# What are our assumptions? Testing the influence of fine-scale forest structure on grizzly bear (*Ursus arctos*) habitat selection

Brandon Prehn, Nicholas C. Coops, Scott E. Nielsen, Cole A. Burton, Gordon B. Stenhouse
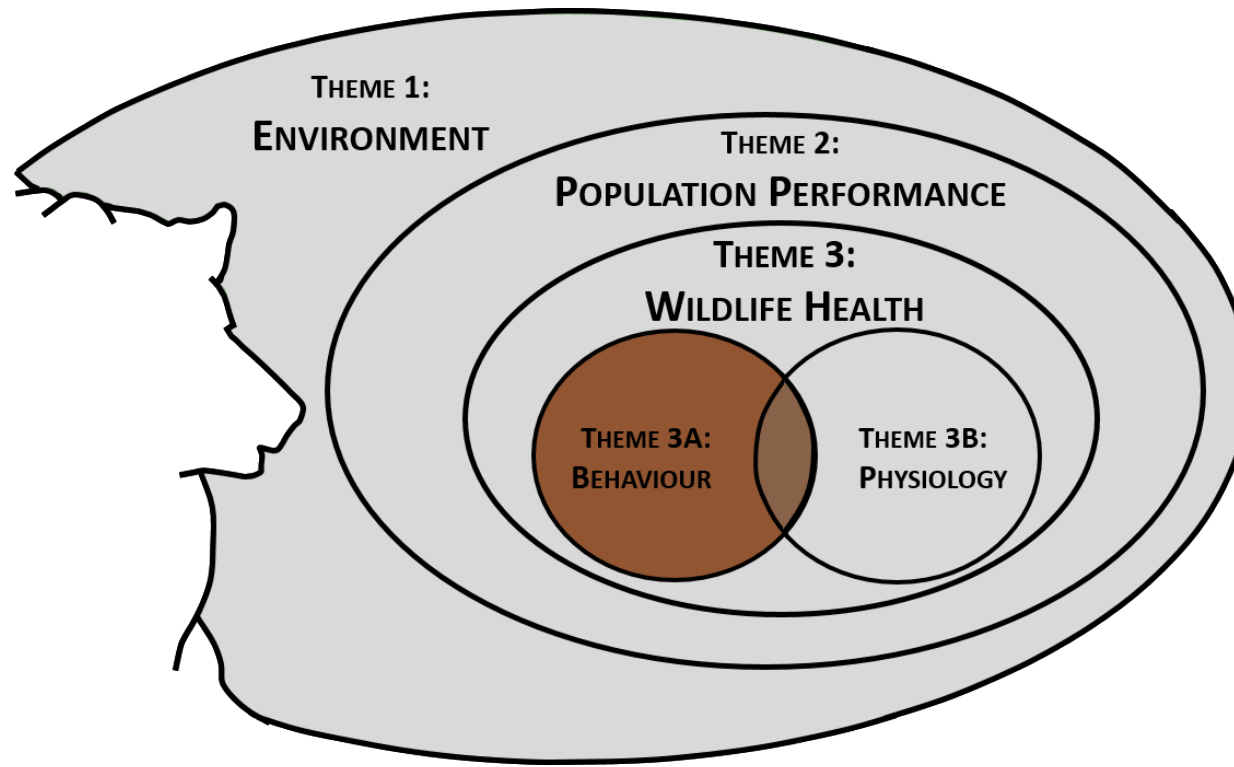
presented by

Brandon Prehn

# Research question

Q3A2: Can grizzly bear movements be related to fine scale changes in forest structure, such as openings, gaps, and vegetation patterns?

# Question:

Do grizzly bears display preference for certain forest heights or canopy cover conditions?

# Hypothesis:

The interaction between forest edge distance and overstory cover can best explain habitat selection.

- Grizzly bear habitat selection is heavily influenced by vegetation structure, especially in the case of interior continental bears

# Grizzly Bears in North America

- Range once extended south to Mexico and east to Mississippi river

- Range Contractions of over 50%

- Eastern slopes of the Canadian Rocky Mountains are the edge of their current range
  - Heavily forested
  - Many natural resources
  - Characterized by anthropogenic disturbances, making management a challenge



5363331

Terry L Spivey, Terry Spivey Photography, Bugwood.org
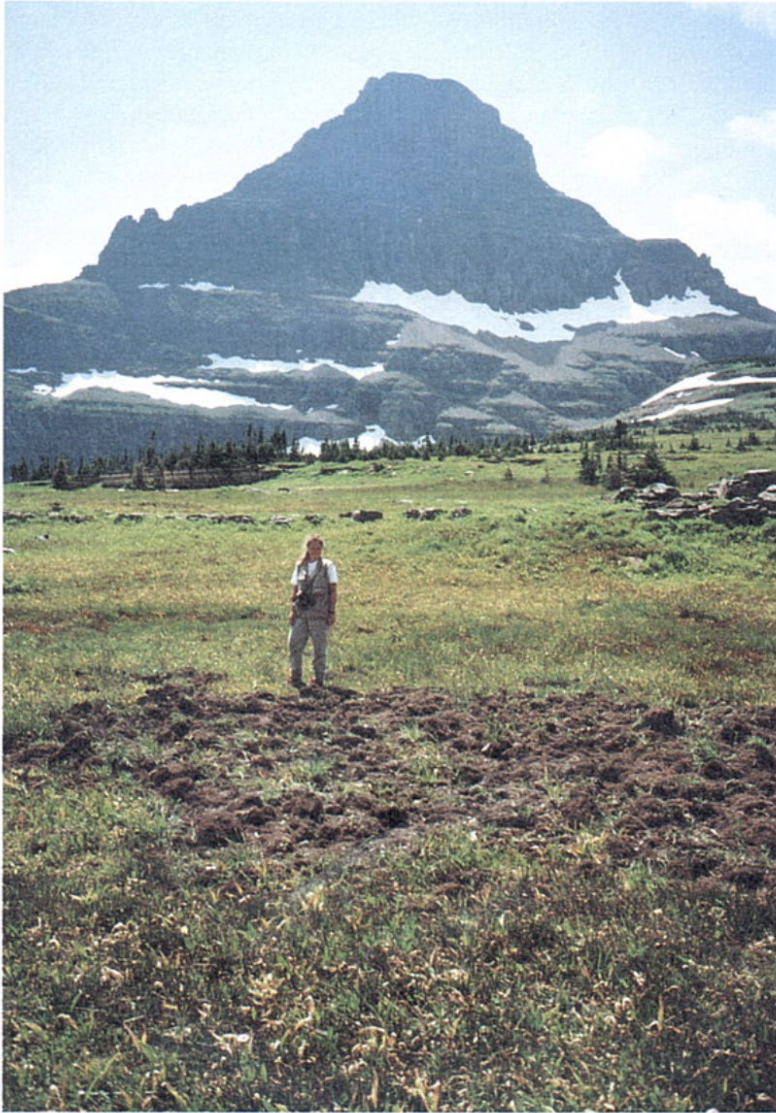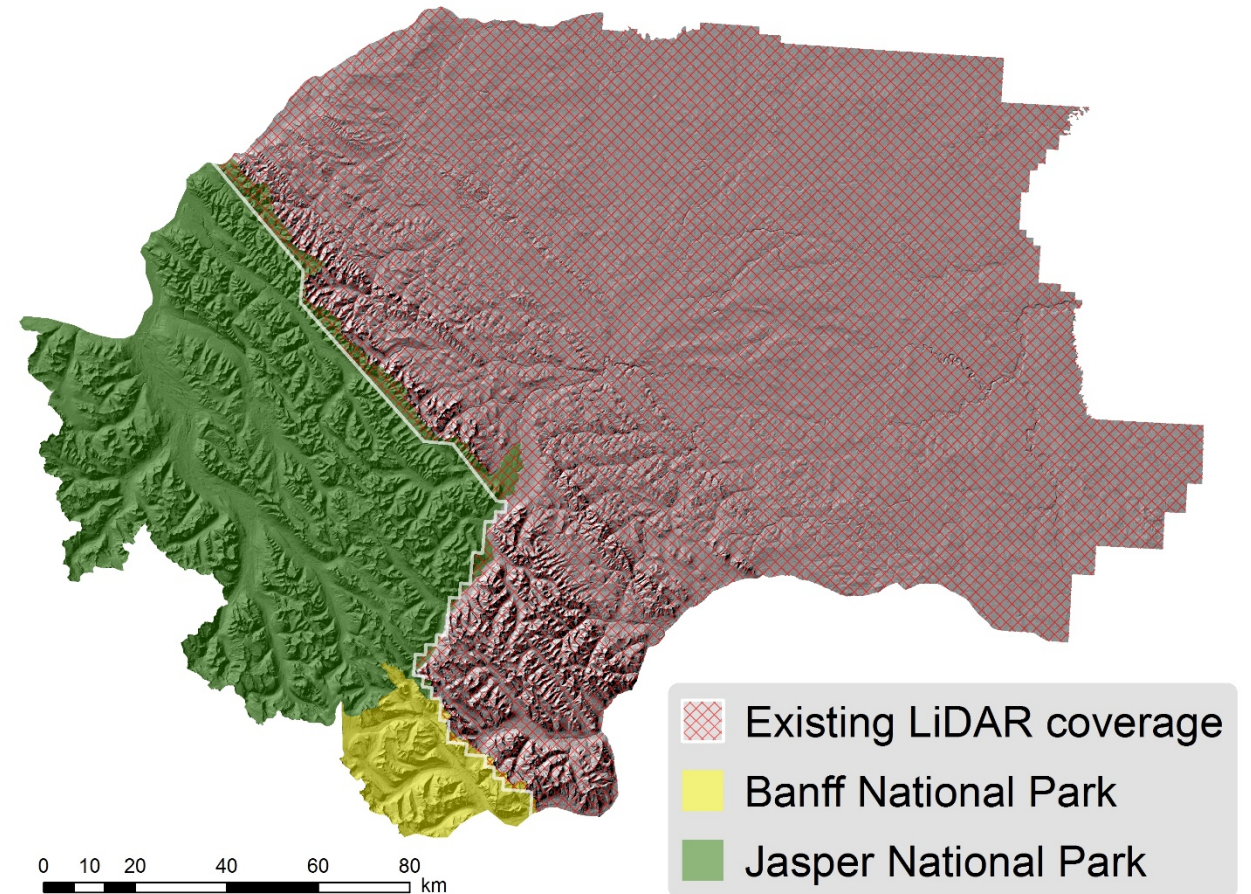
Tardiff & Stanford, 1998
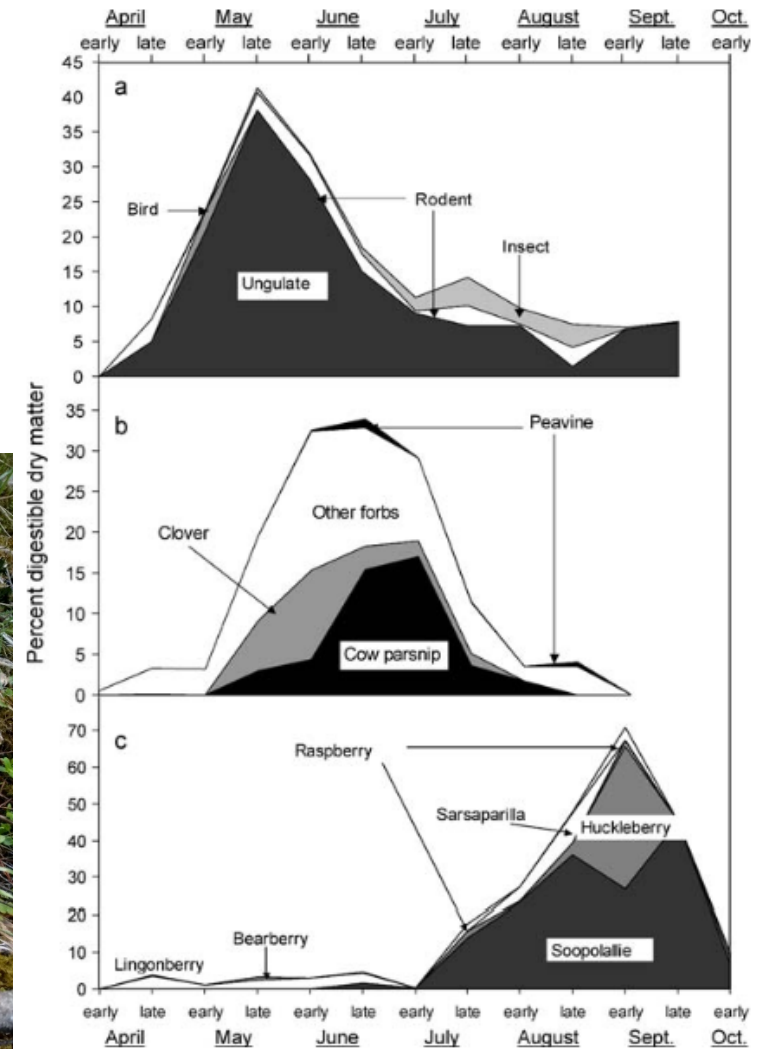
Munro et al., 2006

The study area:

West central Alberta

Jasper NP, Banff NP

Upper Foothills

-Lodgepole pine in mixed coniferous

(with associated spruce) or pure stands

-Mining activity

-Forestry operations

-Legacy seismic lines



0  10  20    40    60    80
km

Existing LiDAR coverage

Banff National Park

Jasper National Park

- Traditionally, forest height and cover estimates from remote sensing can be quite poor.

- A new technology, Light Detection And Ranging (LIDAR); or airborne laser scanning (ALS); is revolutionizing forest structure assessment globally

- Active remote sensing technology

- Measures the distance to target surfaces using narrow beams of near-infrared light

- Laser beam penetrates the canopy to give multiple distance measurements

- Forest structure can be estimated from the distribution of these return points

ALS: cover
- < 20
- 20.1 - 40
- 40.1 - 60
- 60.1 - 80
- 80.1 - 100
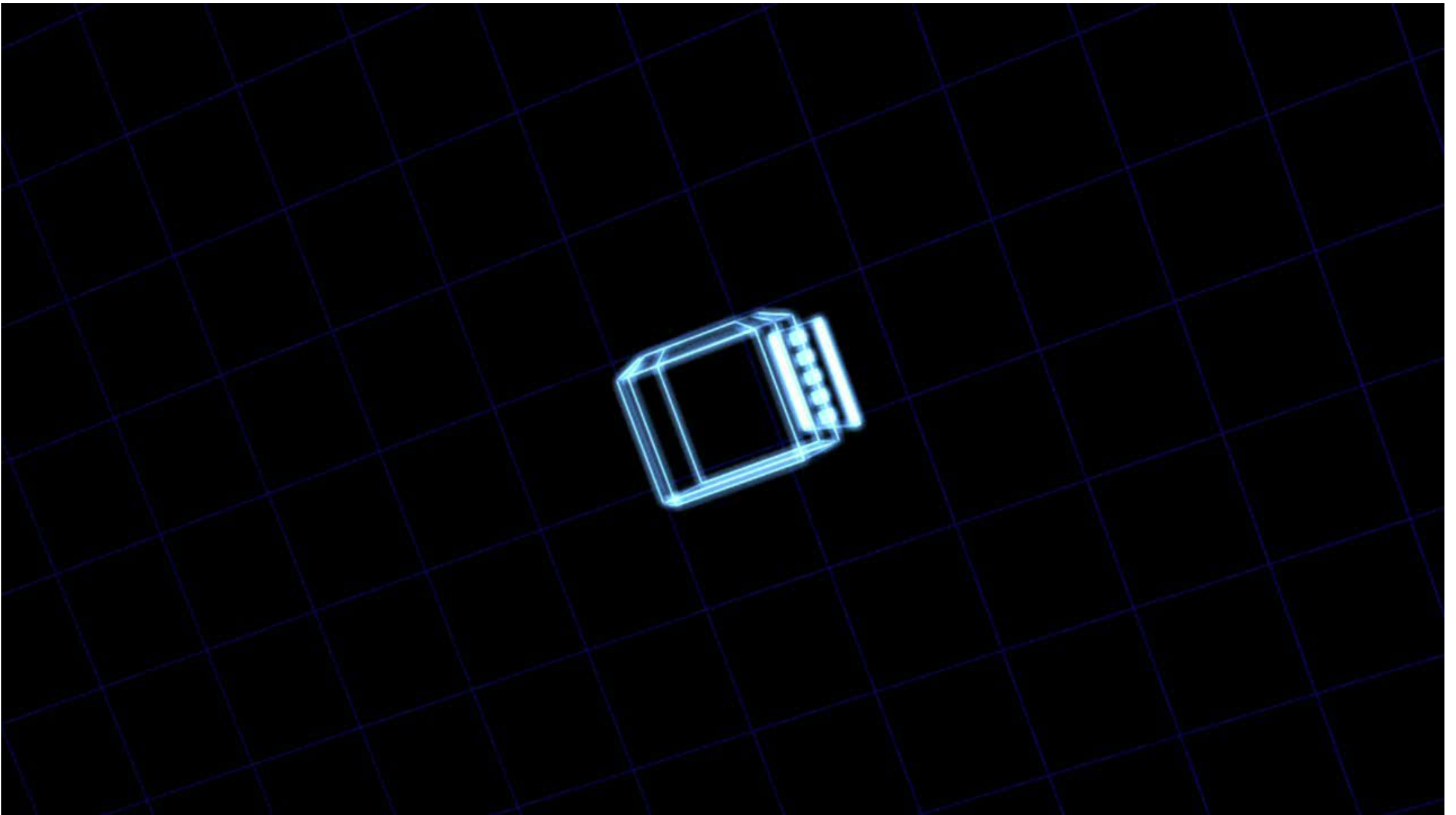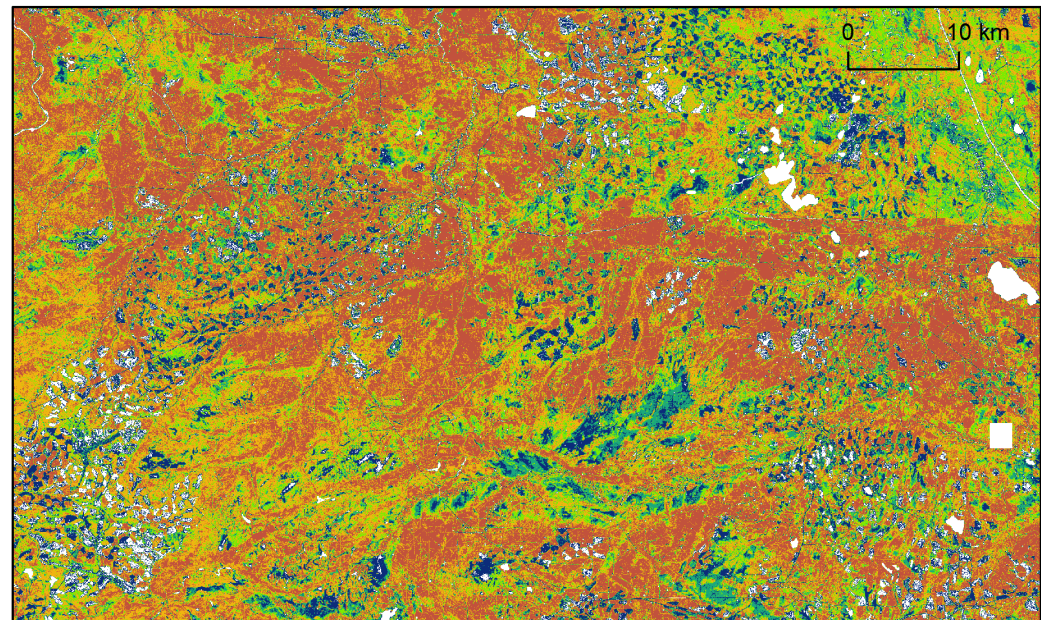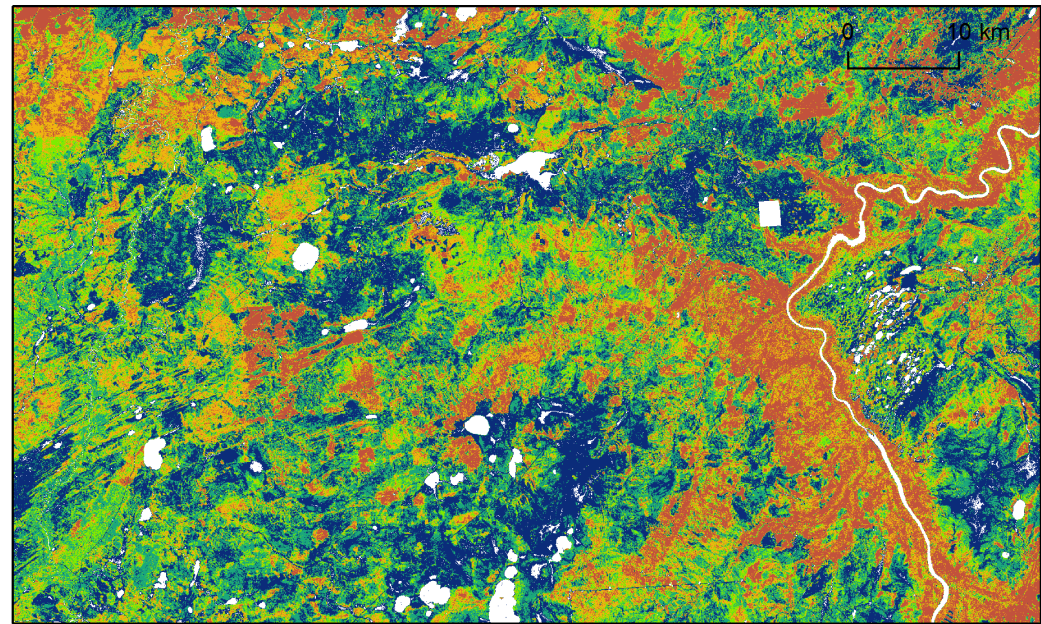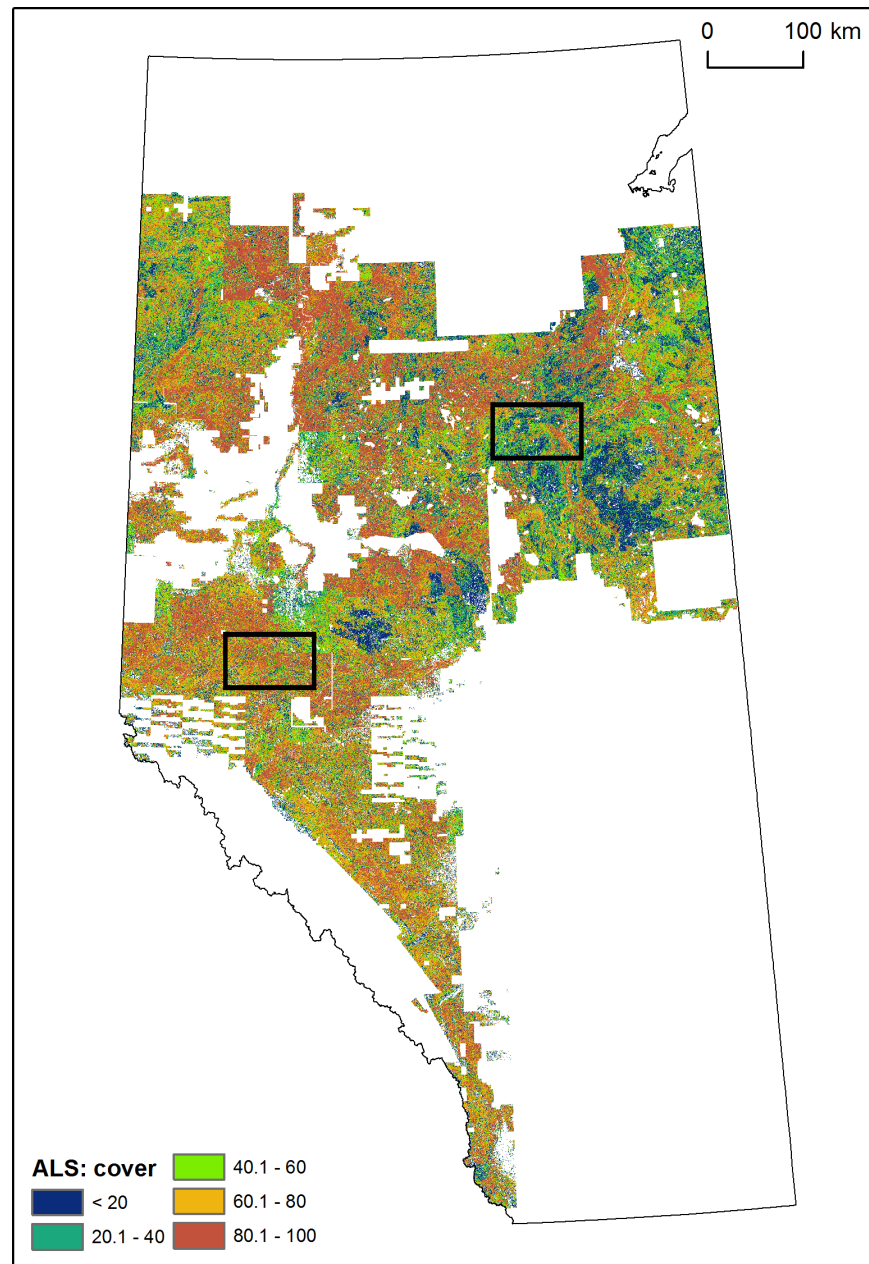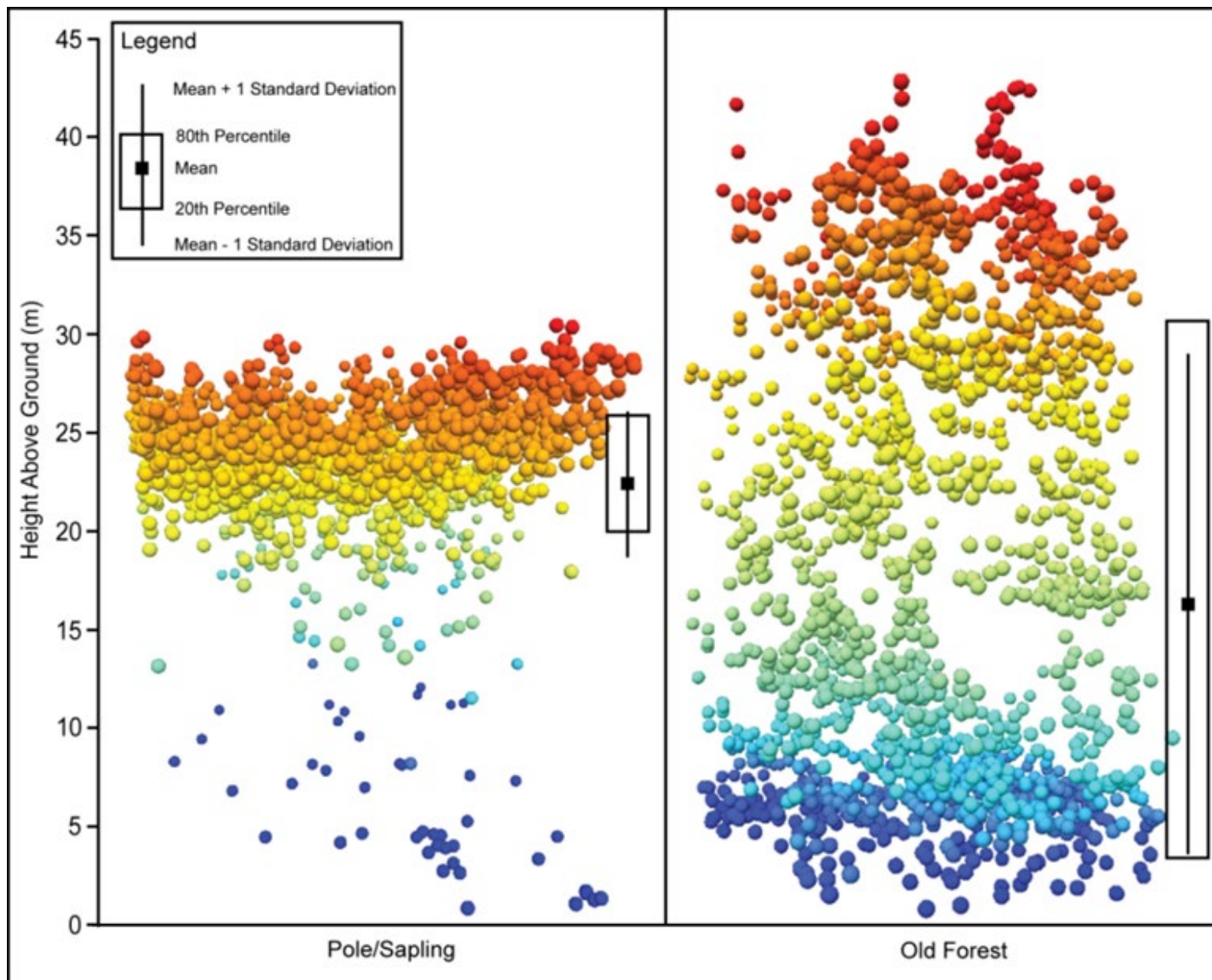
# Collar Data

| Sex | Season | # Clusters | Range of Strata Totals | Total Observations (1:11 Matching) |
|---|---|---|---|---|
| **Male** | | | | |
| | Hypophagia | 5 | 61-224 | 5302 |
| | Early Hyperphagia | 8 | 70-231 | 14179 |
| | Late Hyperphagia | 7 | 110-322 | 16379 |
| **Female** | | | | |
| | Hypophagia | 7 | 85-310 | 14740 |
| | Early Hyperphagia | 14 | 60-240 | 25311 |
| | Late Hyperphagia | 8 | 104-412 | 23243 |
| **Female W/ Cubs (FWC)** | | | | |
| | Hypophagia | 3 | 123-194 | 4895 |
| | Early Hyperphagia | 4 | 188-243 | 9834 |
| | Late Hyperphagia | 2 | 277-307 | 6424 |

# Methods

Step Selection Function
-     1:10 matched case:control design
-     Conditional logistic regression, fit to 3 separate season by each reproductive class:
  - Males, Females, and Females w/ Cubs > 1 year
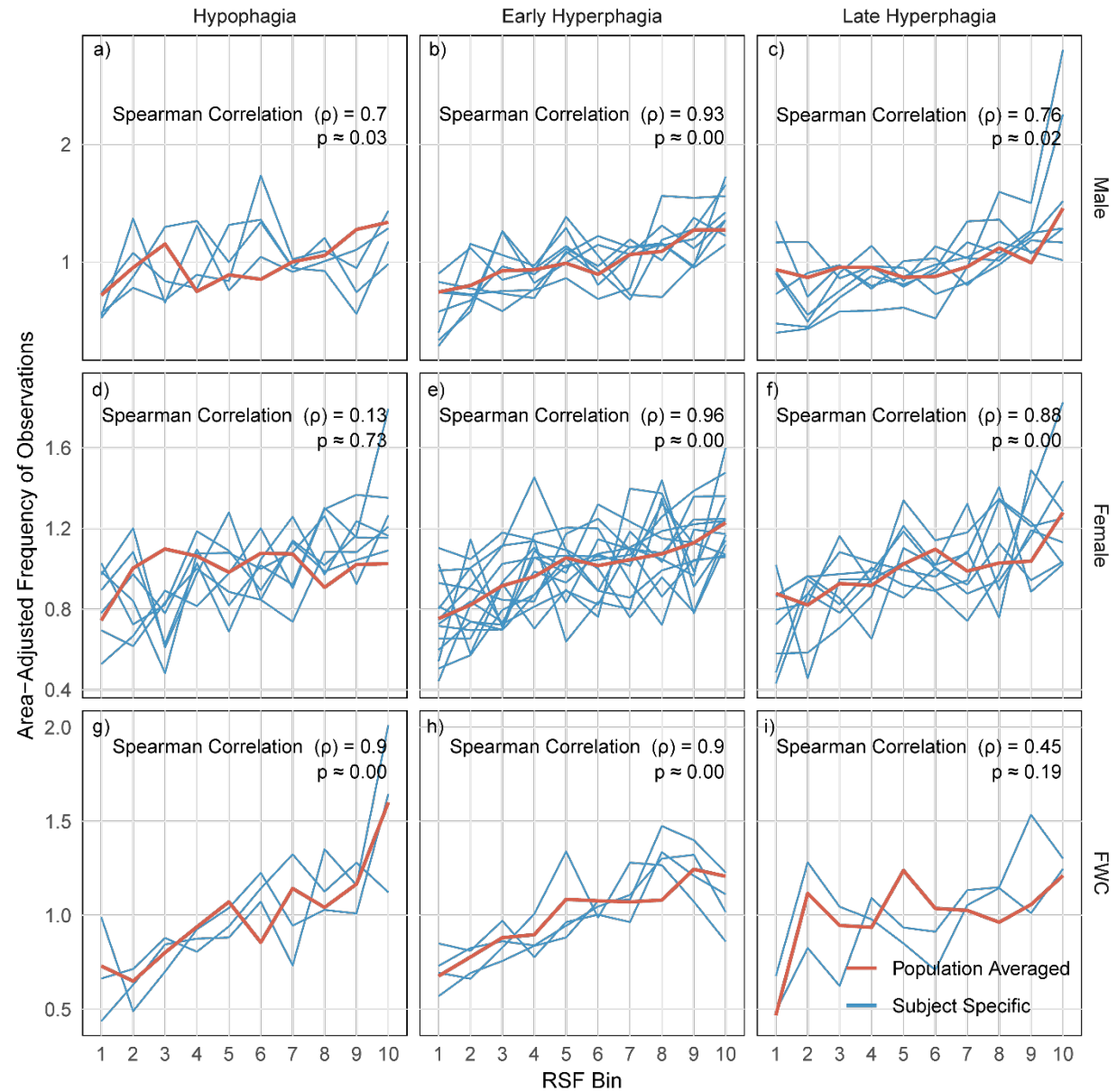
Variables
- Compound topographic index (derived from 30m DEM)
- Elevation (30m DEM)
- Slope Aspect Index
- Distance to forest edge (lidar-derived)
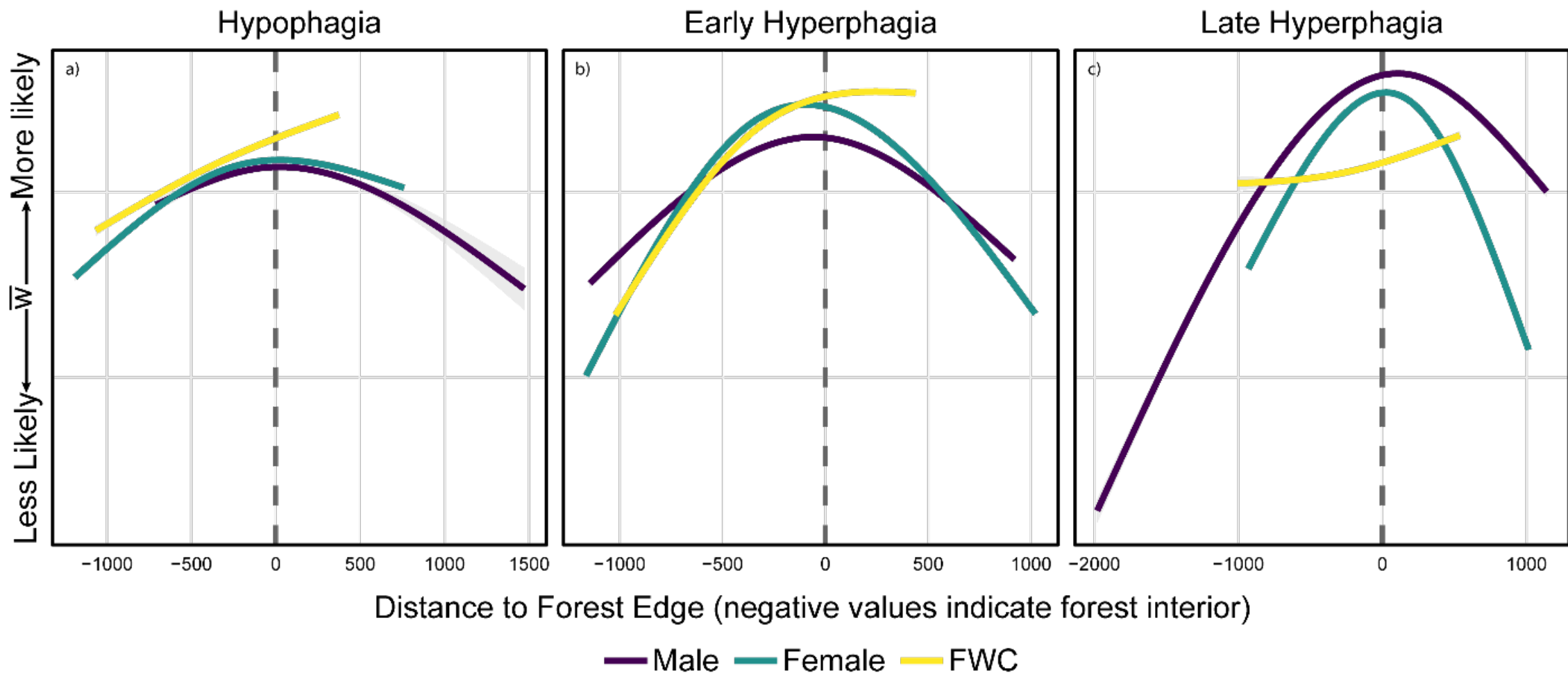- 75$^{th}$ Height Percentile
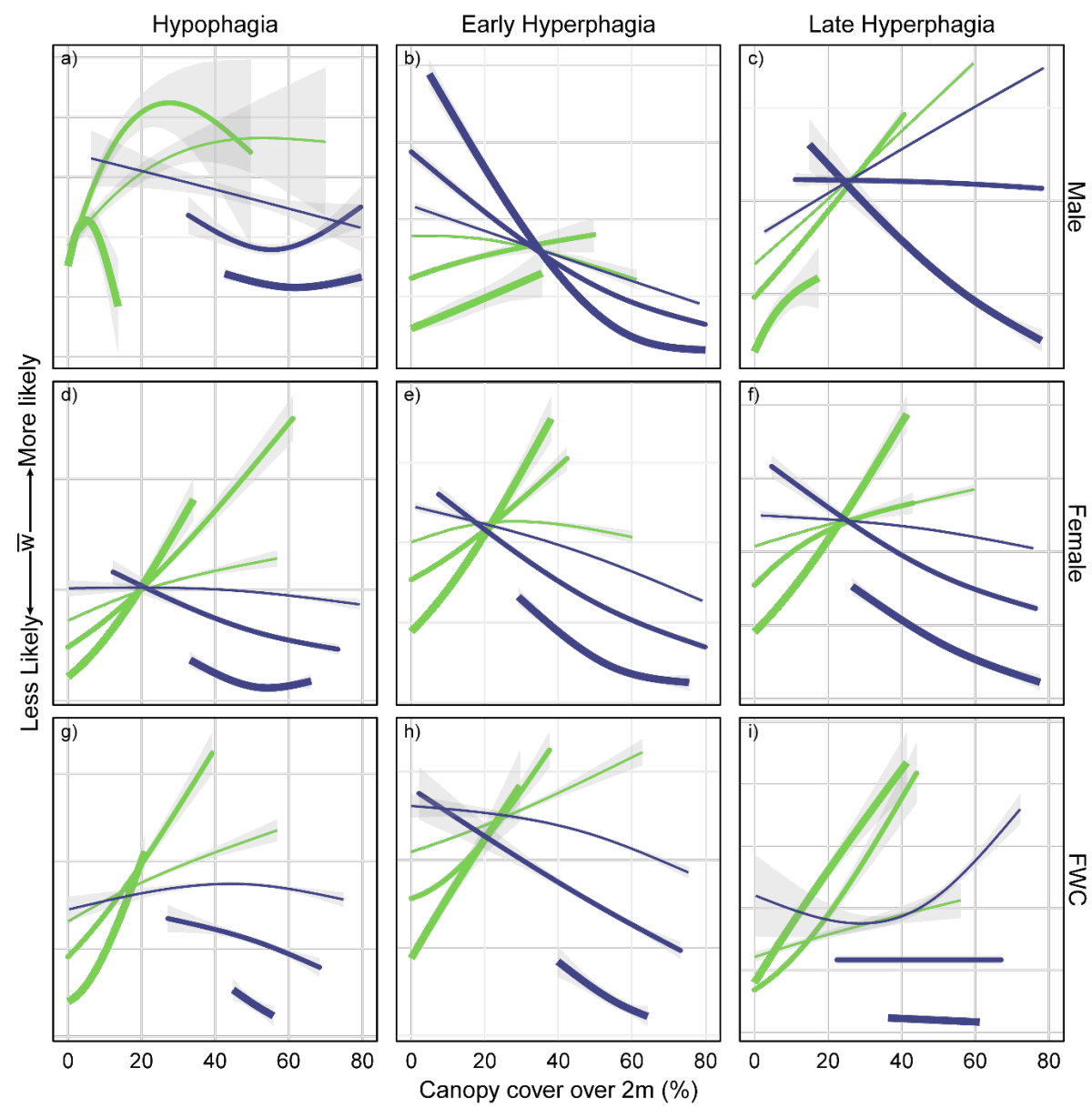- Percentage all returns above 2 meters

Model Selection
- AIC Tally
  - AICs cannot be directly compared

# AIC Tally

| Model | k | Male | | | Female | | | Female w/ Cubs | | | Sum |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | H | EH | LH | H | EH | LH | H | EH | LH | |
| Core | 4 | 1 | 1 | 1 | 1 | 3 | 1 | 0 | 1 | 0 | 9 |
| Core + height + cover | 6 | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 5 |
| Core + cover + edge distance + cover* edge distance | 7 | 1 | 4 | 2 | 3 | 4 | 3 | 2 | 2 | 1 | 22 |
| Core + height + edge distance + height* edge distance | 7 | 0 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 16 |
| Core + height + cover + edge distance + cover* edge distance | 8 | 1 | 4 | 2 | 3 | 4 | 3 | 2 | 2 | 1 | 22 |
| Core + height ^2 + cover ^2 | 8 | 1 | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 5 |
| Core + height ^2 + cover + edge distance + cover *edge distance | 9 | 1 | 1 | 1 | 1 | 3 | 1 | 0 | 1 | 0 | 9 |

Hypophagia      Early Hyperphagia      Late Hyperphagia

Distance to Forest Edge (negative values indicate forest interior)

— Male — Female — FWC

# Conclusions

- As we all know, wildlife is a phenomenon of edges
- Here in the study area dominated by lodgepole pine, edges are manifest as the greatest source of structural diversity at a fine scale
- Bears prefer low cover conditions inside forested stands, and outside stands they prefer high cover conditions

Practitioner food for thought:

What are the implications for retention block cuts and natural disturbance based forestry?

17

# Thanks, ya'll!
# Questions?

# References

Eitel, J. U., Höfle, B., Vierling, L. A., Abellán, A., Asner, G. P., Deems, J. S., ... & Mandlburger, G. (2016). Beyond 3-D: The new spectrum of lidar applications for earth and ecological sciences. *Remote Sensing of Environment*, *186*, 372-392.

Johnson, Douglas H., "The Comparison of Usage and Availability Measurements for Evaluating Resource Preference" (1980). USGS Northern Prairie Wildlife Research Center. 198.

Koukoulas, S., & Blackburn, G. A. (2004). Quantifying the spatial properties of forest canopy gaps using LiDAR imagery and GIS. International Journal of Remote Sensing, 25(15), 3049-3072.

McGaughey, R. J. (2013). Fusion/LDV: Software for lidar data aalysis and vsualization, 3.30. *USDA Forest Service—Pacific Northwest Research Station: Portland, OR, USA*.

Mcloughlin, P. D., Ferguson, S. H., & Messier, F. (2000). Intraspecific variation in home range overlap with habitat quality: a comparison among brown bear populations. *Evolutionary Ecology*, *14*(1), 39-60.

Munro, R. M., Nielsen, S. E., Price, M. H., Stenhouse, G. B., & Boyce, M. S. (2006). Seasonal and diel patterns of grizzly bear diet and activity in west-central Alberta. Journal of mammalogy, 87(6), 1112-1121.

Nathan, R., Getz, W. M., Revilla, E., Holyoak, M., Kadmon, R., Saltz, D., & Smouse, P. E. (2008). A movement ecology paradigm for unifying organismal movement research. *Proceedings of the National Academy of Sciences*, *105*(49), 19052-19059.

Alberta Environment and Parks. 2016. Alberta Grizzly Bear (Ursus arctos) Recovery Plan,. Alberta Environment and Parks, Alberta Species at Risk Recovery Plan No. 38. Edmonton, AB. 85 pp.

Tardiff, S. E., & Stanford, J. A. (1998). Grizzly bear digging: effects on subalpine meadow plants in relation to mineral nitrogen availability. *Ecology*, *79*(7), 2219-2228.