Monitoring Wildlife

Upcoming Schedule

- Today – Wildlife
- Tomorrow – Human Footprint
- March 27th – Environmental Change
- March 28th – Future
- April 3rd – Canada from space
- April 4th – Final exam review

Learning Objectives

- Wildlife
  - What is it?
  - Why monitor it?
  - Historical monitoring
  - Remote sensing technologies used to monitor wildlife
    - How do we track animal movement?
    - How do we quantify animal habitat?
    - How to we combine animal movement data and satellite derived animal habitat data to answer questions related to conservation?
      - What kinds of questions can we answer?
  - Applications/examples
    - Grizzly bear

Wildlife Introduction

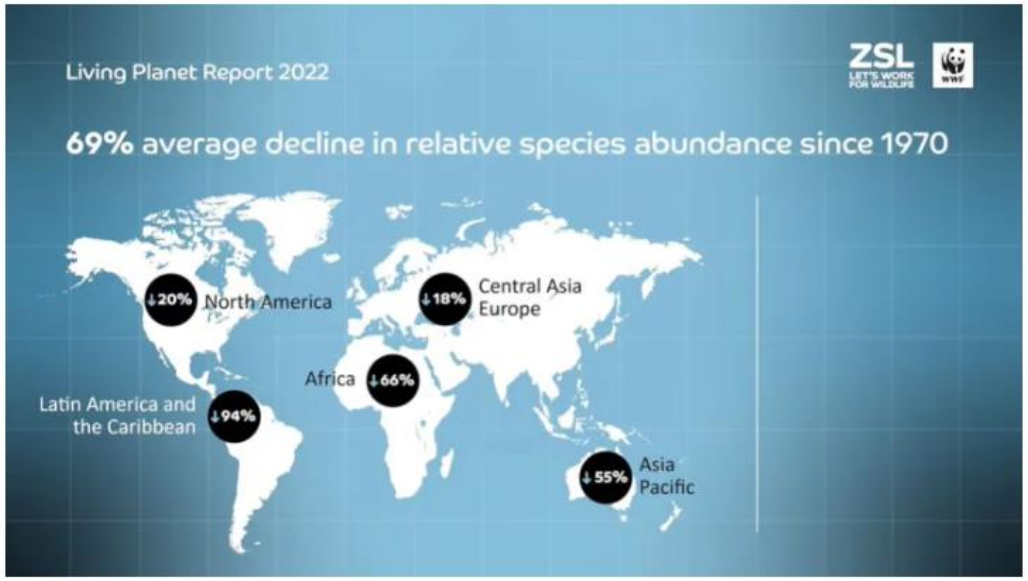
- The term wildlife refers to:
  - Undomesticated animal species
    - Meaning they live independently of people
- Typically includes:
  - Mammals
  - Birds
  - Fishes
  - Amphibians
  - Reptiles

Why Monitor Wildlife?

- Ethical
  - Preserve species for future generations
  - Intrinsic value in wildlife species
- Political
  - Endangered & threatened species
  - IUCN list
- Cultural
  - Identities
  - Sustenance
- Ecological
  - Serve key purposes in ecosystem functions

Why Monitor Wildlife?

- Monitoring wildlife allows us to:
  - Track population trends
  - Identify threatened/endangered species
- The addition of earth observation remote sensing allows us to:
  - Efficiently collect data on animal movement
  - Efficiently quantify animal habitat
    - To ultimately make inferences on why species may be threatened
    - And make management decisions to improve conservation



This map produced by the Zoological Society of London shows the average declines in monitored wildlife populations across the globe over a 48-year period, starting in 1970. (Zoological Society of London)

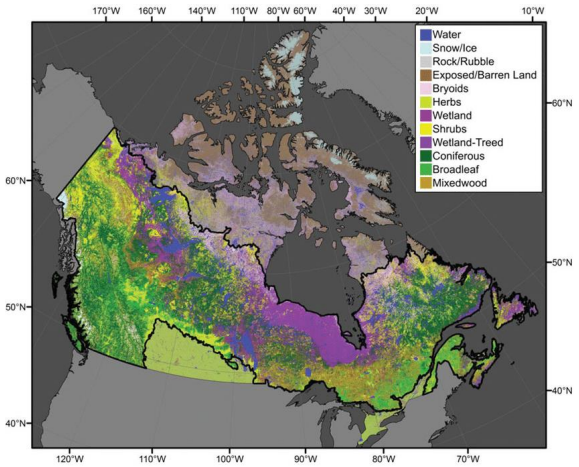
2 Key Aspects

Tracking Animal Movement

- GPS Collars
- GPS Tags
- Camera Traps

Quantifying Animal Habitat

- Satellite data
  - Describe habitat
  - Disturbance info
    - Year
    - Type

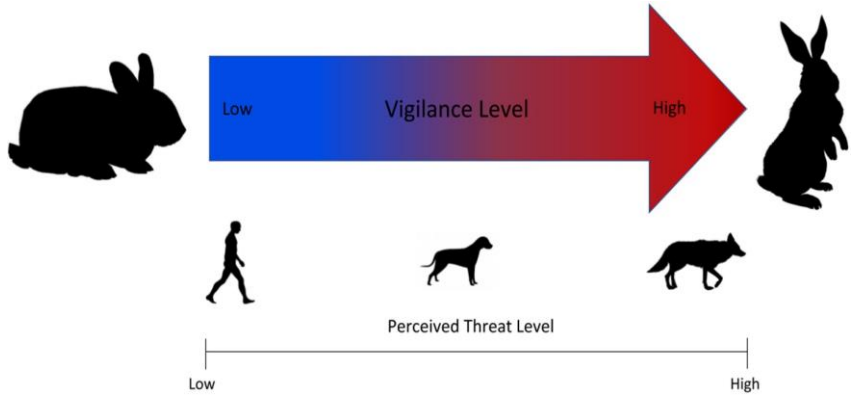


Historically Tracking Animal Movement

- Scientists would go to the field
  - Place themselves in a safe position
  - Or use an aircraft
- Quantify animal movement and behaviour for hours, days, weeks
- Highly susceptible to human error

Historically Tracking Animal Movement

- These field expeditions were still important
  - Provided first datasets on animal movement
  - And animal behaviour
- Did allow quantification of behaviour
  - Sleeping
  - Moving
  - Vigilance
    - How scared are they of predators?
  - Feeding



Tracking Animal Movement: Two Approaches

Lagrangian

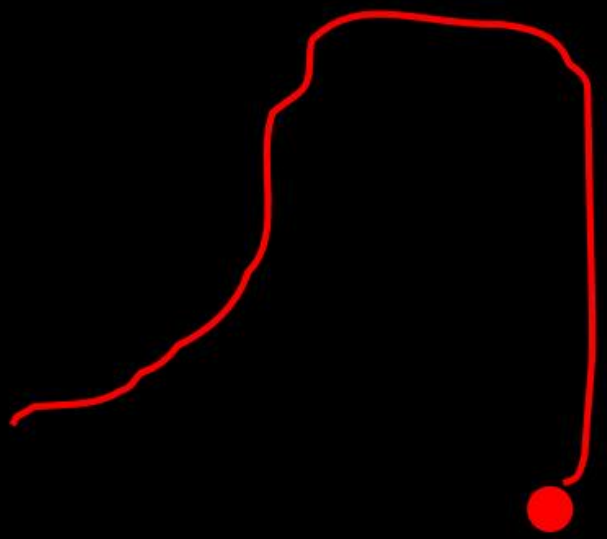
- Animal borne tracking device
- GPS collar
- GPS tag

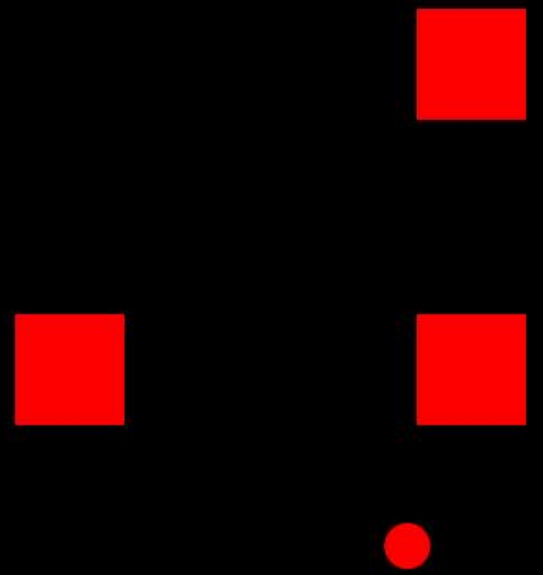
Eulerian

- Pre-determined frame of reference
- Visual surveys
- Camera traps

Animal Tracking
(Lagrangian)

Camera Trapping
(Eulerian)





GPS Collars

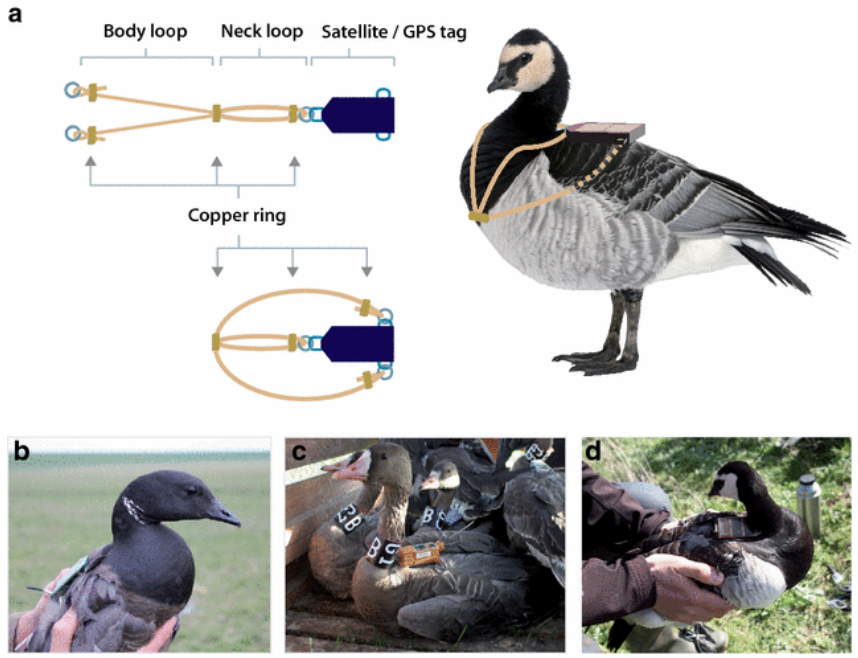
- We put collars on a wide variety of species:
  - Wolves
  - Moose
  - Bears
  - Caribou
  - Deer

GPS Collars

- Accuracy can be 5-10m
  - Depends on terrain
- Can now customize how often we get locations
  - For example:
    - Once each day
    - Once each hour
    - Once every 30 mins
- Collars are removed
  - With a “rot-off” feature
  - Or electronic mechanism

GPS Tags

- We use GPS tags for birds
- Lighter weight version of GPS collars
- Can be attached via rings around body/neck
  - Or to the leg



GPS Collar/Tags

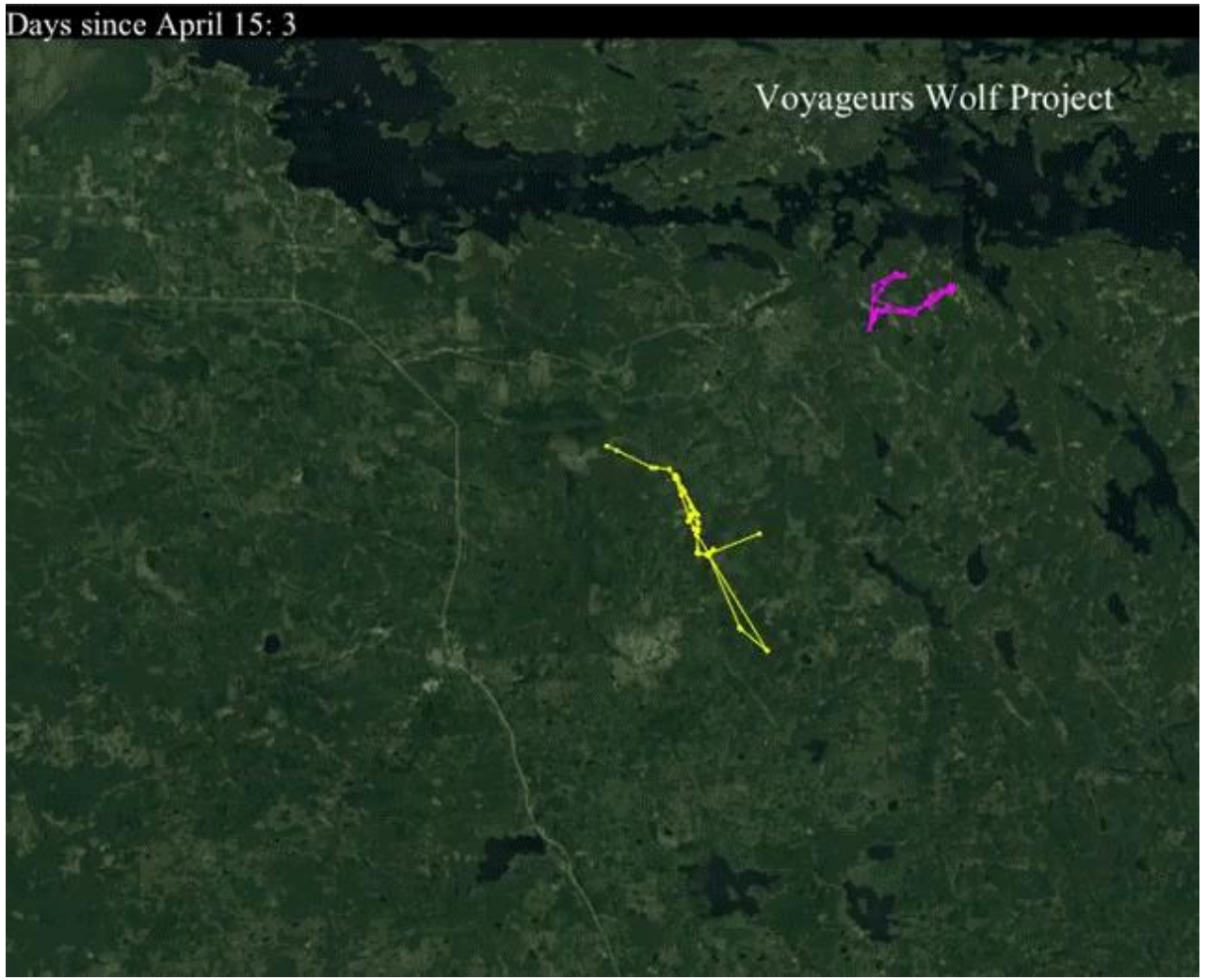
Advantages

- Fine scale movement data
  - Locations up to every 30 mins
- Remote data collection
  - Via satellites

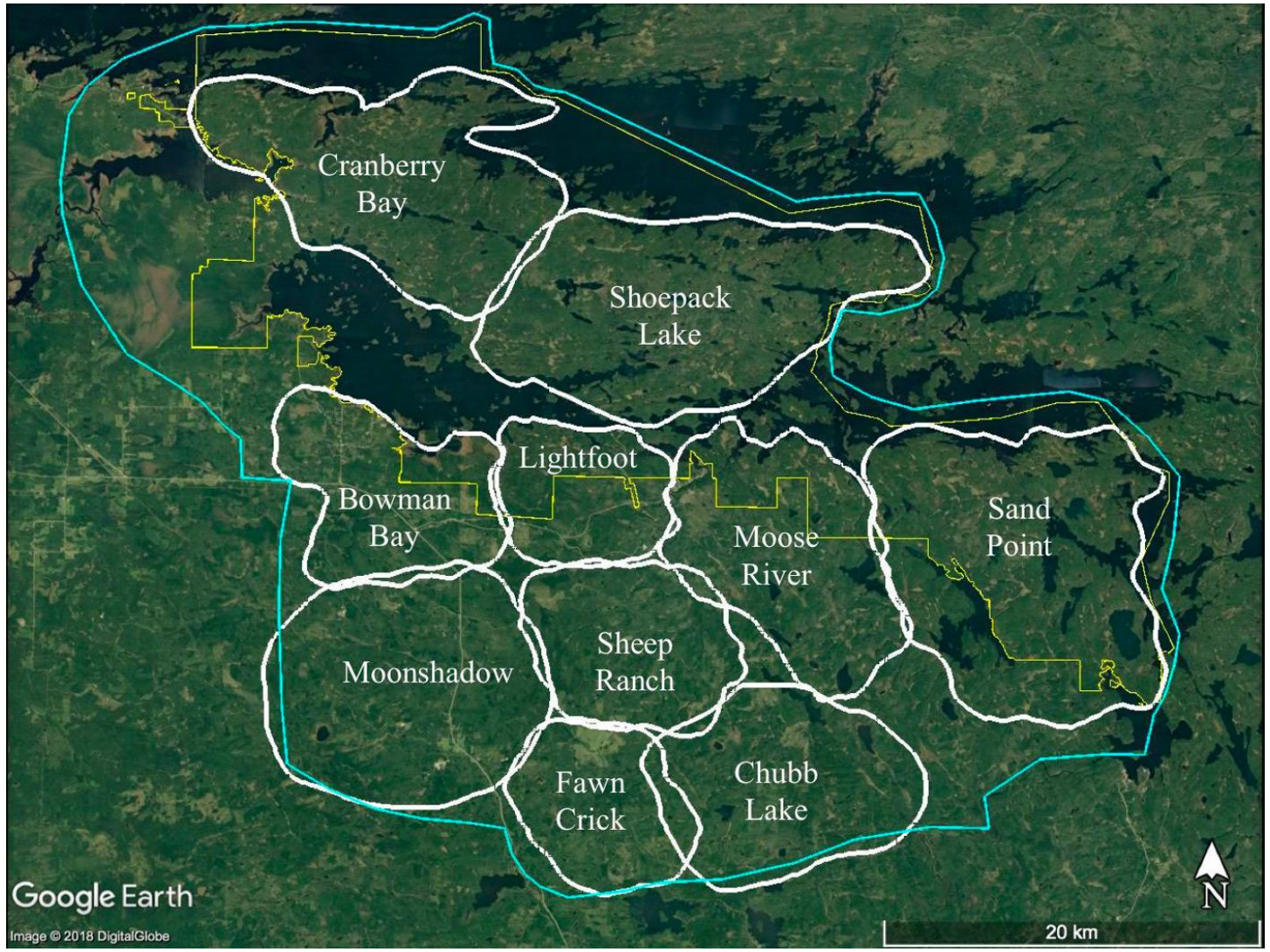
Disadvantages

- Individual level movement
- Expensive
  - Physical collar is expensive
  - Field work to place collars on animals also expensive/time consuming
- Invasive
- Malfunctions

GPS Data Example: Wolf Packs

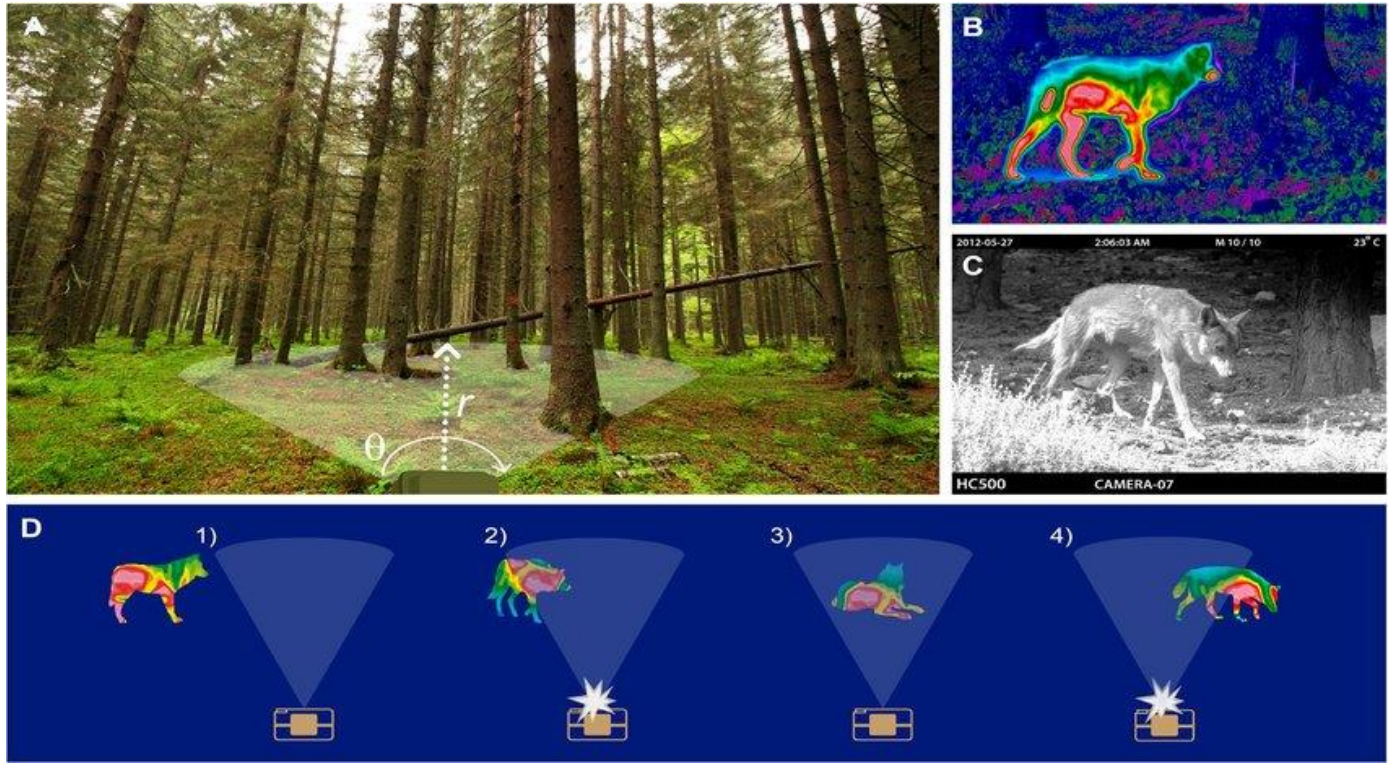


https://www.thisiscolossal.com/2019/01/voyageurs-wolf-project/


Cranberry Bay
Shoepack Lake
Lightfoot
Bowman Bay
Moose River
Sand Point
Moonshadow
Sheep Ranch
Fawn Crick
Chubb Lake
Google Earth
Image © 2018 DigitalGlobe
N
20 km

Camera Traps

- Remotely triggered by moving warm objects



Wearn & Glover-Kapfer 2017

Camera Traps

Advantages

- Non-invasive
- Cost effective
- Population level data
- Multi-species
- Behaviour info

Disadvantages

- Coarser movement data
- Manual data retrieval
  - Have to travel to where cameras are located
- Effected by weather
  - Sometimes get covered in snow or water

Camera Trap Data Examples

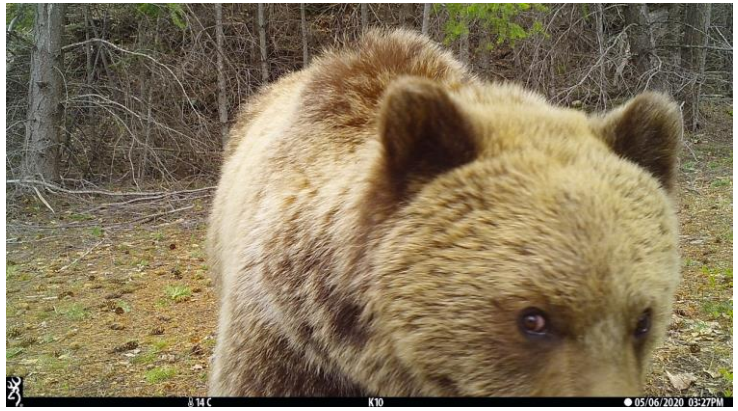


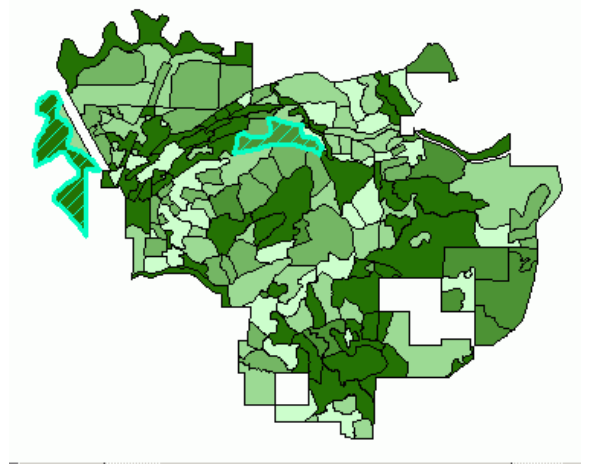
Image credits: Robin Naido & Wildlife Co-existence Lab (UBC)

Quantifying Animal Habitat

- So now we have animal movement data
- Need to relate it to the environment
- To answer questions like:
  - What kind of habitat do animals prefer?
  - What kind of habitat do animals avoid?
- Ultimately for management
  - For Example:
    - Close certain areas to people
    - Harvest forest in only certain areas

Before Satellites

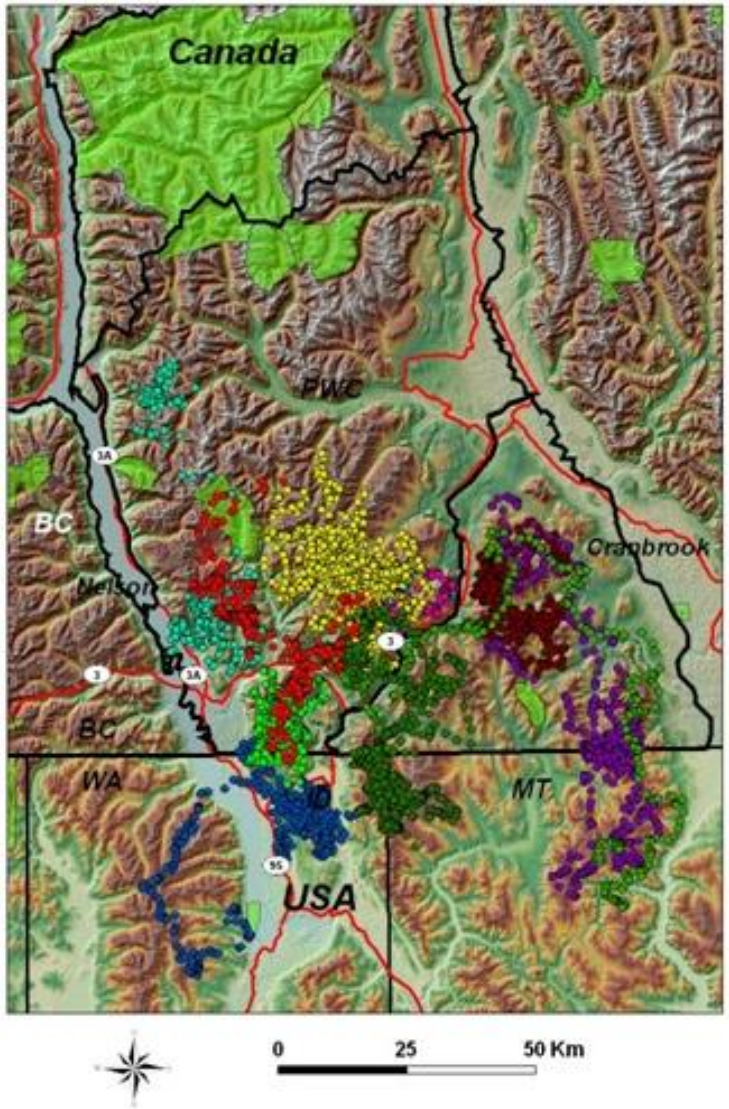
- Historically we quantified habitat manually
- Field work
  - Go to a site an animal spent lots of time in
  - Identify the plant species there
    - Count how many of each species are there
  - Look at the terrain
    - Slope, aspect, etc.
- Often times used aerial surveys
  - Scientists drew maps by hand
  - Sometimes digitized these



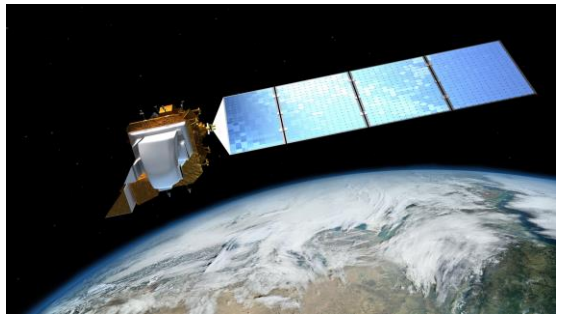
So you have GPS collar data….

- This is an example from Dr. Michael Proctor (Trans-border grizzly bear project)
- 18,000 GPS telemetry locations
- 13 grizzly bears

- Now what?

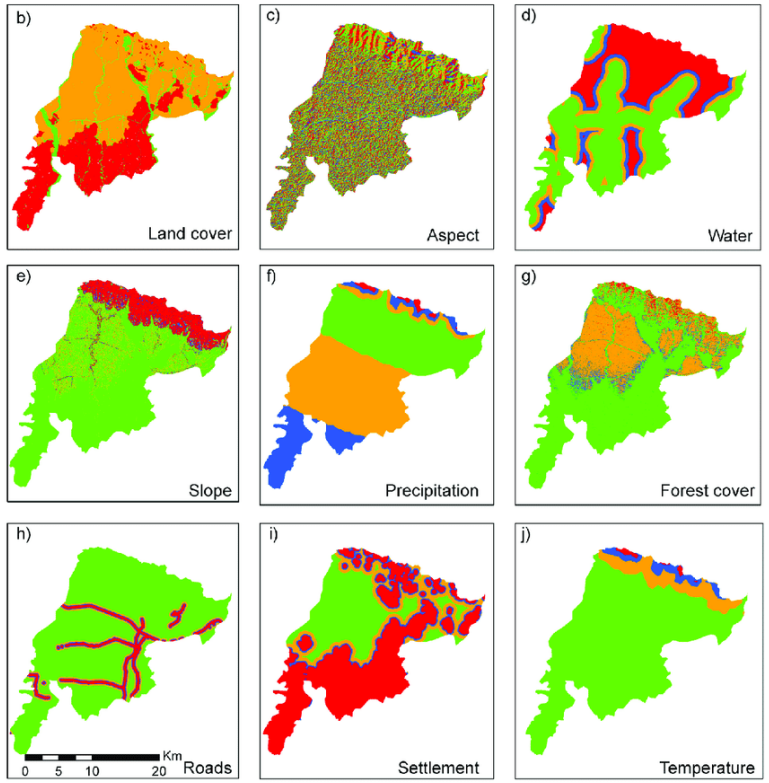


Satellite Habitat Characterization

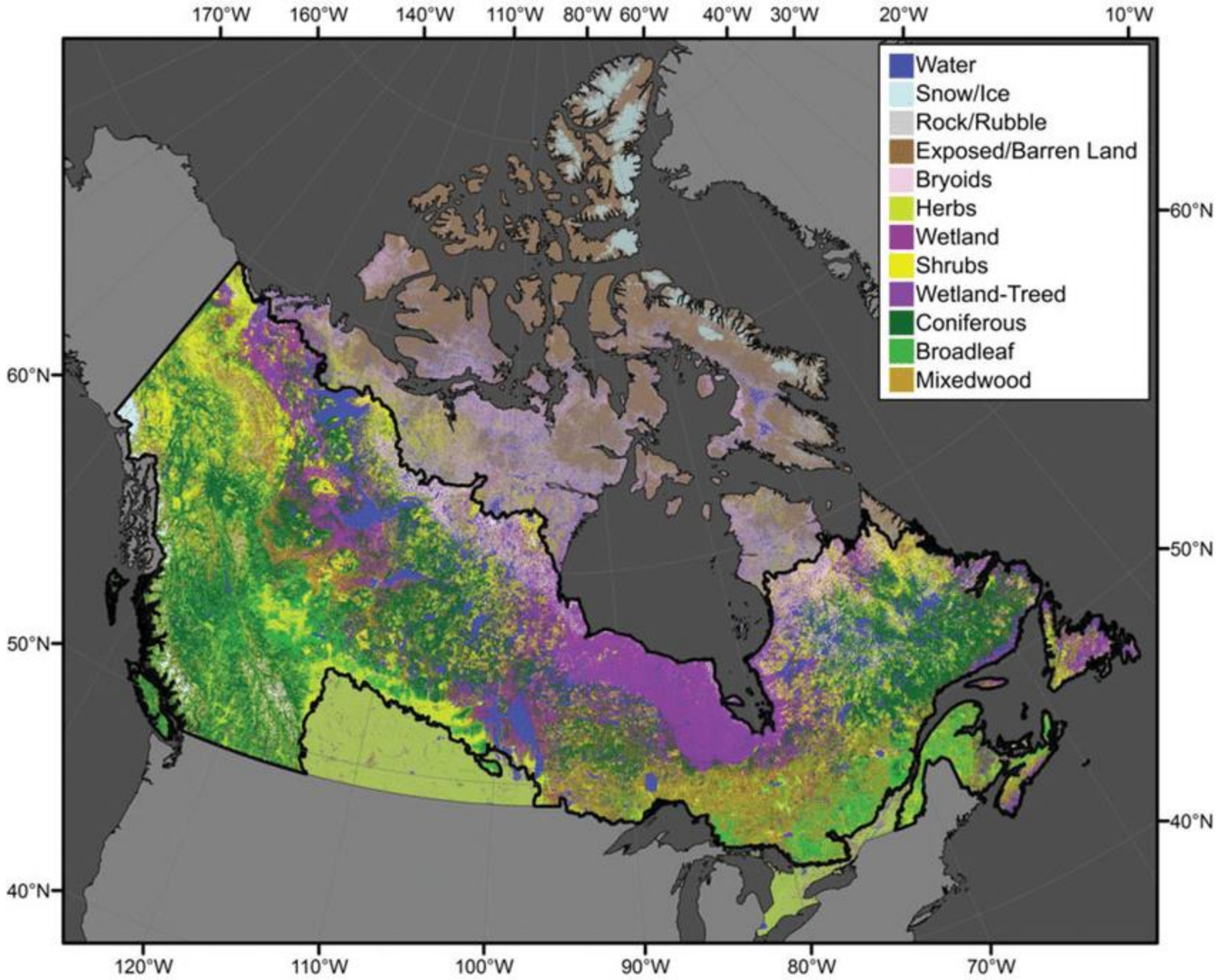


- Field work still required
  - To validate data
- But overall:
  - Efficient
  - Informative
  - Large coverage

Habitat characterization of rhinos



Rimal et al. 2018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60°N
50°N
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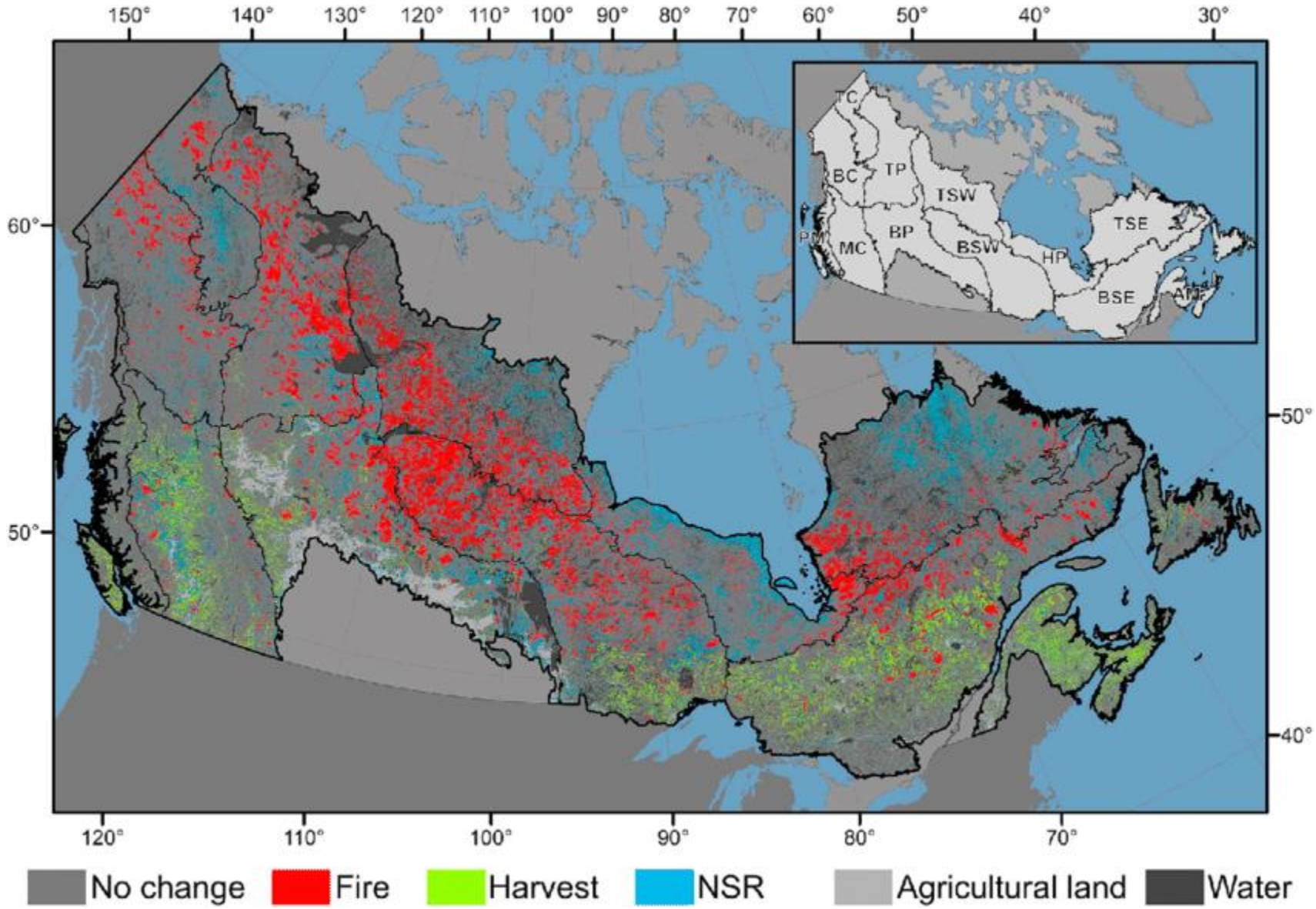
120°W
110°W
100°W
90°W
80°W
70°W
Water
Snow/Ice
Rock/Rubble
Exposed/Barren Land
Bryoids
Herbs
Wetland
Shrubs
Wetland-Treed
Coniferous
Broadleaf
Mixedwood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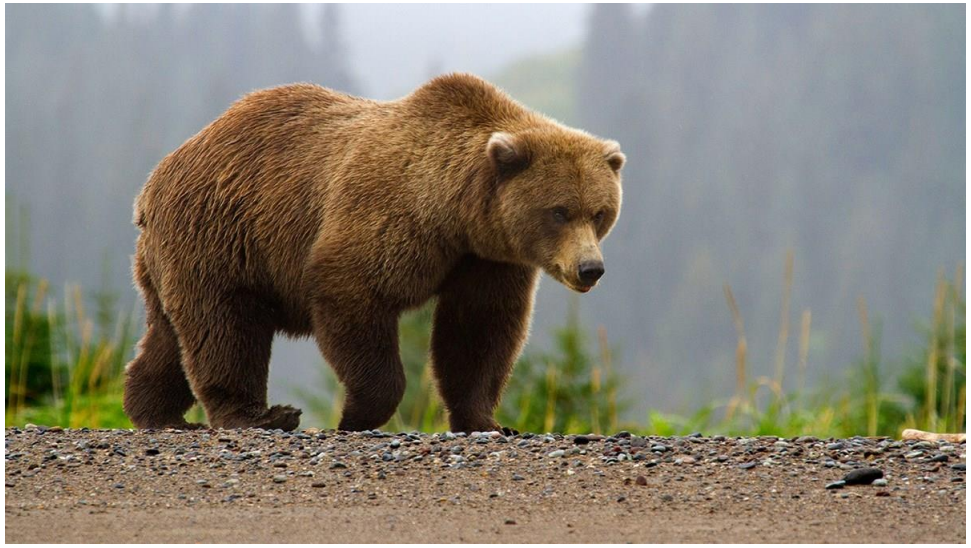
TC
BC
TP
TSW
TSE
PM
MC
BP
BSW
HP
BSE
AP
No change
Fire
Harvest
NSR
Agricultural land
Water

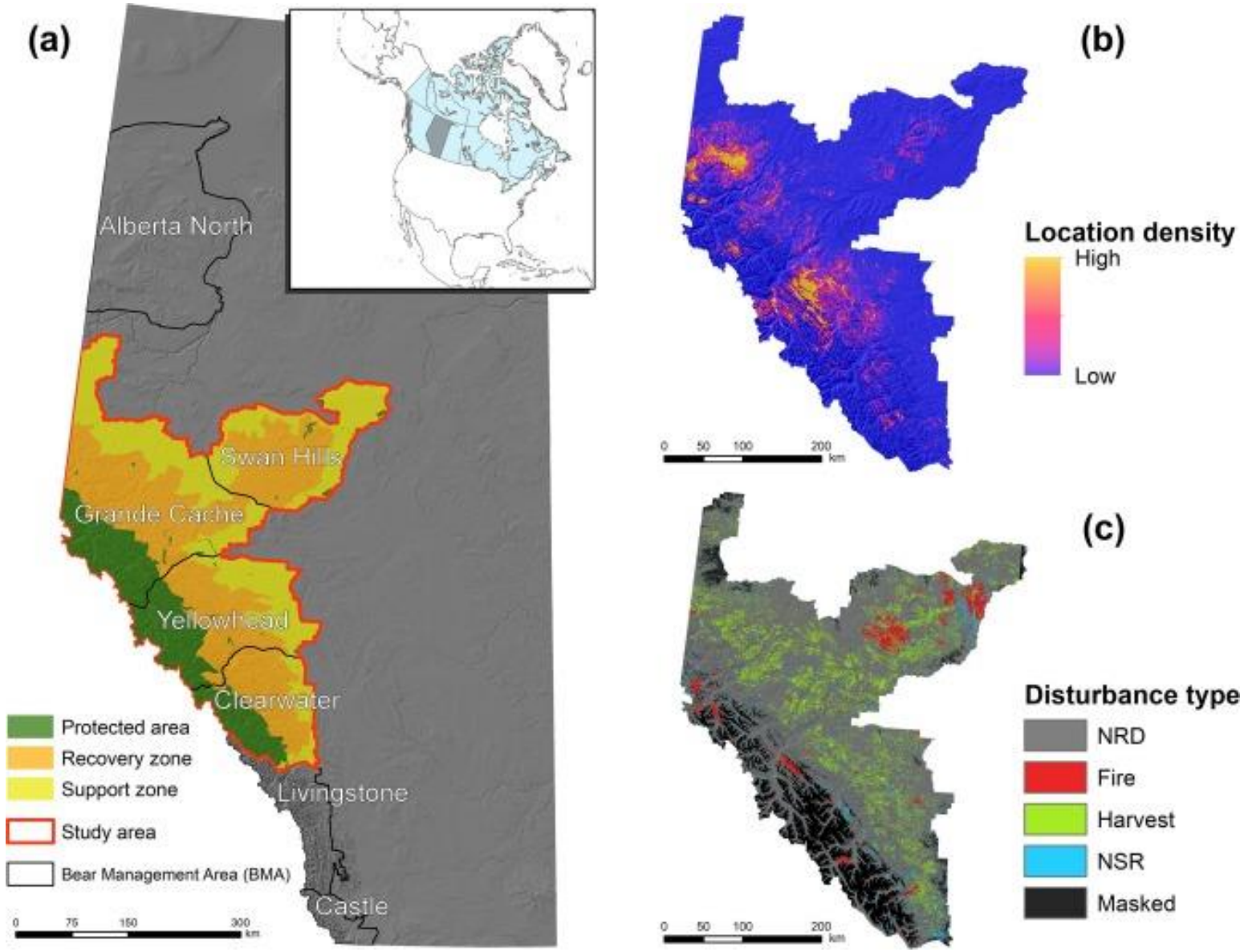
Grizzly Bear Example

- Focal point of wildlife conservation:
  - Ethical
  - Political
  - Cultural
  - Ecological reasons
    - Keystone species
    - Umbrella species



Grizzly Bear Example

- GPS Collar Data
- Landsat data
  - Land cover
  - Disturbance
    - Fires, logging, etc.
    - When and where



Kearney et al. 2019

Grizzly Bears and Forestry

Season	Coefficient	Robust (S.E.)	95% CI		Odds ratio	95% CI	
			Lower	Upper		Lower	Upper
Hypophagia	0.128	0.128	−0.124	0.379	1.137	0.883	1.461
Early hyperphagia	0.443	0.088	0.270	0.616	1.557	1.310	1.852
Late hyperphagia	−0.162	0.189	−0.531	0.208	0.850	0.588	1.231

Nielsen et al. 2004

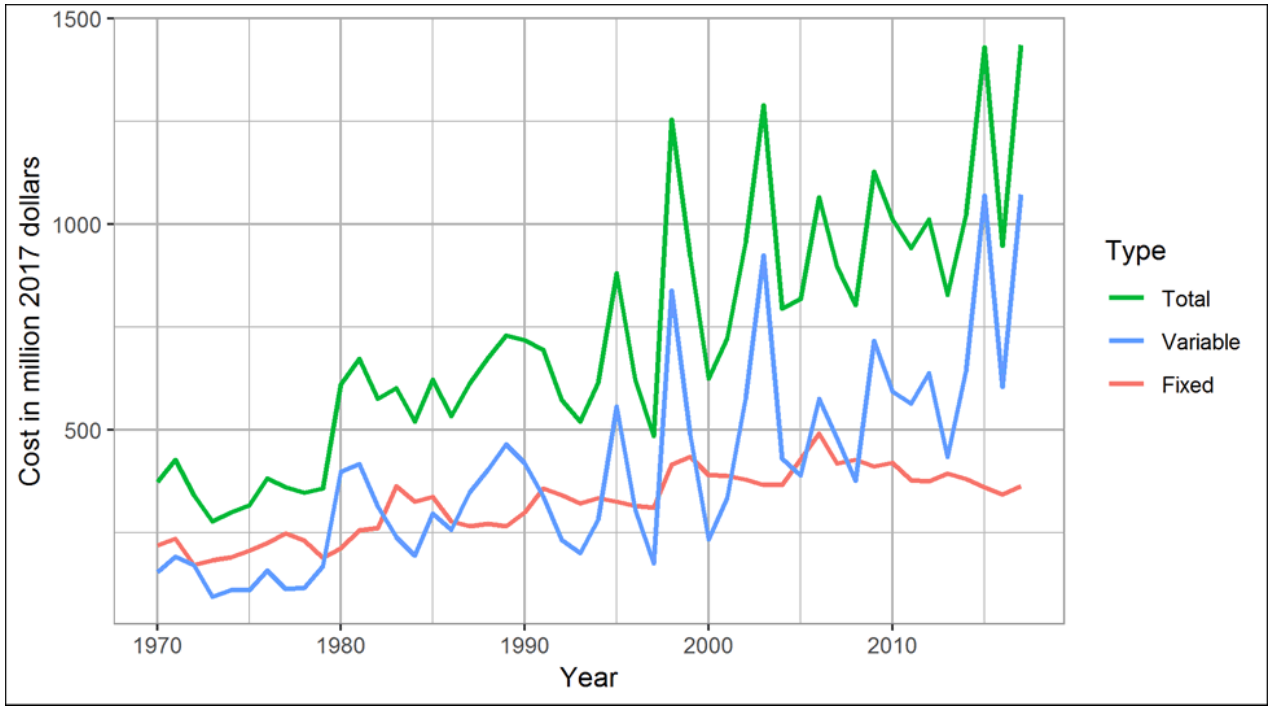
- Bears were 1.6 times more likely to be found in forestry cut blocks than any other habitat (during certain times of the year)

Why might grizzly bears like cut blocks?

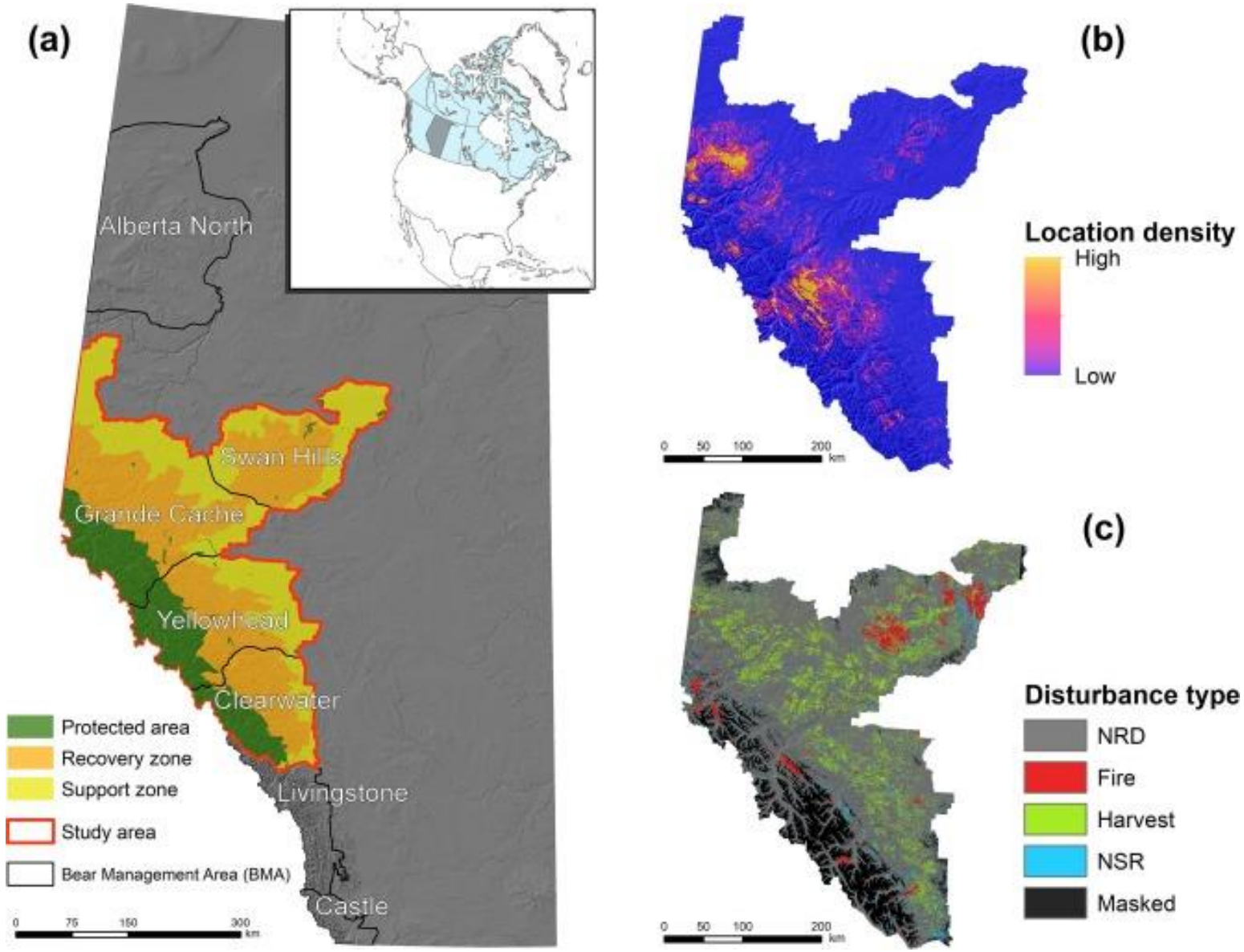
- Food
- Grizzly bears love berries
- 7-30 year old cut blocks preferable
  - Because they have more berries and other food
  - Than other habitat types

But what about other disturbances

- Wildfires for example
  - Historically suppressed
- Result:
  - Overall lack of natural forest openings for grizzly bear habitat
  - Bears have adapted to use cut blocks



The cost of wildland fire protection in Canada from 1970 to 2017 (in million 2017 Canadian dollars)



Kearney et al. 2019

Management

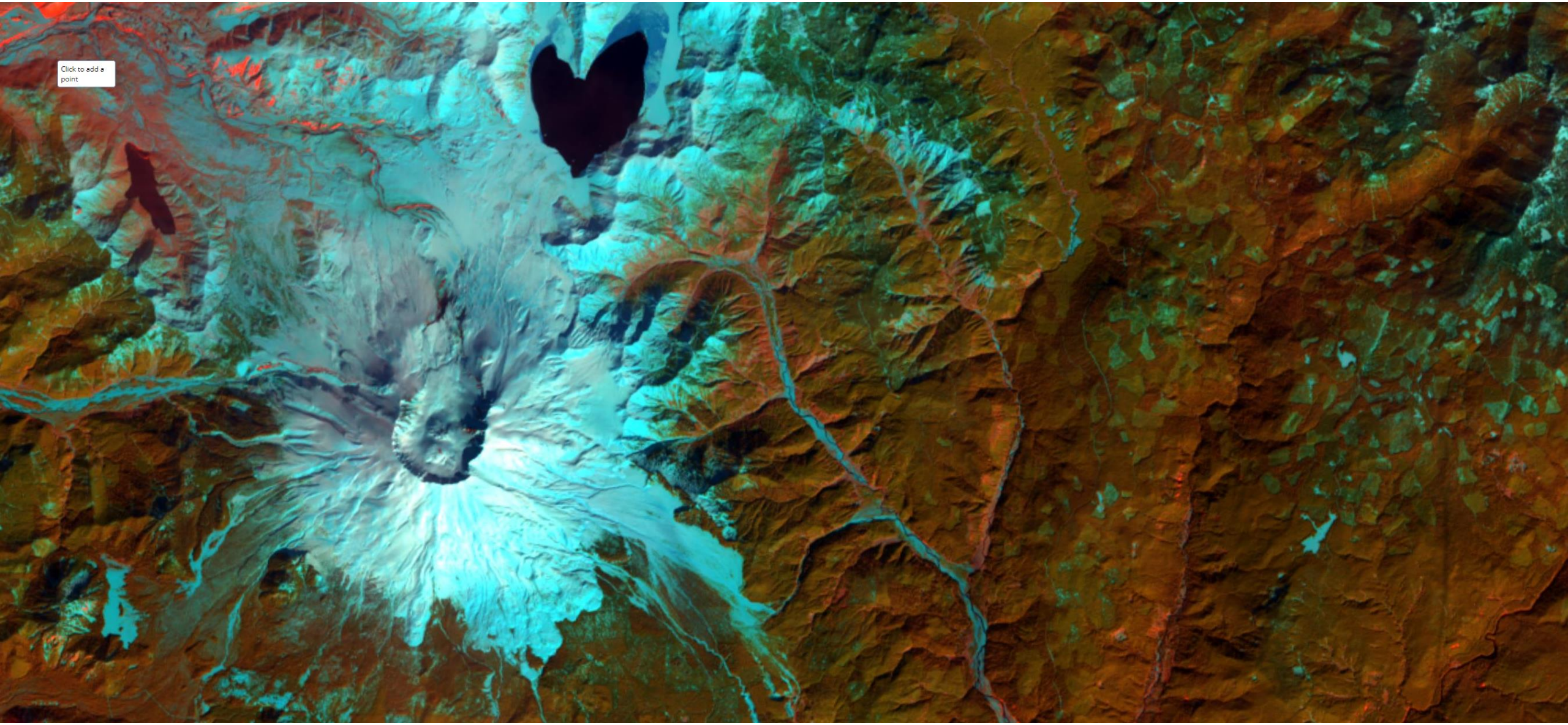
- Managers can make decisions for grizzly bear conservation from these findings
- For example, in the forestry industry:
  - Harvest forest in strategic areas
    - Where natural forest openings lack
  - Protect disturbed areas
    - Cut blocks that provide a lot of food
    - Reduce human access

Summary

- How do we track animal movement?
  - GPS Collars
  - GPS Tags
  - Camera traps
- How do we quantify animal habitat with satellite data?
  - Land cover
  - Disturbance type & year

Important Topics

- What are some advantages of using Camera Traps to collect animal movement data?
- What are some advantages of using GPS collars to collect animal movement data?
- Describe how you might use GPS collar data and Landsat data to determine what habitat an animal prefers?
  - You can use the grizzly bear example to help explain
- What insights have we gained about grizzly bear habitat preference using GPS collar data and Landsat data in western Alberta?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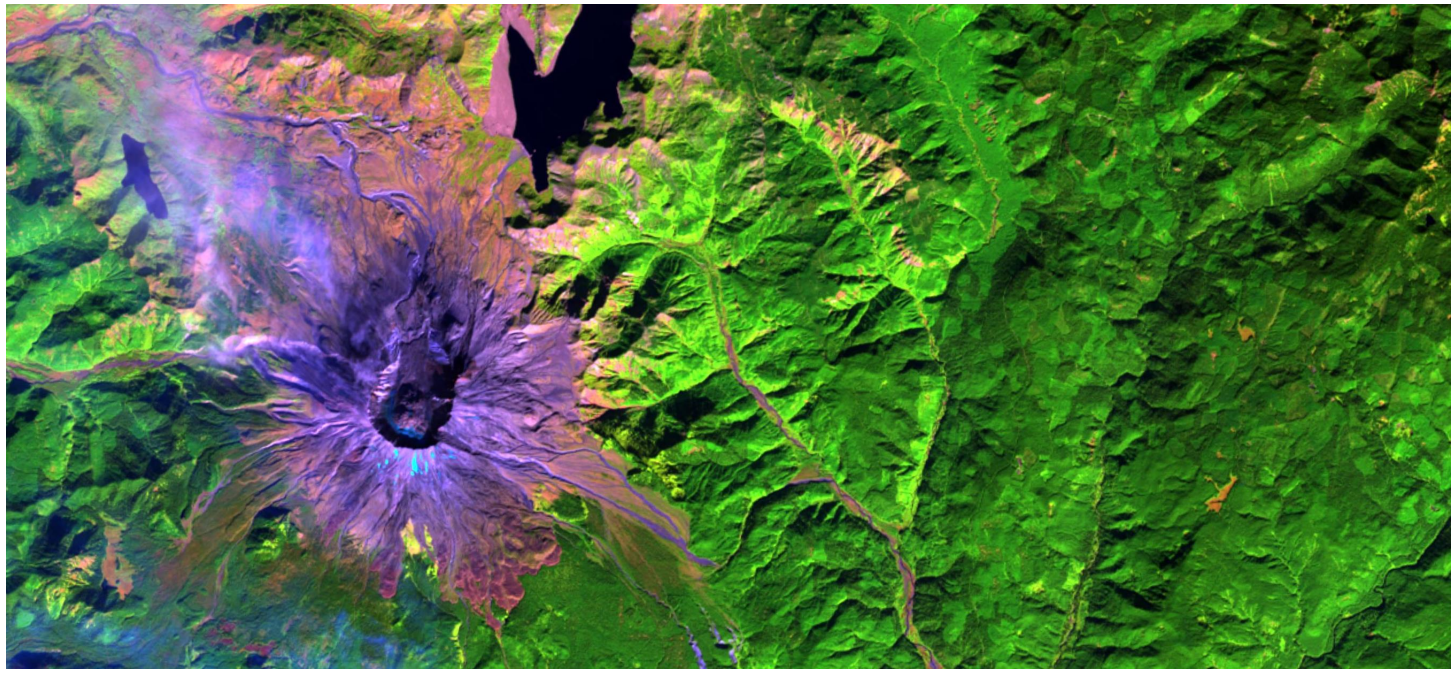

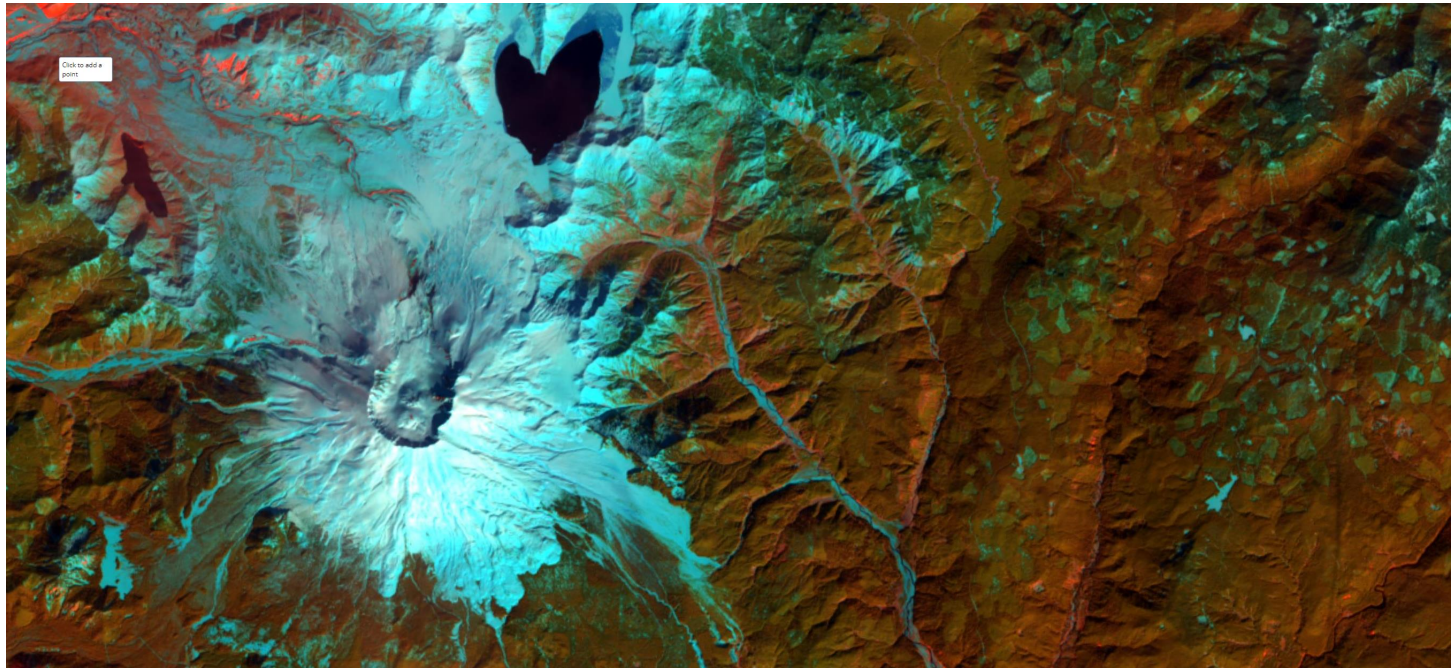
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