Incorporating perception into understanding grizzly bear behavioural response to roads

presented by

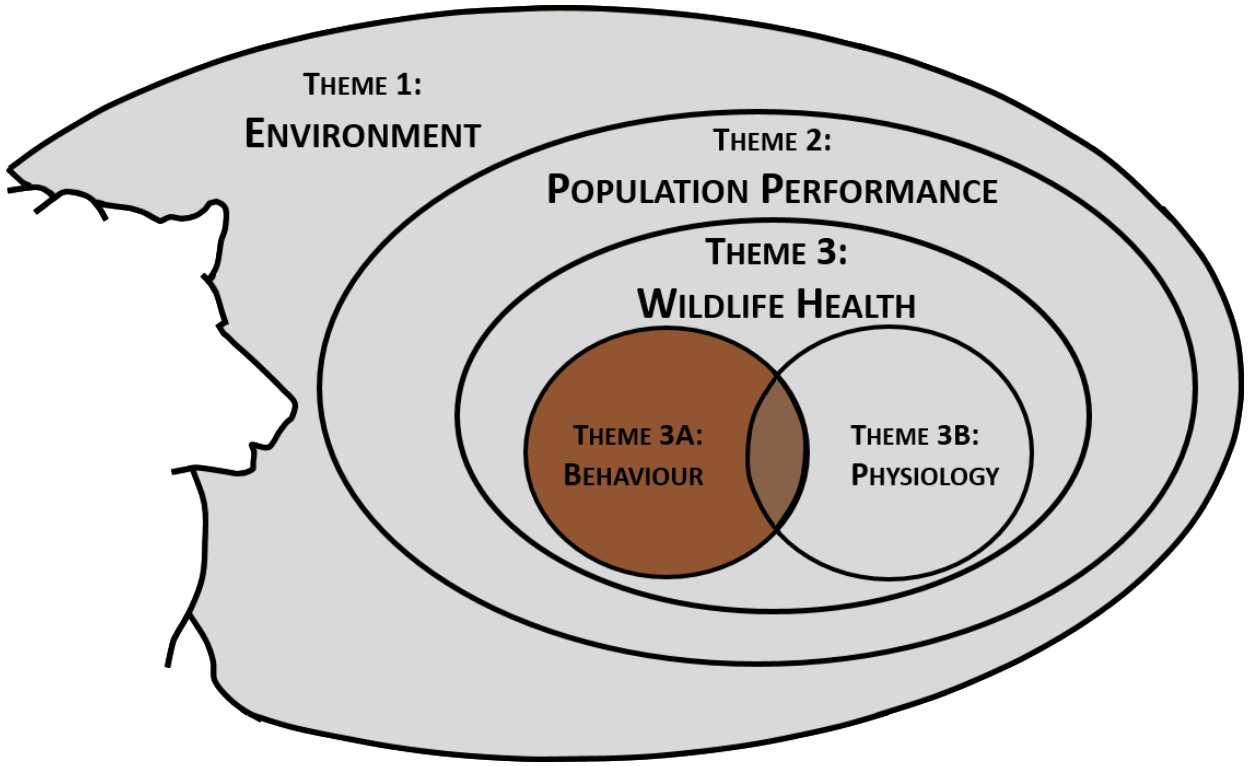
Bethany Arndt

MSc Student, Integrated Remote Sensing Studio

bethany.arndt@alumni.ubc.ca

UBC Forestry University of British Columbia

NSERC CRSNG



Research question

Q3A.4 What are the fine scale movement, health and survival responses to cumulative effects that are dynamic in space and time?

Link to Industrial Research Need

5. Are the movement patterns of grizzly bears being impacted by natural resource extraction activities, including the development and use of roads and linear features, and have approaches to access control on the landscape influenced habitat use or grizzly bear movements?

7. Have changing landscape conditions affected grizzly bear mortality risk within the study area?

Roads and Grizzlies

- Most mortalities human-caused near roads
  - 19/22 mortalities within 500 m of a road (Boulanger et al. 2014)
- decreased reproductive success at high road densities (Roever et al. 2008)
- Greater use of roads than null expectations
  - Potential attraction to roadside food
- Traffic dependent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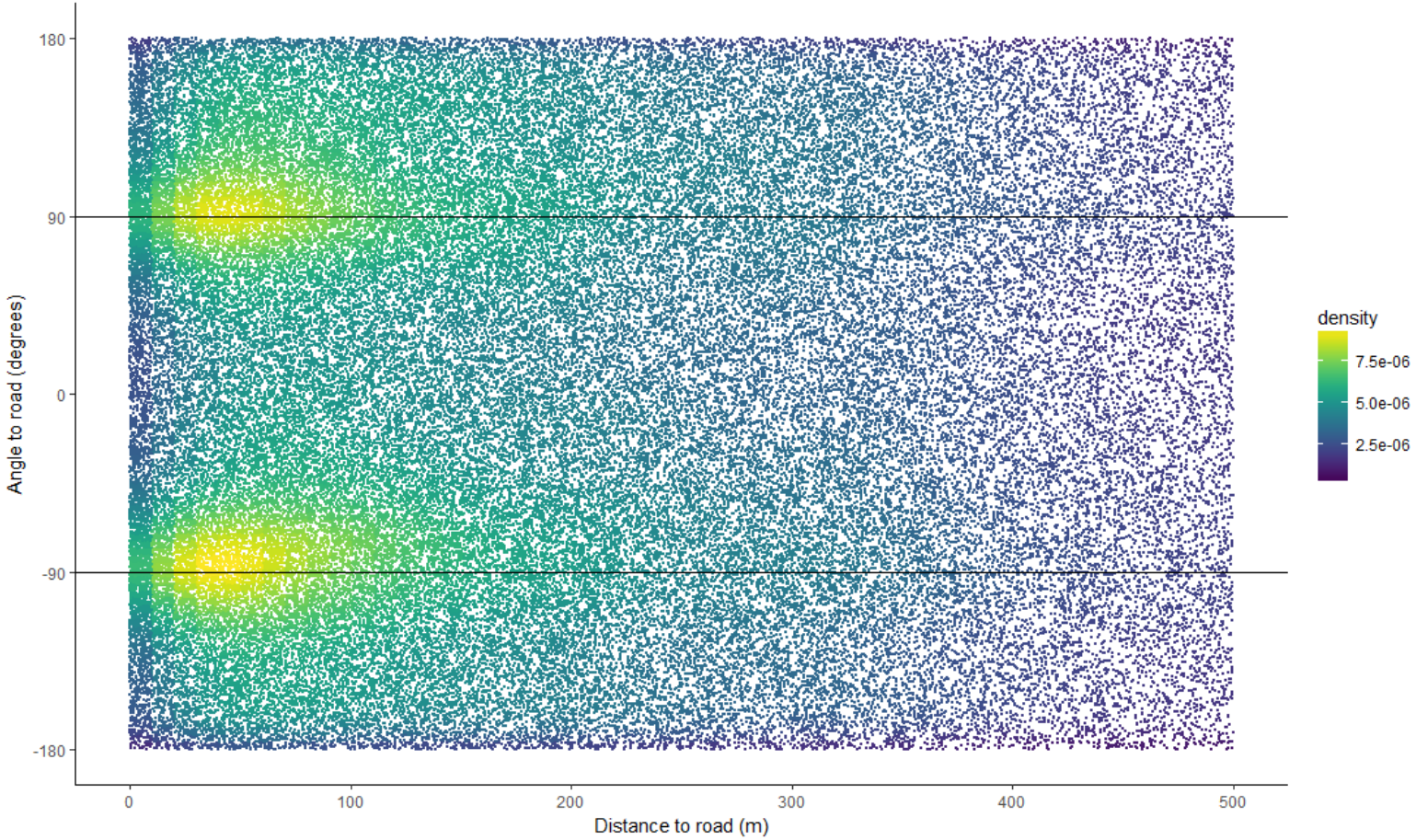
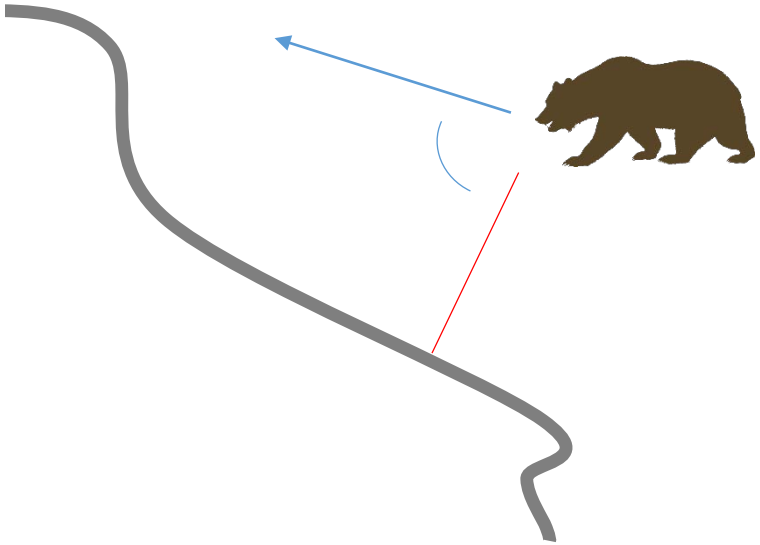
Movement Patterns around Roads





Movement – understanding behaviour

- Intrinsic constraints (Martin et al. 2008)
  - Physiology, speed
- Extrinsic constraints (Martin et al. 2008)
  - Topography, anthropogenic features
- Habitat selection (Martin et al. 2008, Avgar et al. 2013)
  - Individual decisions based on knowledge of the landscape

Objectives

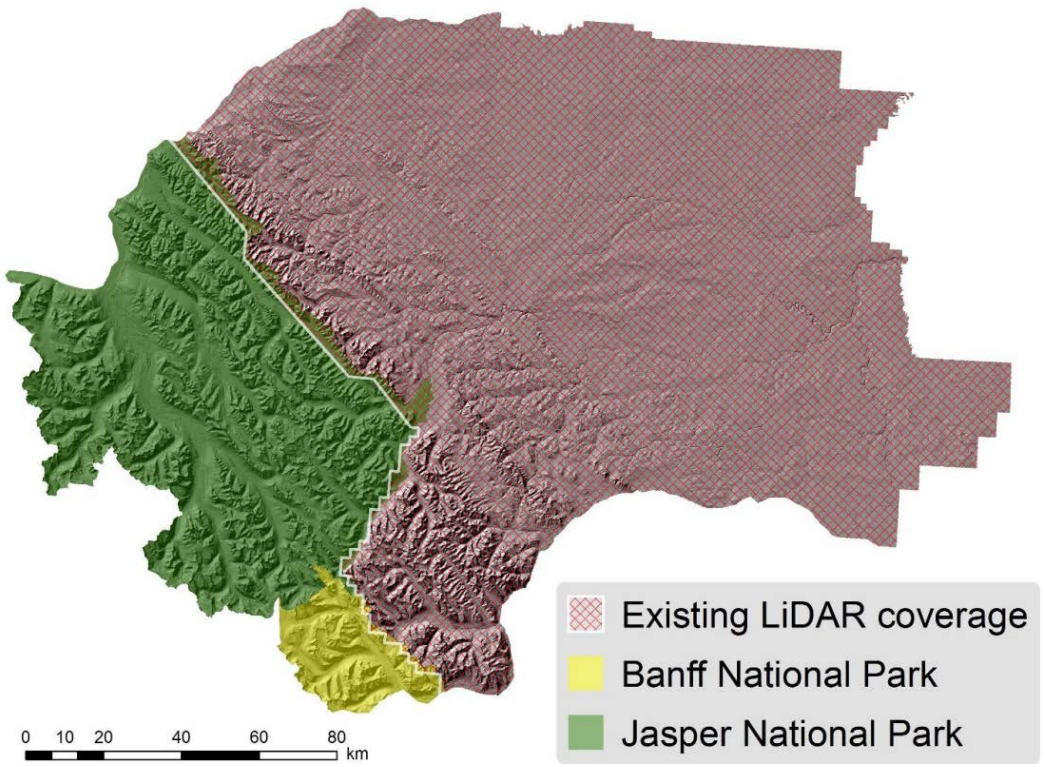
Advance understanding of road impacts on grizzly bears by incorporating biologically significant variables associated with what a bear sees and hears

1) Build zones of impact around roadways based on grizzly bear perception and movement

2) Use perception layers to analyse and predict bear movement and survival

Perception Mapping

- Covariates:
  - road visibility raster
  - road audibility raster
  - combined road perception raster
- Based on remotely sensed LiDAR data (2007)

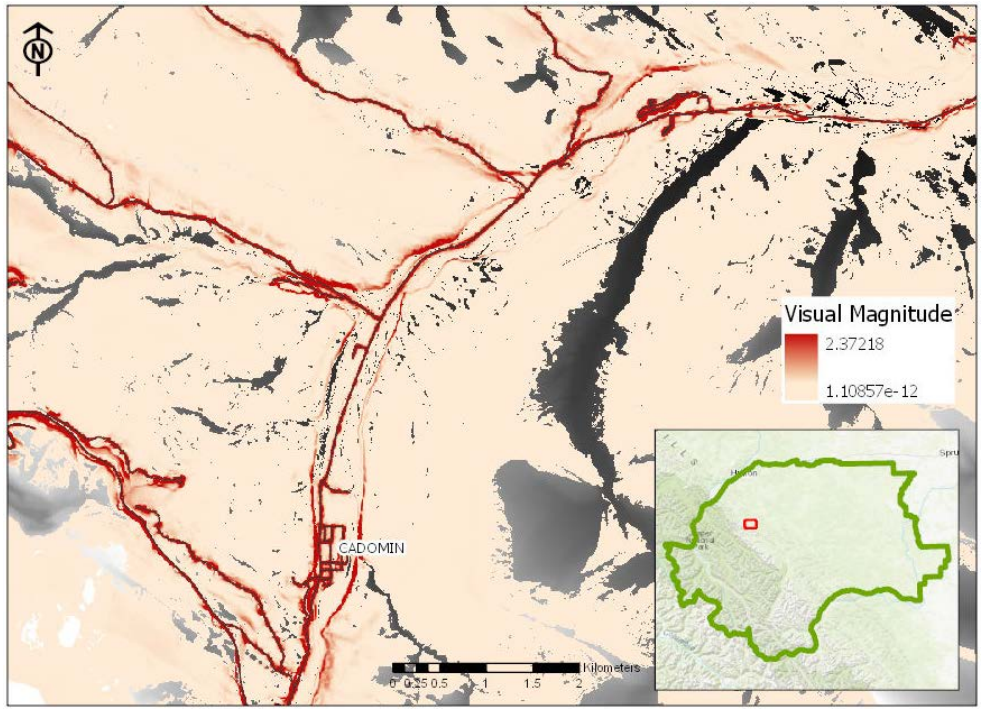


Quantifying visual perception - viewsheds

- Using LiDAR to build viewsheds from x, y, z location
- Used in behavioural studies
  - predation, mating displays, den selection
- Also important to understanding poaching

Viewsheds - Visual Magnitude

Proportion of an observer's field of view calculated from distance, slope, and angle (Chamberlain and Meitner 2013)

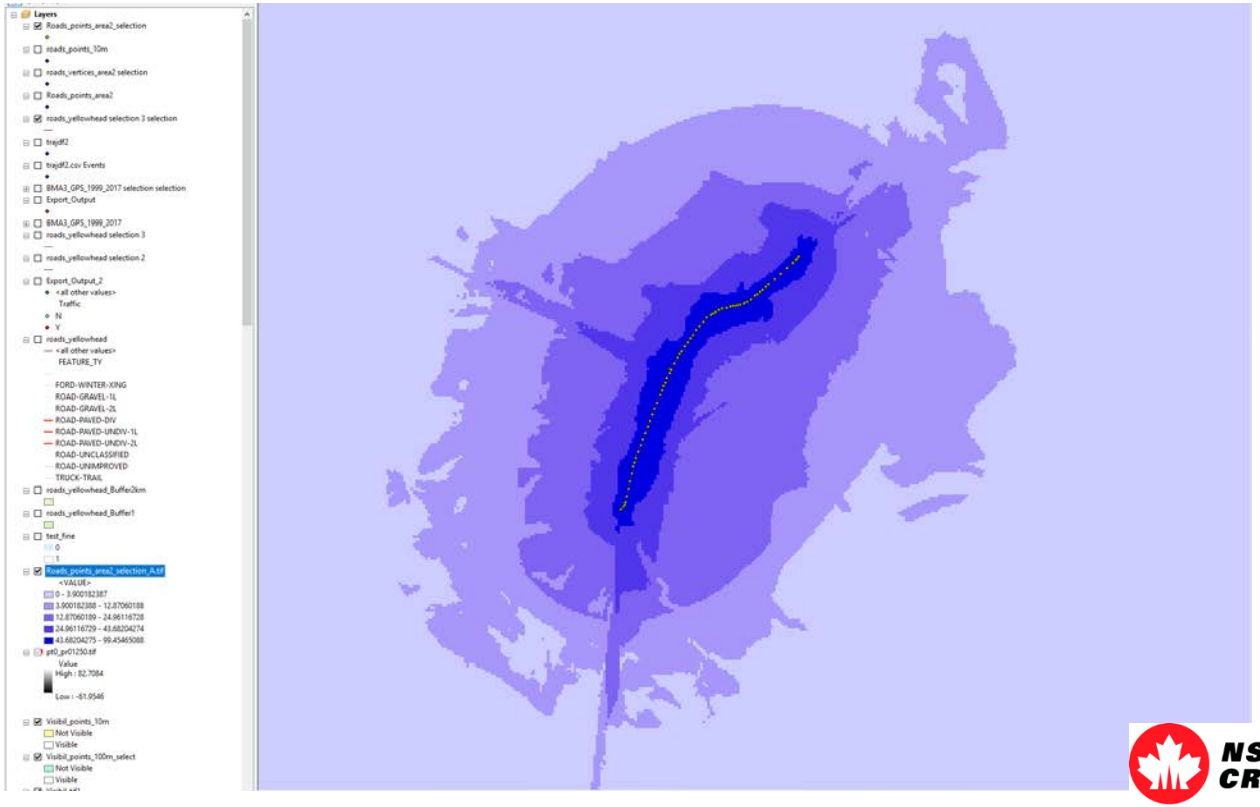


Quantifying auditory perception - soundscapes

- Built from sound propagation models from point sources
- Most commonly used for animals that use vocalizations for communication over distances
- Incorporates the importance of traffic

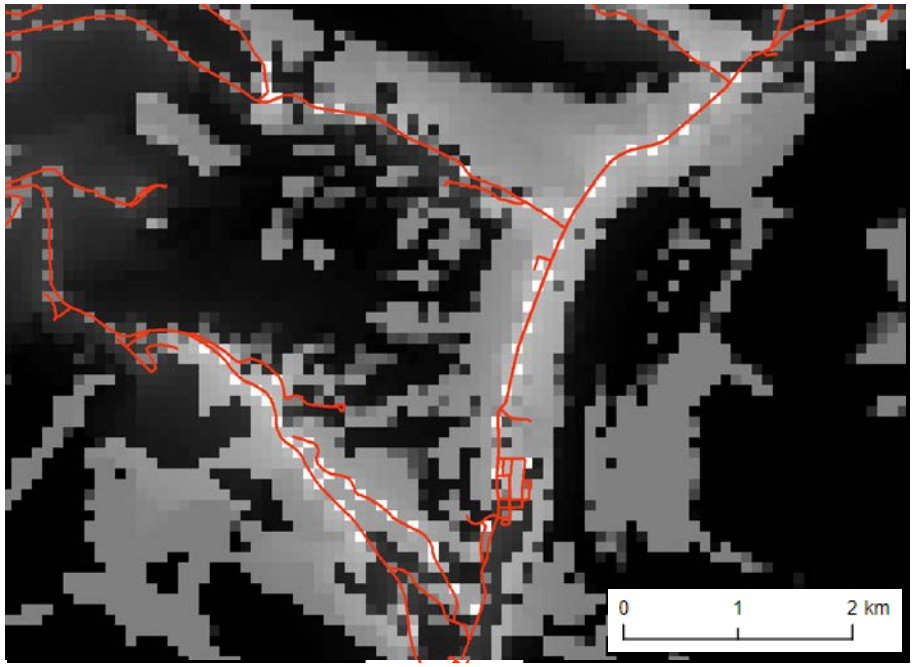
Soundscapes – SPreAD-GIS

- Developed by the USDA Forest Service
- Built for rural landscapes
- Based on elevation, landcover type, and weather conditions
- Considers different frequencies
- Validation from sound monitors



Zones of Influence : How far do the effects of a disturbance extend?

- Commonly a Euclidean buffer zone
- Highly variable estimates for grizzly bears around roads
- Context dependent



Relating Back to Movement Responses

Semivariograms:

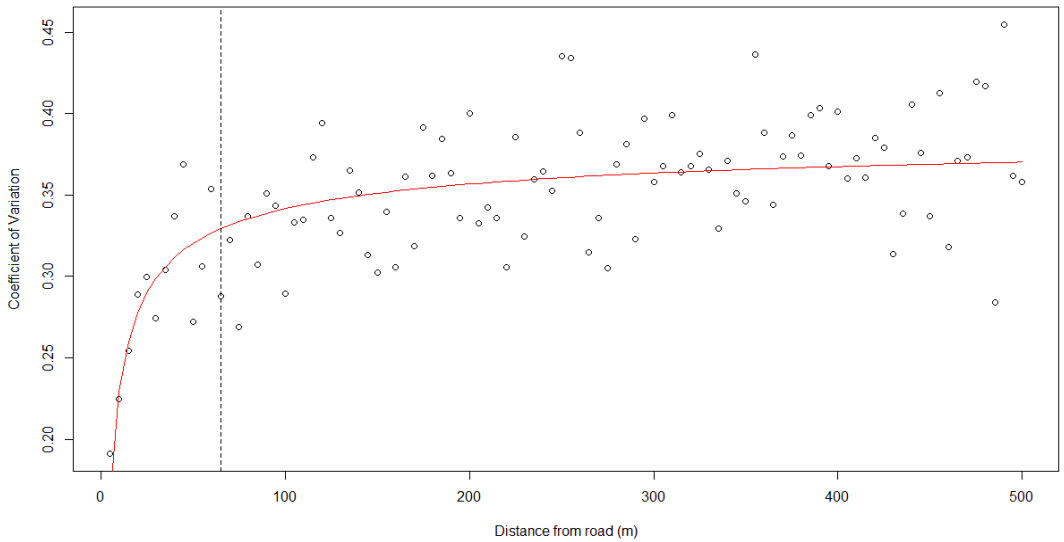
- assess autocorrelation by visualizing the variance between pairs of attributes at increasing distances

Modification by Kite et al. (2016)

- Use distance to feature instead of distance between pairs

Proposed New Modification

- Use measures of perception in lieu of distance



Behavioural Analyses: How do grizzlies respond to roads and why?

- Untangling when grizzly bears avoid and select for roads based on their perception of the nearest road

Integrated Step Selection Analysis (iSSA)

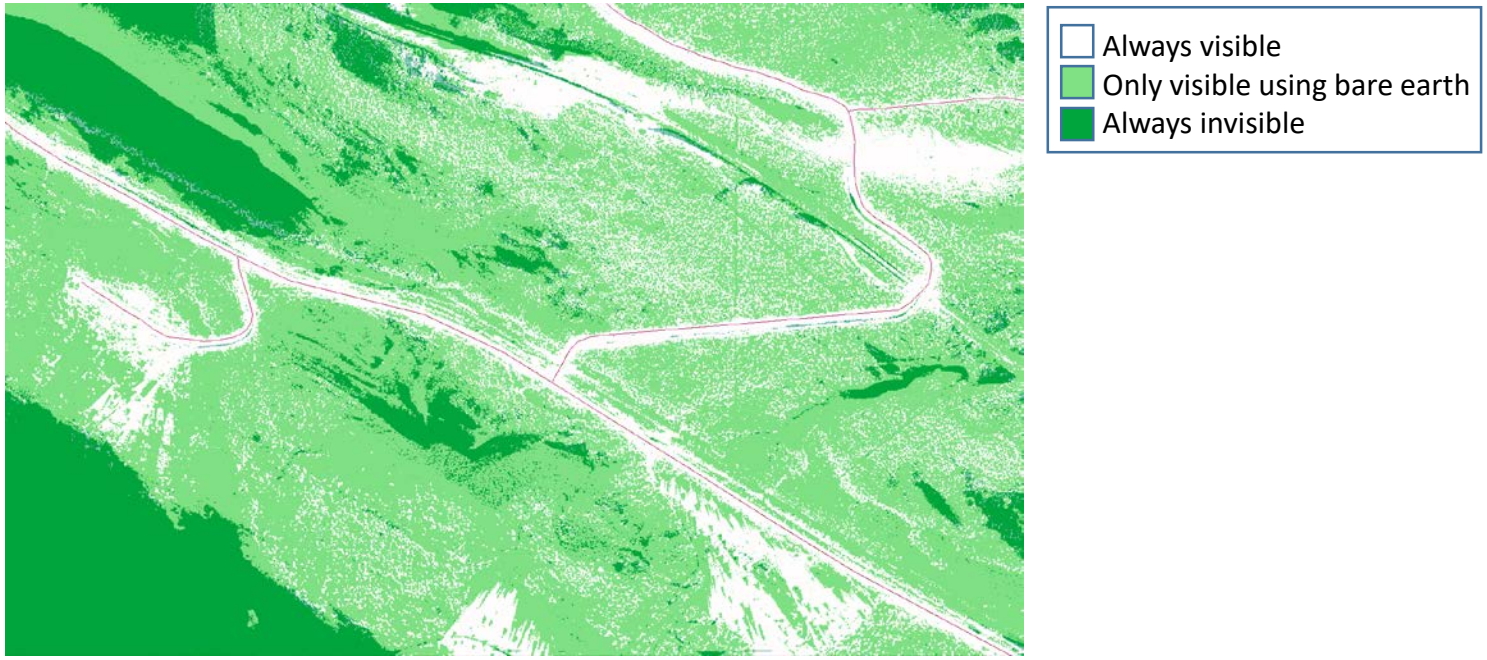
- Incorporates both habitat selection and movement (Prokopenko et al. 2017)
- Compare models with perception as predictors with null models

Survival Analyses

- Are grizzly bears more likely to be killed within a viewshed?
  - 10/22 known deaths due to hunting or poaching (Boulanger et al. 2014)

Forest Management Applications

- How would different logging practices affect perception and grizzly bear movement?



Comparing viewsheds using bare earth and canopy height models

Impact

- Determine extent of road influence
- Understand grizzly bear movement and mortality
- Assess importance of traffic to inform access management
- Inform road placement and screening buffers

Thank you!

Bethany Arndt

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bethany.arndt@alumni.ubc.ca

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