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

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Photo: G. Smith

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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

Jim Peaco

Approach

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

NCDE Data

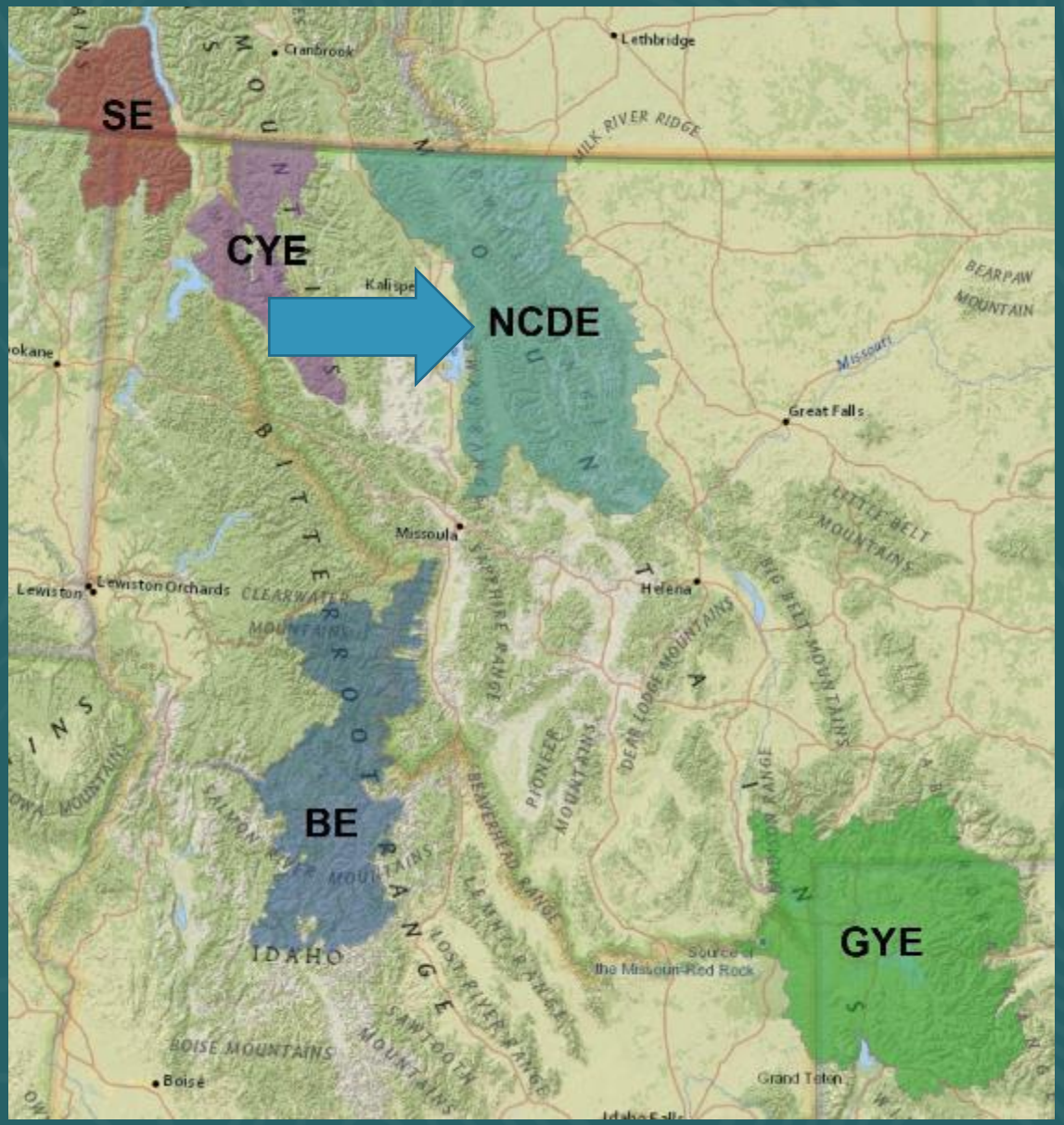
- **GPS collars, 2003 – 2021**
  - May – Nov
  - 3-hour fix rate
  - 47 females
    - >59,000 fixes
  - 20 males
    - >16,000 fixes

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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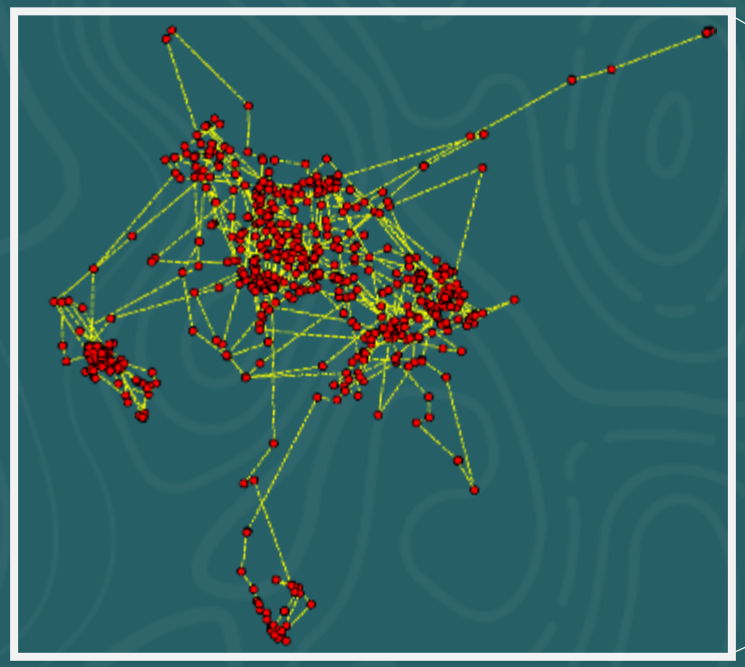
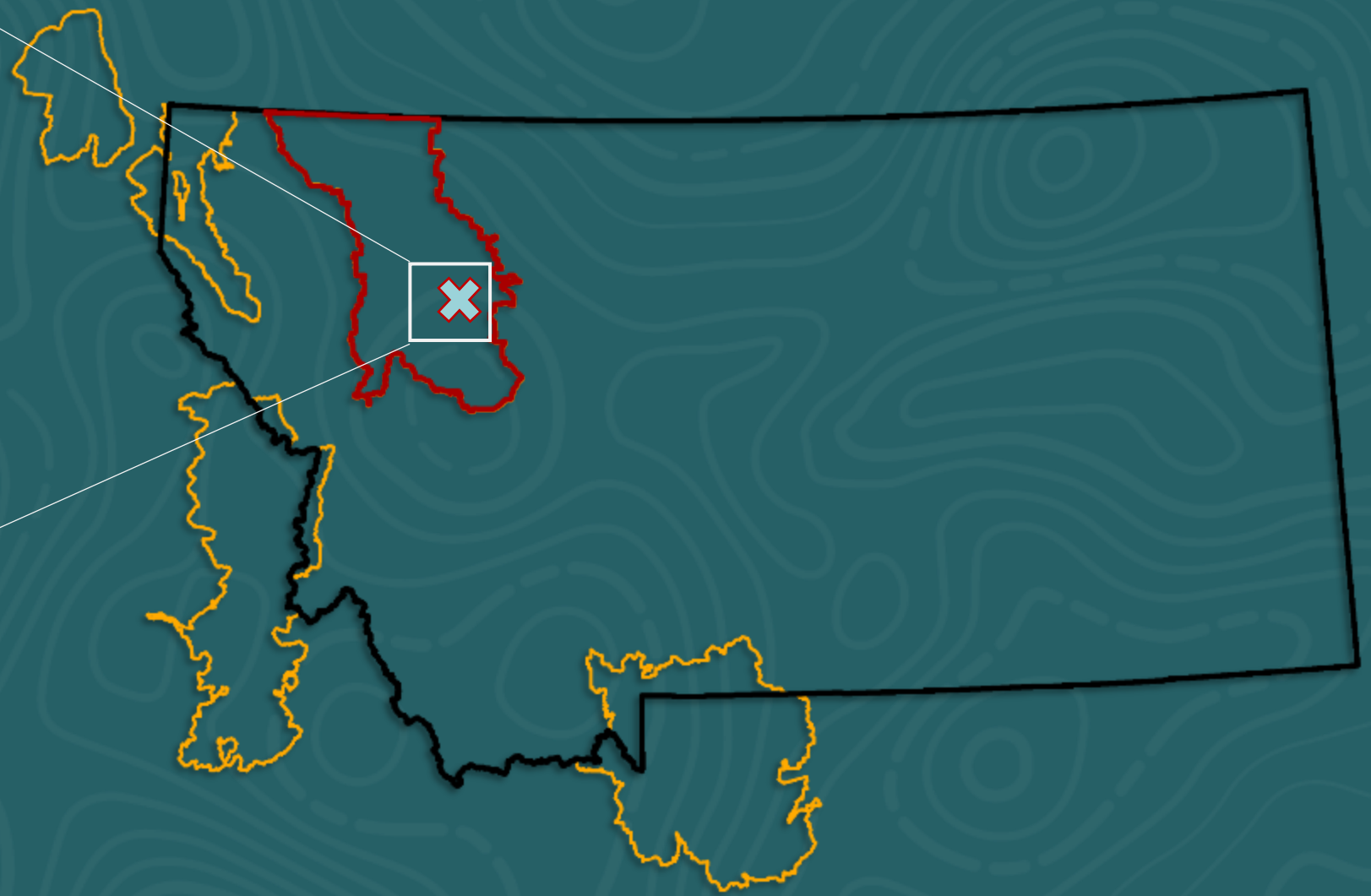
Simulating Spatial Behavior

- Simulate individual's movements

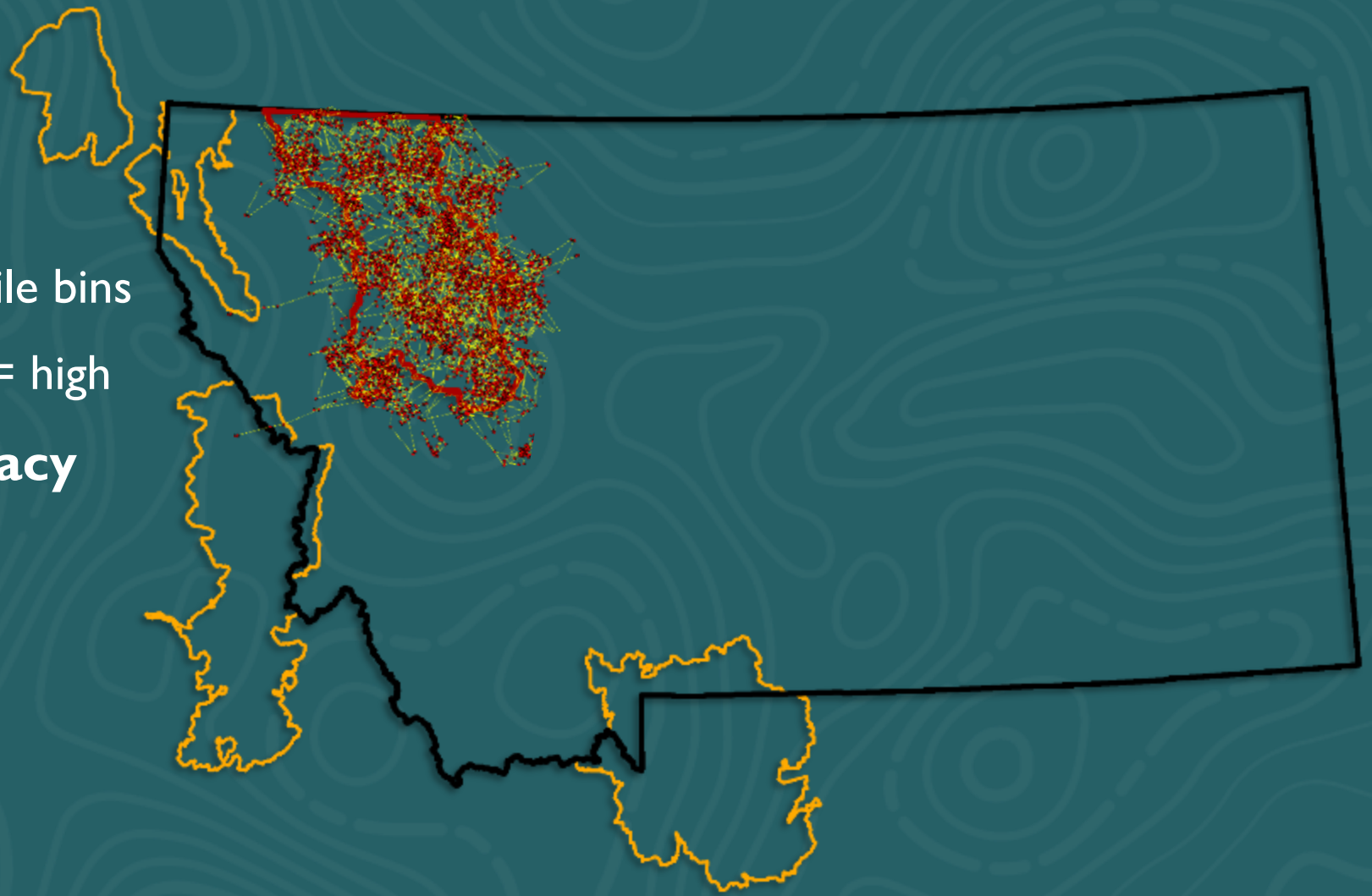
Simulating Spatial Behavior





Simulating Spatial Behavior

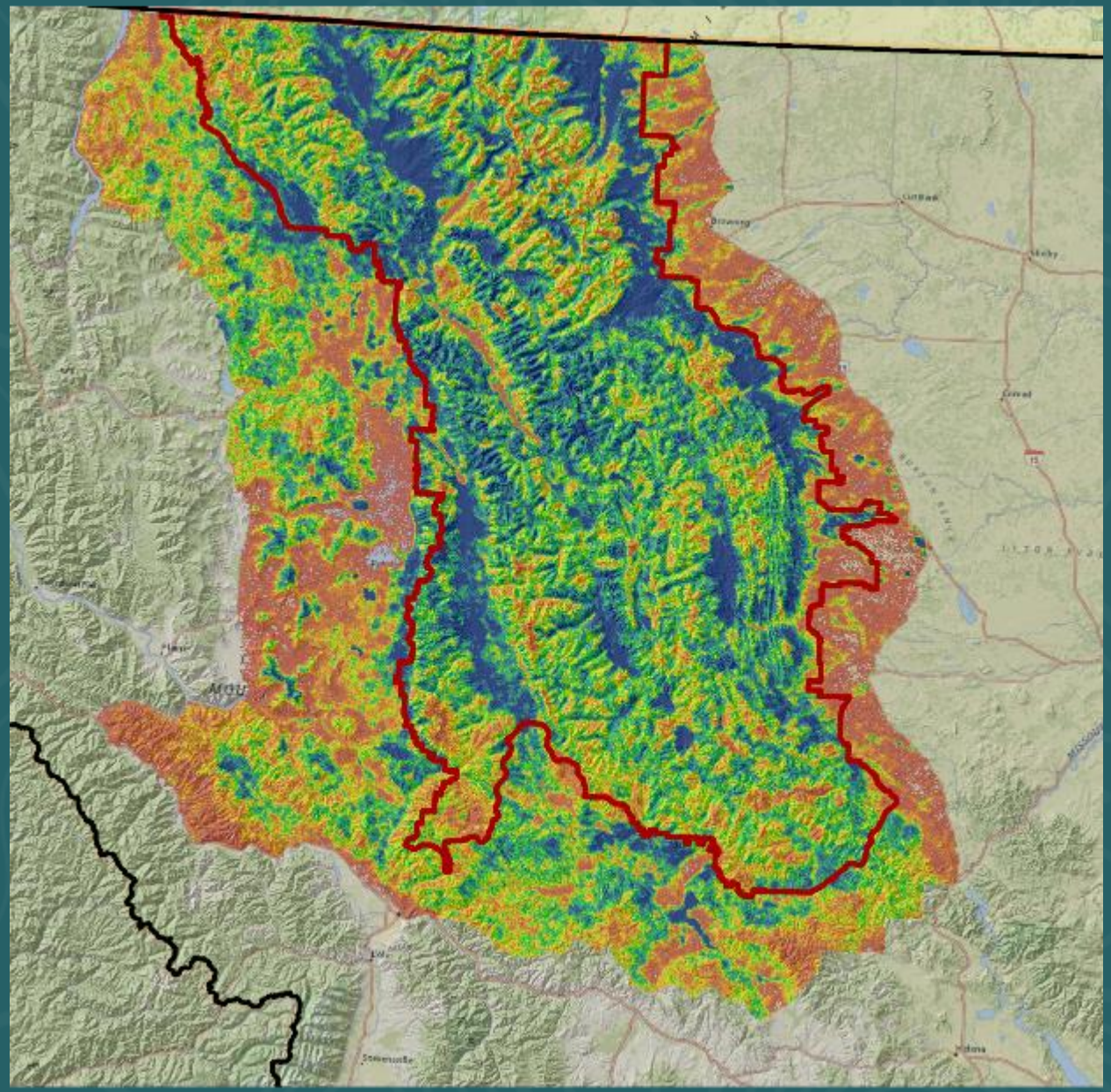
- **Repeat**
- **Summarize results**
  - # of steps/cell → 10 quantile bins
  - iSSF class: 1 = low use, 10 = high
- **Assess predictive accuracy**

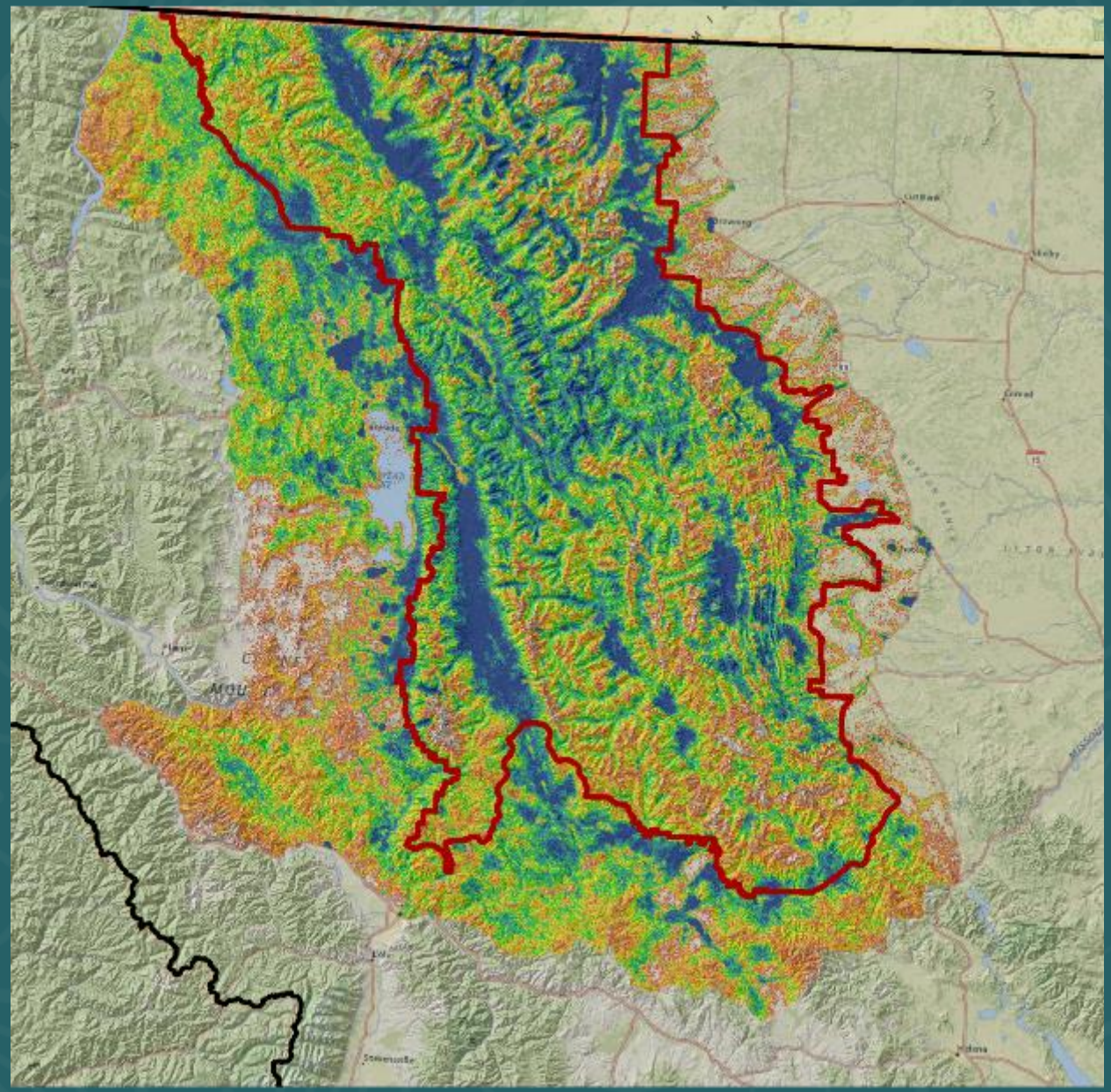


Females

Low iSSF Class *High*

Males





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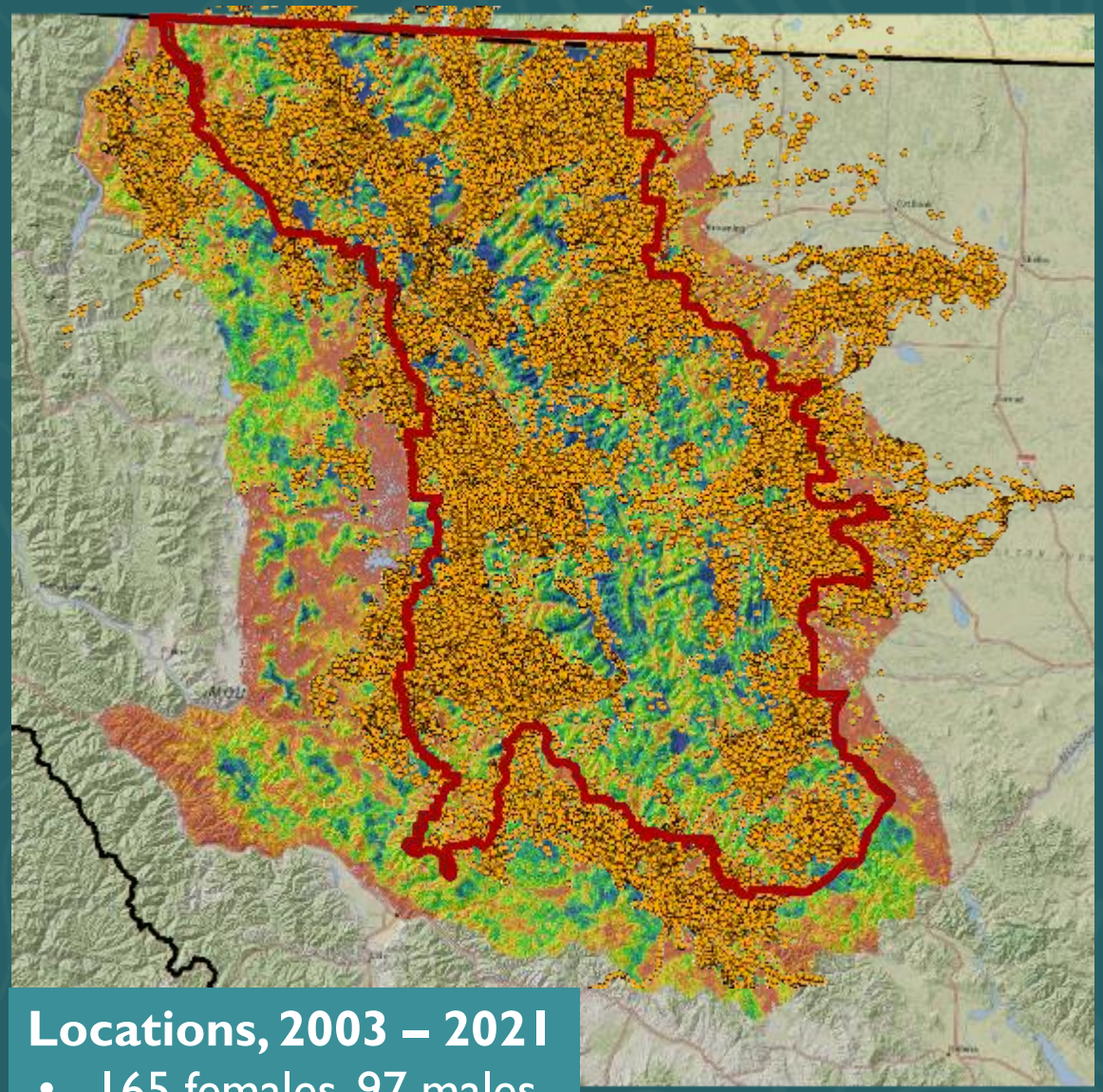
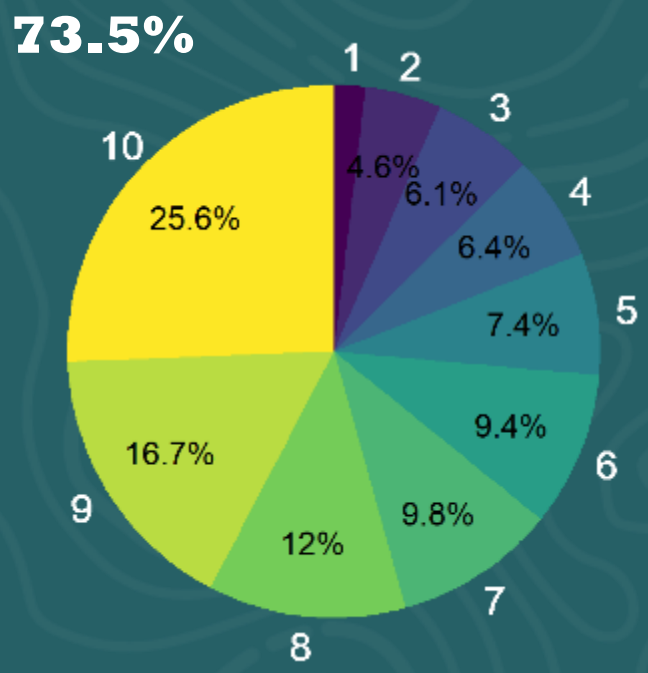


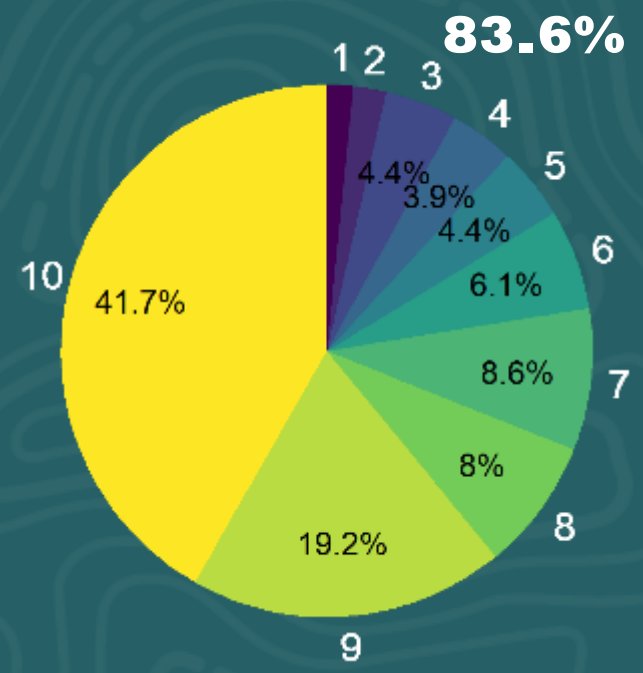
Locations, 2003 – 2021

- 165 females, 97 males
- >377,000 fixes

Females:
% fixes per class



Males:
% fixes per class



Highly predictive across season & years

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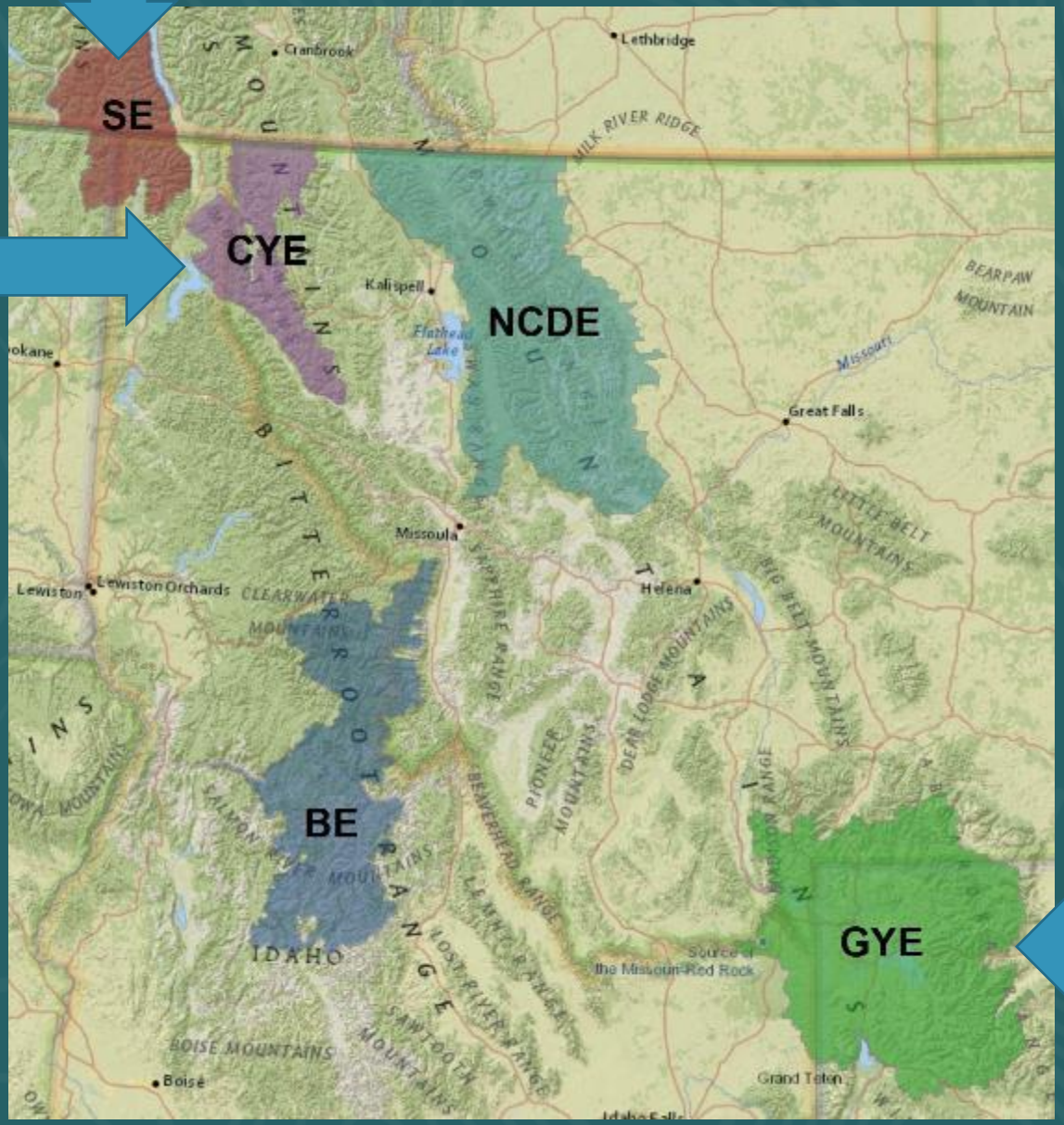
Model Application: Phase 2



- Simulate for other populations
- Evaluate transferability of results

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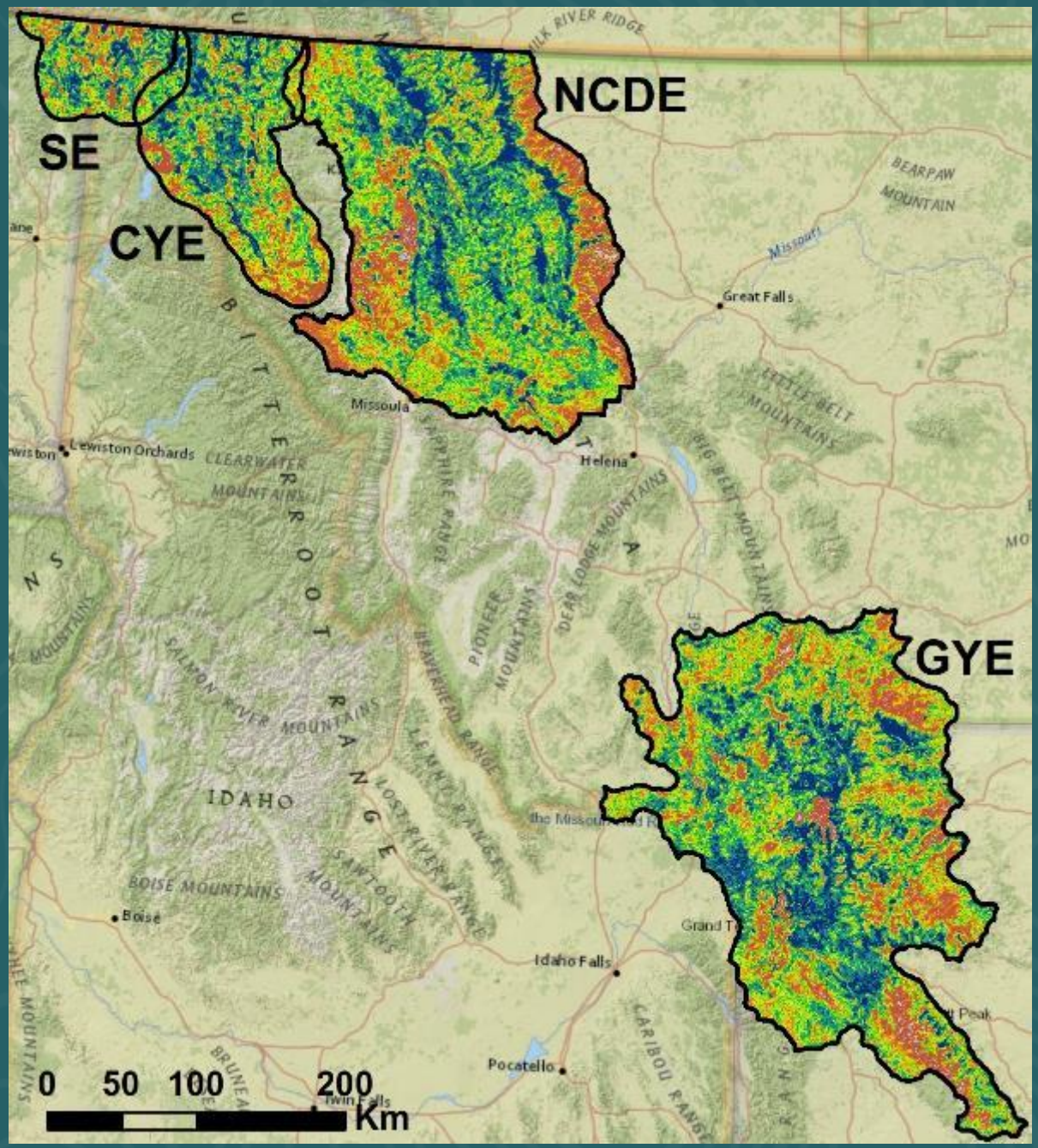
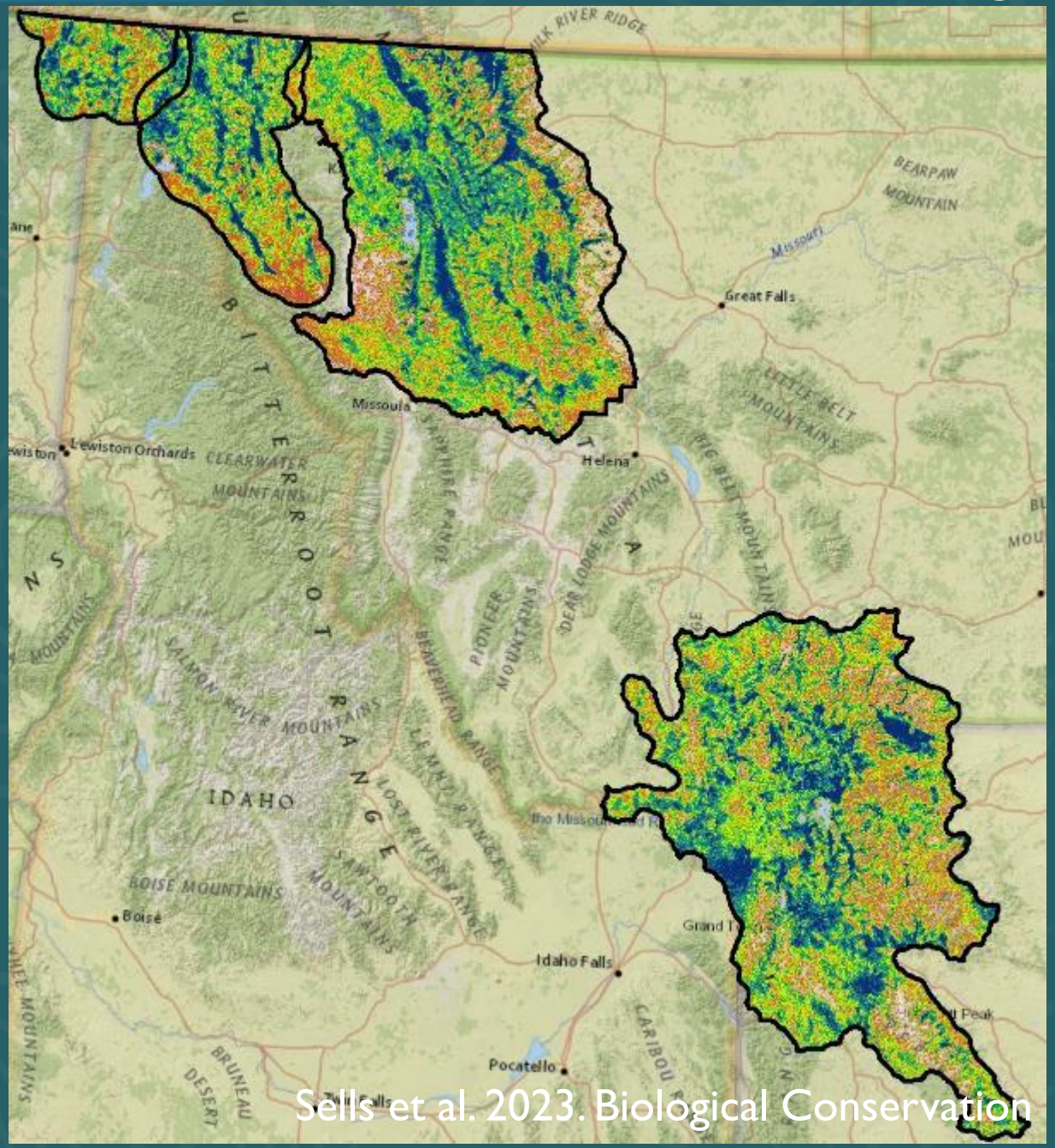
Females

Low iSSF Class High

Males





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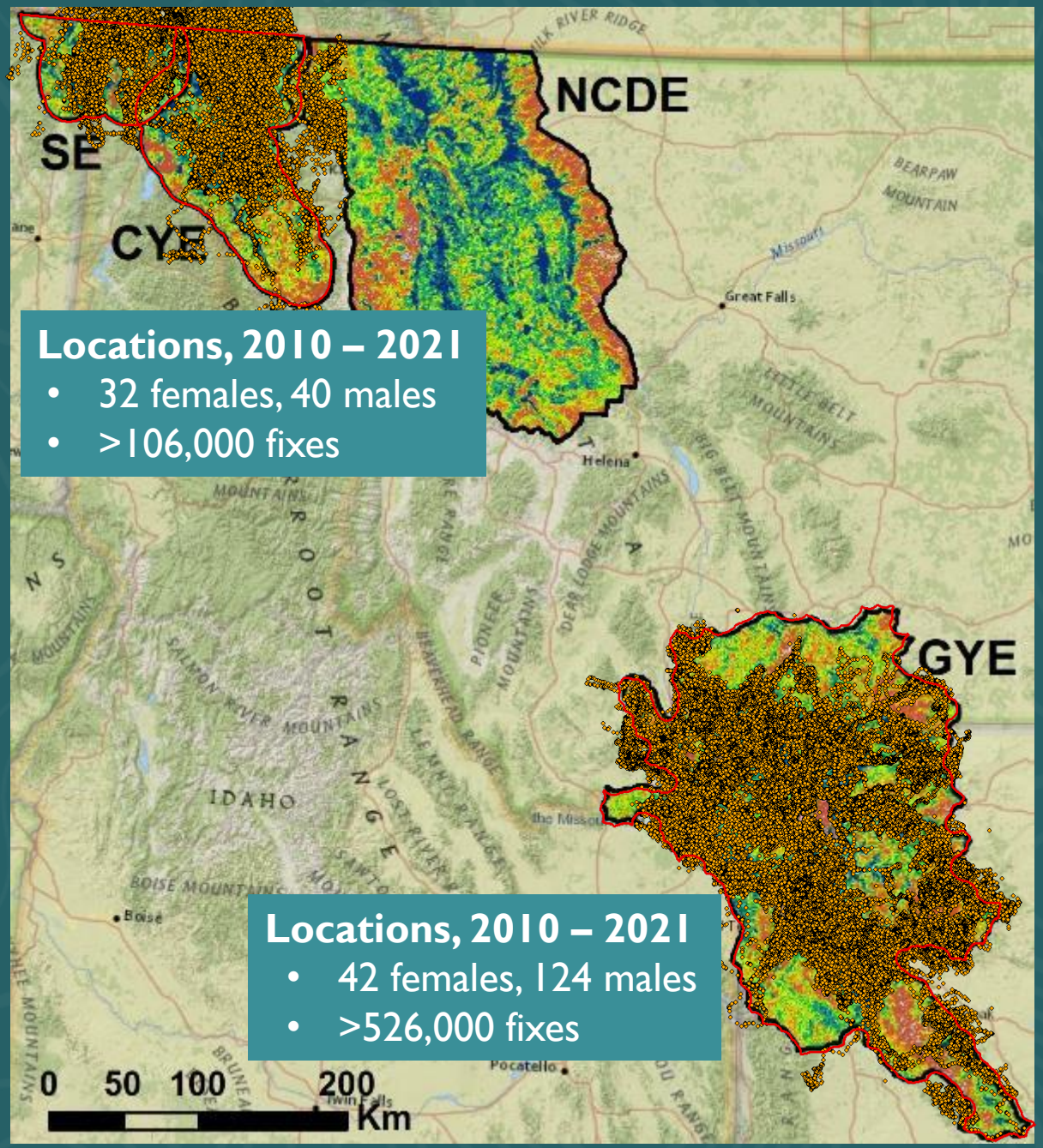
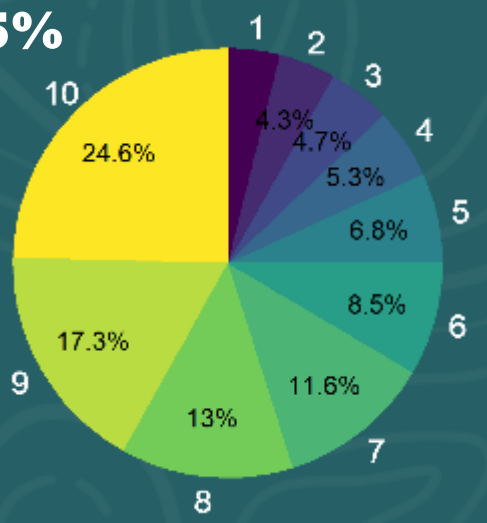


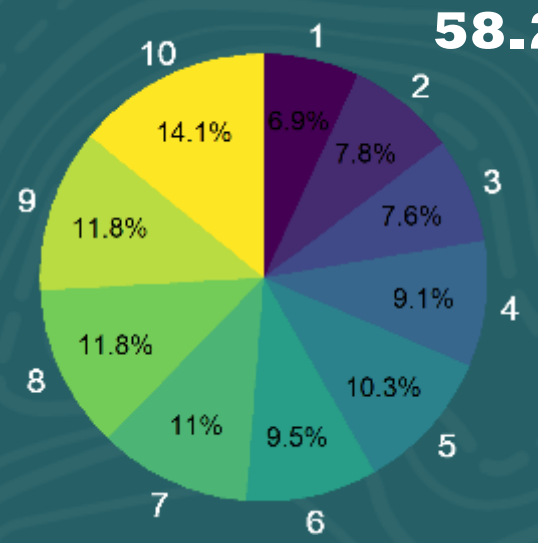
Locations, 2010 – 2021
- 32 females, 40 males
- >106,000 fixes

Locations, 2010 – 2021
- 42 females, 124 males
- >526,000 fixes

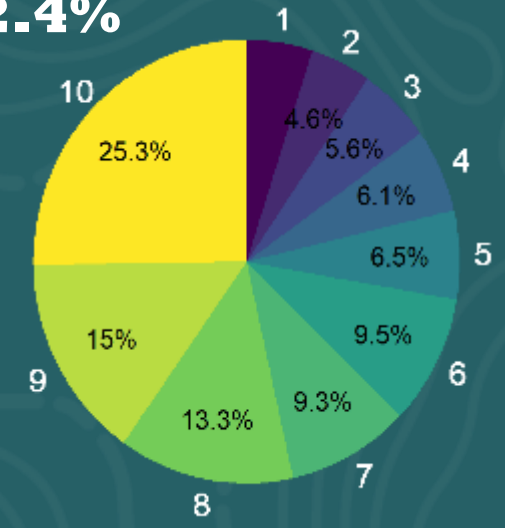
SE/CYE Females: 75%



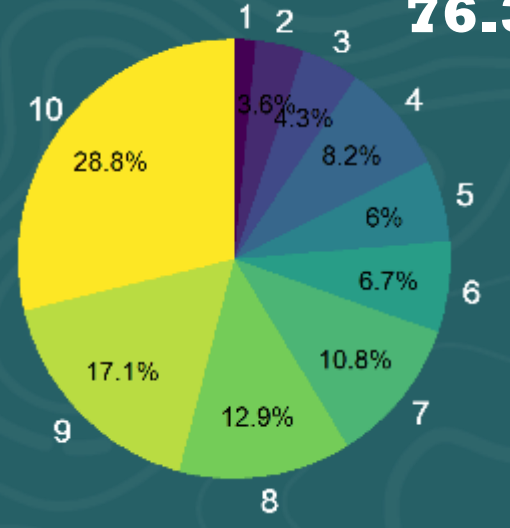
SE/CYE Males: 58.2%



GYE Females: 72.4%



GYE Males: 76.3%



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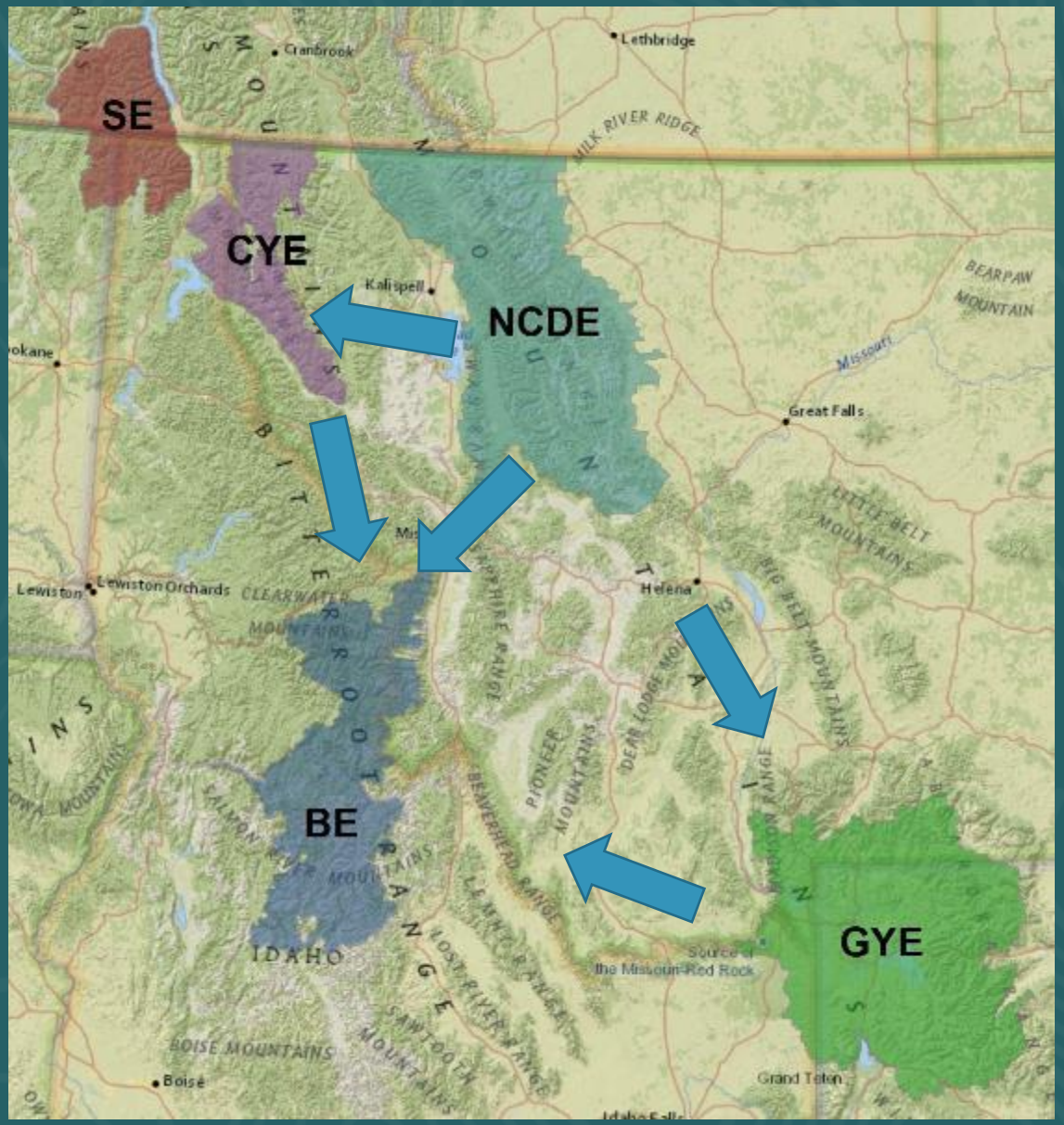
Model Application: Phase 3



- **Simulate directed connectivity paths**
  - Start & end nodes
  - Randomized shortest paths
- **Simulate undirected connectivity path**
  - Start nodes only
  - 5,000 steps (~3 active seasons)

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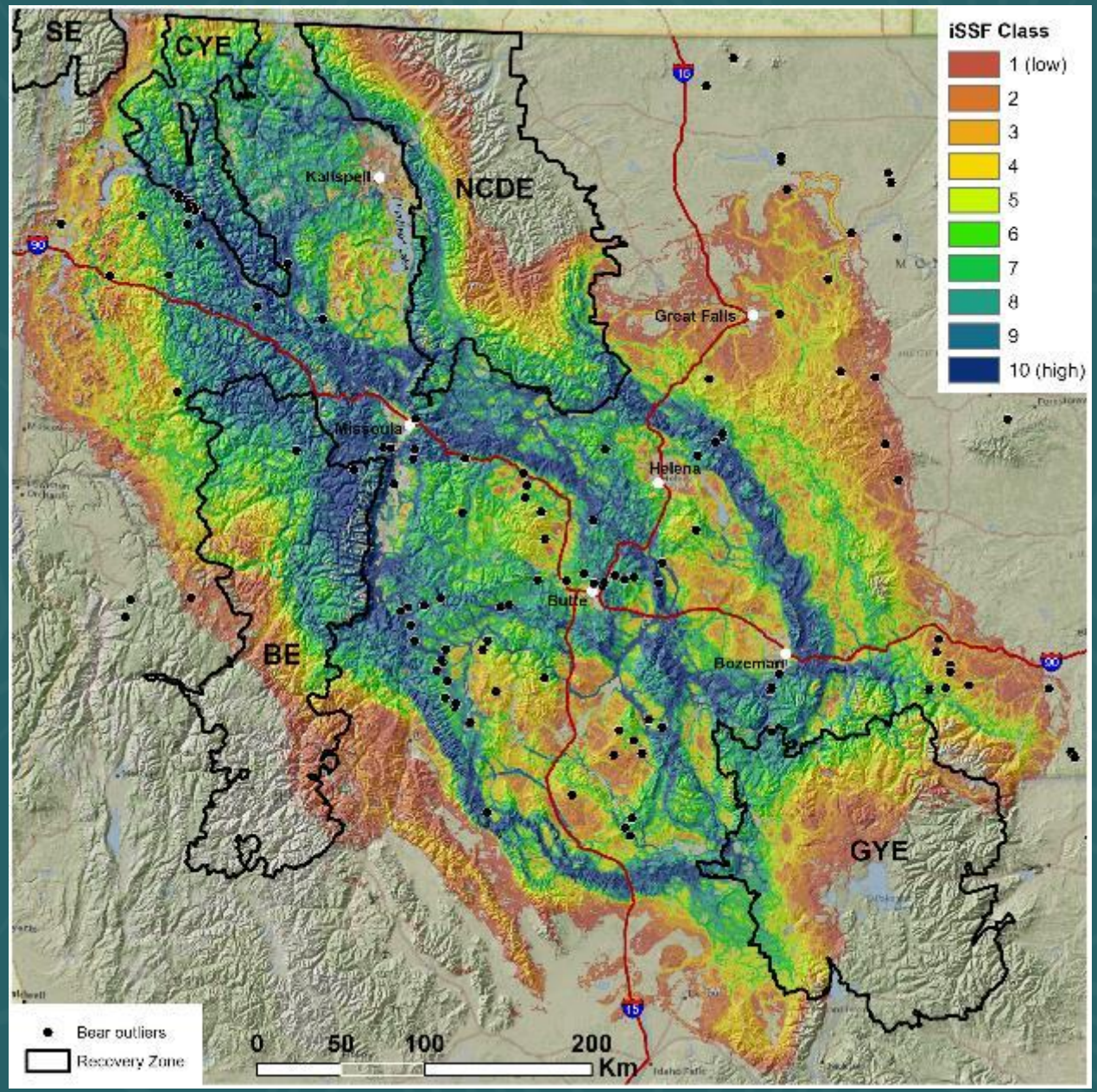
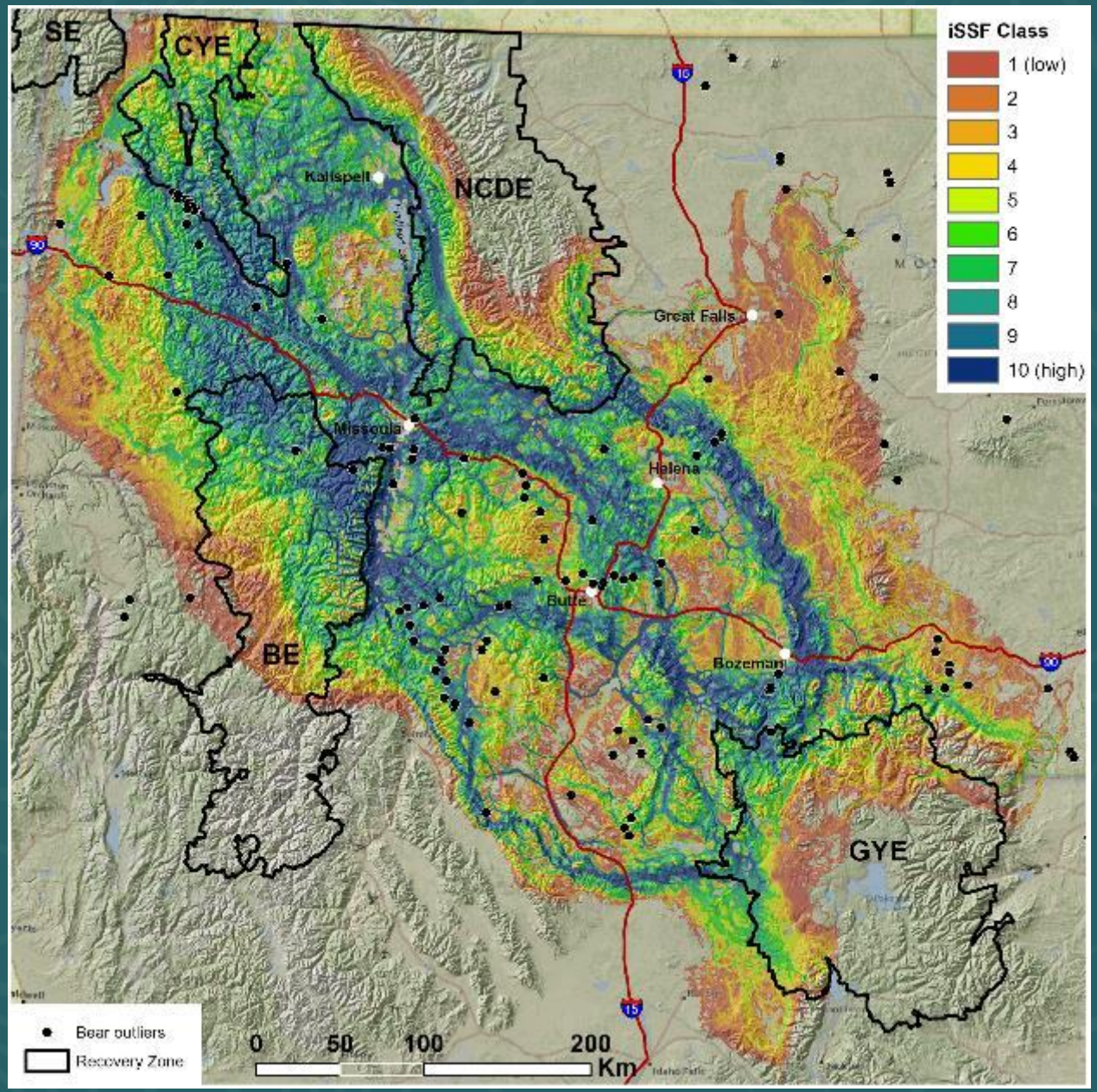
Females



Males



*Draft results – do not publish

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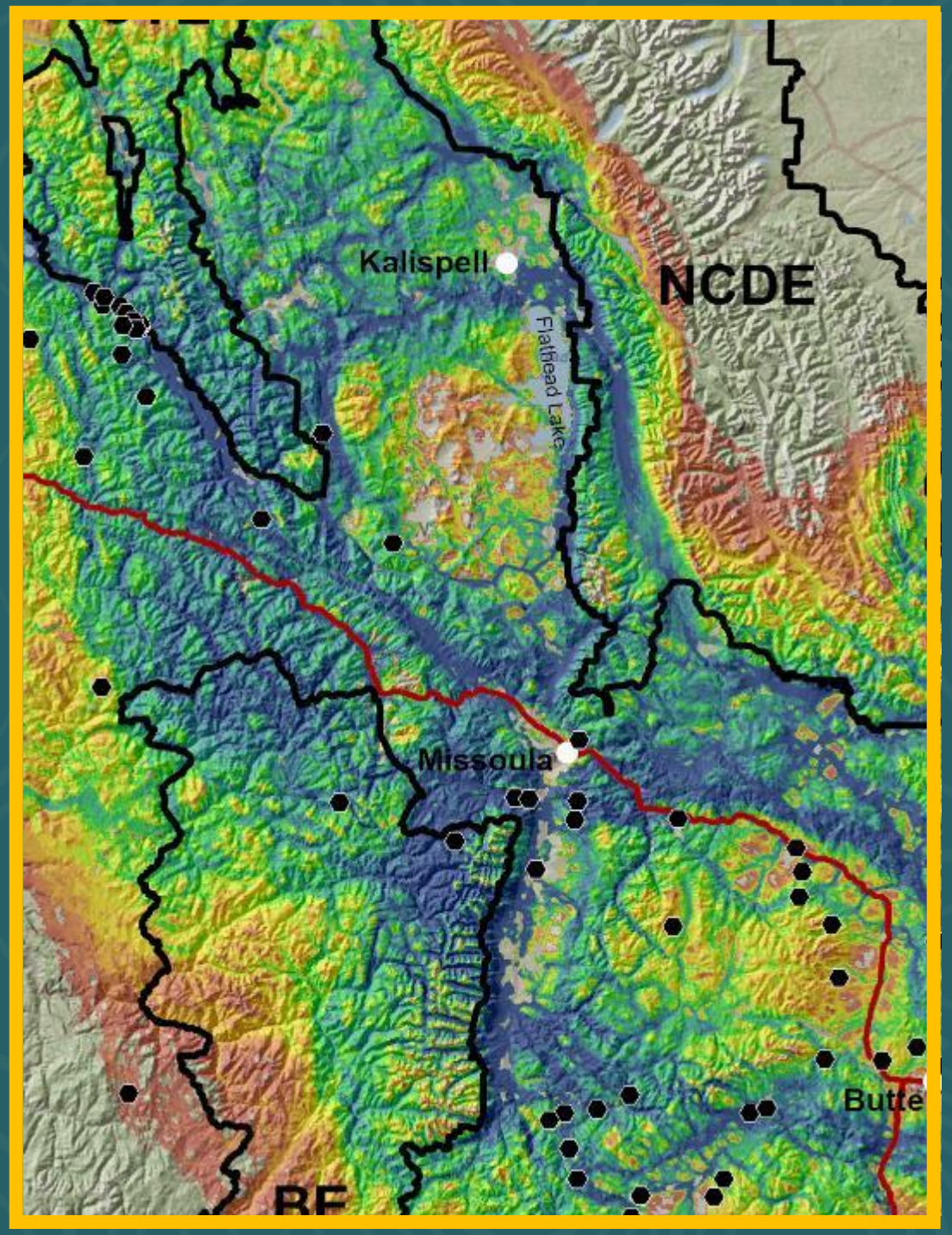

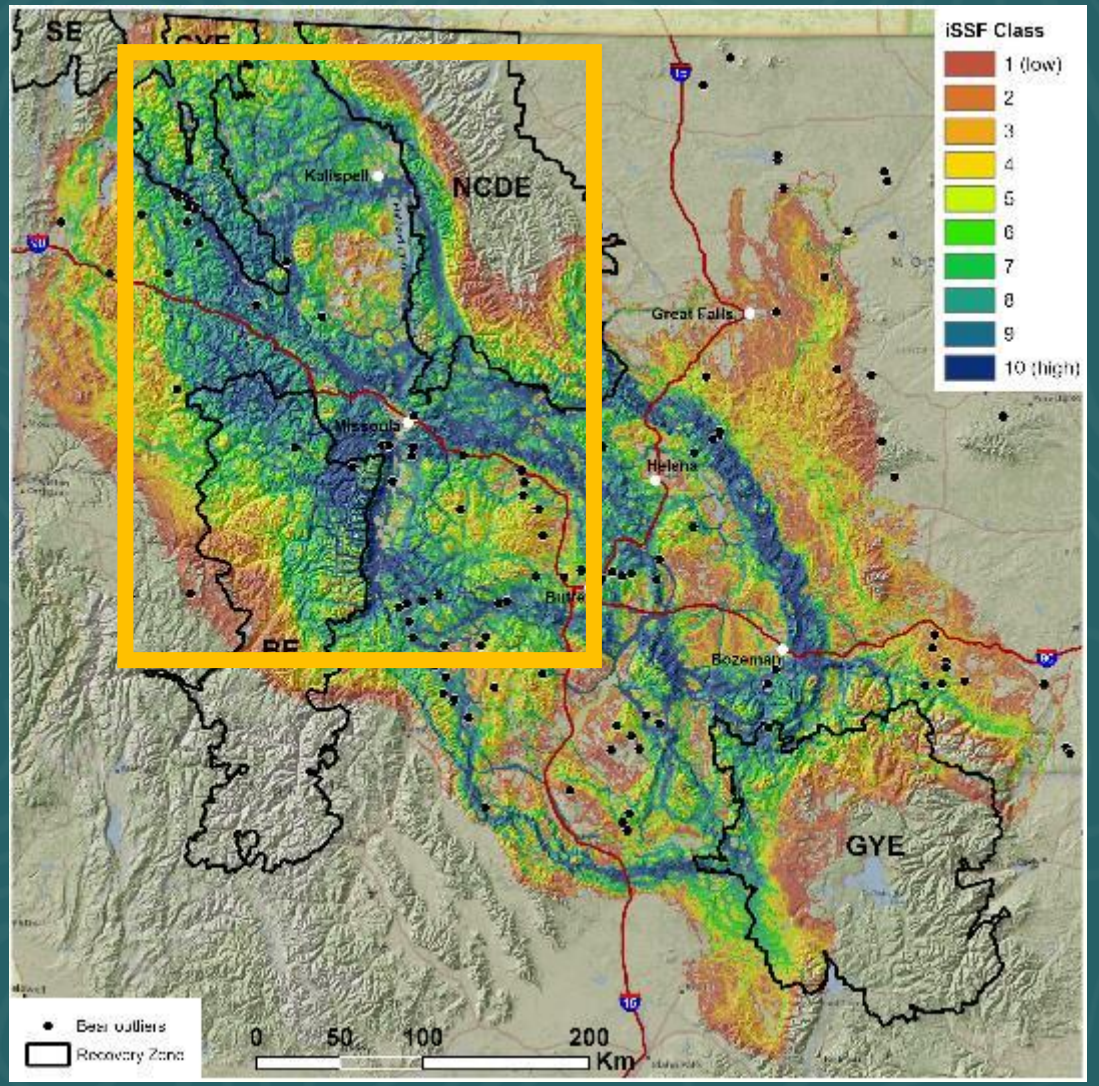

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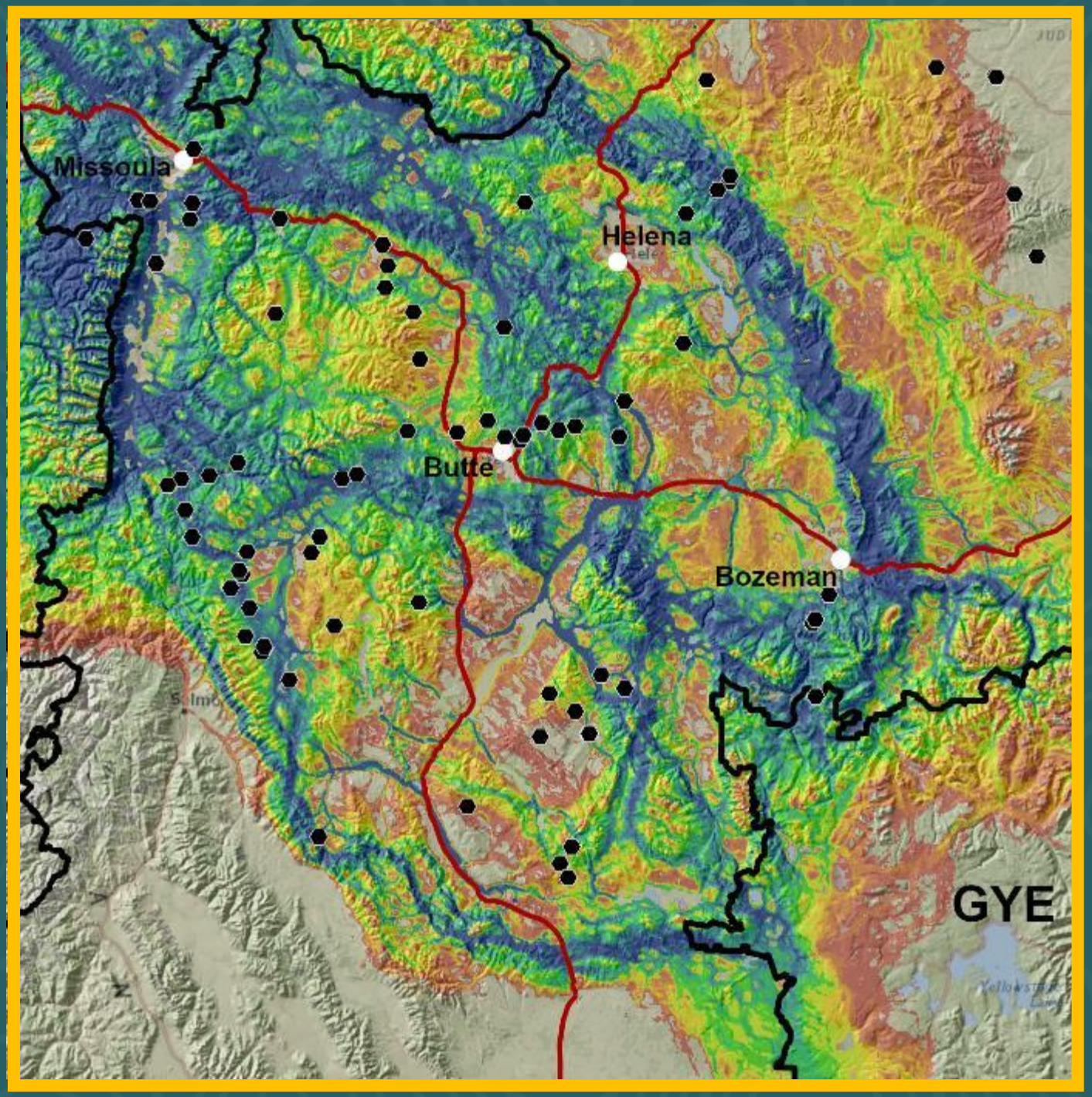

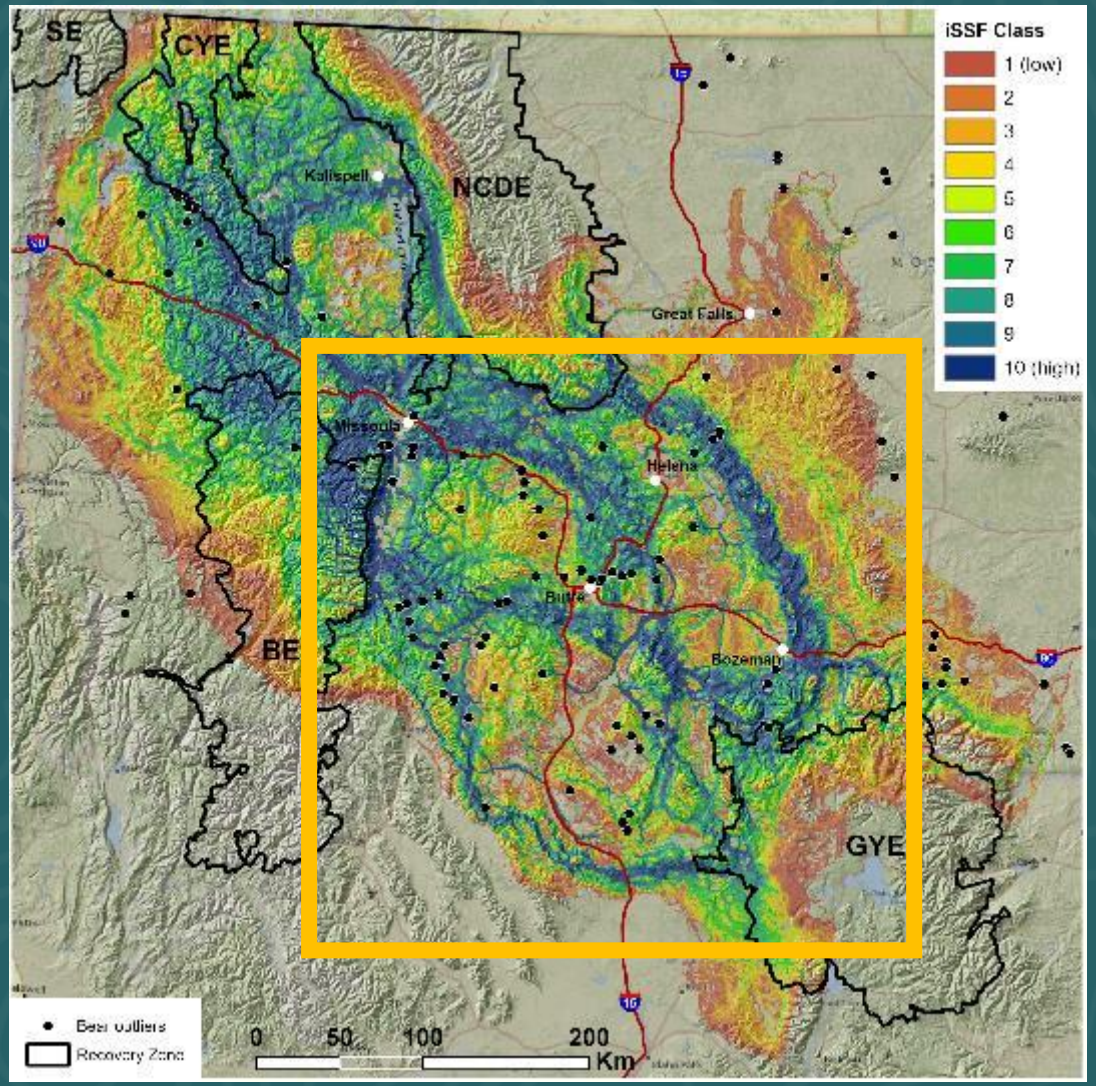

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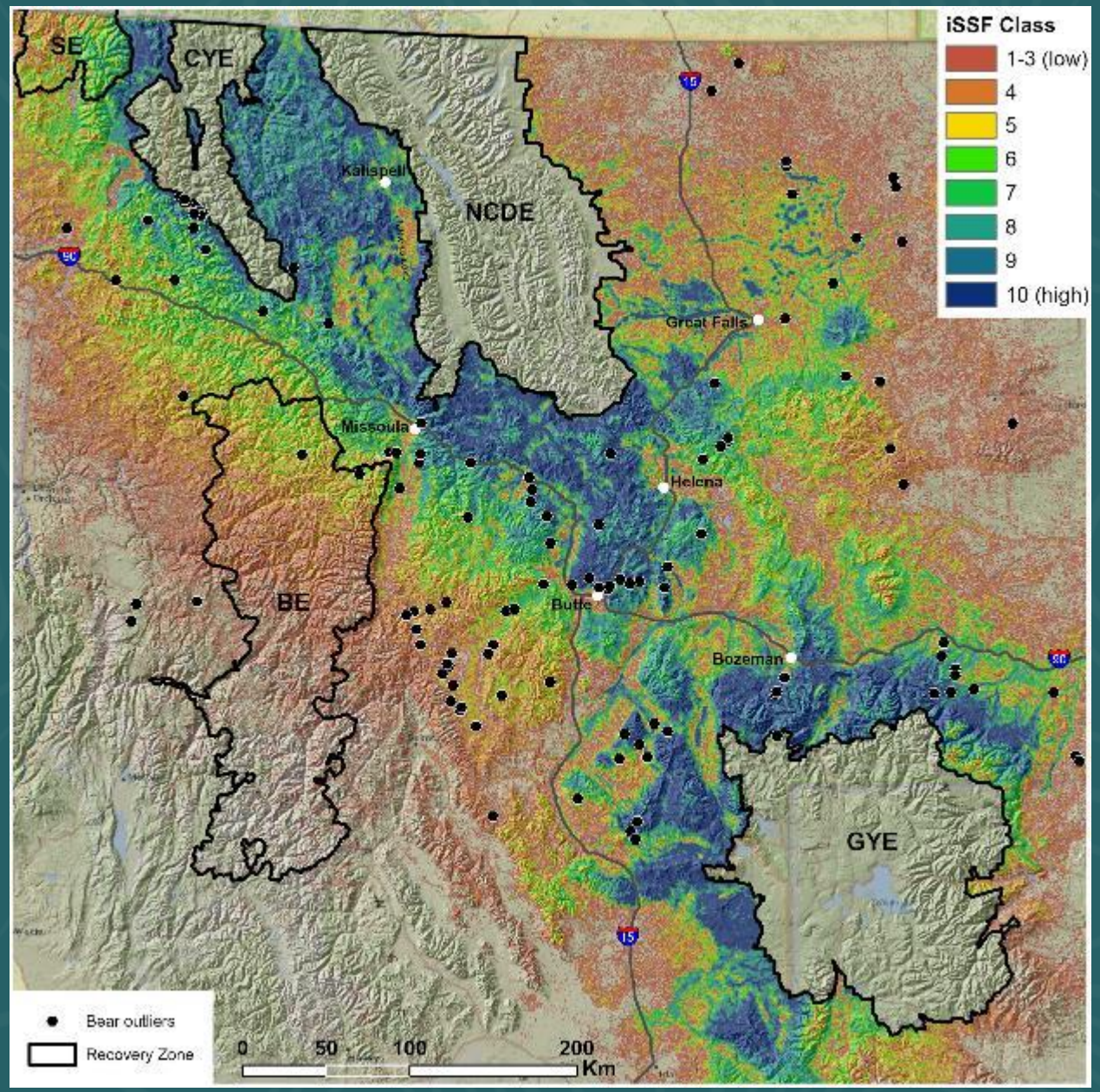
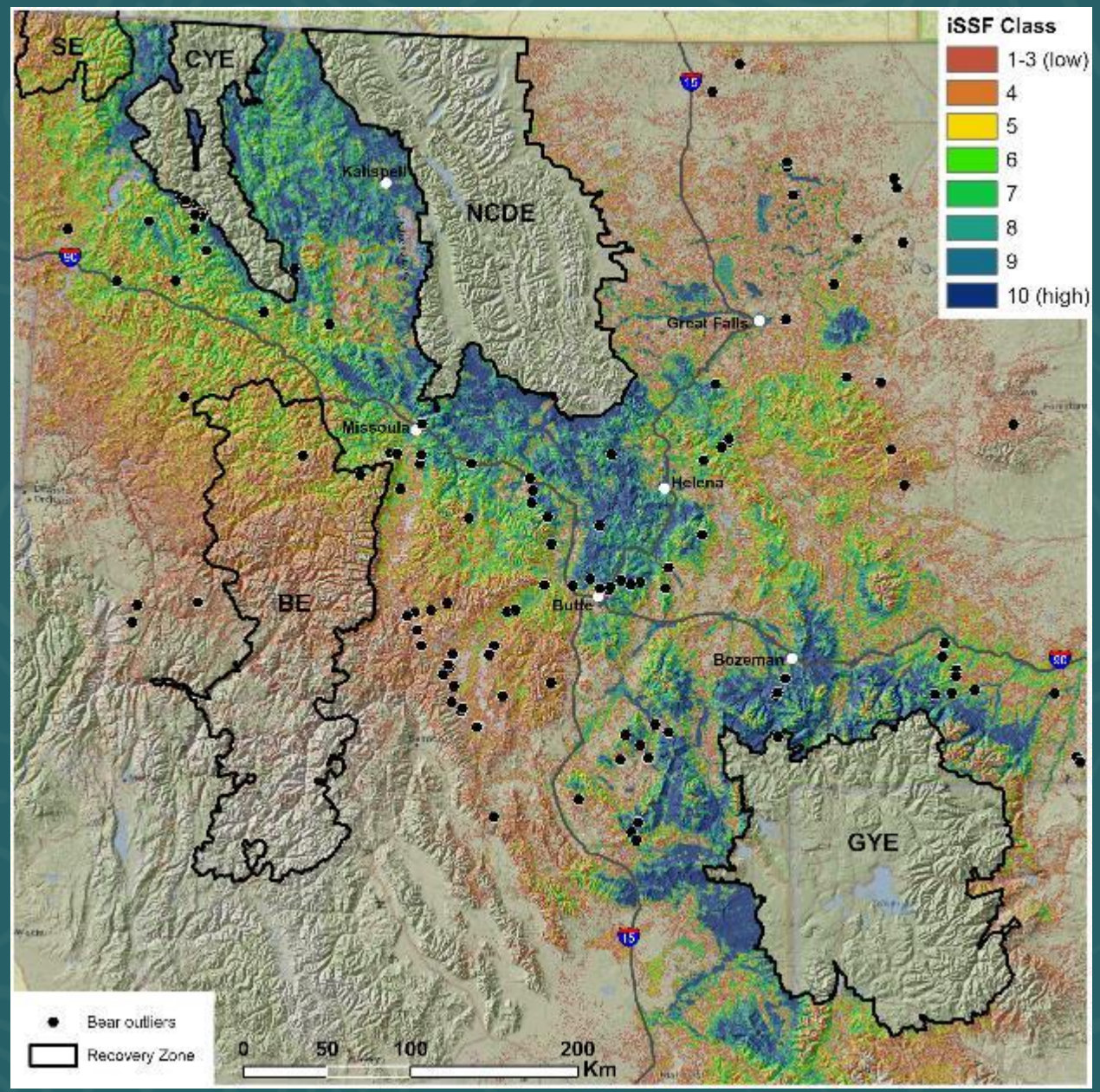
Females



Males



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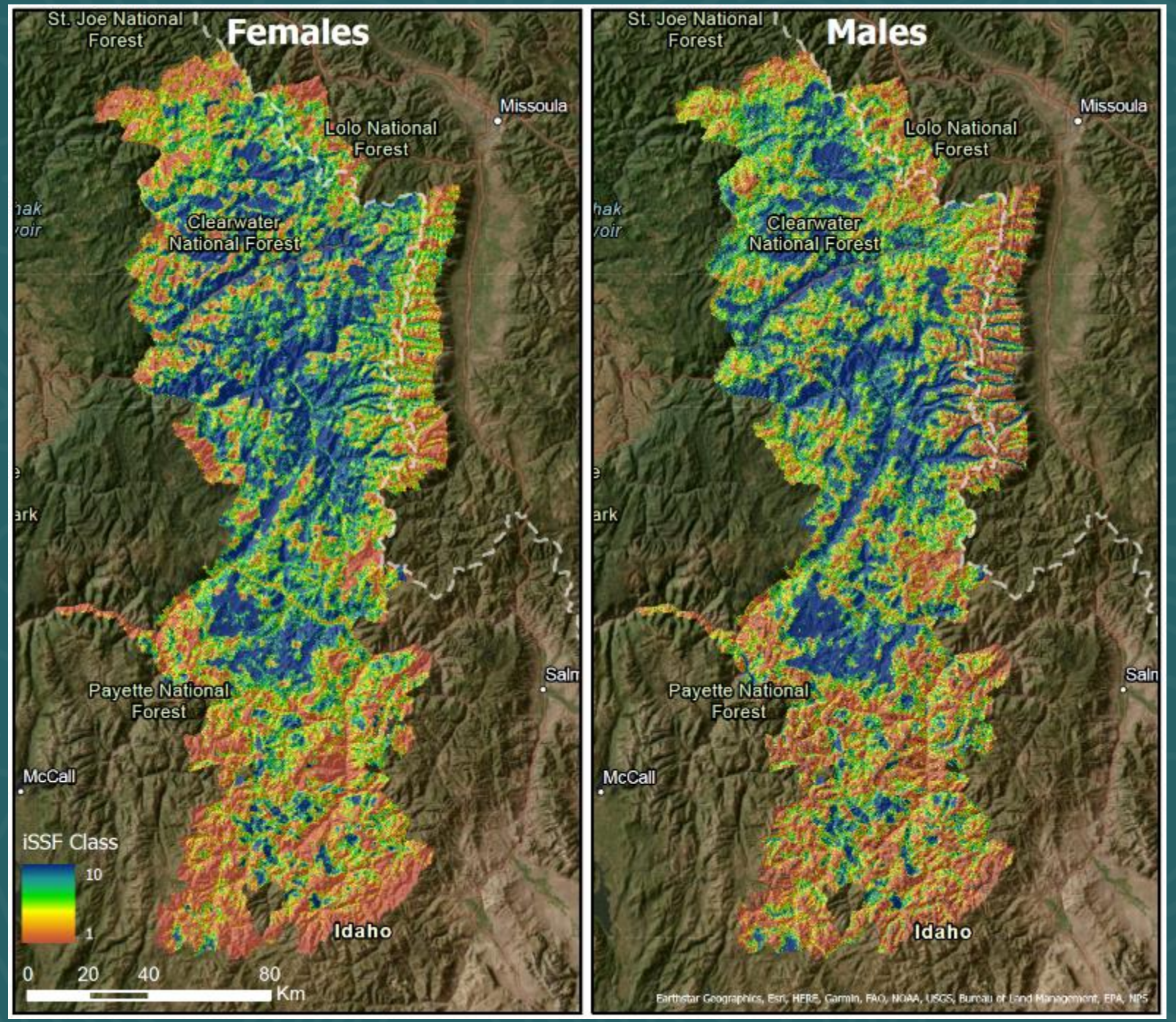
Next Steps

- **External predictions**
  - Model NCE & BE
- **Model home ranges**
  - Understand range expansion



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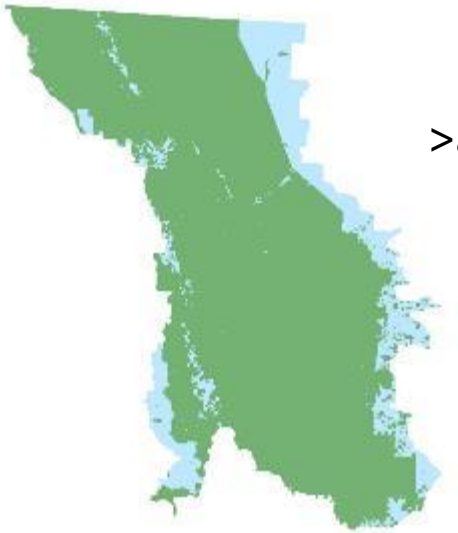
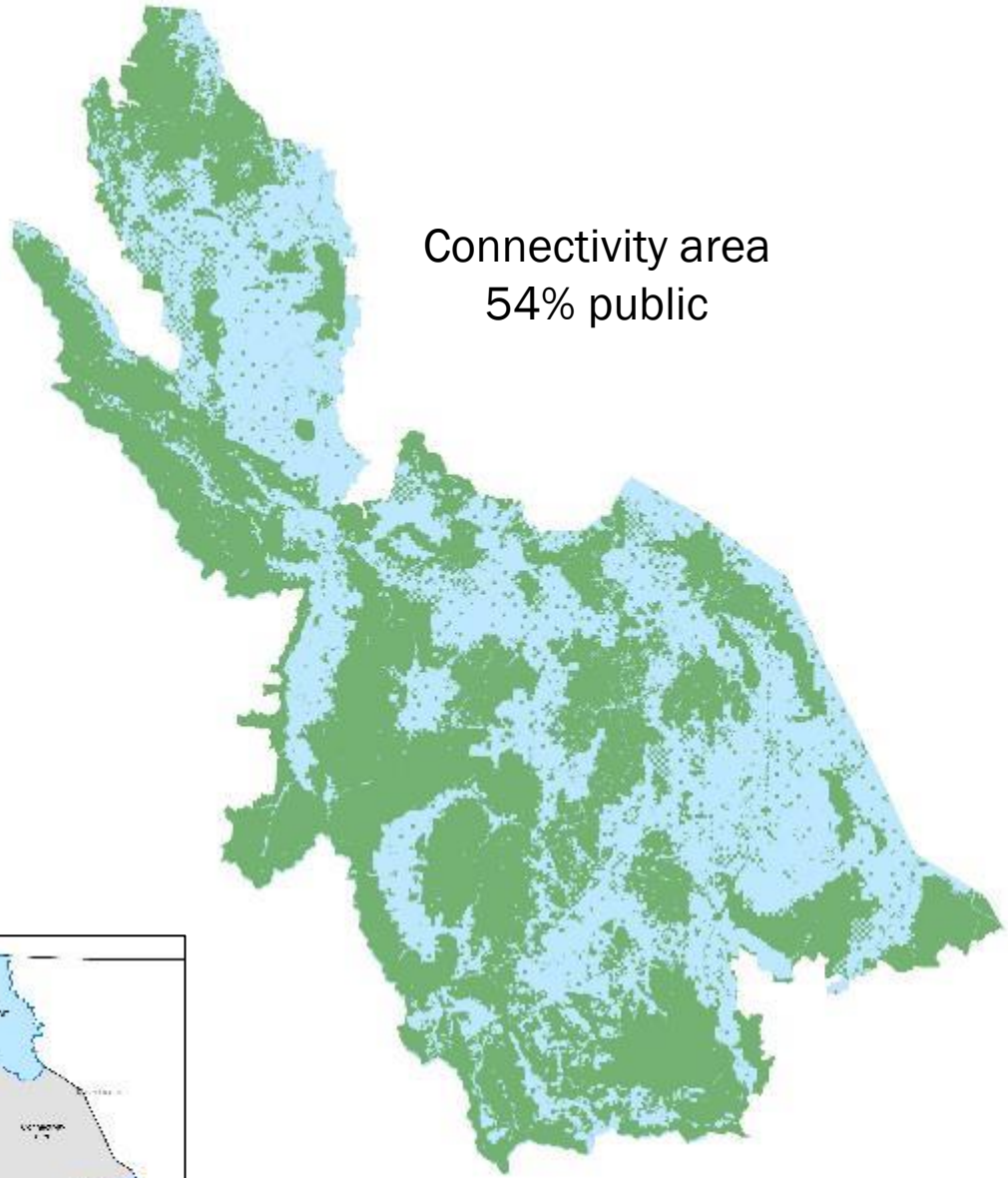
Application

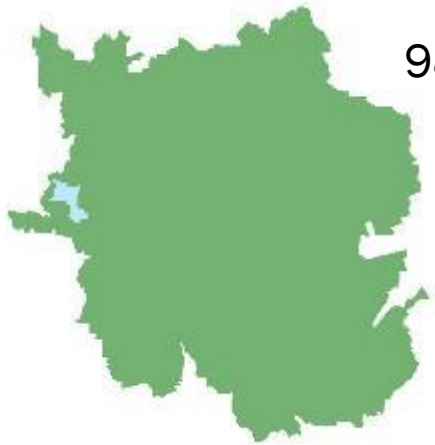
- **Decision-making, e.g.,**
  - Conservation strategies
  - Habitat management
  - Monitoring design
- Remember this is movement model, not residency model



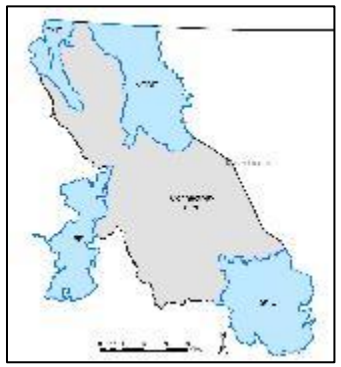
NCDE
>84% public



Connectivity area
54% public



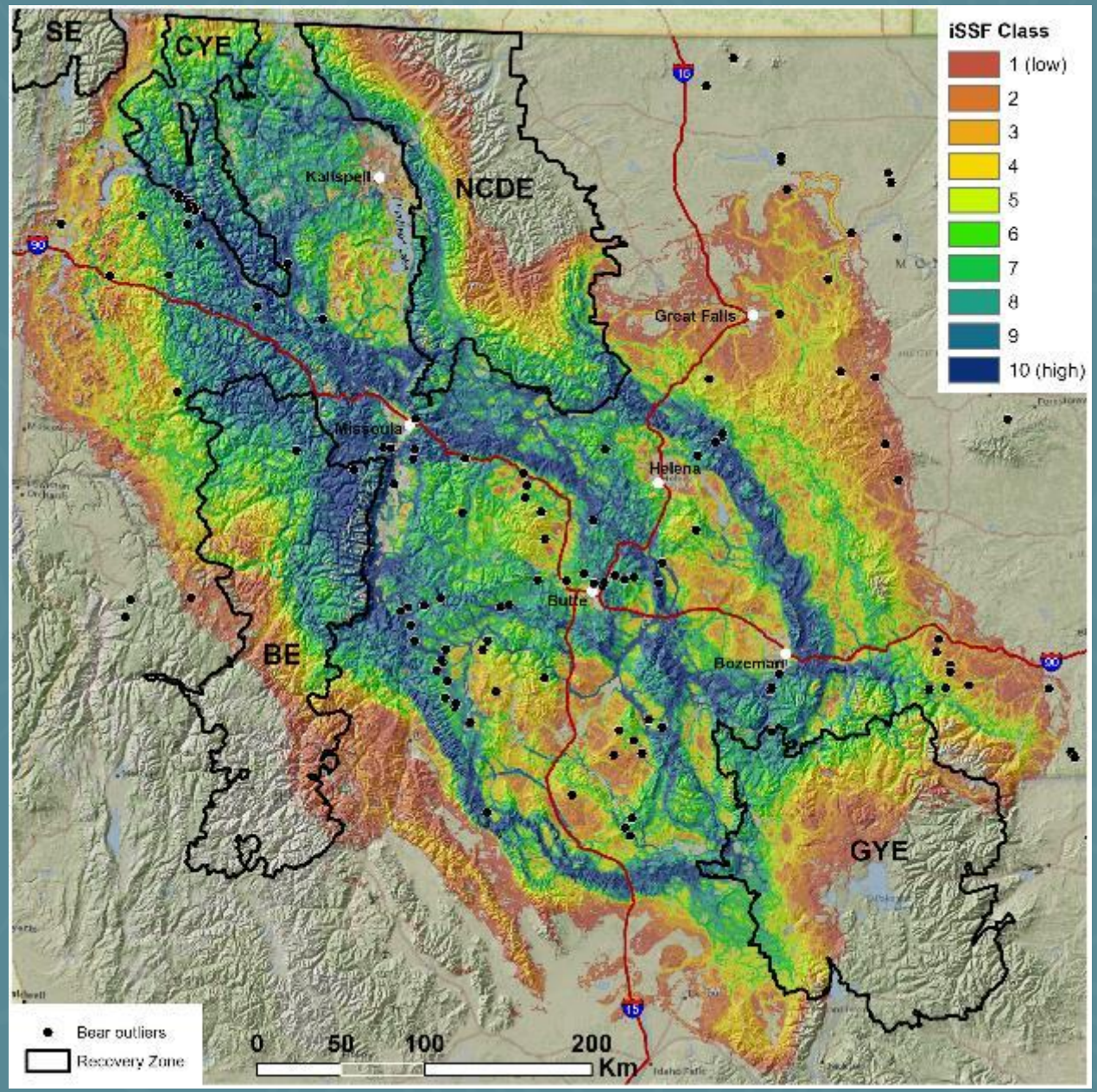
GYE
98% public



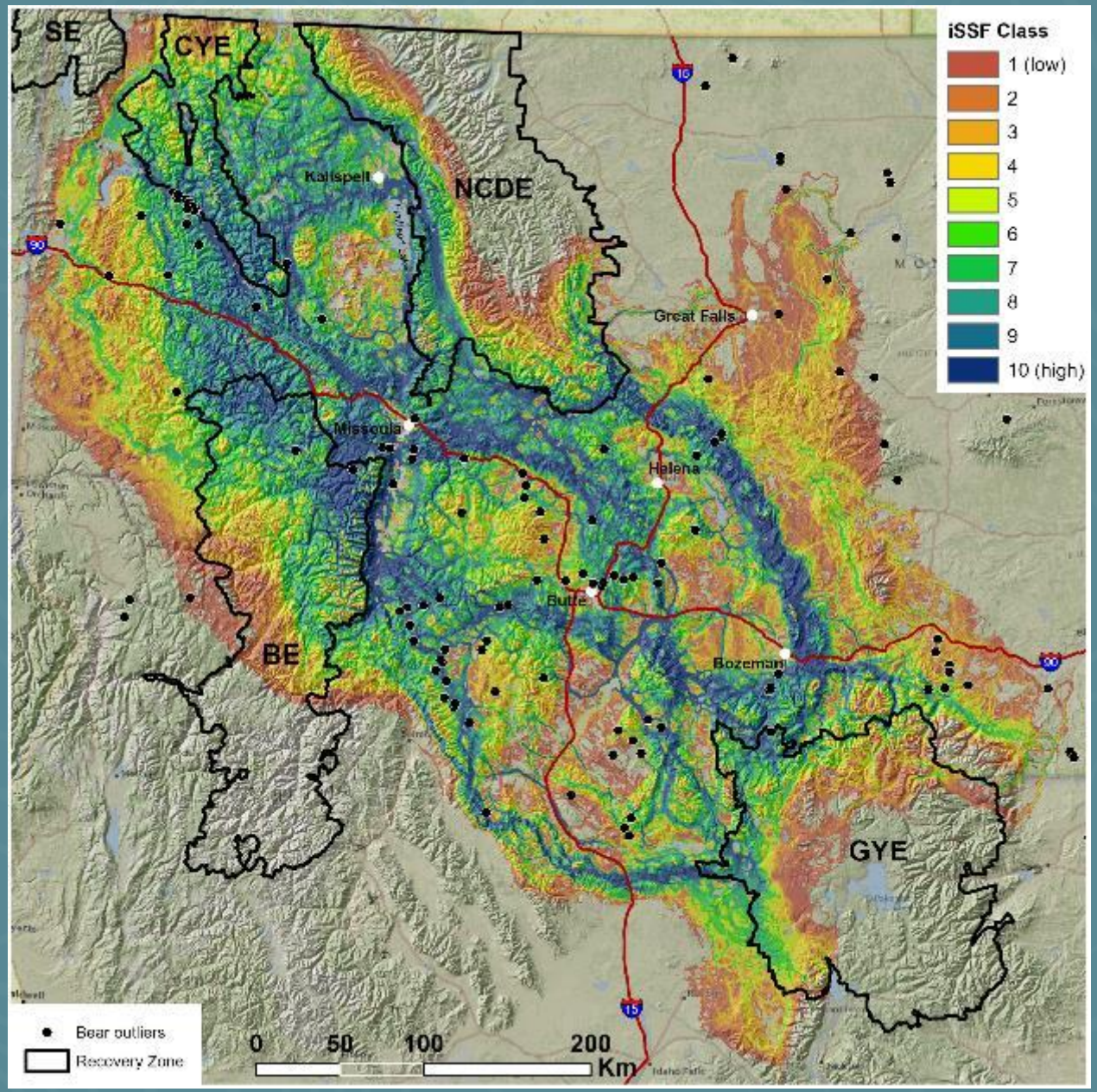
0 12.5 25 50 75 100
Miles

N

Females



Males



*Draft results – do not publish

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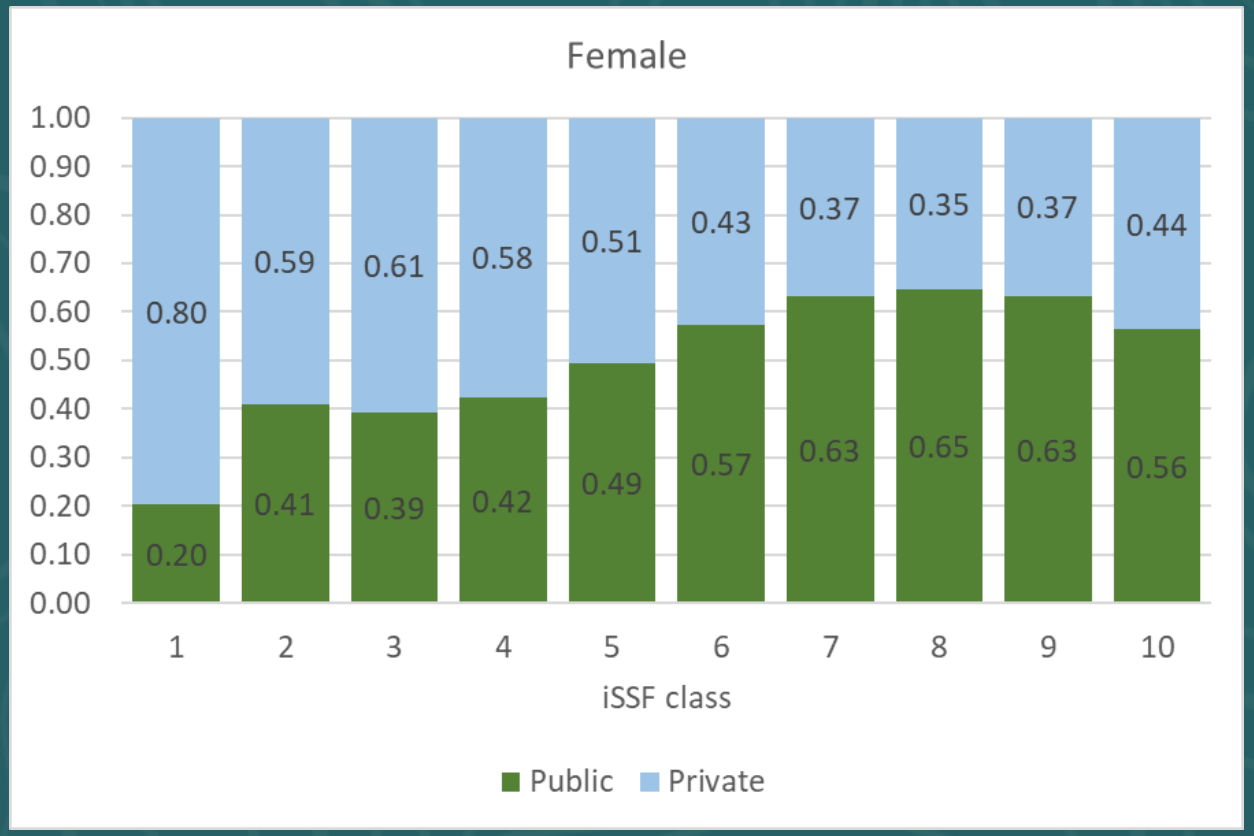

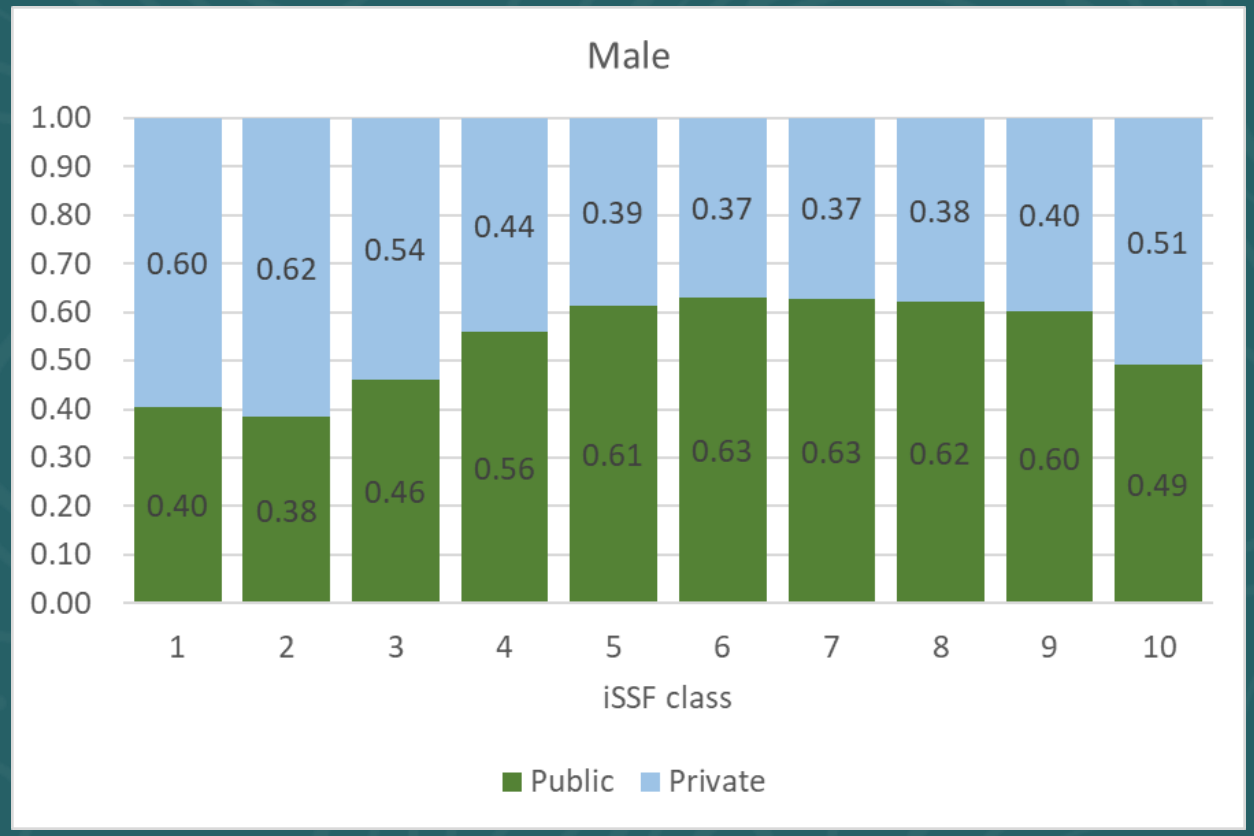

*Draft results – do not publish

Engagement
Deterrents
Livestock compensation
Bear safety workshops
Private land conservation easements
Mortality management
Education
Public habitat management
Management removals
Temporary closures
Homeowner outreach
Carcass composting
Incentive programs
Hunter education
Conflict response
Bear resistant infrastructure
Securing attractants
Garbage management
Monitoring and science
Law enforcement
Hunter bear ID training
Bear spray training
Food storage orders
Relocation
Electric fencing
Bear Smart Communities
Ordinances
Carcass removal
Highway crossings

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