Climate effects on Coupled Human-Natural Systems in Northern Alaska

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BNZ & ARC LTERs

University of Alaska Fairbanks

Questions

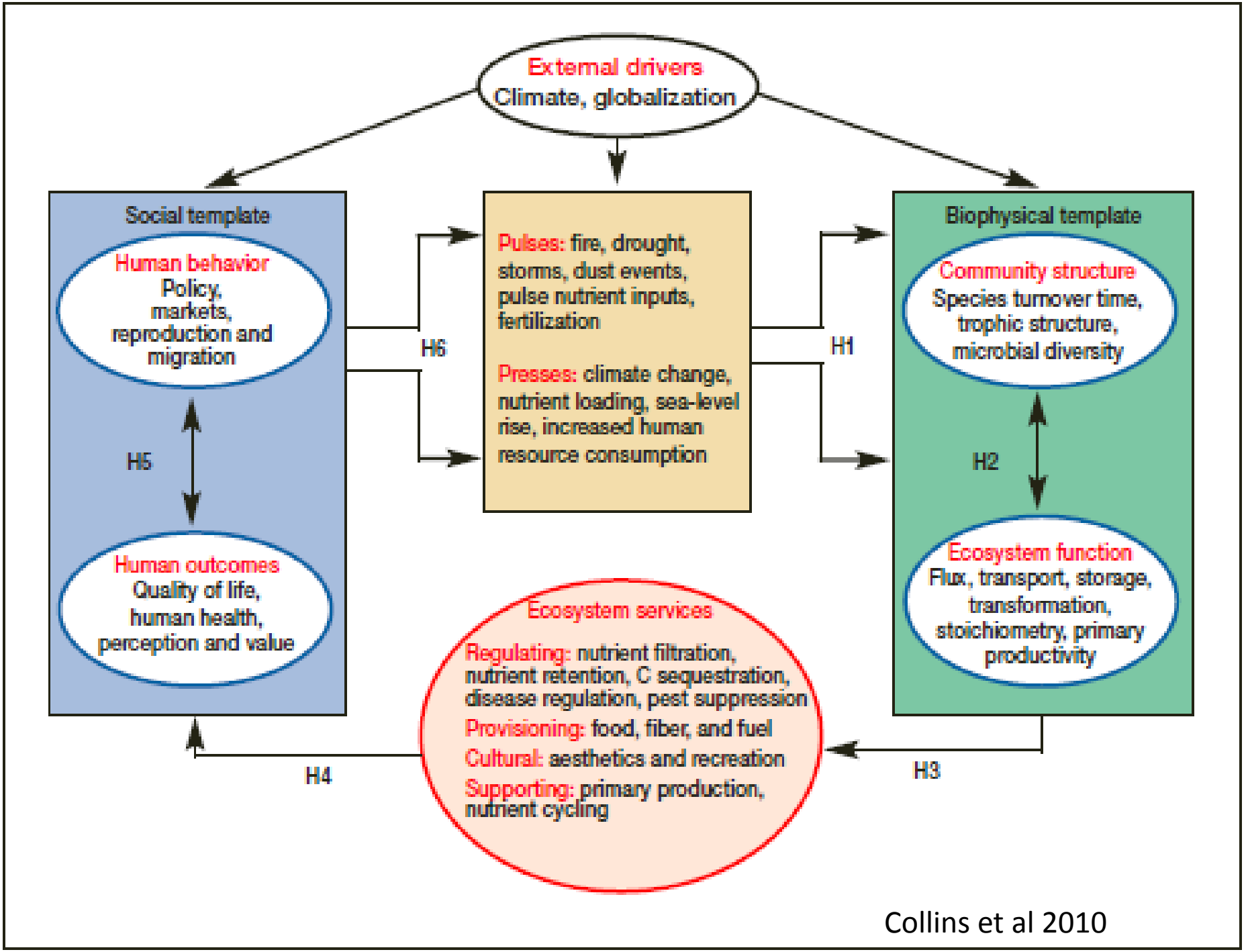
- What are the effects of CC on northern communities?
  - North Slope vs Interior Alaska comparisons
- What can we learn about response strategies from those differences?
- What are the methodological implications for Alaska and the LTER Network?

- **Bonanza Creek and Arctic LTER -SES Research Program**
  - MALS - Maps and Locals Project / NSF

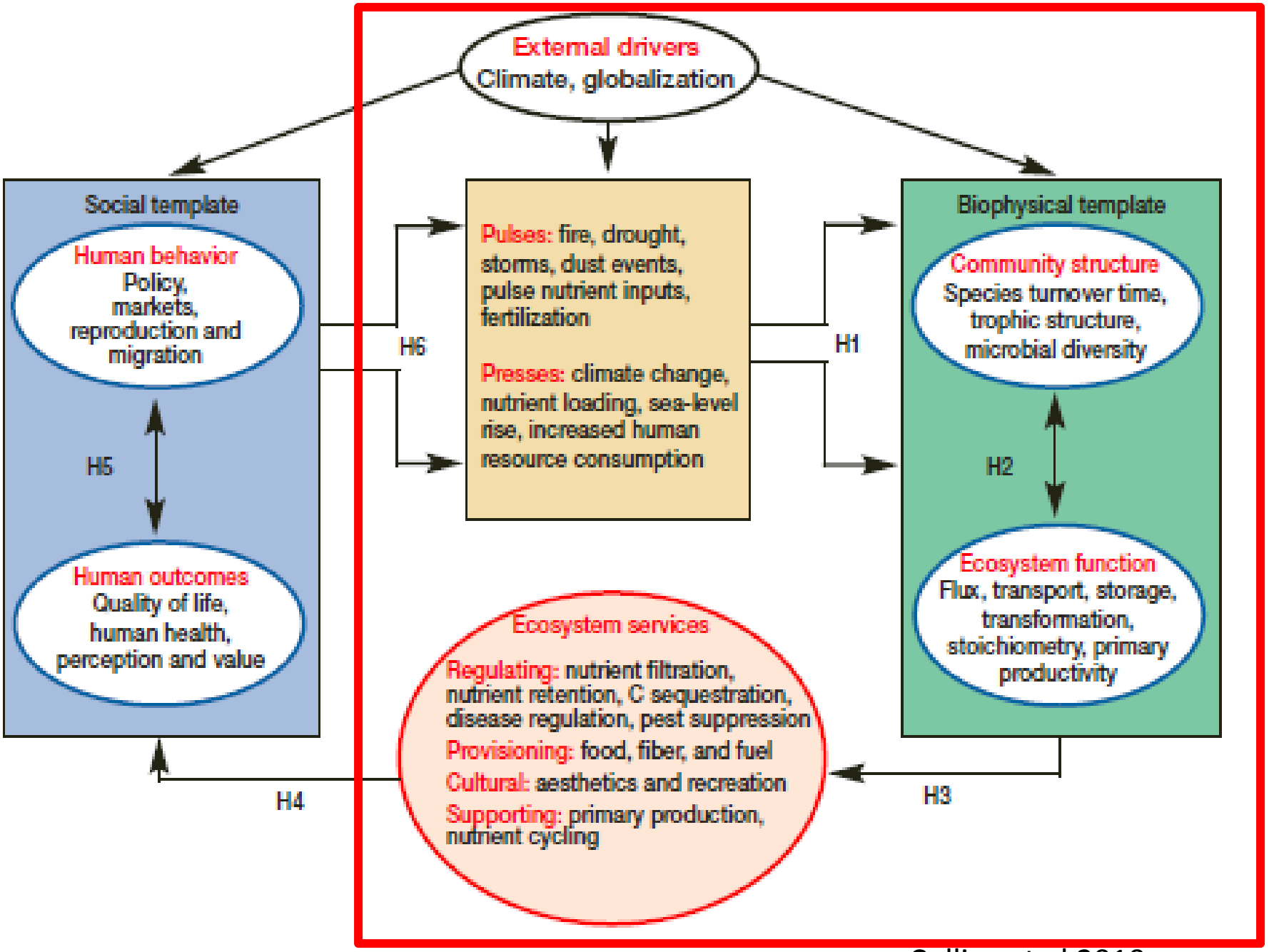
- **Study of Sharing Networks to Assessment Vulnerability of Coastal Communities to Oil and Gas Development** (Kofinas, BurnSilver, Fix) / BOEMRE (MMS)

- **Modeling harvesting behavior to understand adaptation, mitigation, and transformation in northern subsistence systems** (Kofinas, Valcic, De Roo) NSF

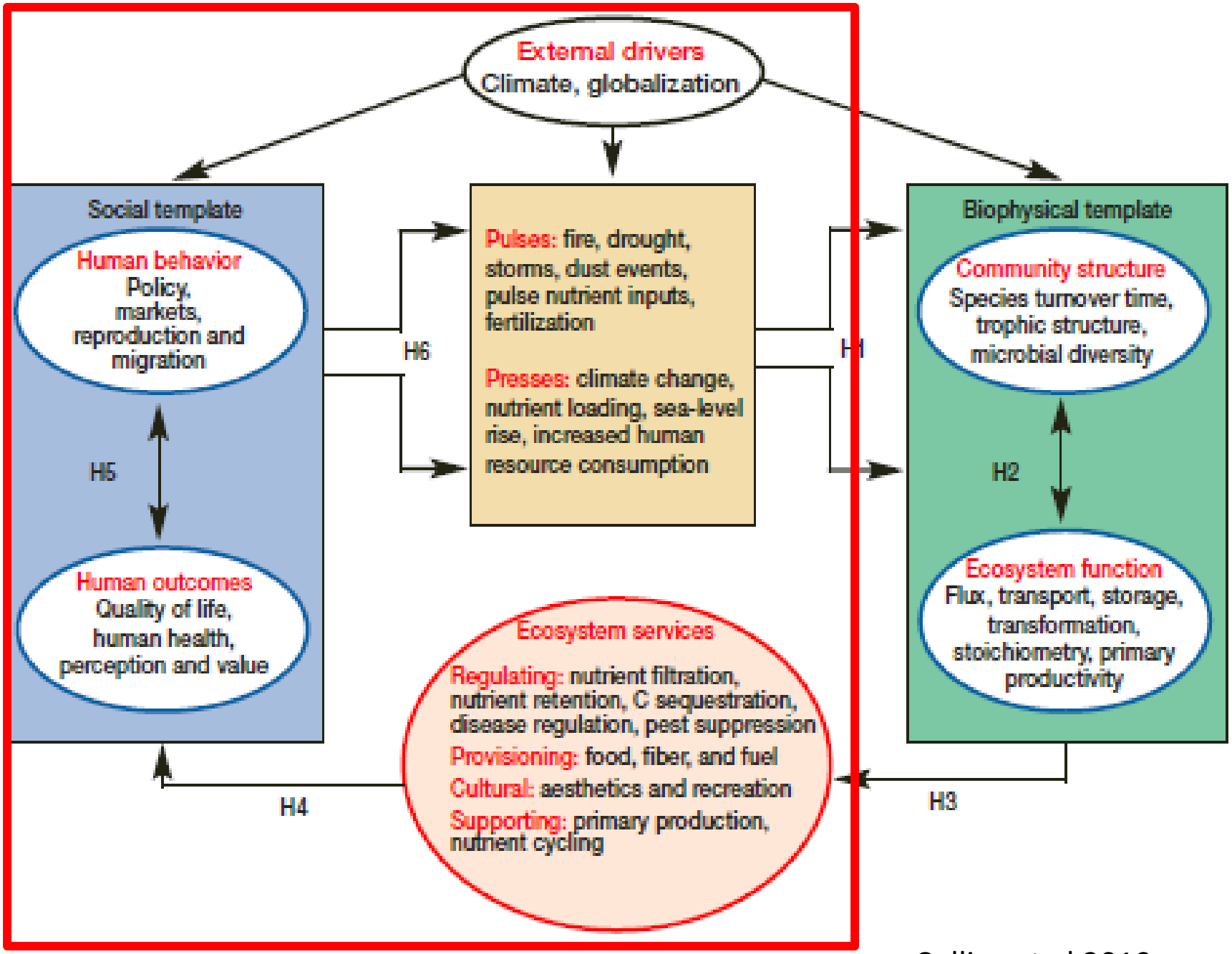
- **IPY: Climate Change, Ecosystem Services, and Society** (Chapin, Kofinas, Hepa, Rupp, Brinkman, BurnSilver) / NSF



Collins et al 2010



Collins et al 2010



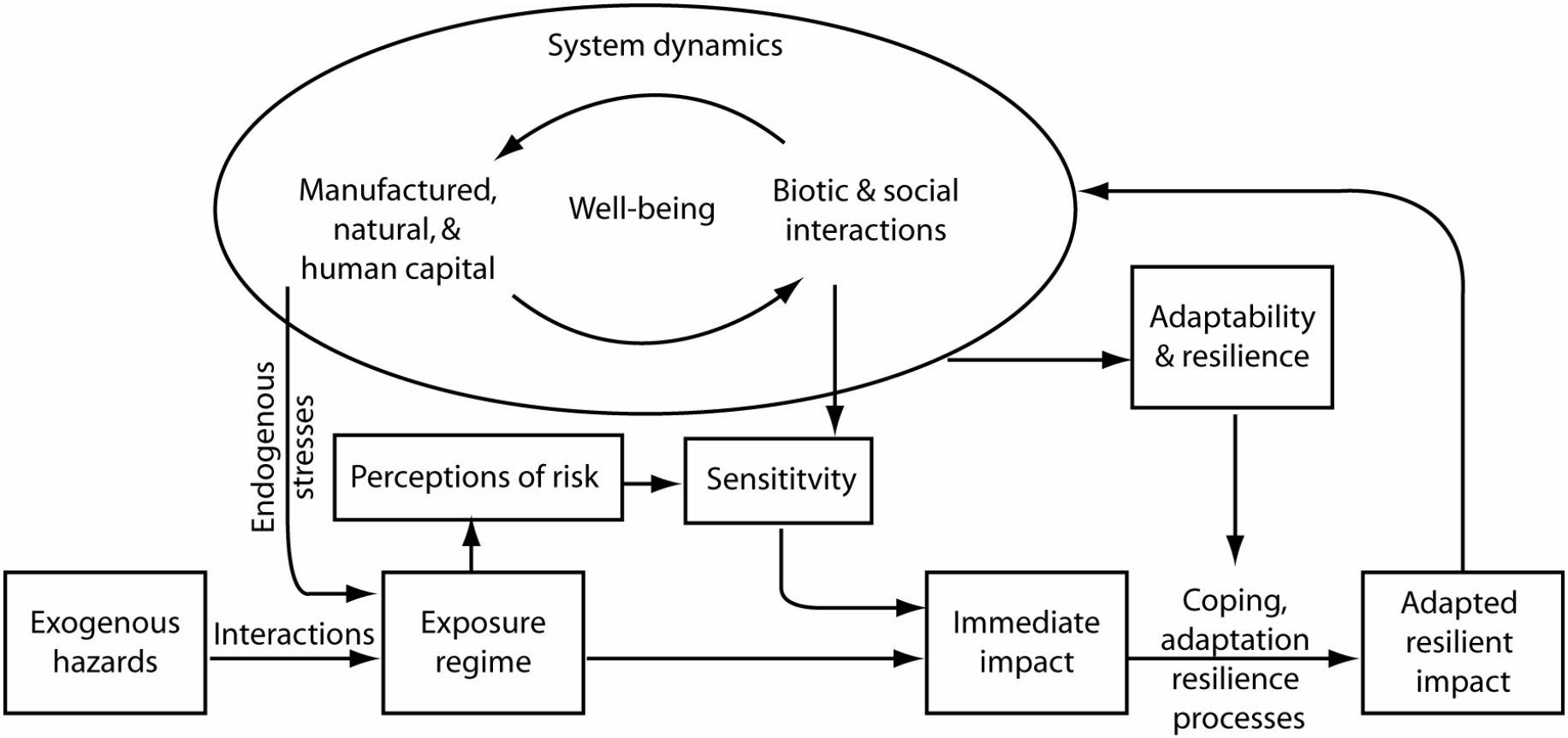
Collins et al 2010

Vulnerability = Exposure & Sensitivity + Adaptive Capacity

Adaptation: **Adjustment to a change in environment.**

- Biologists and anthropologists: a genetic change in a population.
- Anthropologists: Social, economic or cultural adjustment to a change in the physical or social environment.

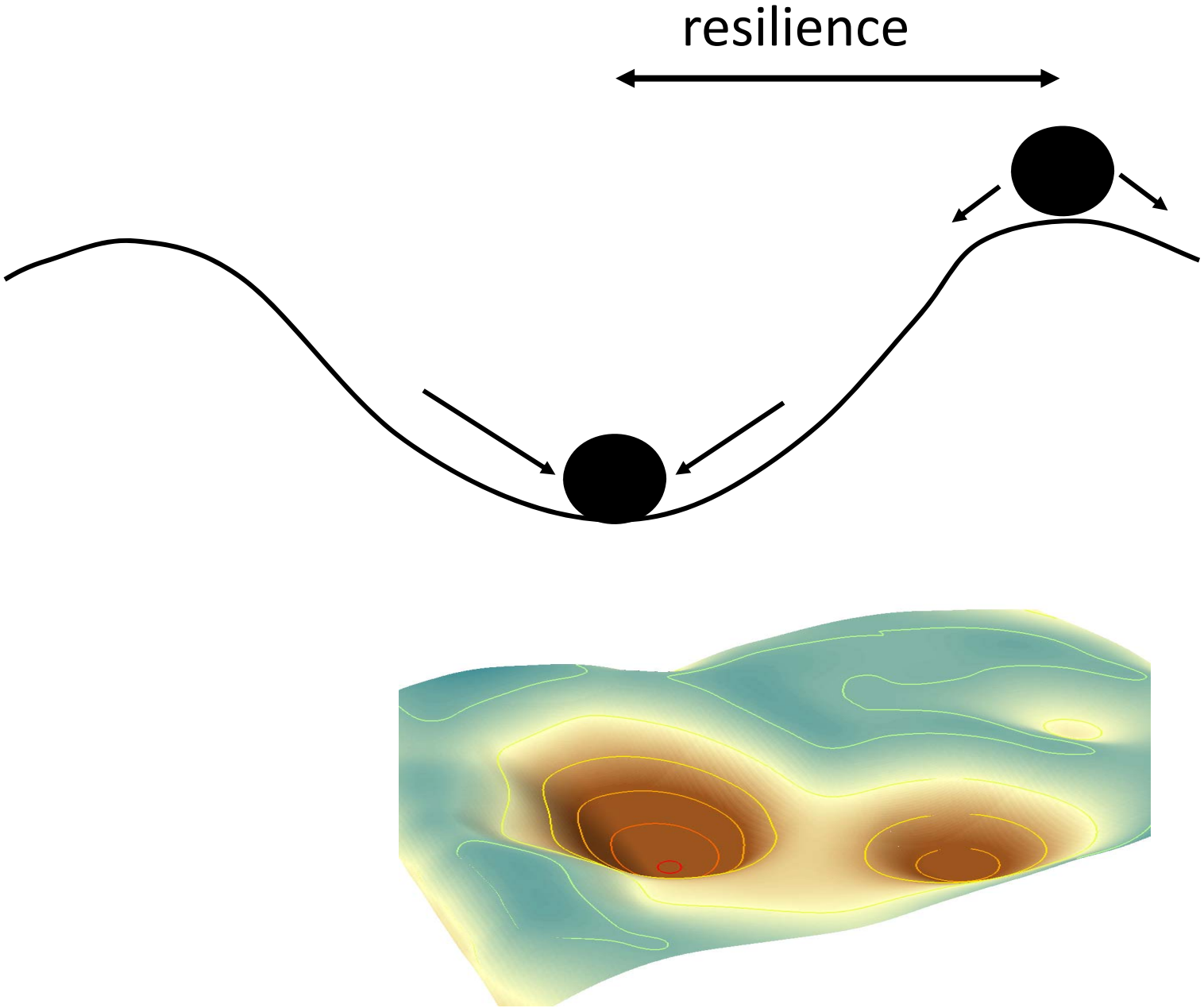
Adaptive capacity: **Capacity of human actors, both individuals and groups, to respond to, create, and shape variability and change <u>in the state of the system.</u>**

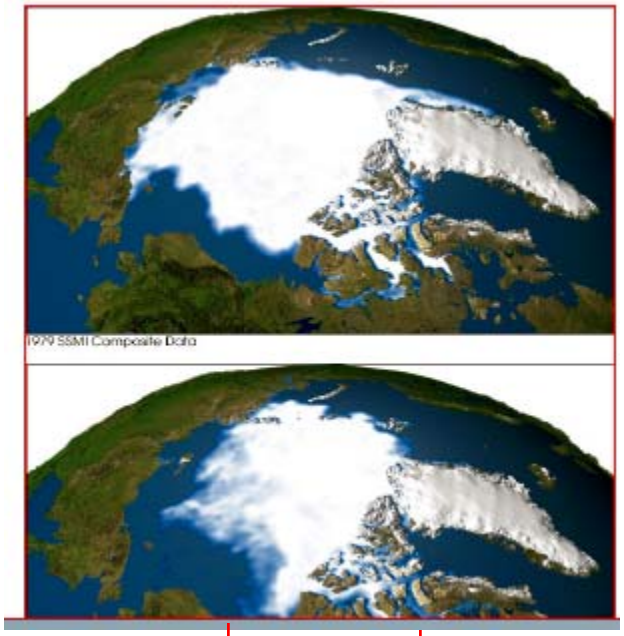


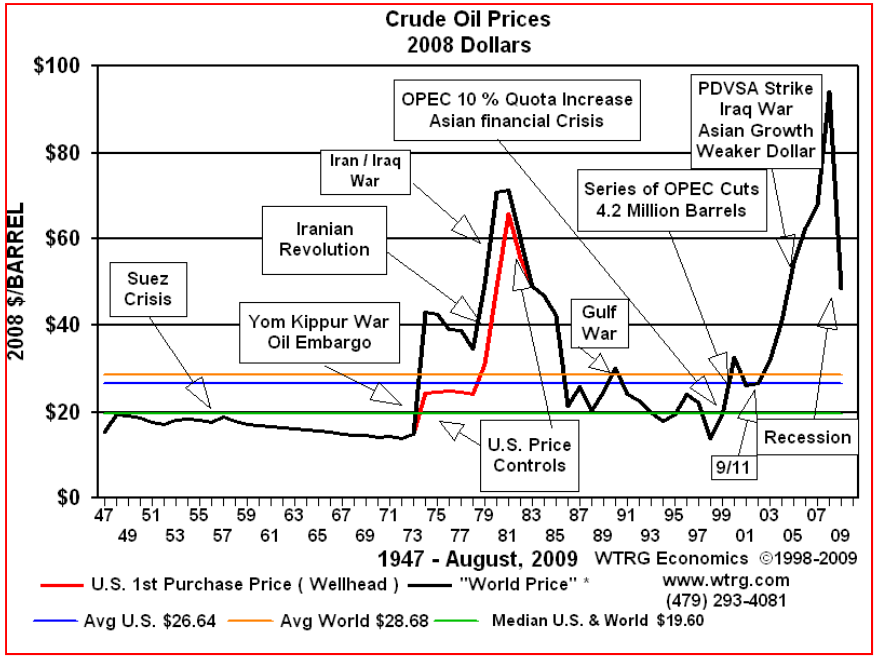
(Kofinas and Chapin 2009)

- Resilience defined: "The ability of a system to absorb disturbance and re-organise so as to retain the same structure, function, feedbacks and (therefore) identity." (Walker et al 2002)

- Regime shifts
- Specified Resilience
- General Resilience
- Resilience Tradeoffs


resilience





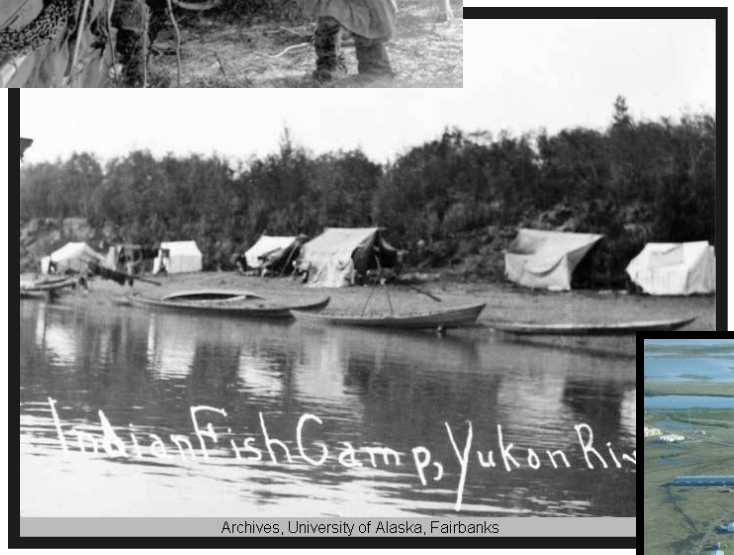
Sources: http://www.wtrg.com/oil_graphs/oilprice1947.gif

Ecoregions

Indigenous languages and peoples

Communities & Settlement

Nunamiut family, early 1900 century

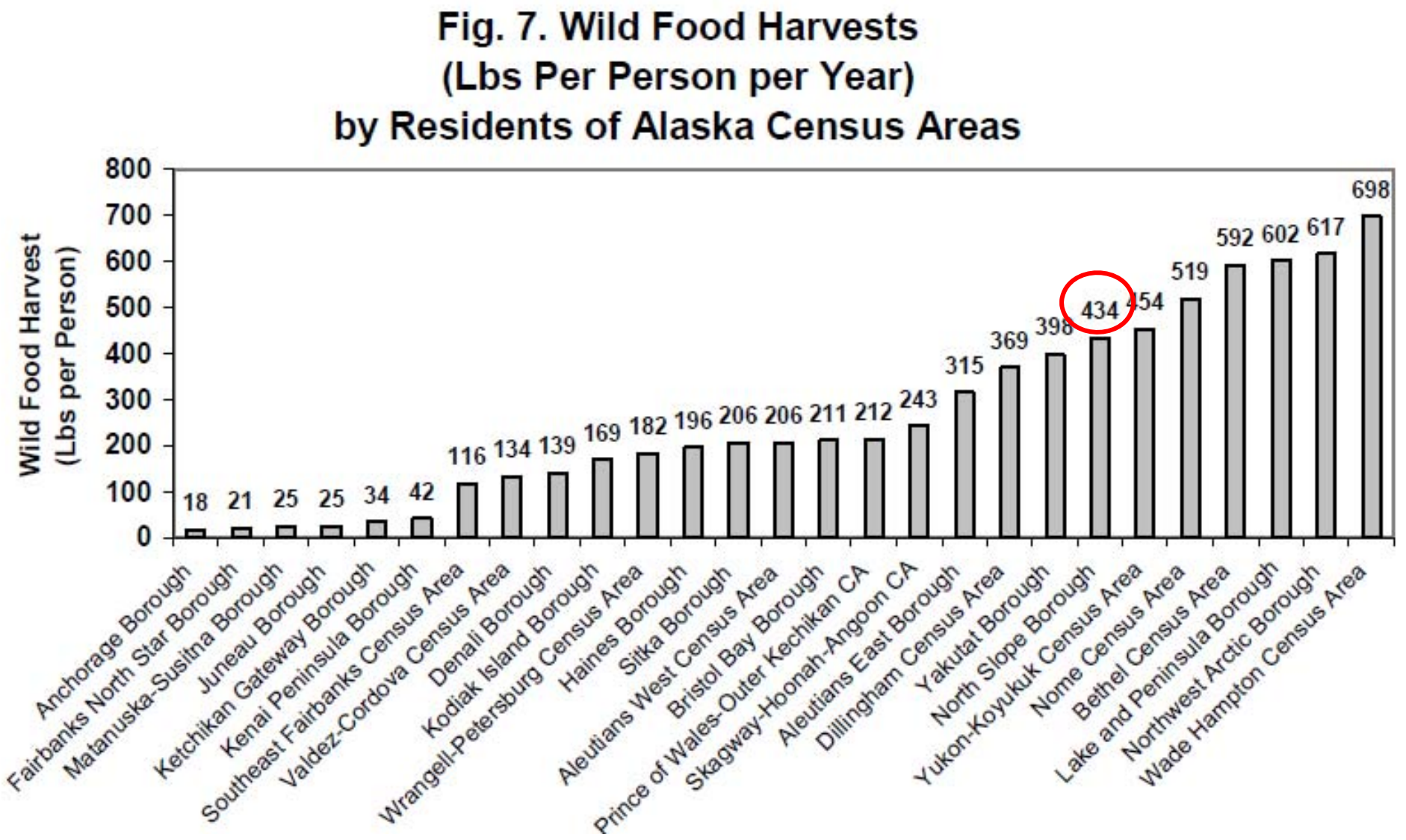


Indian Fish Camp, Yukon River (Stevens Village)

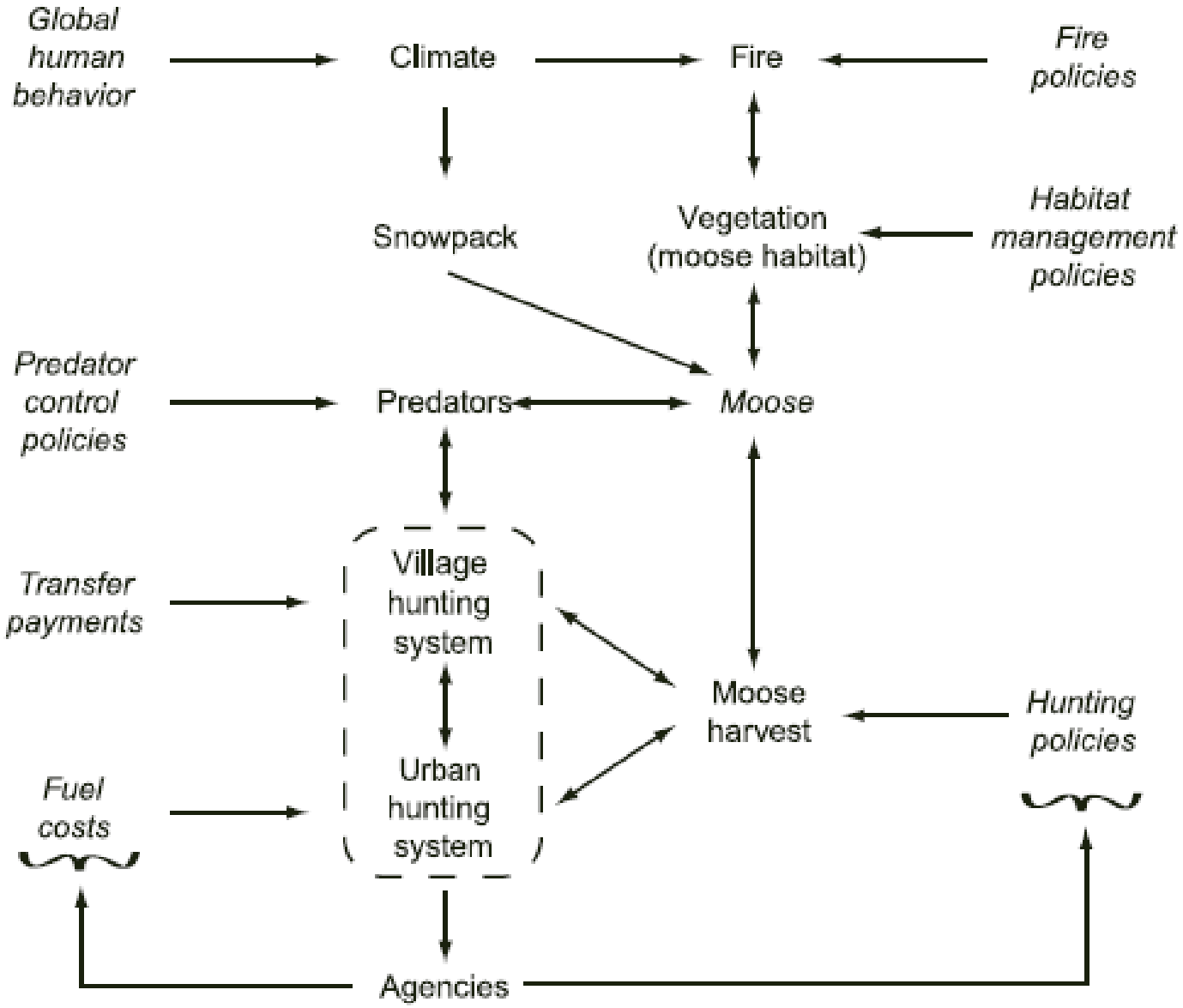
c. 1910-1912.

Selawik, Alaska

2008



Wolfe et al 2004

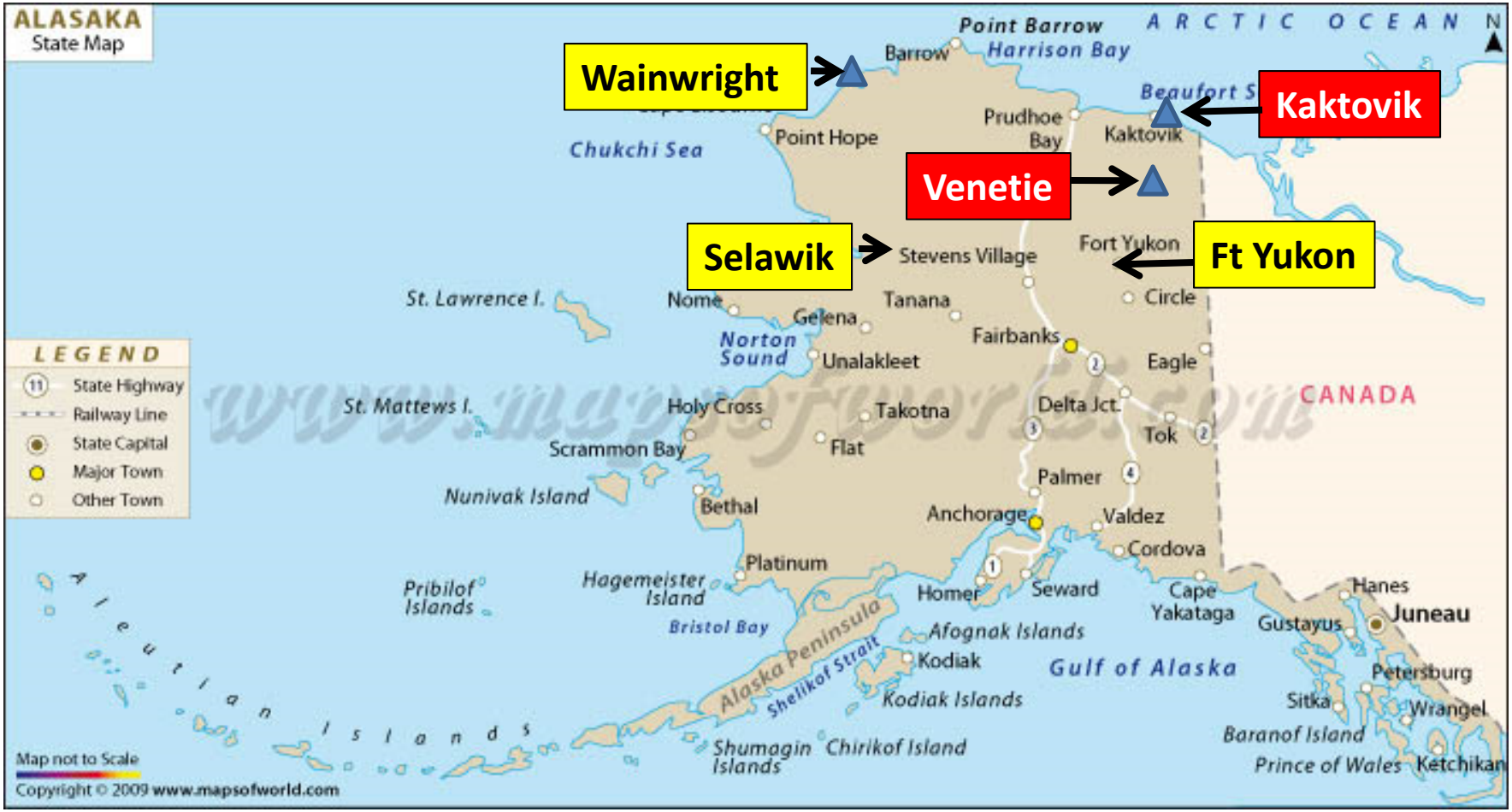

Global human behavior
Climate
Fire
Fire policies
Snowpack
Vegetation (moose habitat)
Habitat management policies
Predator control policies
Predators
Moose
Transfer payments
Village hunting system
Urban hunting system
Moose harvest
Hunting policies
Fuel costs
Agencies

Speculated village-level transformations

- Ecological Transformations: Δ in key species and mode of subsistence harvesting
- Economic Transformations: Mixed to cash/jobs based economy
- Ethnic Transformation: Indigenous to community of mixed ethnicity
- Cultural Transformation: loss of indigenous spoken language
- Settlement Transformation: Permanent -> to holiday settlement or unviable settlement

Methodological Implications for Study of Climate Change in Northern Alaska

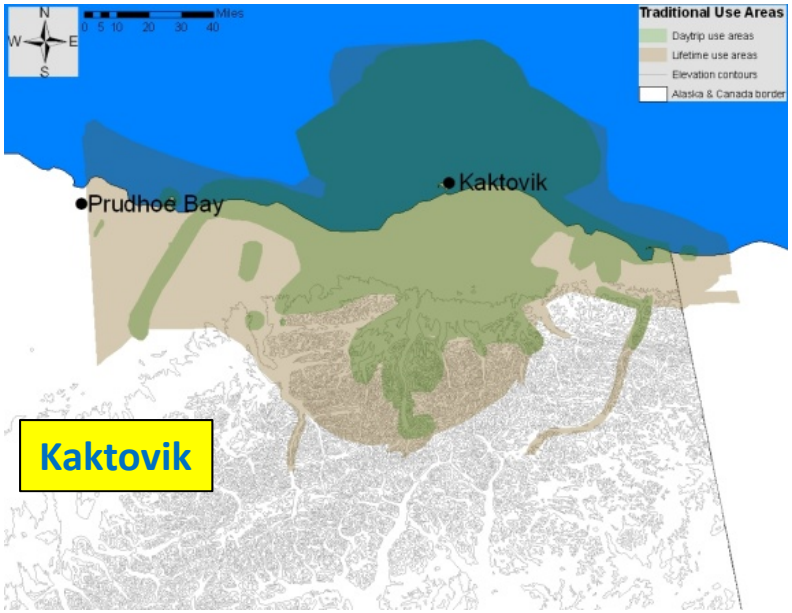
- Traditional and Local Ecological Knowledge
- Distinction between knowledge as process vs. knowledge as information
- Opportunities to
  - Link social and ecological
  - Address the problem of Scale
- Research Partnerships for co-production of knowledge

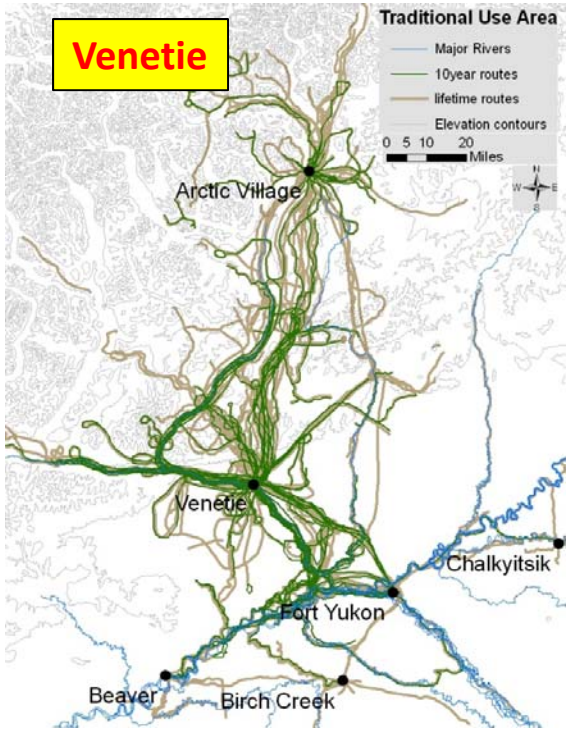

ALASAKA
State Map
Wainwright
Kaktovik
Venetie
Selawik
Ft Yukon
Point Barrow
ARCTIC OCEAN
N
Barrow
Harrison Bay
Beaufort S
Prudhoe Bay
Kaktovik
Point Hope
Chukchi Sea
Fort Yukon
Stevens Village
St. Lawrence I.
Nome
Tanana
Circle
Gelena
Fairbanks
Norton Sound
Unalakleet
Eagle
CANADA
St. Mattews I.
Holy Cross
Takotna
Delta Jct.
Tok
Scrammon Bay
Flat
Palmer
Nunivak Island
Bethal
Anchorage
Valdez
Cordova
Platinum
Pribilof Islands
Hagemeister Island
Homer
Seward
Cape Yakataga
Hanes
Juneau
Gustavus
Bristol Bay
Afognak Islands
Alaska Peninsula
Shelikof Strait
Kodiak
Gulf of Alaska
Petersburg
Kodiak Islands
Sitka
Wrangel
Baranof Island
Aleutian Islands
Shumagin Islands
Chirikof Island
Prince of Wales
Ketchikan
LEGEND
State Highway
Railway Line
State Capital
Major Town
Other Town
Map not to Scale
Copyright © 2009 www.mapsofworld.com

	Kaktovik	Venetie
Population	202	294
# of HHs	90	80

Traditional use area

Ten year and lifetime use areas defined by ~15 active harvesters per community





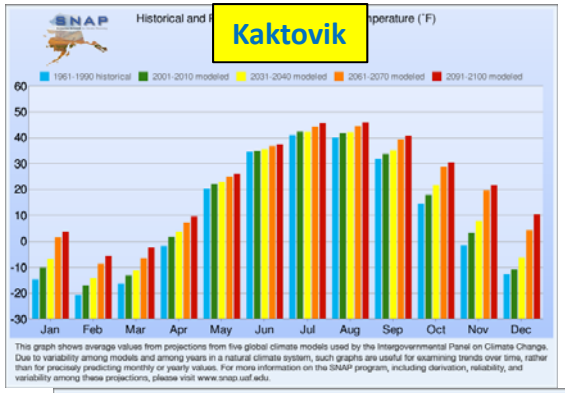
	Reported lifetime use areas
Kaktovik	67,200 sq km
Venetie	108,900 sq km

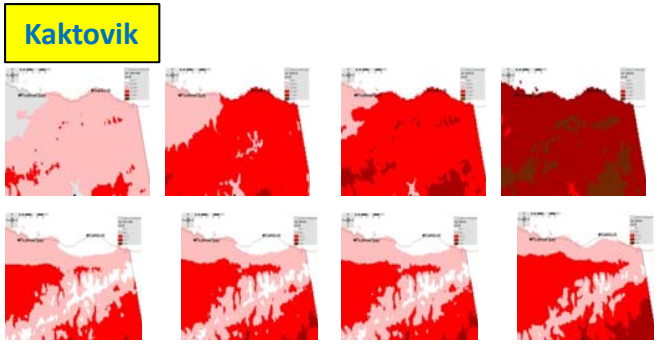
warming

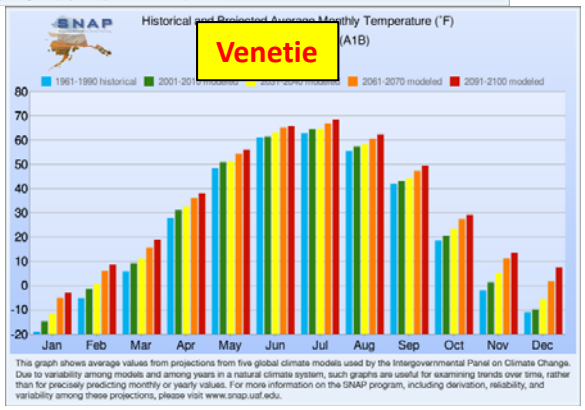
	Annual	MAM	JJA	SON	DJF
Interior	**+1.4°**	**+1.7°**	**+0.5°**	+0.2°	**+3.1°**
Arctic	**+1.2°**	**+1.2°**	**+0.9°**	+0.4°	**+2.0°**

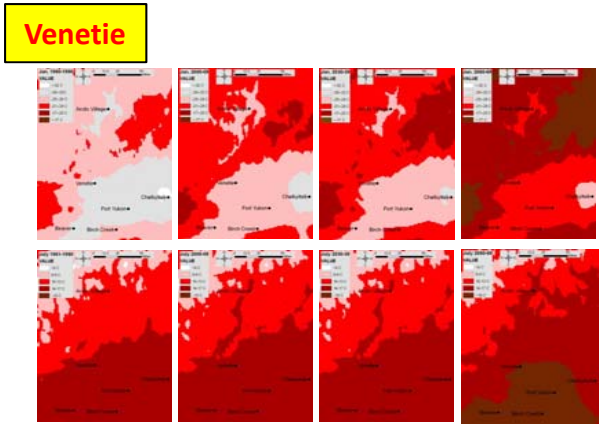
(Hartman and Wendler 2005; BF is significant trend)

(Scott Rupp et al)



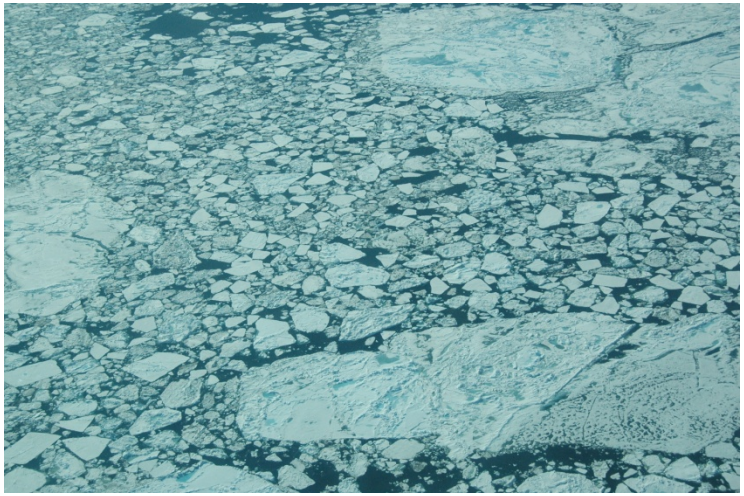






Significant changes in land /sea surface conditions…

Melting ice



Sea Ice loss; late freeze up and melt)

Permafrost melting in Interior AK

Increased fire frequency

2004 Venetie Fire
(2/3 of Venetie's 1.8 million acres private lands

2007 North Slope Anaktuvuk tundra fire (1000 sq km)

Tundra fire brings dramatic increase in thermokarst activity in burned tundra

Permafrost thaw interacts strongly with hydrology to influence surface water distribution

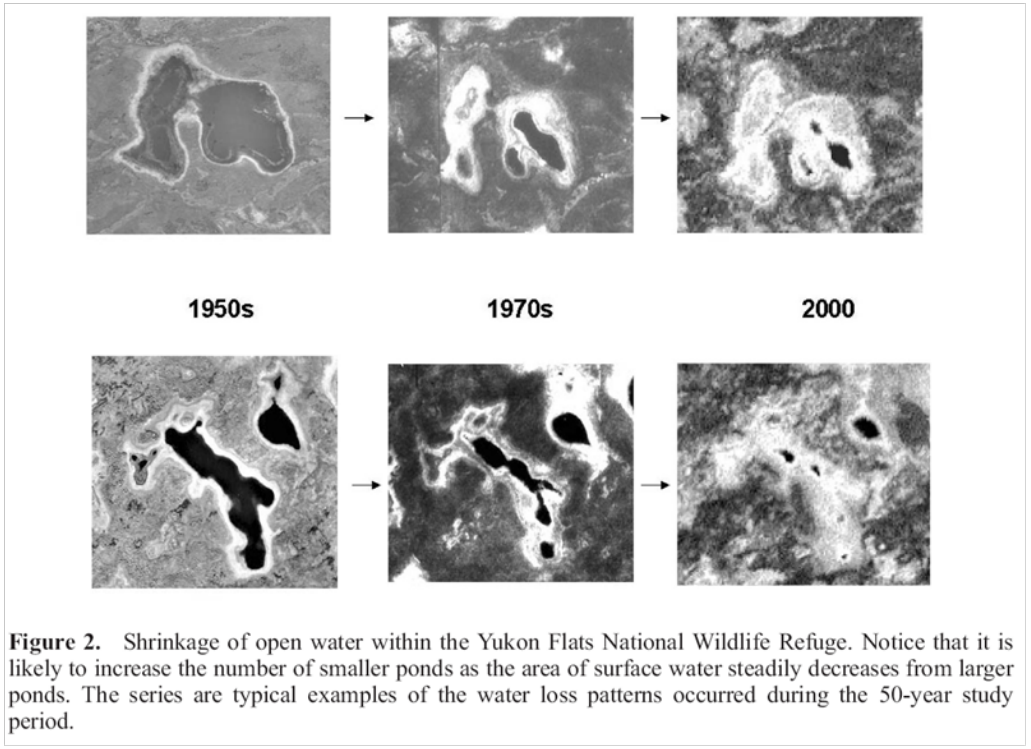
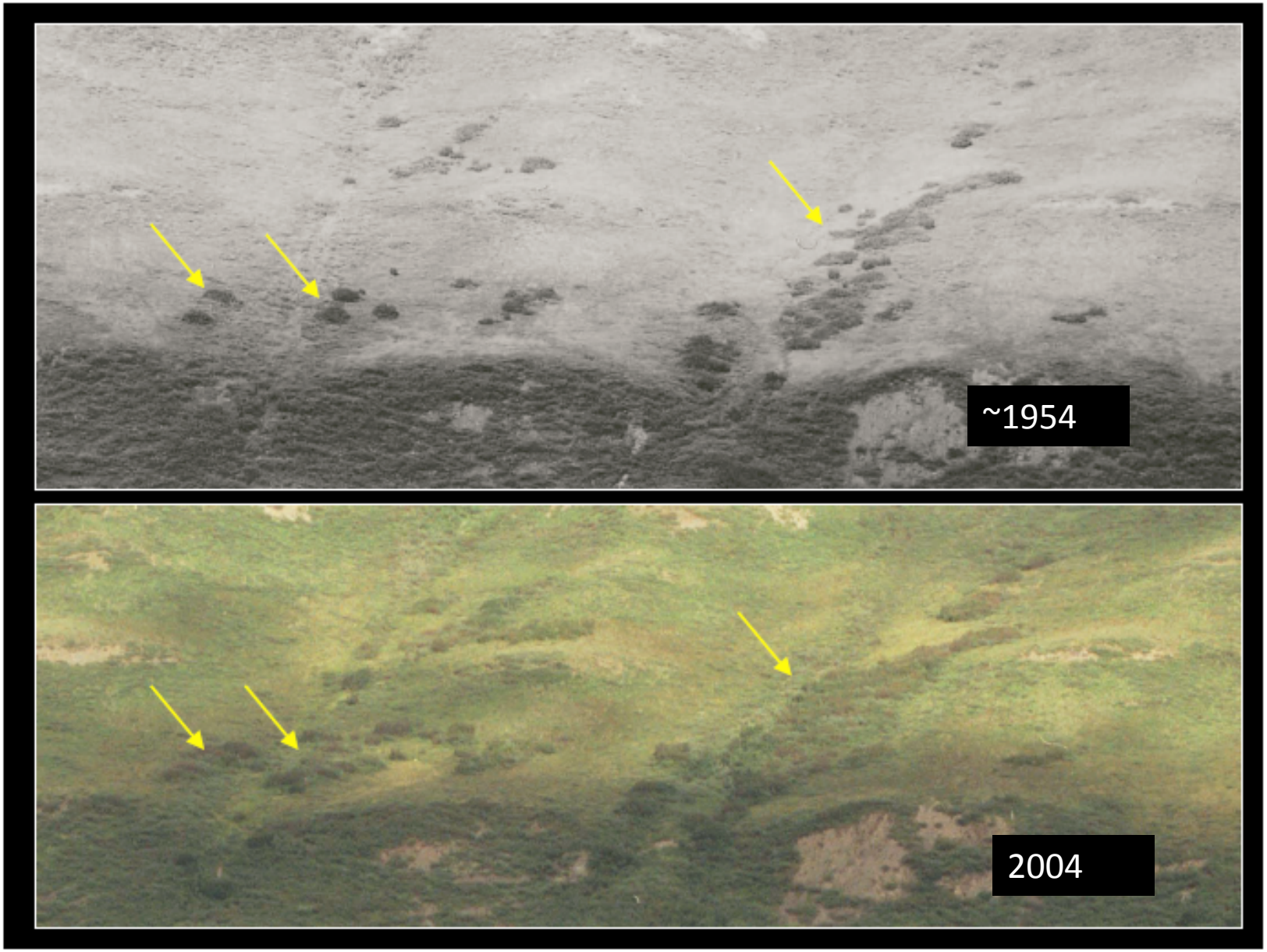


Figure 2. Shrinkage of open water within the Yukon Flats National Wildlife Refuge. Notice that it is likely to increase the number of smaller ponds as the area of surface water steadily decreases from larger ponds. The series are typical examples of the water loss patterns occurred during the 50-year study period.

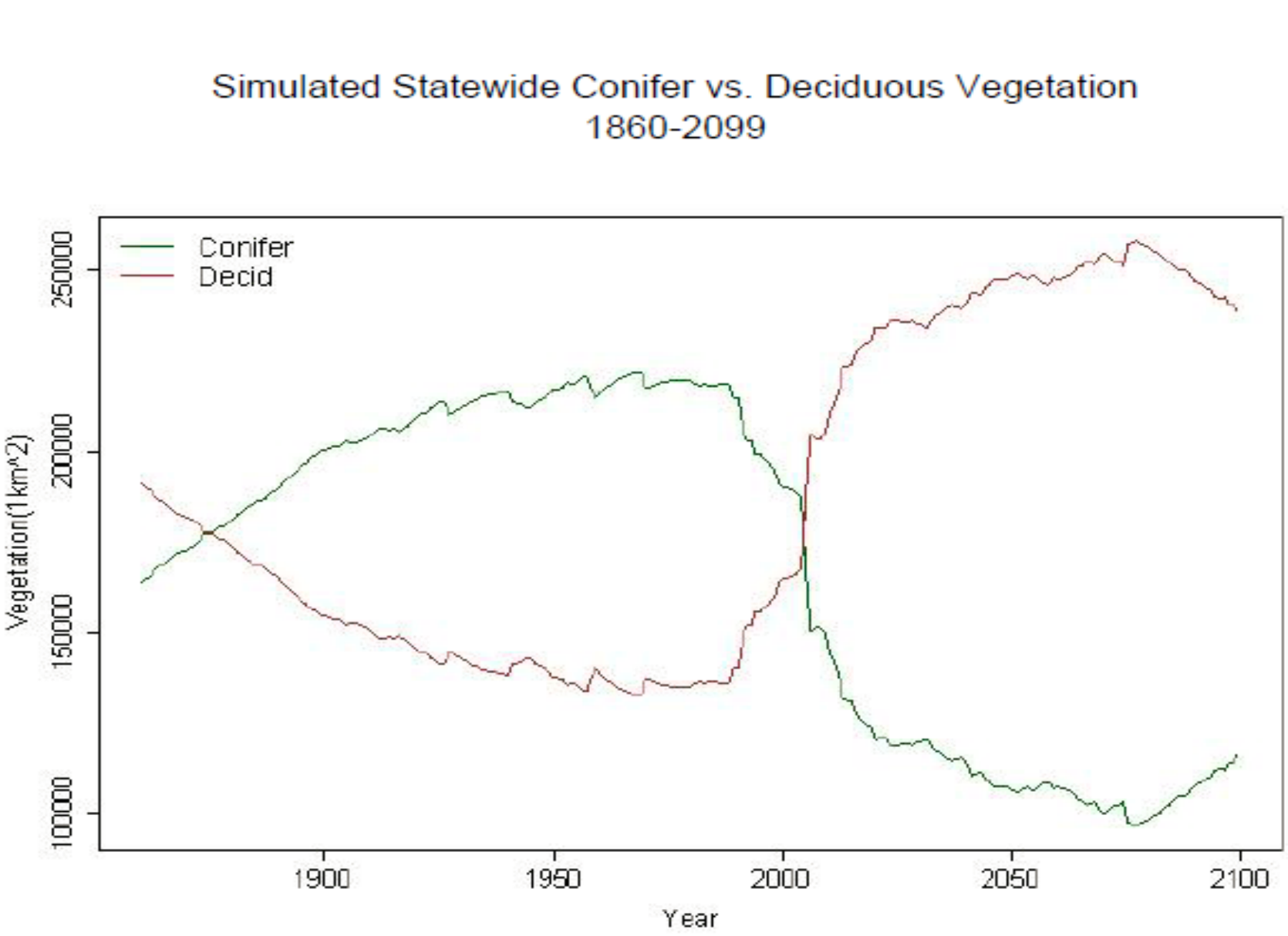
AK wetlands (> 60% of total US) cover 77 million acres and comprise 81% of the National Wildlife Refuge System.

(Riordan et al. 2006)

Shrubification of the Arctic



K. Tape

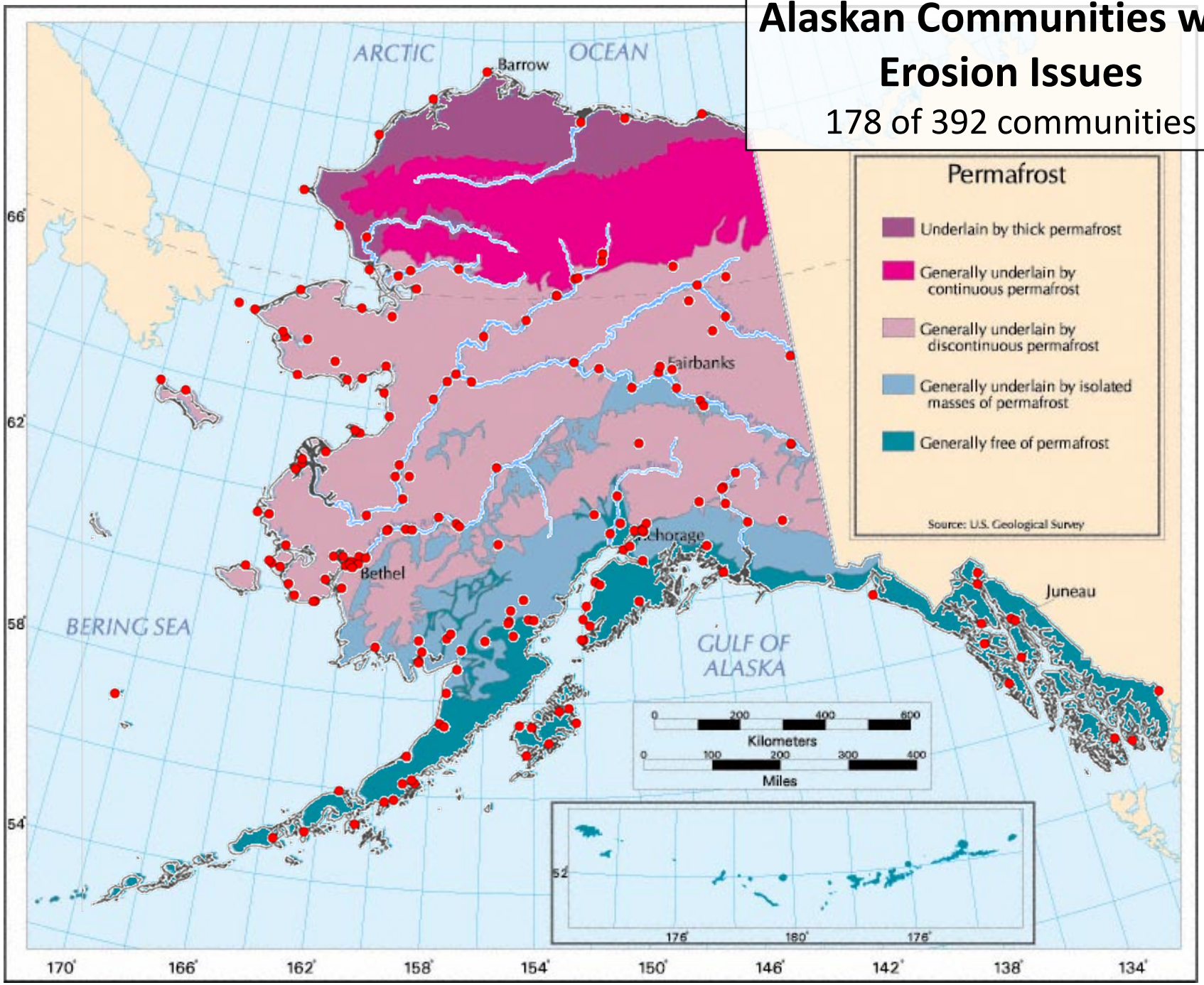

Simulated Statewide Conifer vs. Deciduous Vegetation
1860-2099
Conifer
Decid
Vegetation(1km^2)
100000
150000
200000
250000
1900
1950
2000
2050
2100
Year

CC effects and implications to people

	Kaktovik	Venetie
Melting of permafrost	•Minor infrastructure problems; ice cellars •Coastal erosion	•Net loss of wetlands •River bank erosion •Limited infrastructure
Storm surges->coastal erosion 	•Possible relocation of airport; •shore stabilization effort •Lagoon camp losses	•none 
Changes in river hydrology	•Lowering Water levels- problems travel on rivers	•Quickly changing river course – •Difficult travel on rivers
Lightening events	•Fire management •Caribou migration	•Fire management •Employment
Overall changes in seasonality	•Earlier and longer ice free period	•Later fall; earlier spring

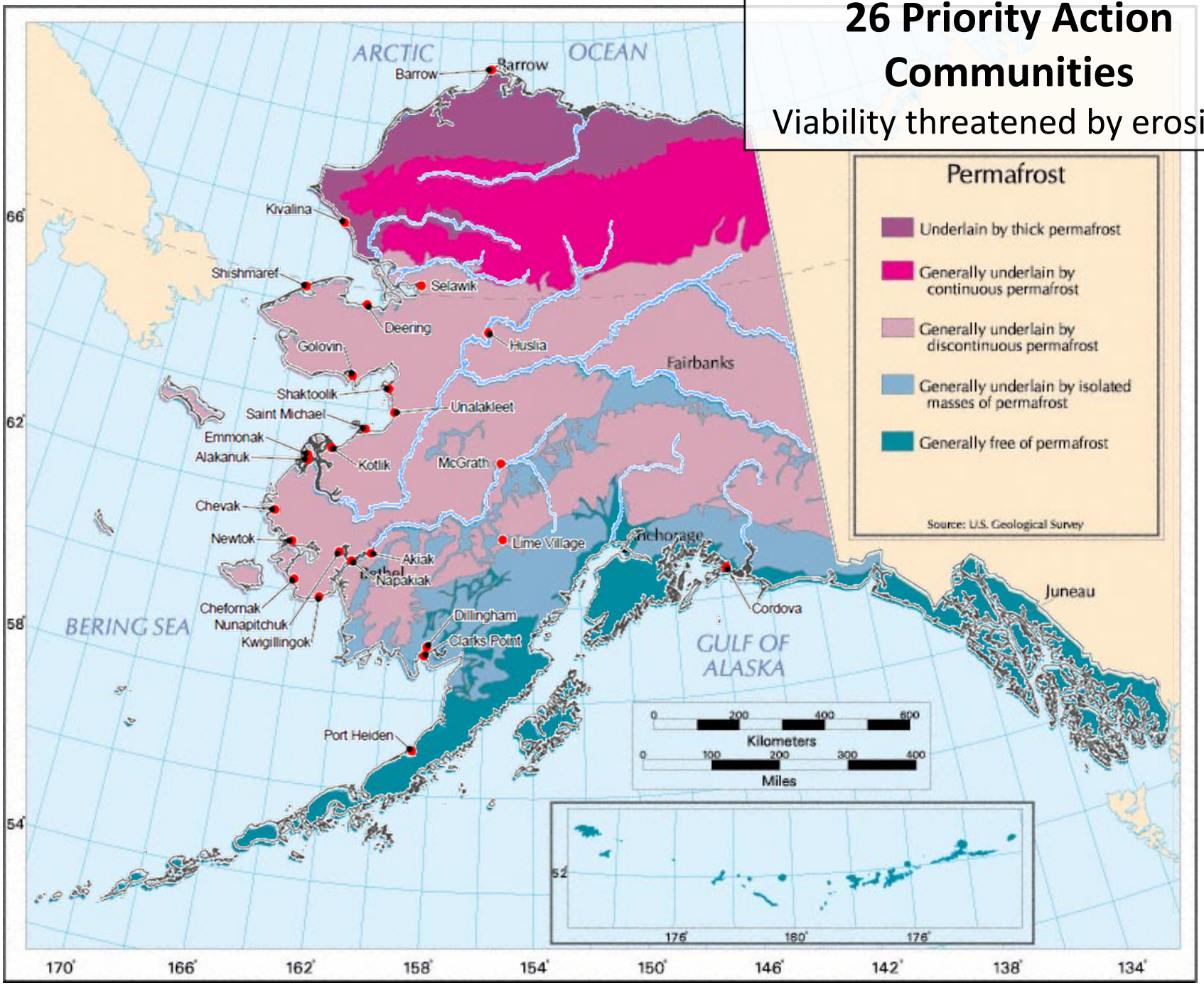
Alaskan Communities with Erosion Issues

178 of 392 communities



26 Priority Action Communities

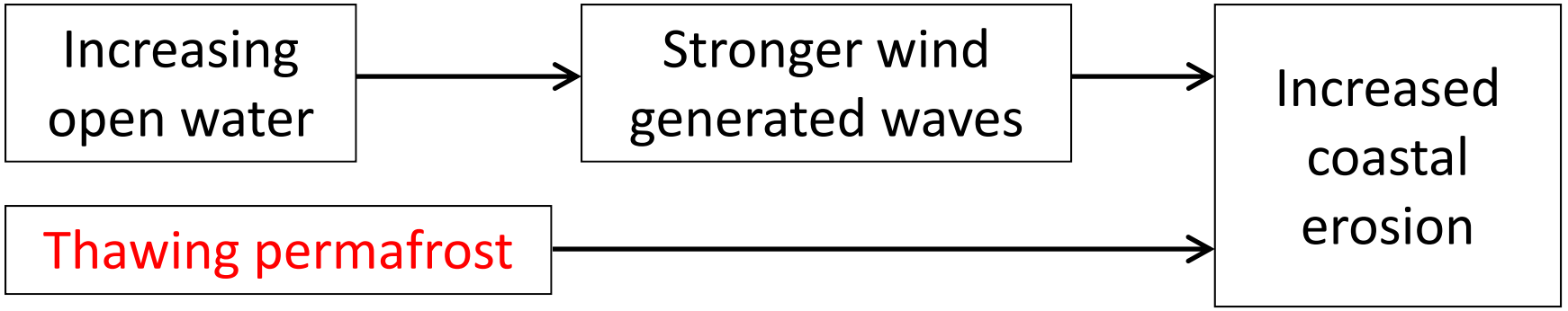
Viability threatened by erosion



“Forced Migration”

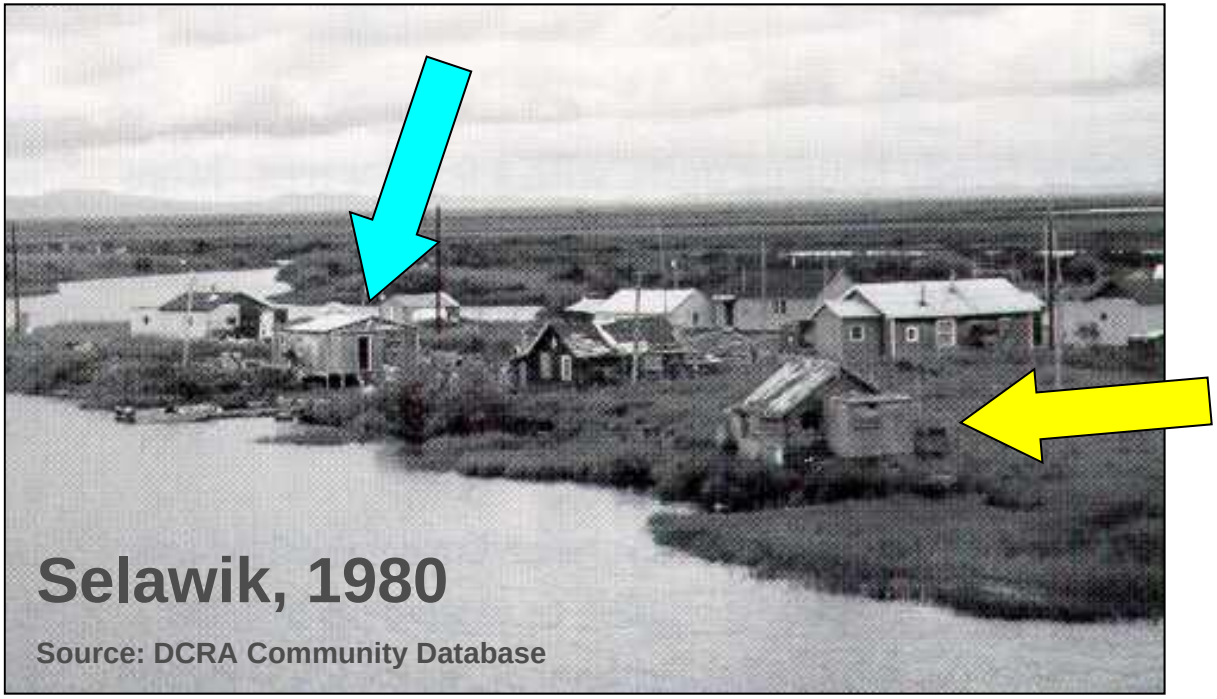
Photos: T. Weyiouanna http://www.shishmarefrelocation.com/

Shishmaref, AK



(Chris Petrich)

Repeat Photography



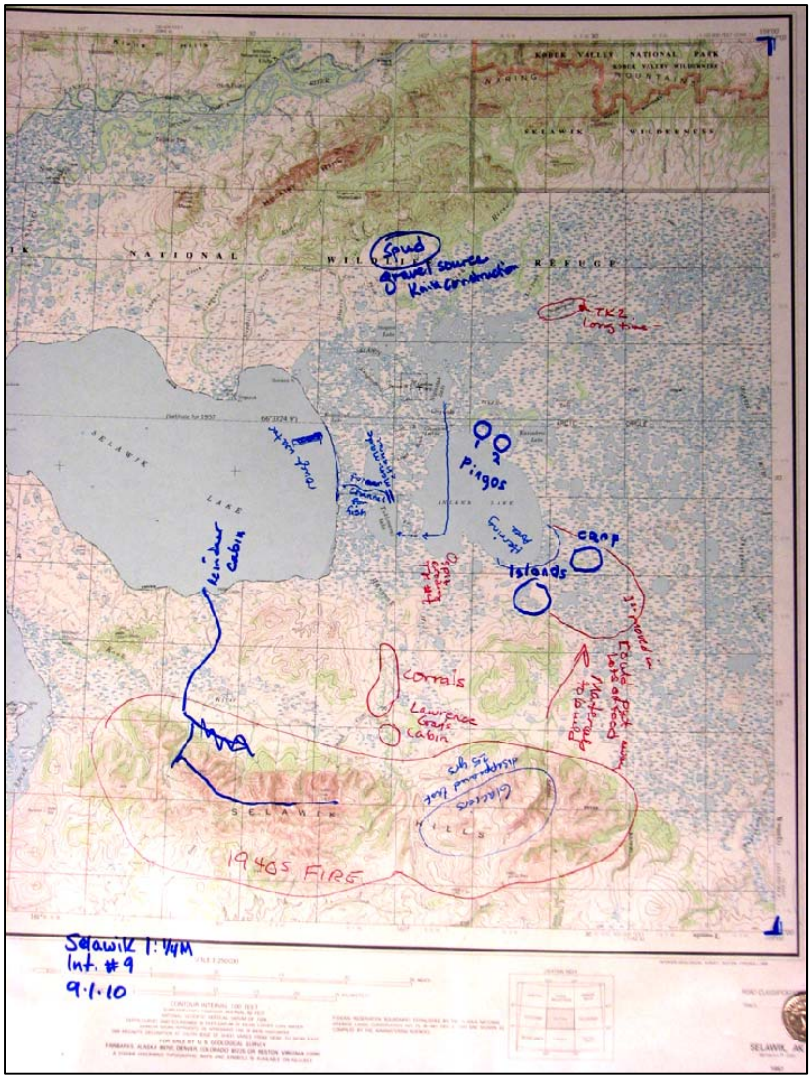
Woodward

Spatial Mapping of Local Knowledge

Selawik 1999

Stay put or relocate?

- Maniilaq's prophecy
- Selawik → Spud? Ambler?
- Social impacts of relocation
- Who coordinates?
- Who pays?



Woodward

Subsistence Resource Availability =

Abundance + Distribution + Access

(Berman and Kofinas 2003)

Venetie	Abundance	Distribution	Access
Moose	Short-term lower; long-term higher	Less near river; displacement after fire; return	Difficulty with trails after fires; lower water levels for river travel
Caribou	-	Less likely to migrate south	Difficulty on trails after fires; lower water levels for river travel
Salmon	more	Changes in water course	
Whitefish	-	Changes do to lake changes	No problem
Waterfowl	Perceived decrease	-	No problem
Fire Wood	Higher due to fires	No problem	More difficult due to trail conditions

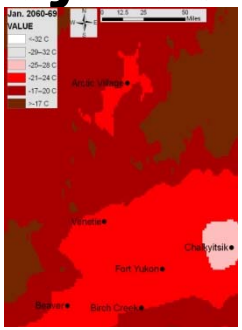
Kaktovik	Abundance	Distribution	Access
Bowhead	-	-	Dangerous seas
Caribou	-	-	Low water; lagoon access problems
Arctic Char	-	-	Low water for river access
Bearded & Ringed Seal	Less ice; decrease	Further from shore	Dangerous seas
Dall Sheep	-	-	Spring and autumn snow conditions
Cisco	-	-	Access to fish camps; coastal errosion
Musk ox	-	-	Spring and autumn snow conditions

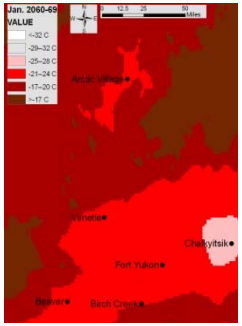
(Brinkman)

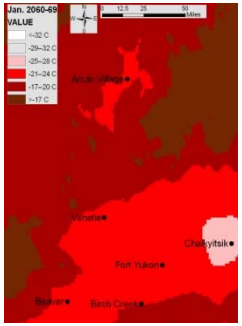
Link Interactions with Future Projections

Best Science

Local Hunter Information





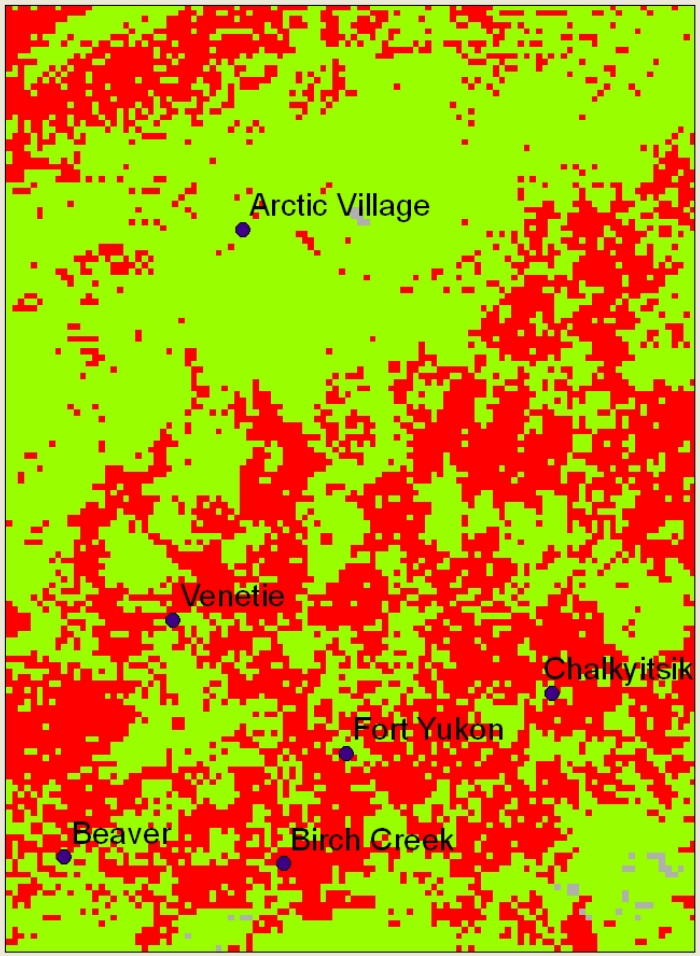


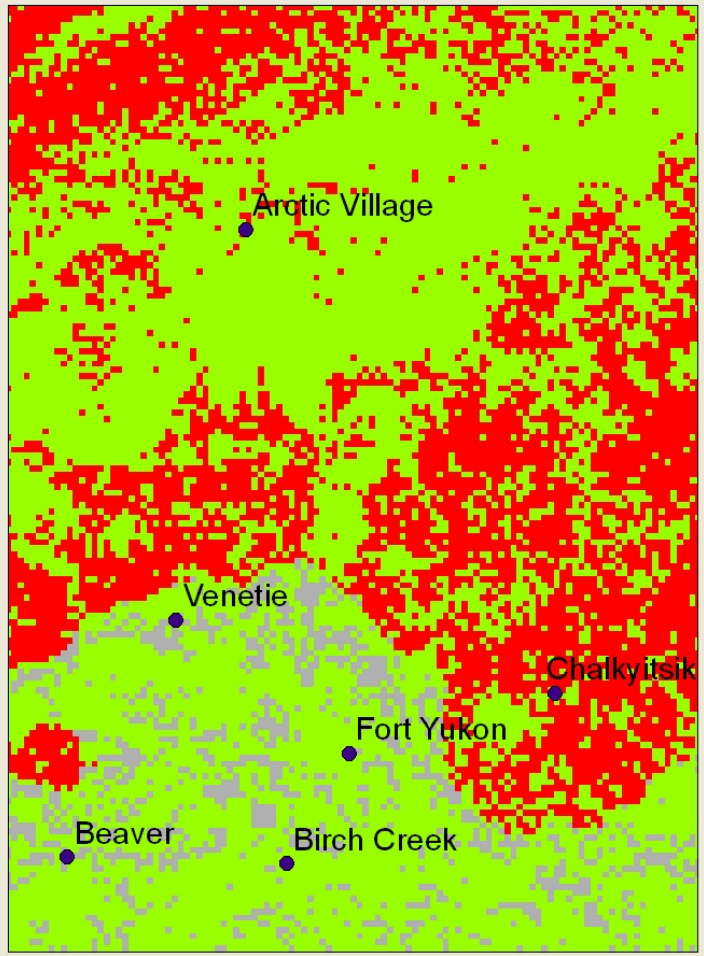
Future Scenario of Availability

Future Scenario of Availability

Future Scenario of Availability

Moose availability





Modeling seasonal Rounds & Δ in seasonality

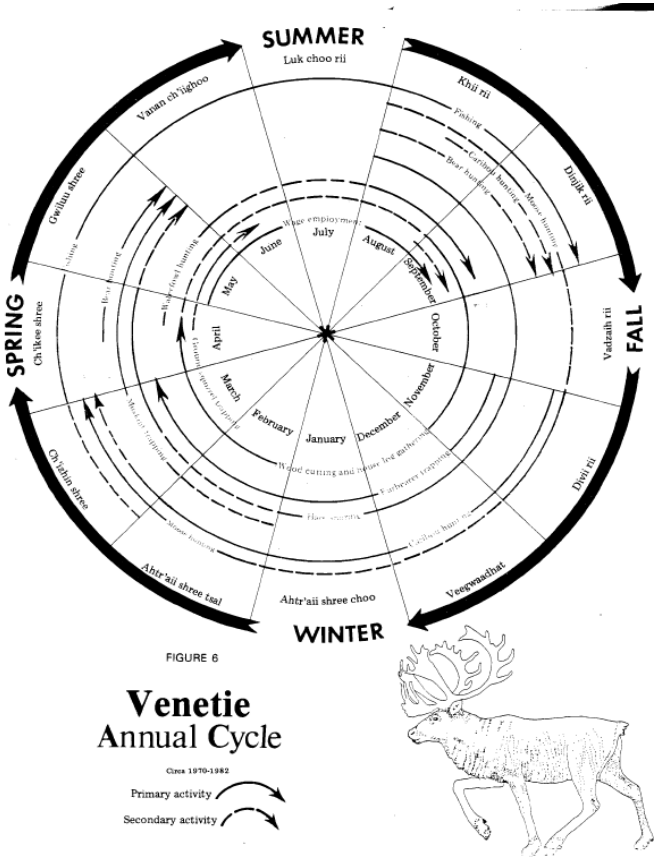


FIGURE 6

Venetie
Annual Cycle

Circa 1970-1982

Primary activity

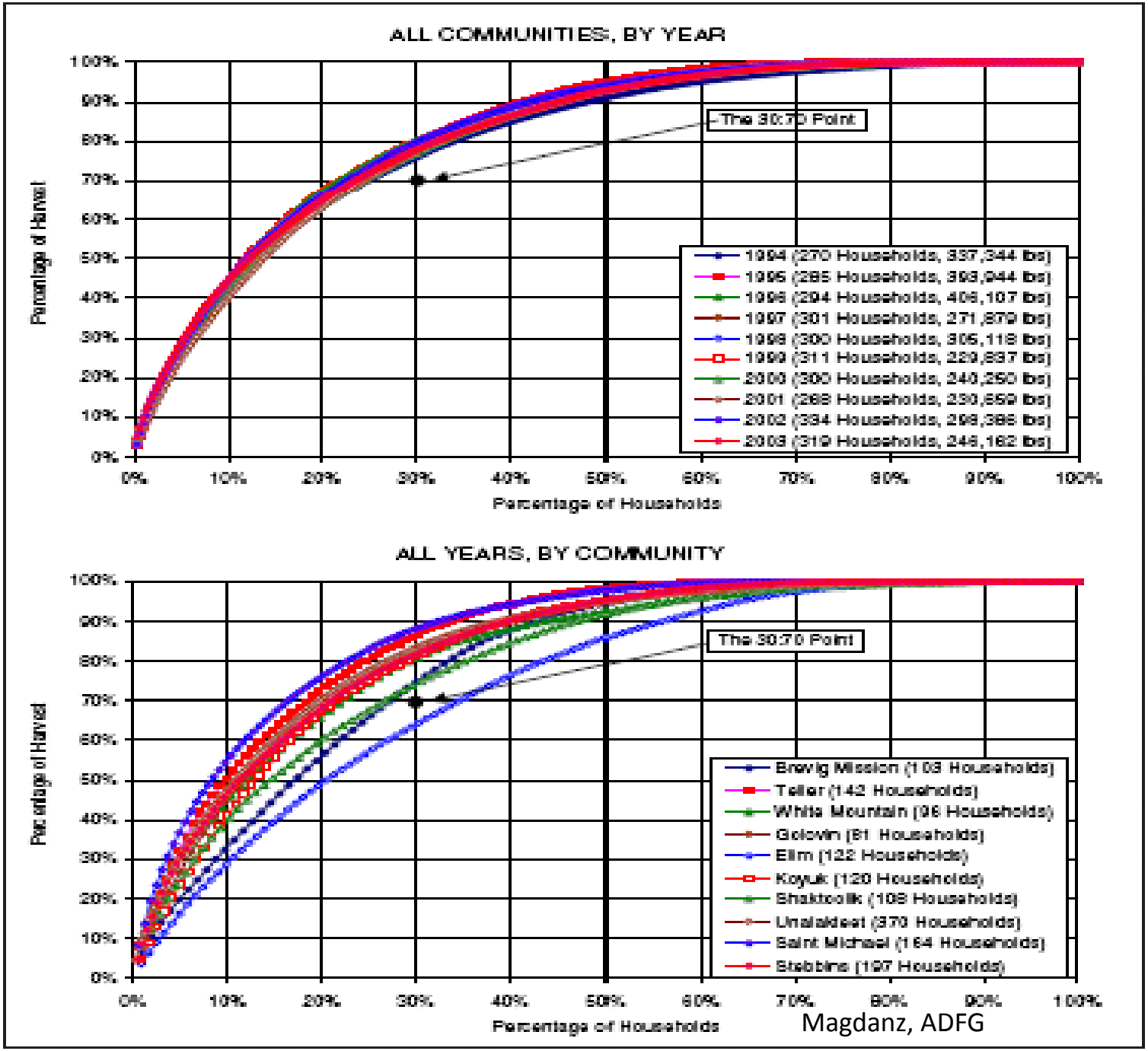
Secondary activity

- Heterogeneity of resources
- Shifts in seasonality
- Implications of Δ to Availability
- Relative vulnerability of villages

(De Roo et al)

Institutional dimensions

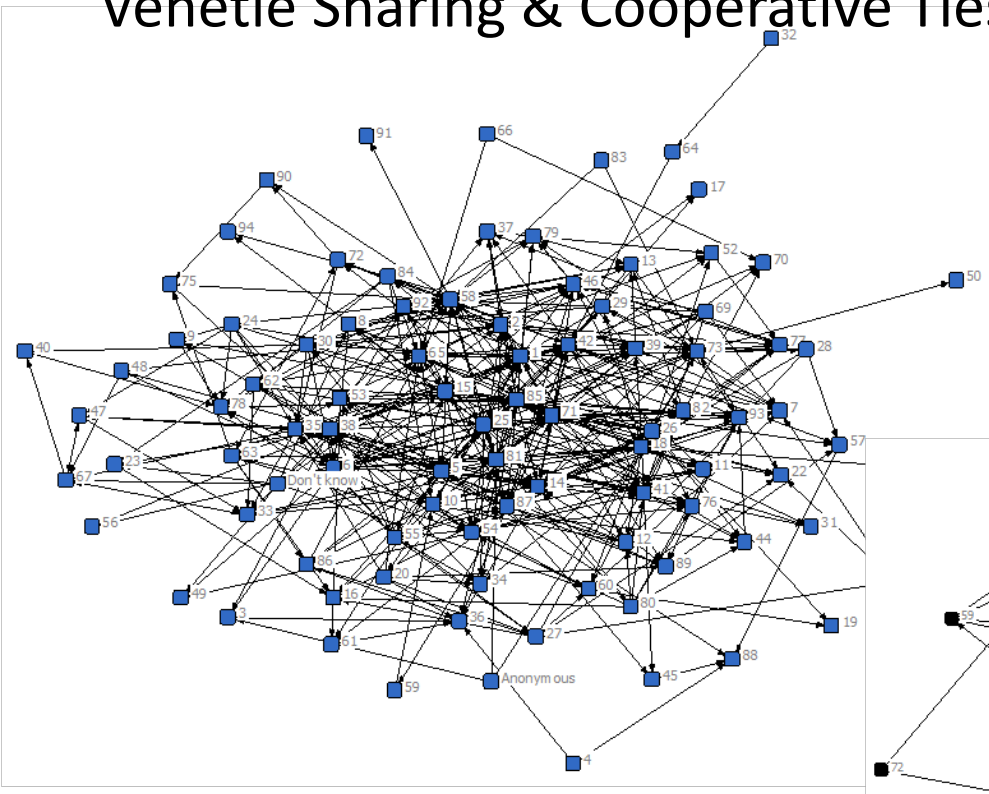
	Kaktovik	Venetie
Land Claims & for-profit corporations	ANCSA: V successful regional and village corporations	ANCSA: Regional corporation; no village corporation but more land
Governance of lands	"Home Rule" with power of taxation; land selections to capture oil resources	Fee simple large land base ownership (land rich/cash poor)
Fish and Game policy	Little to no competition from non local harvesters	Non-local hunting and urban dominated policy process
Language	North Slope: 22% mostly over 40 year of age (ANLC) vs. **63%** (1980 census) -	AK Gwich'in 27% (ANLC data) vs. **27%** (1980 census) -
Sharing	Formalized through whaling	Informal for strong traditions

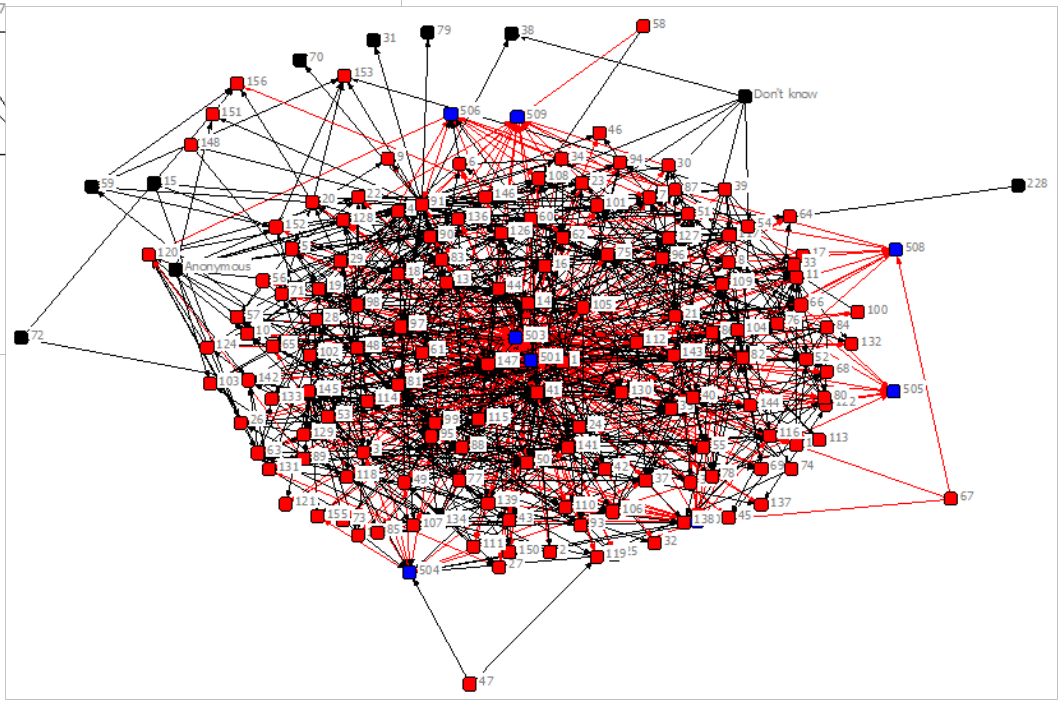


Magdanz, ADFG

Venetie Sharing & Cooperative Ties

All relationships / key species



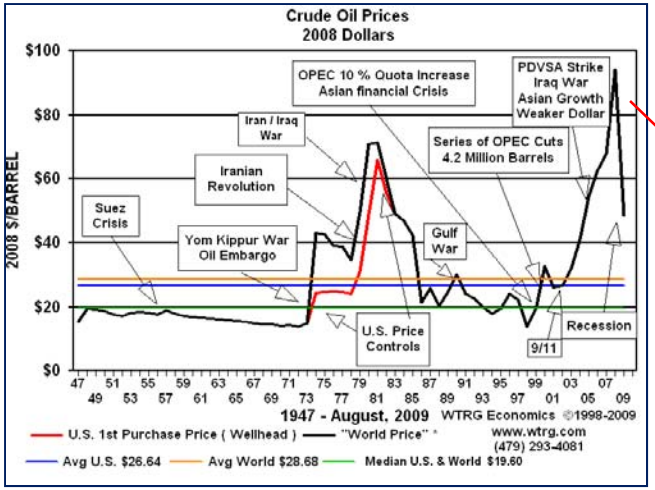


Wainwright Sharing & Cooperative Ties

A mixed economy:
Cash and infrastructure as buffers

	Kaktovik	Venetie
# of people / HH	**Larger/multi generational**	**smaller**
Mean HH Income	**$55,625**	**$21,429**
% of HHs below poverty level	**7%**	**43%**
Gear ownership		
CIVIL VS PRIVATE JOBS; civil = dependency on gov funding	*Low to med* Total: 117 •Private emp:28 •Self emp:8 •Gov temp:81 **# jobs/HH**	*Low* Total: 44 •Private: 11 •Self: 0 •Gov temp: 33 **# jobs/HH**
Locally operated tourism	Emerging	None to speak of
Home Water and sewer	yes	no
Regional capital projects and Grants	2005-6: Multi-million dollar water & sewer project	(add)

Fuel costs



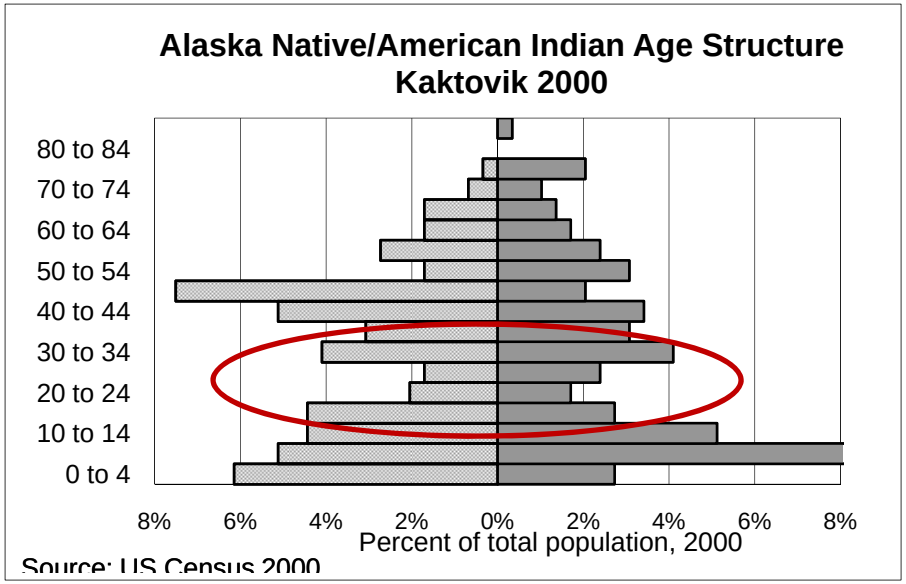
	Kaktovik	Venetie
Fuel spike in 2007	**300% ***	***629%***
subsidy	**North Slope Borough fuel subsidy**	**Accepted Chavez's gift of 100 gals to low income HHs**

Rural Alaska

Population - Alaska

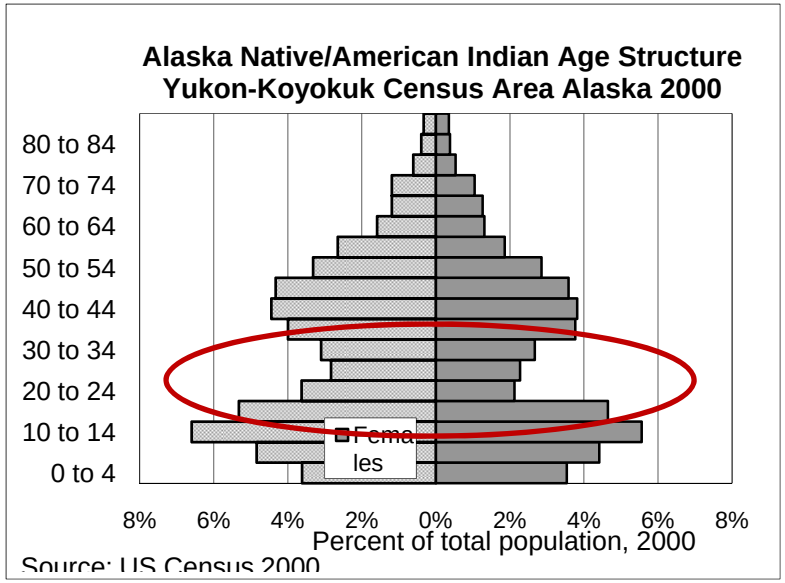
Year	Rural	Total
1980	39%	401,851
1990	28%	550,043
2000	25%	626,932
2009	22%	698,473

Human migration thresholds



- "viable" village pop questionable with some changes
- Out migration of young women is key w/ kids to urban areas

Change in village population	Kaktovik	Venetie
1960 to 2000	+5.5%	+5.1%
1990 to 2000	+2.2%	+1.0%



(Stephanie Martin)

Types of responses

- Shifts in temporal and spatial use patterns
- Technological shifts
- Species switching
- Diversification in livelihoods
- Sharing/Exchanges of resources
- Modification of landscapes
- Changes in mobility
- Greater engagement in science
- Active political action

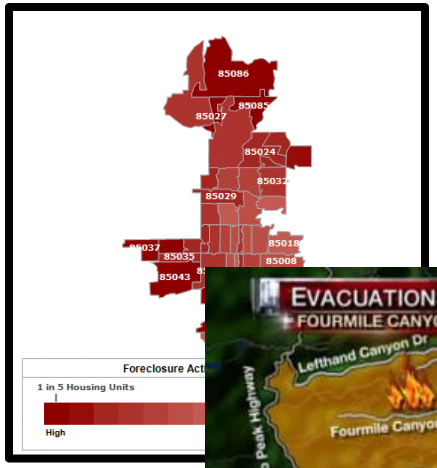

On-going persistence

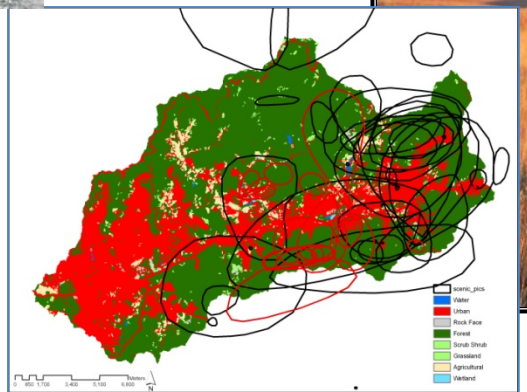
Thoughts and questions…

- The contrasting conditions illustrate how *legacy*, *geography* and *choice* shape community vulnerability and resilience.
- Consider climate effects in the context of cumulative effects
- Questions:
  - In what ways and to what extent do cash resources contribute to the adaptive capacity of northern communities to cope with (thrive in spite of) the drivers of climate change?
  - Is there a strategic adaptive advantage to <u>not</u> being highly engaged in the cash economy and living a more "traditional" way of life?
    - The poverty trap vs. the infrastructure trap
  - What are the opportunities for greater comparisons?

MALS: Maps and Locals Project

- Integrate local knowledge with LCLUC spatial analysis to understand implications to human well being.
- 11 sites involved
- Map analysis complete
- Inventory of LK methods



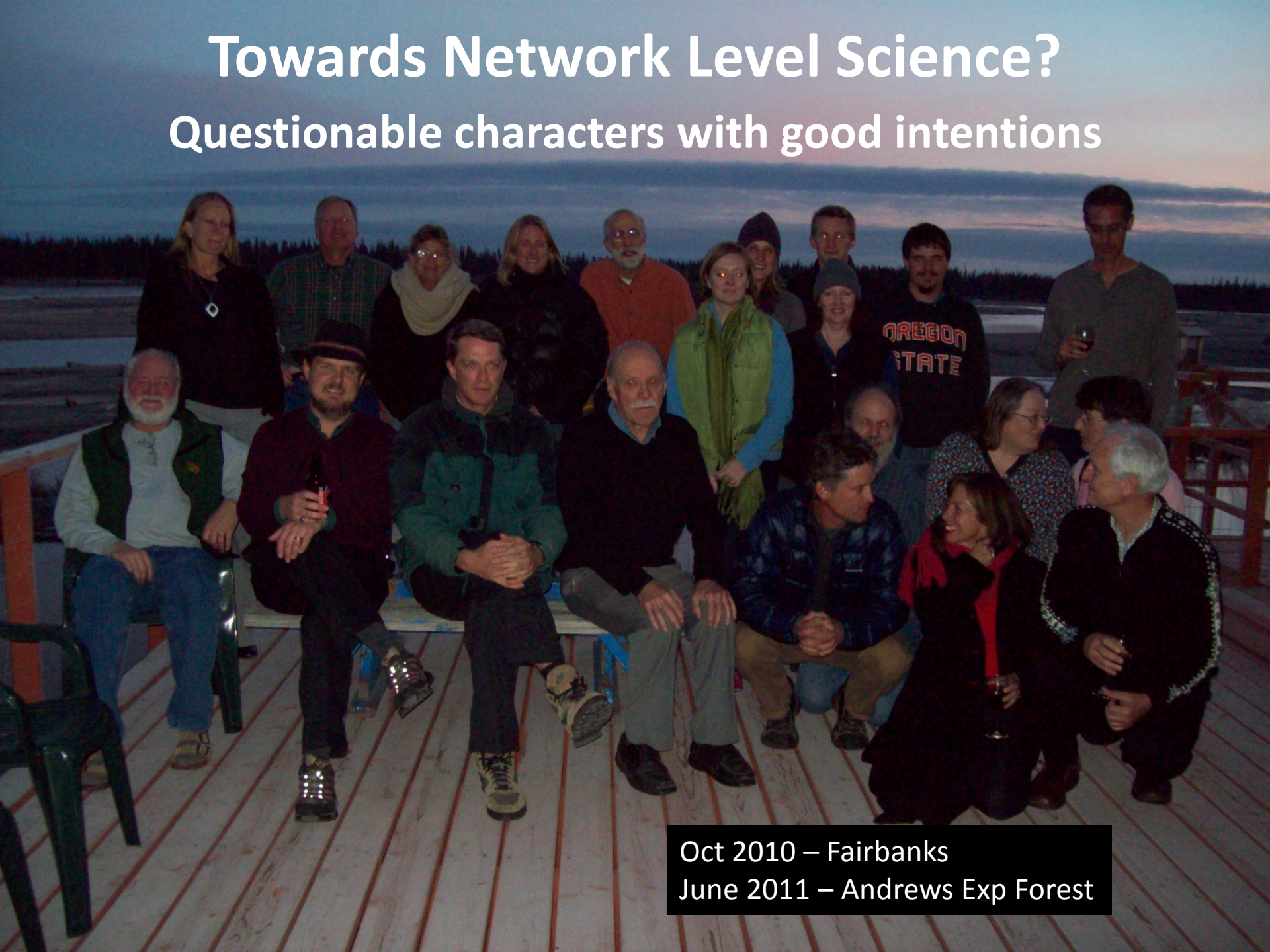


- MALs Search for Common Currencies (gradients; variables):
  - *Drivers* Demographic change; global economic change; climate change
  - *Issues* Fragmentation; Eco Services; Inequity; Δ in disturbance regimes
  - *Dynamics*: Thresholds; Feedbacks; Reversibility, toggle, inertia.

- Emerging Science and Methological questions for MALs:
  - How does degree of “coupledness “ affect responses to change?
  - How does rate of change affect responses to change?
  - How does LK feedback into decisions about LULC?
  - How (where) can local knowledge best contribute?
  - How do we best integrate?

Towards Network Level Science?

Questionable characters with good intentions



Oct 2010 – Fairbanks
June 2011 – Andrews Exp Forest