

Unmarked but not unseen: Estimating density of American black bears and grizzly bears in Yellowstone National Park using camera traps

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What abundance tells us

Knowing how many

Trends & status

Is it changing?
Is it at risk?

Management

Are actions needed?
Is it working?

Ecological impact

How does it impact the ecosystem?

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Abundance estimation

Challenges for grizzly and black bears

- Low densities
- Large home ranges
- Typically lack individual markings



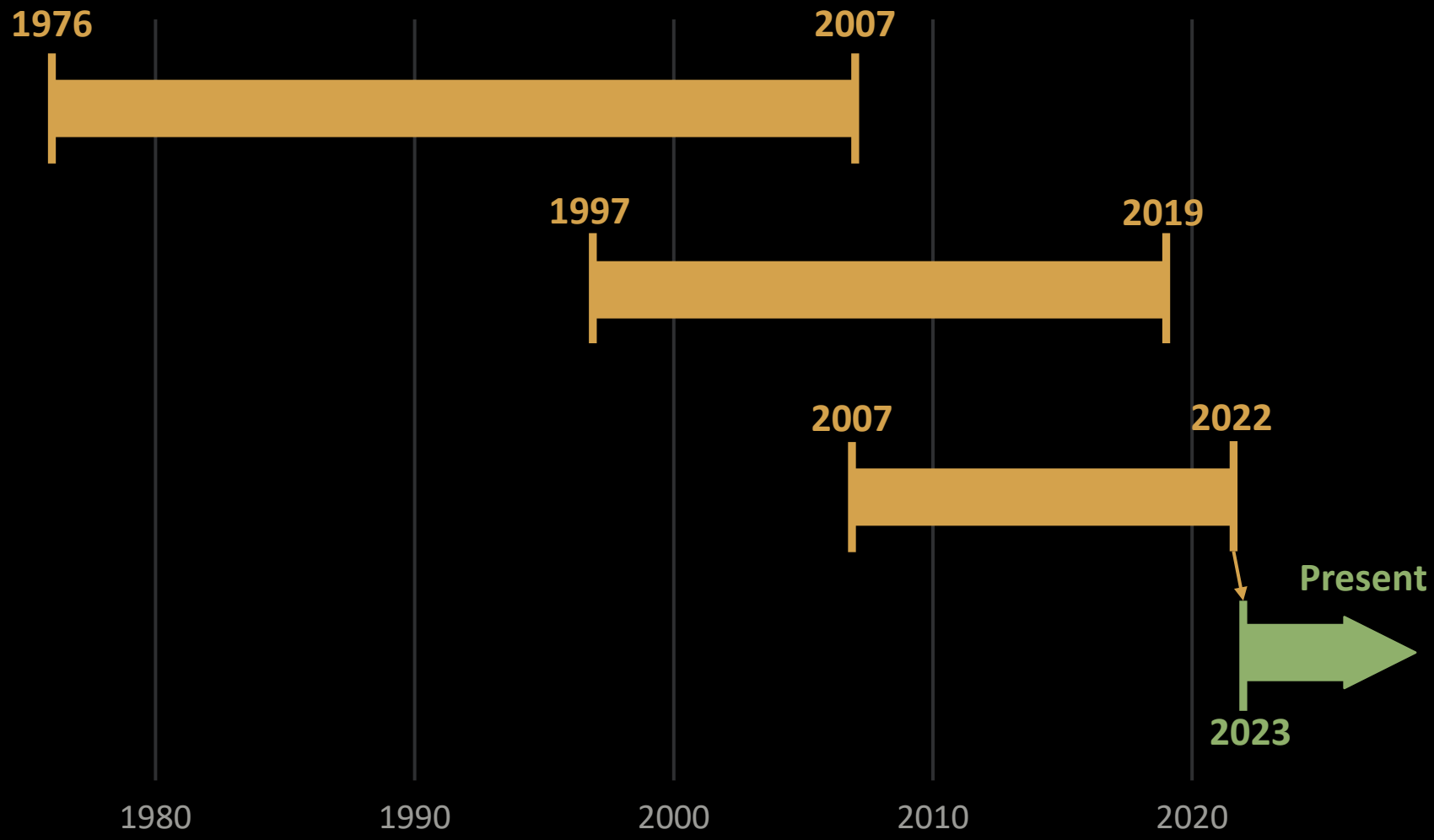
How grizzly abundance has been estimated

Minimum counts of unique females with COY
Knight et al. 1995

Mark-resight
Higgs et al. 2013

Chao2
Cherry et al. 2007

IPM
Gould et al. 2024



Alternative methods



+ Inexpensive
- Effort
- Bias



+ Genetic insight
- Effort
- Cost



+ Remote data collection
+ Other insights gained
- Processing time

Challenge of individual identification





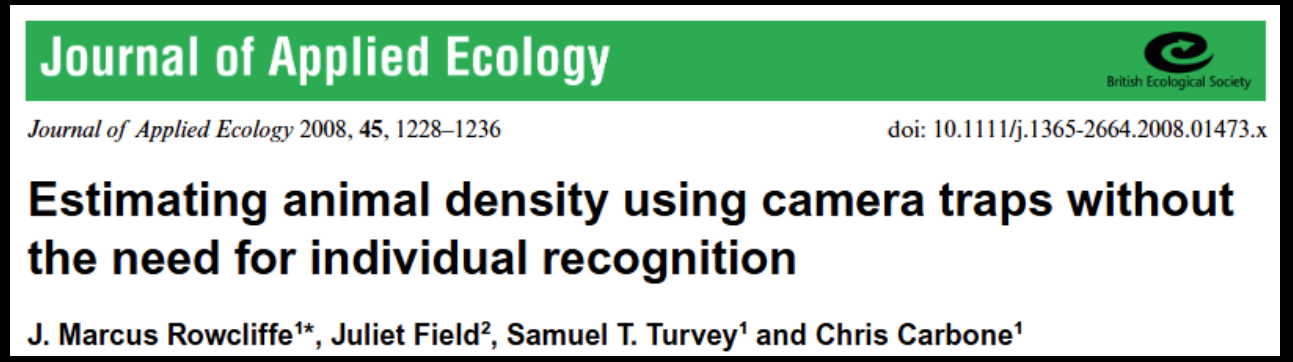


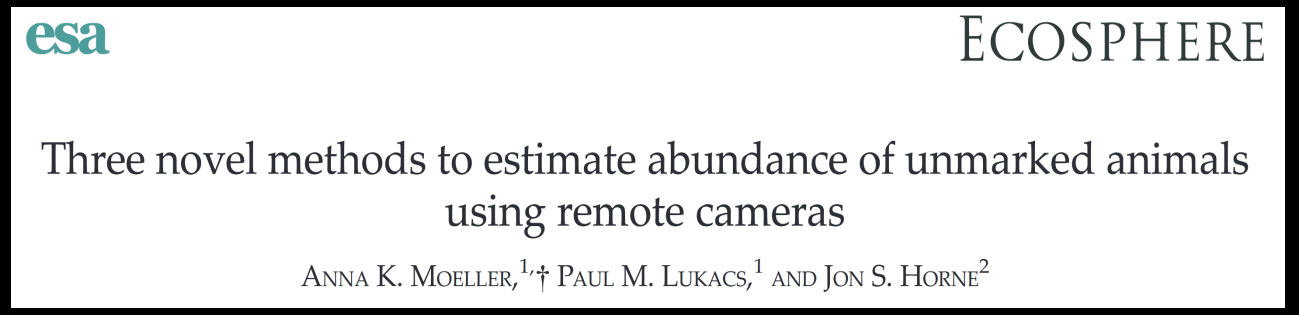


Photos provided by J. Argyle

Unmarked abundance estimation

- Statistical advancements remove the need for individual identification
- Little known about their efficacy in bears
- Focus on two models

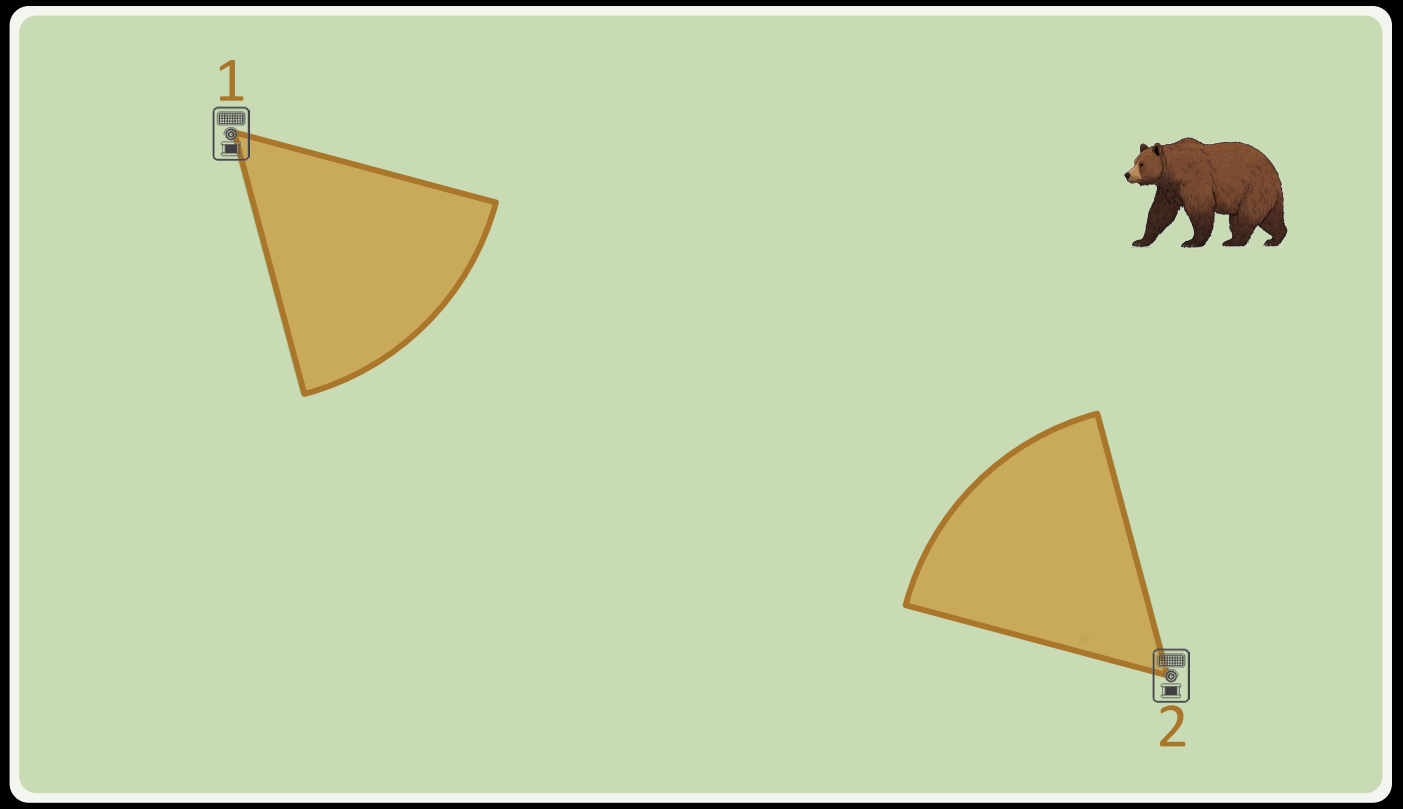




Time-to-event: measuring time to detection

Occasion	1	2	3	4
Camera 1				
Camera 2				

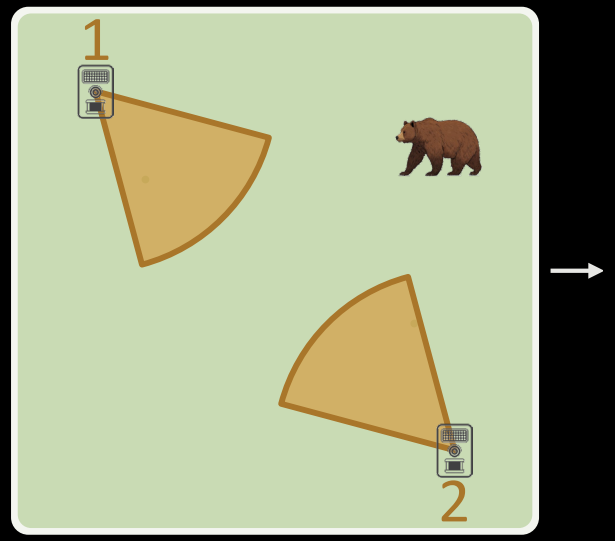




Space-to-Event: measuring space to detection

Occasion	1	2	3	4
Detection				

both cameras click - nothing



Occasion 1

Comparing the approaches

Time-to-event

- Time sampled until detection is a function of:
  - Abundance
  - Detectability
  - Movement rate

Comparing the approaches

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Space-to-event

- Area sampled until detection is a function of:
  - Abundance
  - Detectability

Assumptions and trade-offs

Assumptions

- Random placement
- Statistical distribution
- Independence
- Population closure
- Perfect detection

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Time-to-event

☑ Can model spatial variation in density

⚠ Requires an independent estimate of movement rate

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Assumptions

- Random placement
- Statistical distribution
- Independence
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Time-to-event

☑ Can model spatial variation in density

⚠ Requires an independent estimate of movement rate

Space-to-event

☑ Does not require an estimate of movement rate

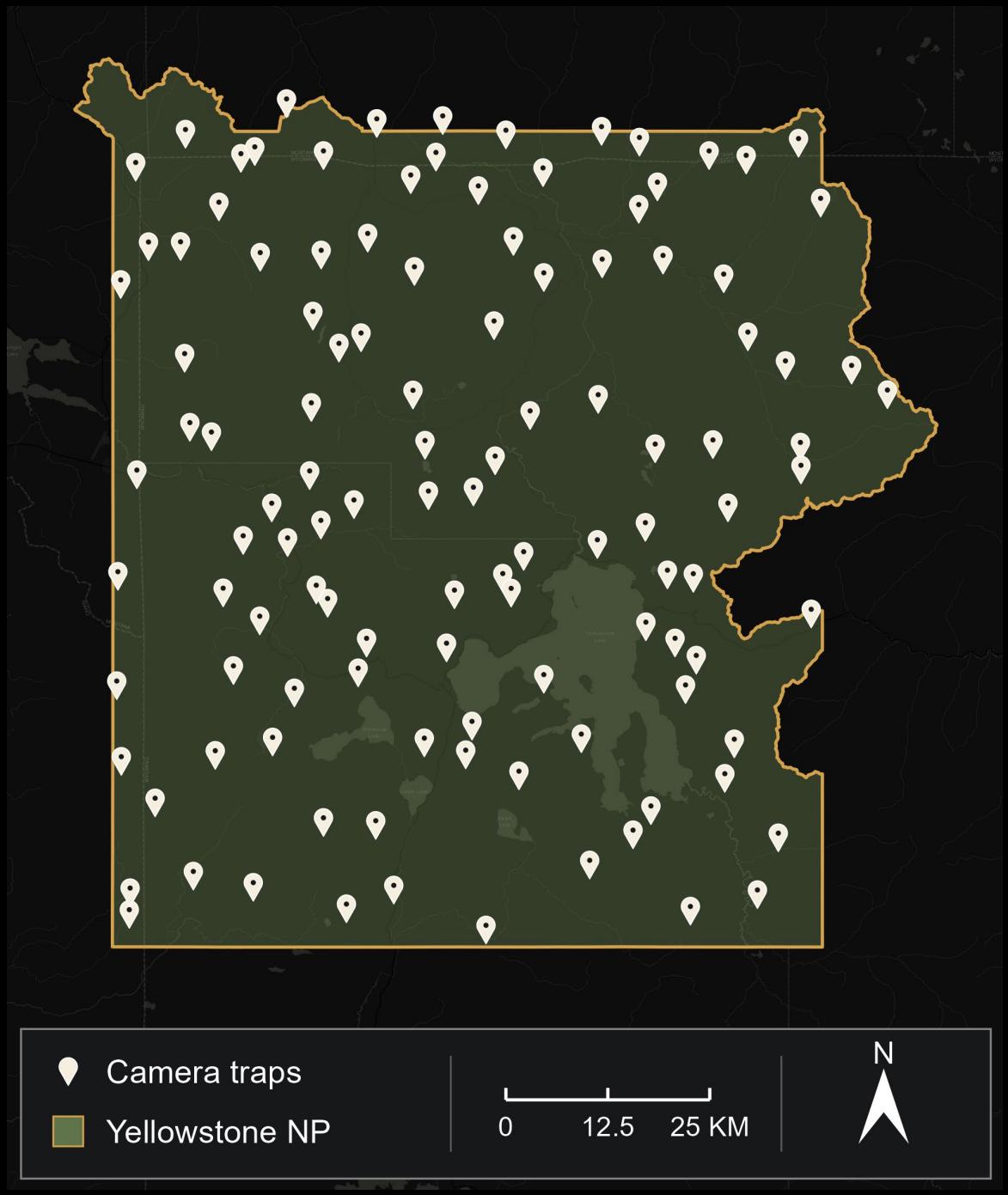
⚠ May result in small sample sizes for rare species

Goal and study design

Evaluate unmarked abundance estimators as a tool to estimate American black and grizzly bear density in Yellowstone National Park, USA

120 cameras randomly placed

- Motion trigger images
- Timelapse images every 10 minutes
- Sampled July and August



Preliminary information-subject to revision. Not for citation or distribution.

Field effort

- 7 technicians
- 22 volunteers and partners
- 5,000+ km hiked







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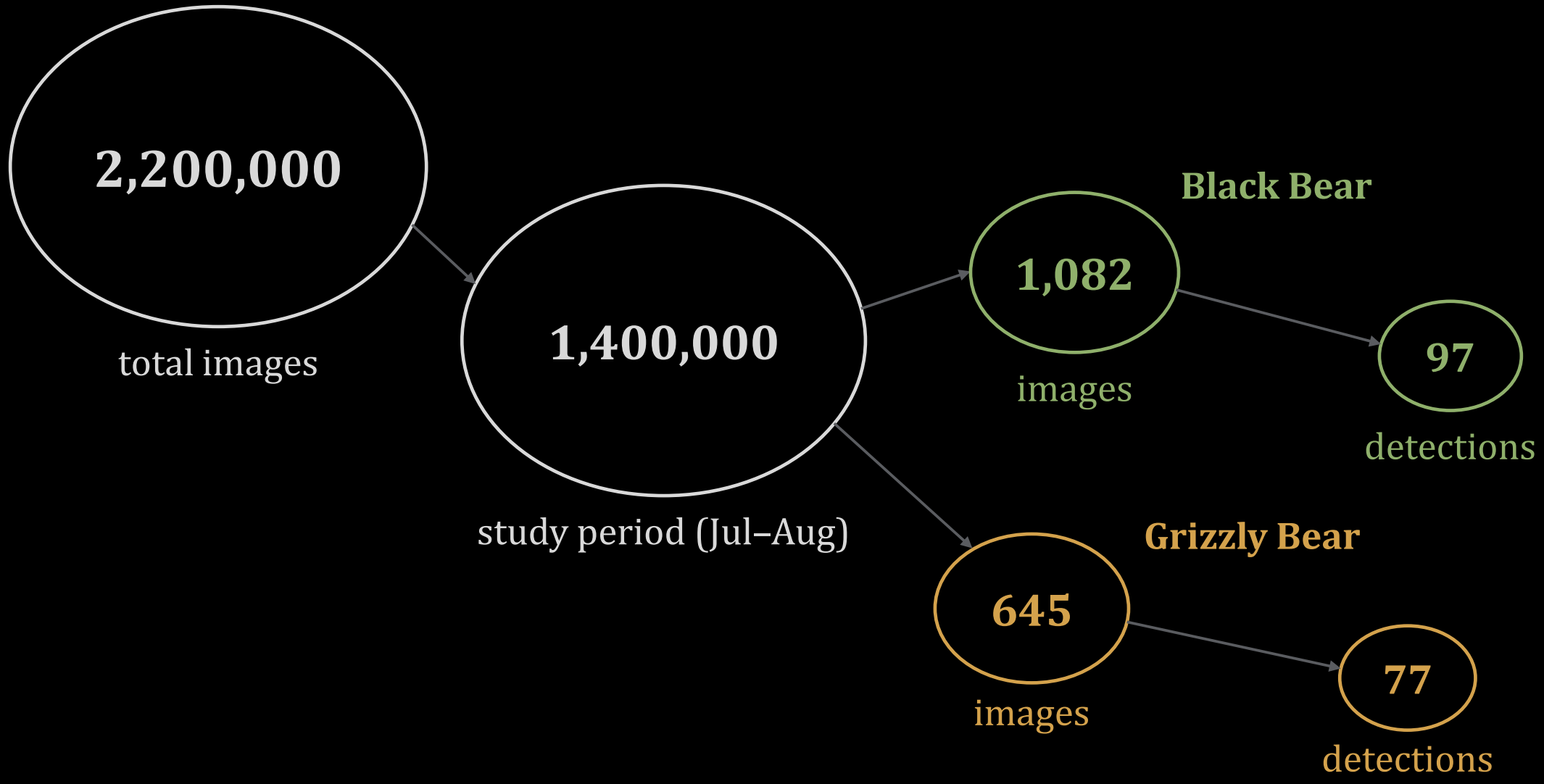
Results



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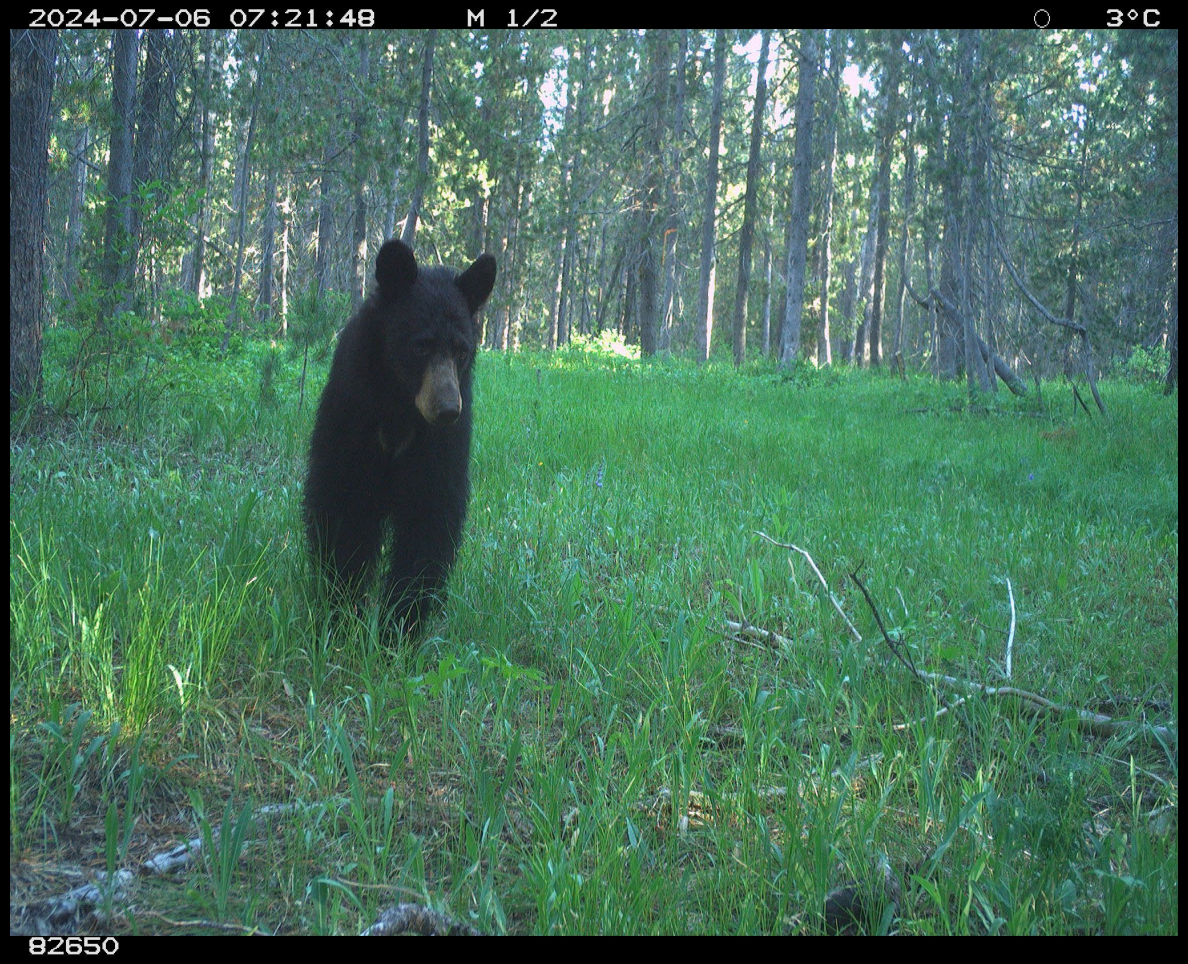
Preliminary density estimates



Black bears

- 9.8 per 100 km² (8.0-12.1)

Comparisons

Area	Density per 100 km²
YNP Northern Range Bowersock et al. 2023	16 (10–26)
Southwest MT Mace & Chilton-Radandt 2011	8–12
Glacier NP Stetz et al. 2014	12 (10–14.4)

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Preliminary density estimates



Grizzly bears

- Estimate forthcoming

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In progress work

Improving movement rate estimates

- Additional sensors in collars give new insights



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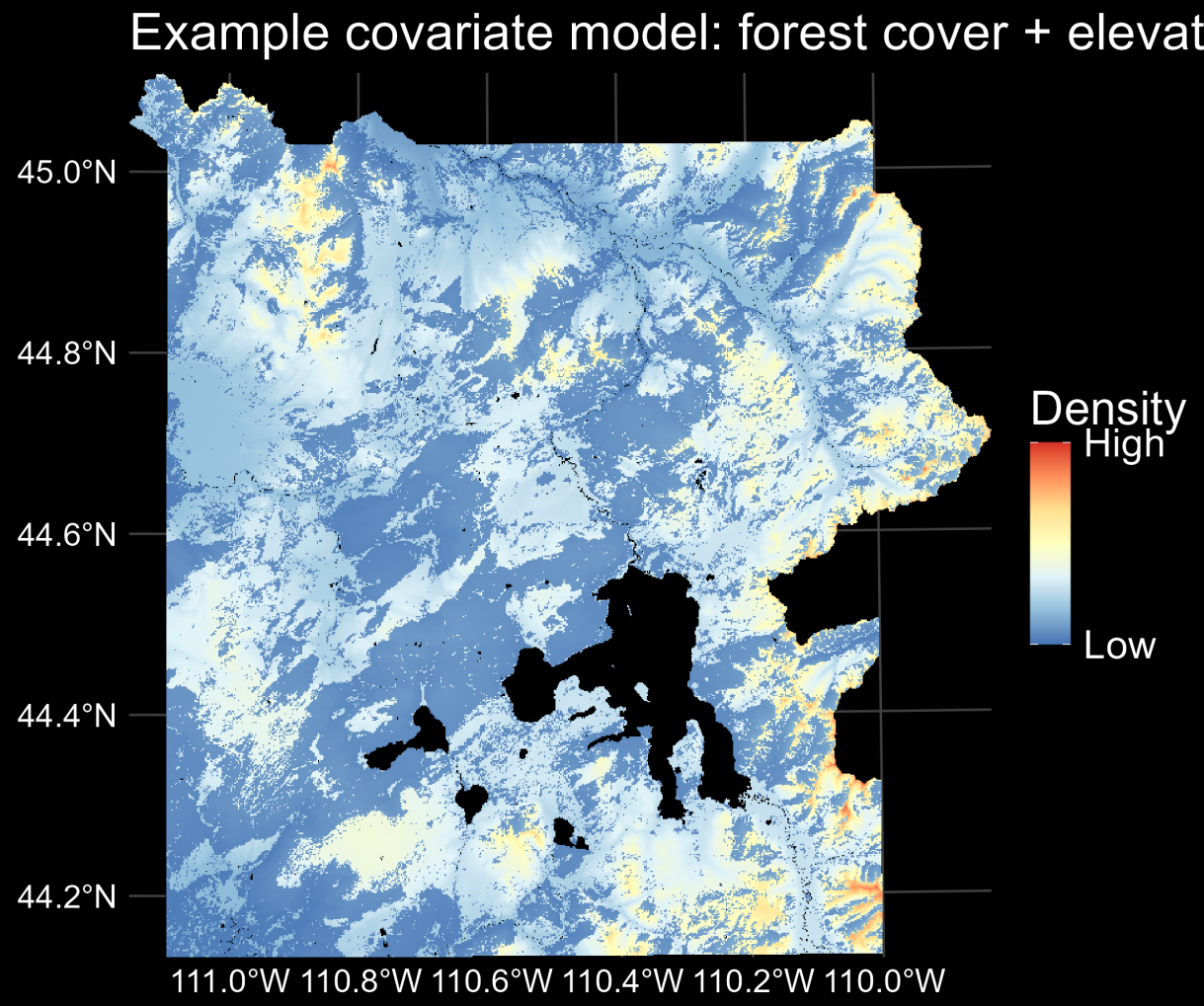
In progress work

Spatial variation in density from time-to-event model



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Other possibilities













Takeaways

- Test new techniques for robust abundance estimates
- Improve novel modeling approaches
- Characterize fine-scale movement of grizzly bears



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Questions?



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