Projected arctic and boreal habitat changes and implications for subsistence

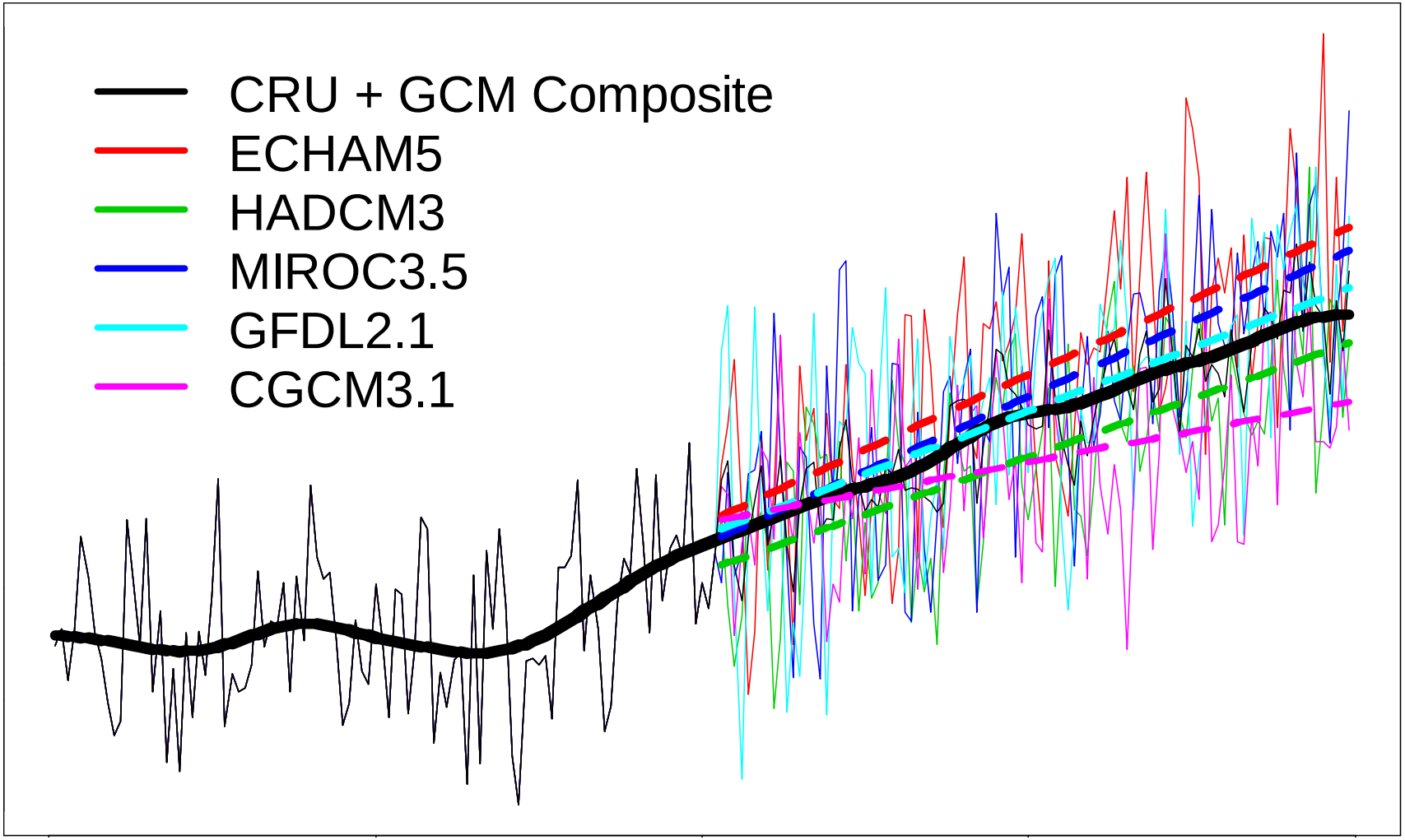
Terry Chapin, Scott Rupp, and Gary Kofinas

University of Alaska Fairbanks

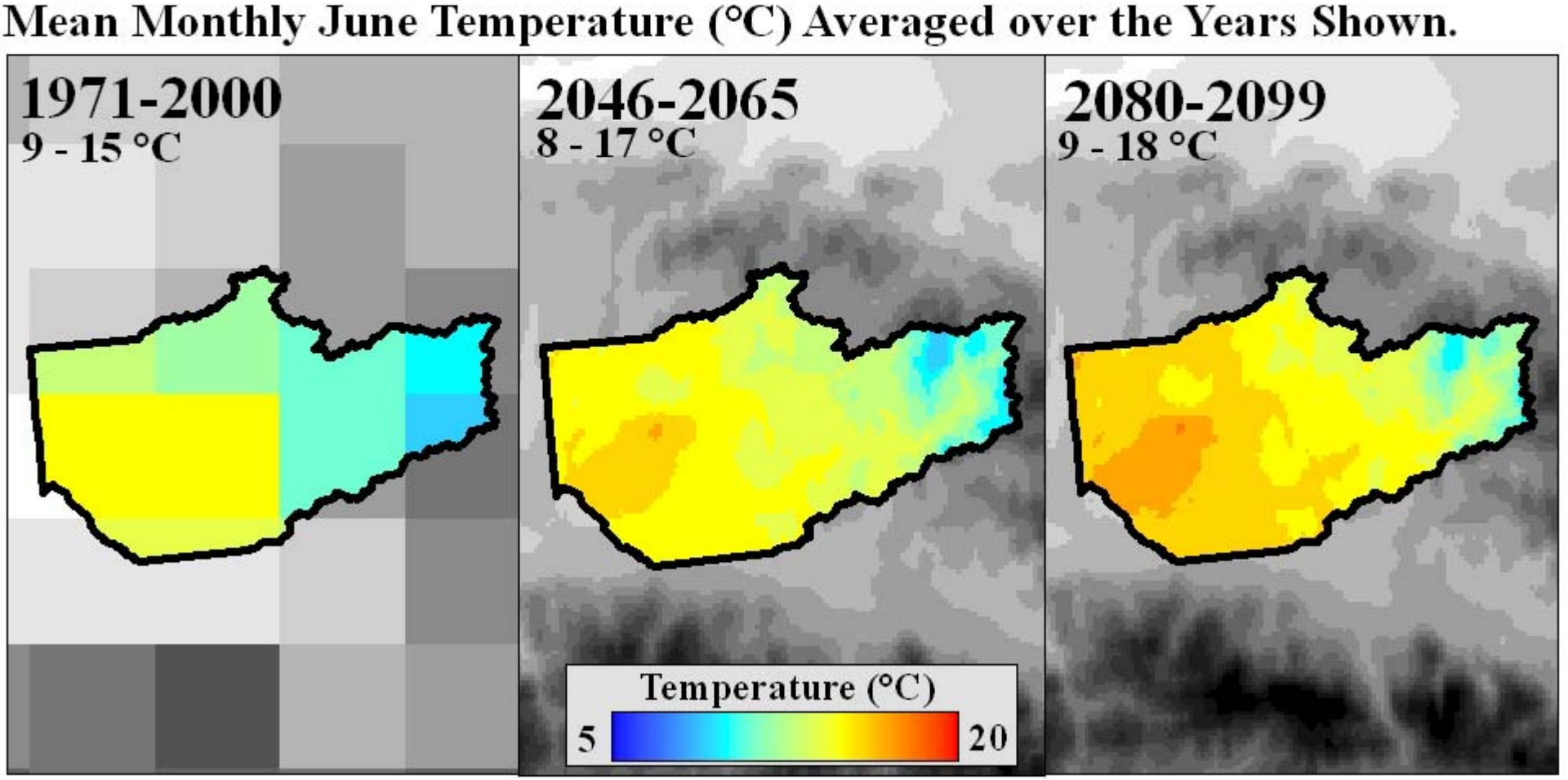
Outline

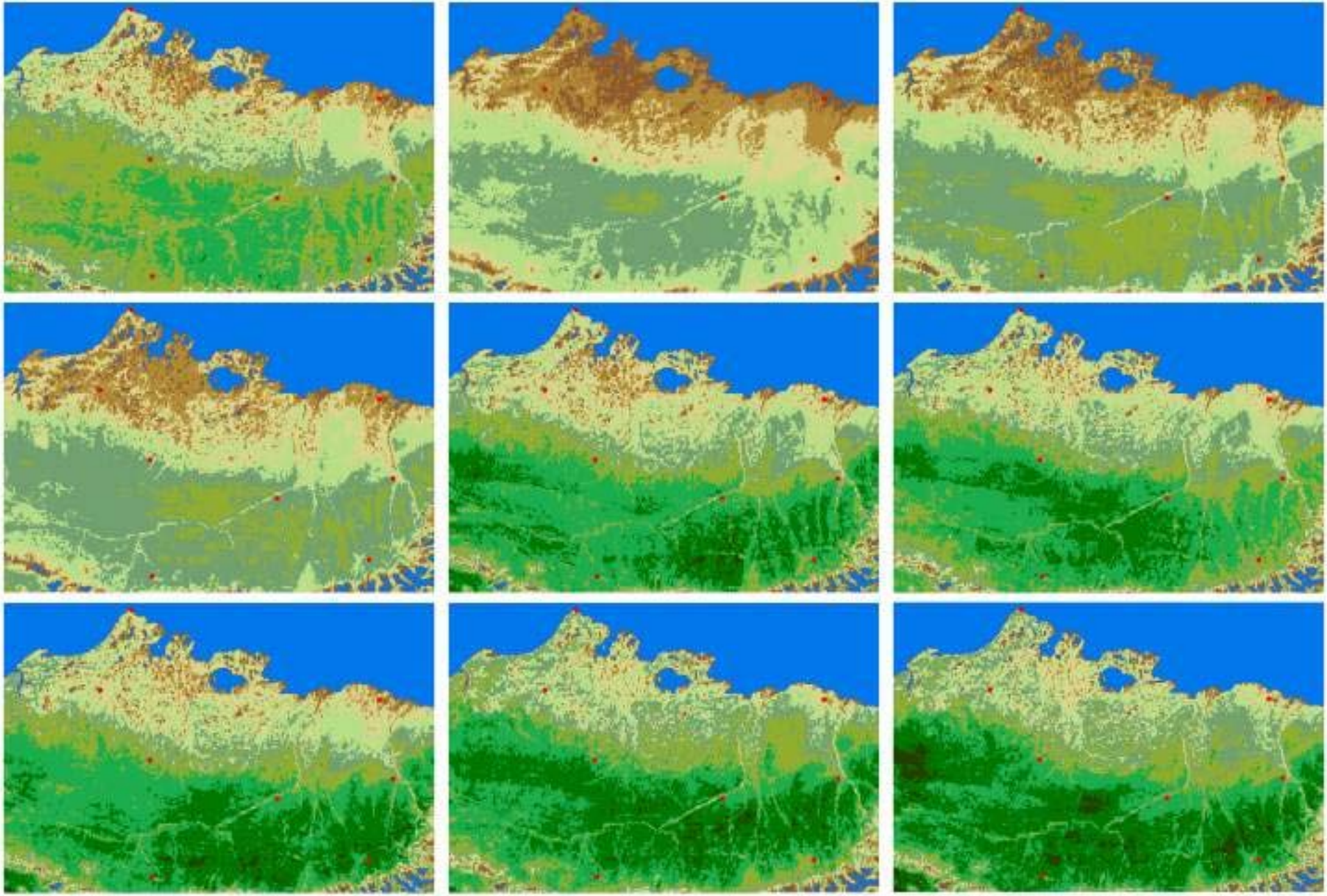
- Projected changes in habitat
  - Arctic
  - Boreal
- Implications for rural communities
  - IPY Ecosystem Services project

March-June Average Temperature (C°)
Alaska: 1901-2099



Fairbanks is expected to get warmer





Time Integrated NDVI
Epstein and Walker

91	92	93
94	95	96
97	98	99

Low ← → High

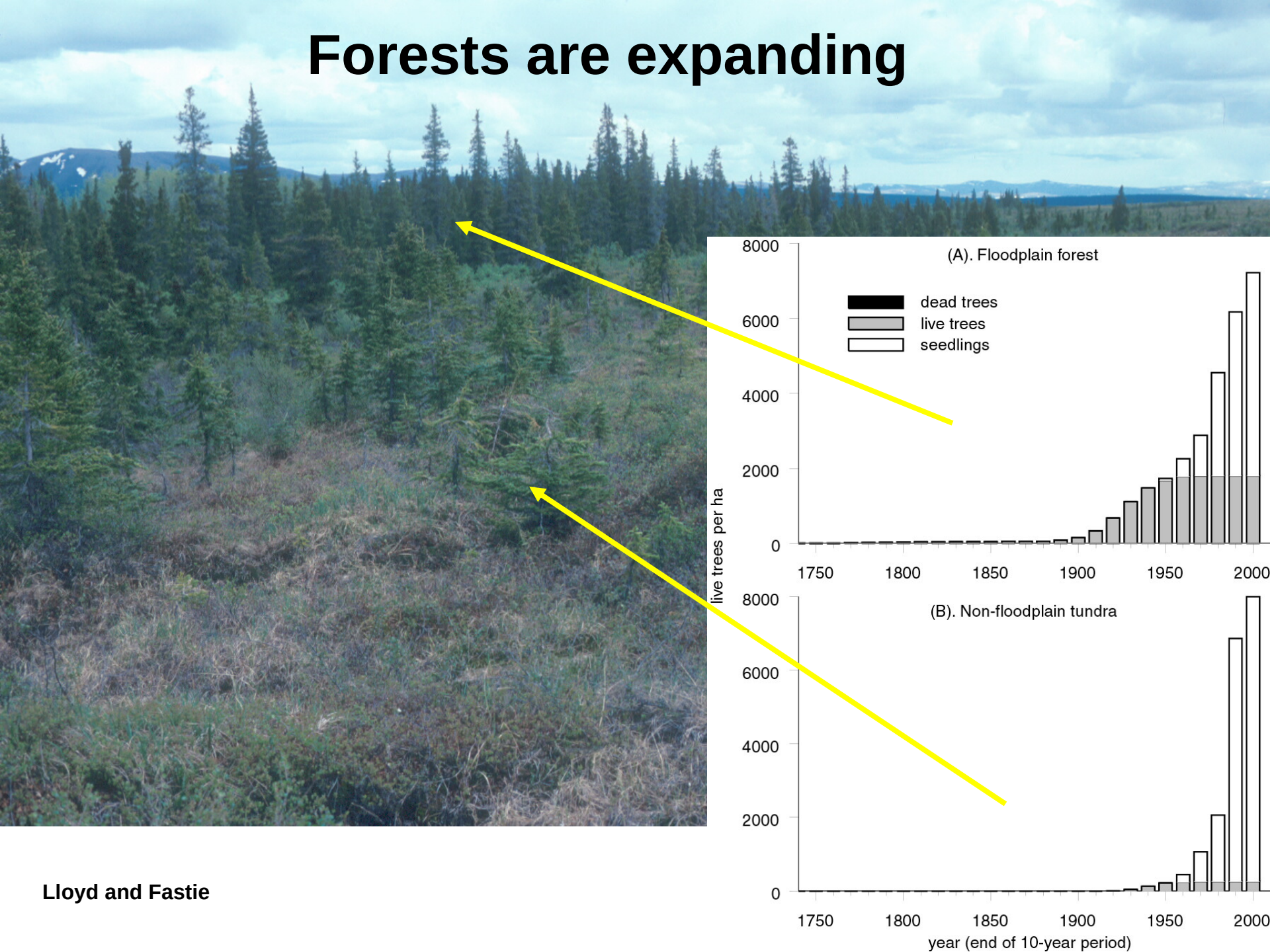
1949

Shrub density has increased

2000

Sturm

Forests are expanding



Lloyd and Fastie

Consequences of increased shrubs and trees

- Enhances local climate warming
- Greater retention of winter snow
- Reduces lichen abundance
  - Reduced quality of caribou winter range
- Increases forage for moose
  - Increased moose densities on North Slope?

Surprises are inevitable!

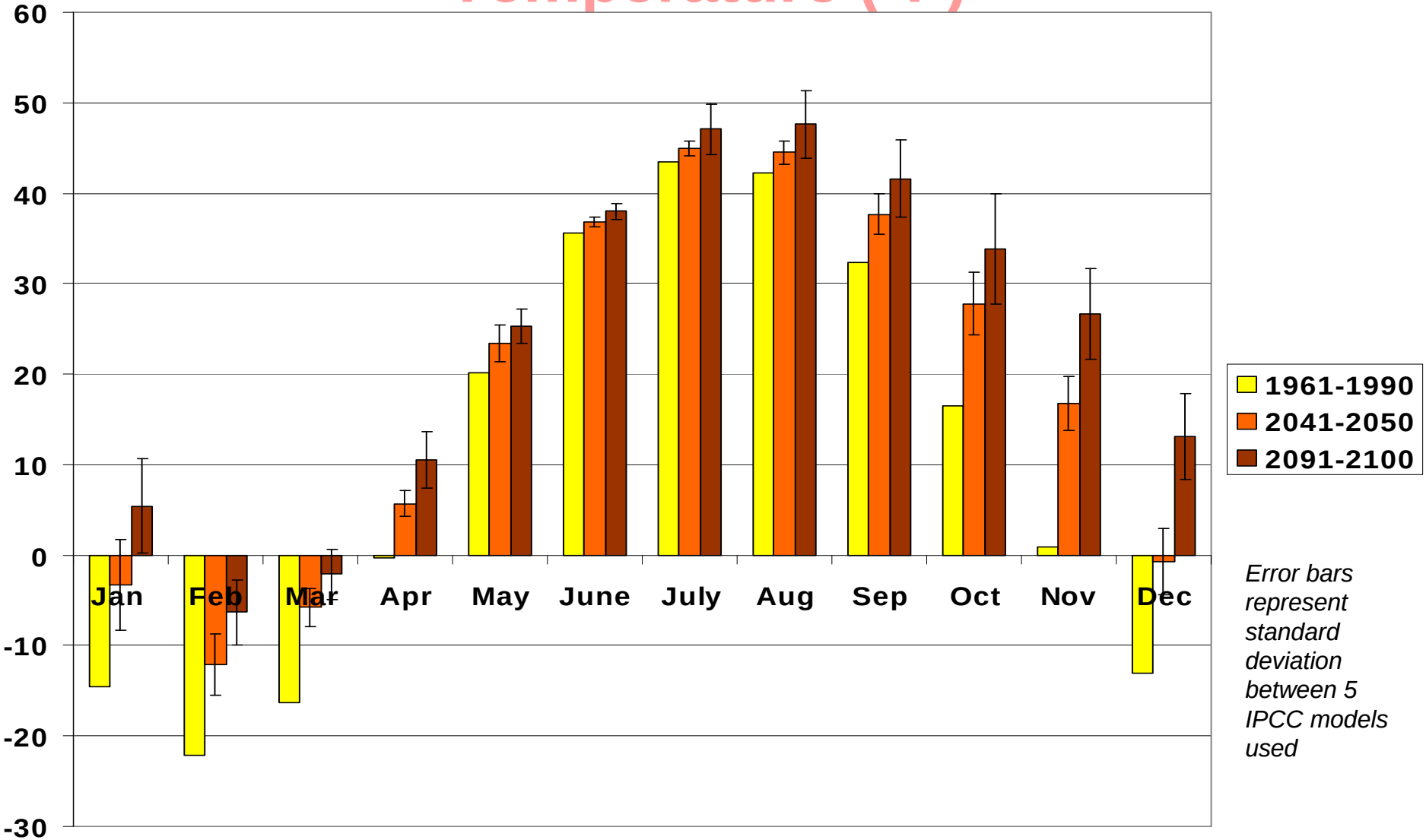
- We cannot predict many of the important changes that will occur
- Manage for flexibility rather than a single resource
- Use crises as opportunities for constructive changes

Potential management scenarios

- Foster favorable changes that may occur
  - Moose expansion in response to shrubs
    - Manage for high moose densities near their current range limit
  - Increased salmon in Arctic Ocean
    - Establish linked terrestrial and marine reserves near communities

Wainwright Projections

Temperature (°F)



Error bars represent standard deviation between 5 IPCC models used

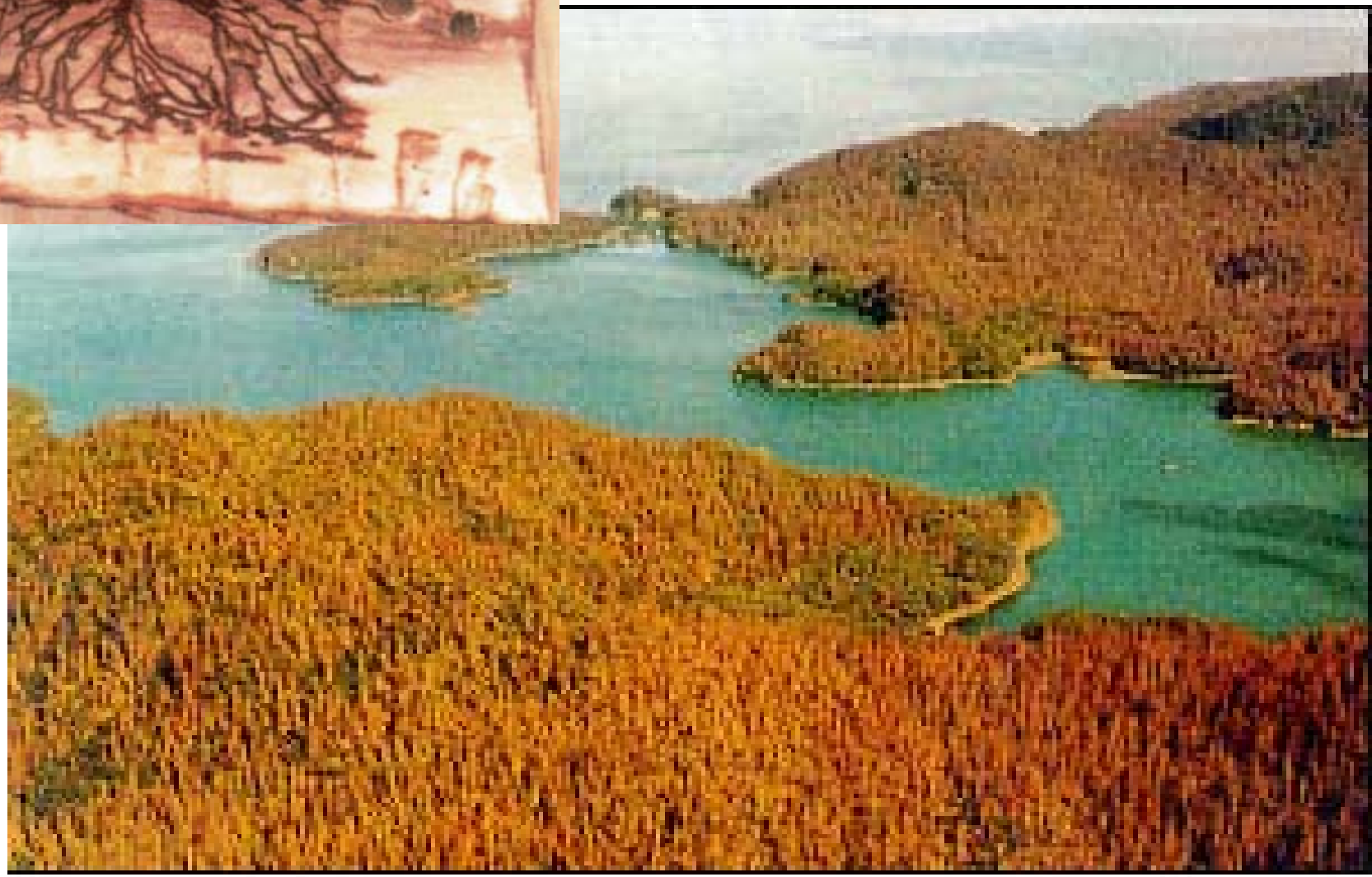
Ice-dependent sea mammals (and communities) at risk

New management challenges

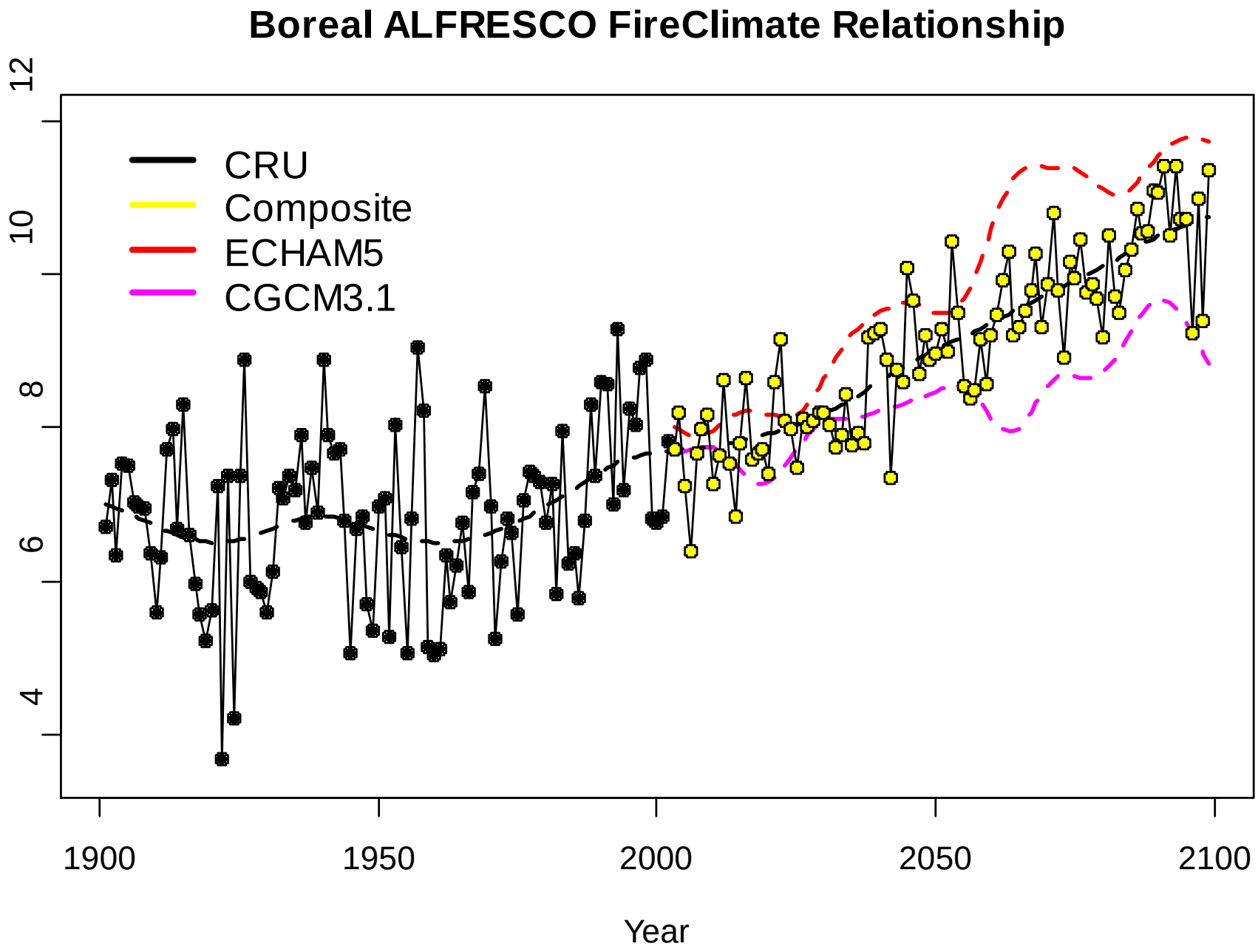
Where can the walrus go when the sea ice disappears?

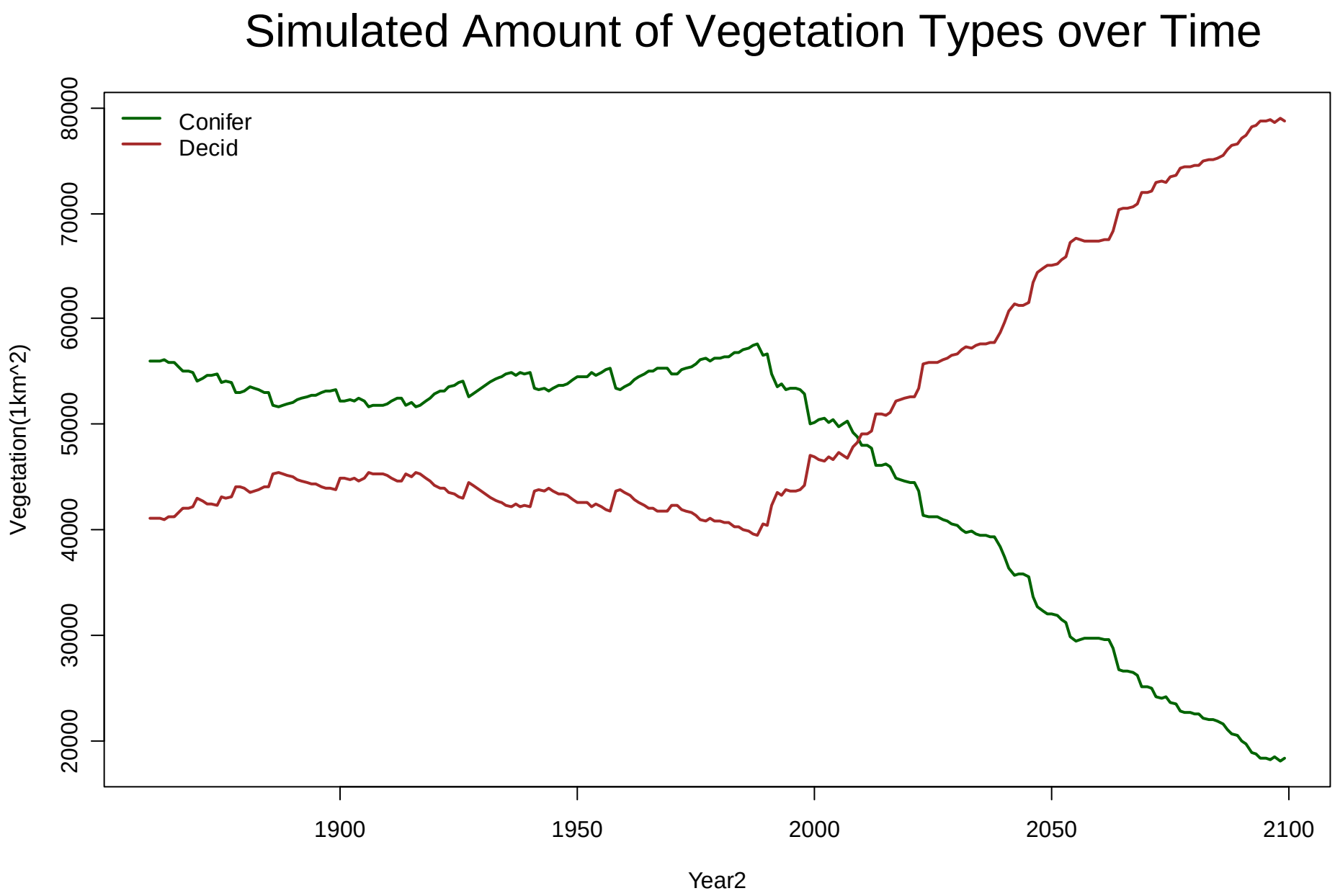
Photo: USFWS

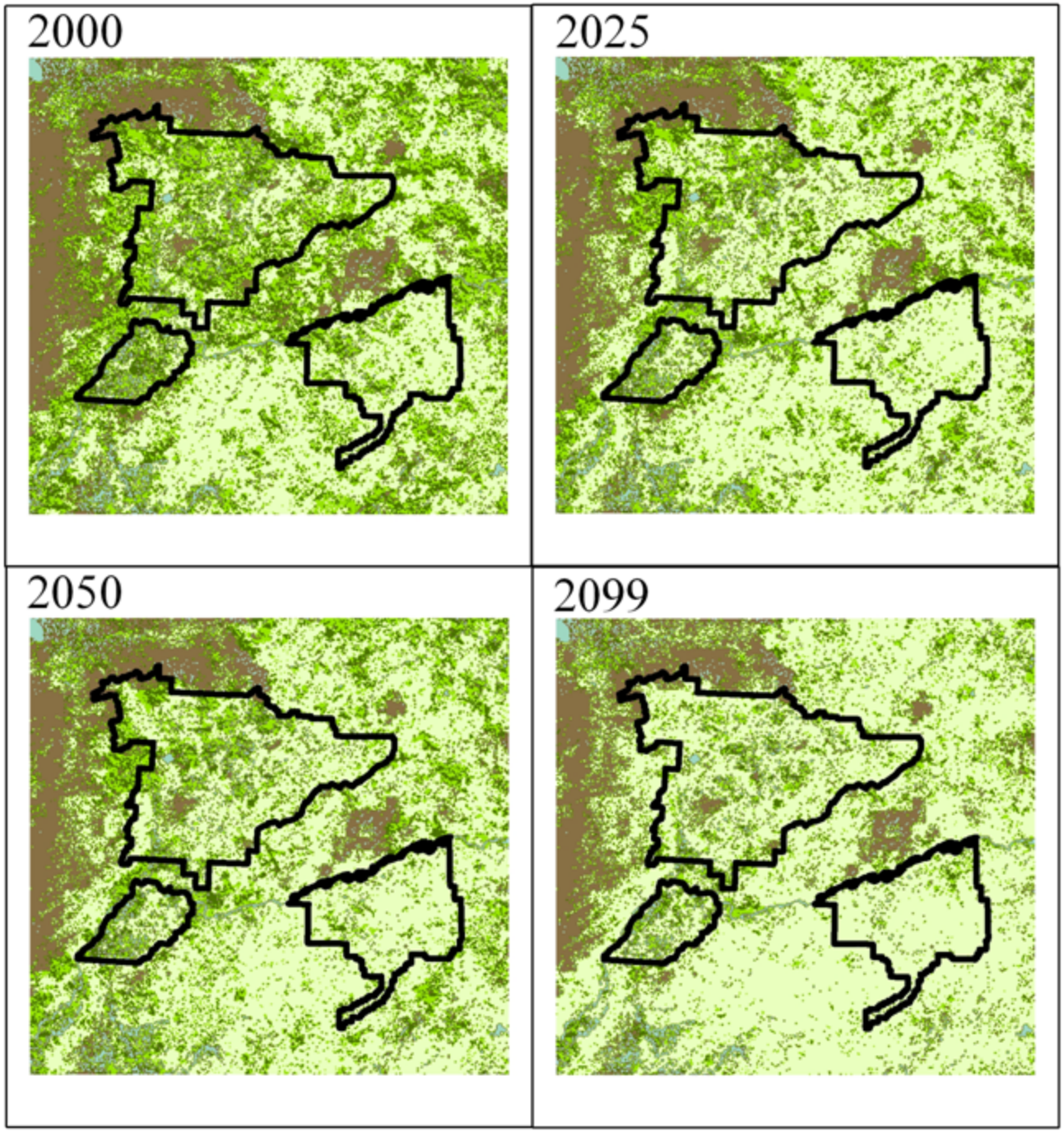
Kenai bark beetle outbreak



Area burned in W. North America has doubled in last 40 years


Boreal ALFRESCO FireClimate Relationship
CRU
Composite
ECHAM5
CGCM3.1
12
10
8
6
4
1900
1950
2000
2050
2100
Year


Simulated Amount of Vegetation Types over Time
Conifer
Decid
Vegetation(1km^2)
20000
30000
40000
50000
60000
70000
80000
1900
1950
2000
2050
2100
Year2

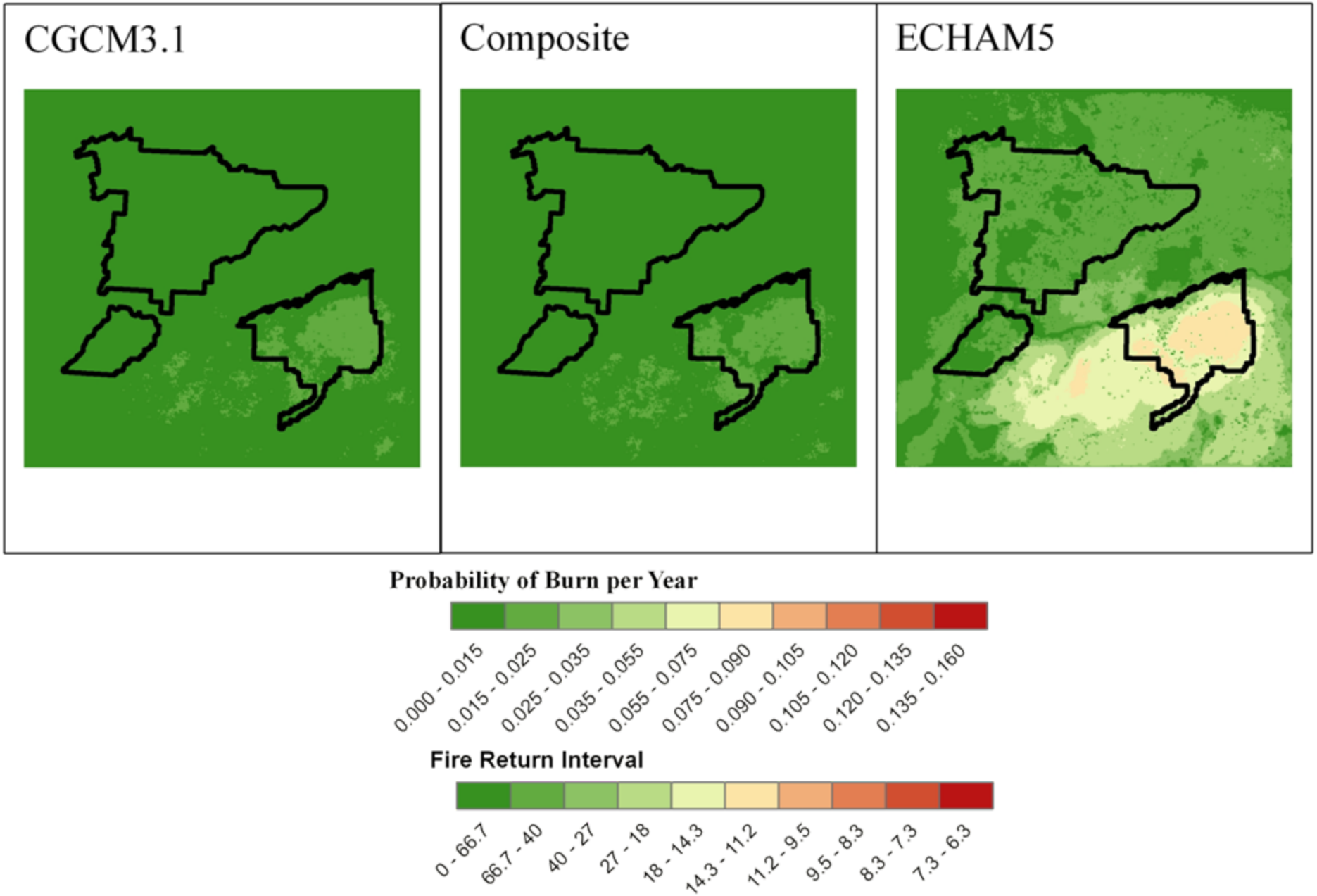


Single Rep Simulated Vegetation Type

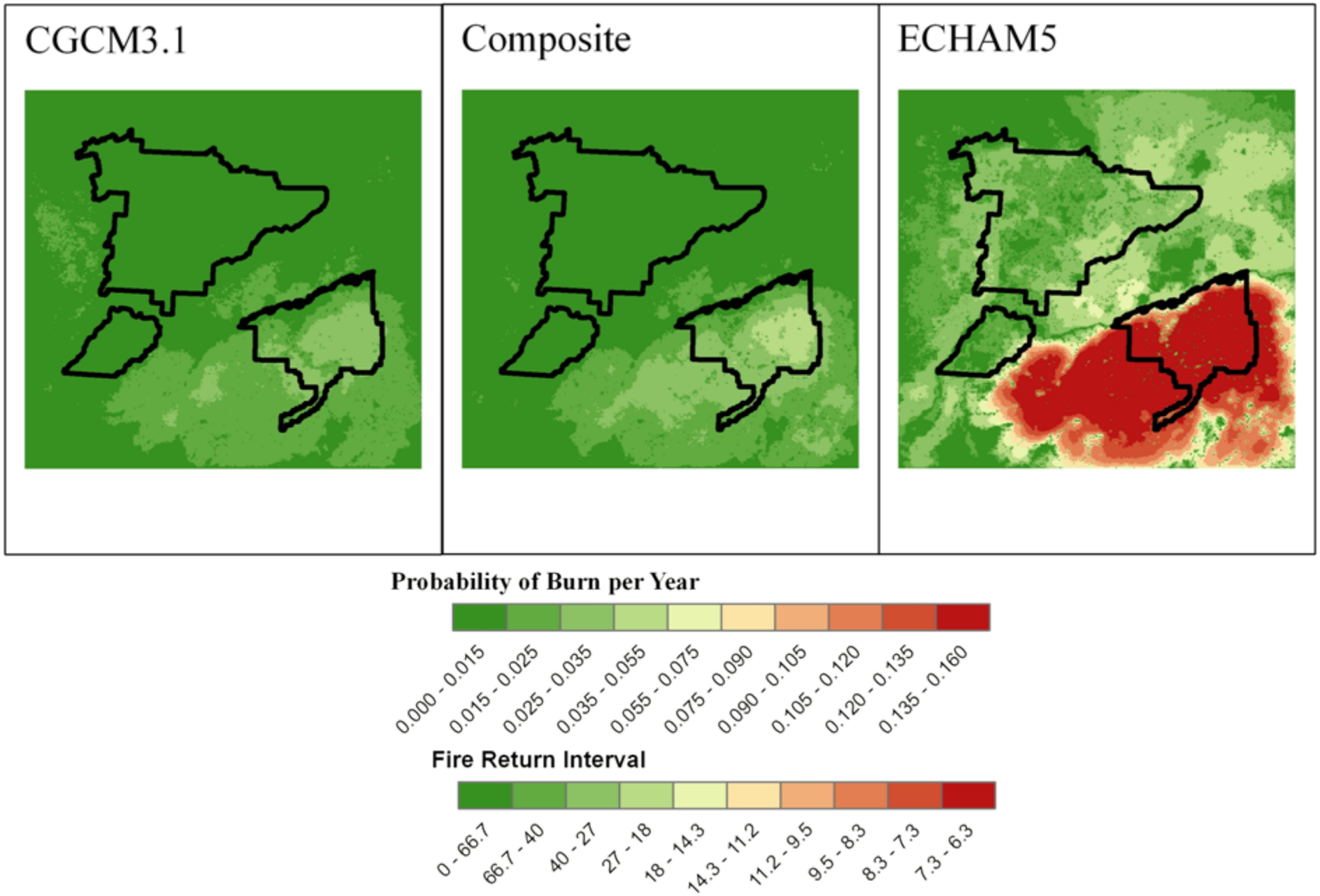
- No Vegetation
- Tundra
- Black Spruce
- White Spruce
- Deciduous

Composite

2000-2049


CGCM3.1
Composite
ECHAM5
Probability of Burn per Year
0.000 - 0.015
0.015 - 0.025
0.025 - 0.035
0.035 - 0.055
0.055 - 0.075
0.075 - 0.090
0.090 - 0.105
0.105 - 0.120
0.120 - 0.135
0.135 - 0.160
Fire Return Interval
0 - 66.7
66.7 - 40
40 - 27
27 - 18
18 - 14.3
14.3 - 11.2
11.2 - 9.5
9.5 - 8.3
8.3 - 7.3
7.3 - 6.3

2050-2099


CGCM3.1
Composite
ECHAM5
Probability of Burn per Year
0.000 - 0.015
0.015 - 0.025
0.025 - 0.035
0.035 - 0.055
0.055 - 0.075
0.075 - 0.090
0.090 - 0.105
0.105 - 0.120
0.120 - 0.135
0.135 - 0.160
Fire Return Interval
0 - 66.7
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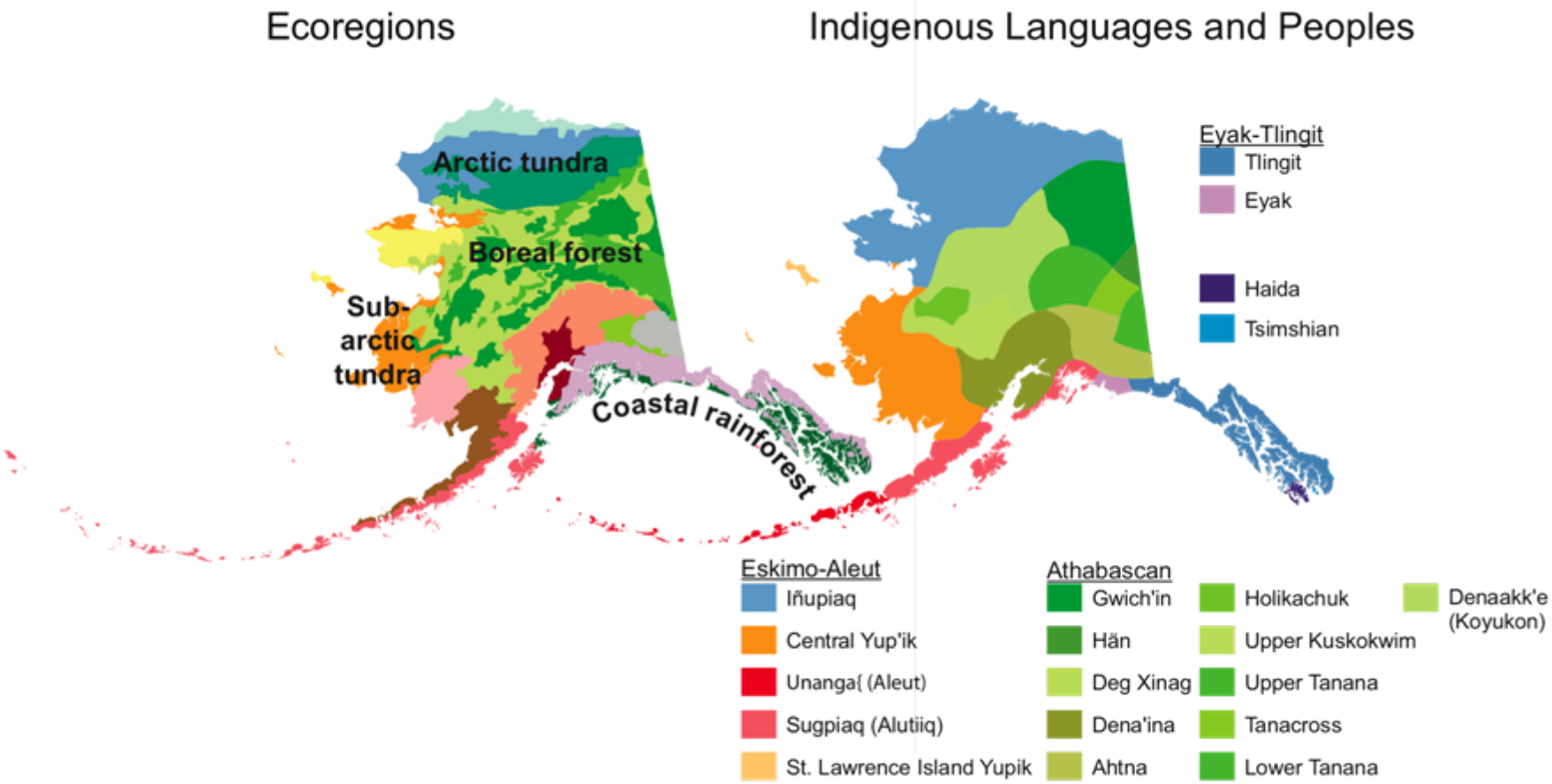
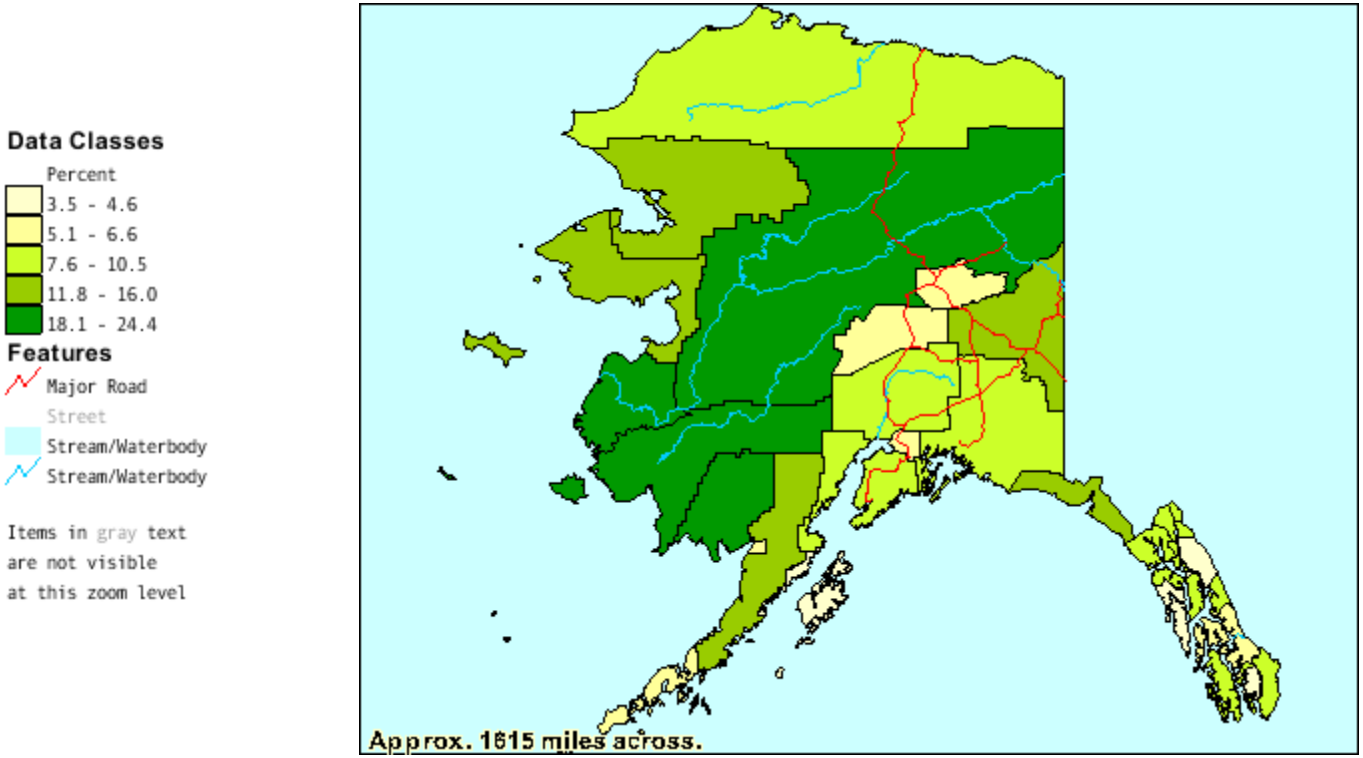
7.3 - 6.3

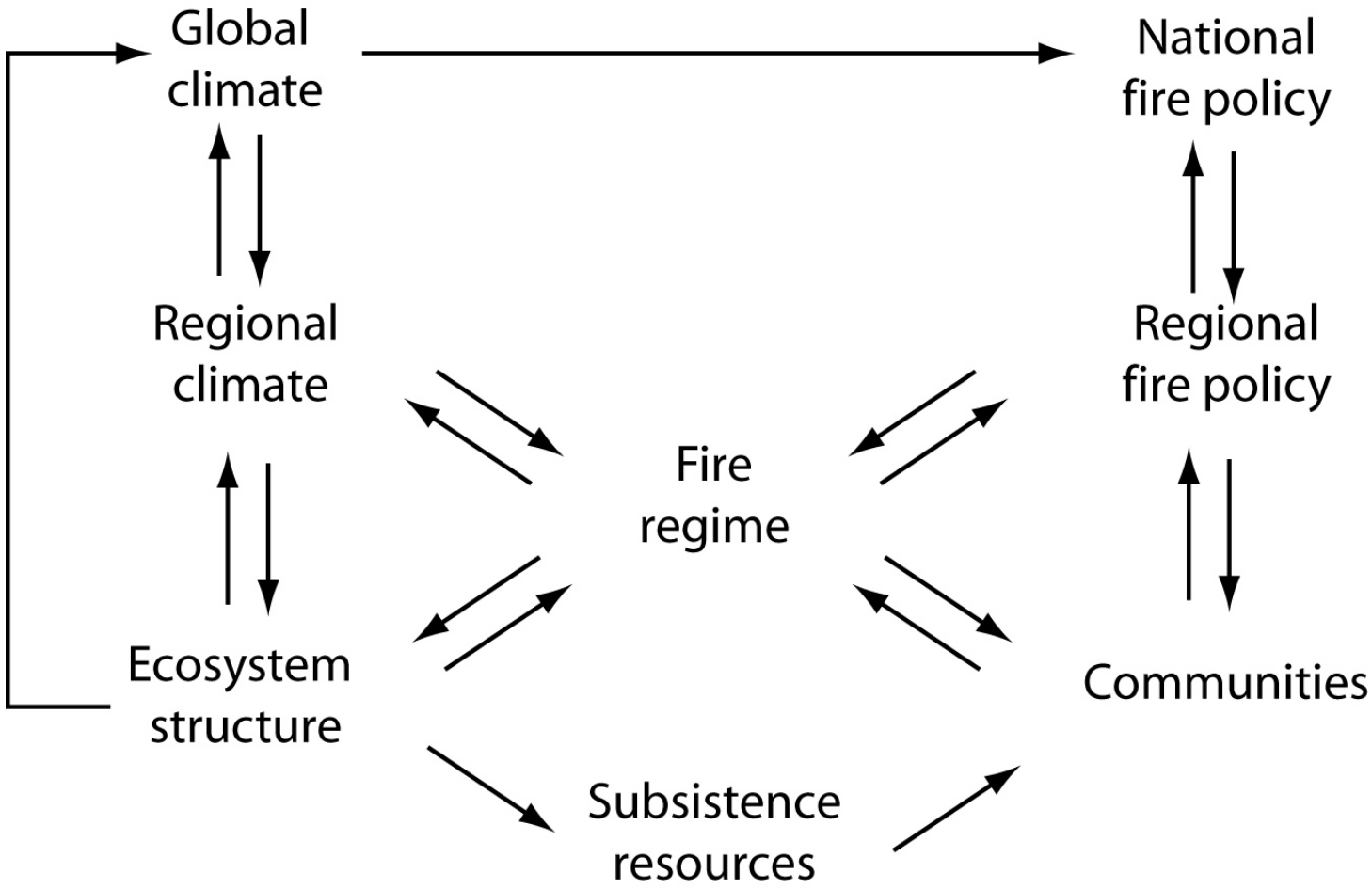


Map by C. West, M. Wilson and J. Kerr - ISER

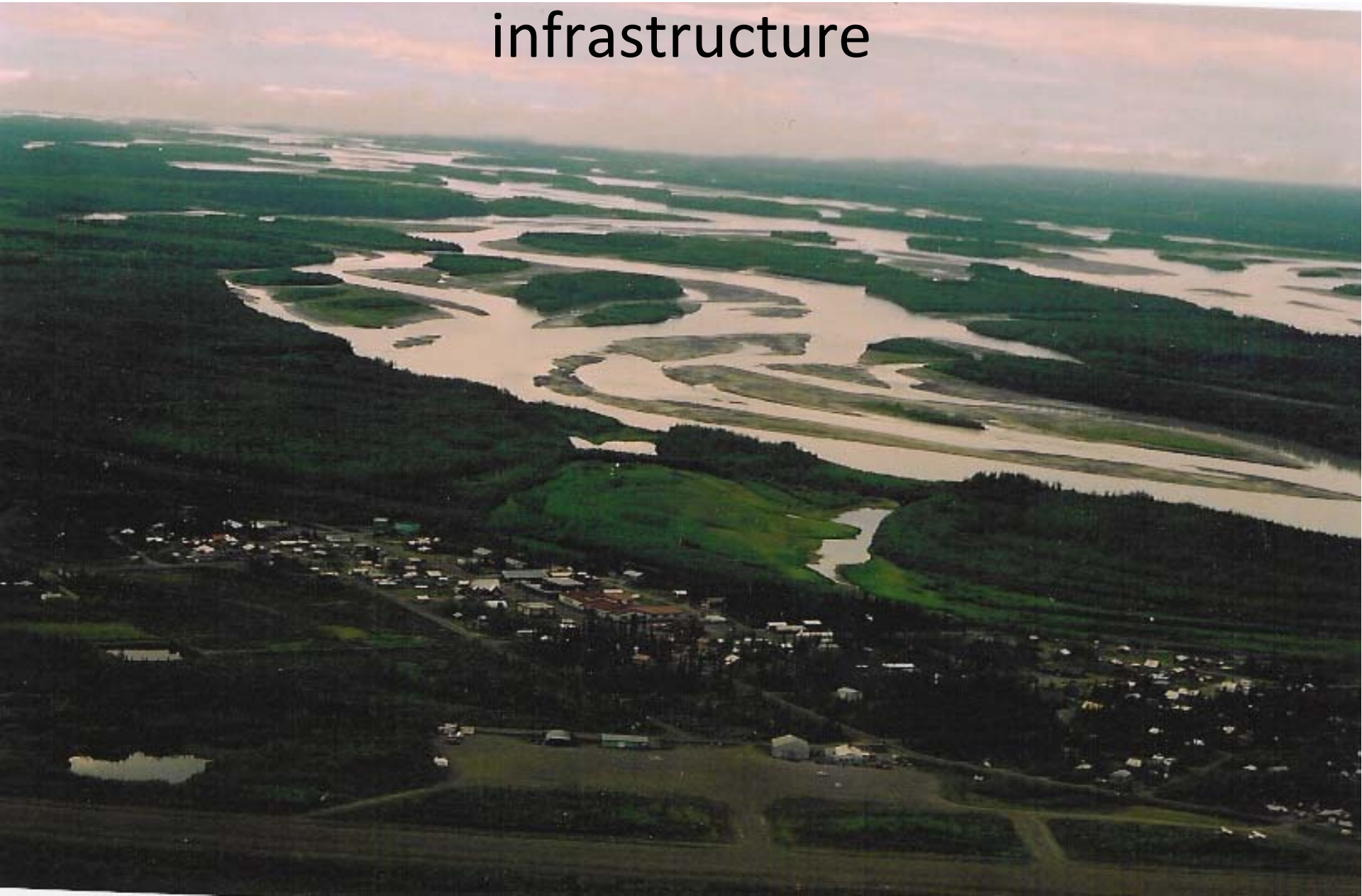
Percent of Families Below the Poverty Level in 1999: 2000



U.S. Census, **TM-P069.**

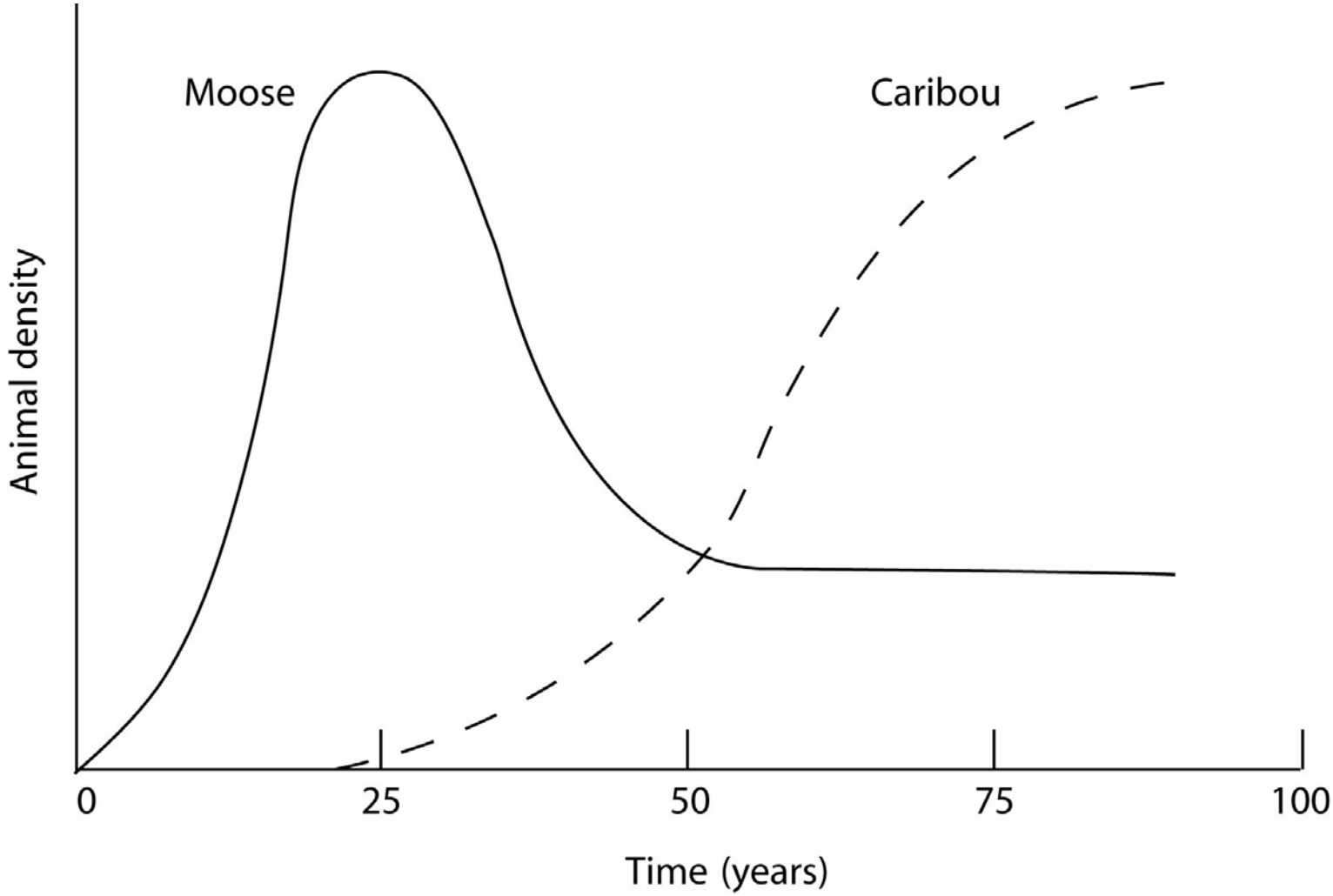

Global climate
National fire policy
Regional climate
Regional fire policy
Fire regime
Ecosystem structure
Communities
Subsistence resources

Rural community locations fixed by infrastructure

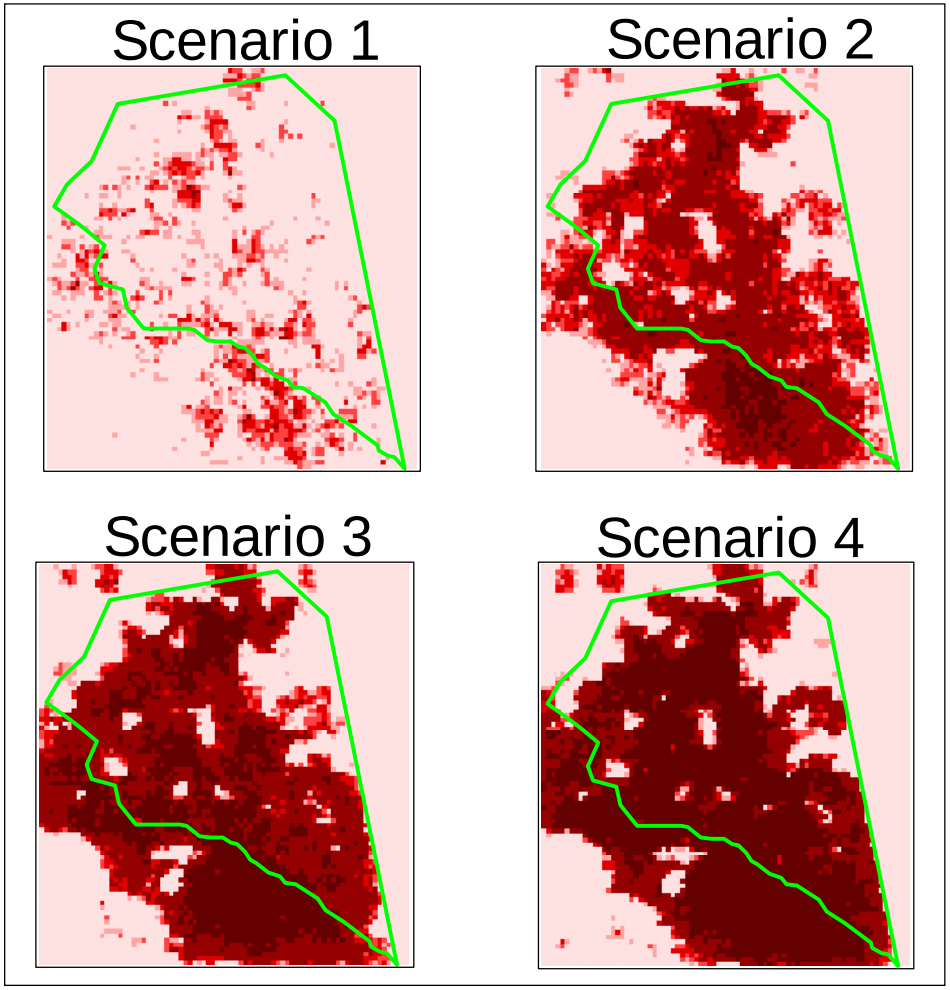


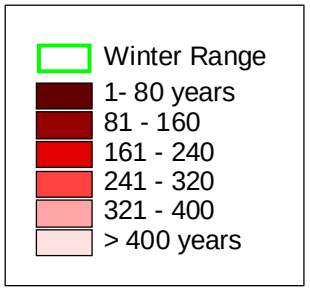
People’s fine-scale relationship with fire has changed over time

- Pre-contact: Mobile family groups
  - People adjusted to fire regime
- 1950s: Consolidation in permanent settlements
  - Fire affects communities

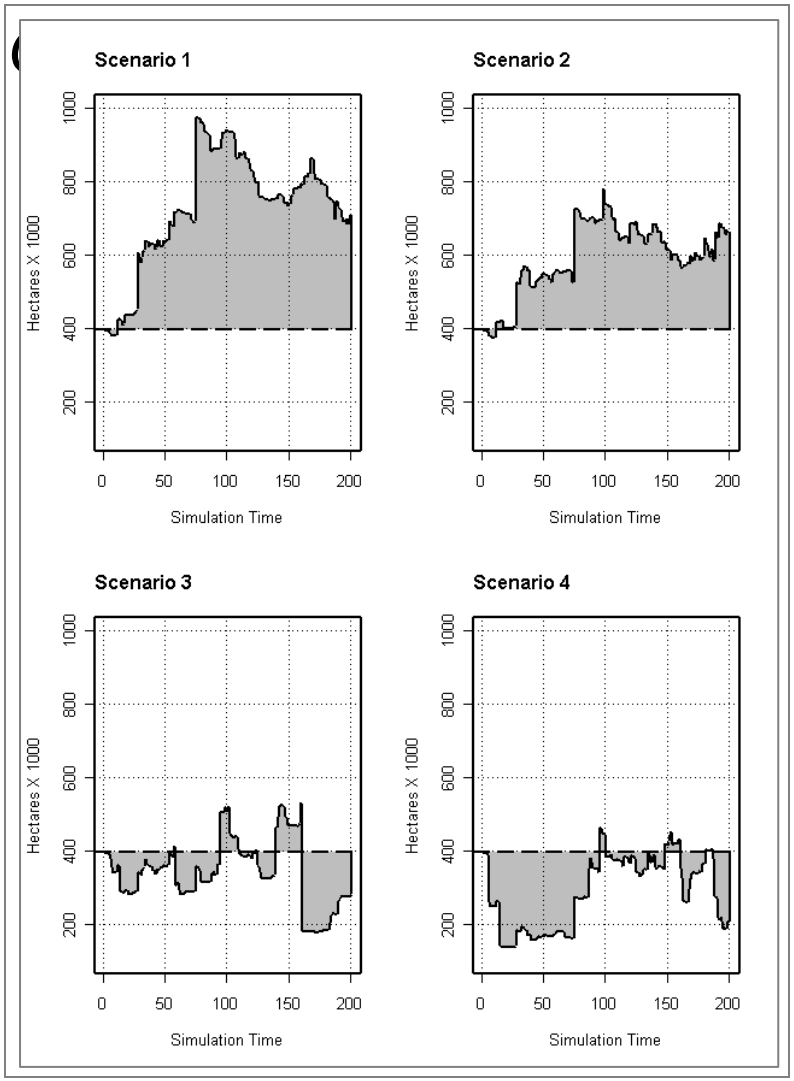

Moose
Caribou
Animal density
0
25
50
75
100
Time (years)

Simulated Fire Return Intervals





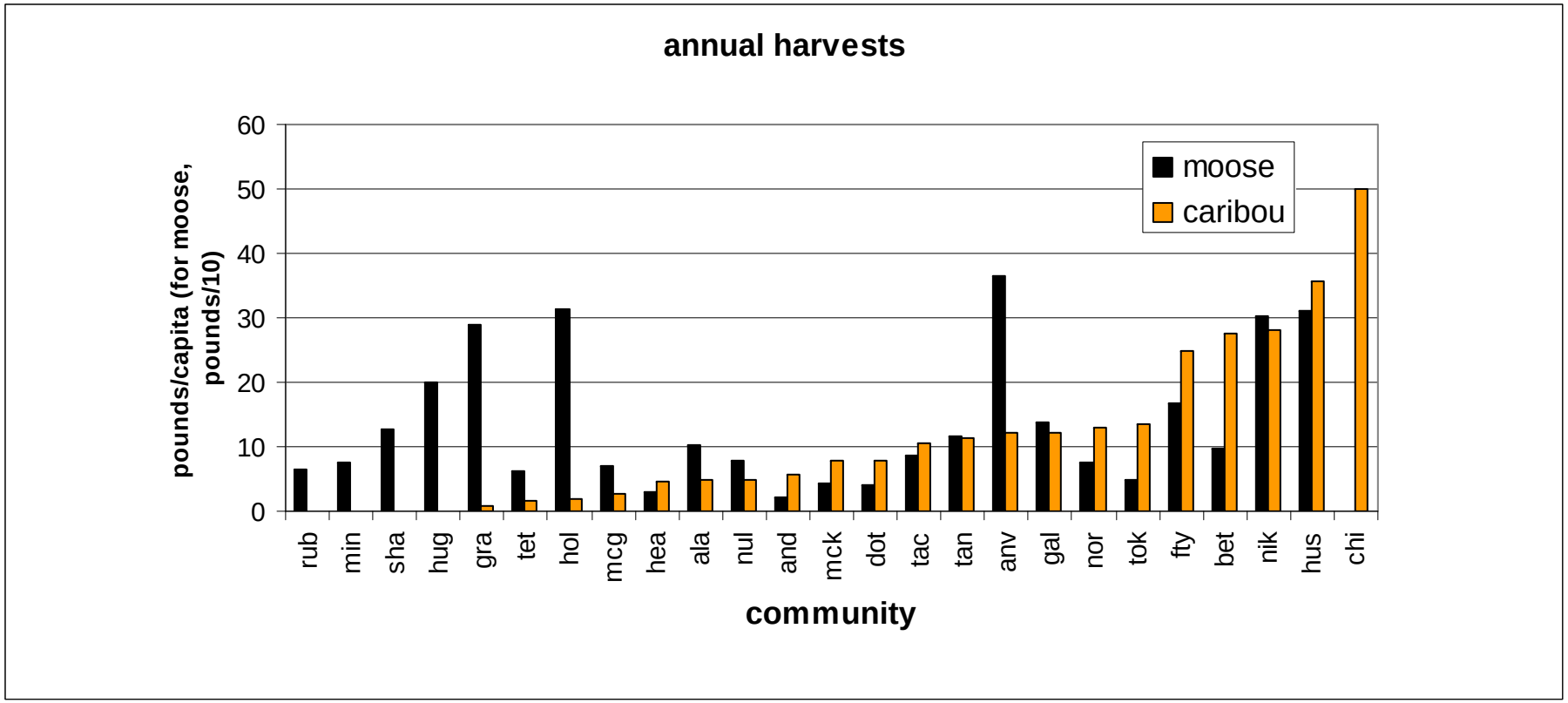
Estimated Available



Managing fire for the Nelchina Caribou Herd

[Rupp et al. 2006 – Ecological Applications]

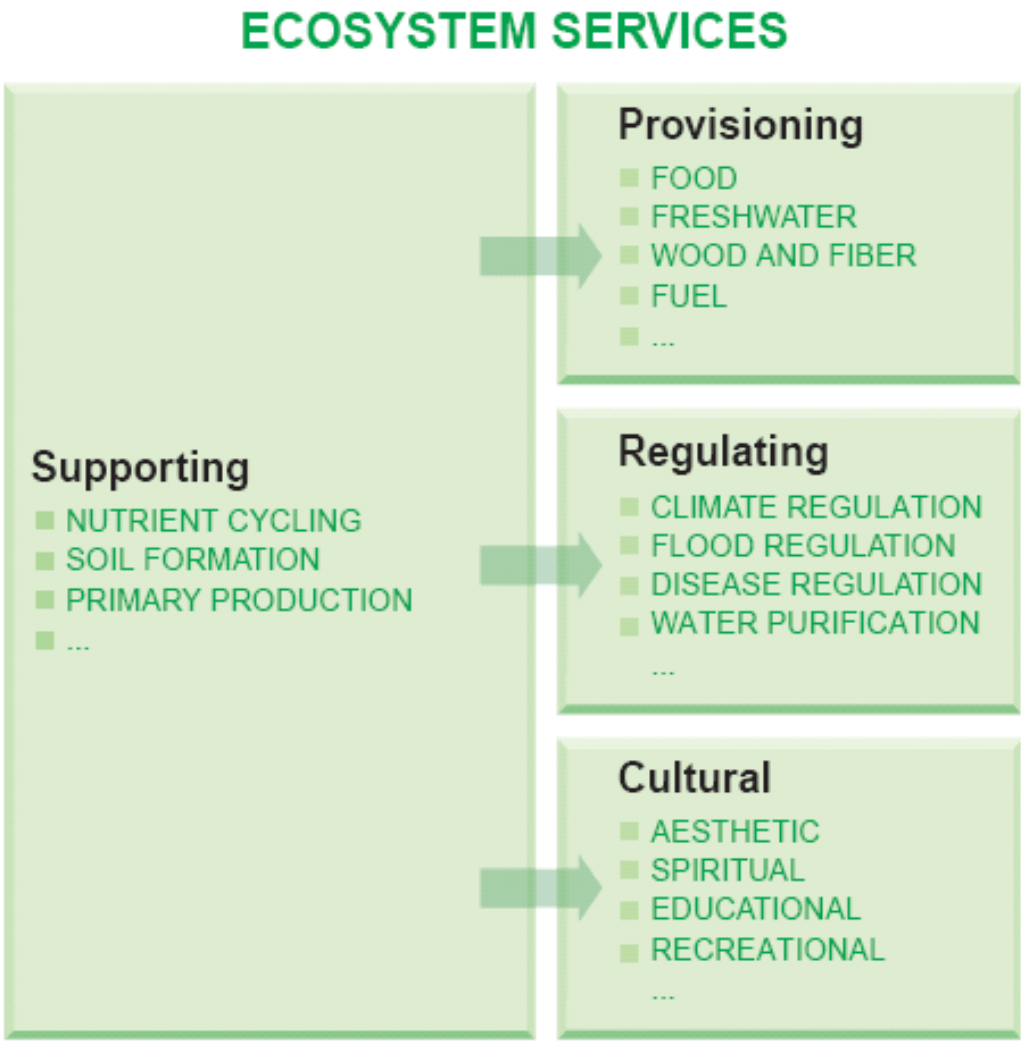
Communities differ in moose/caribou dependence



Nelson et al. In press

Ecosystem Services:

The benefits people obtain from ecosystems



Millennium Ecosystem Assessment 2005

IPY Ecosystem Services project

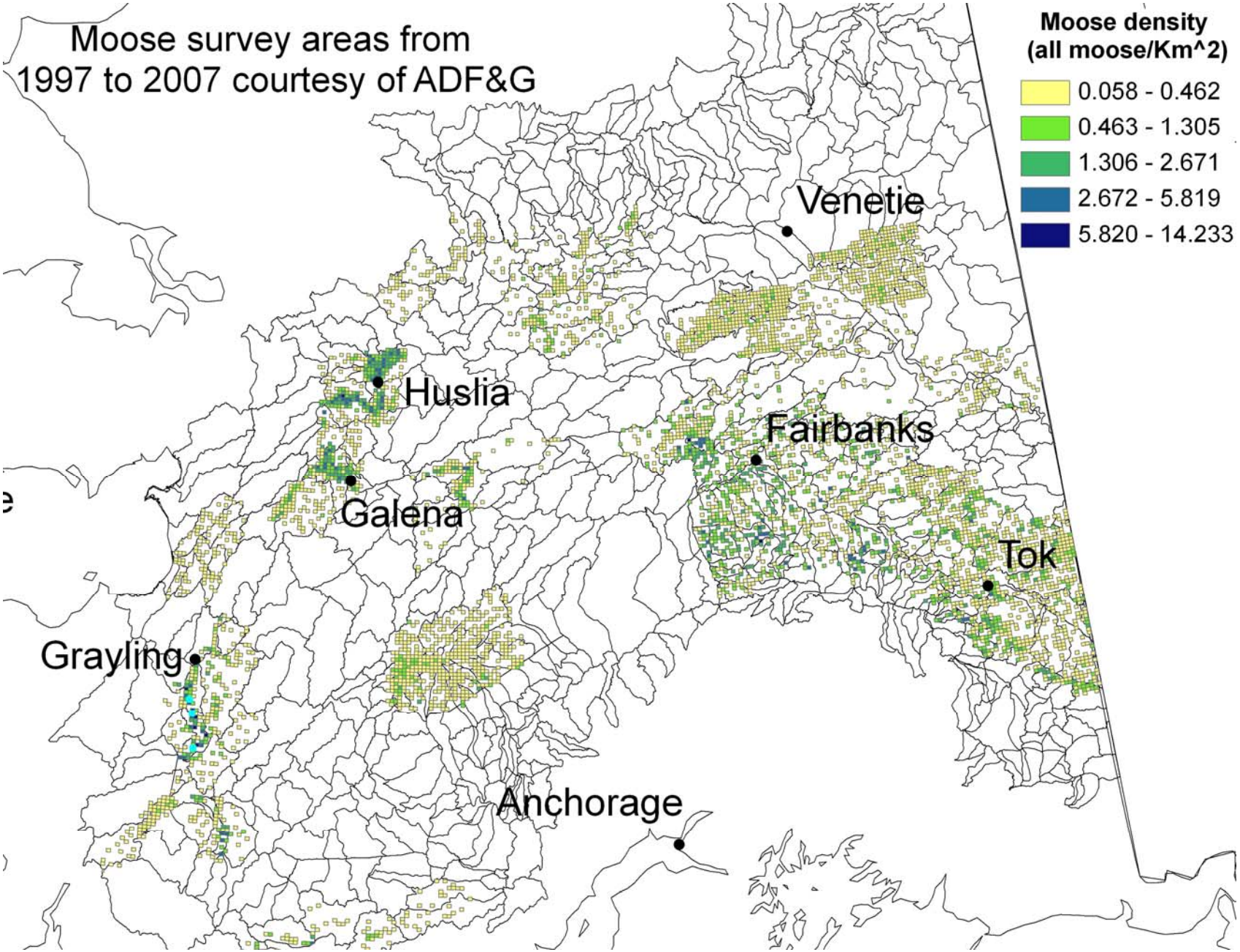
- Collaboration
  - Chapin, Rupp, Kofinas
  - Wildlife biologists (e.g., Griffith, Paragi)
  - Communities (e.g., Wainwright, Venetie)
- Approach
  - Communities define ecosystem services of concern (e.g., moose, berries, fire risk)
  - We project changes in habitat and accessibility
  - Communities develop climate-change adaptation plans

Services identified by villages

- Wainwright
  - Walrus, ring seal
  - Caribou, trout
- Venetie
  - Moose, caribou
  - Salmon
  - Firewood, berries

Projected wildlife changes (e.g., moose)

- Document historical relationship between climate, habitat, and moose
  - Basis for “rules” that predict moose distribution
- Projected changes in climate and wildfire
- Projected changes in habitat and moose distribution
- Rules that predict hunter harvest
  - Distinguish between local and non-local hunters
    - Changes in traditional use areas
  - e.g., distance from road/river, transport mode


Moose survey areas from
1997 to 2007 courtesy of ADF&G
Moose density
(all moose/Km^2)
0.058 - 0.462
0.463 - 1.305
1.306 - 2.671
2.672 - 5.819
5.820 - 14.233
Venetie
Huslia
Fairbanks
Galena
Tok
Grayling
Anchorage

Examples of moose-habitat rules

- Climate unfavorable to moose
  - Summer > 23F (-5C); Winter > 57F (14C)
  - Snow >70 cm
- Moose habitat choice
  - Move into burns if moose density high (average distribution pattern)
  - Select habitat if snow <70 cm (seasonal variation in distribution)
- Moose prefer relatively recent burns
  - 11 to 25 years
- Moose favor edge habitat and unburned patches within a burn
- Hunter behavior
  - Concentrate near roads and rivers
  - Influence of weather (e.g., warm fall, early snow) on harvest level
  - Influence of gas price/employment on harvest level