Predicted Habitat Selection and Movement Corridors for Grizzly Bears in Western Montana

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Grizzly bear habitat selection across the Northern Continental Divide Ecosystem

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Grizzly bear movement models predict habitat use for nearby populations

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Motivation

- Understand spatial behavior
  - Habitat use
  - Range expansion
  - Potential for connectivity
Approach

- Develop movement models
  - Integrated step selection functions (iSSFs)
  - Model for each individual
- Test hypotheses
- Identify predictive models
- Simulate movements
NCDE Data

- GPS collars, 2003 – 2021
  - May – Nov
  - 3-hour fix rate
  - 47 females
    - >59,000 fixes
  - 20 males
    - >16,000 fixes
Hypotheses

• **Grizzly bears select habitat with:**
  
  • > food availability to maximize fitness
  
  • < ruggedness to reduce energy expenditure
  
  • > forest & riparian areas for security, thermal regulation, & food
  
  • < building density to avoid humans
  
  • < distance to secure habitat* to avoid humans

• **Generally true, with extensive individual variation**

* USFWS: areas > 500 m from roads on federal, state, & tribal lands
Model Application: Phase 1

- Simulate for NCDE
- Evaluate predictive accuracy

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Simulating Spatial Behavior

- Simulate individual’s movements
Simulating Spatial Behavior
Simulating Spatial Behavior

- Repeat
- Summarize results
  - # of steps/cell → 10 quantile bins
  - iSSF class: 1 = low use, 10 = high
- Assess predictive accuracy
Females

Males

Low ISSF Class High

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Locations, 2003 – 2021
- 165 females, 97 males
- >377,000 fixes

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Highly predictive across season & years

Females: % fixes per class
- 73.5%

Males: % fixes per class
- 83.6%
Model Application: Phase 2

- Simulate for other populations
- Evaluate transferability of results

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Females

Males

Low ISSF Class

High

Sells et al. 2023. Biological Conservation
Low ISSF Class

High

75%

58.2%

SE/CYE Females:

SE/CYE Males:

GYE Females:

GYE Males:

Locations, 2010 – 2021

• 32 females, 40 males
• >106,000 fixes

Locations, 2010 – 2021

• 42 females, 124 males
• >526,000 fixes

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Model Application: Phase 3

- **Simulate directed connectivity paths**
  - Start & end nodes
  - Randomized shortest paths

- **Simulate undirected connectivity path**
  - Start nodes only
  - 5,000 steps (~3 active seasons)

Sells et al. In review. Biological Conservation
Females

Males

*Draft results - do not publish

Sells et al. In review. Biological Conservation
*Draft results – do not publish
Females

Males

*Draft results - do not publish
Next Steps

- External predictions
  - Model NCE & BE

- Model home ranges
  - Understand range expansion
Application

- Decision-making, e.g.,
  - Conservation strategies
  - Habitat management
  - Monitoring design
  - Remember this is movement model, not residency model
NCDE
>84% public

GYE
98% public

Connectivity area
54% public
Females

Males

*Draft results – do not publish

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*Draft results - do not publish*
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