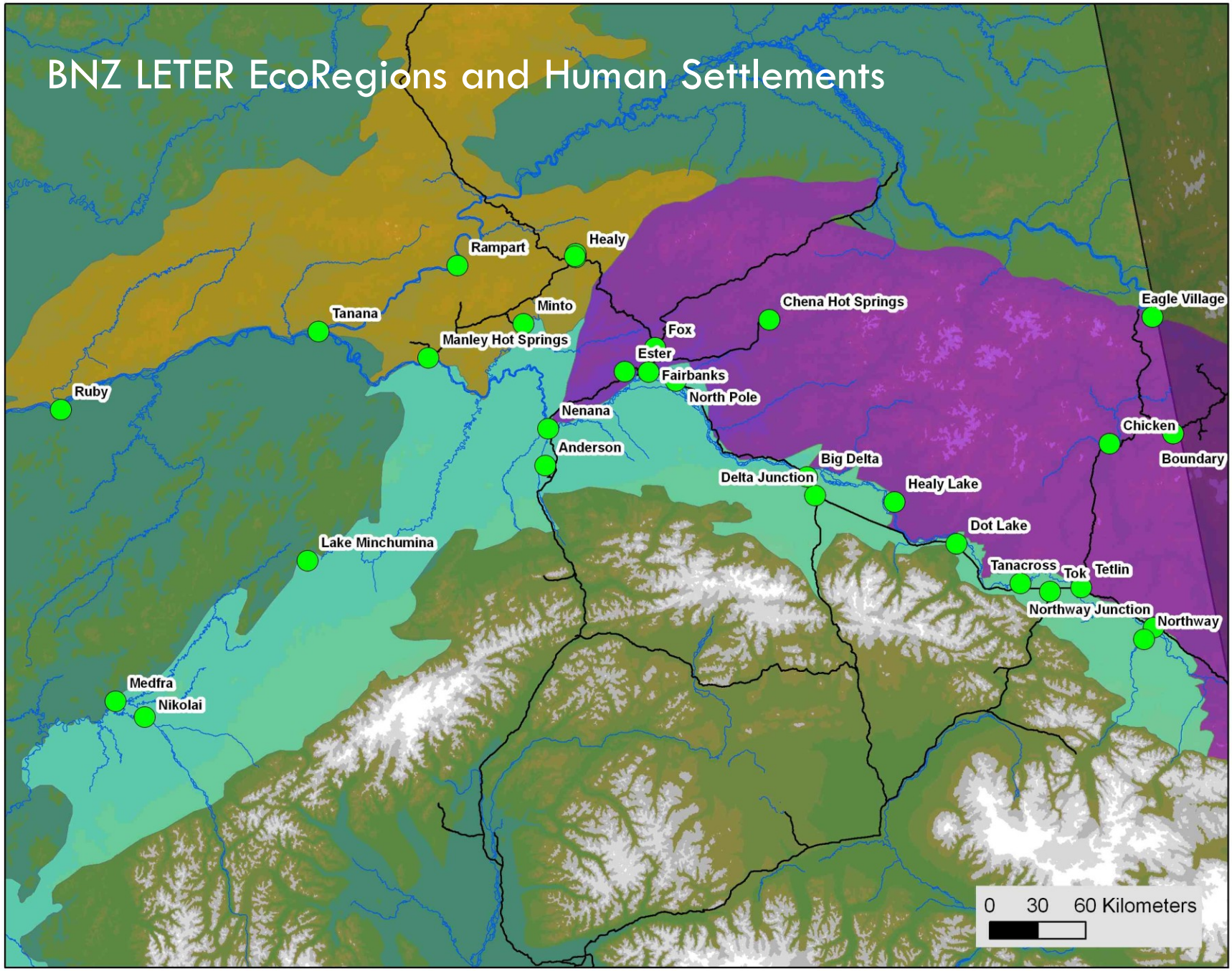
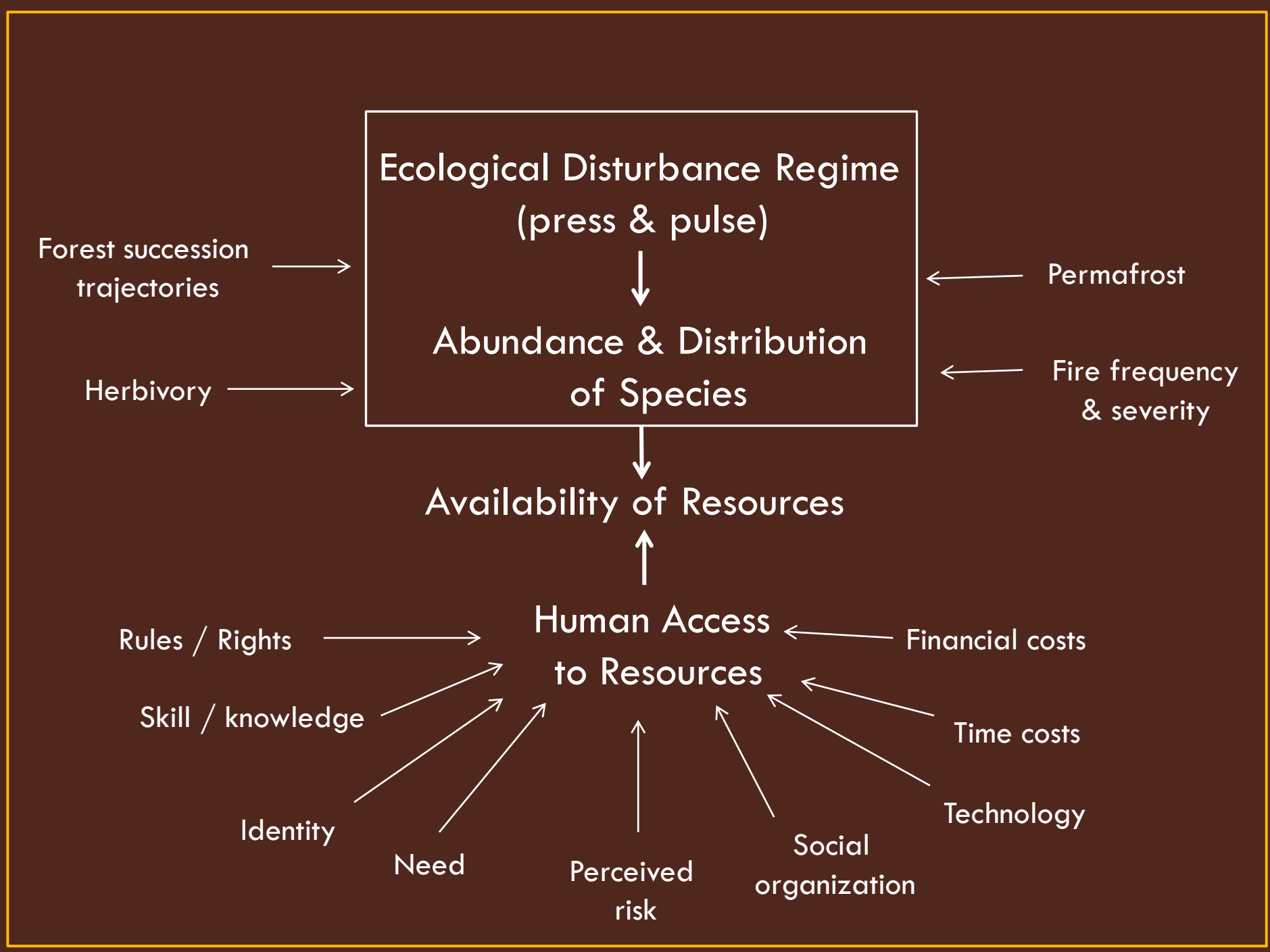
Social-Ecological System Studies at BNZ

Gary Kofinas, Colette de Roo & Todd Brinkman

Bonanza Creek LTER symposium

February 18, 2012


BNZ LETER EcoRegions and Human Settlements
Rampart
Healy
Minto
Tanana
Manley Hot Springs
Chena Hot Springs
Eagle Village
Fox
Ester
Fairbanks
North Pole
Ruby
Nenana
Anderson
Chicken
Boundary
Big Delta
Delta Junction
Healy Lake
Dot Lake
Lake Minchumina
Tanacross
Tok
Tetlin
Northway Junction
Northway
Medfra
Nikolai
0 30 60 Kilometers


Ecological Disturbance Regime
(press & pulse)
Abundance & Distribution
of Species
Forest succession
trajectories
Herbivory
Permafrost
Fire frequency
& severity
Availability of Resources
Human Access
to Resources
Rules / Rights
Skill / knowledge
Identity
Need
Perceived
risk
Social
organization
Financial costs
Time costs
Technology

BNZ SES Questions

1. What ecosystem services are most important to communities and how have they changed?
2. How do changes in social and ecological conditions affect availability of ecosystem services (harvesting of wildlife)
3. What are the relative vulnerabilities of communities of Interior Alaska to climate change?
4. How can we best integrate science and local ecological knowledge to understand change?

Projects

Funded:

- *Sharing Project* (BOEM)
- *Ecosystem Services* (NSF)
- *Modeling Subsistence Tradeoffs* (NSF)
- *MALS Training Workshop* (LTER Network)
- *Human Dimensions of Thawing Permafrost* (NSF)

Proposed:

- *Cross-site Maps and Locals* (CHNS at NSF)
- *Predators and Wildlife Management* (CHNS at NSF)
- *Alaska Adaptation to Environmental Change* (EPSCoR/ NSF)

Vulnerability of Subsistence Systems in Rural Alaskan Communities

- Interior AK is undergoing rapid social-ecological change.
- How vulnerable are rural communities to these changes?
- Are some rural communities more vulnerable than others?
- What framework will guide us to answer these questions?

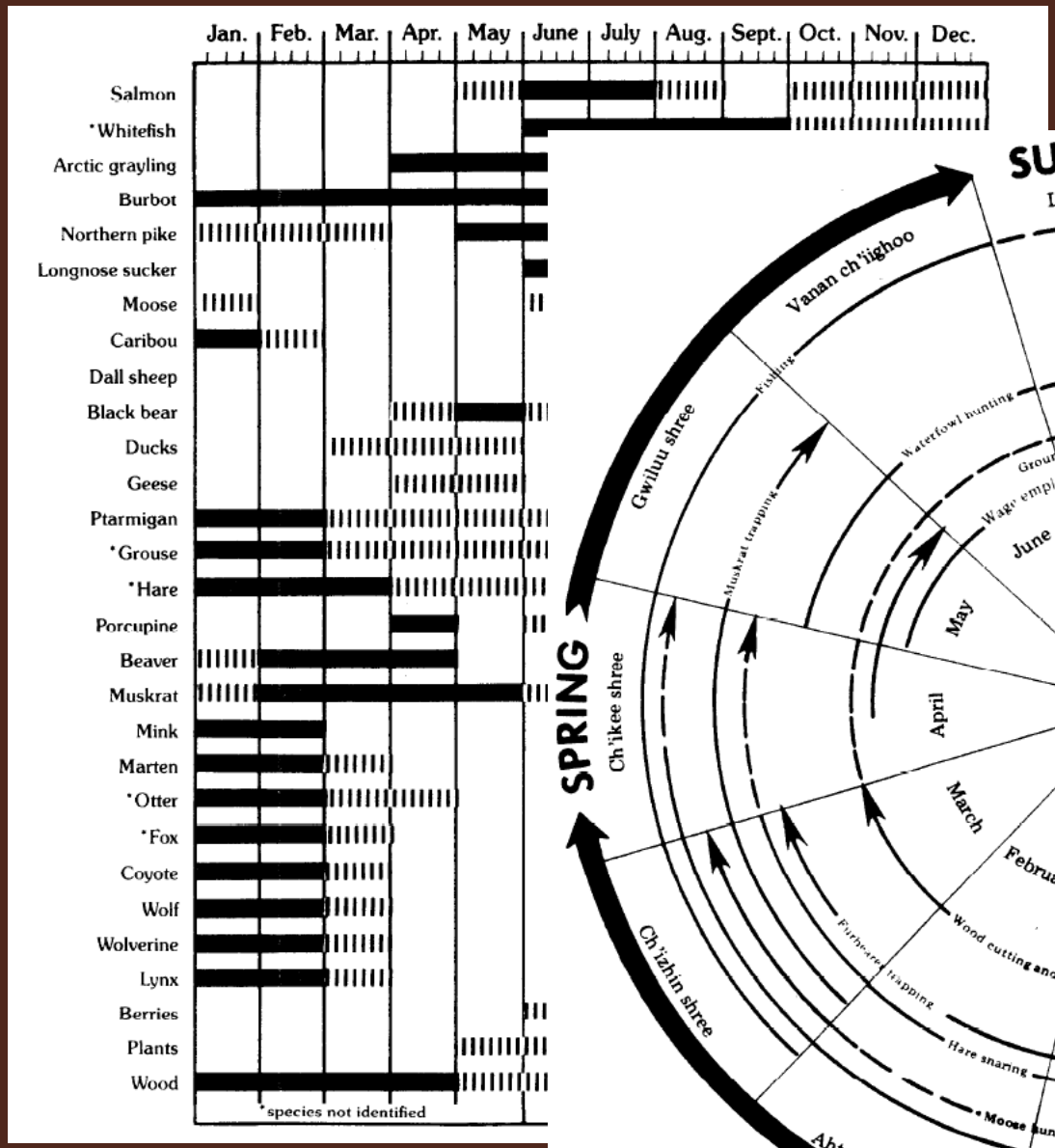
Vulnerability

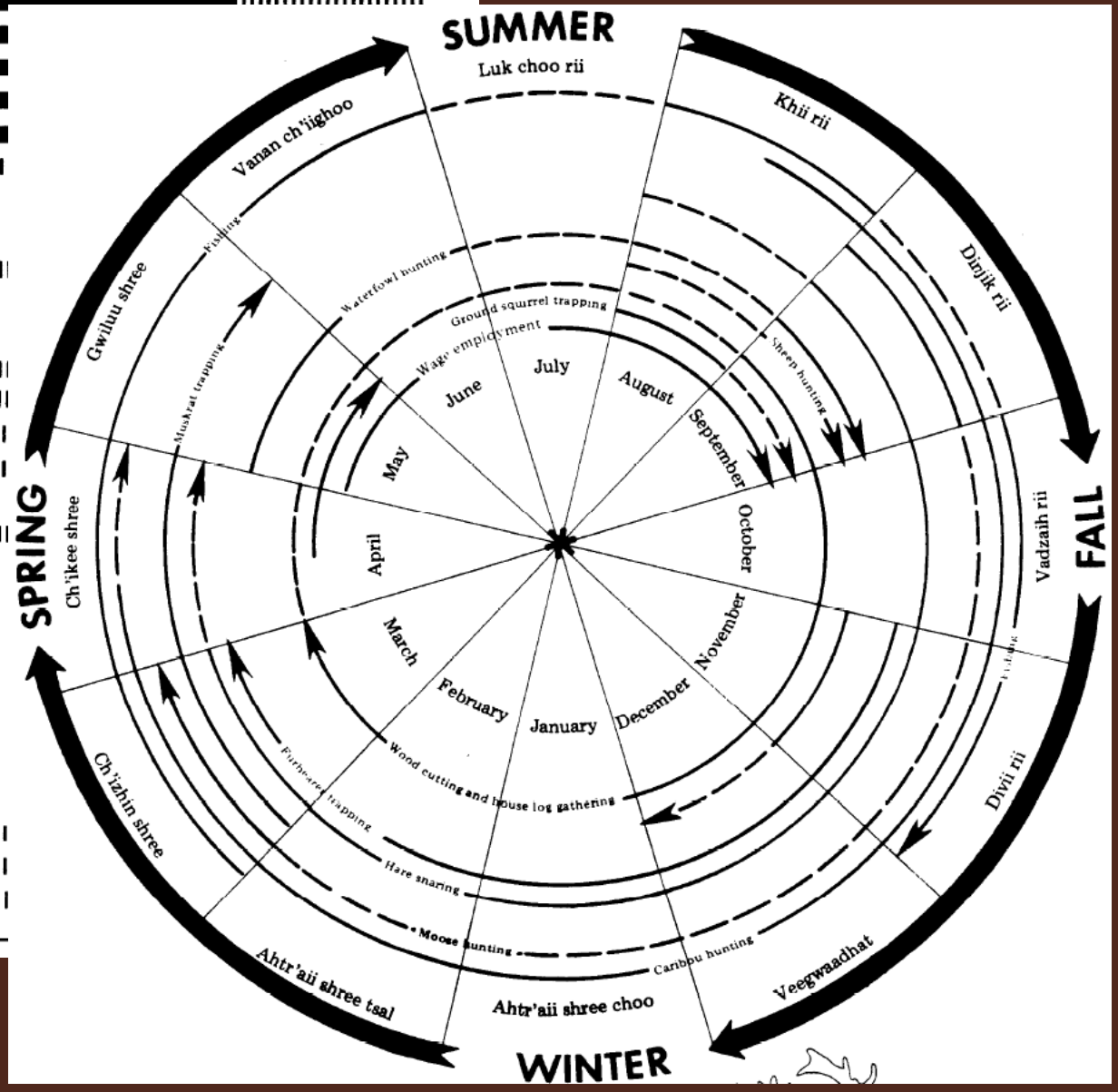
- Vulnerability of a system to changes is determined by:
  - Sensitivity of system characteristics (current status of the system)
  - Exposure to changes potentially compromising the system characteristics (context)

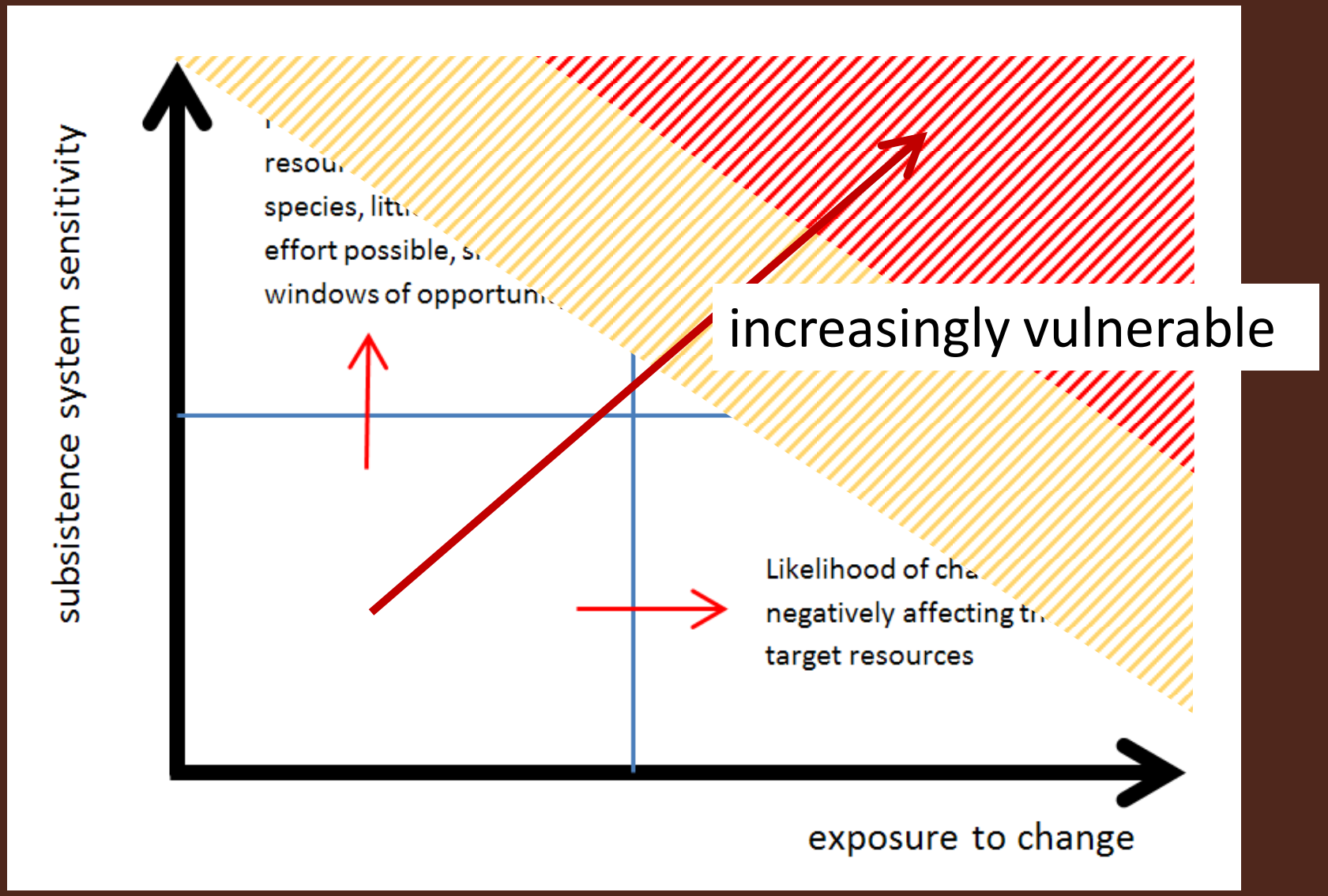
How sensitive are communities?

- Specifically regarding subsistence
- Sensitivity indicators
  - How many resources can communities harvest (over the course of a year)?
  - How many of those resources are efficient? (in pounds of harvest per days of harvesting)?
  - Are there conflicts in timing of efficient resources? (Is there an overlap in when the resources can be harvested?)

Resource (animal)	Meat per animal	Animals per effort (2 days)	Max pounds per effort in two days
Moose	250-500 lb	1	~500 lb
Caribou	50-100 lb	5	~500 lb
Salmon	5-15 lb	50	~750 lb


Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Salmon
*Whitefish
Arctic grayling
Burbot
Northern pike
Longnose sucker
Moose
Caribou
Dall sheep
Black bear
Ducks
Geese
Ptarmigan
*Grouse
*Hare
Porcupine
Beaver
Muskrat
Mink
Marten
*Otter
*Fox
Coyote
Wolf
Wolverine
Lynx
Berries
Plants
Wood
*species not identified


SUMMER
Luk choo rii
Khii rii
Dinjik rii
FALL
Vadzaih rii
Divii rii
Veegwaadhat
WINTER
Ahtr'aii shree choo
Ahtr'aii shree tsal
Ch'izhin shree
SPRING
Ch'ikee shree
Gwiluu shree
Vanan ch'ighoo
May
June
July
August
September
October
November
December
January
February
March
April
Fishing
Waterfowl hunting
Ground squirrel trapping
Wage employment
Muskrat trapping
Sheep hunting
Wood cutting and house log gathering
Fur-bearer trapping
Hare snaring
Moose hunting
Caribou hunting

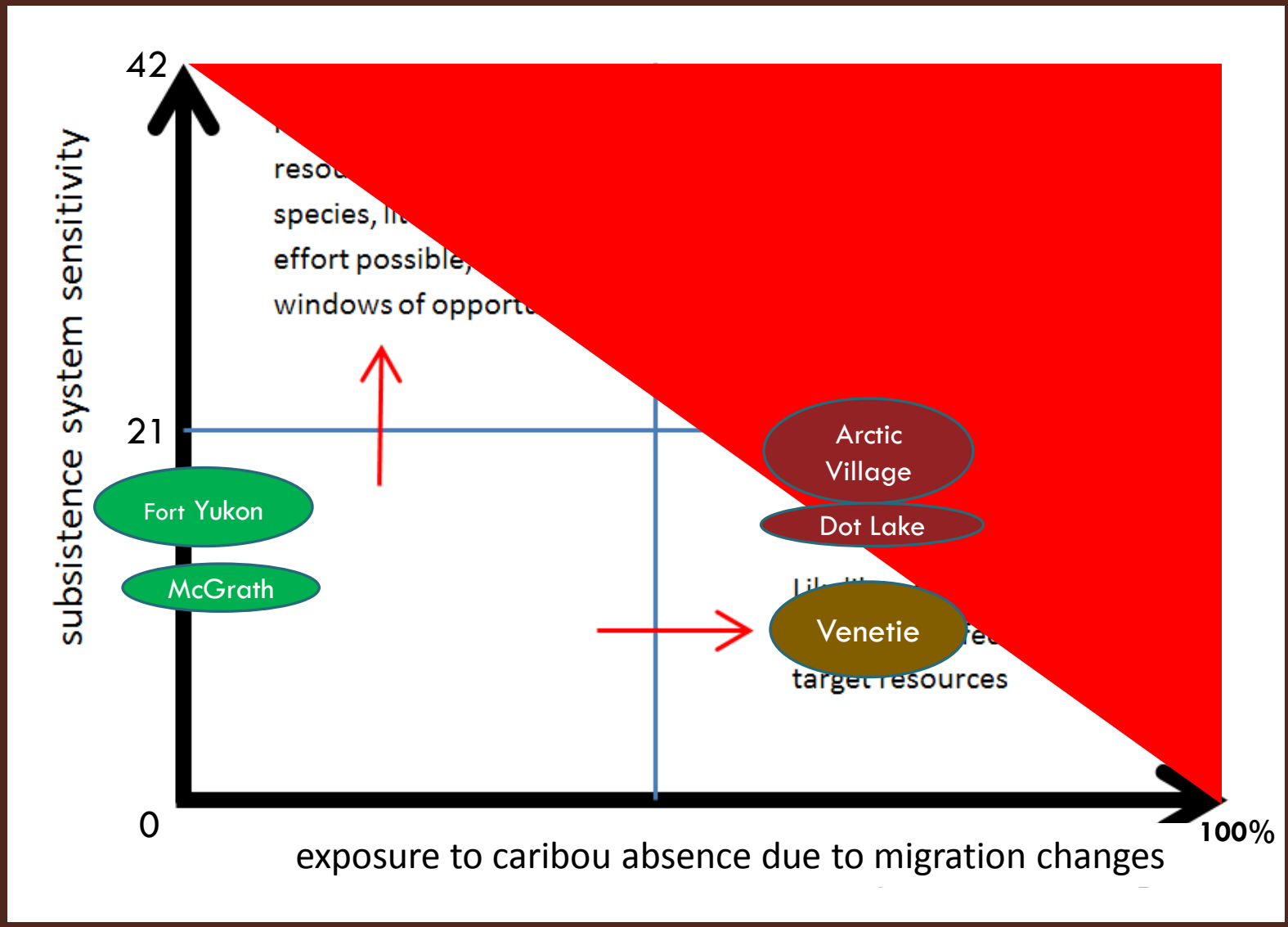

subsistence system sensitivity
resou
species, litt
effort possible, s
windows of opportun
increasingly vulnerable
Likelihood of cha
negatively affecting t
target resources
exposure to change

Thought experiment

- Five Interior Alaskan communities:
  - Arctic Village, Dot Lake, Fort Yukon, McGrath, Venetie
- Assuming their exposure is the same, can we say something about their relative sensitivity?

Sensitivity of communities (SR data)

	# of species		*Efficiency*		*Exclusivity*			*Total relative sensitivity*
INTERIOR community	Total # of species (out of 47)	*Points (5-4-3-2-1 for each increment of 5)*	Efficient species	*Points (5 for each efficient species)*	Months exclusive / months available	*Points (0 for none, 1 for <half, 2 for >half, 4 for all)*		*Score (42 as the highest possible score minus sum)*
Arctic Village	17	*12*	Caribou	*10*	7 / 9	*2*	*2*	***18***
			Moose		0 / 2	*0*		
Dot Lake	28	*15*	Caribou	*10*	4 / 5	*2*	*2*	***15***
			Moose		0 / 1	*0*		
Fort Yukon	19	*12*	Moose	*10*	3 / 4	*2*	*4*	***16***
			Salmon		3 / 4	*2*		
McGrath	27	*15*	Moose	*10*	2 / 3	*2*	*4*	***13***
			Salmon		2 / 3	*2*		
Venetie	21	*14*	Caribou	*15*	2 / 5	*1*	*5*	***8***
			Moose		0 / 3	*0*		
			Salmon		6 / 6	*4*		

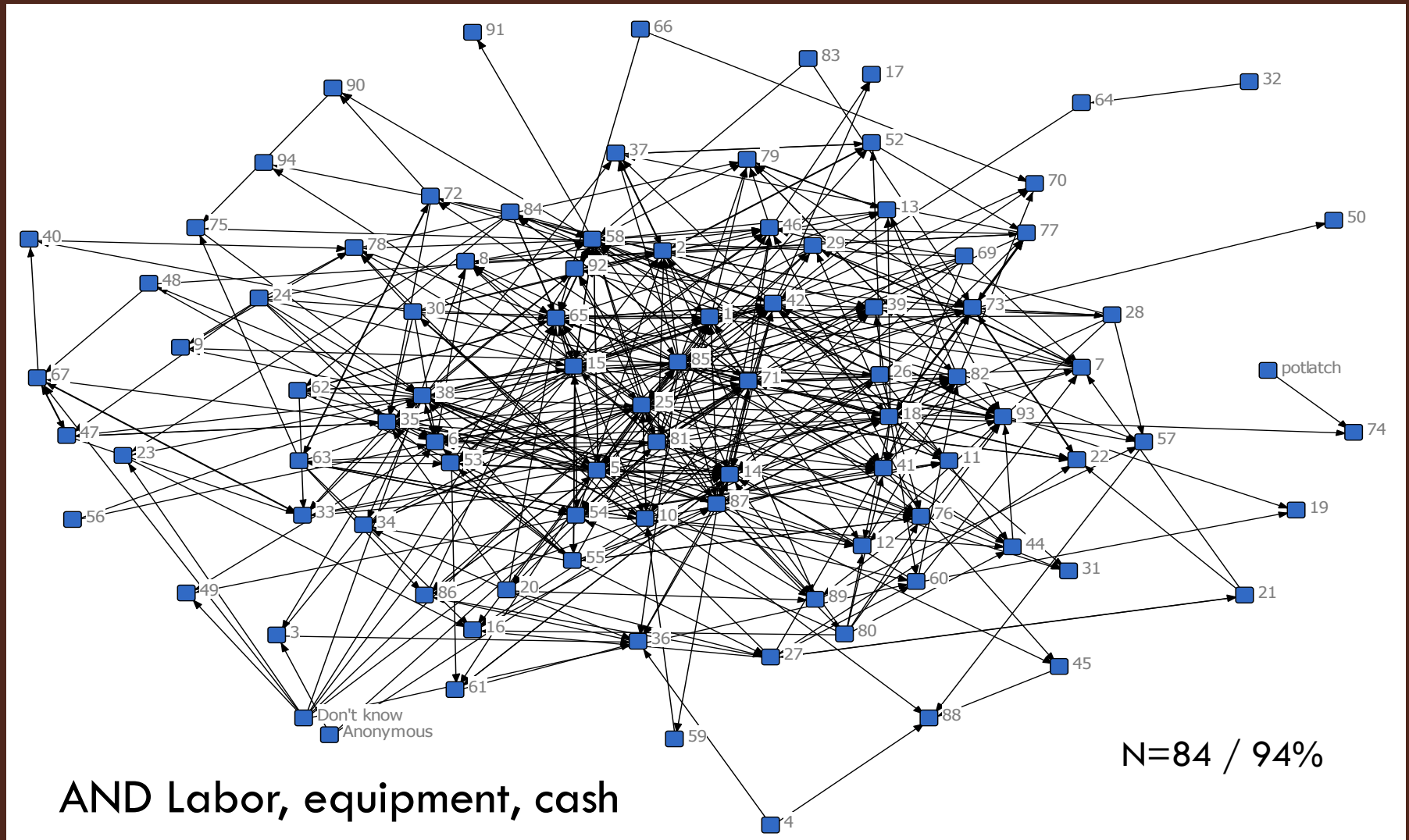

42
21
0
subsistence system sensitivity
species, li
effort possible
windows of opport
Fort Yukon
McGrath
Arctic Village
Dot Lake
Venetie
target resources
100%
exposure to caribou absence due to migration changes

Outstanding Needs:

- More (current) data on community sensitivity
  - Household harvest surveys
  - Ethnographic studies
- Translation of findings on different pressures on harvest resources into degrees of exposure.

Subsistence Sharing as a source of Resilience

Receiving ties in Venetie: Caribou, moose, geese, ducks, salmon, berries, bowhead



AND Labor, equipment, cash

MAPS and Locals (MALS)

North Slope landscape change

Maps and Locals (MALS) project

Increase in surface standing water due to melting of ice-wedges between polygons 2001-2010

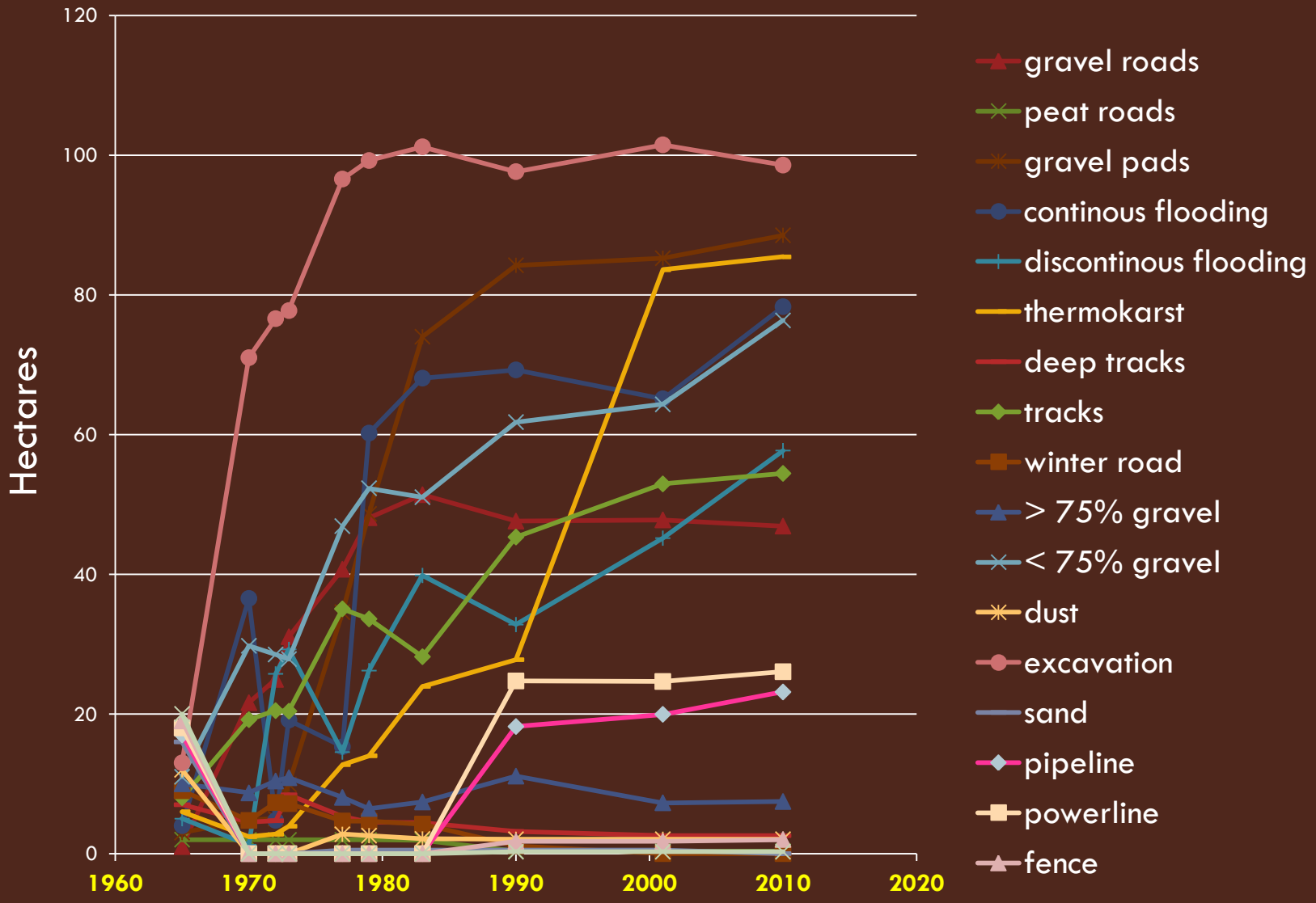
Martha Reynolds

North Slope landscape change

Maps and Locals (MALS) project

(1990, 2000, 2010 data new)

Martha Reynolds



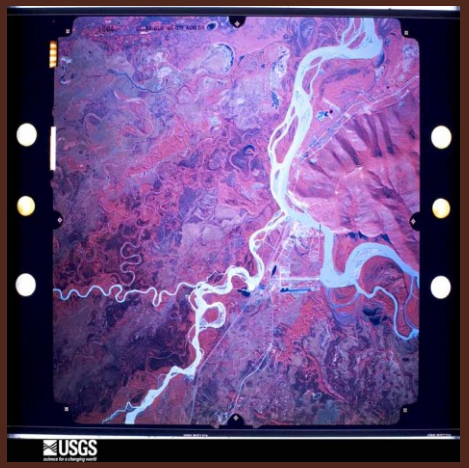
Nenana, AK

pop.= 402; 41% AK Native; per cap income $17,334

1949

1972

1986



1996

2012

IMPACTS OF CLIMATE CHANGE ON ECOSYSTEM SERVICES:

An Integrative Model

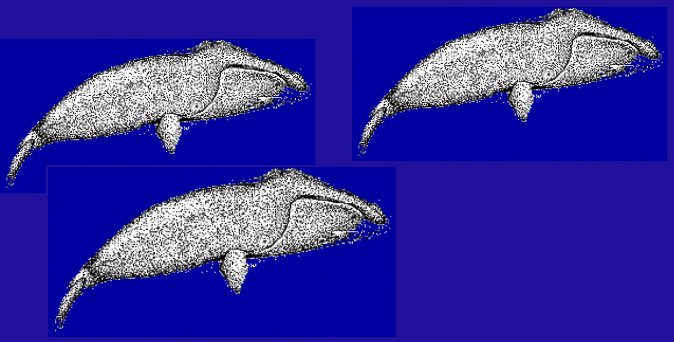
Todd J. Brinkman, Winslow Hansen, Terry Chapin, Gary Kofinas and Scott Rupp

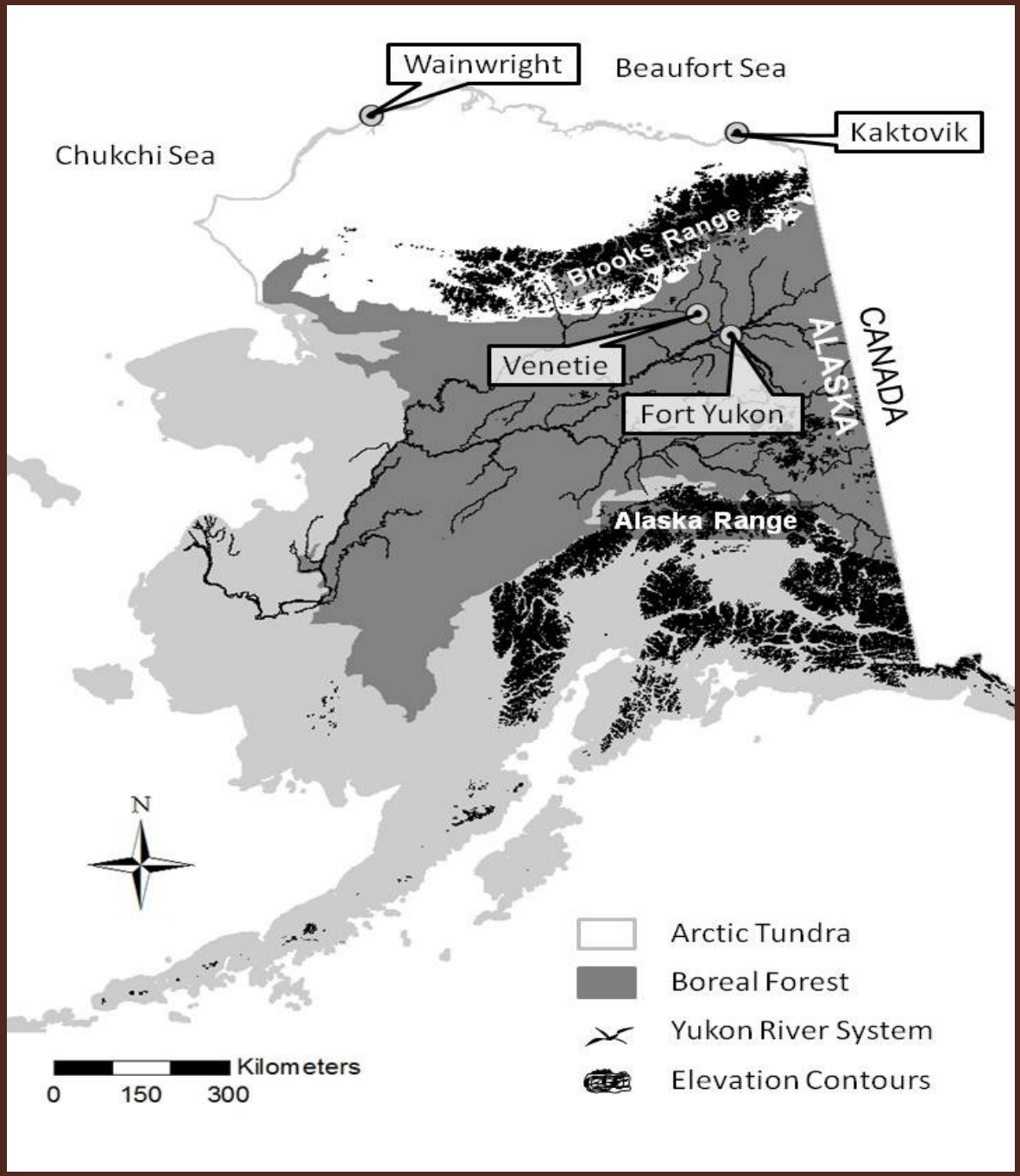
Research Questions

- How are climate-driven changes affecting the availability of subsistence resources?
- How might these changes affect availability of resources in the future?

species abundance + hunter access + seasonal distribution

= Availability




Wainwright
Beaufort Sea
Kaktovik
Chukchi Sea
Brooks Range
CANADA
ALASKA
Venetie
Fort Yukon
Alaska Range
N
Arctic Tundra
Boreal Forest
Yukon River System
Elevation Contours
Kilometers
0
150
300

Critical species or species groups (19 species)

Community	Species
Wainwright (n = 6)	Bowhead, Caribou, Beluga, Fish, Waterfowl, Bearded Seal
Kaktovik (n = 6)	Bowhead, Caribou, Dall sheep, Fish, Waterfowl, Bearded seal

Document status and trends

- For each species (Ex. Moose)
  - **When does most moose harvest occur?**
    - **What factors affect timing of harvest?**
  - **How are moose distributed around the landscape?**
    - **What factors affect distribution?**
  - **How do you access your hunting areas?**
    - **What factors affect access ?**
  - **What is the current size of the moose population around your village?**
    - **What affects abundance?**

Identify Relationships between Climate Variables and Availability

	Temperatures	Rain & Drought	Snow	Freeze up /Thaw Date	Fire	Wind
Seasonal distribution						
Access						
Abundance						

"Warmer temperatures have made September hunting more challenging."

"Forest fires destroy our trails and makes access to moose hunting areas difficult for years."

Moose	Fire
Abundance	+Creates better habitat
Seasonal Distribution	-Displaces initially, +then is selected for soon after
Hunter Access	-Destroys trails Regrowth -Obstructs sightability -Rougher travel conditions off trails -Destroys seasonal cabins

Caribou	Fire
Abundance	-Destroys habitat
Seasonal Distribution	-Pushes caribou away, caribou avoid burns for several human generations
Hunter Access	-Destroys trails Regrowth -Obstructs sightability -Rougher travel conditions off trails -Destroys seasonal cabins

Fish	Fire
Abundance	?
Seasonal Distribution	-Alters channels and eddies in unpredictable ways
Hunter Access	-Loads debris in waterways: Tangles nets, Damages fish wheels -Creates dangerous travel conditions -Employment opportunities overlaps with peak harvest time

Community	Individual species	Component	Change	Availability	All species
Fort Yukon	Moose	Abundance	+	-	-
		Access	-		
		Distribution	-		
	Waterfowl	Access	-	-	
	Fish	Distribution	-	-	
		Access	-		
Venetie	Moose	Abundance	+	0	-
		Access	-		
		Distribution	0		
	Caribou	Abundance	-	-	
		Access	-		
		Distribution	-		
	Waterfowl	Access	-	-	
	Fish	No change expected		0	

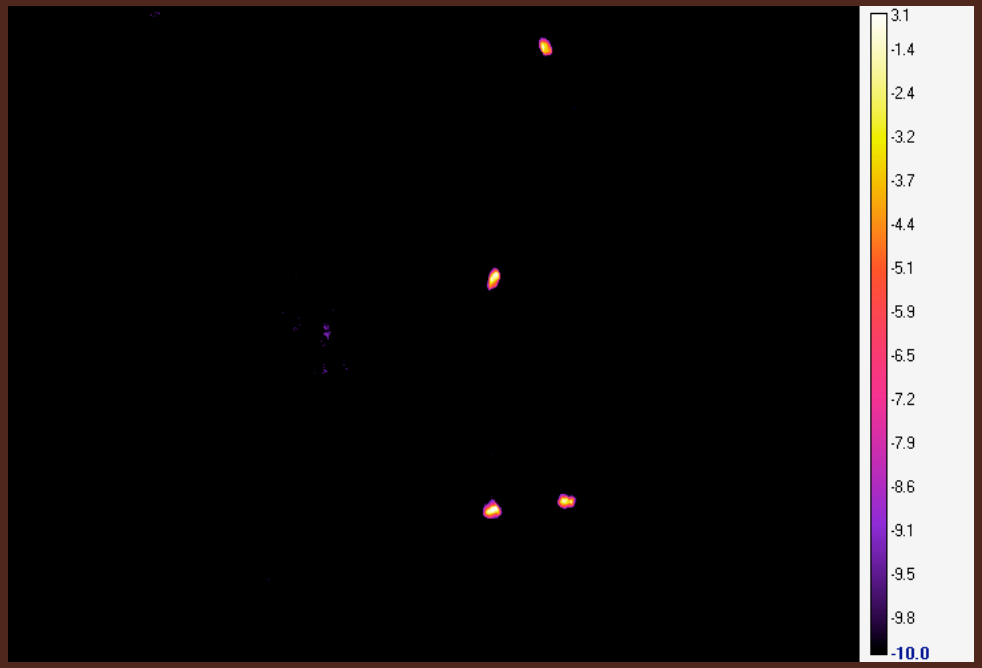
Environmental changes in access driving changes in availability

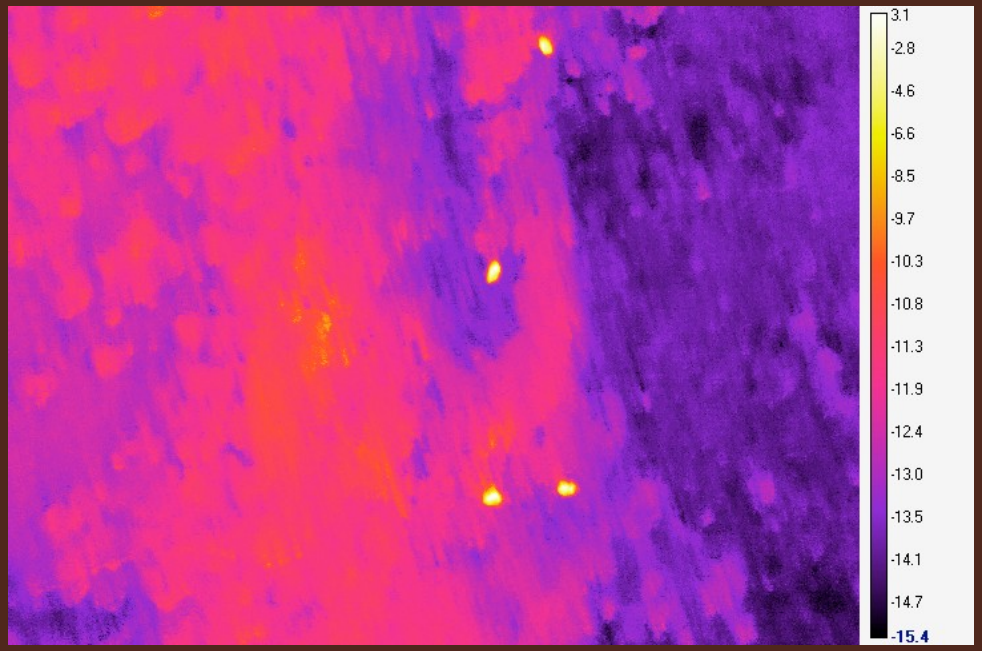
Availability Component	# of Relationships	# Species
Hunter Access	28	13
Distribution	13	7
Abundance	5	4

Relevant Access-Driven Proposals & Projects

How are moose responding to warmer fall temperatures?

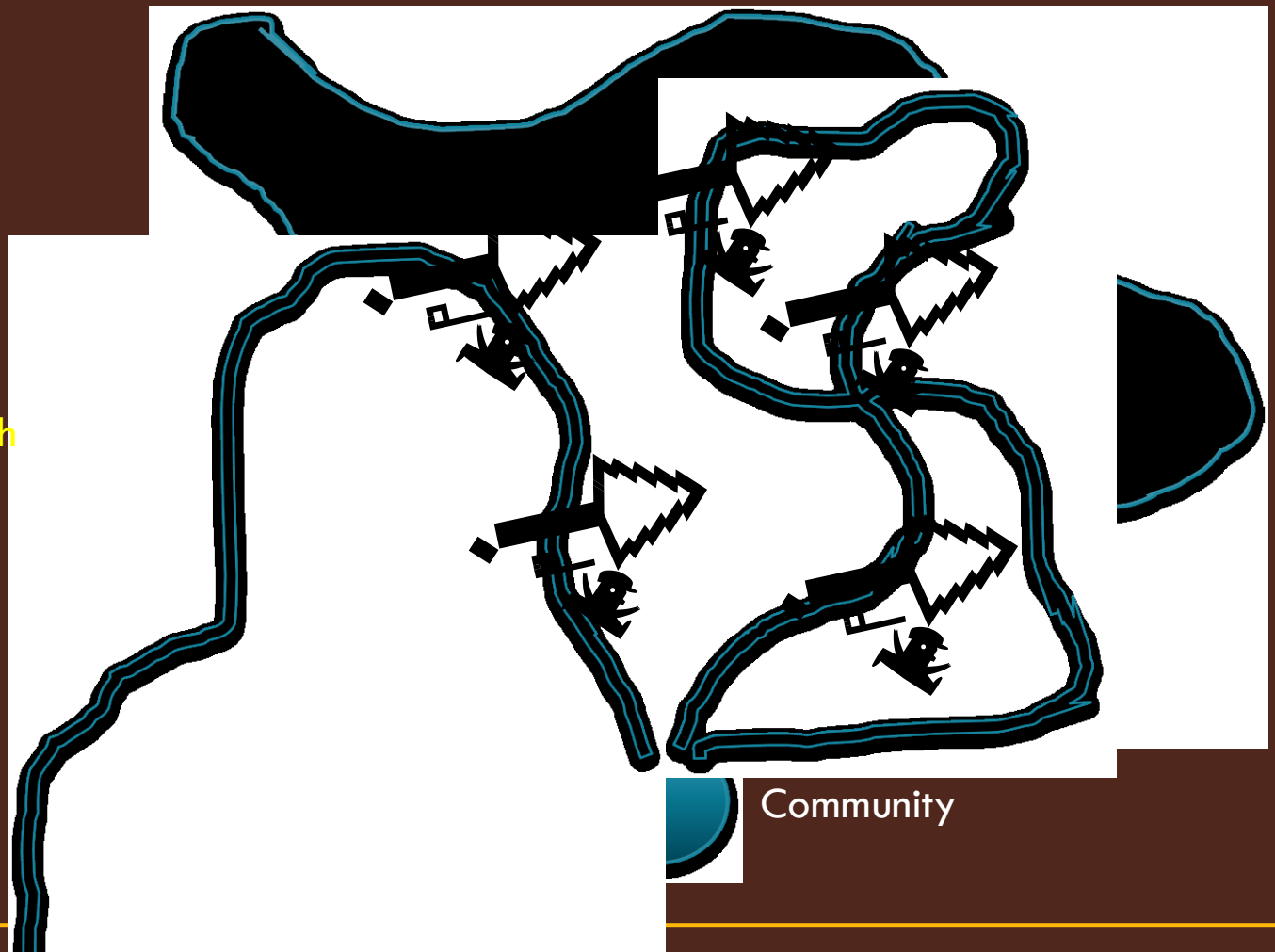
Collaborators:
Todd Brinkman
Jessica Cherry
Kalin Seaton
Keith Cunningham





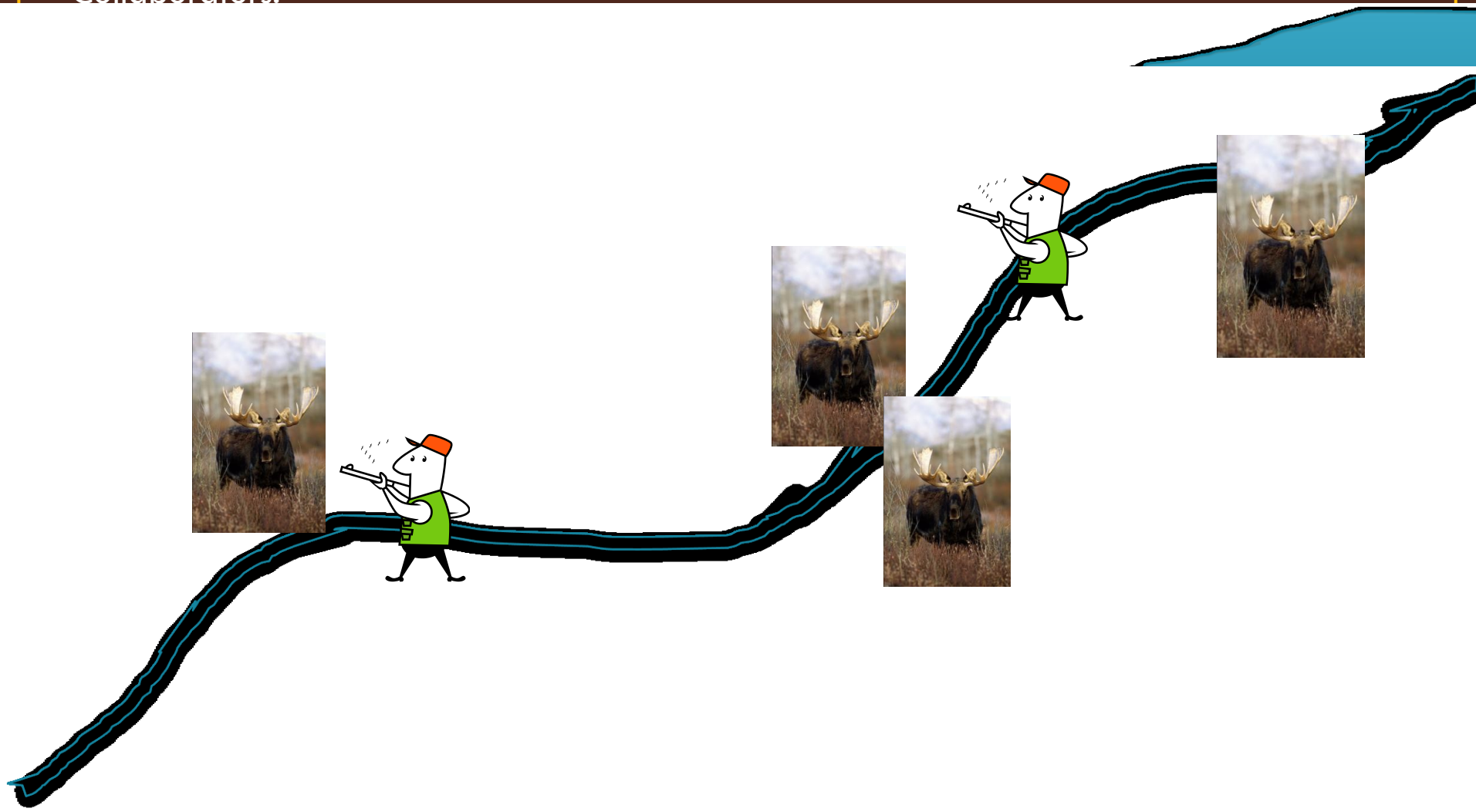
To what extent are wildfires affecting hunter access?

Collaborators:
Venetie Hunters
Todd Brinkman
Keith Cunningham
Kirsten Barrett
Teresa Hollingsworth



Relationship between moose activity and hunter activity

Collaborators:



Others projects of interest to the LTER

- Survey of hunters attitudes toward antlerless hunts in wildlife management unit 20 (~10,000 interior hunters)
- Survey of the impact of fuel costs on subsistence activities in Interior Alaska (150 hunters from 10 communities)
- Impact of lake basin change on important hunting areas.

With thanks to

- Carolyn Brown, Jim Fall, Jim Magdanz, David Koster (ADF&G), Shauna BurnSilver (ASU), Jen Schmidt (SNAP), and others. . .