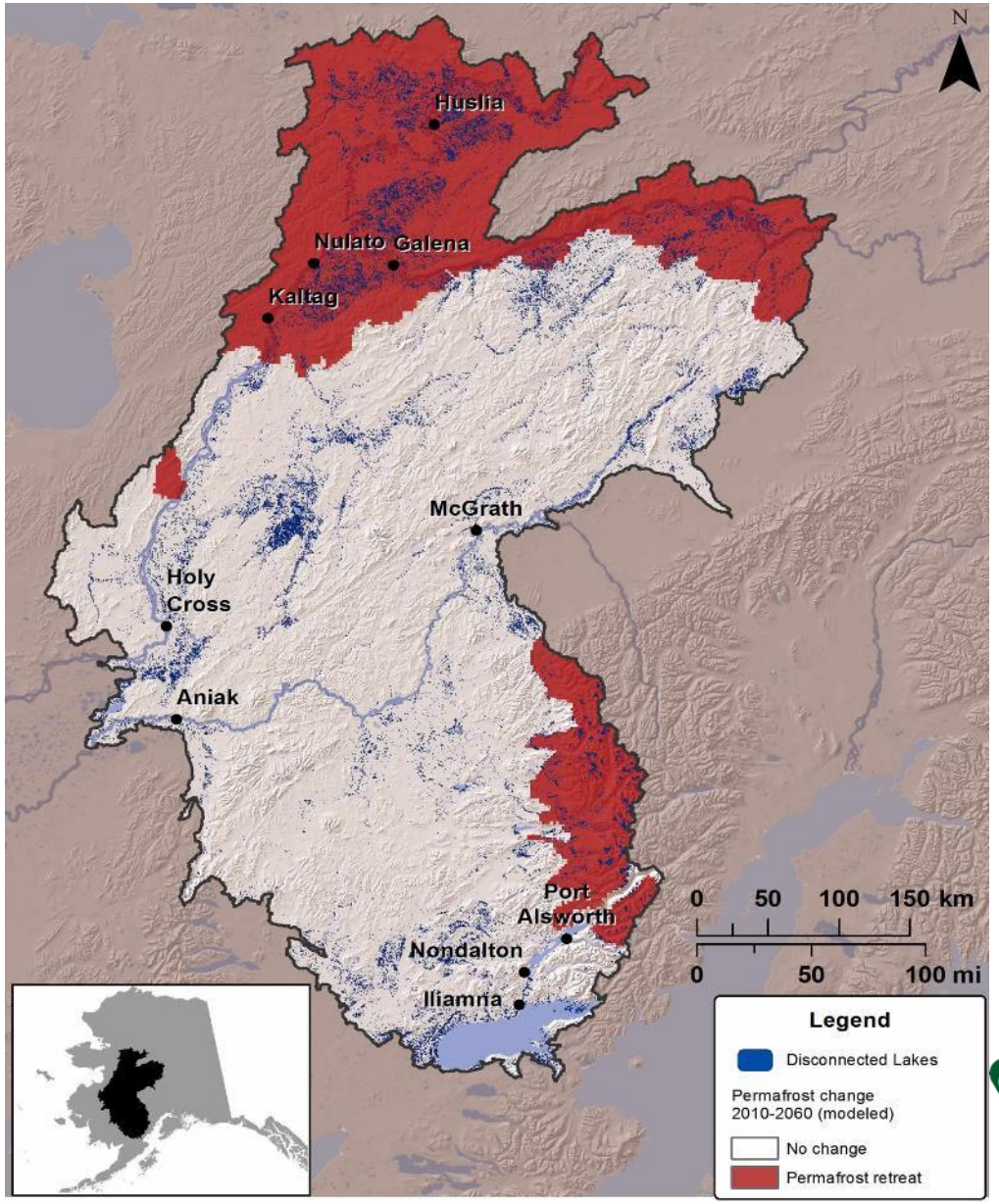
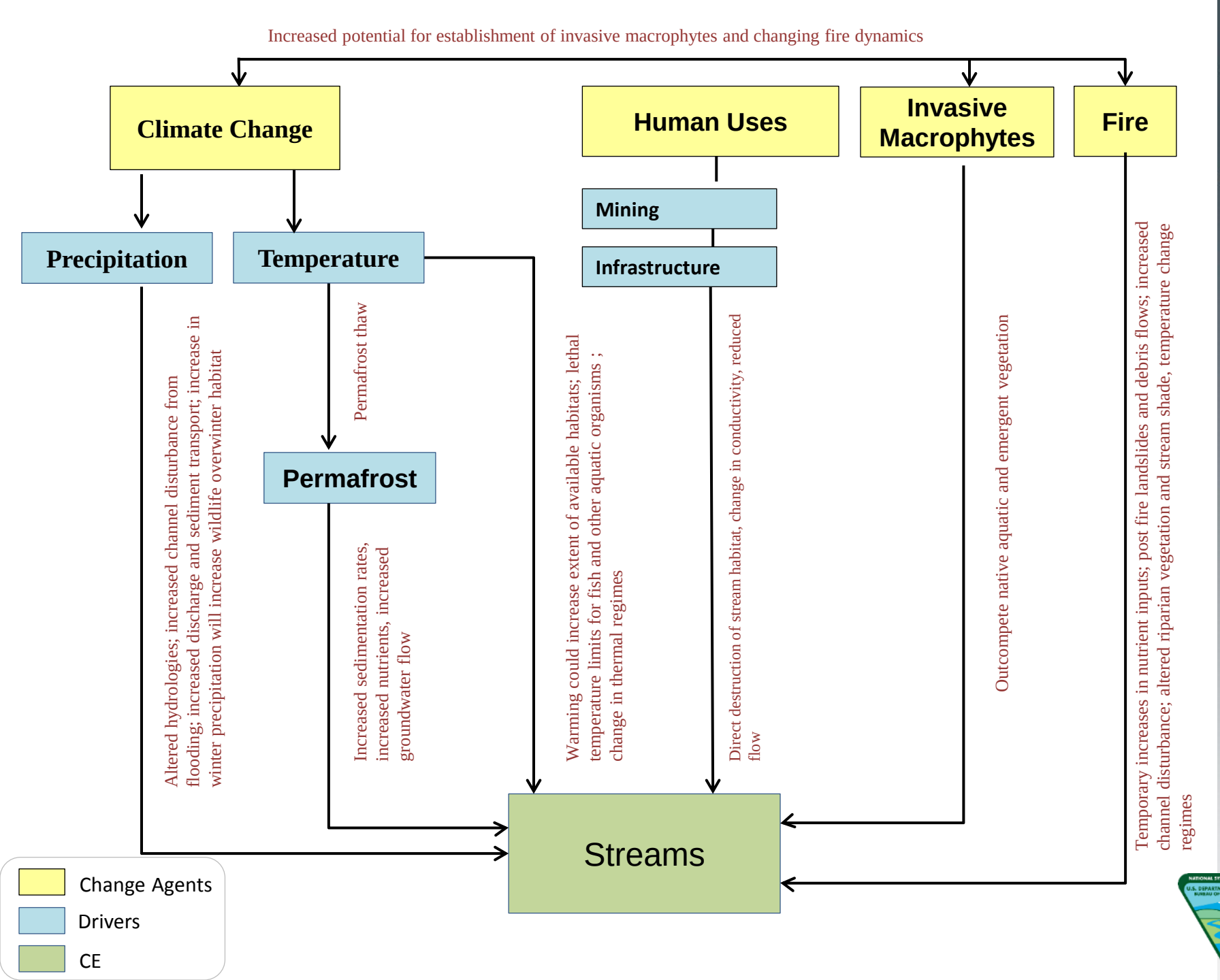
Climate Change
Human Uses
Invasive Macrophytes
Fire
Precipitation
Temperature
Mining
Infrastructure
Permafrost
Permafrost thaw
Lake area increase through increased precipitation; increased winter habitat for aquatic species
Decrease in lake area; lake drainage; increase in methane emissions
Lake drying in summer decreasing lake area; expanded ice-free season allow for early wildlife use (birds and fish); changes in thermal regimes
Direct destruction of lake habitat
Outcompete native aquatic and emergent vegetation; faster growing vegetation overtaking lake area
Temporary increases in nutrient inputs; postfire landslides and debris flows
Disconnected Lakes
Change Agents
Drivers
CE


Climate Change
Temperature
Permafrost thaw
Permafrost
Decrease in lake area; lake drainage; increase in methane emissions
Disconnected Lakes
Change Agents
Drivers
CE

Disconnected Lakes and Permafrost Change: 2010 to 2060

- Decrease in permafrost related to decline in lake area
  - Roach et al. 2013 FWS refuge lake study
  - Important wildlife management implications
- Increase methane release from lakes
- Increased nutrient inputs
  - Temporary





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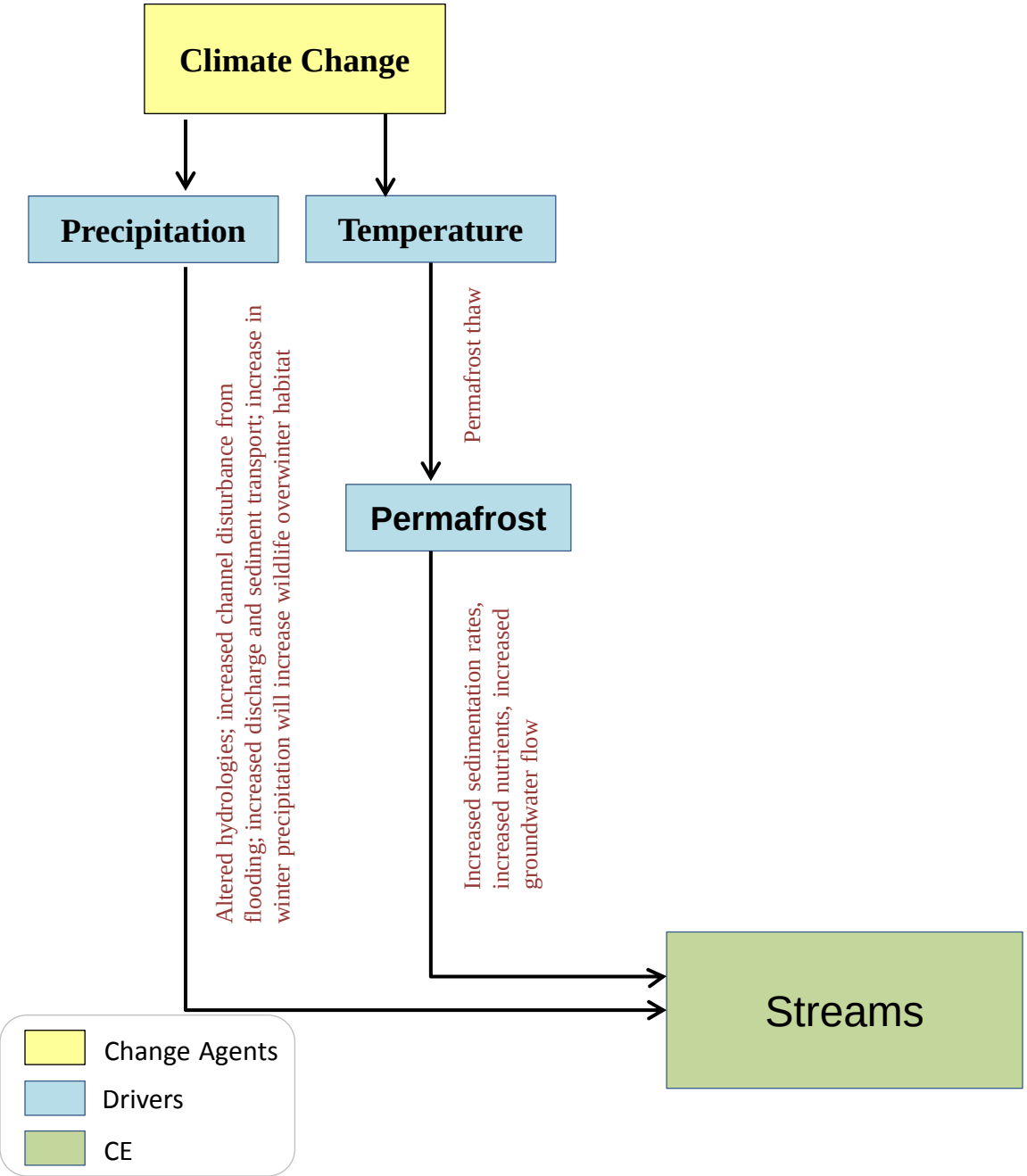
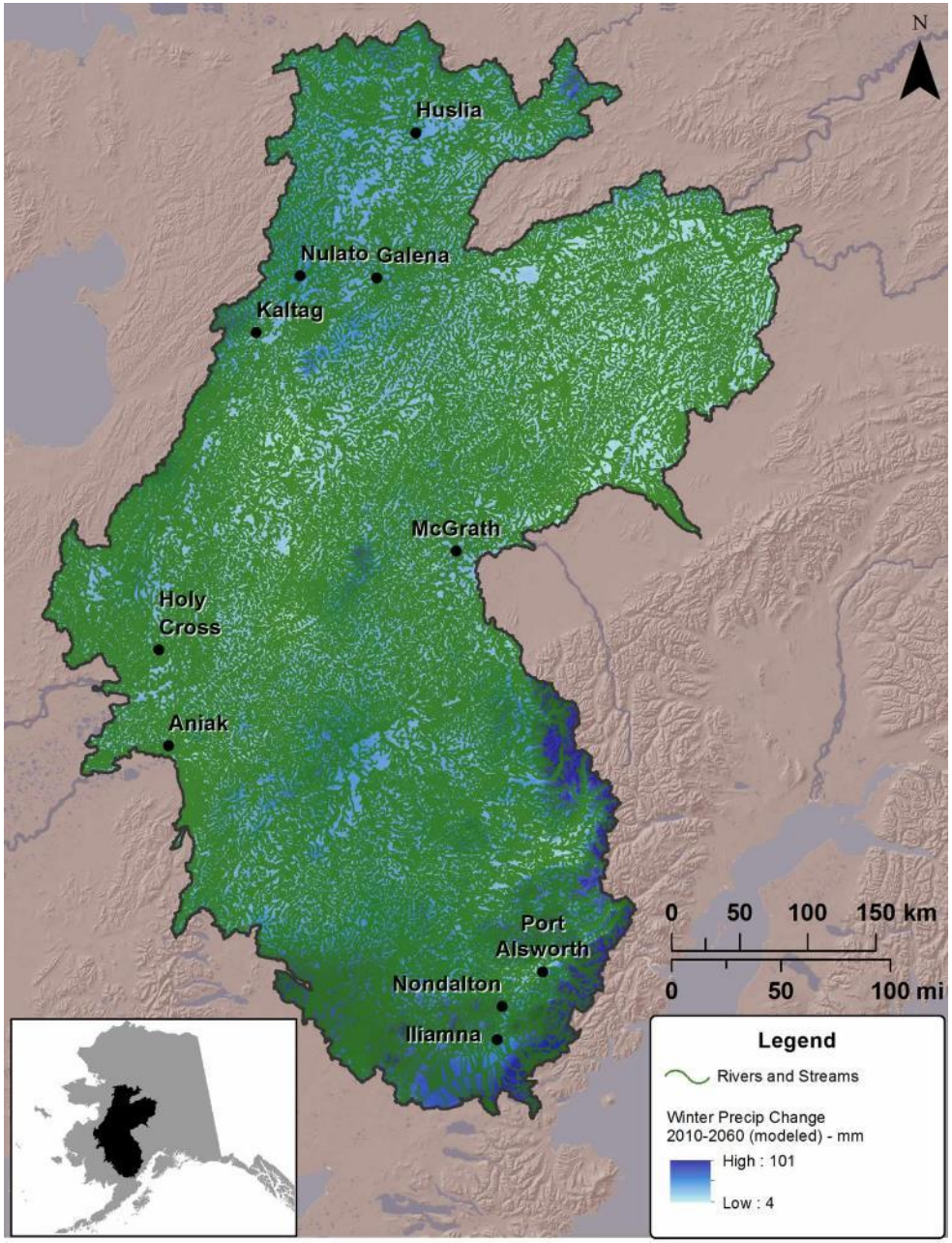
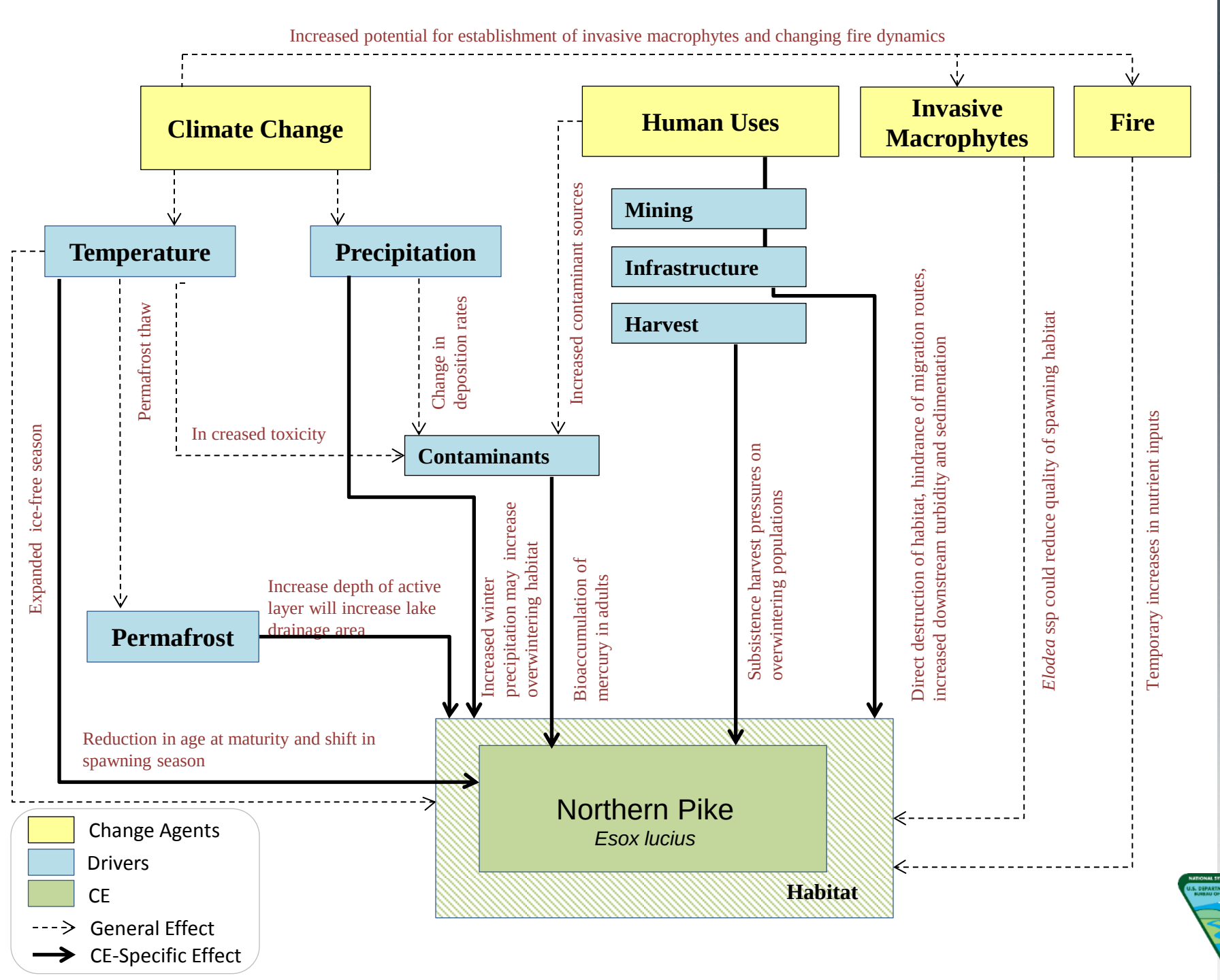
Rapid Ecoregional Assessment


Climate Change
Precipitation
Temperature
Permafrost thaw
Permafrost
Altered hydrologies; increased channel disturbance from flooding; increased discharge and sediment transport; increase in winter precipitation will increase wildlife overwinter habitat
Increased sedimentation rates, increased nutrients, increased groundwater flow
Streams
Change Agents
Drivers
CE

Streams and Winter Precipitation: 2010 to 2060

- Increased nutrient inputs
- Increased groundwater flows will likely improve overwintering habitat
  - In small to medium high gradient streams
- Increased sedimentation may reduce habitat:
  1) macroinvertebrates
  2) scour fish redd's
  3) erode streambanks
- Lowering the quality of stream habitat either directly or indirectly

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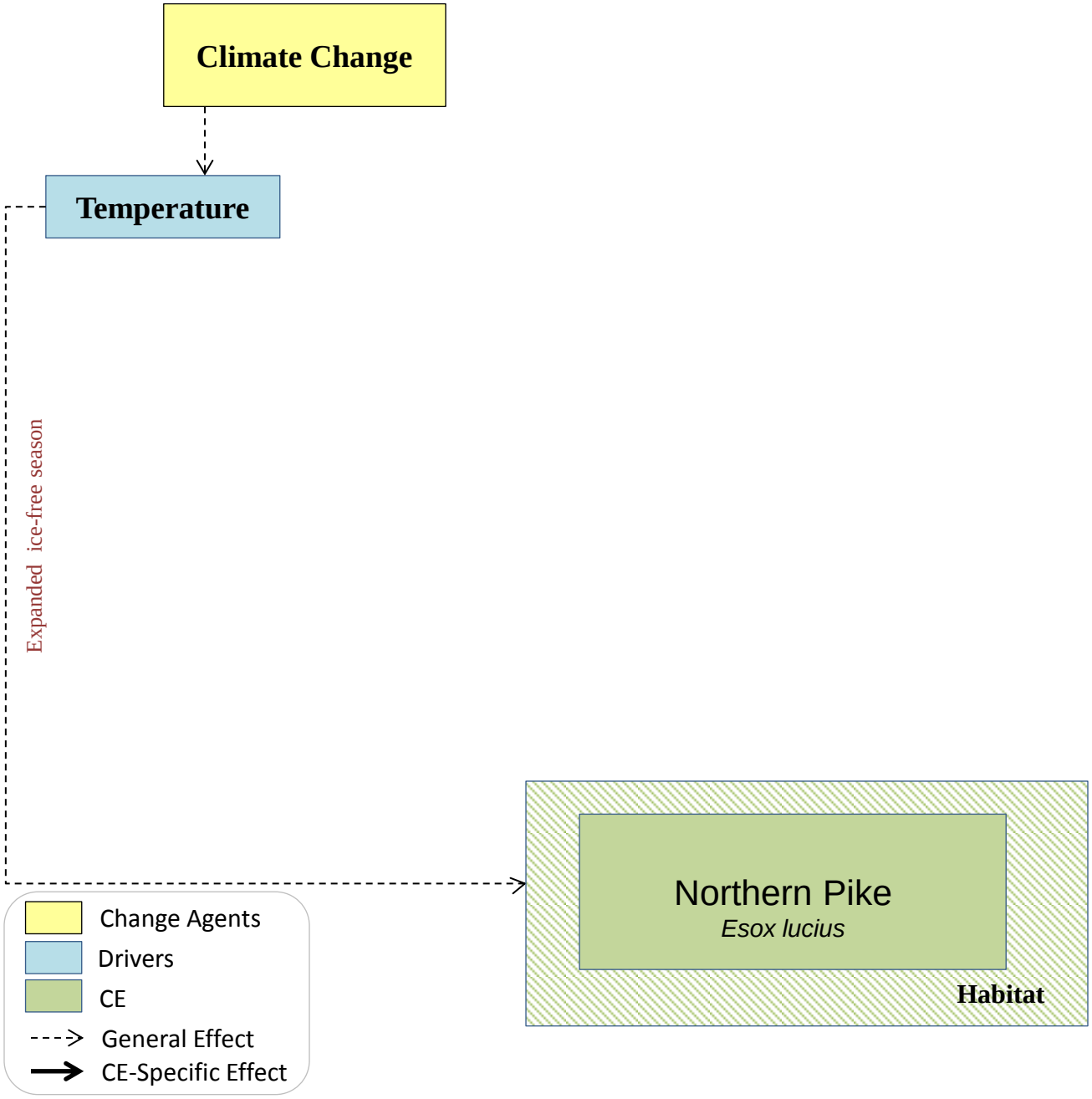
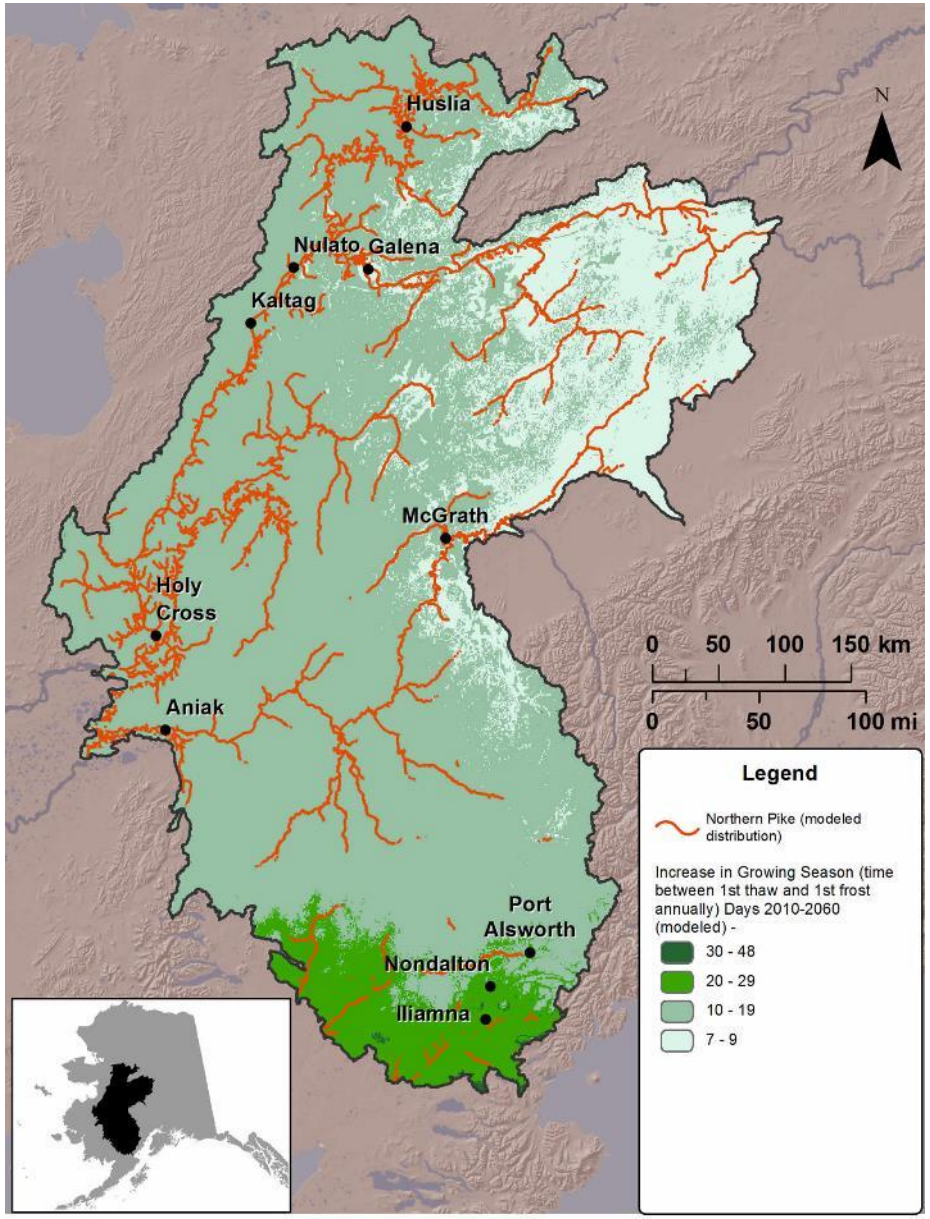
Precipitation
Permafrost
Contaminants
Permafrost thaw
Change in deposition rates
Increased contaminant sources
In creased toxicity
Expanded ice-free season
Increase depth of active layer will increase lake drainage area
Increased winter precipitation may increase overwintering habitat
Bioaccumulation of mercury in adults
Subsistence harvest pressures on overwintering populations
Direct destruction of habitat, hindrance of migration routes, increased downstream turbidity and sedimentation
Elodea ssp could reduce quality of spawning habitat
Temporary increases in nutrient inputs
Reduction in age at maturity and shift in spawning season
Northern Pike
Esox lucius
Habitat
Change Agents
Drivers
CE
General Effect
CE-Specific Effect


Climate Change
Temperature
Expanded ice-free season
Northern Pike
Esox lucius
Habitat
Change Agents
Drivers
CE
General Effect
CE-Specific Effect

Northern Pike and Growing Season: 2010 to 2060

- Pike year-round resident
- Migrate out of overwintering habitat when water becomes ice-free
  - Spawning will shift to earlier in season
- Longer open water season could increase primary productivity
  - Improve feeding habitat
- Age at maturity for fish will decrease

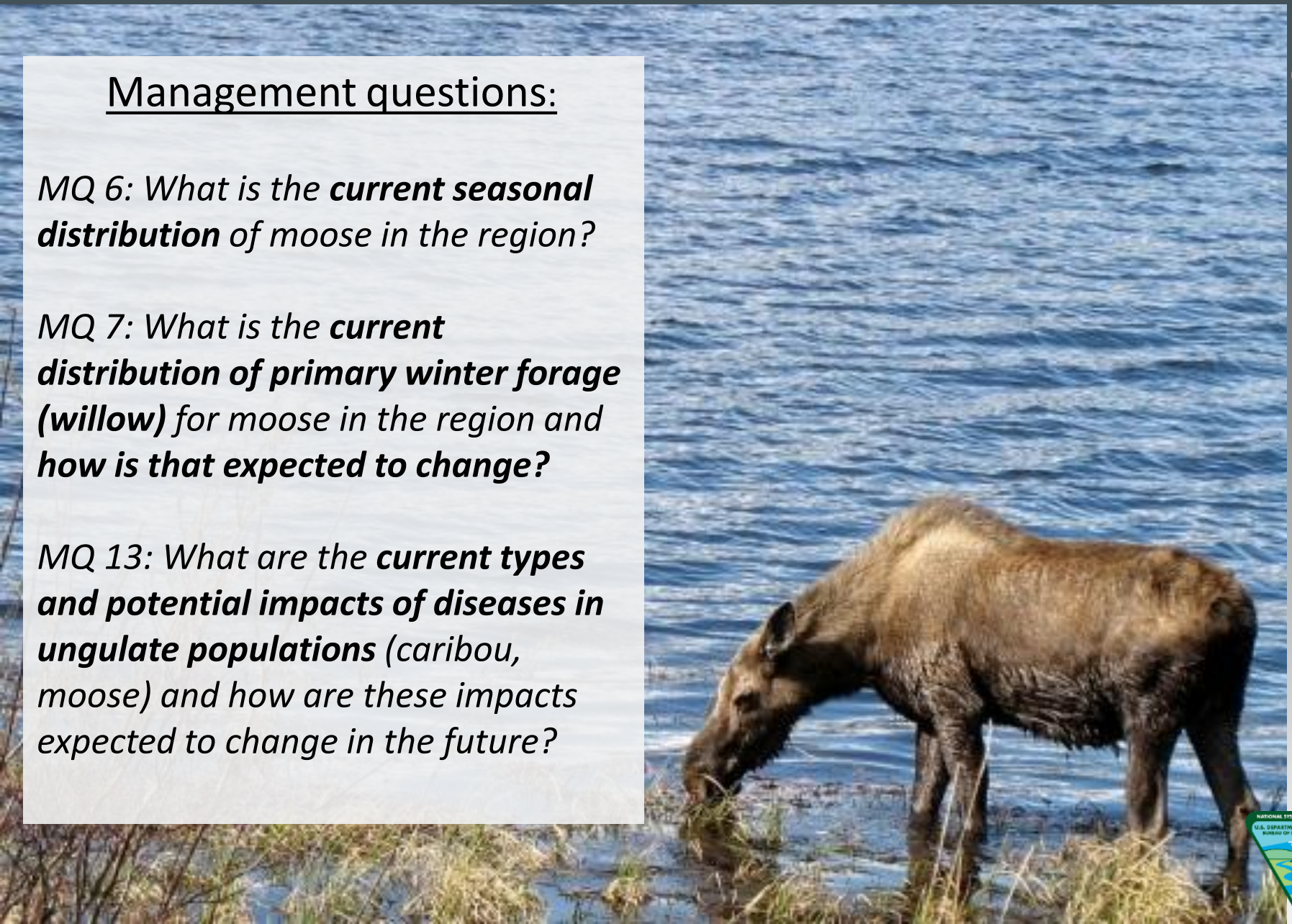


Wildlife MQs

BLM

Rapid Ecoregional Assessment

Wildlife MQs - Moose



Management questions:

*MQ 6: What is the **current seasonal distribution** of moose in the region?*

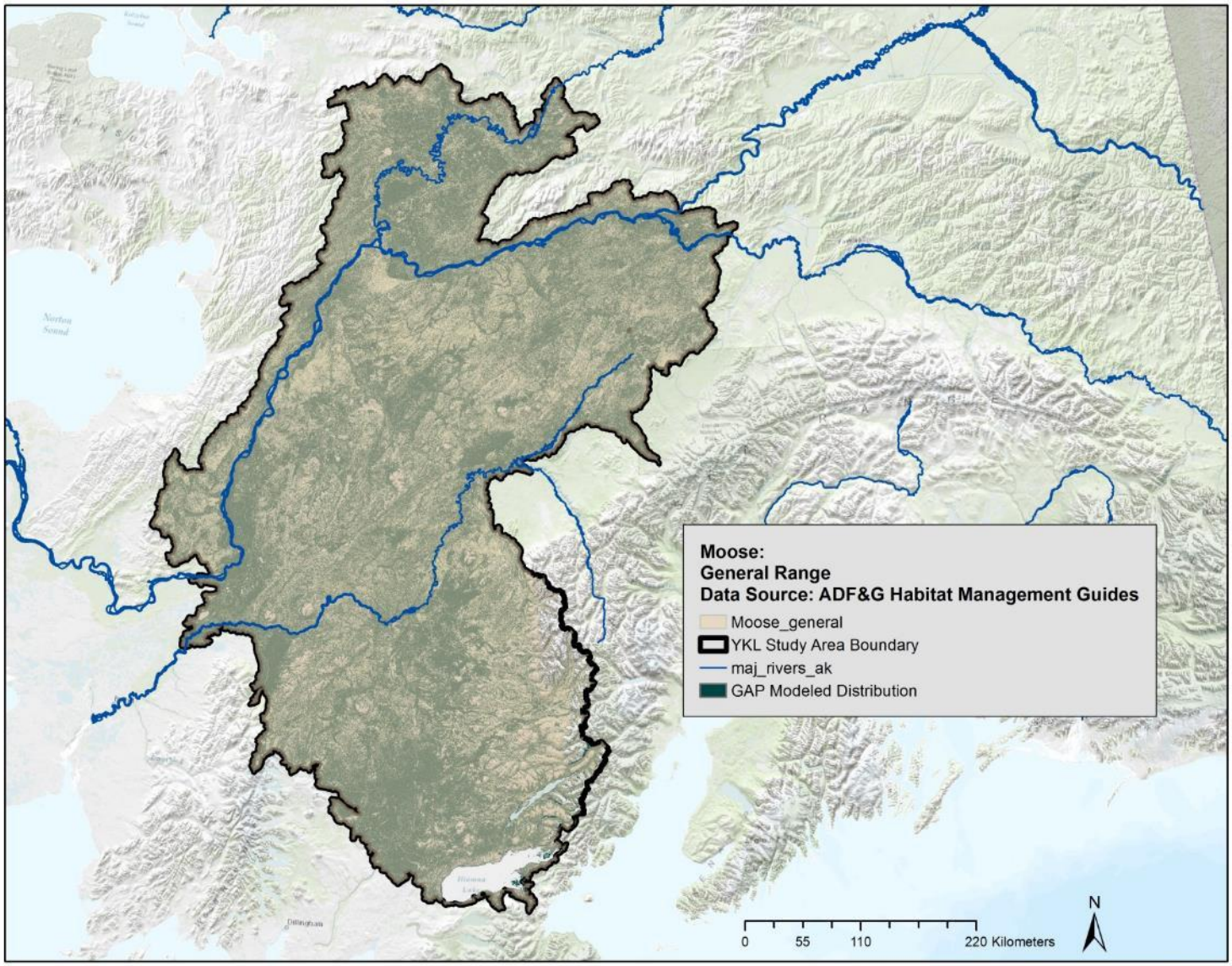
*MQ 7: What is the **current distribution of primary winter forage (willow)** for moose in the region and **how is that expected to change?***

*MQ 13: What are the **current types and potential impacts of diseases in ungulate populations** (caribou, moose) and how are these impacts expected to change in the future?*

BLM

Rapid Ecoregional Assessment

MQ 6: *What is the current seasonal distribution of moose in the region?*



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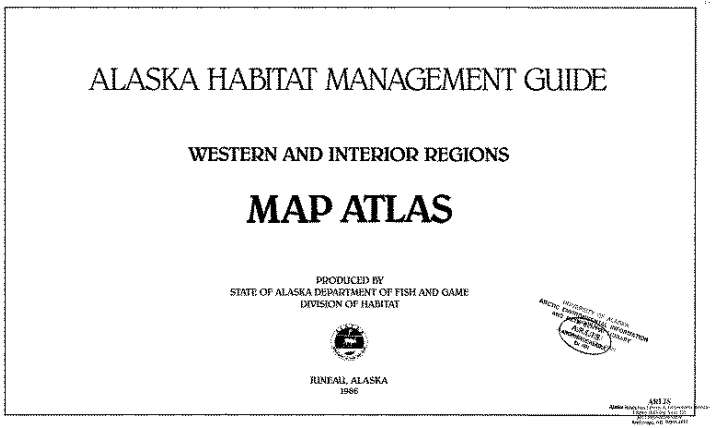


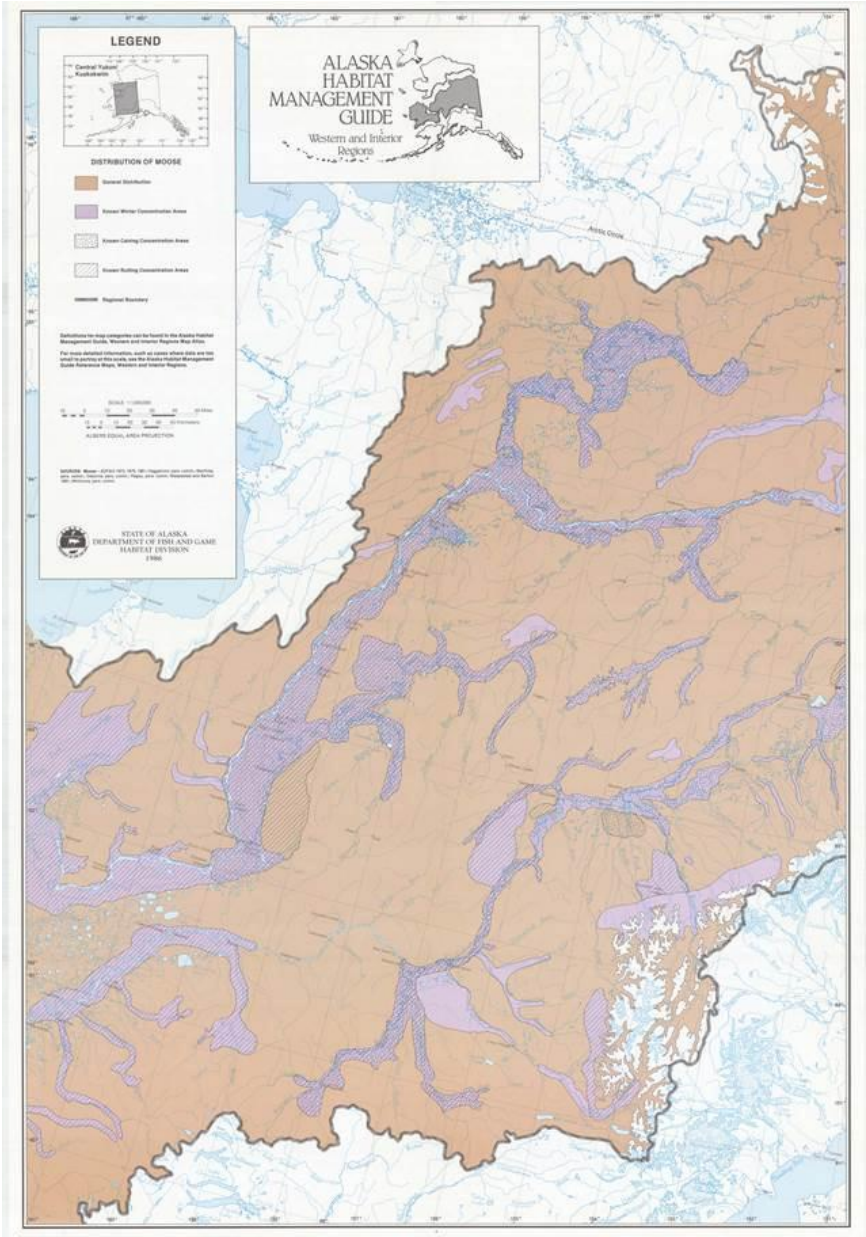
ALASKA HABITAT MANAGEMENT GUIDE

WESTERN AND INTERIOR REGIONS

MAP ATLAS

PRODUCED BY
STATE OF ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF HABITAT

JUNEAU, ALASKA
1986



BLM

Rapid Ecoregional Assessment

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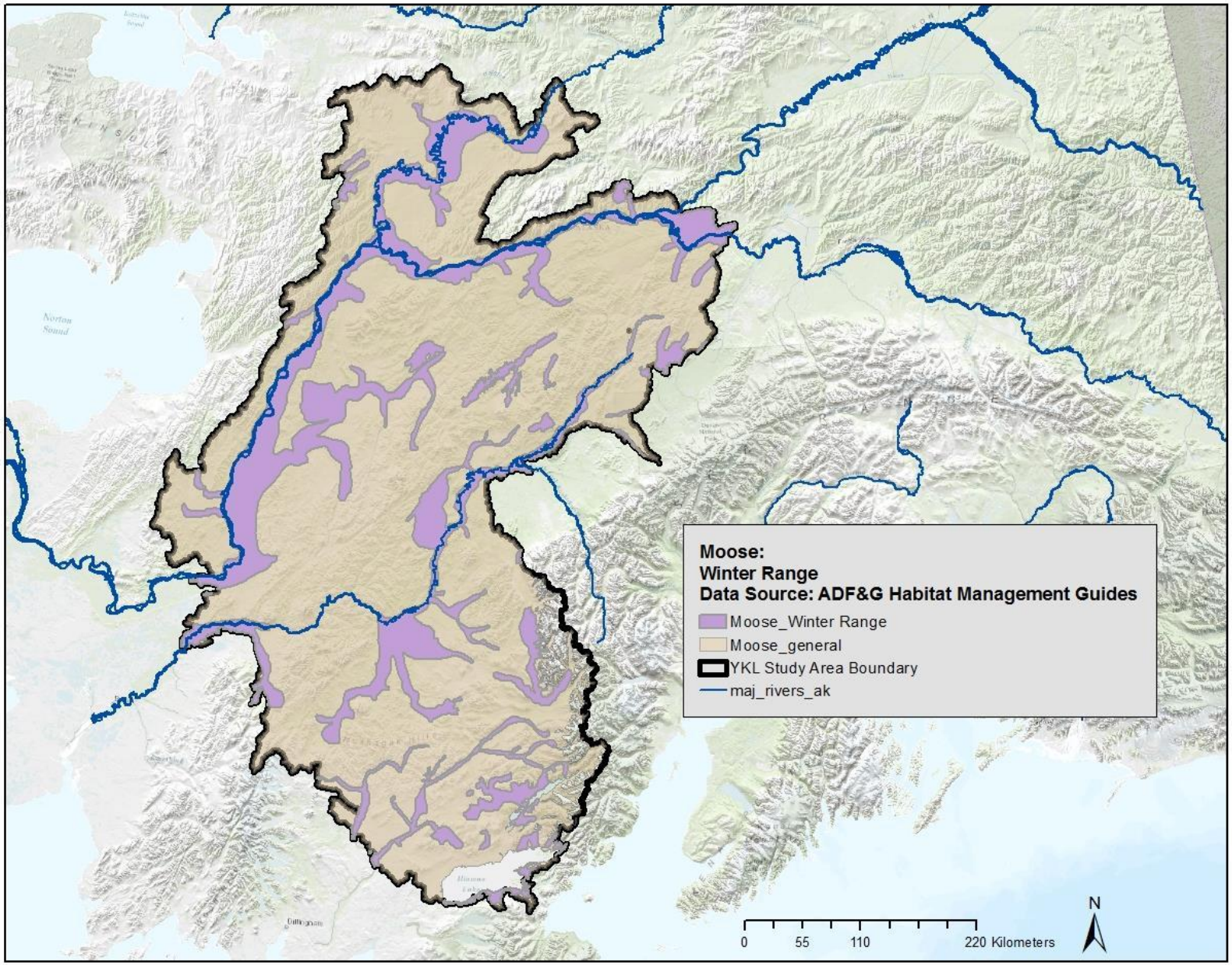

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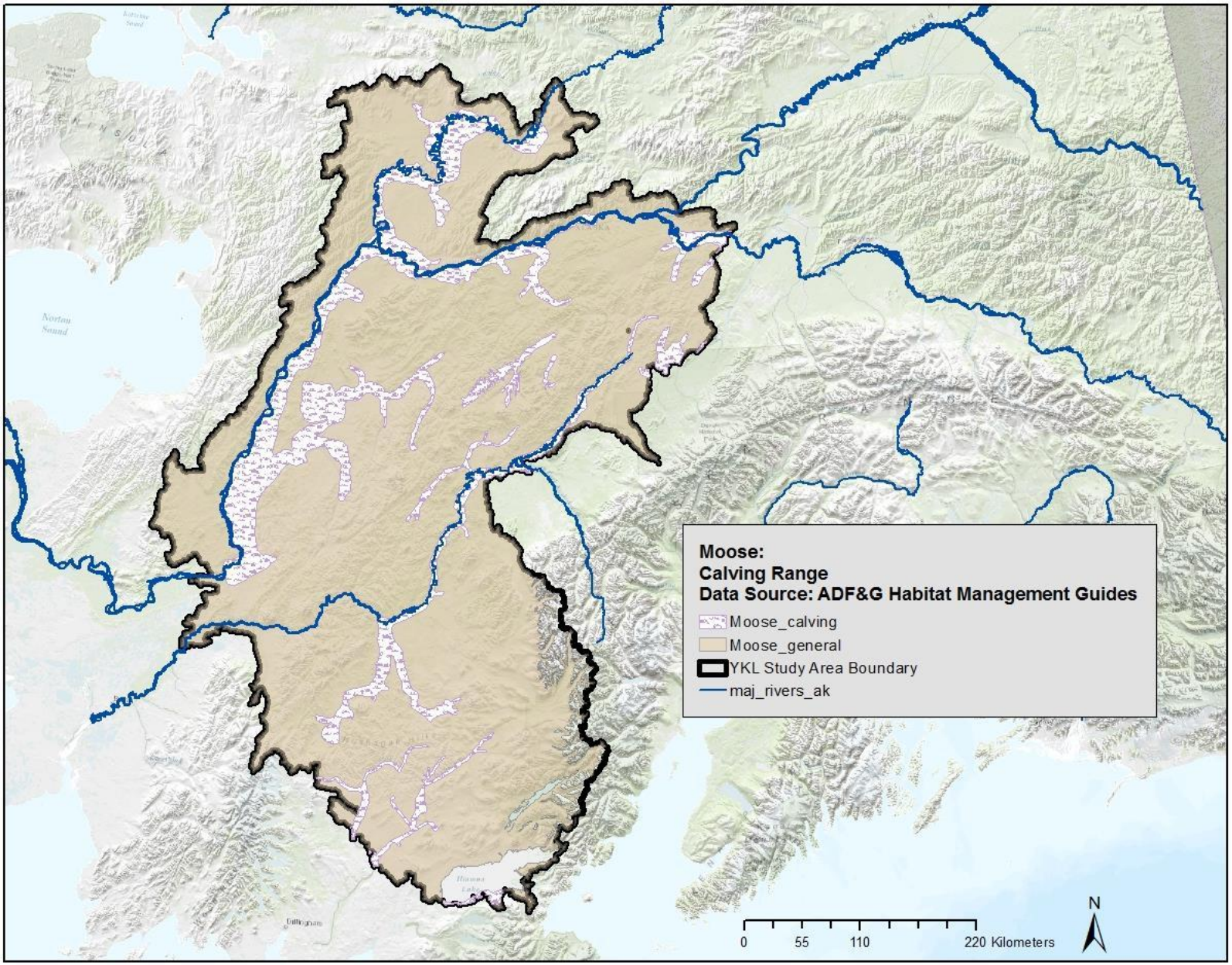

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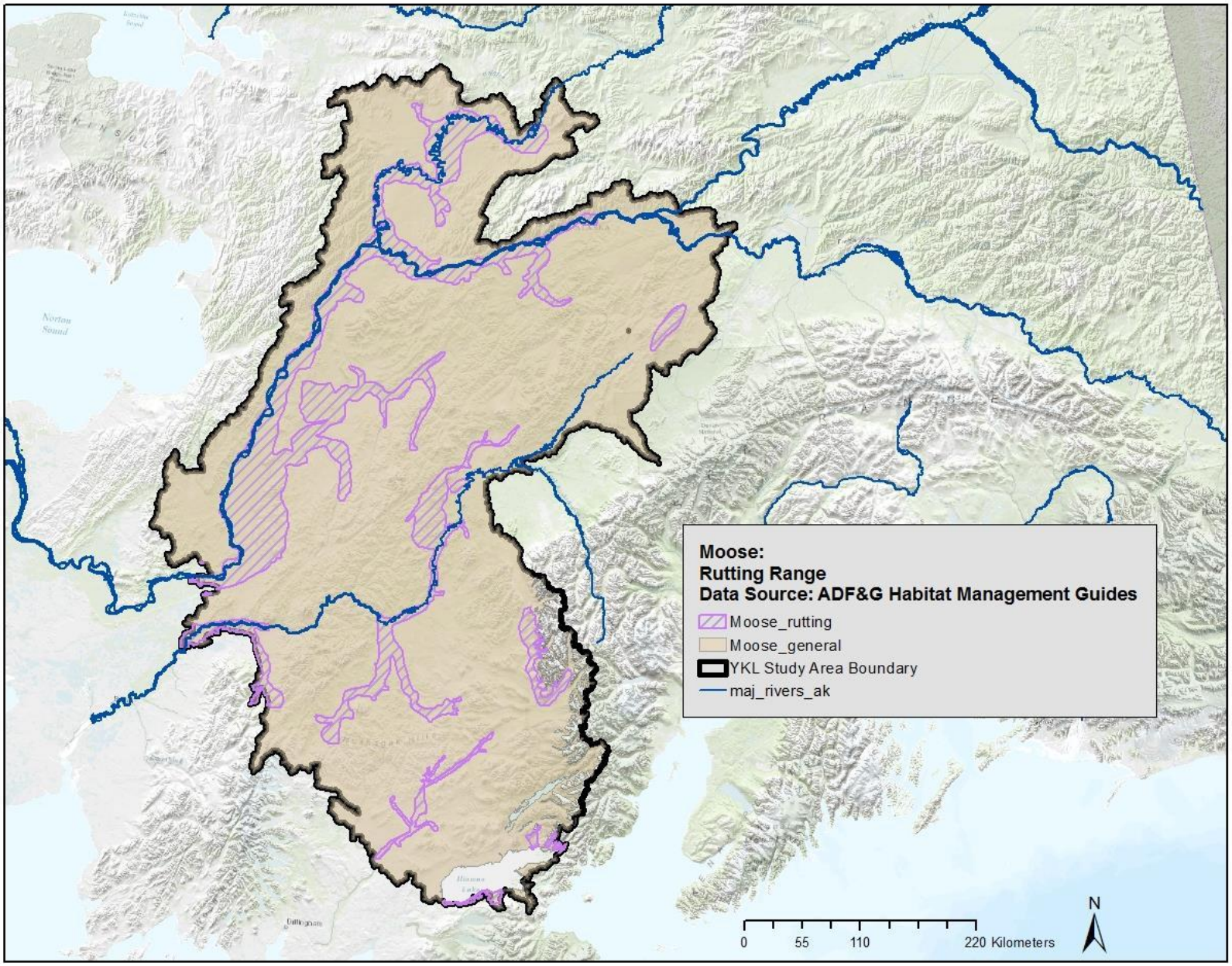

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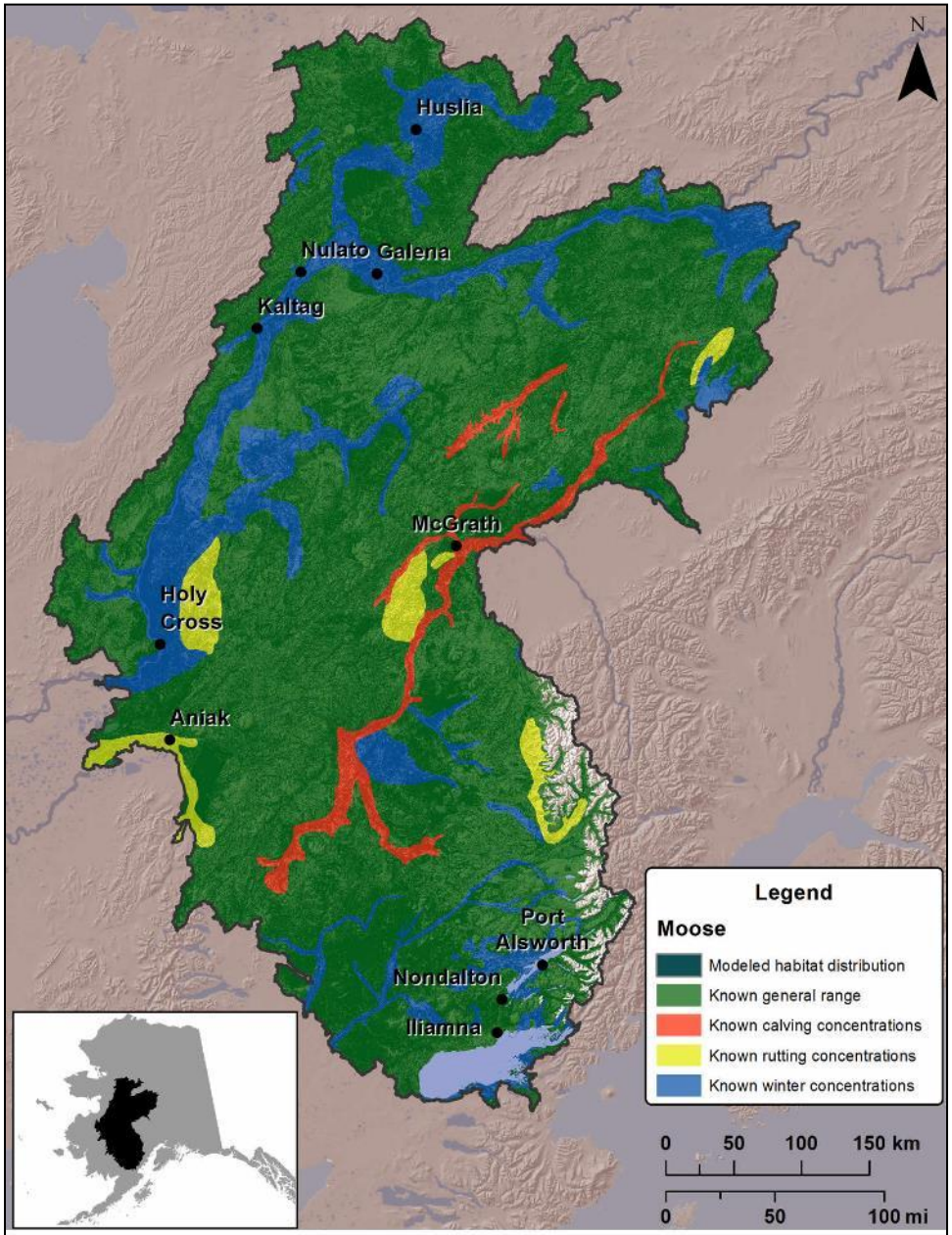
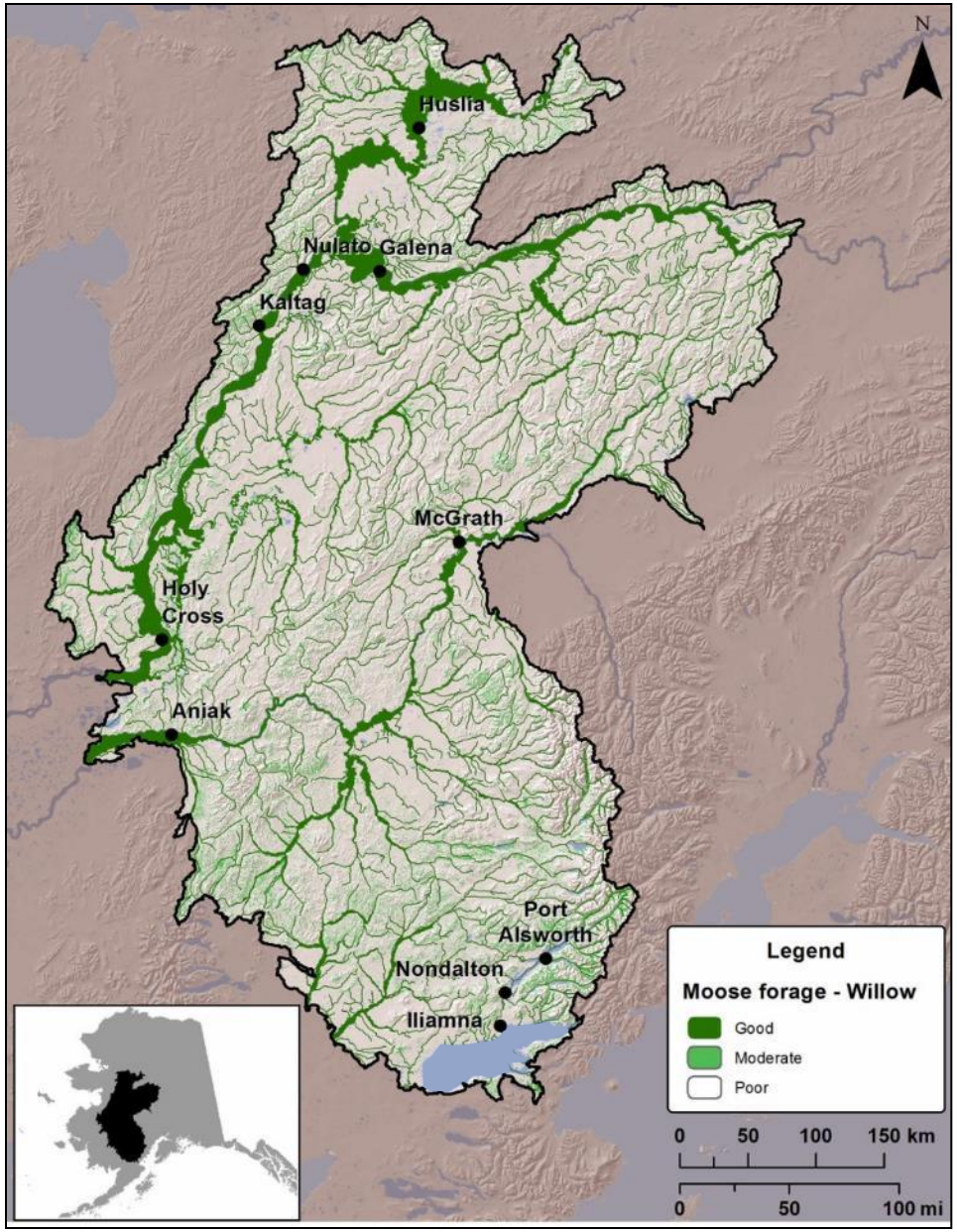


*MQ 7: What is the **current distribution** of primary winter forage (willow) for moose in the region and how is that expected to change?*



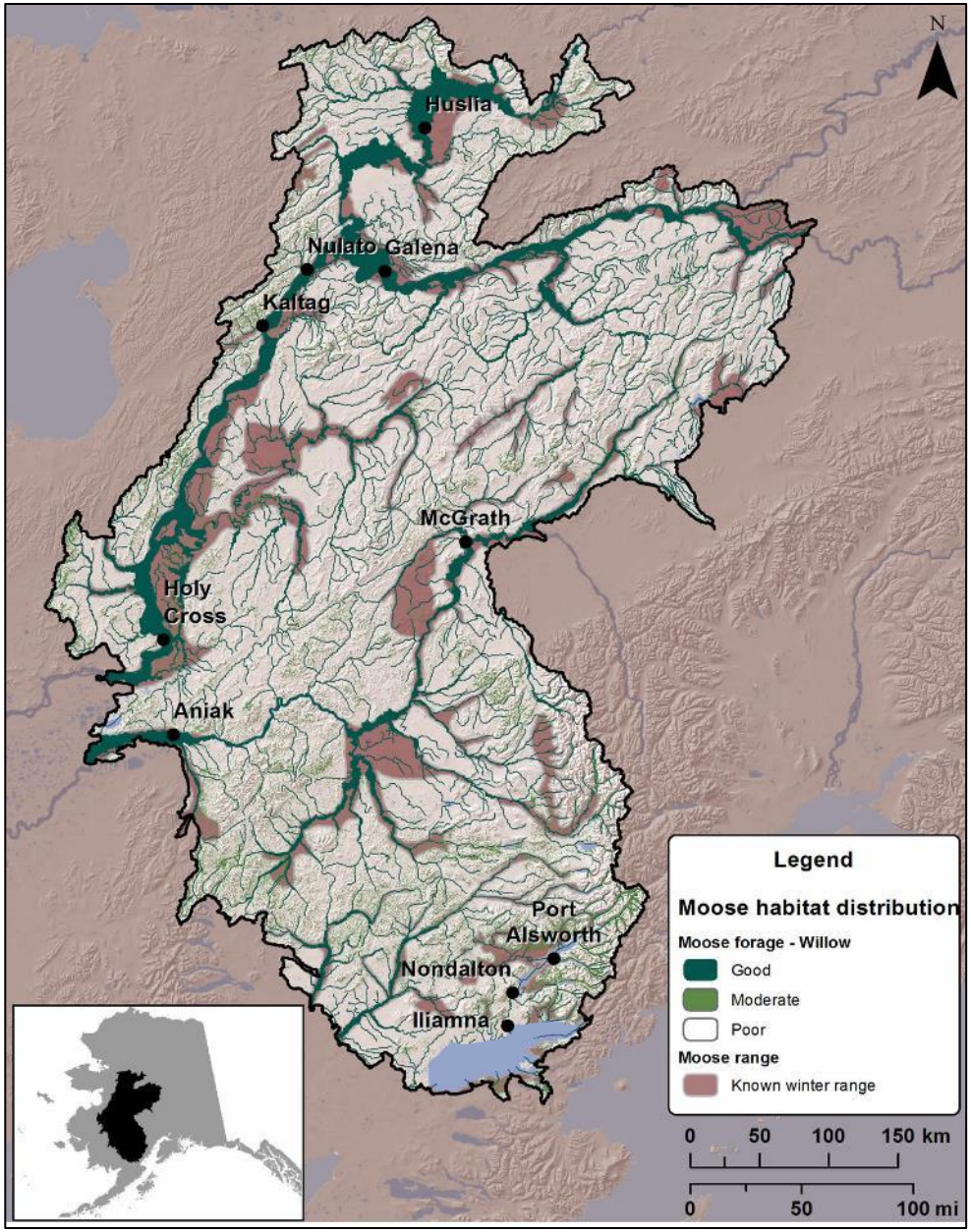
Winter forage = willow

- Pulled out all map classes containing willow
  - Assigned forage quality per map class
- Delineated floodplains and buffered small streams
  - *Major floodplains*: developed using heads-up digitizing refined from Statsgo Soils Map
  - *Small floodplains*: developed using NDH 1:2million resolution streams with 30 meter buffers
  - *High elevation (above treeline) floodplains:* eliminated above ~2,100 feet
- Assigned post-fire forage quality per map class
  - Forage quality years post-fire:
    - Moderate = 0-10
    - Good = 10-30
    - Poor = 30+
- Snow depth layer = unavailable

Forage quality per map class

Landcover class	Habitat quality
Tall Shrub (Open-Closed) (Floodplain)	Good
Low Shrub (Floodplain)	Good
Deciduous Forest (Open-Closed) (Floodplain)	Moderate
White Spruce or Black Spruce-Deciduous Forest (Open-Closed) (Flo	Moderate
Tall Shrub (Open-Closed)	Moderate
Low Shrub	Moderate
White Spruce or Black Spruce (Open-Closed)	Poor
White Spruce or Black Spruce (Open-Closed) (Floodplain)	Poor
White Spruce or Black Spruce (Woodland)	Poor
White Spruce or Black Spruce/Lichen (Woodland-Open)	Poor
Deciduous Forest (Open-Closed)	Poor
White Spruce or Black Spruce-Deciduous Forest (Open-Closed)	Poor
Low Shrub/Lichen	Poor
Tussock Tundra (Low Shrub or Herbaceous)	Poor
Dwarf Shrub	Poor
Dwarf Shrub-Lichen	Poor
Lichen	Poor
Herbaceous (Aquatic)	Poor
Herbaceous (Marsh) (Interior Alaska, Cook Inlet Basin)	Poor
Herbaceous (Wet) (Interior Alaska, Cook Inlet Basin)	Poor
Herbaceous (Mesic) (Interior Alaska, Cook Inlet Basin)	Poor

MQ 7: *What is the* ***current distribution*** *of primary winter forage (willow) for moose in the region and how is that expected to change?*



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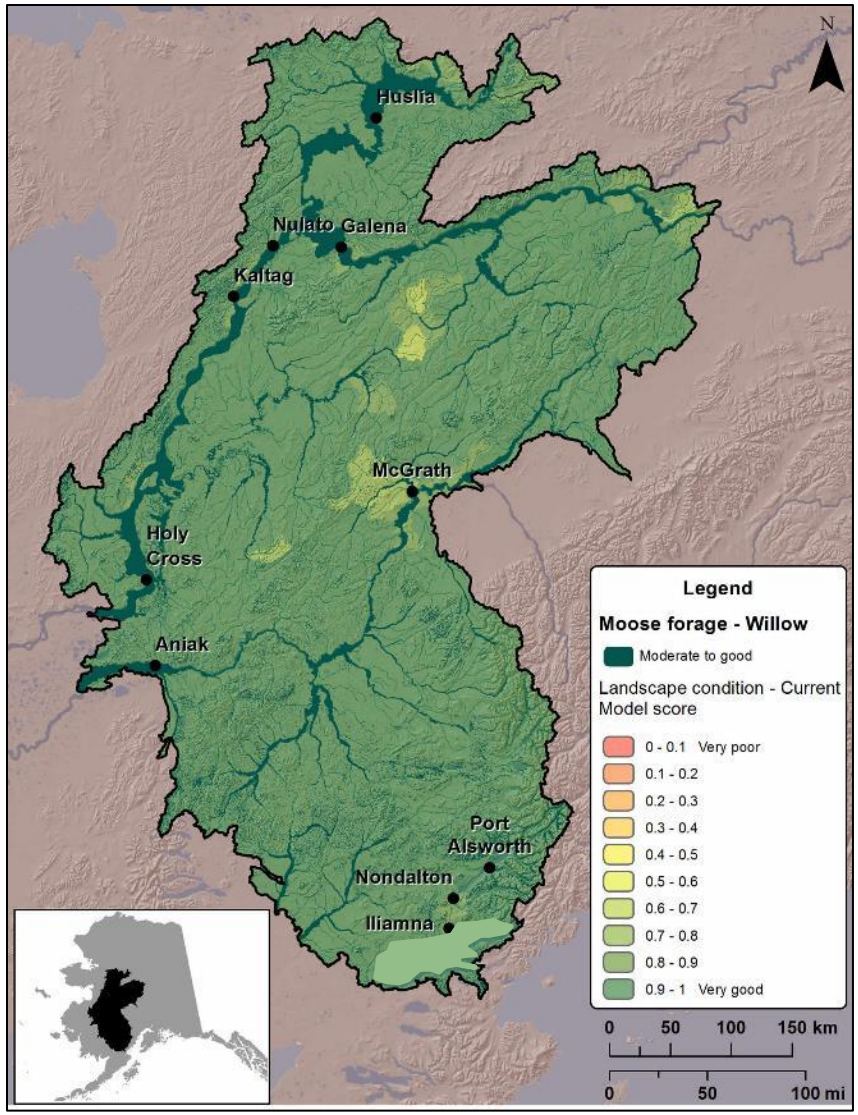
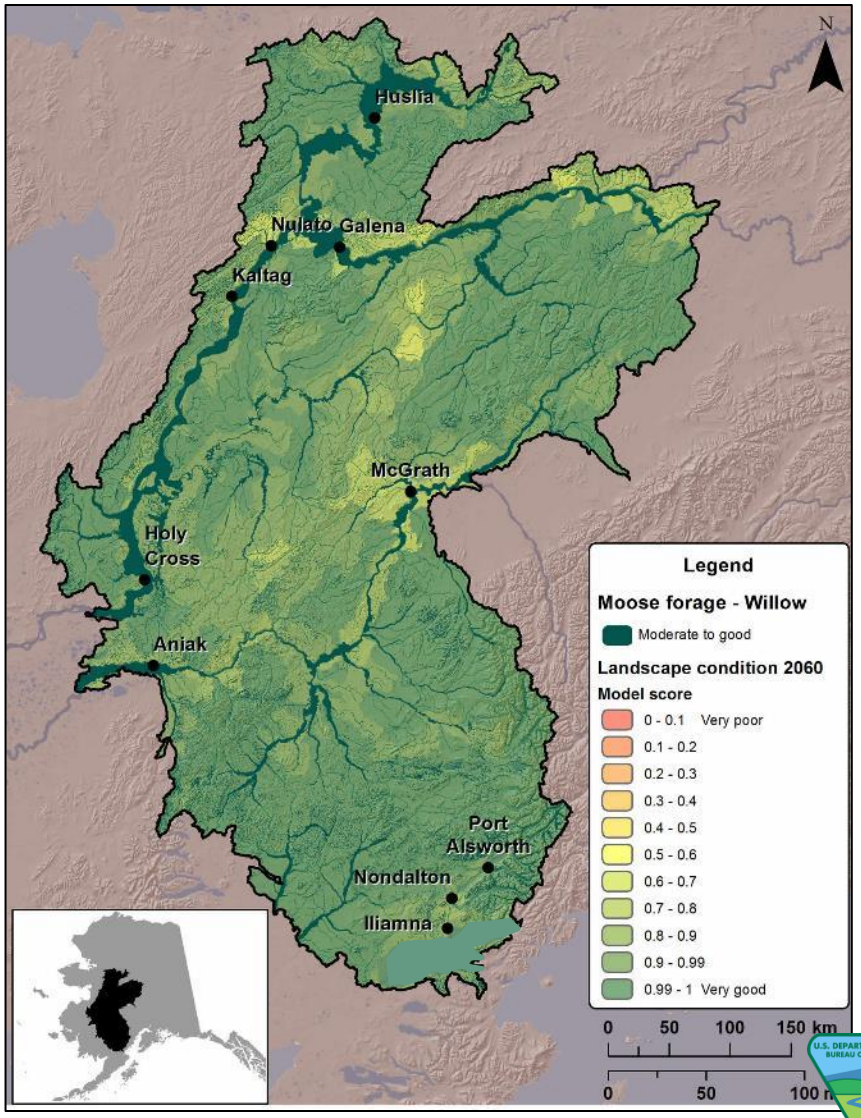
LCM Current



LCM Long Term (2060)



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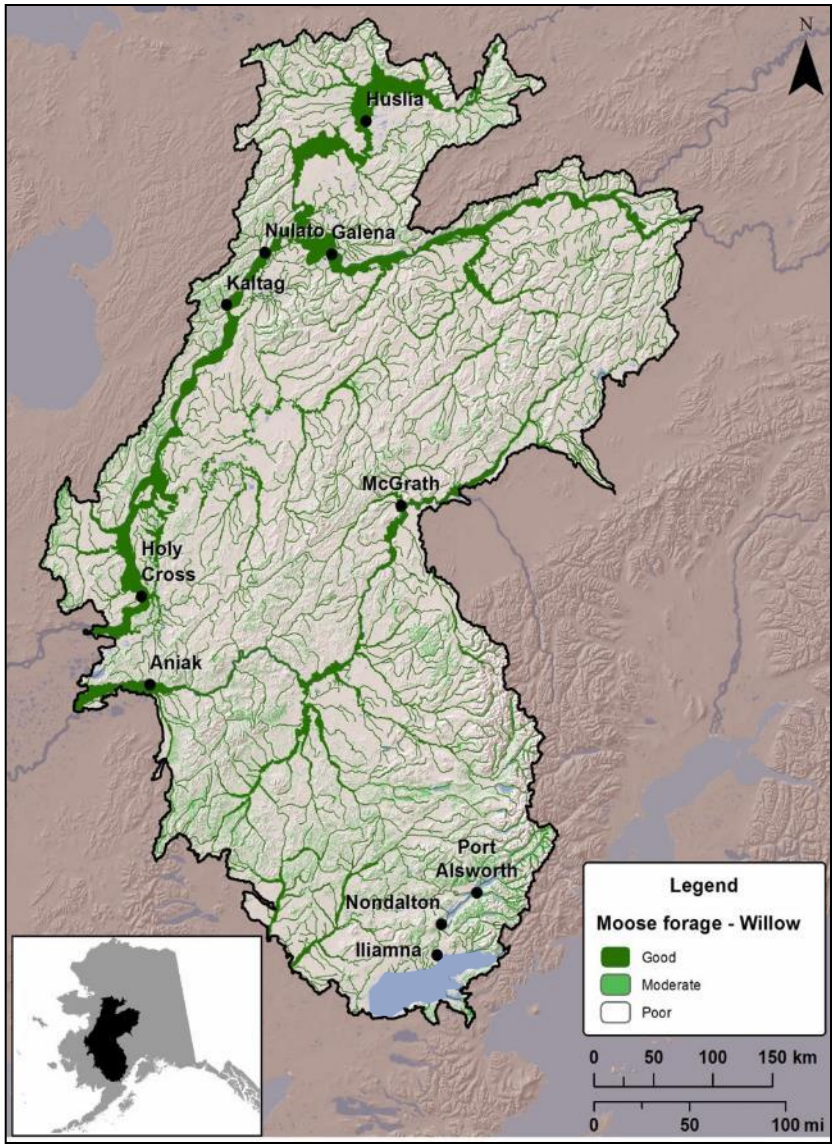
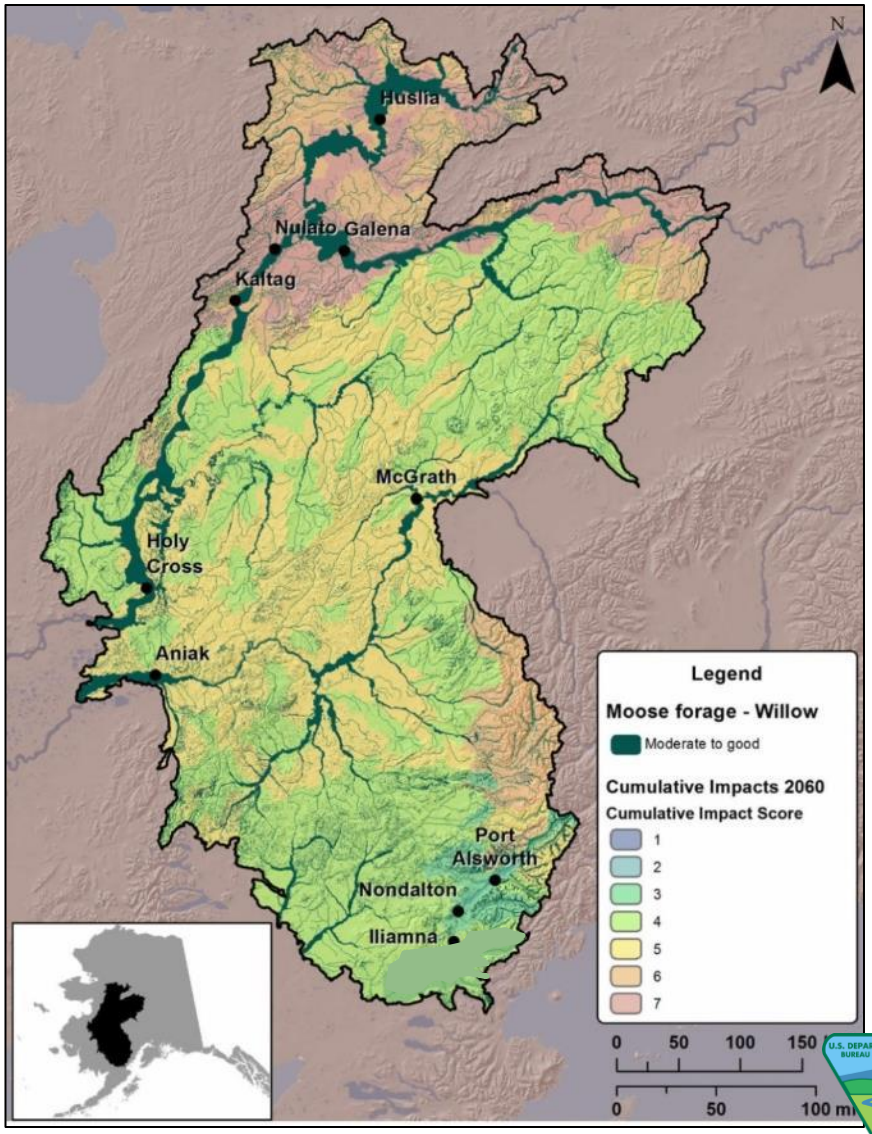
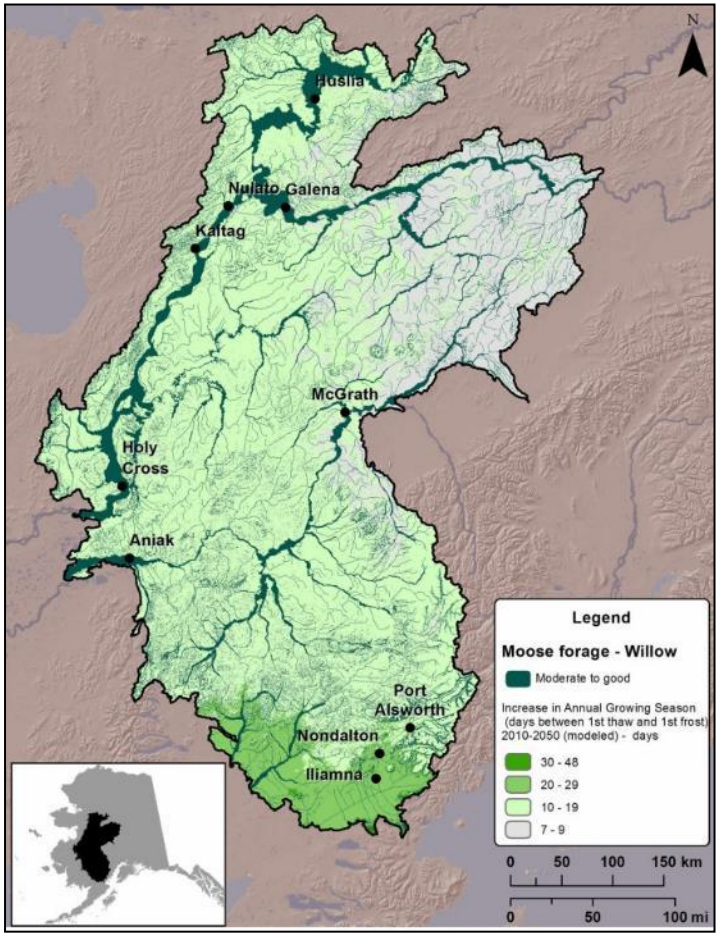
Current

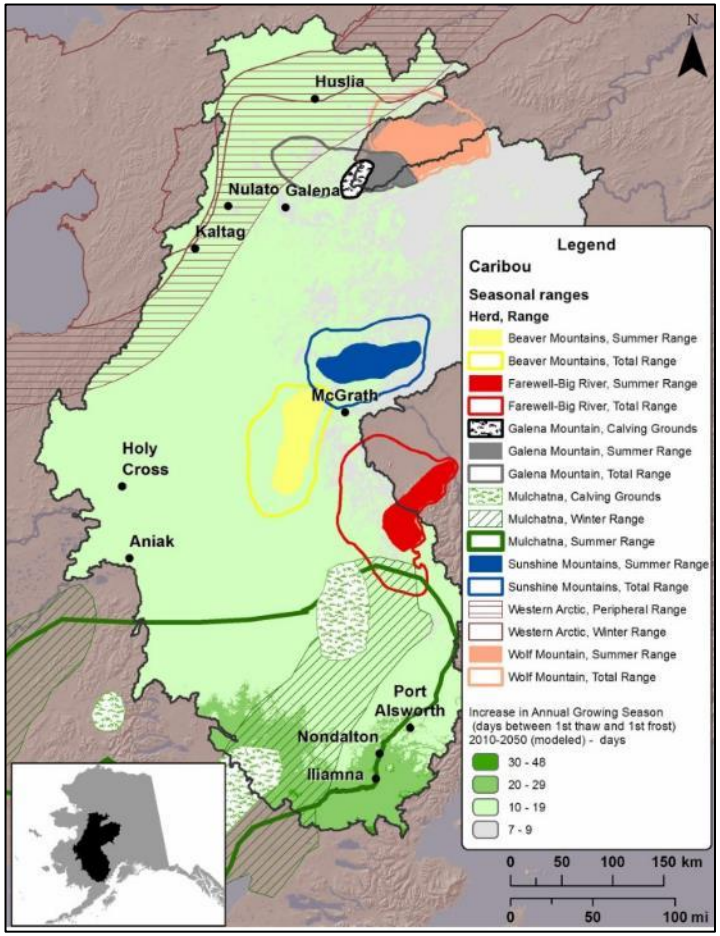


CI Long Term (2060)



MQ 13: *What are the current types and potential impacts of diseases in ungulate populations (caribou, moose) and how are these impacts expected to change in the future?*





Climate change is likely to cause an amplification of parasite populations through increased rates for development, reduction in generation times, **and broadened seasonal windows for transmission**.

- In particular, warmer temperatures will likely benefit bacteria and parasites that are limited by temperature.

Hoberg, E. P., A. A. Kocan, and L. G. Rickard. 2001. Gastrointestinal strongyles in wild ruminants. In Parasitic diseases of wild mammals (ed. W. M. Samuel, M. J. Pybus, and A. A. Kocan), pp. 193–227. Iowa State University Press, IA.

Wildlife MQs - Caribou

BLM

Rapid Ecoregional Assessment

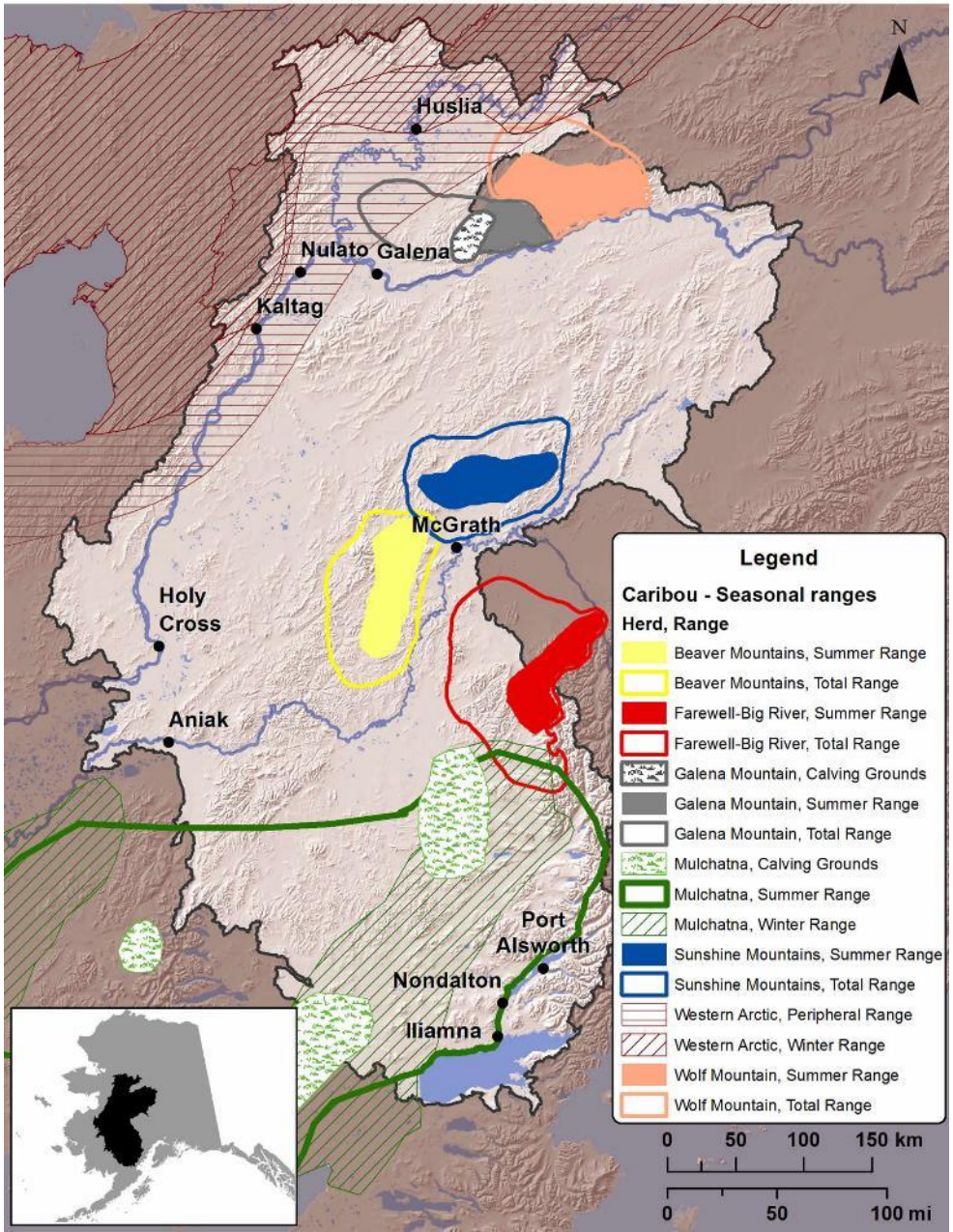
Management questions:

*MQ 4: What is the **current distribution of primary winter forage (lichen)** for caribou in the region and how is that expected to change?*

*MQ 5: Where are **caribou calving grounds** in the region and **how are they expected to change?***

*MQ 9: What is the **current distribution of migration corridors** for caribou and how are they likely to change in the future?*

Wildlife MQs - Caribou

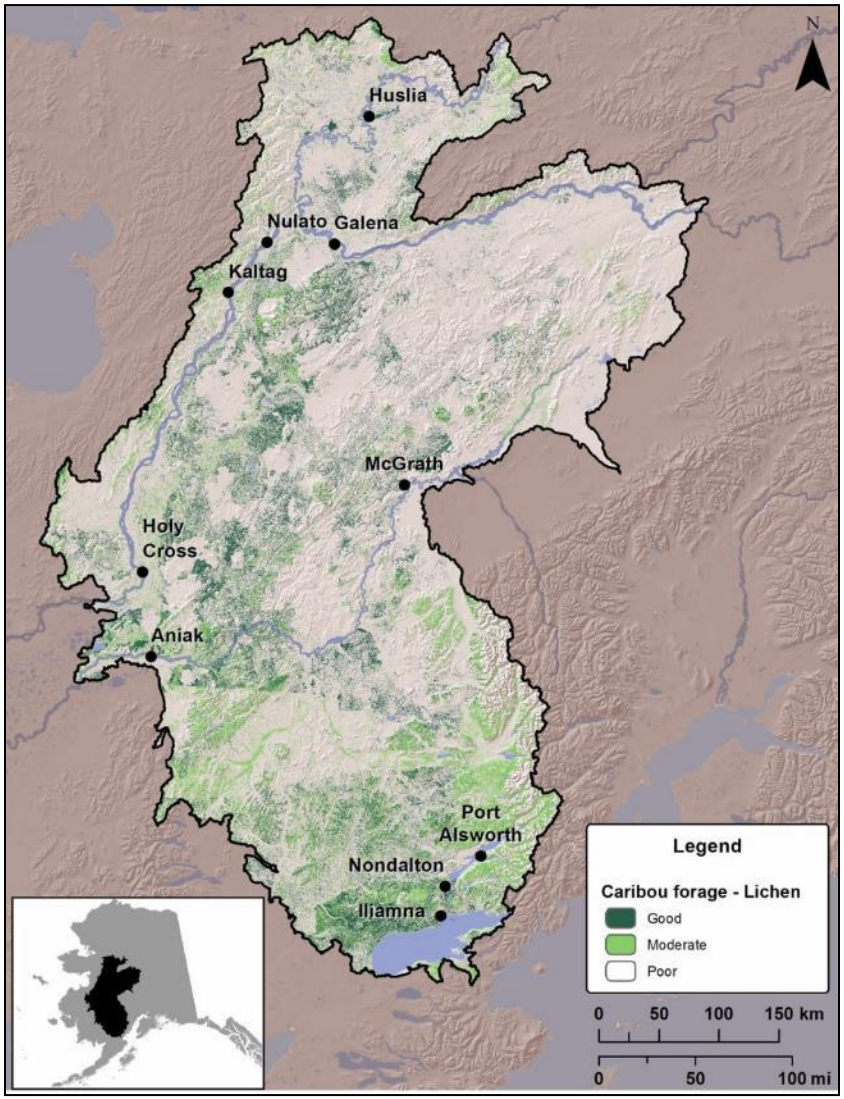


*MQ 4: What is the **current distribution** of primary winter forage (lichen) for caribou in the region and how is that expected to change?*

BLM

Rapid Ecoregional Assessment

Lichen - Current



Lichen Vegetation Classes	Forage Quality of Lichen Classes Without Fire	Years Post Fire	Forage Quality Post Fire
White Spruce or Black Spruce/Lichen (Woodland-Open)	Good	0-60	Poor
		60-180	Moderate
		180+	Good
Low Shrub/Lichen	Good	0-60	Poor
		60-180	Moderate
		180+	Good
Dwarf Shrub	Moderate	0-60	Poor
		60-180	Poor
		180+	Moderate
Dwarf Shrub-Lichen	Good	0-60	Poor
		60-180	Moderate
		180+	Good
Lichen	Good	0-60	Poor
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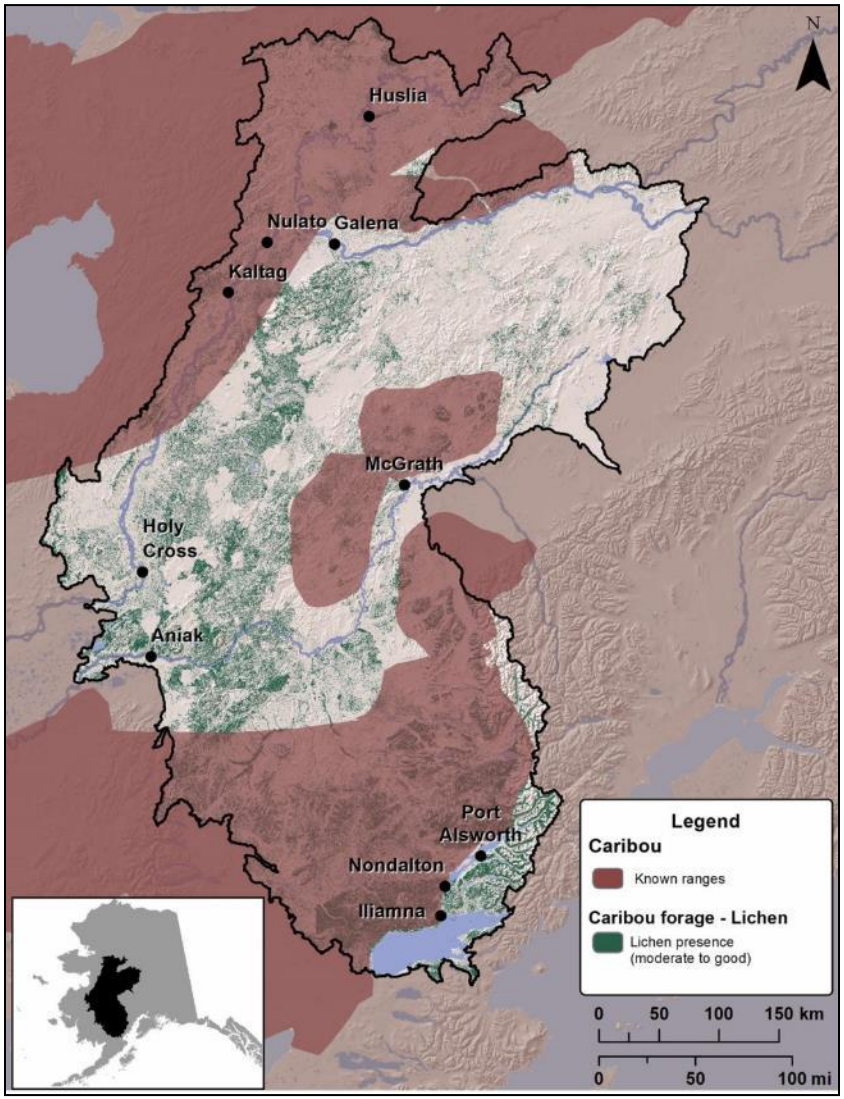
BLM

Rapid Ecoregional Assessment

Lichen - Current



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Lichen	Good	0-60	Poor
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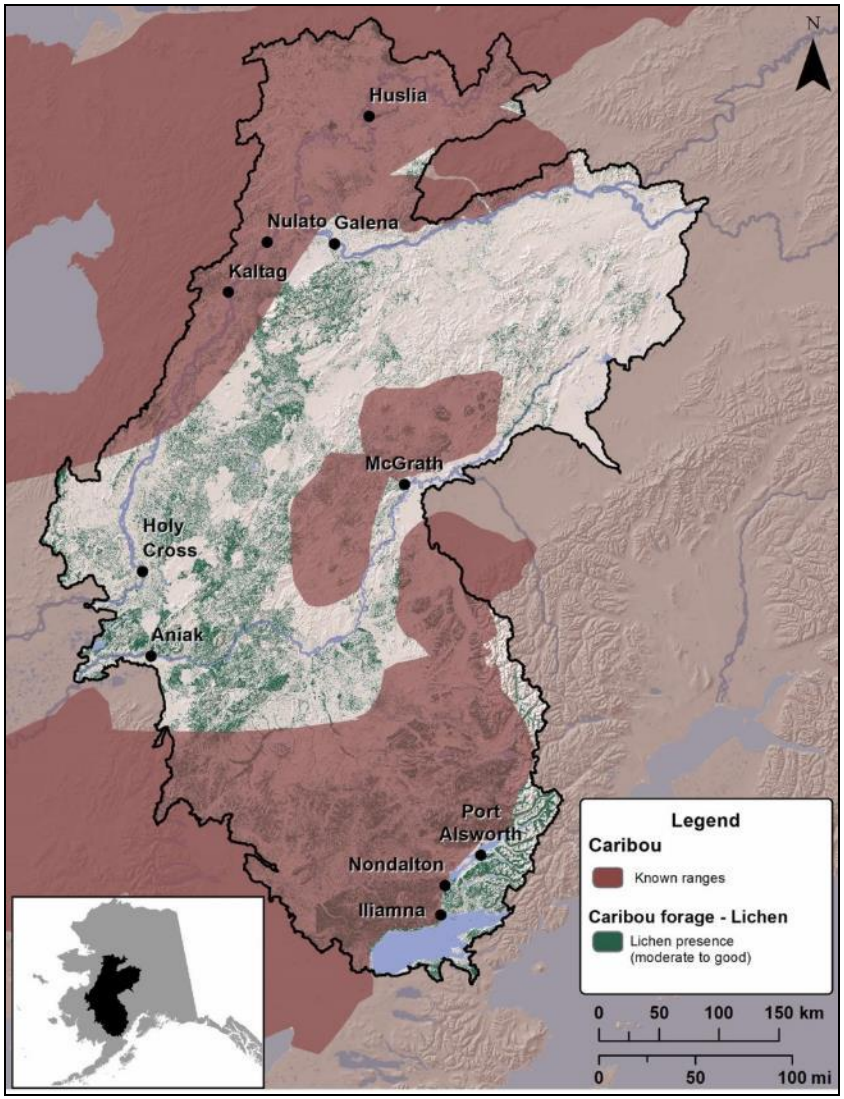
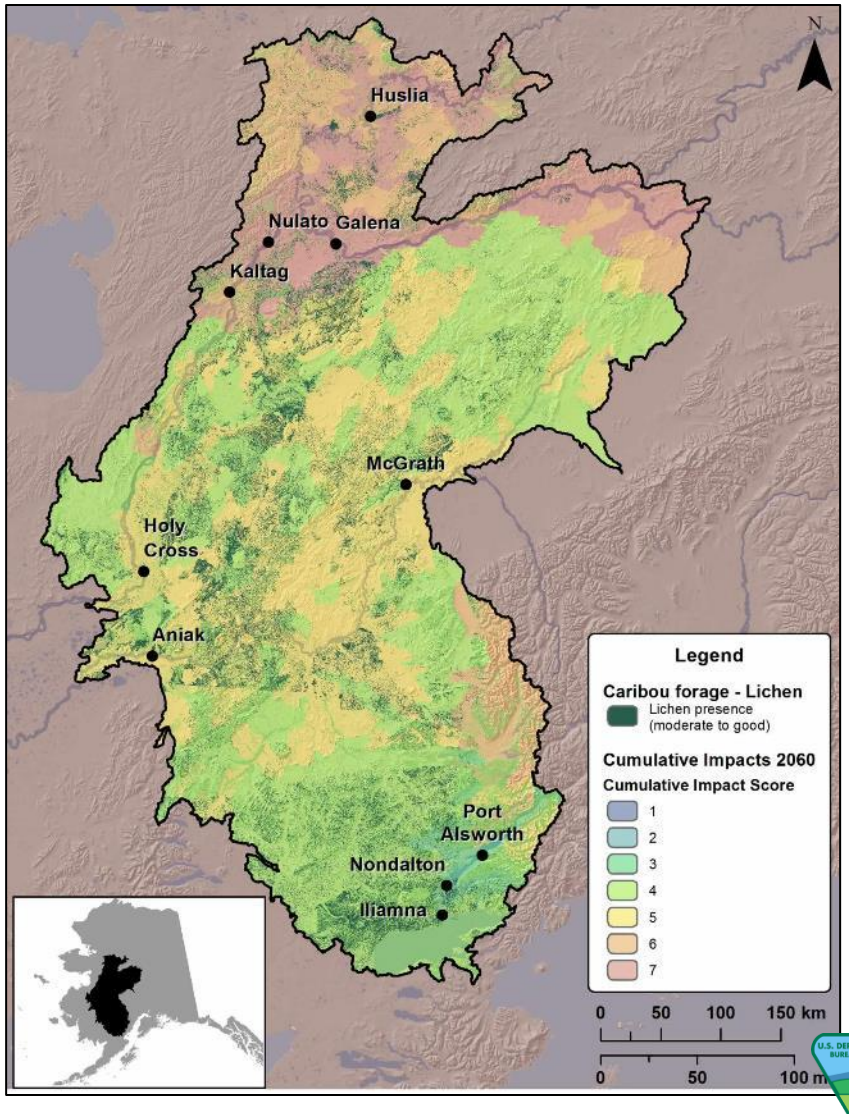
Lichen - Current

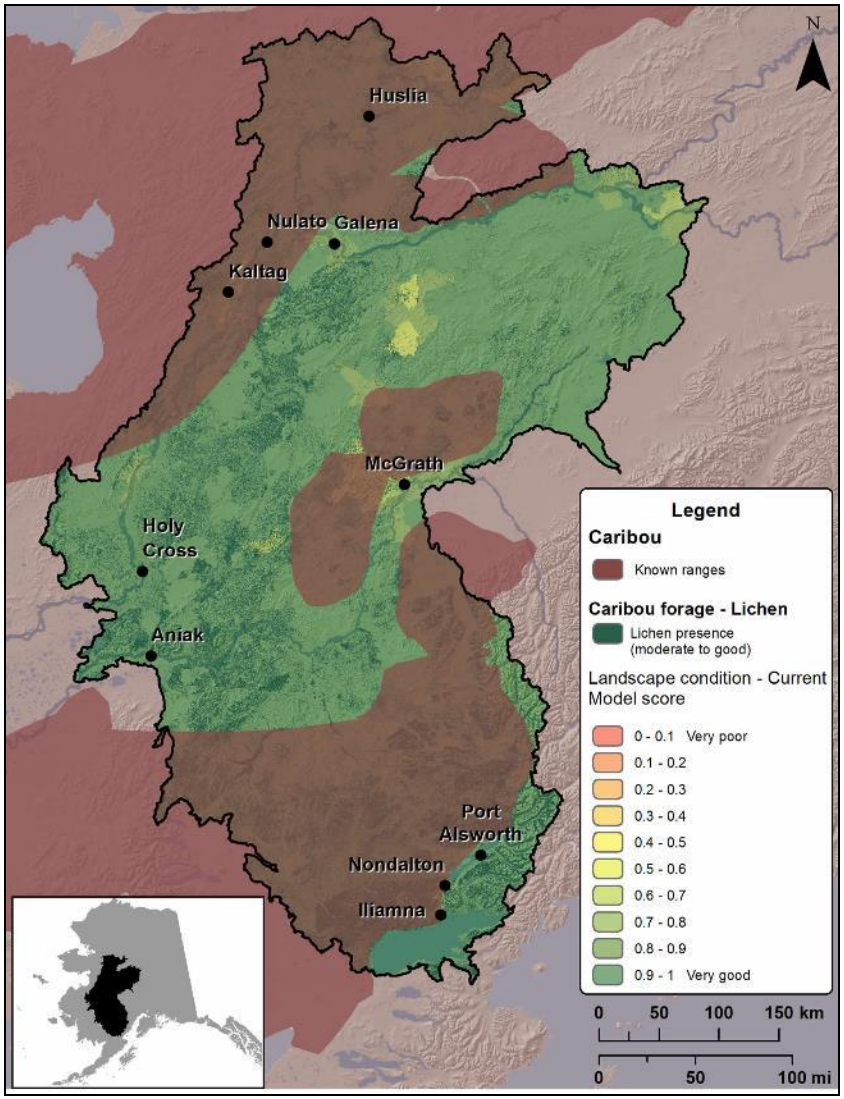


Cumulative impacts - Long Term (2060)

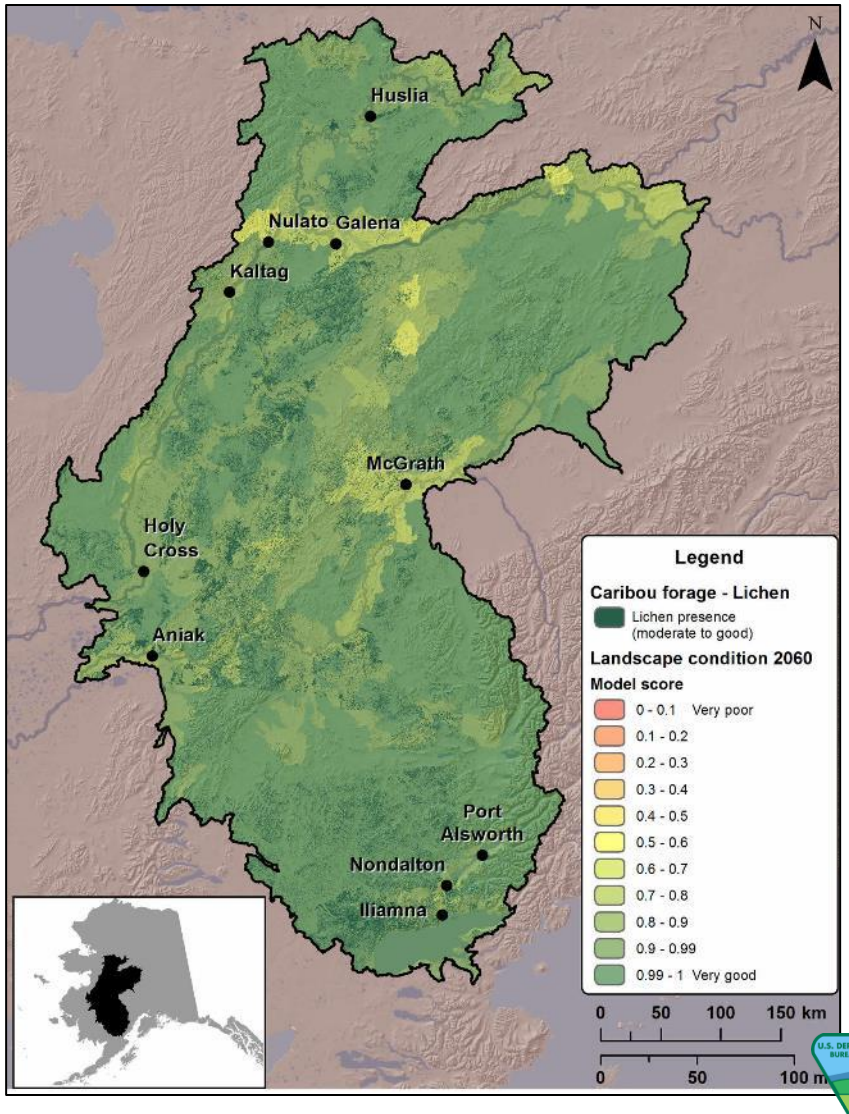


*MQ 4: What is the current distribution of primary winter forage (lichen) for caribou in the region and how is that **expected to change**?*

LCM - Current



LCM - Long Term (2060)



*MQ 5: Where are **caribou calving grounds** in the region and how are they **expected to change**?*

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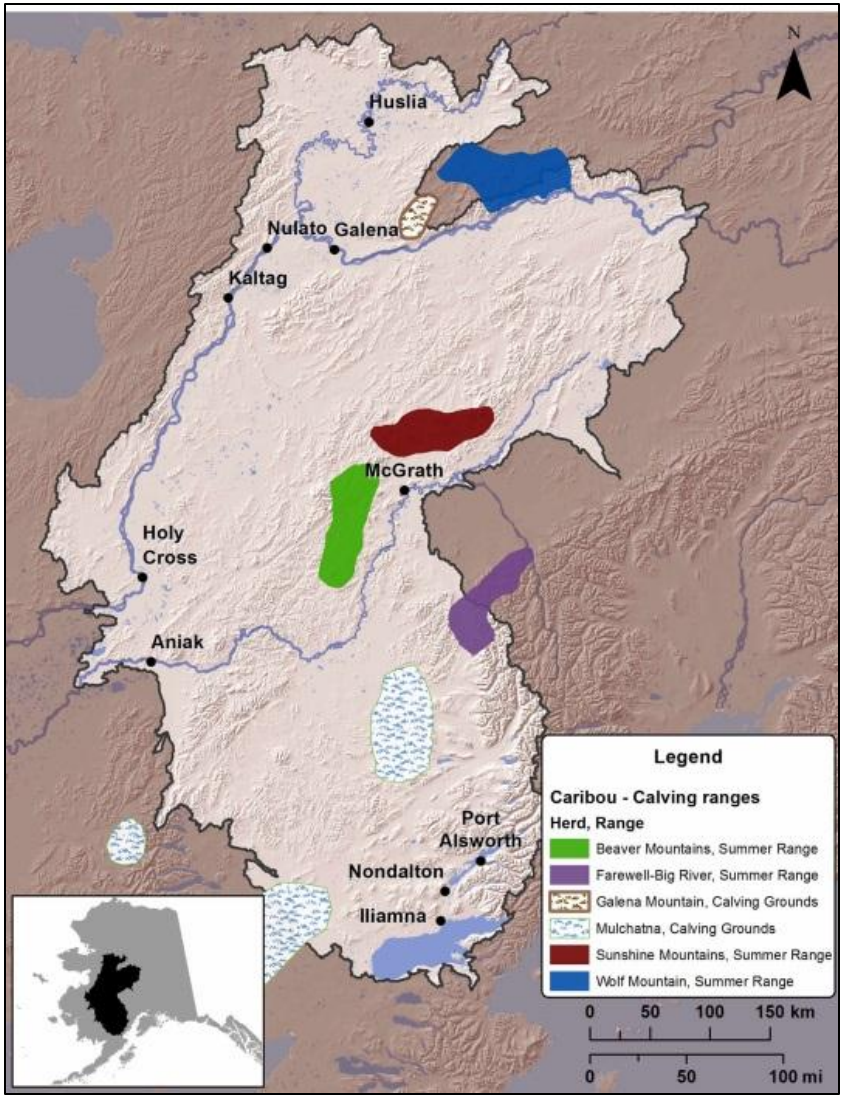
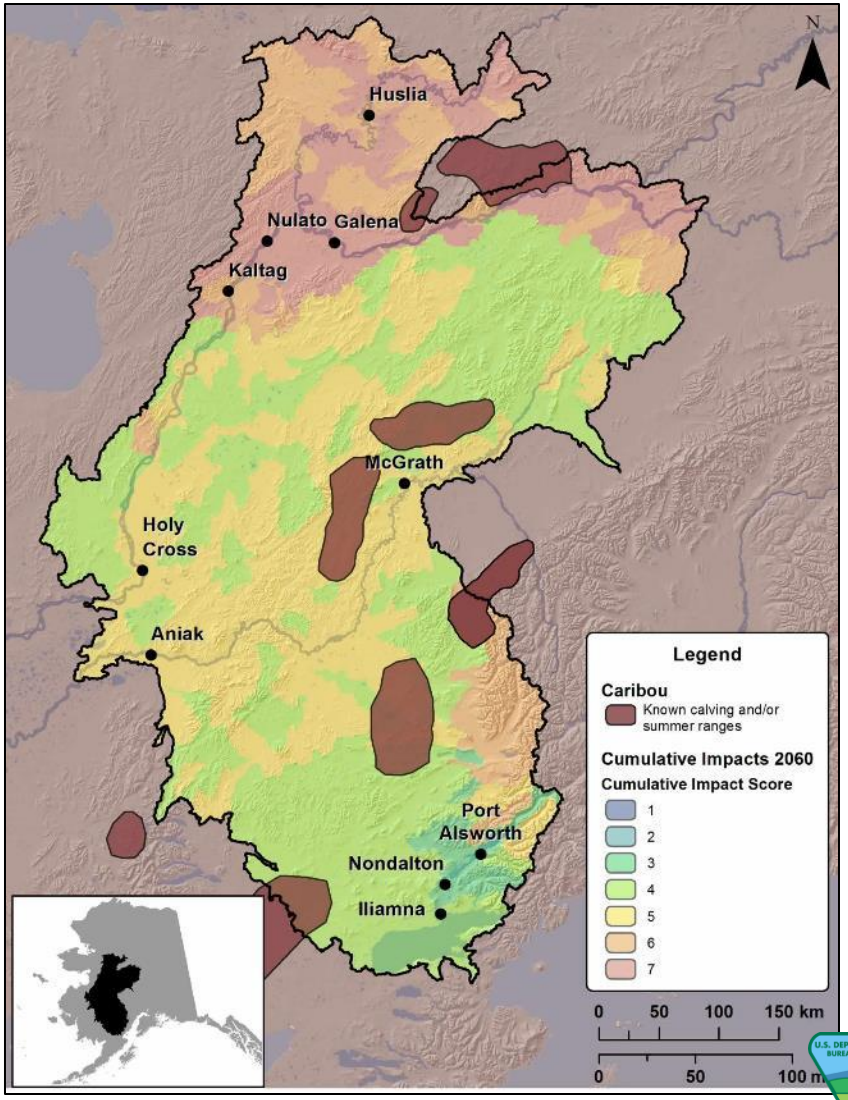
Rapid Ecoregional Assessment

Current Calving Range

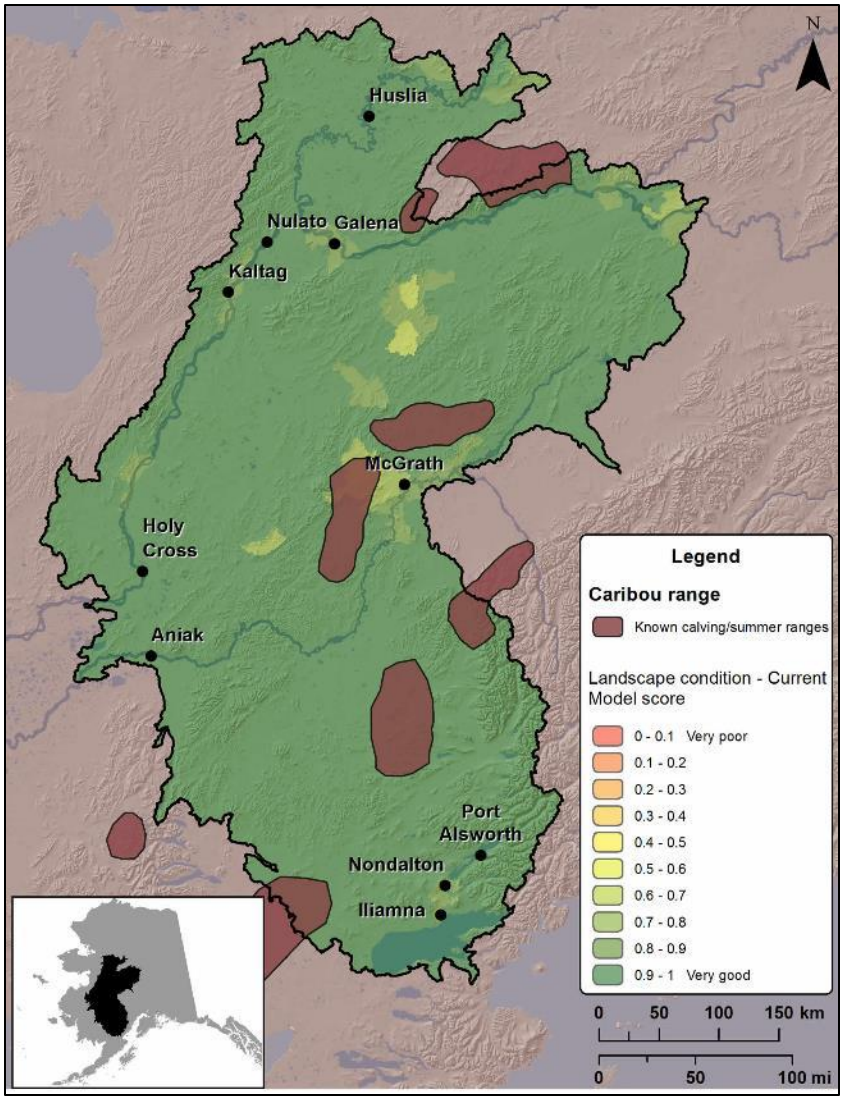


Cumulative impacts - Long Term (2060)

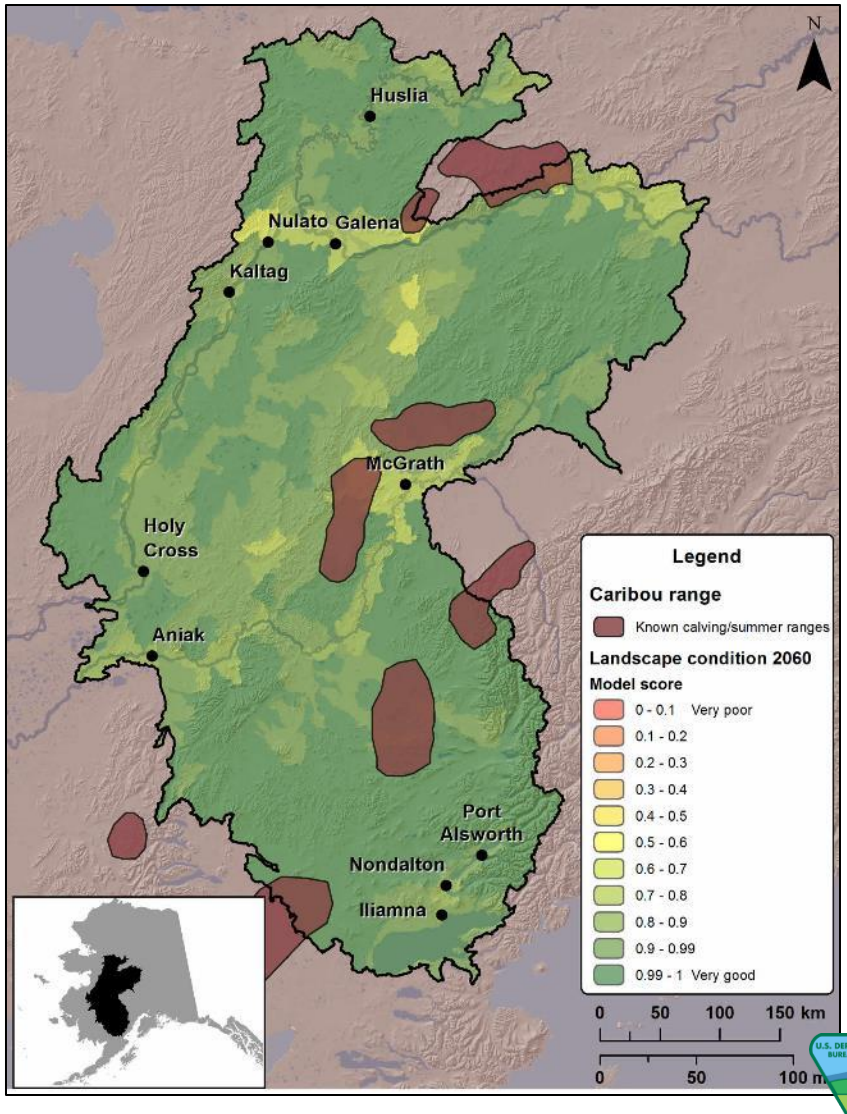


MQ 5: *Where are caribou calving grounds in the region and how are they* ***expected to change****?*

LCM - Current



LCM - Long Term (2060)



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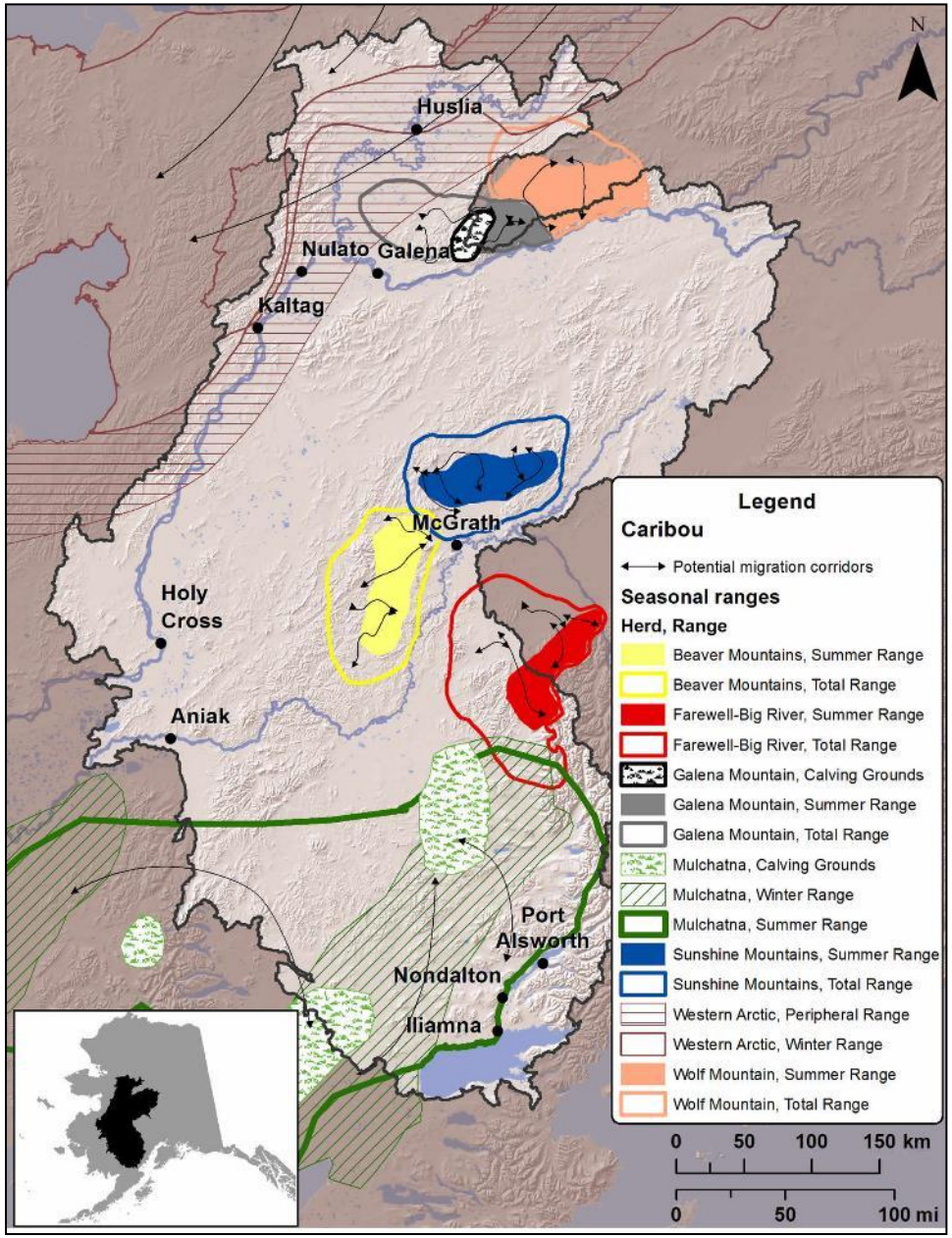
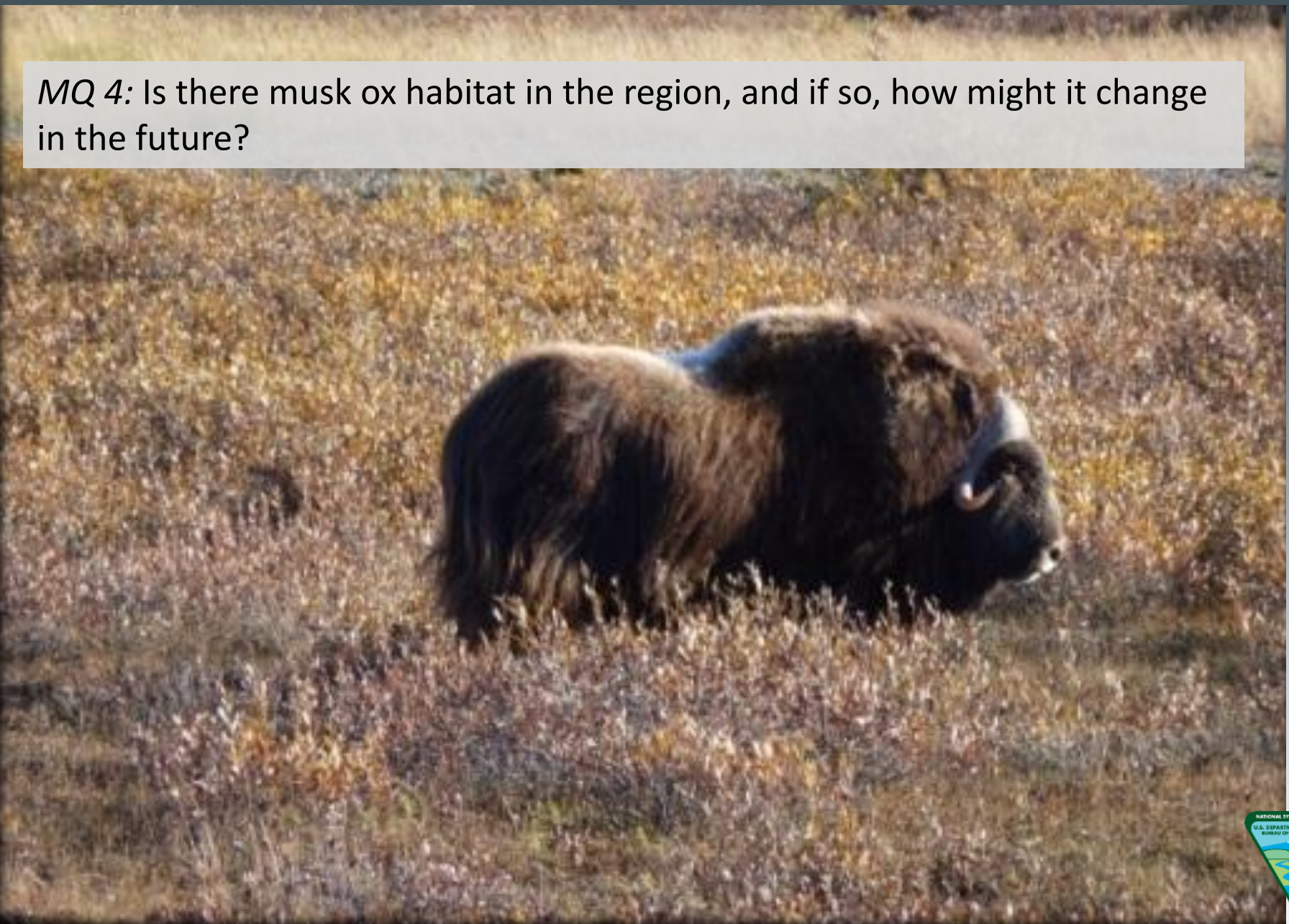


Wildlife MQs - Muskox

MQ 4: Is there musk ox habitat in the region, and if so, how might it change in the future?

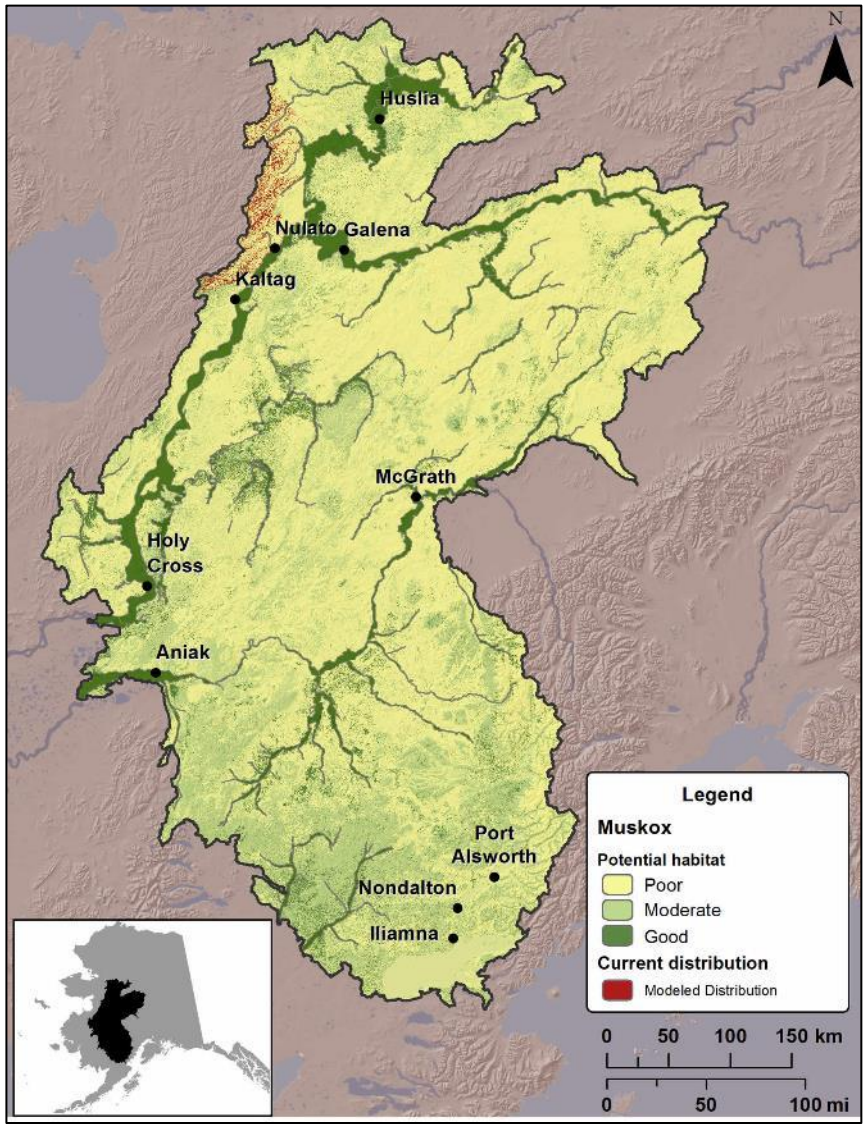


BLM

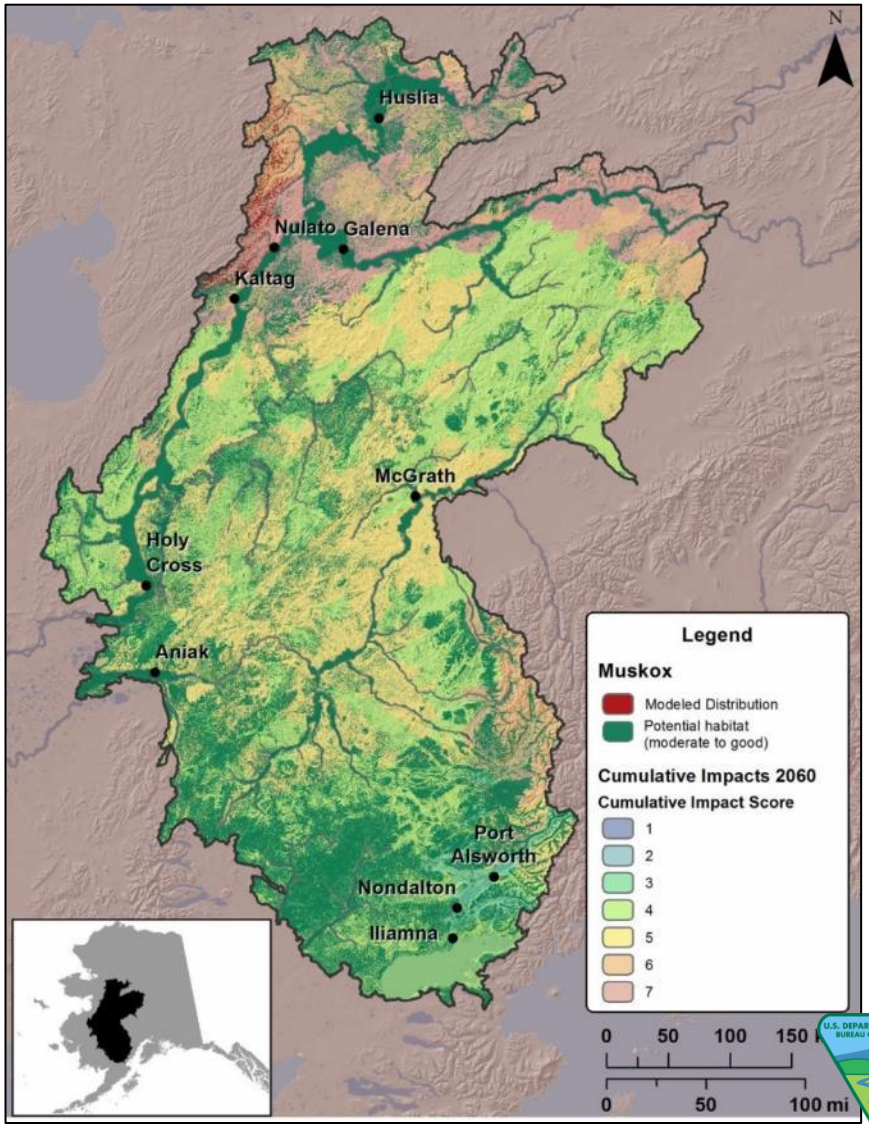
Rapid Ecoregional Assessment

MQ 4: Is there muskox habitat in the region, and if so, how might it change in the future?

Potential Habitat



Cumulative Impacts - Long Term (2060)



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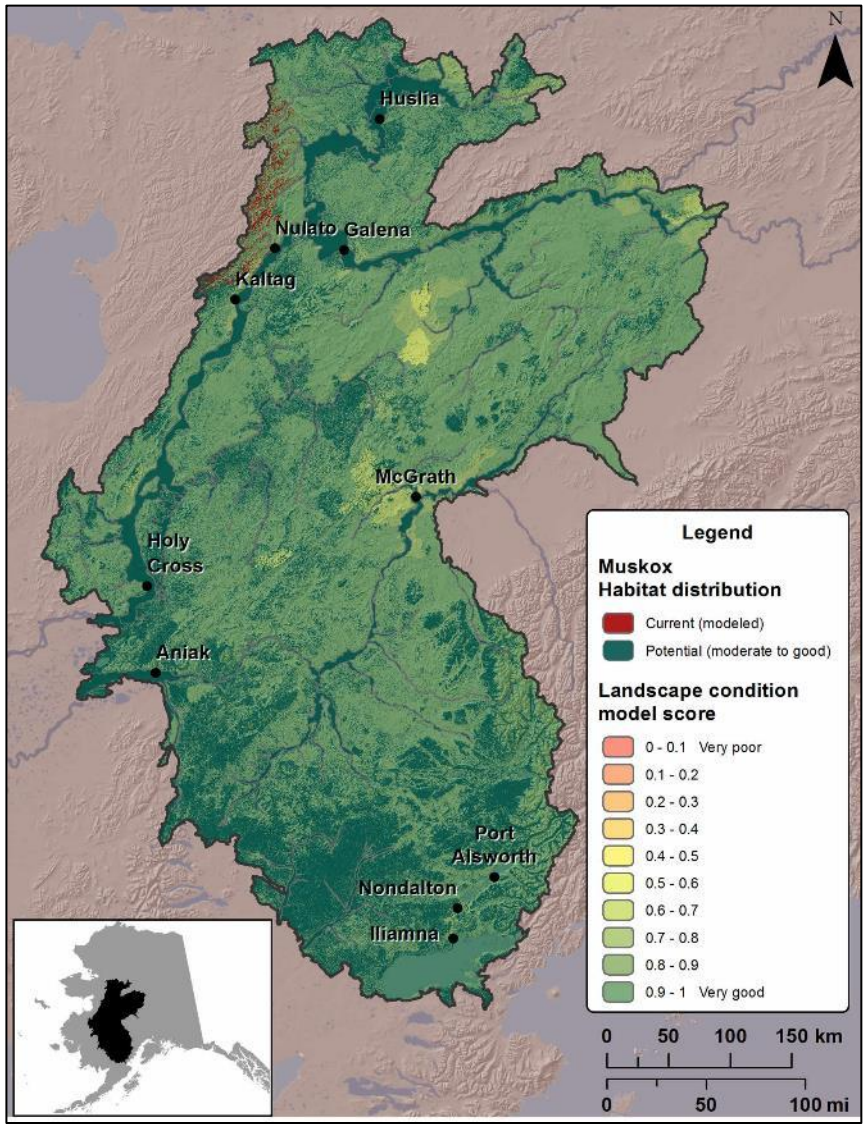
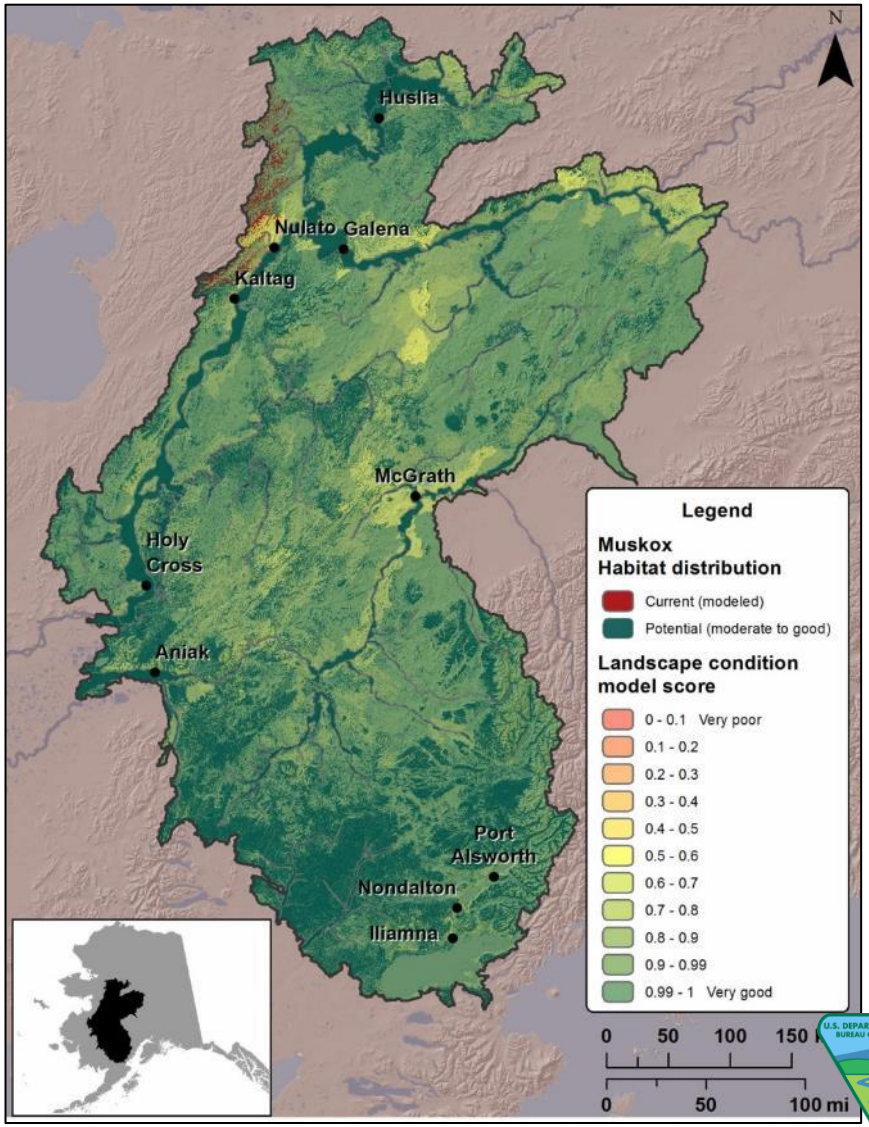
LCM - Current



LCM - Long Term (2060)

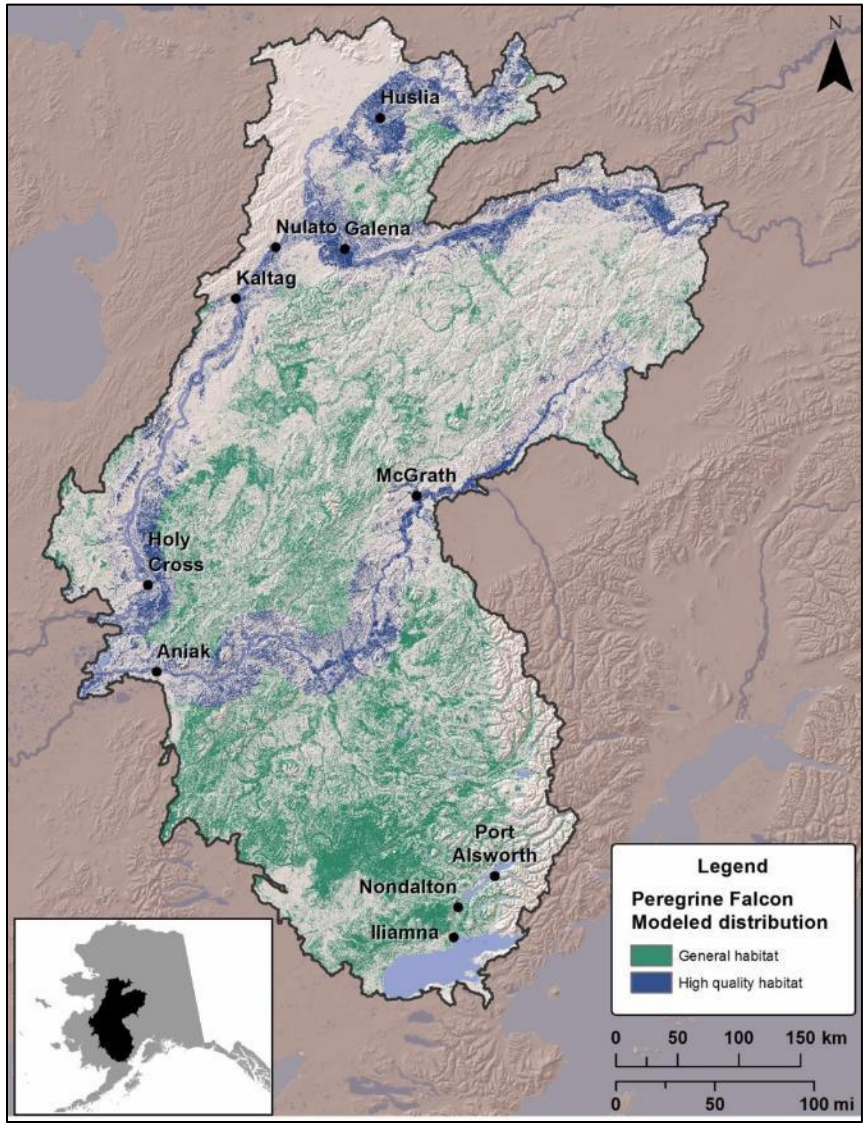


Wildlife MQs – American Peregrine Falcon

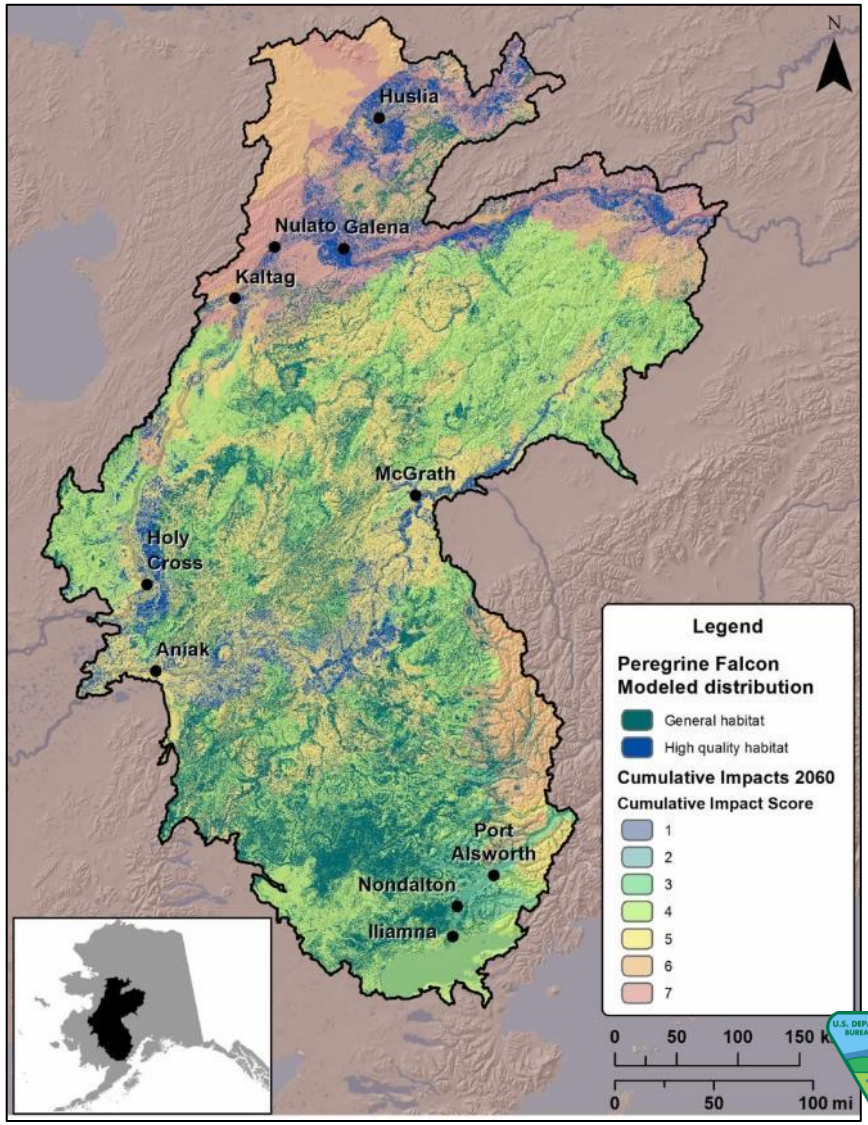
MQ 11: What is the current distribution of the American Peregrine Falcon in the region, and how is that expected to change?

MQ 4: *What is the current distribution of the American Peregrine Falcon in the region, and how is that expected to change?*

Habitat distribution

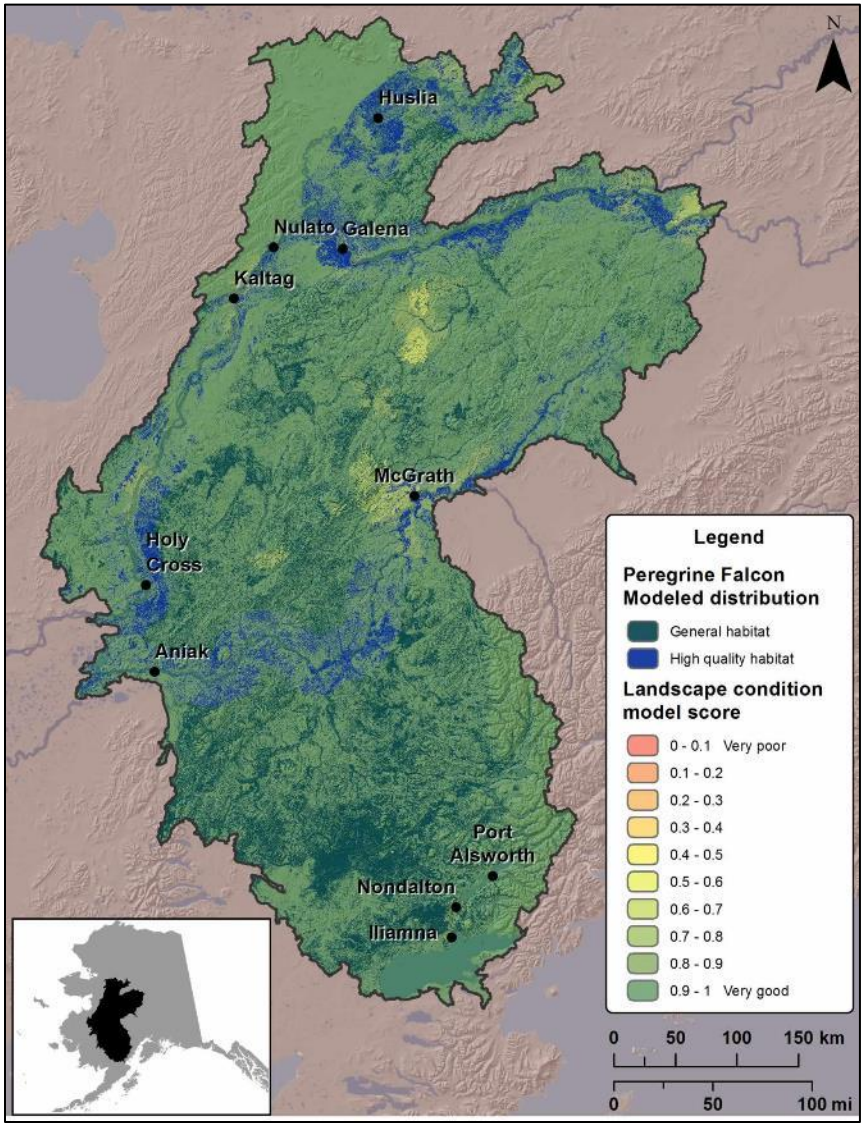


Cumulative Impacts - Long Term (2060)

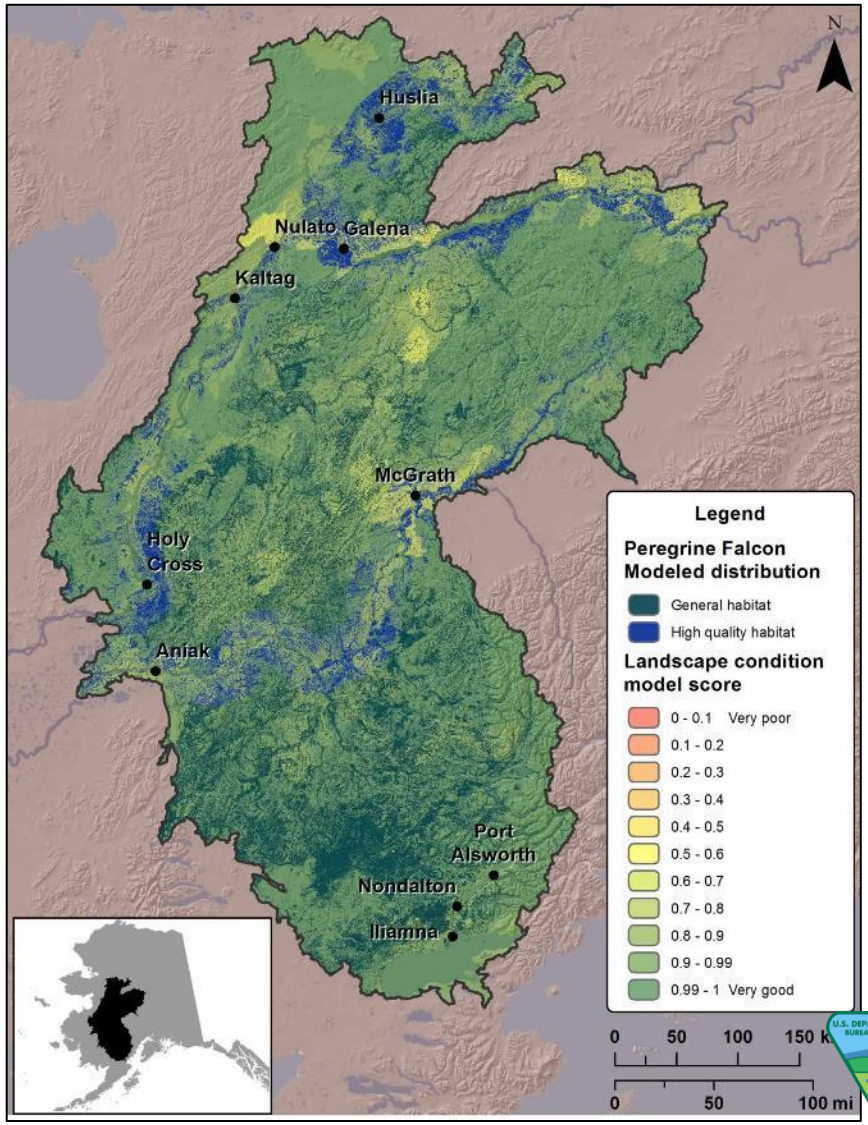


MQ 4: *What is the current distribution of the American Peregrine Falcon in the region, and how is that expected to change?*

LCM - Current



LCM - Long Term (2060)



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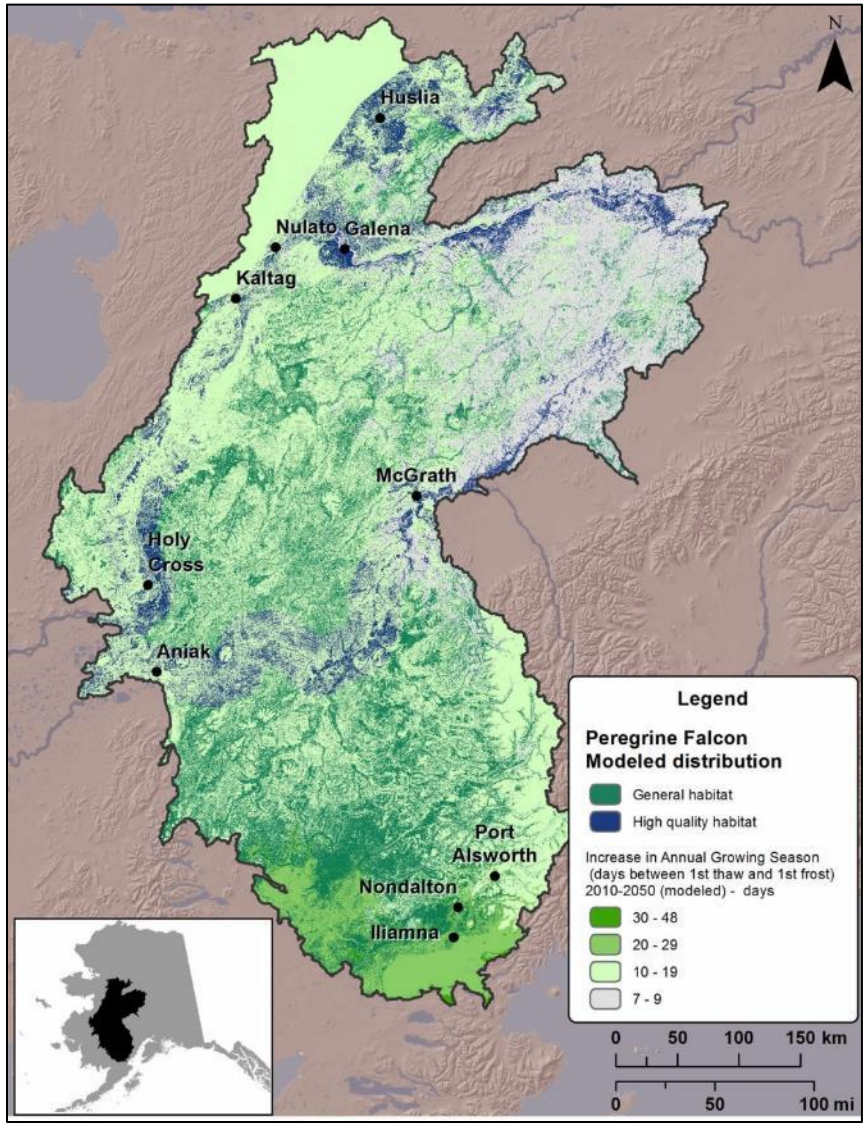
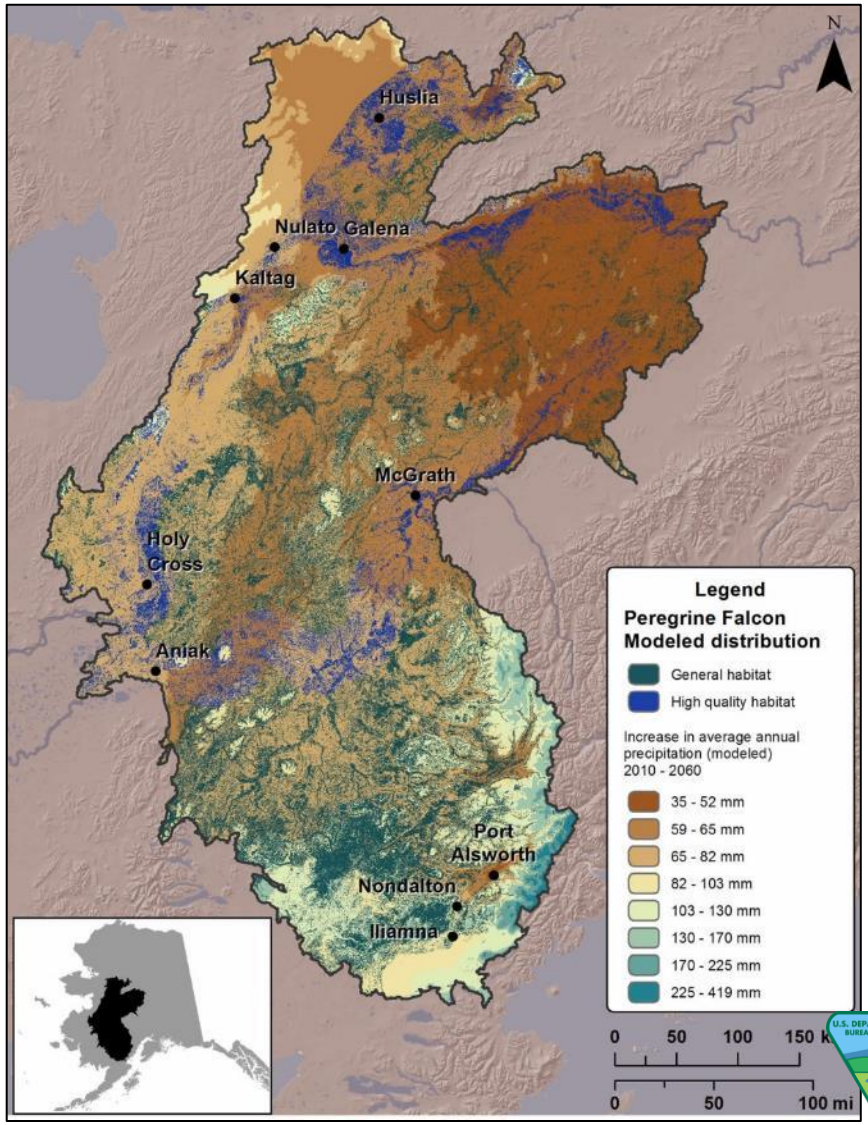
Growing season length



Mean annual precipitation



Wildlife MQs – Sensitive species

MQ 12: *Where is habitat for sensitive species that are also conservation elements?*

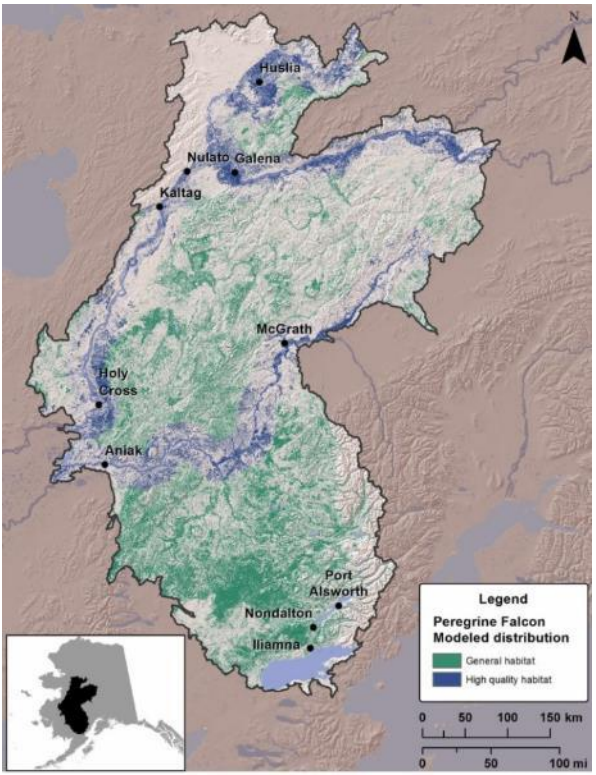
American Peregrine Falcon

Trumpeter Swan

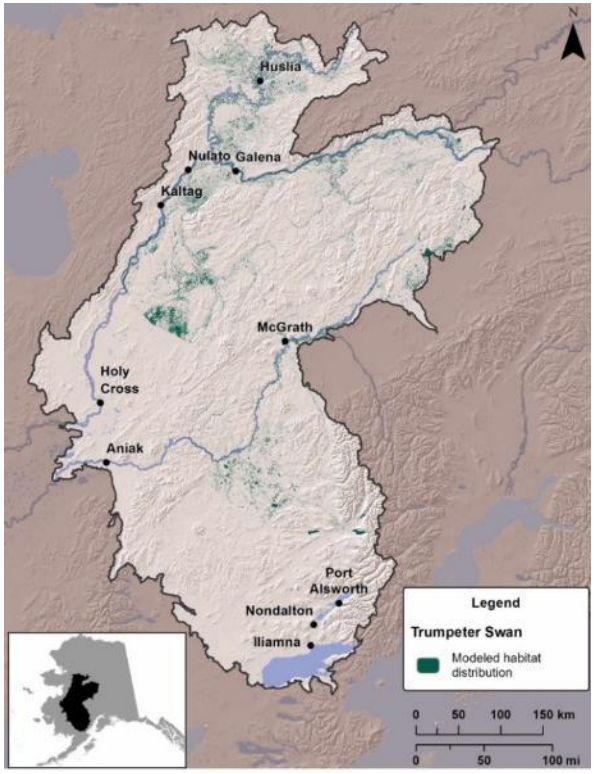
Olive-sided Flycatcher

MQ 12: *Where is habitat for sensitive species that are also conservation elements?*

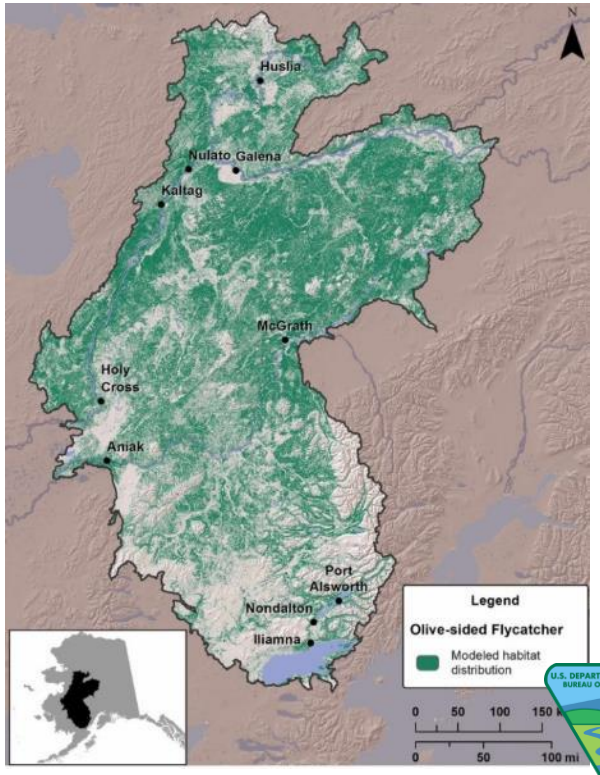
American Peregrine Falcon



Trumpeter Swan



Olive-sided Flycatcher



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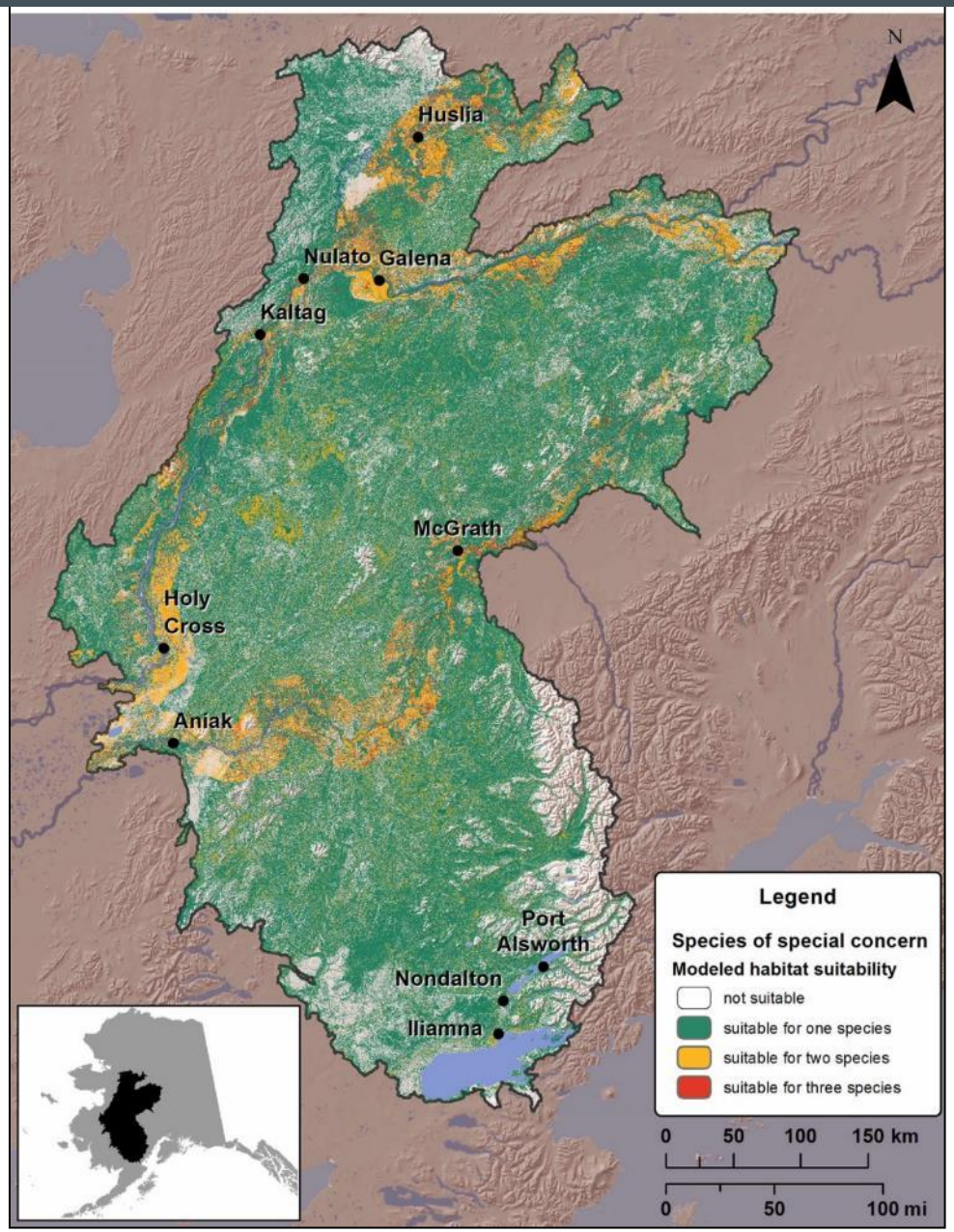

Anthropogenic MQs

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Rapid Ecoregional Assessment

Anthropogenic MQs

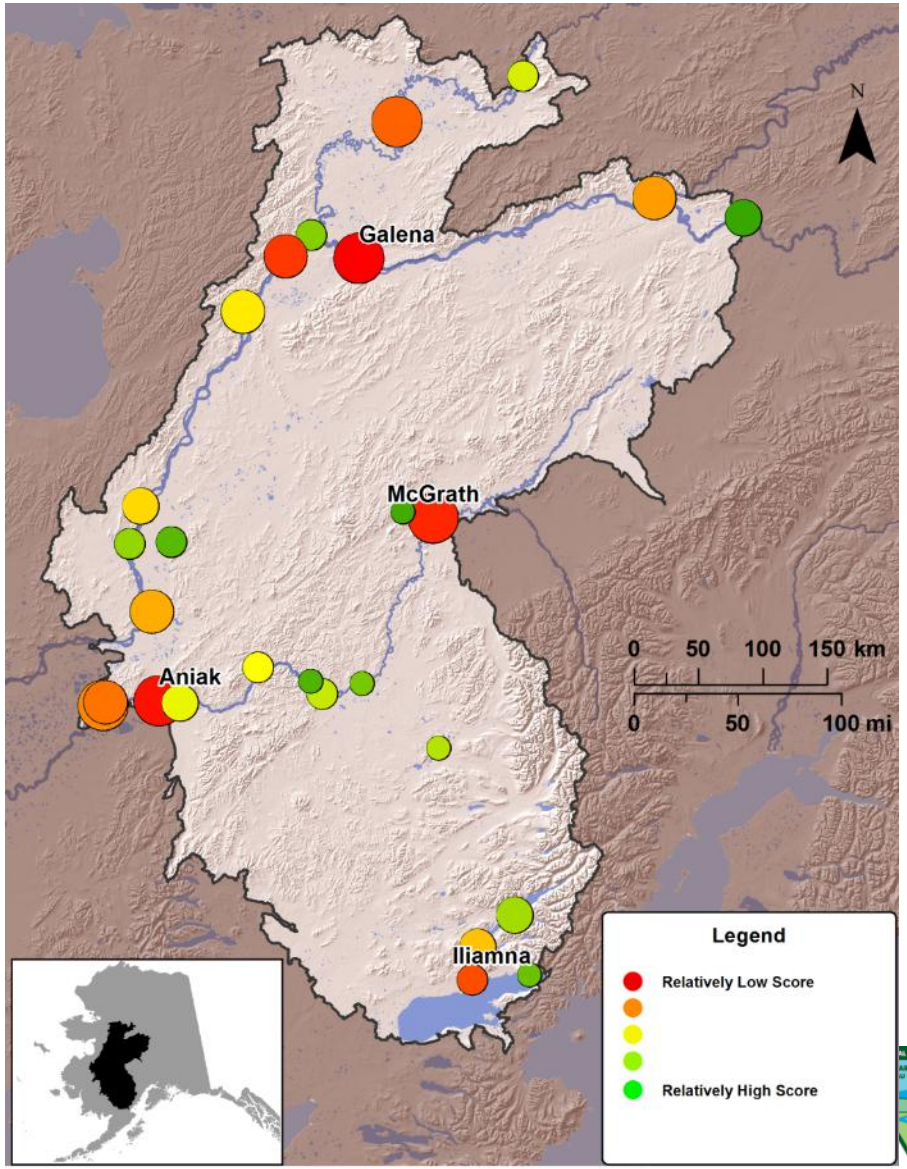
- Efforts on Socio-Economic index (SEI)
- Transportation Infrastructure
- Mining Databases and Maps
- Efforts trying to understand ADF&G data on subsistence harvest

Anthropogenic MQs - SEI

- Tried to build on the Arctic Social Indicators (ASI)
- Identified several variables and conducted a Principal Components Analysis (PCA)
  - Just the YKL communities – very small sample
  - For the entire state – results unhelpful

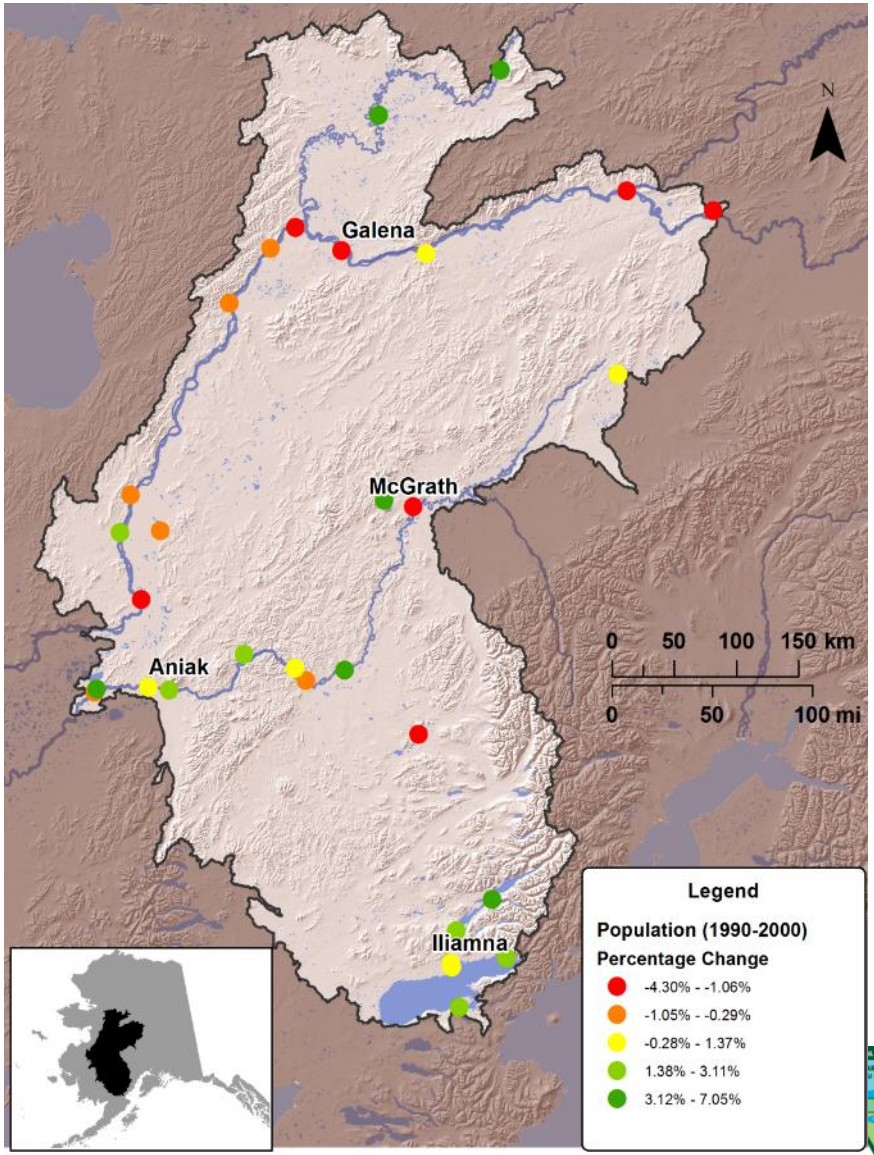
Anthropogenic MQs - SEI

- Material well-being
  - One of four factors
  - Remote communities seem to be faring better.
  - Kuskokwim communities seem to be faring better.
- But the sample is too small.



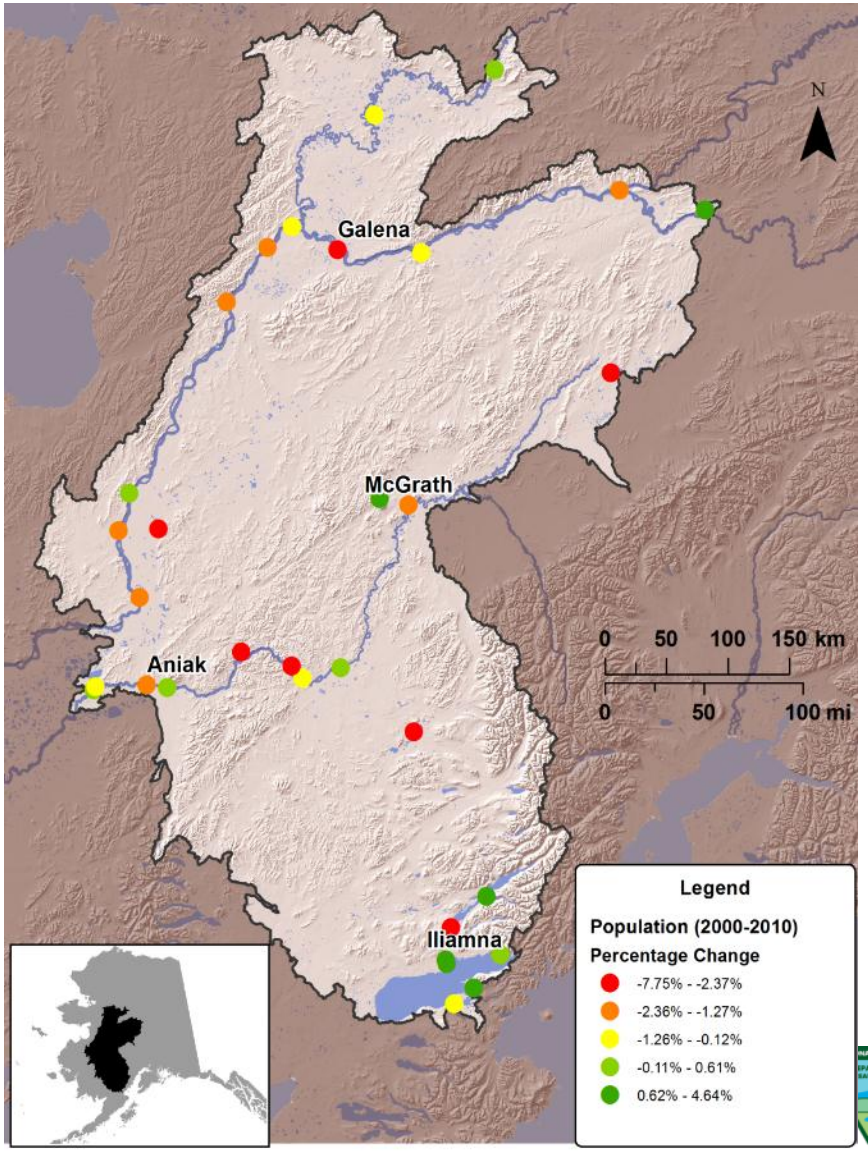
Anthropogenic MQs - Population

- Yukon communities lost population and Iliamna communities gained population during the 90s.



Anthropogenic MQs - Population

- Kuskokwim communities lost population during the 2000s.



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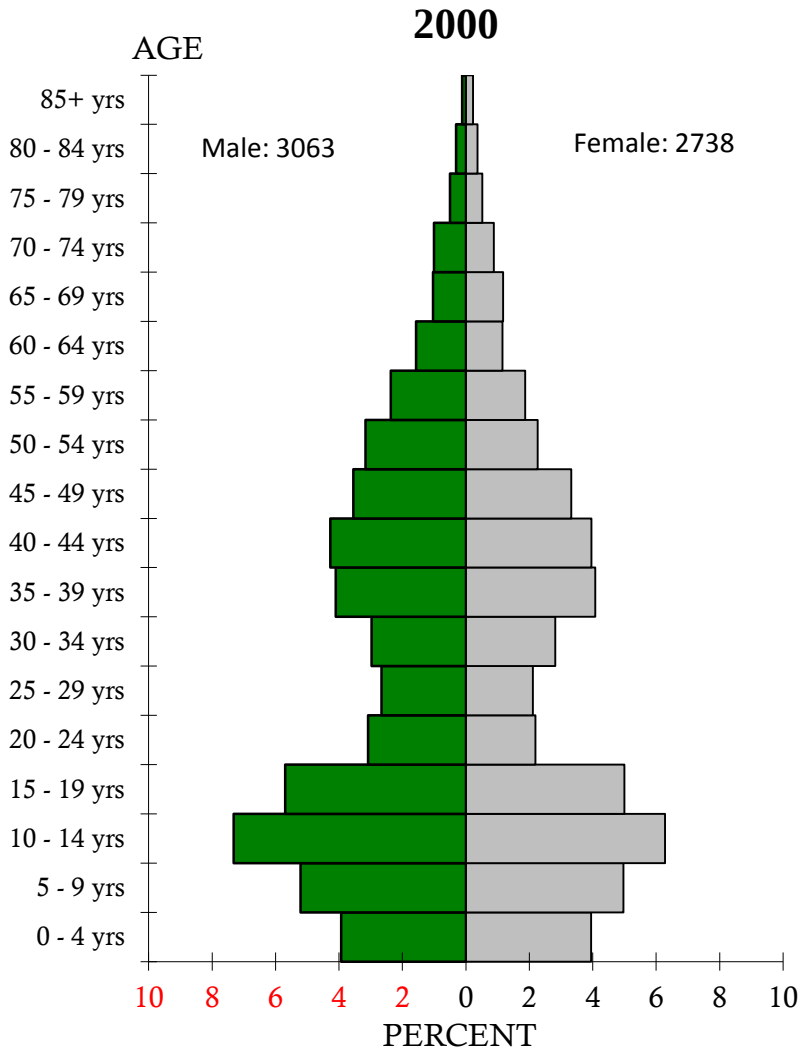
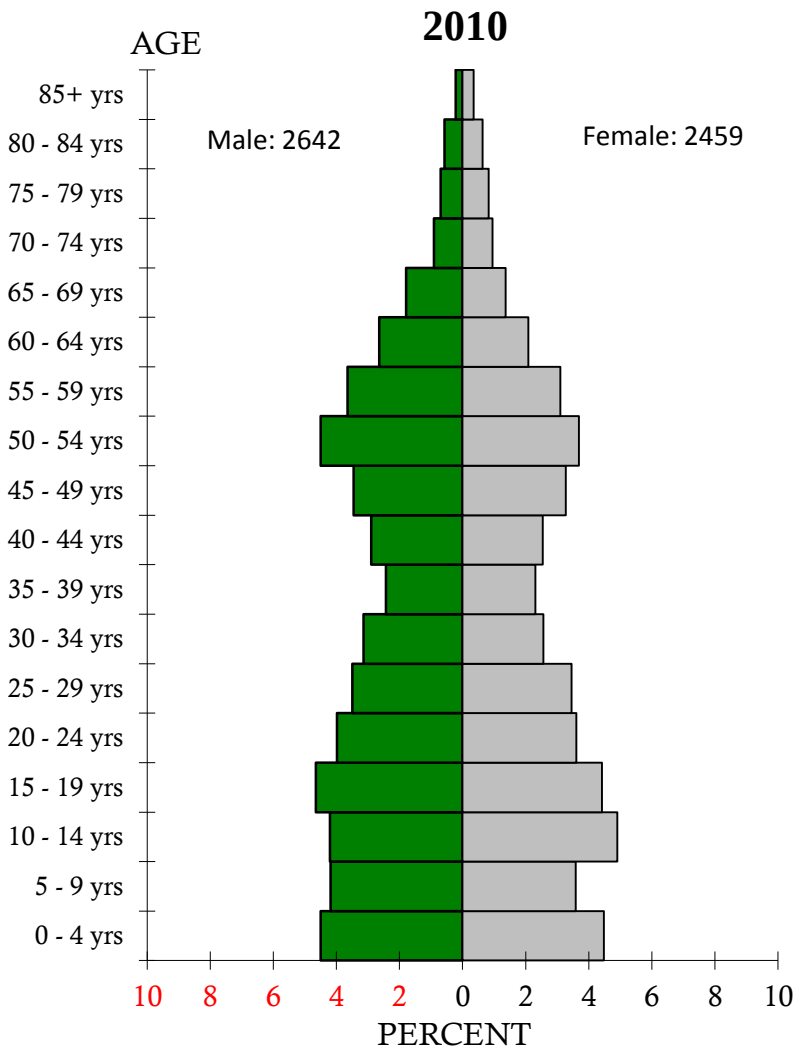
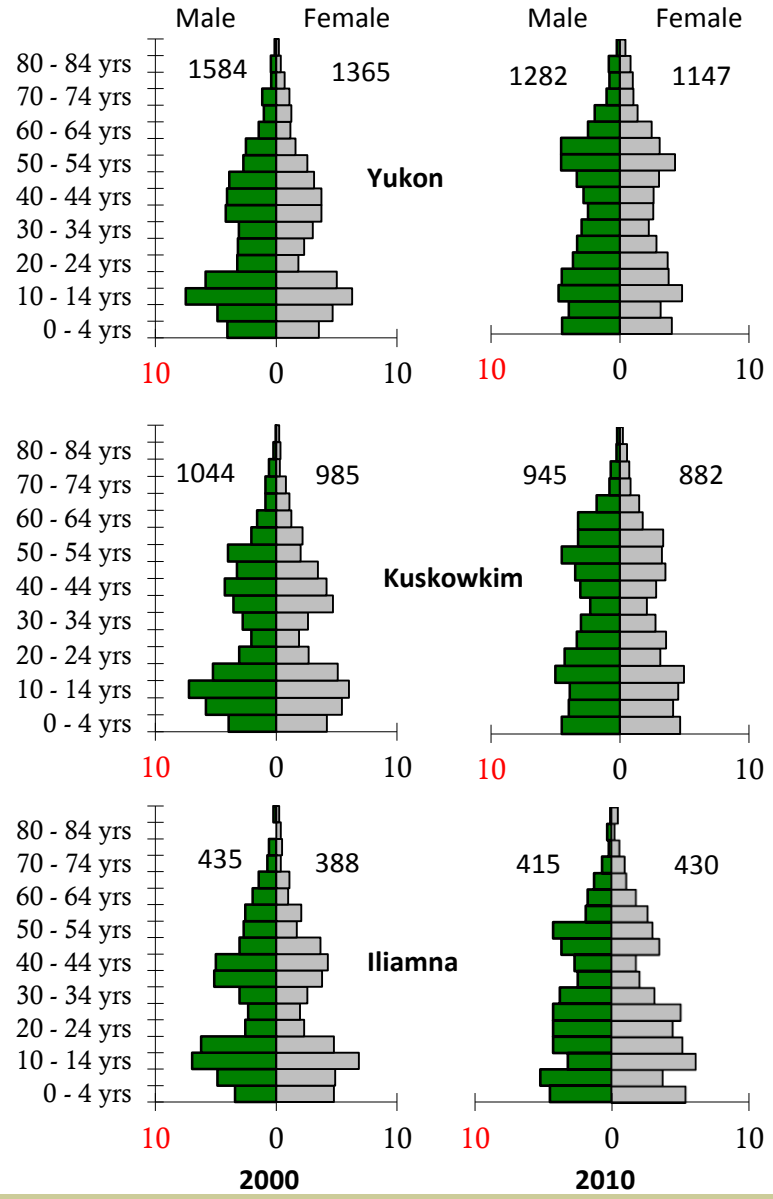
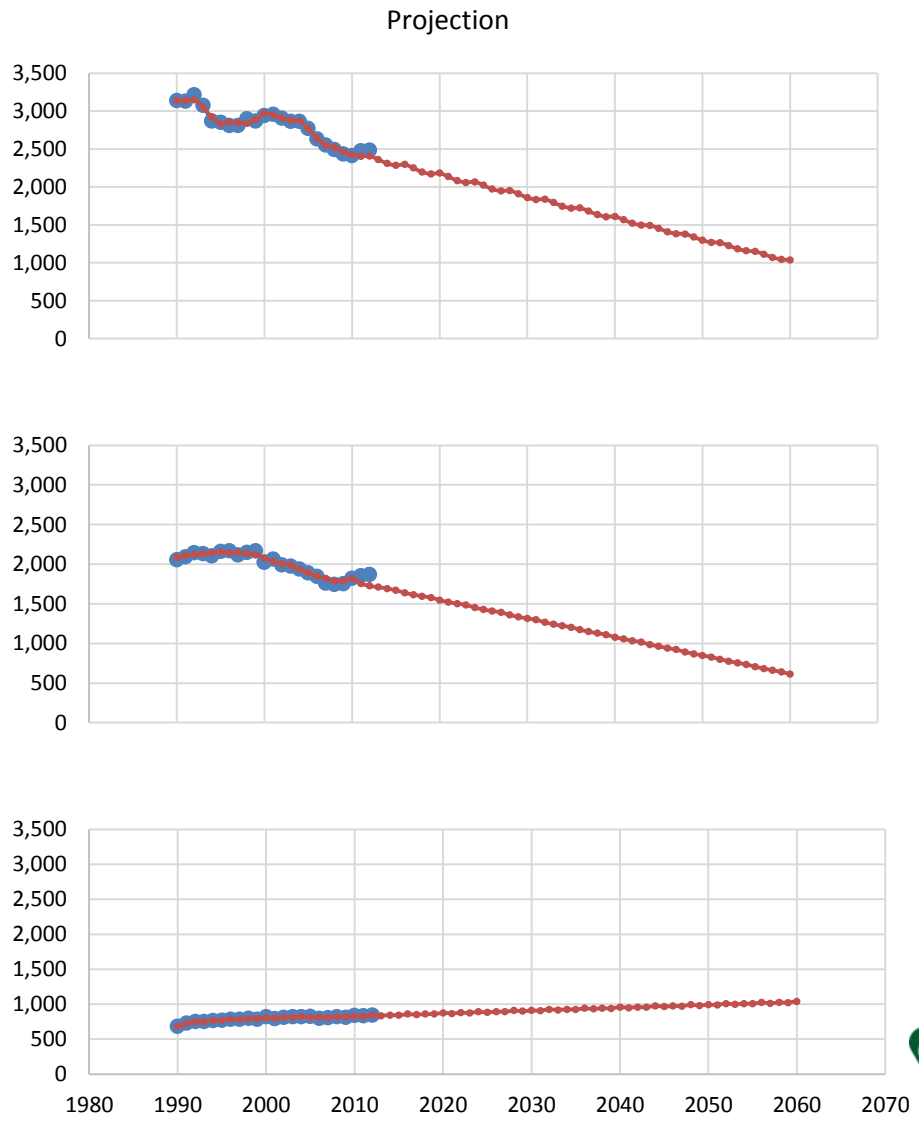




Anthropogenic MQs - Population

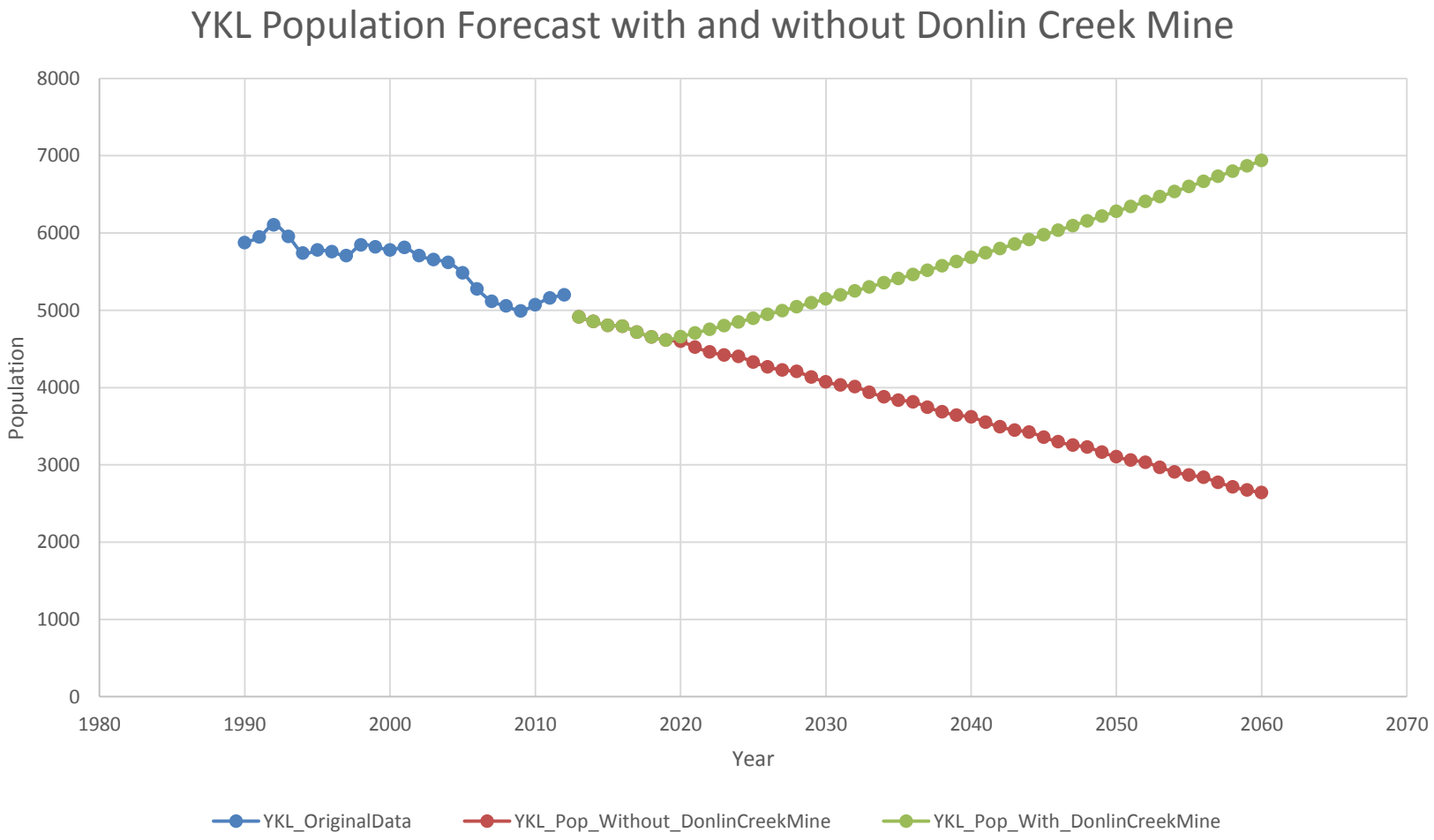




Rapid Ecoregional Assessment

BLM

Anthropogenic MQs - Population

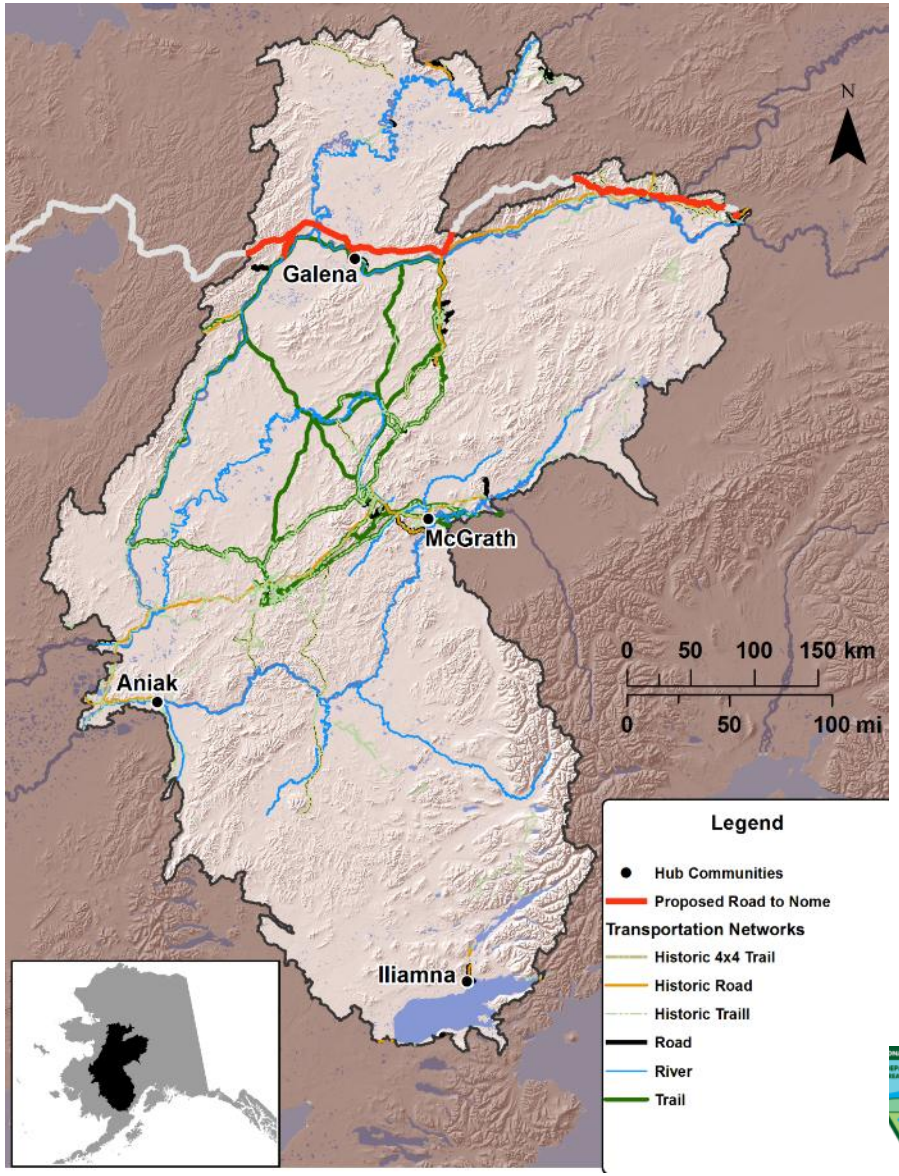


BLM

Rapid Ecoregional Assessment

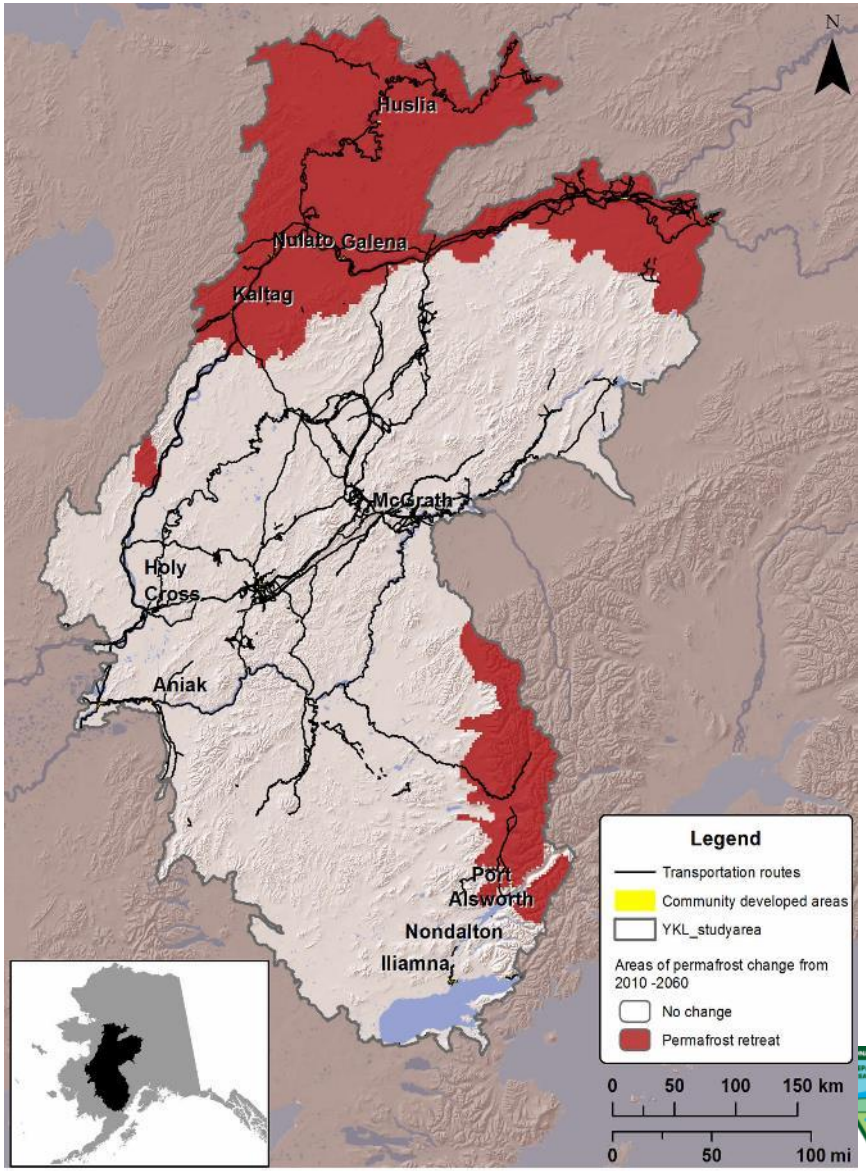
Anthropogenic MQs - Transport

- A thick network of trails around Flat, an indication of past mining activities.
- Rivers are as important for transportation means as the other linear features.
- Impossible to assess the intensity of use



Anthropogenic MQs - Transport

- Proposed road to Nome goes through the area expected to experience some permafrost retreat.



Anthropogenic MQs - Mining

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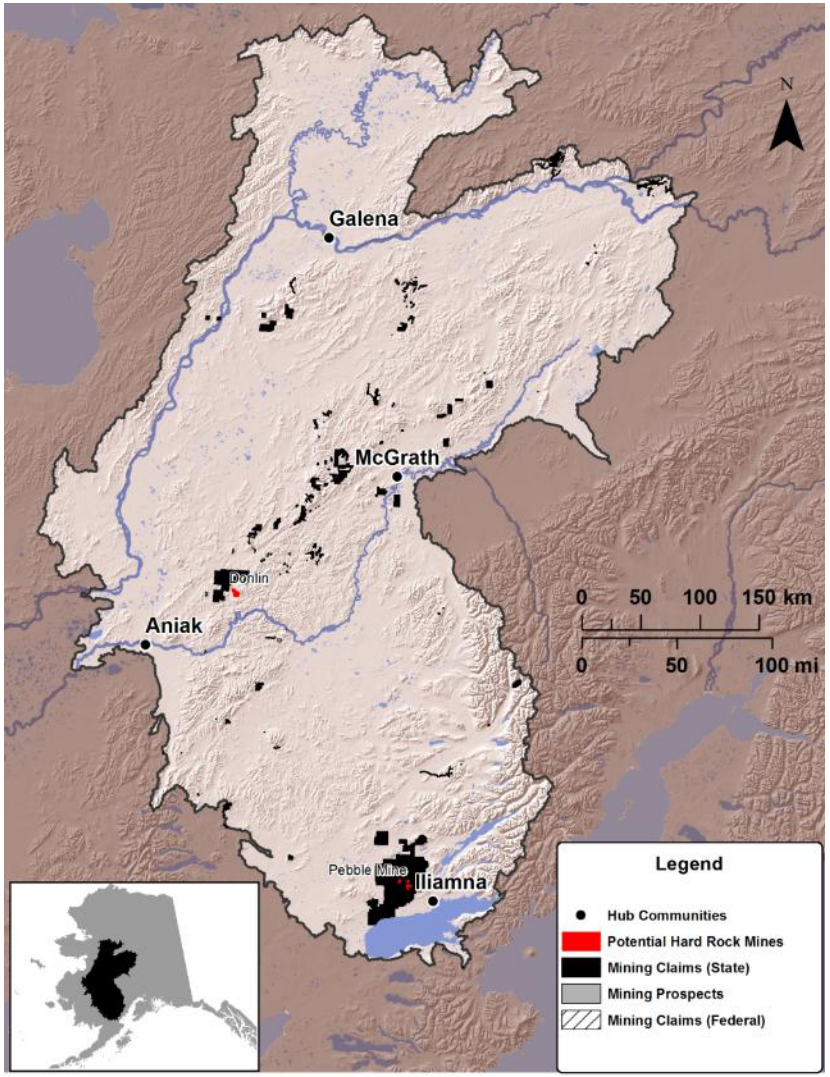
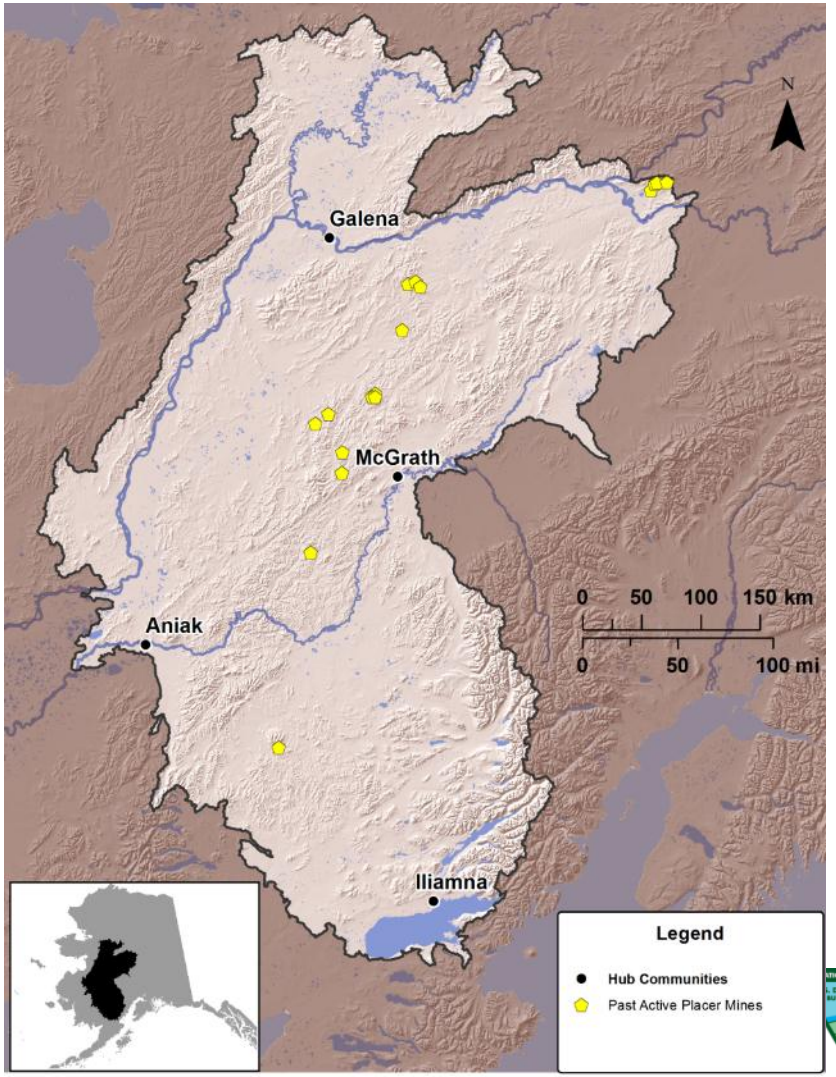
Rapid Ecoregional Assessment

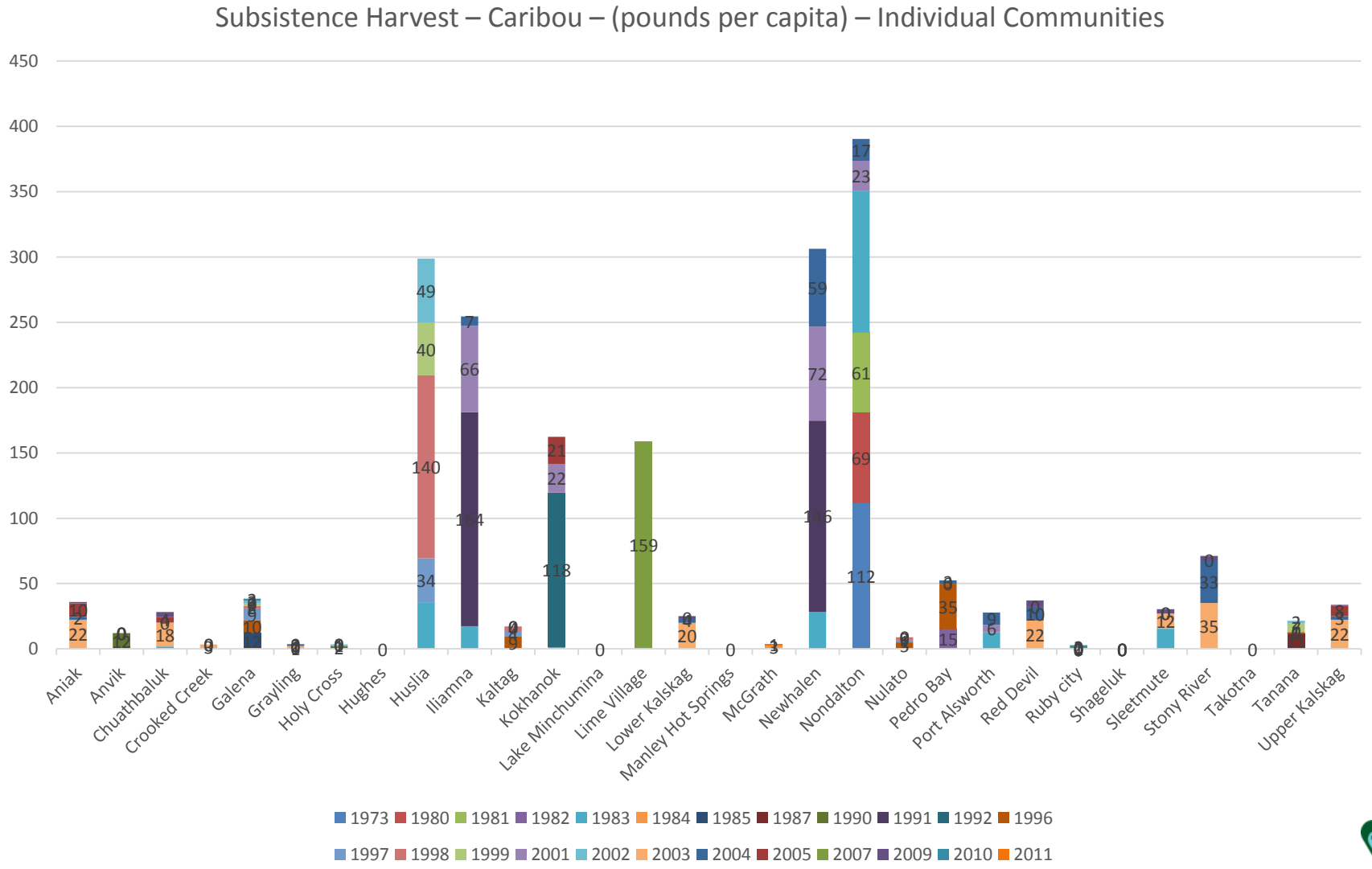
Potential Mining



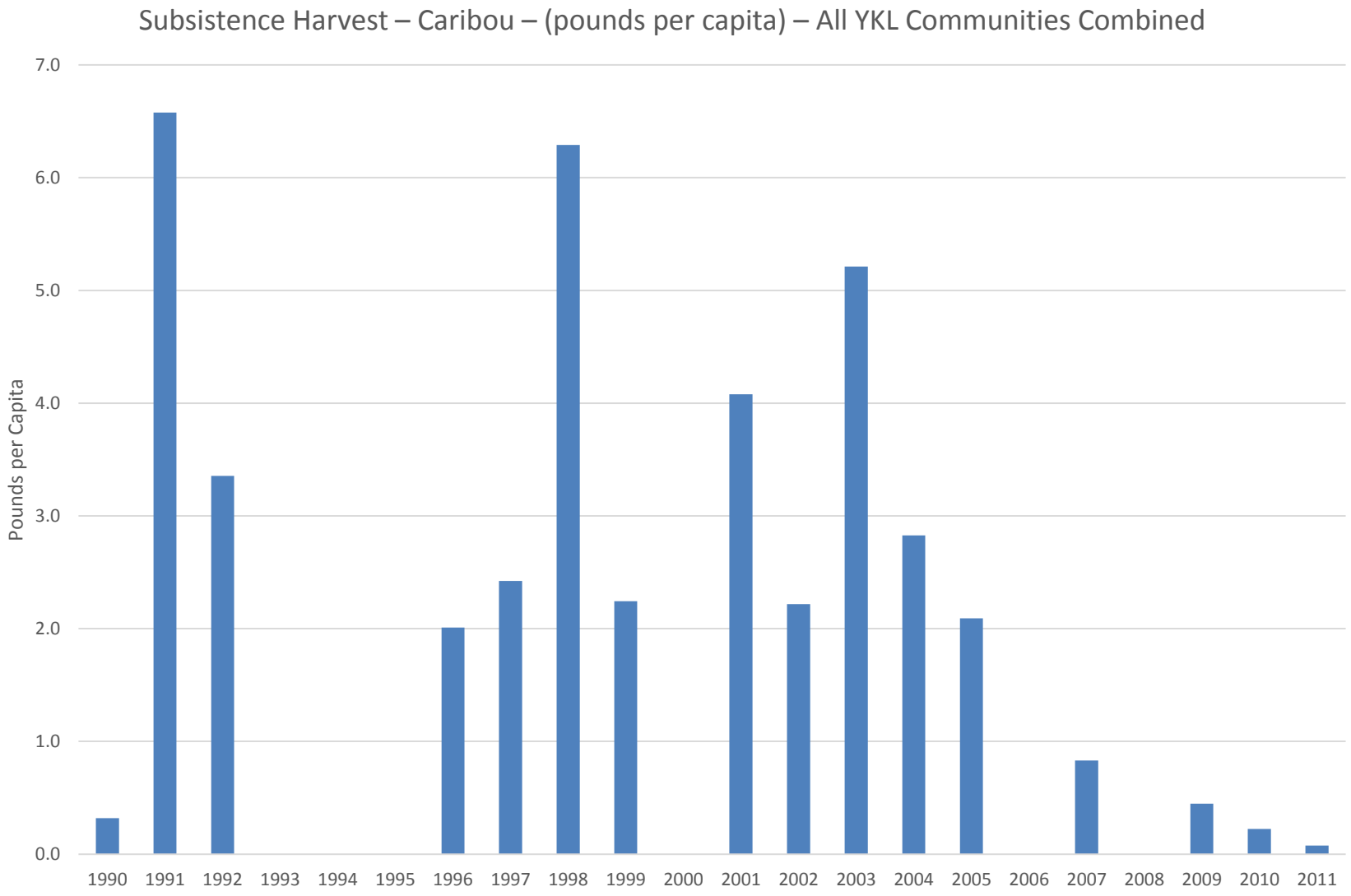
Potential Placer Mining



Anthropogenic MQs - Subsistence



Anthropogenic MQs - Subsistence



Abiotic MQs

BLM

Rapid Ecoregional Assessment

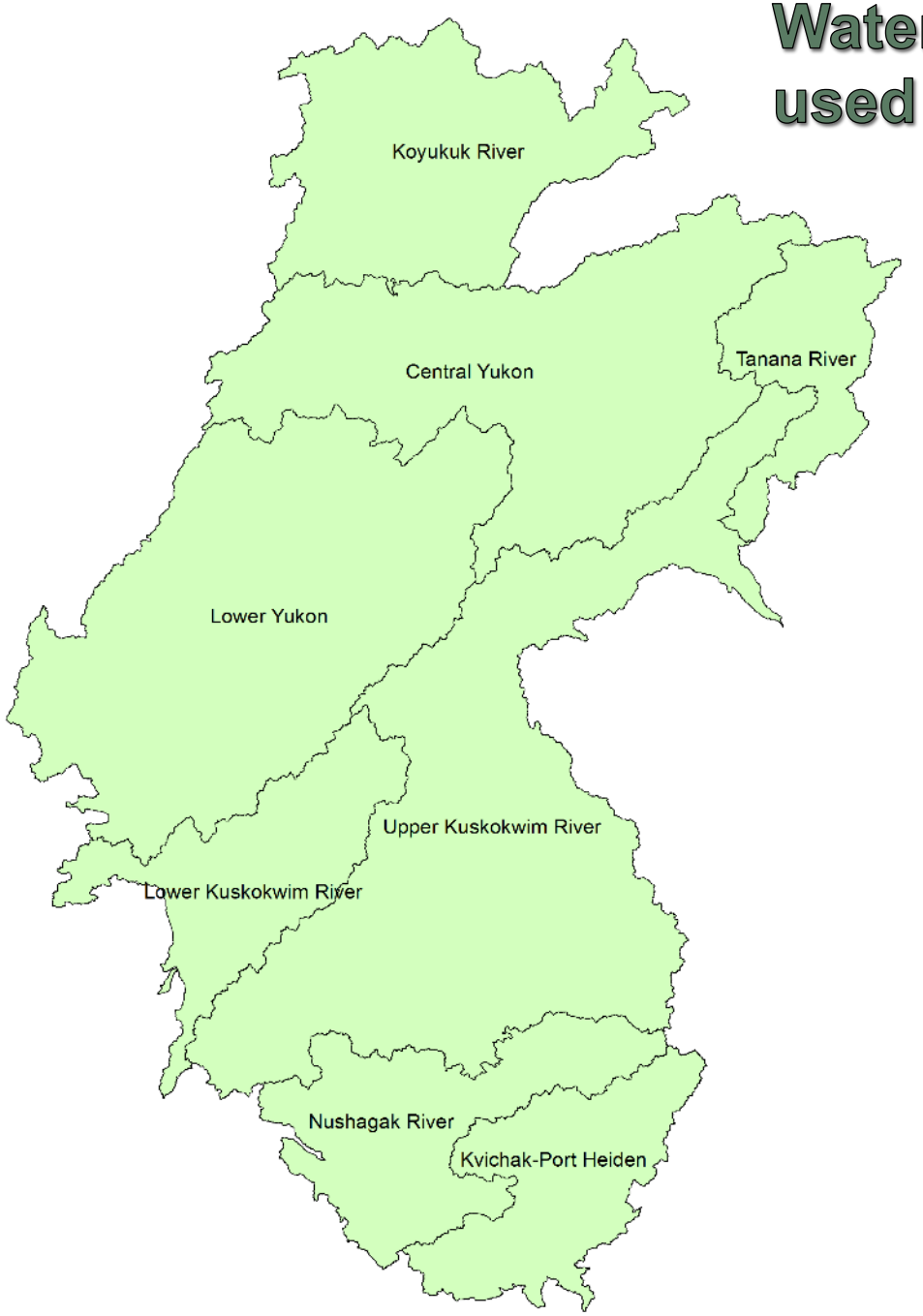
MQs pertaining to climate trends

- What are the projected monthly, seasonal, and annual temperature, precipitation, and length of warm and cold seasons for the REA, and how do these projections vary across time, across the region, and across varying global greenhouse gas emissions scenarios?
- Where will climate change impact CEs, including subsistence species?

Baseline climate across ecoregional landscape

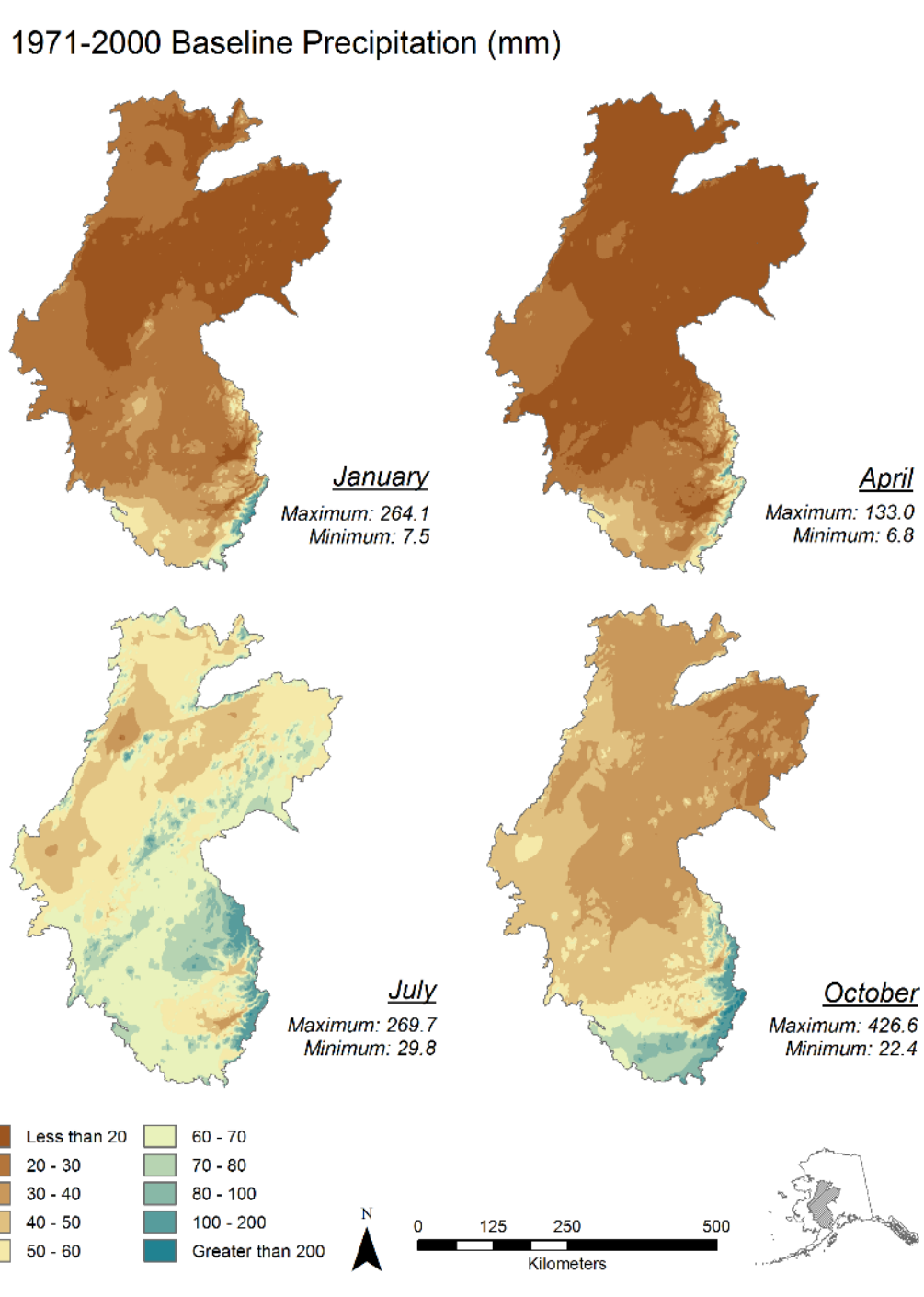
- Between 1949 and 1998, mean temperature increased throughout Alaska
- Trends in precipitation are less clear, due to higher variability
- Both temperature and precipitation varied considerably from year to year across the historical reference period
- This natural variability must be taken into account when considering ongoing and future climate trends

Watershed boundaries used for spatial analysis



Although data were provided at the finest scale available (771 m for most climate data), third-level HUCs provided the best balance between accuracy and scale for regional analysis of outputs.

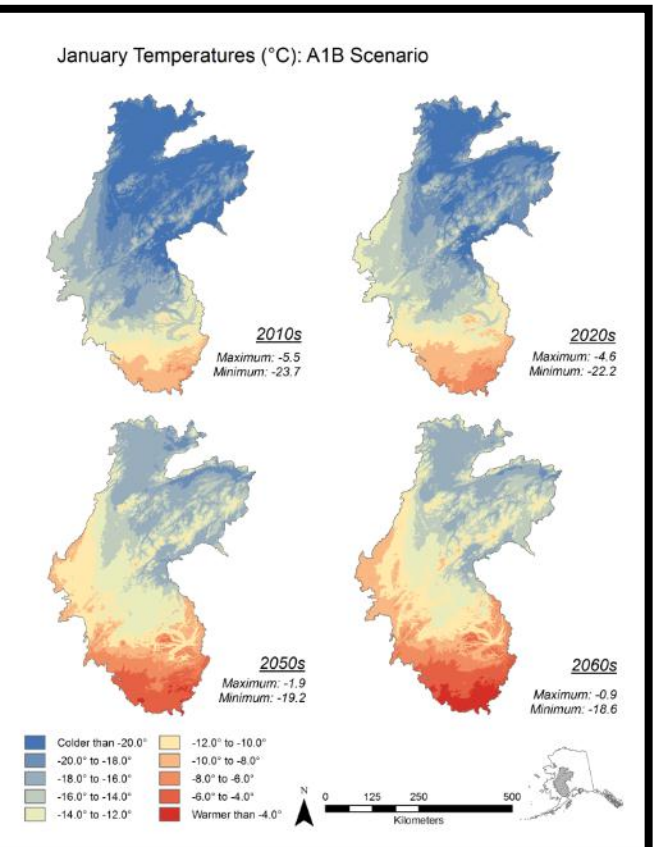
Baseline precipitation

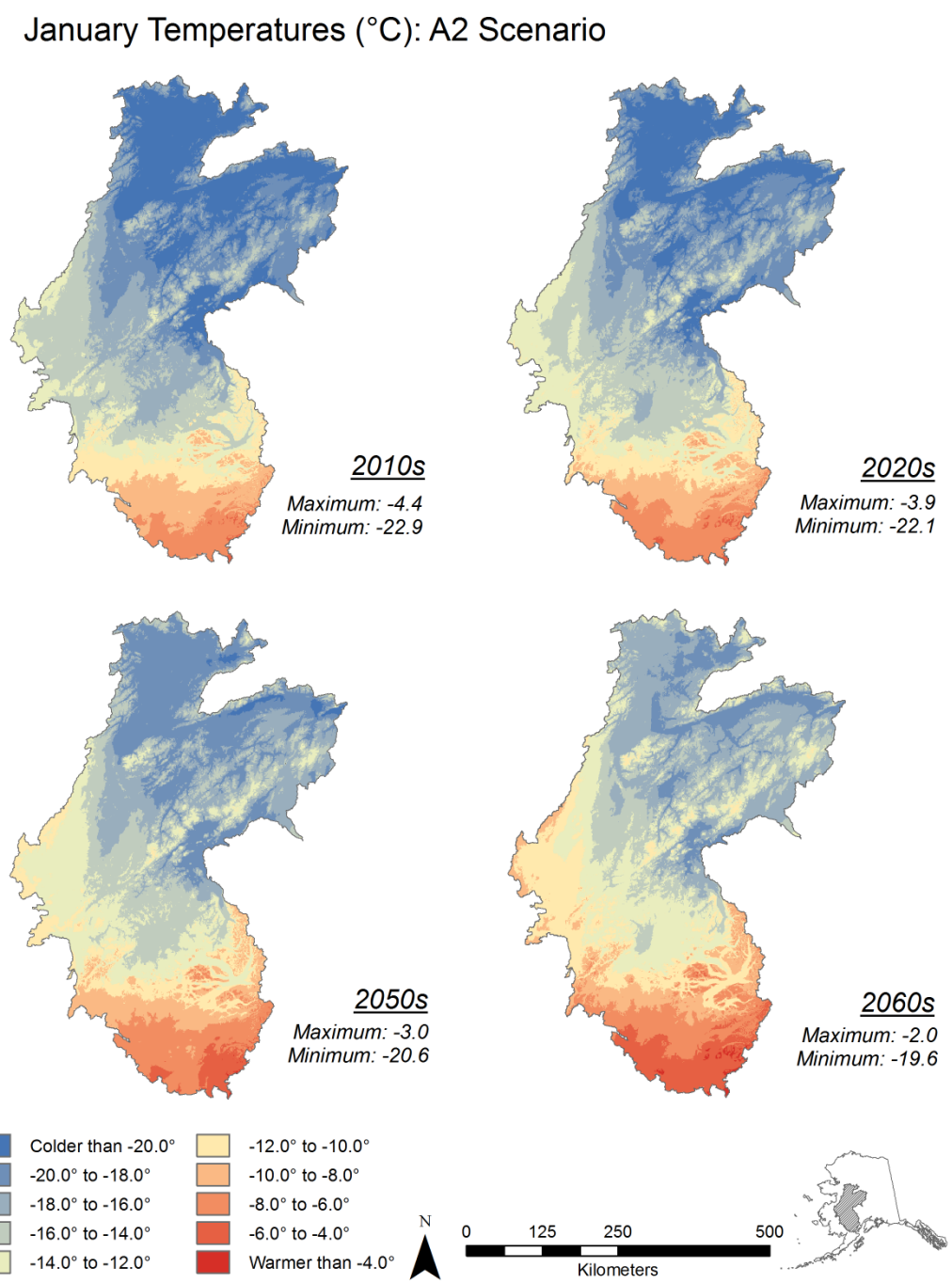


Typically, the YKL ecoregion is driest in the north in all seasons. However, precipitation varies quite widely across the ecoregion, from less than 40 mm per month to more than 170 mm. Summer rainfall is particularly variable.

Projected Temperature

January temperature for current and three future decades, A2 scenaro (right) and A1B (below).



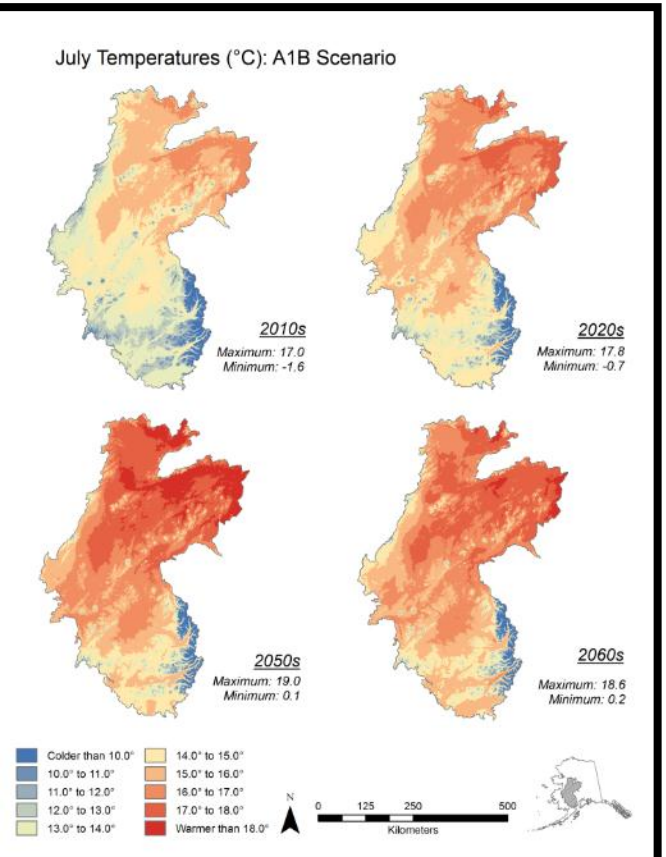


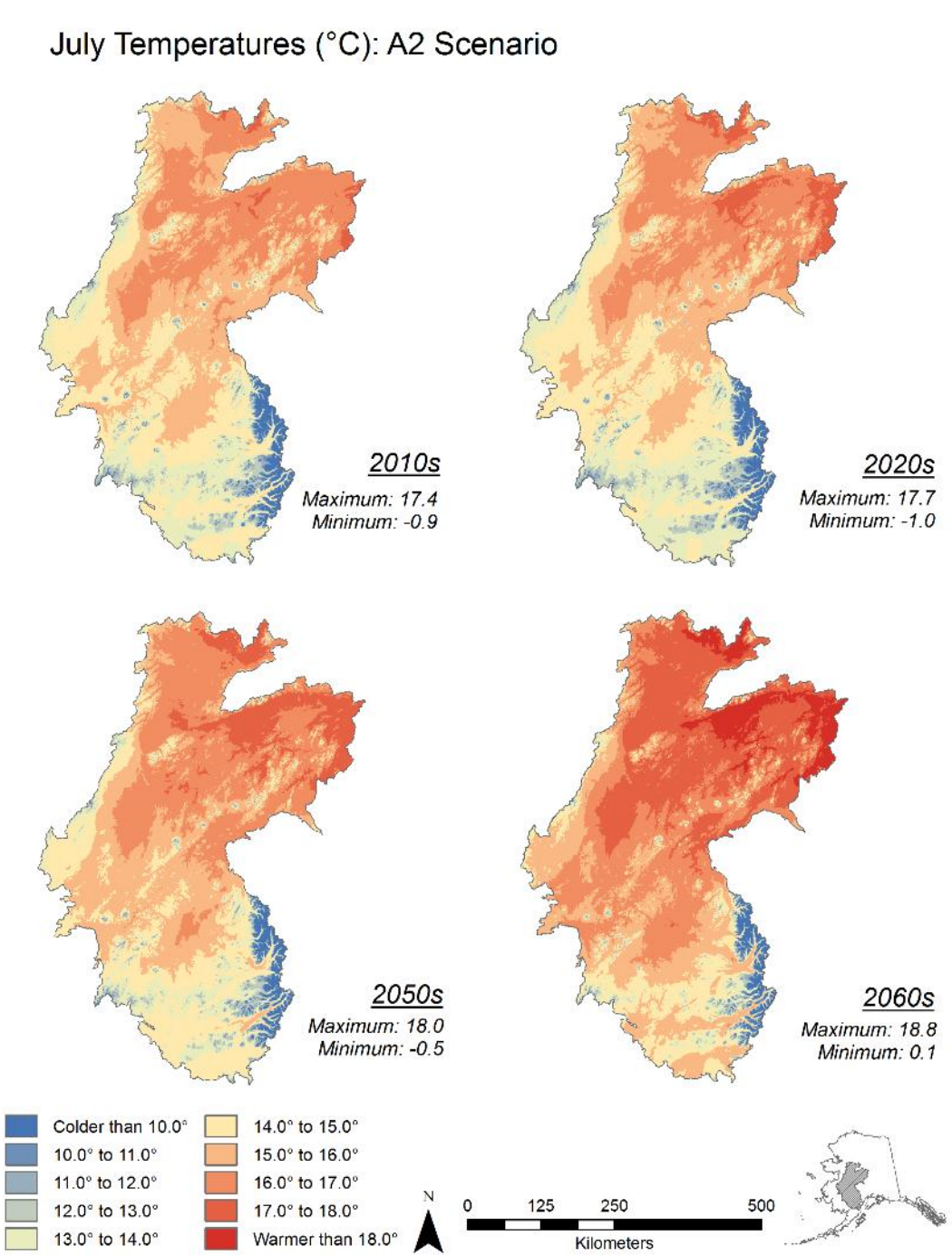
BLM

Rapid Ecoregional Assessment

Projected Temperature

July temperature for current and three future decades, A2 scenaro (right) and A1B (below).



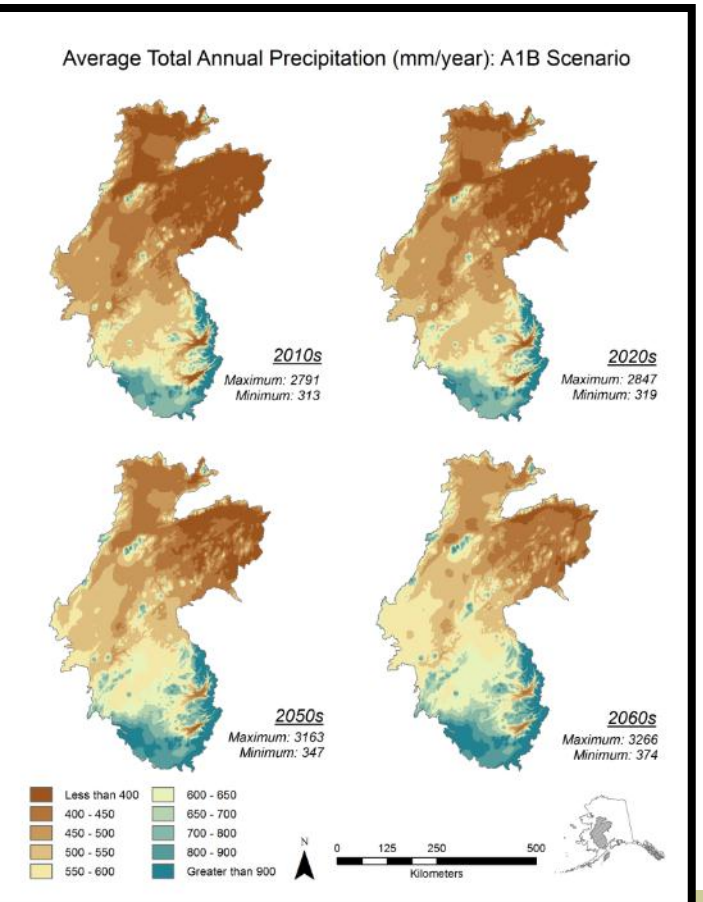


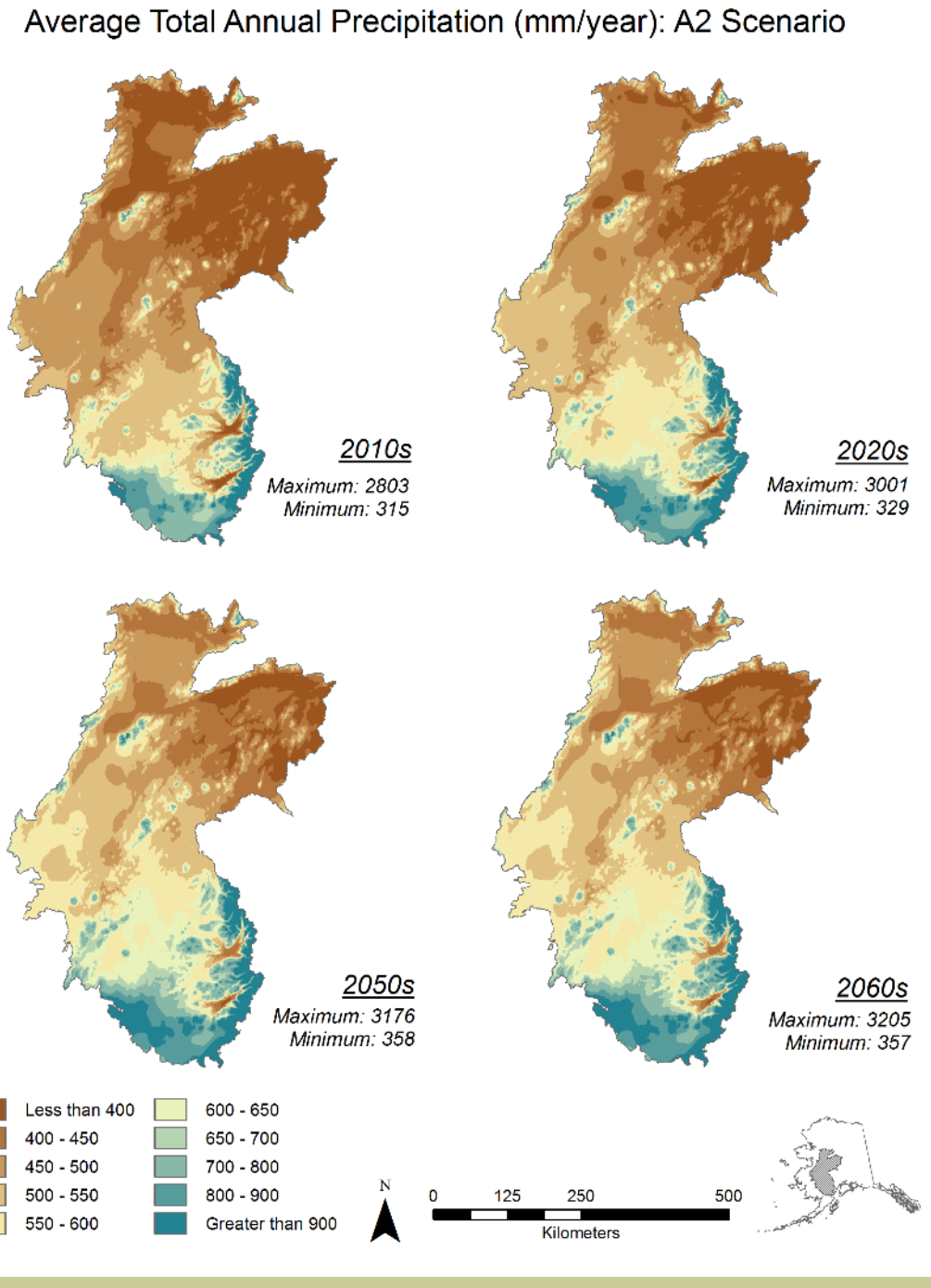
BLM

Rapid Ecoregional Assessment

Projected Precipitation

Mean annual precipitation for current and three future decades, A2 scenaro (right) and A1B (below).





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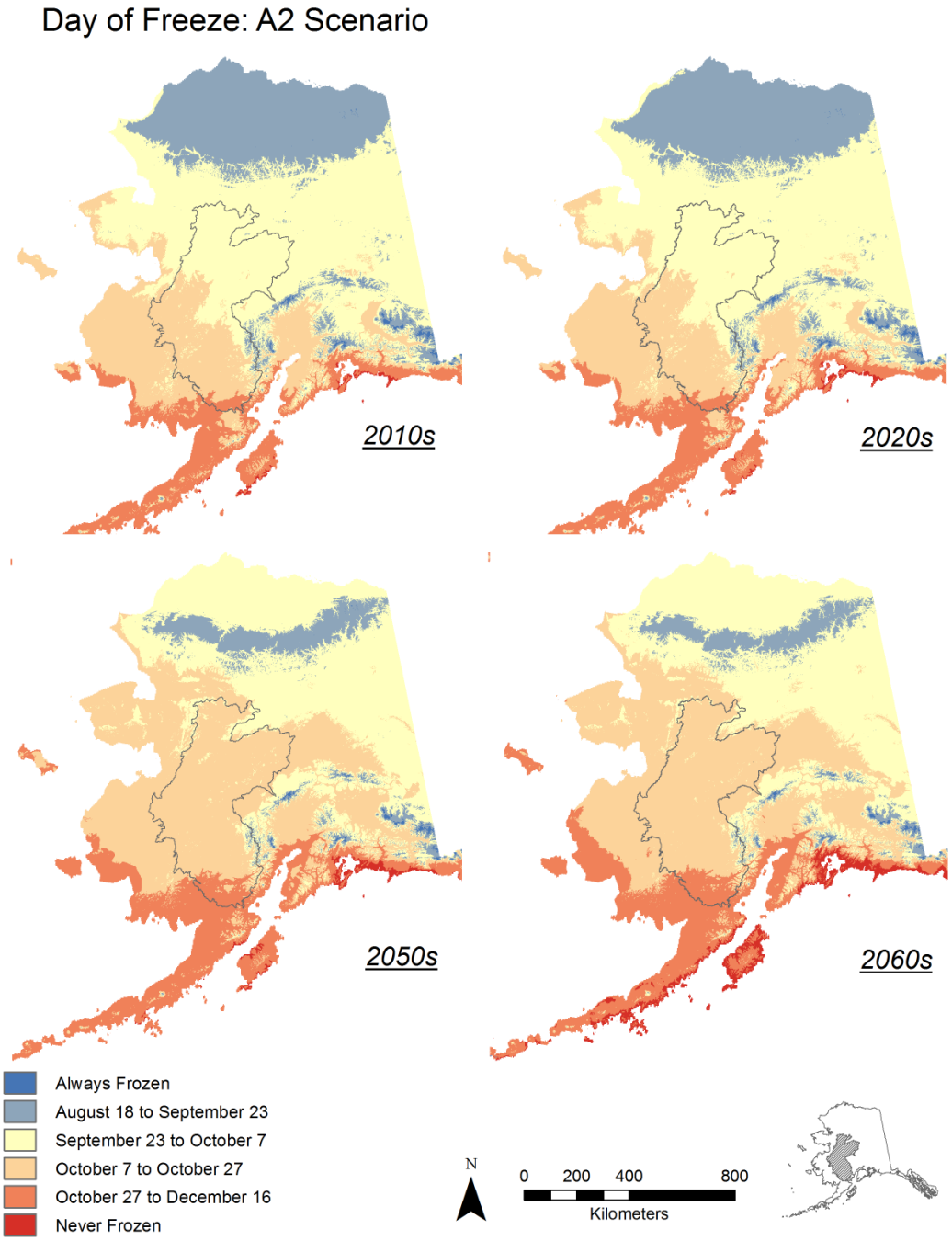
Rapid Ecoregional Assessment

Projected date of freeze

Data at which the running mean temperature crosses the freezing point in the autumn. (Statewide context provides a range of reference).



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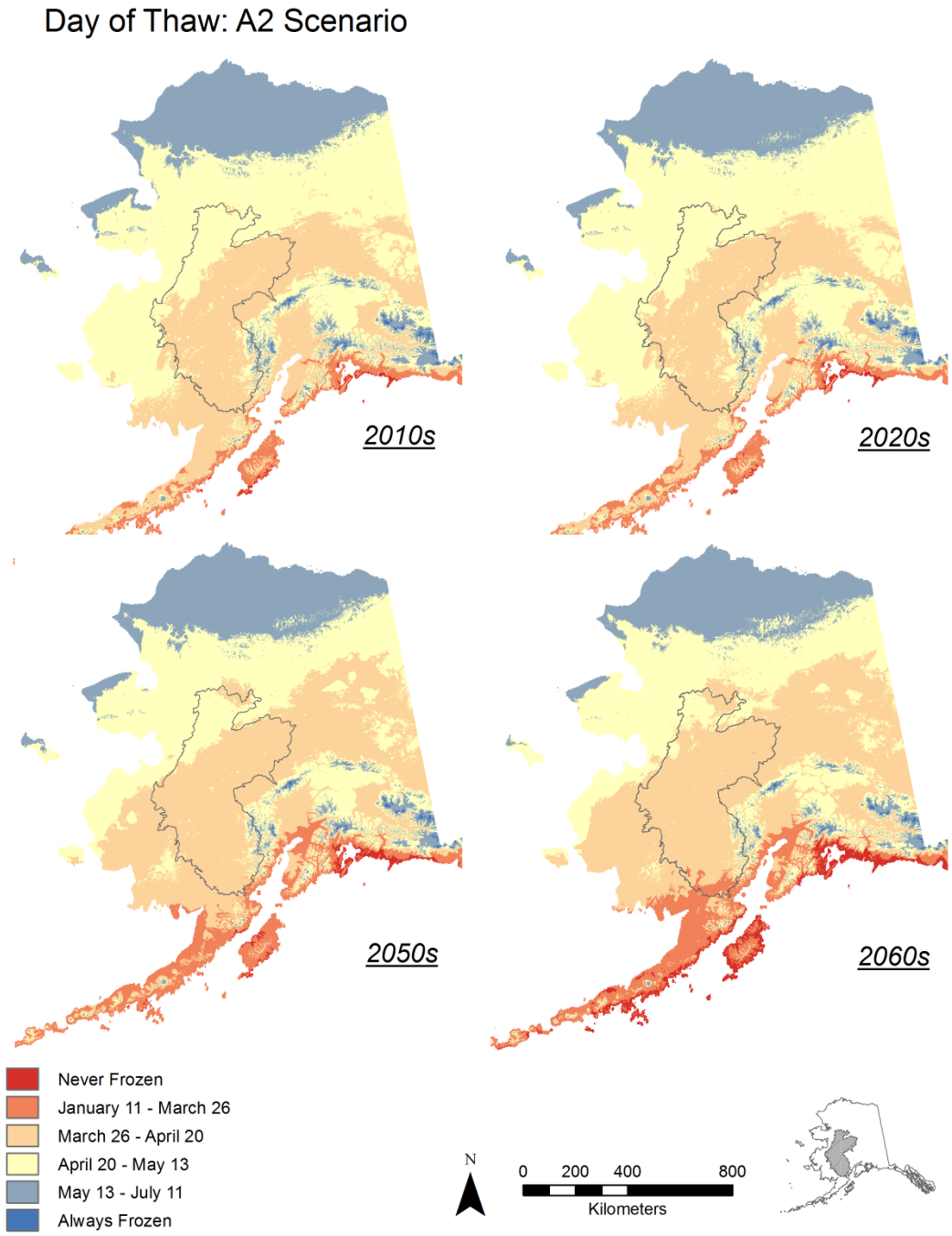
Rapid Ecoregional Assessment

Projected Date of thaw

Data at which the running mean temperature crosses the freezing point in the spring. (Statewide context provides a range of reference).



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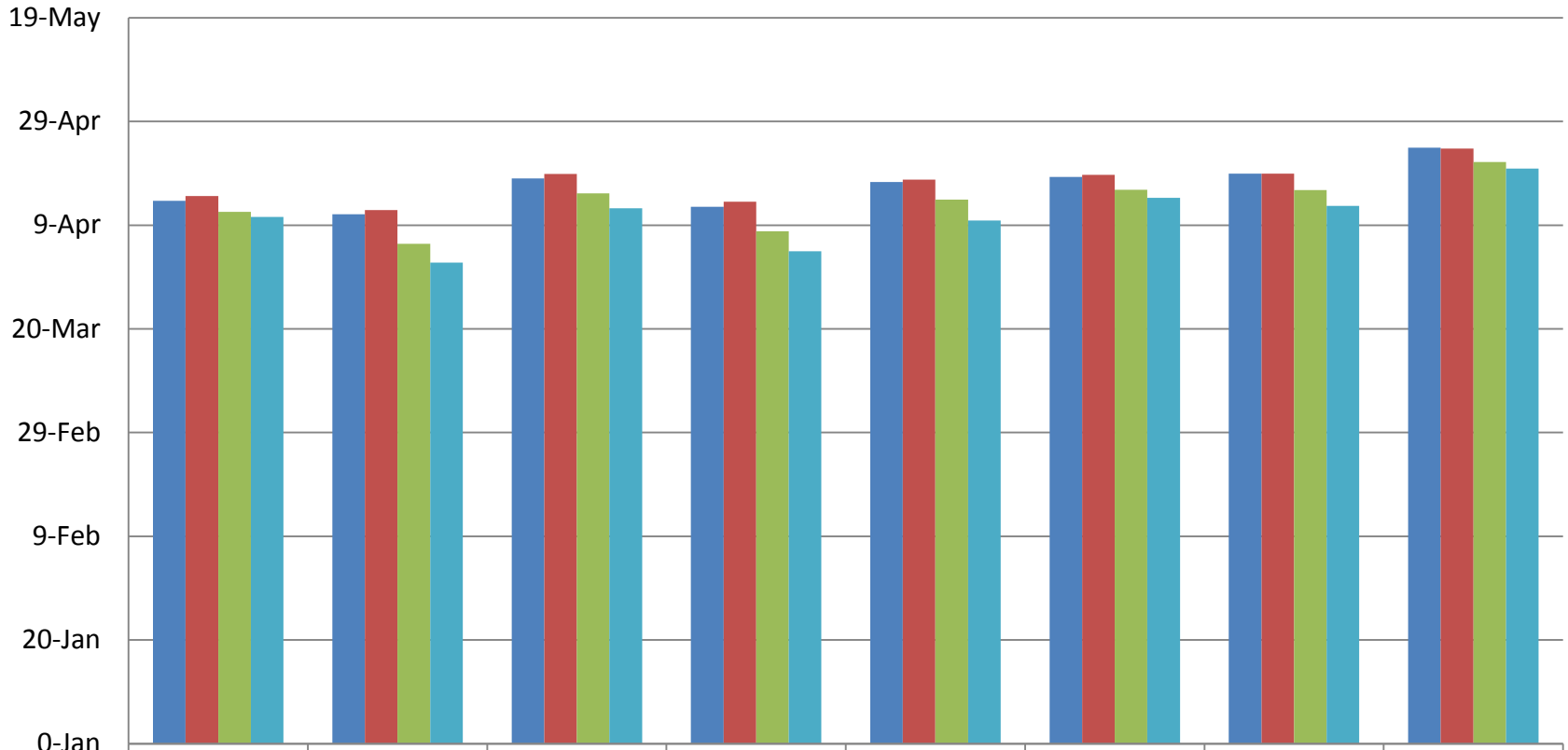
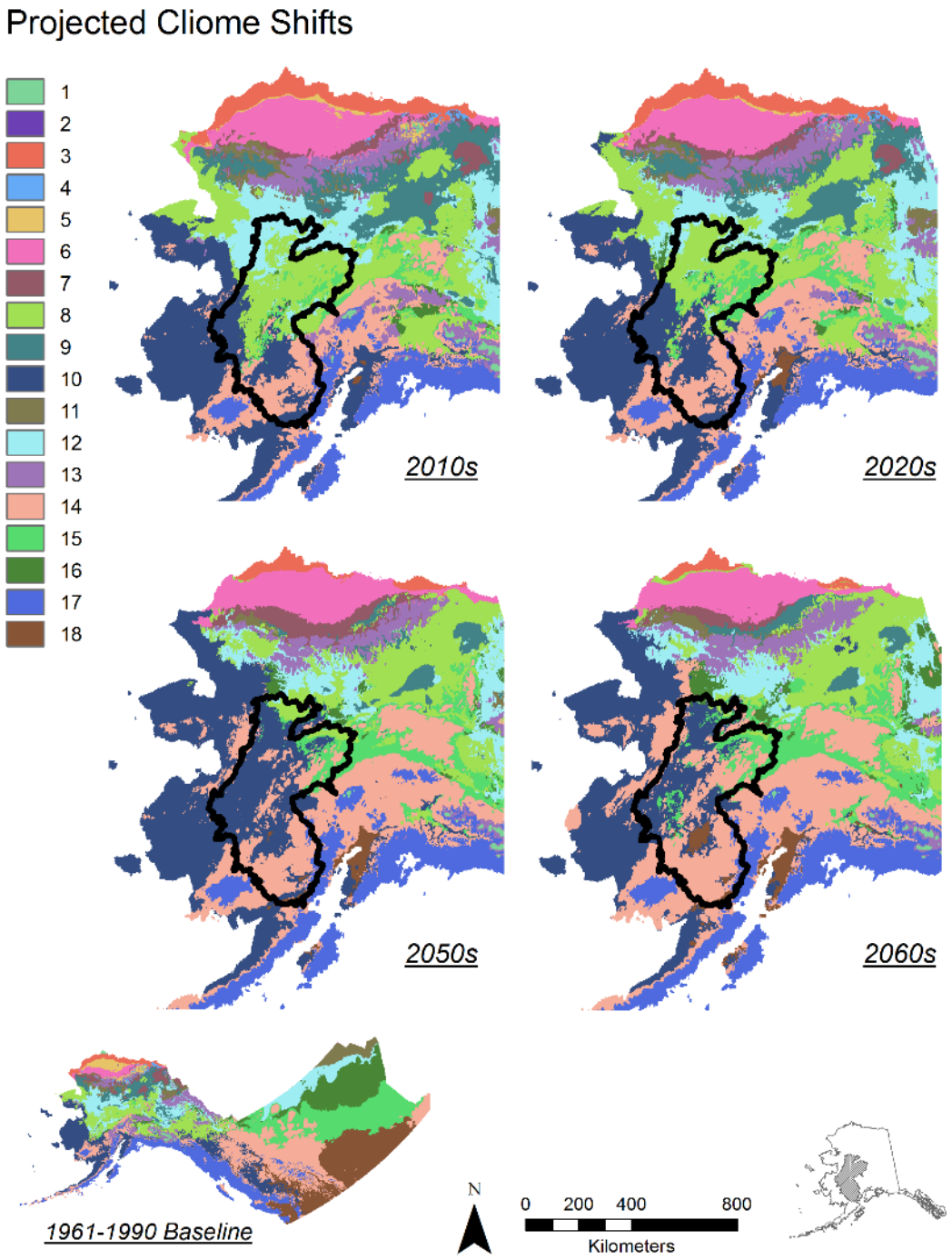
Rapid Ecoregional Assessment

Date of thaw by ecoregion



	Tanana River	Kvichak-Port Heiden	Upper Kuskokwim River	Nushagak River	Lower Kuskokwim River	Central Yukon	Lower Yukon	Koyukuk River
2010s	13-Apr	11-Apr	18-Apr	12-Apr	17-Apr	18-Apr	18-Apr	23-Apr
2020s	14-Apr	11-Apr	18-Apr	13-Apr	17-Apr	18-Apr	18-Apr	23-Apr
2050s	11-Apr	5-Apr	15-Apr	7-Apr	13-Apr	15-Apr	15-Apr	21-Apr
2060s	10-Apr	1-Apr	12-Apr	3-Apr	9-Apr	14-Apr	12-Apr	19-Apr



Cliome projections with REA boundary shown in black

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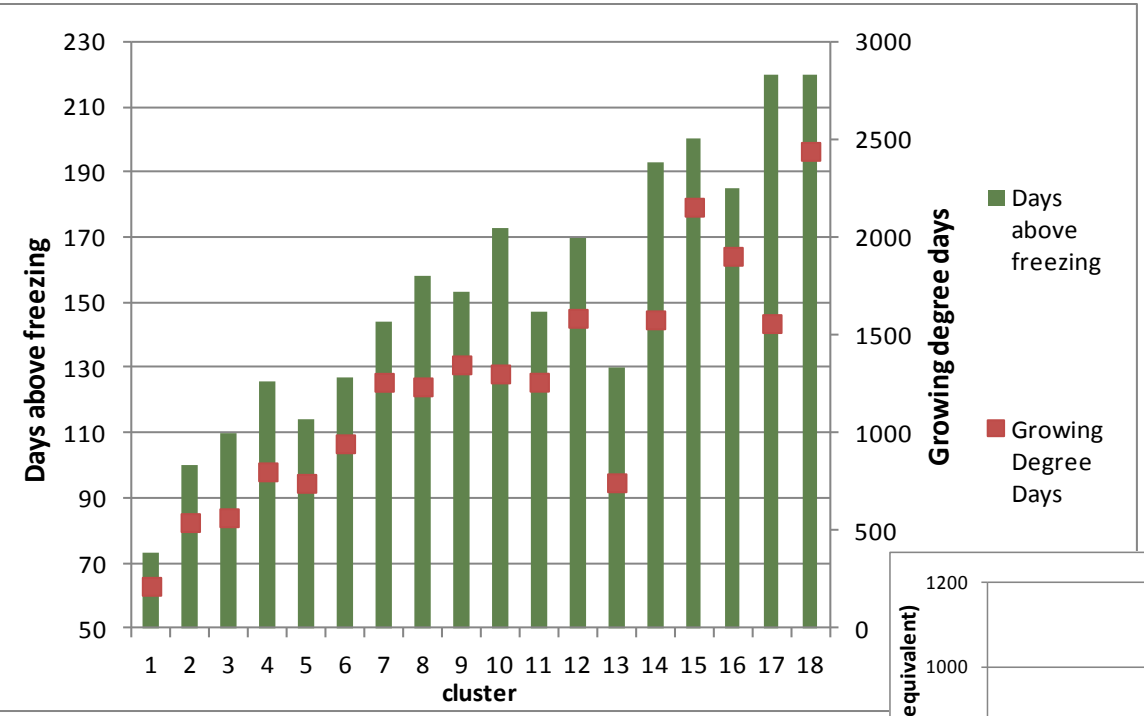
Rapid Ecoregional Assessment

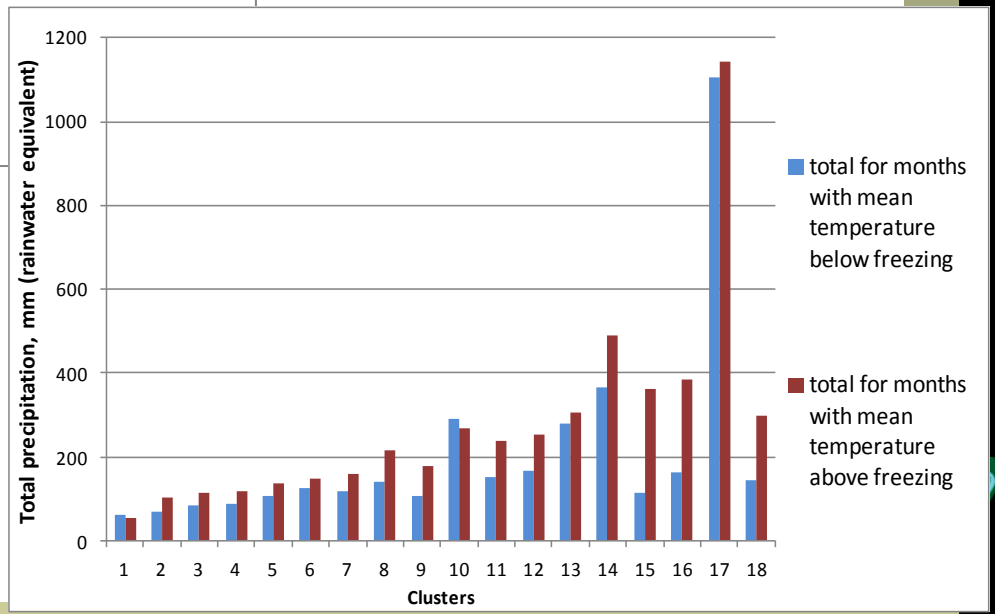
Describing the clusters:

growing degree days, season length, and snowfall

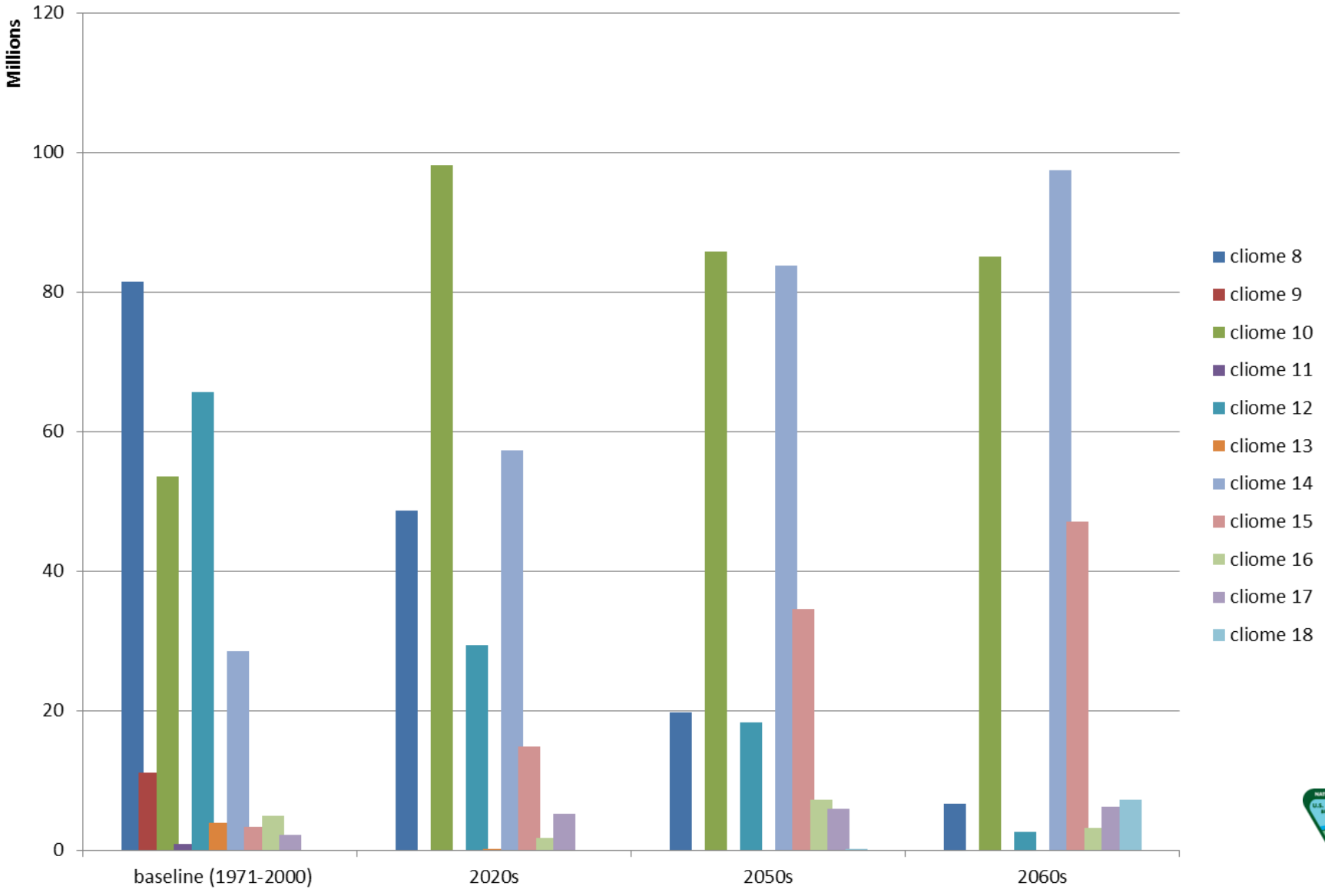


Length of above-freezing season and GDD by cluster. Days above freezing were estimated via linear interpolation between monthly mean temperatures. Growing degree days (GDD) were calculated using 0° C as a baseline.

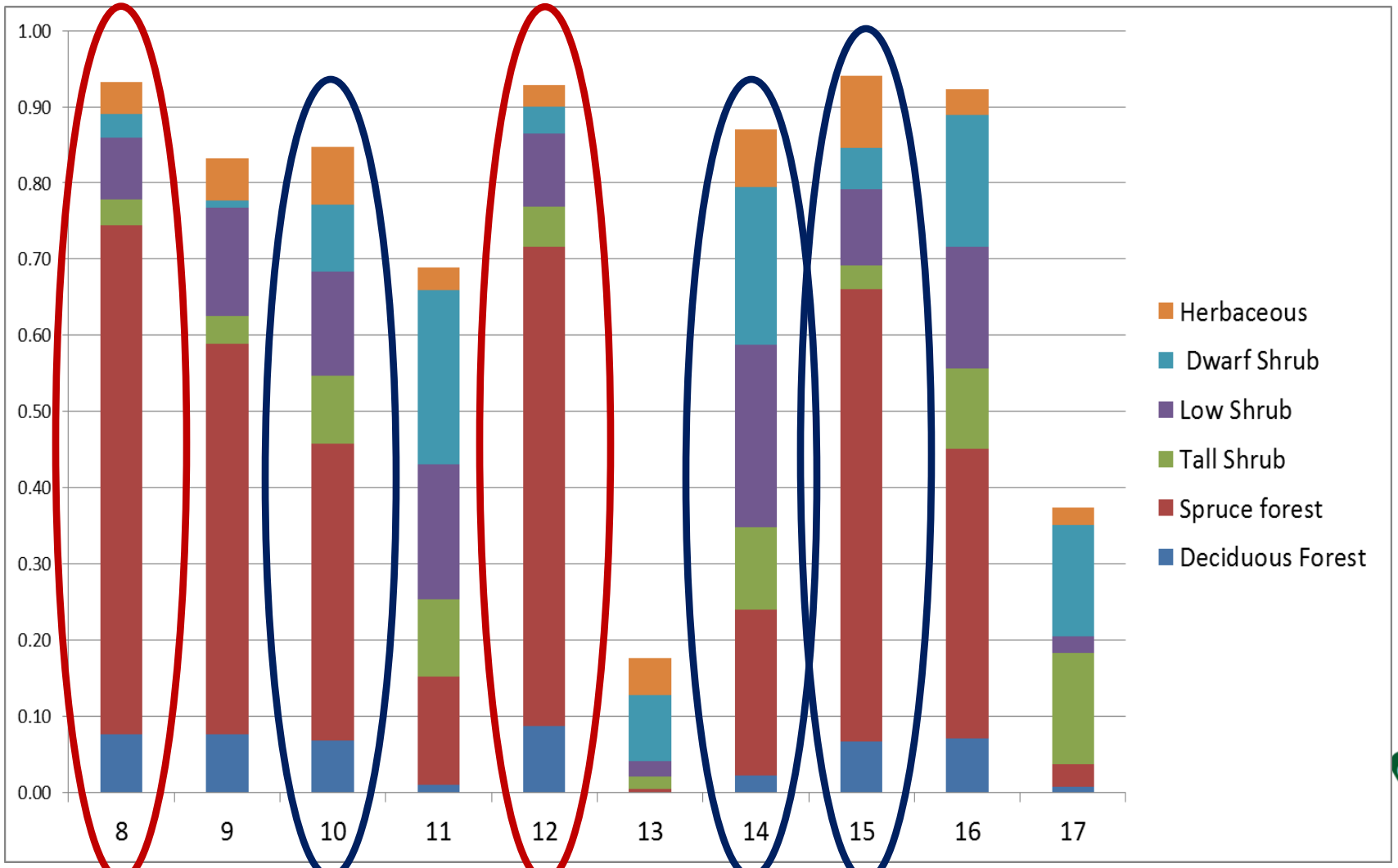
Warm-season and cold-season precipitation by cluster. The majority of precipitation in months with mean temperatures below freezing is assumed to be snow (measured as rainwater equivalent).



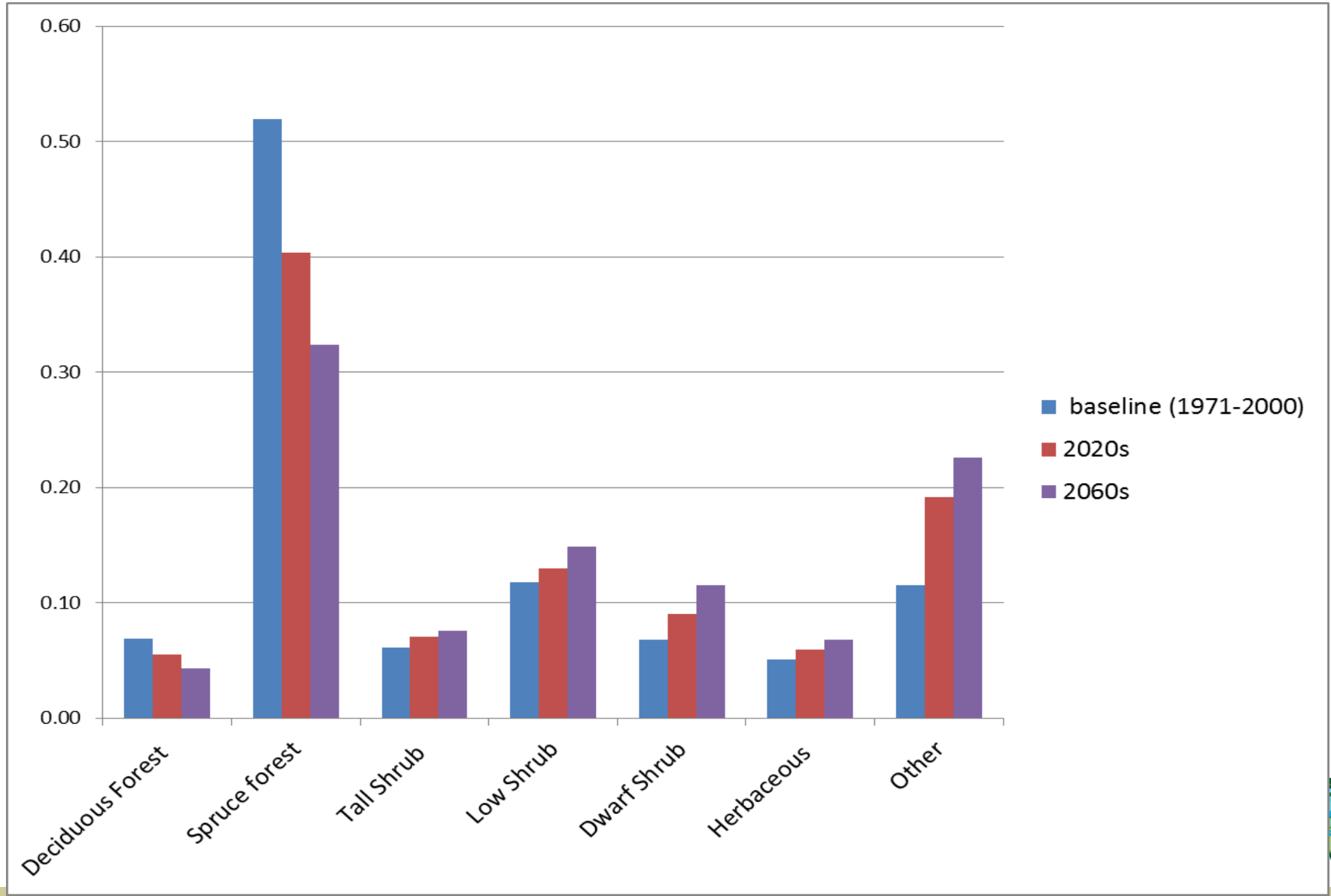
Cliomes by time period (2 km pixels within REA boundaries)



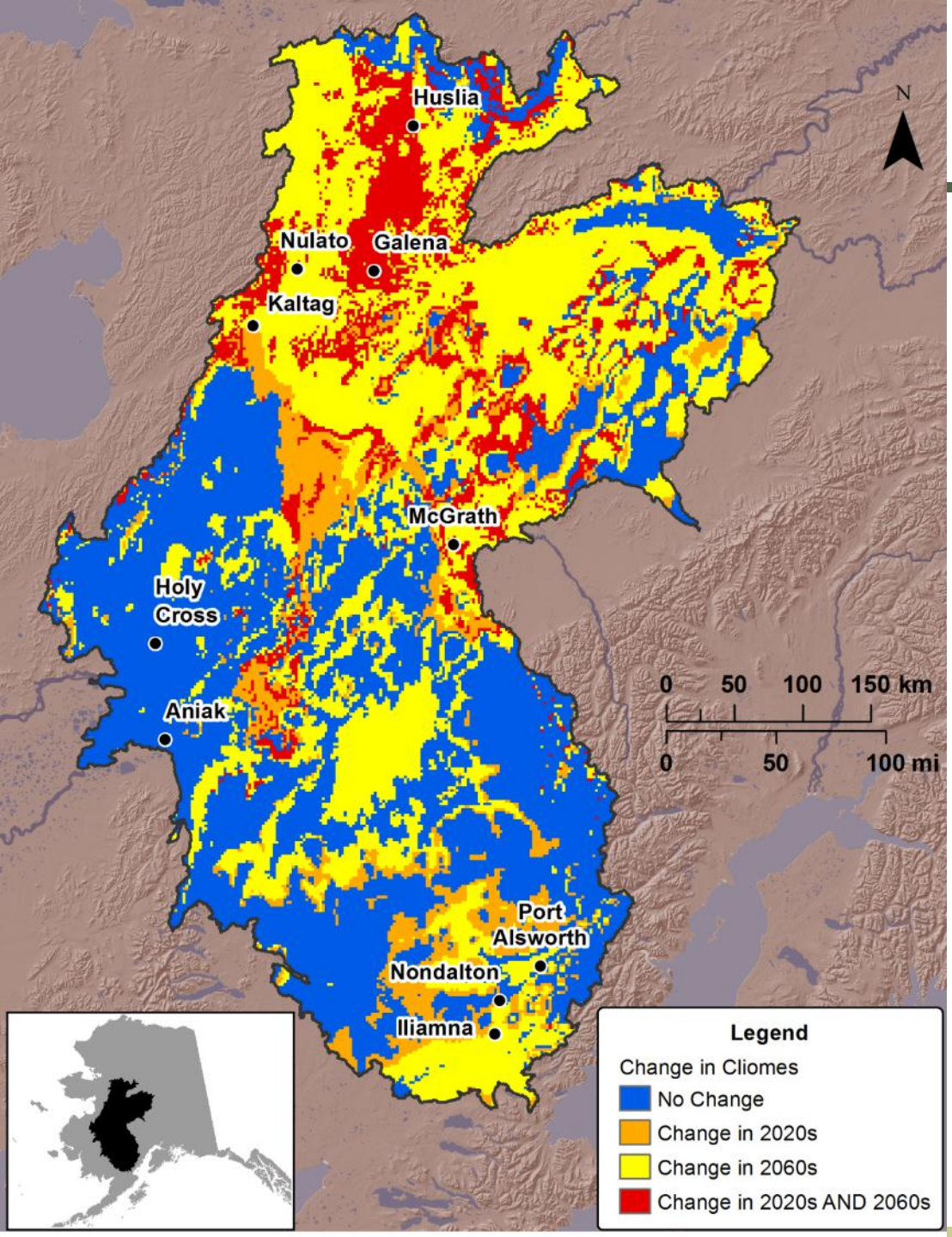
Coarse-filter CEs by cliome



Projected CE change based on cliome change



Cliome shifts



Cliomes (climate clusters) can remain stable, indicating potential resilience; change once; or change twice by the 2060's.

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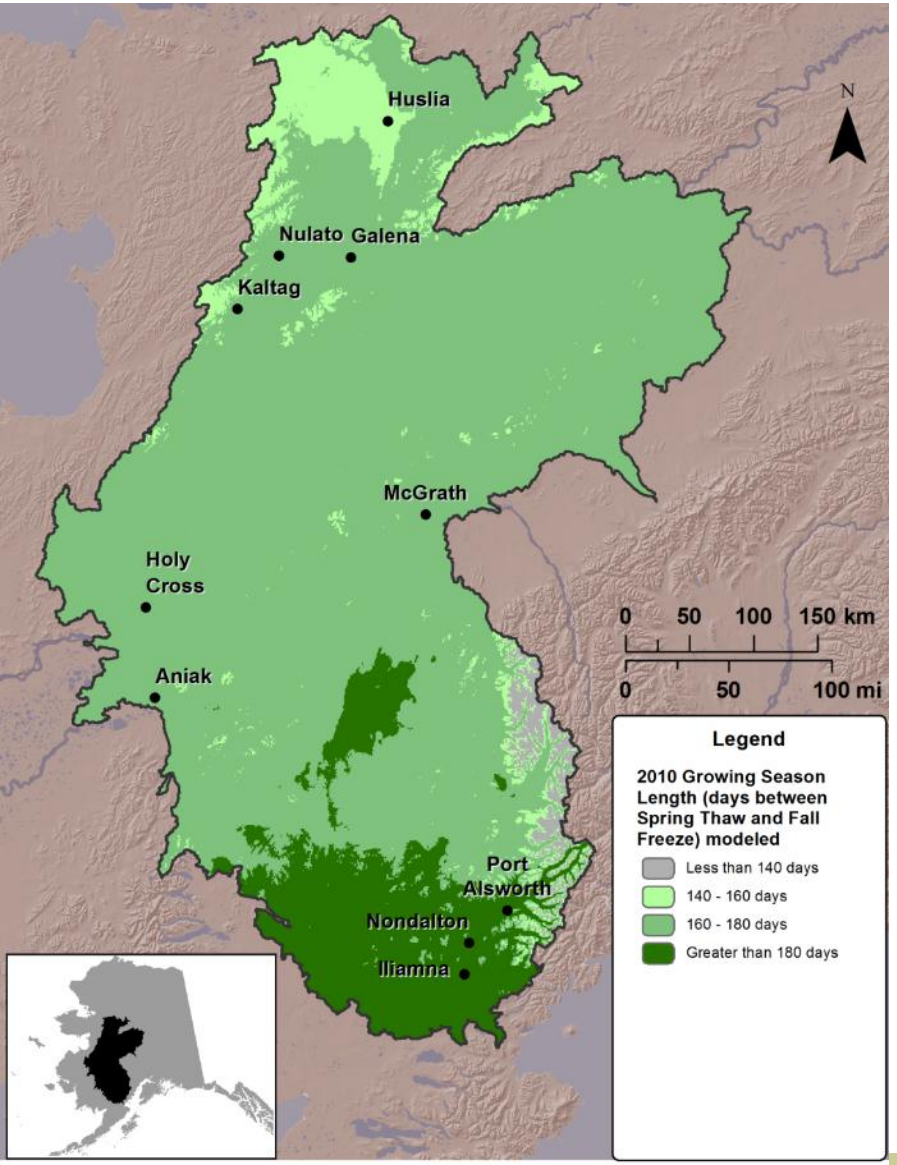
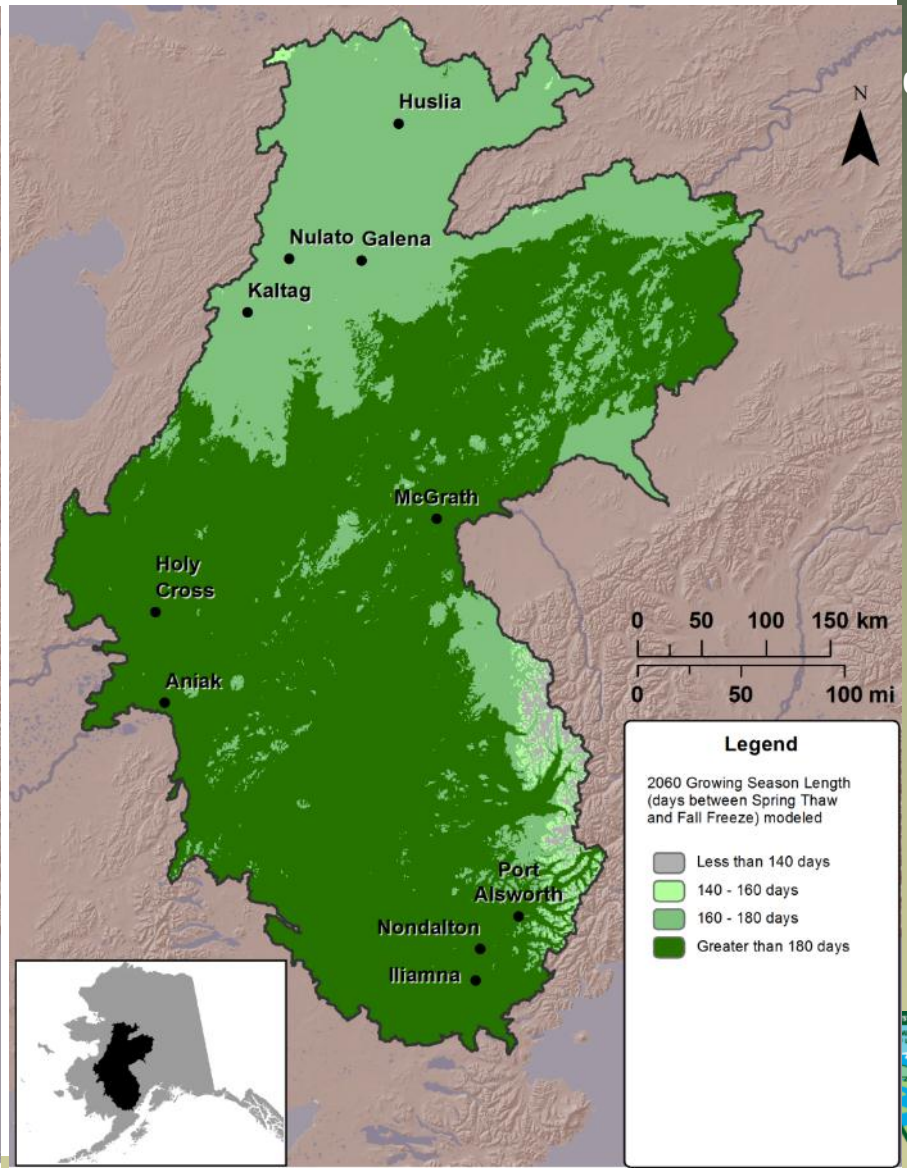
Rapid Ecoregional Assessment

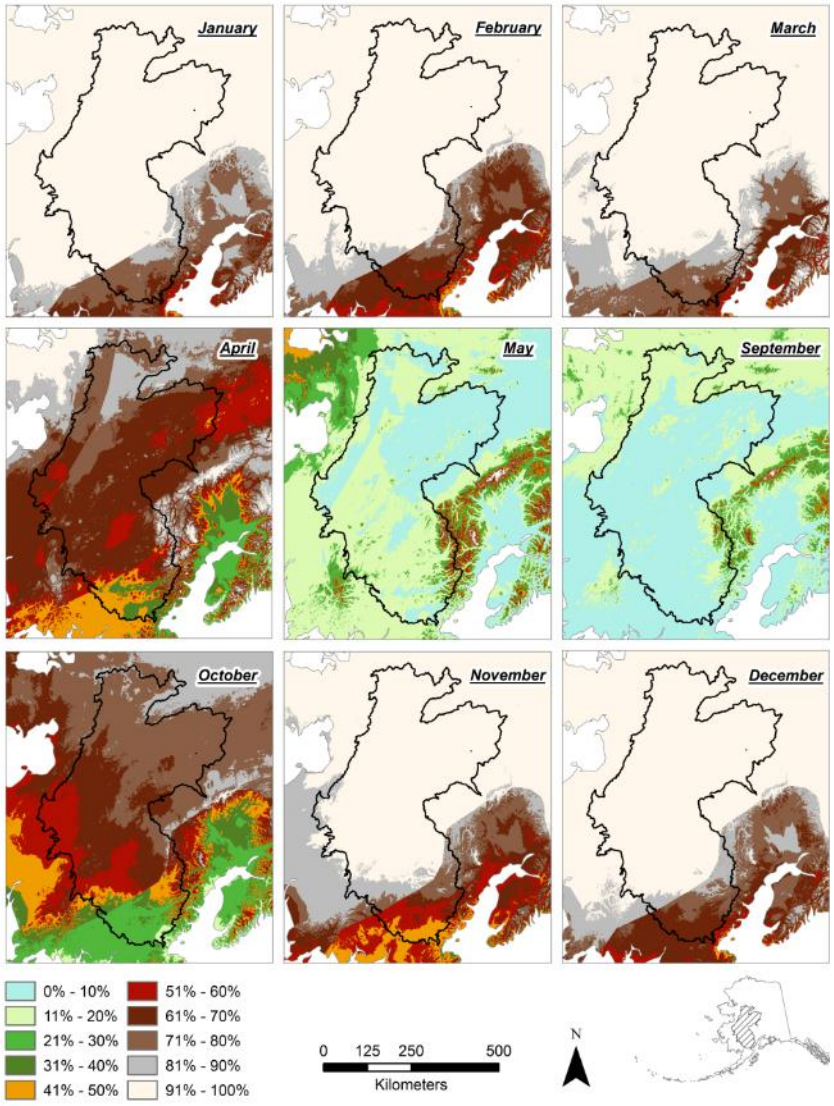
Projected warm season length



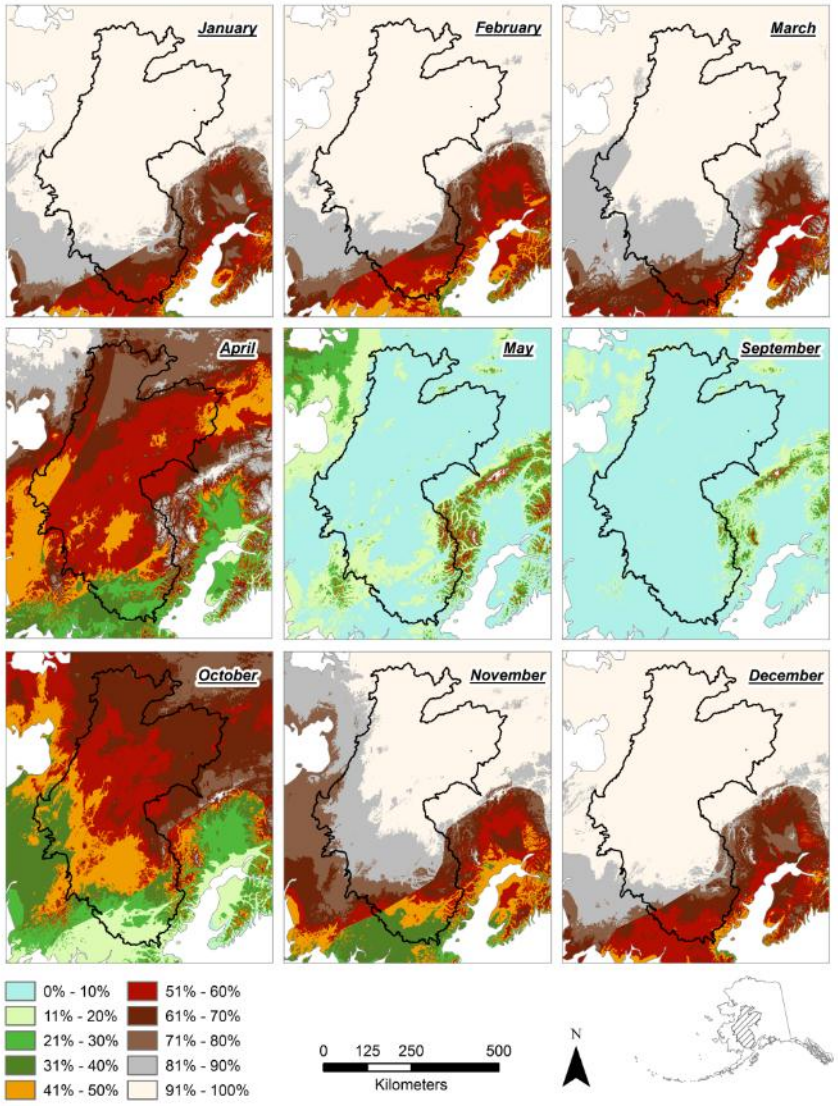


Snow Day Fraction by month

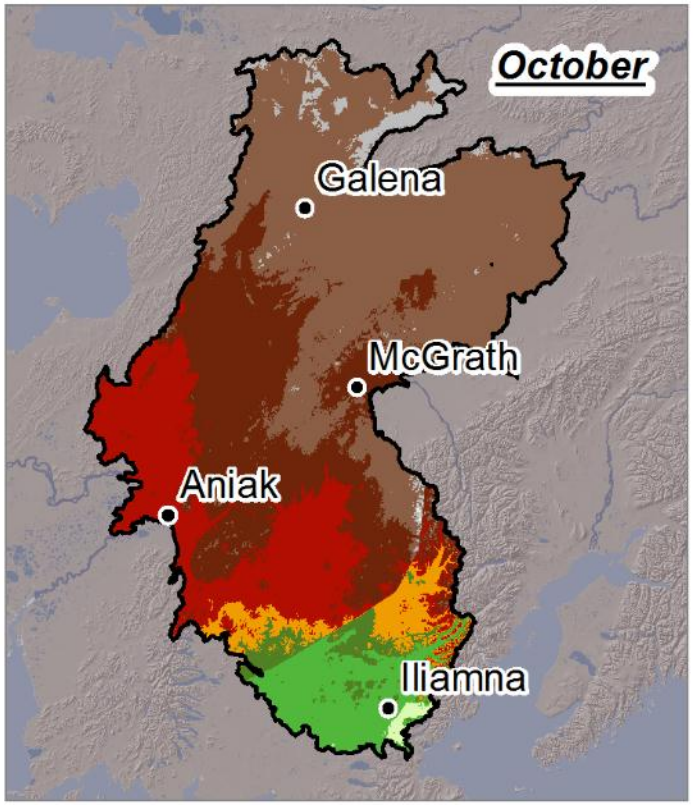
Decadal Average of Monthly Snow Day Fraction (%): 2010s A2 Scenario



Decadal Average of Monthly Snow Day Fraction (%): 2060s A2 Scenario

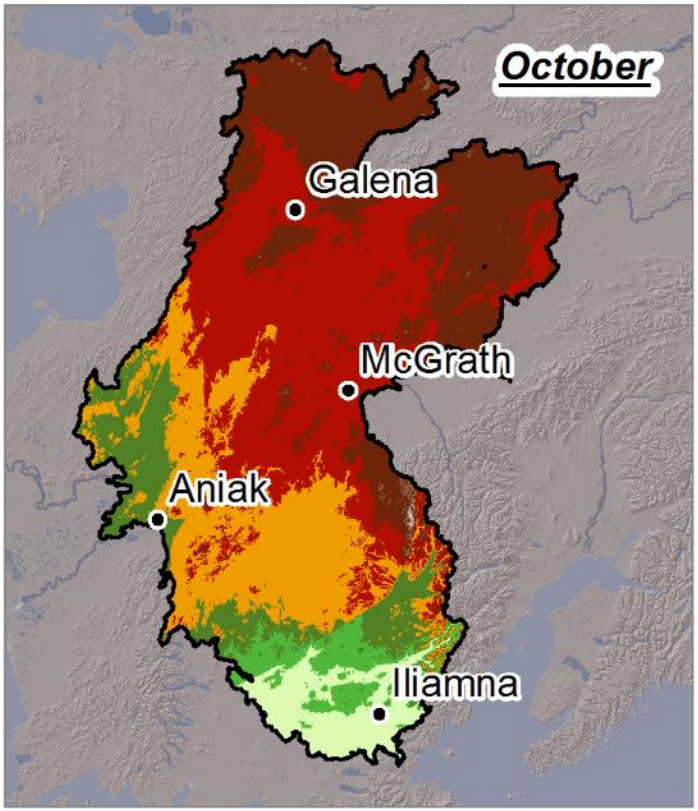


Snow Day Fraction: October



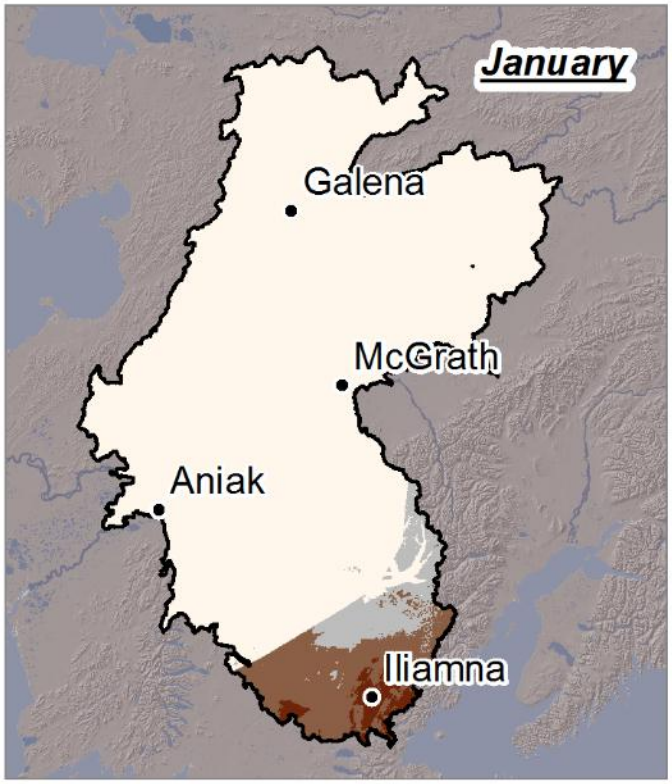
0% - 10%
11% - 20%
21% - 30%
31% - 40%
41% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90
91% - 100%

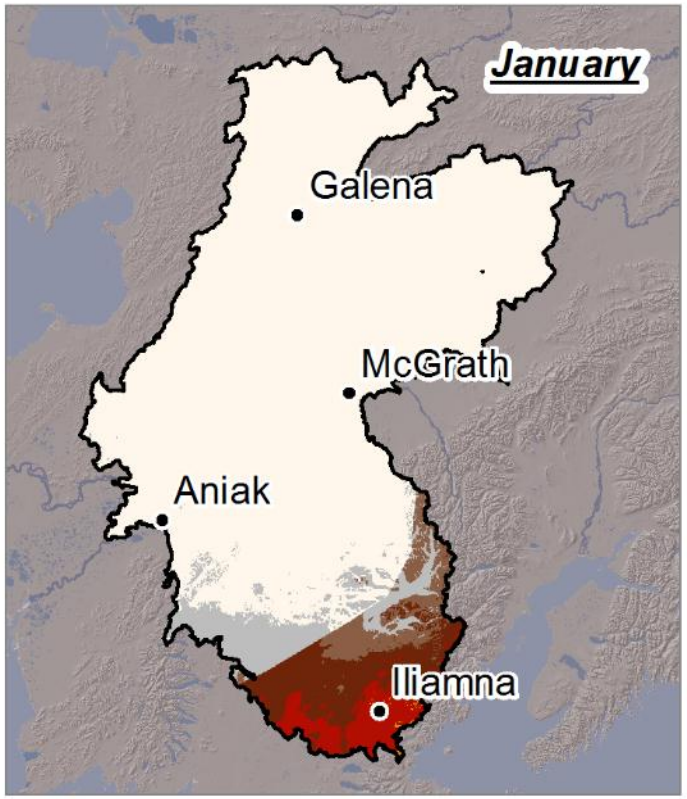
Change in snow day fraction for the month of October between the current decade (left) and the 2060s (right). Where now most October precipitation falls as snow, in 50 years most the majority may be rain.



0% - 10%
11% - 20%
21% - 30%
31% - 40%
41% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90%
91% - 100%

Snow Day Fraction: January





Change in snow day fraction for the month of January between the current decade (left) and the 2060s (right). Rain on snow events can have a profound effect on wildlife.

0% - 10%	51% - 60%
11% - 20%	61% - 70%
21% - 30%	71% - 80%
31% - 40%	81% - 90
41% - 50%	91% - 100%

0% - 10%	51% - 60%
11% - 20%	61% - 70%
21% - 30%	71% - 80%
31% - 40%	81% - 90
41% - 50%	91% - 100%

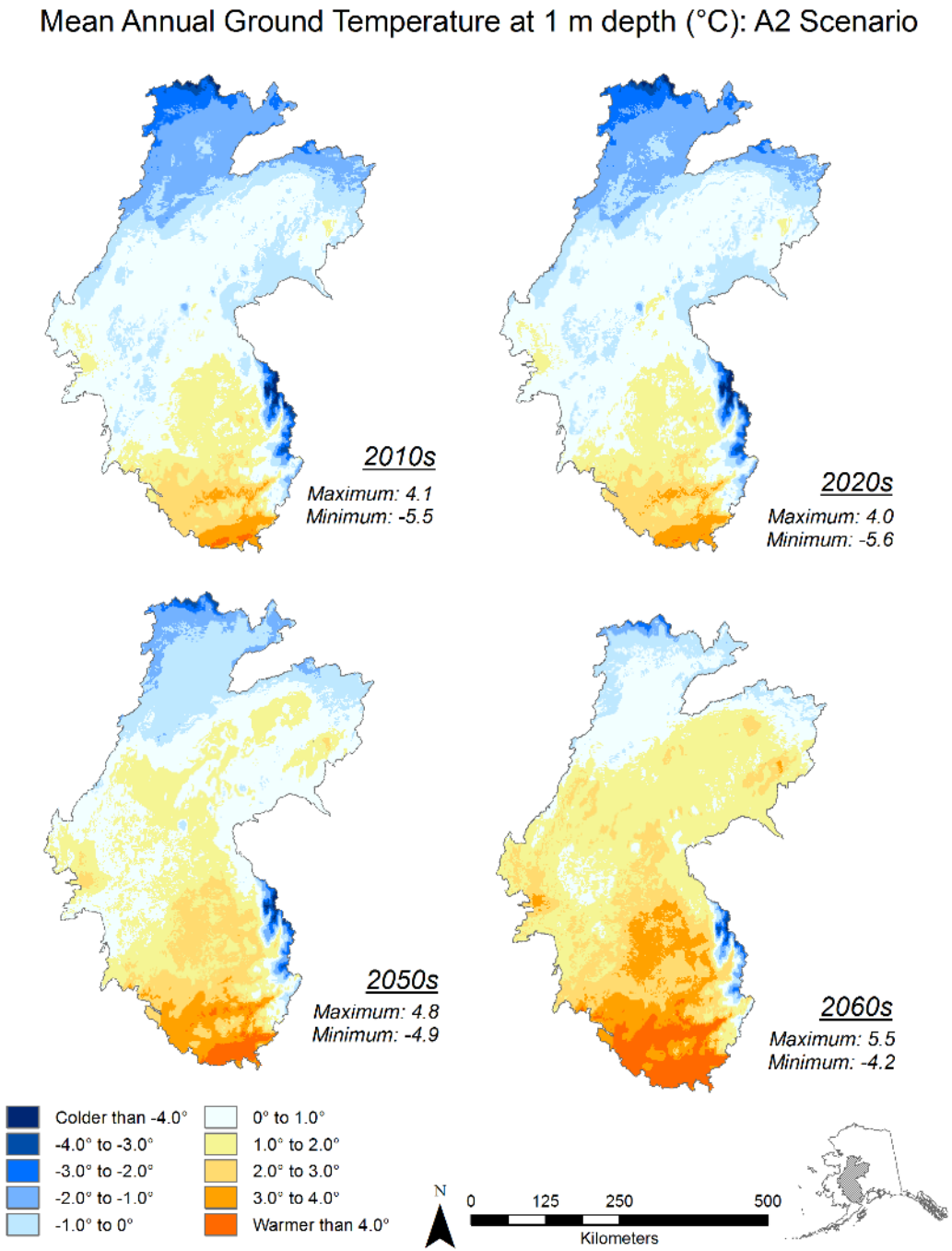
MQs related to permafrost

- What are the current soil thermal regime dynamics?
- Based on the predictions of the best available climate models and soil temperature models, how will soil thermal regimes change in the future?
- Where are predicted changes in soil thermal regimes associated with communities and transportation routes?
- How and where will changes in permafrost impact vegetation?
- How might changes in temperature, precipitation, evapotranspiration, and soil thermal dynamics affect general hydrology and hydrology-dependent CEs such as waterfowl in the region?

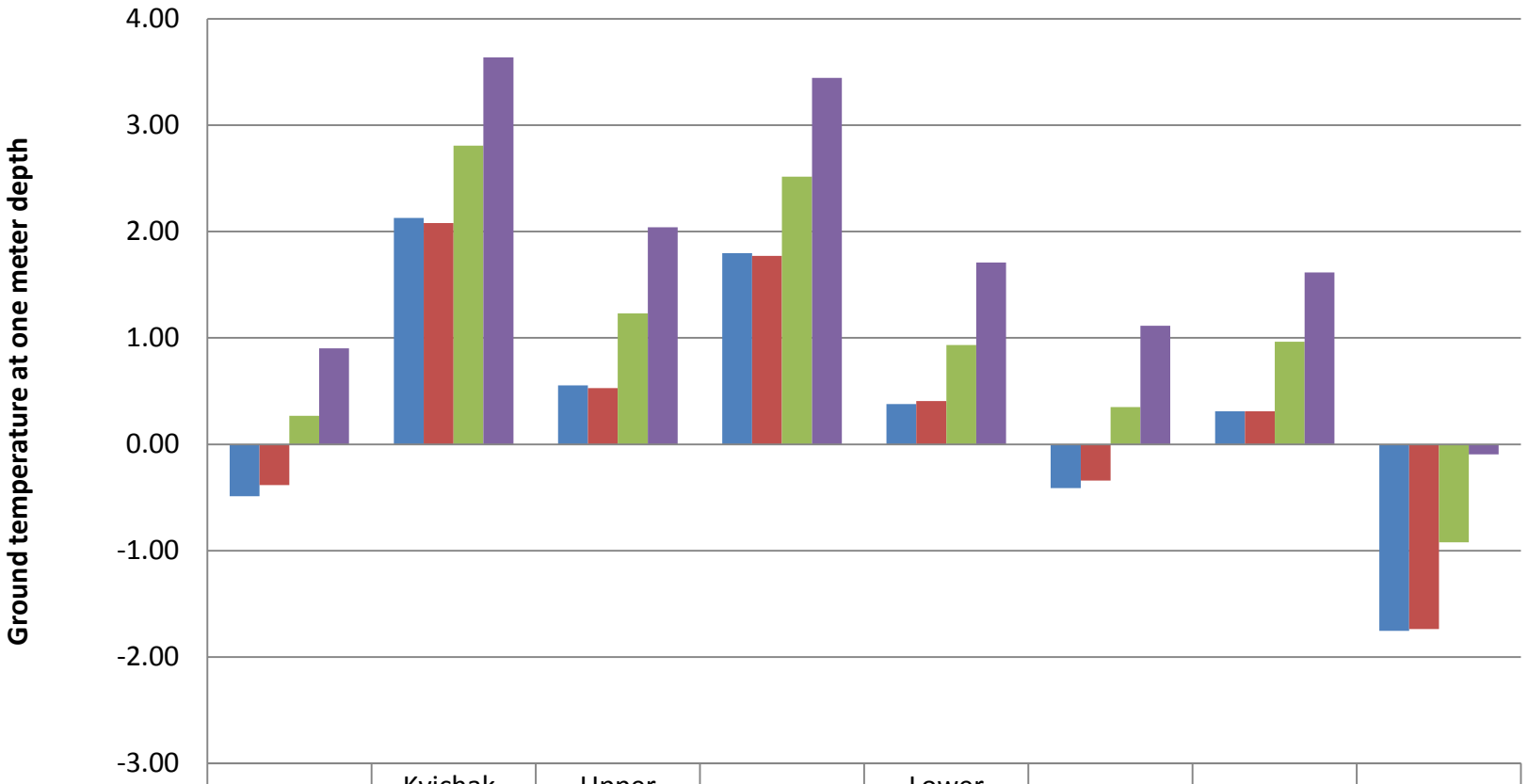
Permafrost: MAGT

Mean annual ground temperature at one meter depth serves as a reasonable proxy for the presence/absence of ecologically significant permafrost.

Blue areas are frozen; white to orange areas are thawed.



Permafrost: MAGT



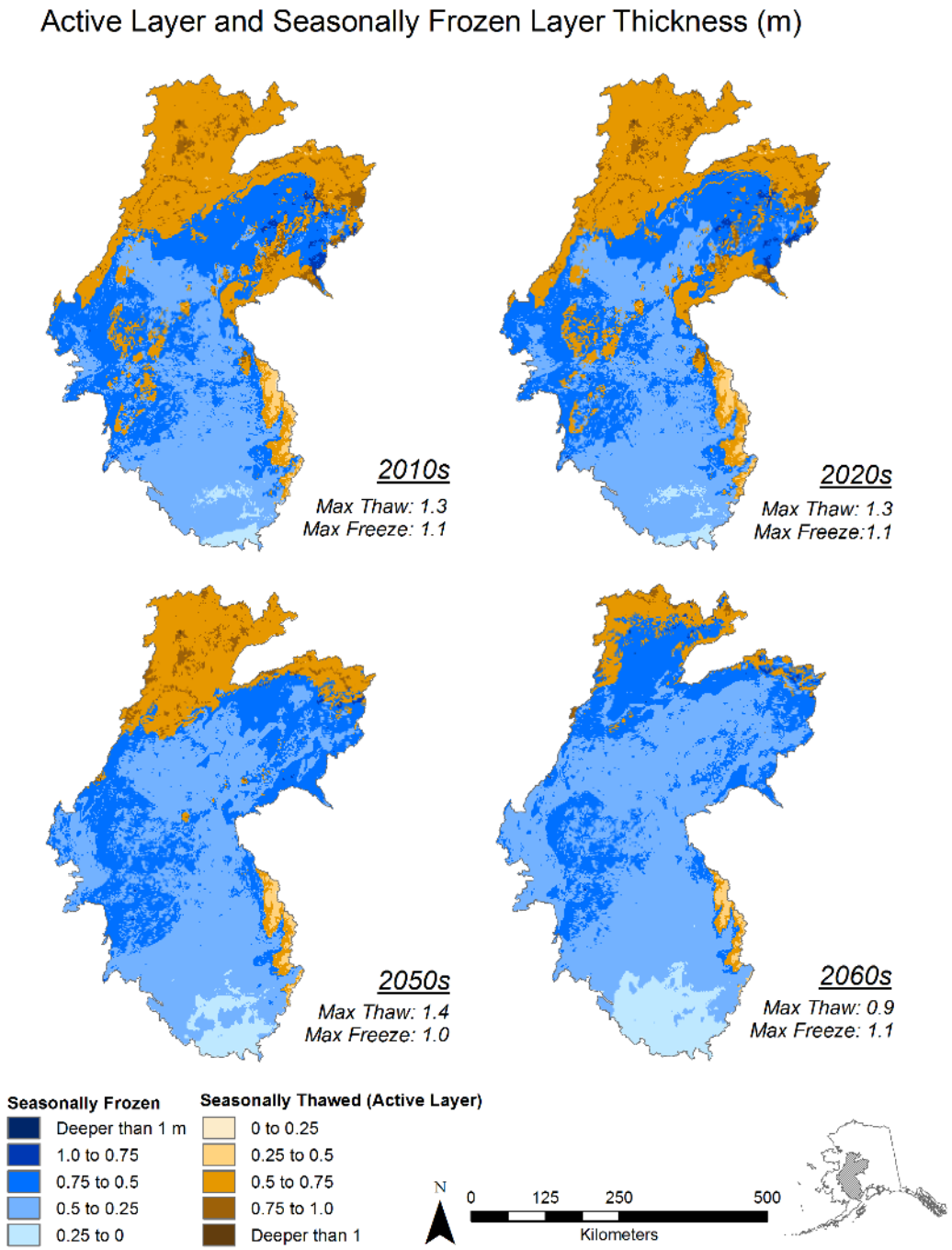
	Tanana River	Kvichak-Port Heiden	Upper Kuskokwim River	Nushagak River	Lower Kuskokwim River	Central Yukon	Lower Yukon	Koyukuk River
MEAN 2010s	-0.49	2.13	0.55	1.80	0.38	-0.41	0.31	-1.75
MEAN 2020s	-0.38	2.08	0.53	1.77	0.40	-0.34	0.31	-1.74
MEAN 2050s	0.27	2.81	1.23	2.51	0.93	0.35	0.96	-0.92
MEAN 2060s	0.90	3.64	2.04	3.44	1.71	1.12	1.62	-0.10

Permafrost: ALT

These maps depict two different variables.

In areas with permafrost (temperatures below freezing at one meter depth), the brown shades show seasonal thaw.

Blue shades show depth of winter freeze in non-permafrost areas.

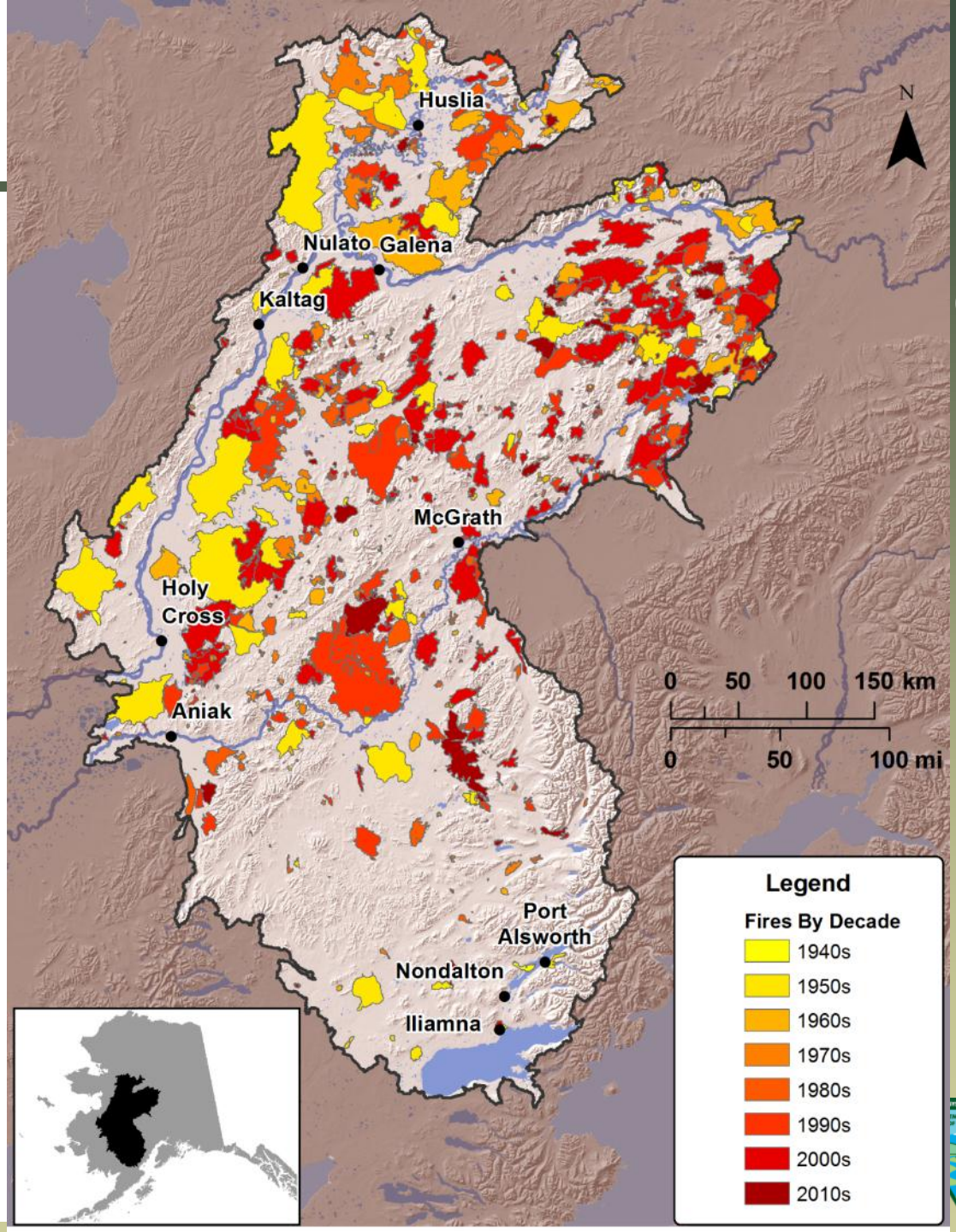


MQs related to fire

- What is the fire history of the ecoregion?
- What climatic conditions are likely to result in significant changes to fire activity?
- What is the current frequency (return interval) and the likely future frequency for fire in the ecoregion and broad sub-regions?

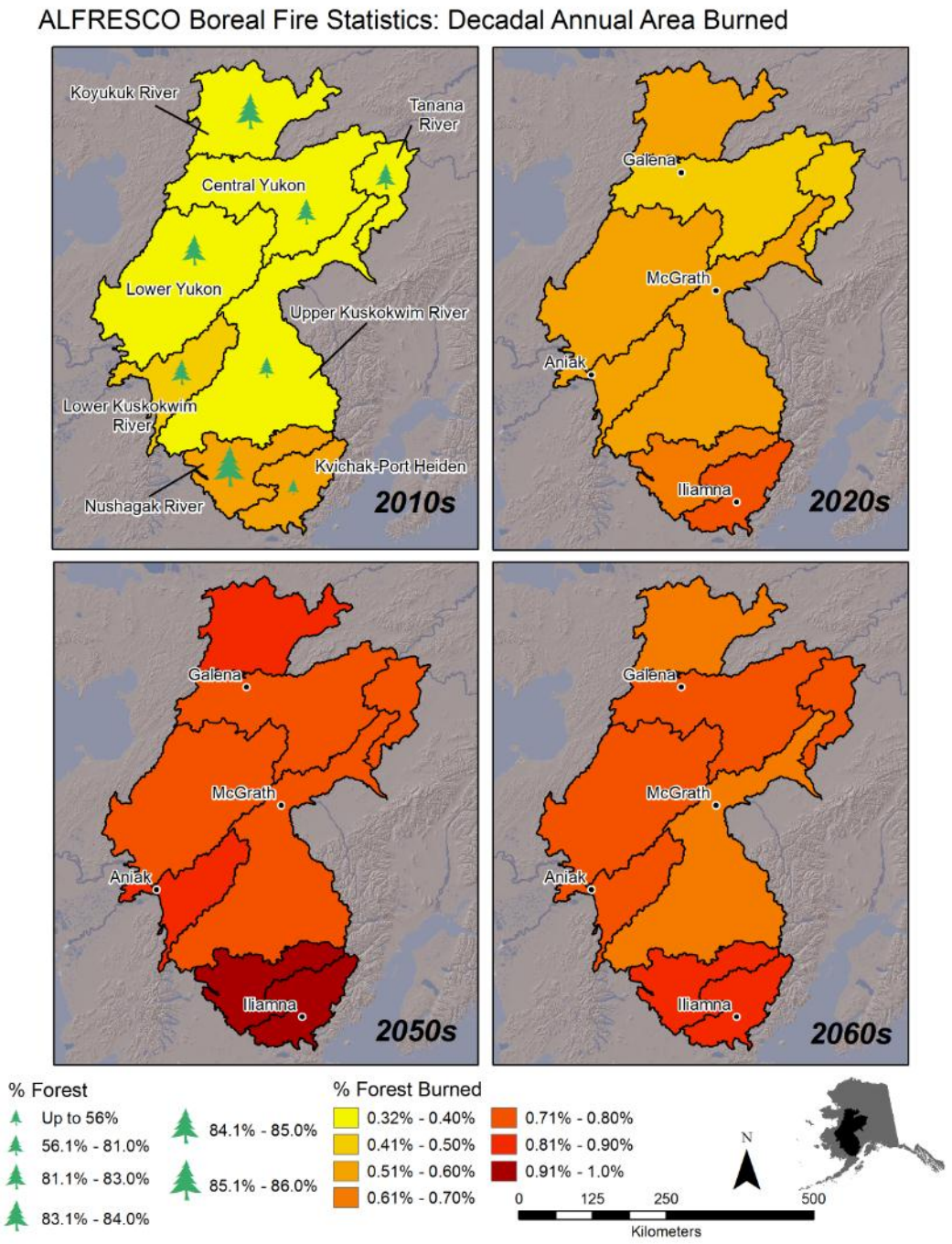
Fire history

Fire scars from 1940 to the present, by decade.



Fire projections

Maps show projected area of forest burned by region. Non-forest areas are omitted. Percent forested ranges from about 50% to 90%. Increased burning is expected.



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Rapid Ecoregional Assessment

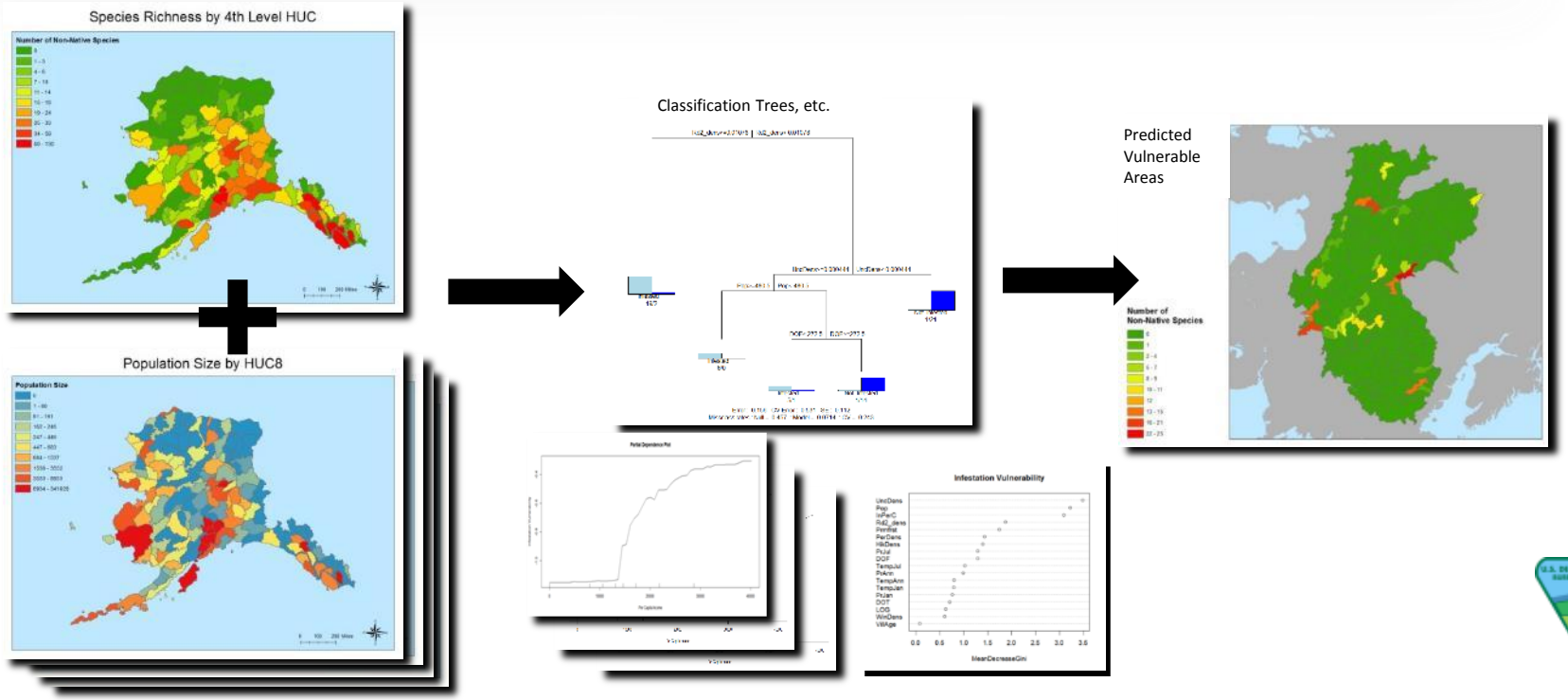
Discussion

- Comments of Products/ Utility
- Product Review Strategy

Additional Slides

Identification of areas susceptible to invasion

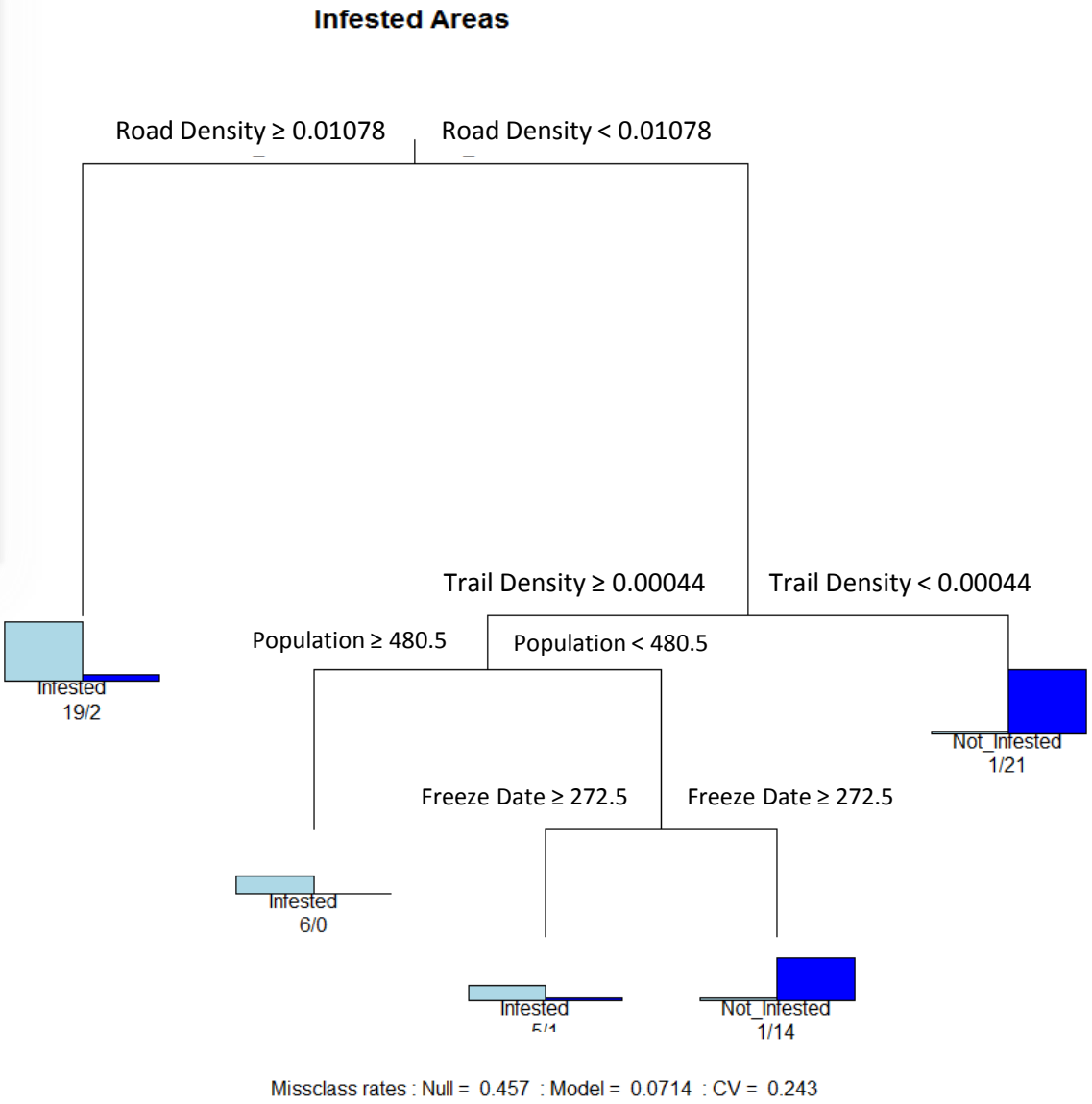
1. Relationship of non-native plant occurrences with environmental and human variables
   - Non-native plant and environmental/human variables summarized by 4th Level HUC for Interior & Western Alaska
   - HUCs with >5,000 people excluded
   - CART & Random Forest models developed
   - Important variables and thresholds identified
   - Predicted “Infestation values” mapped back onto YKL (Current and Future)



Which areas are most susceptible to non-native plant invasion currently and in the future?

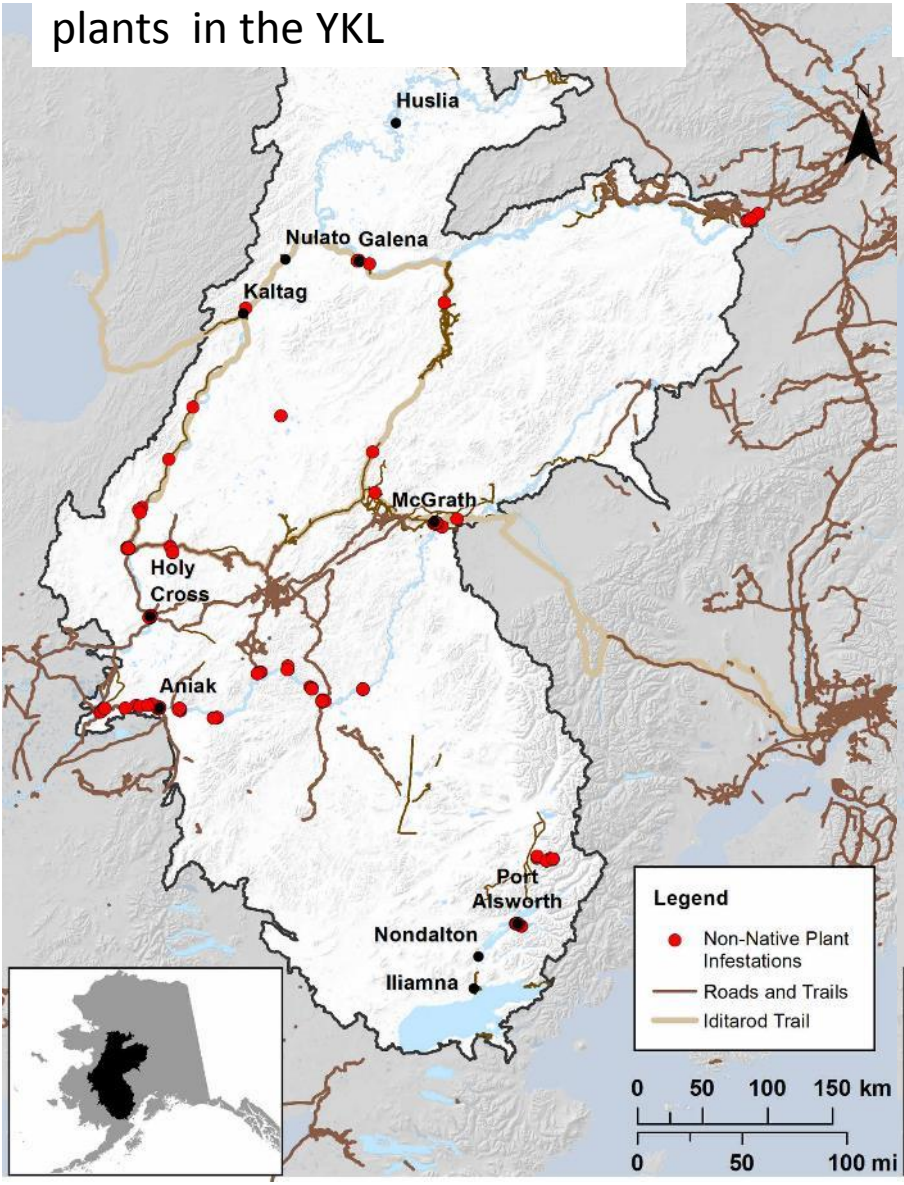
Results

1. Pruned regression tree
   - HUCs associated with more roads, or those with more trails and a sizable population center tend to have weed problems
   - Road Density is the most important explanatory variable

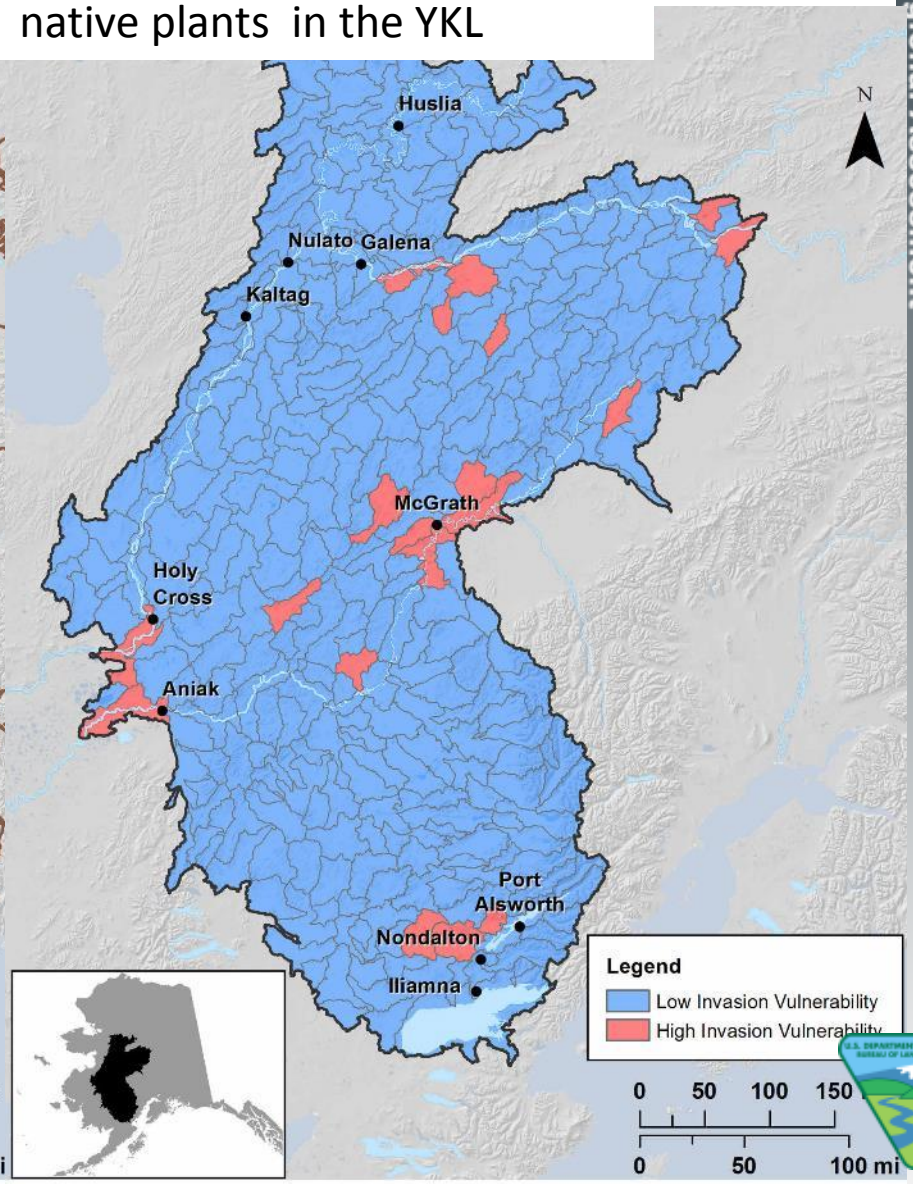


Which areas are most susceptible to non-native plant invasion currently and in the future?

Current patterns of non-native plants in the YKL



Predicted patterns of non-native plants in the YKL



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Rapid Ecoregional Assessment

Which areas are most susceptible to non-native plant invasion currently and in the future?

Rapid Ecore

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Predicted Future Vulnerabilities