Predicted Grizzly Bear Habitat in the Bitterroot & North Cascades Ecosystems

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Photo: G. Smith

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

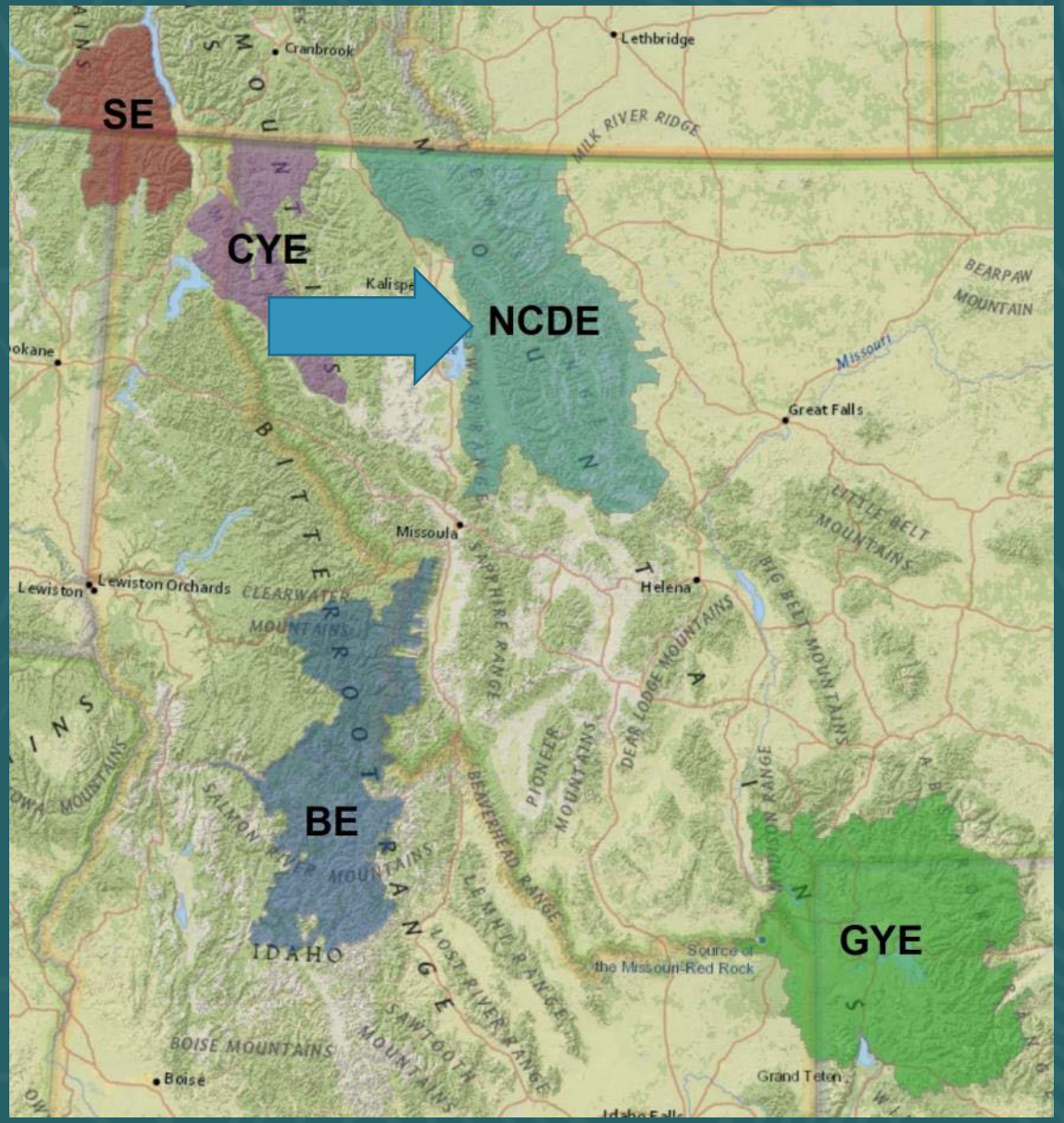
- **GPS collars, 2003 – 2021**
  - May – Nov
  - 3-hour fix rate
  - 47 females
    - >59,000 fixes
  - 20 males
    - >16,000 fixes

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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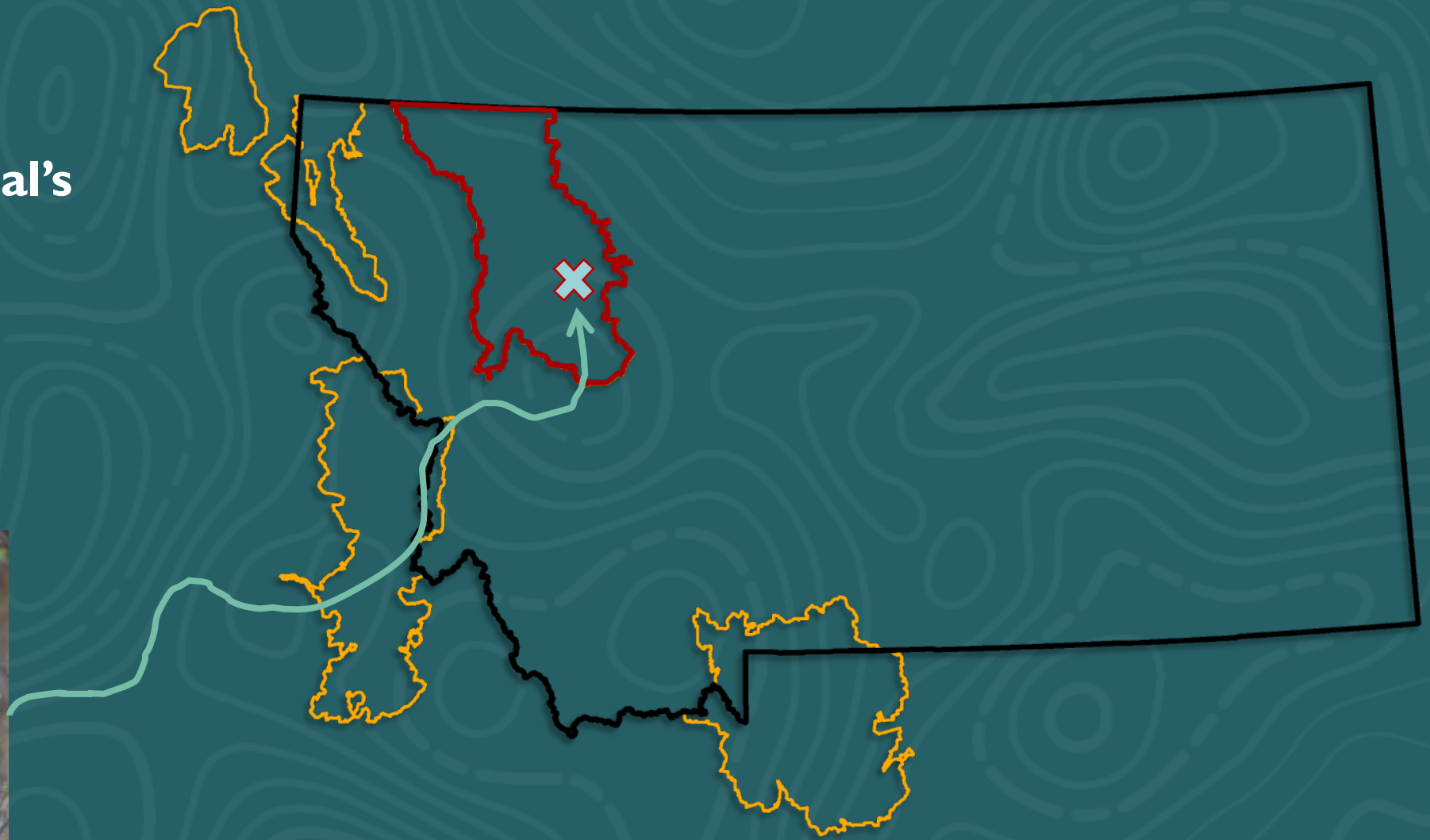
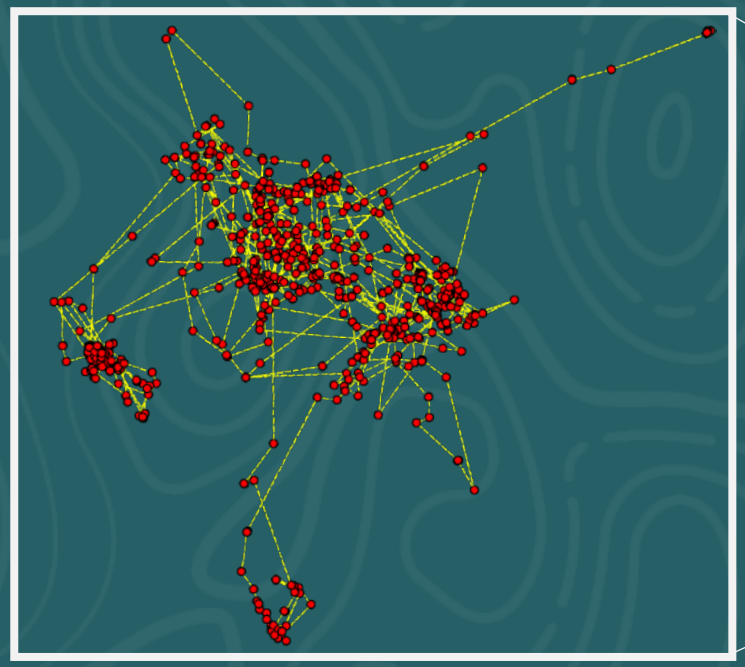
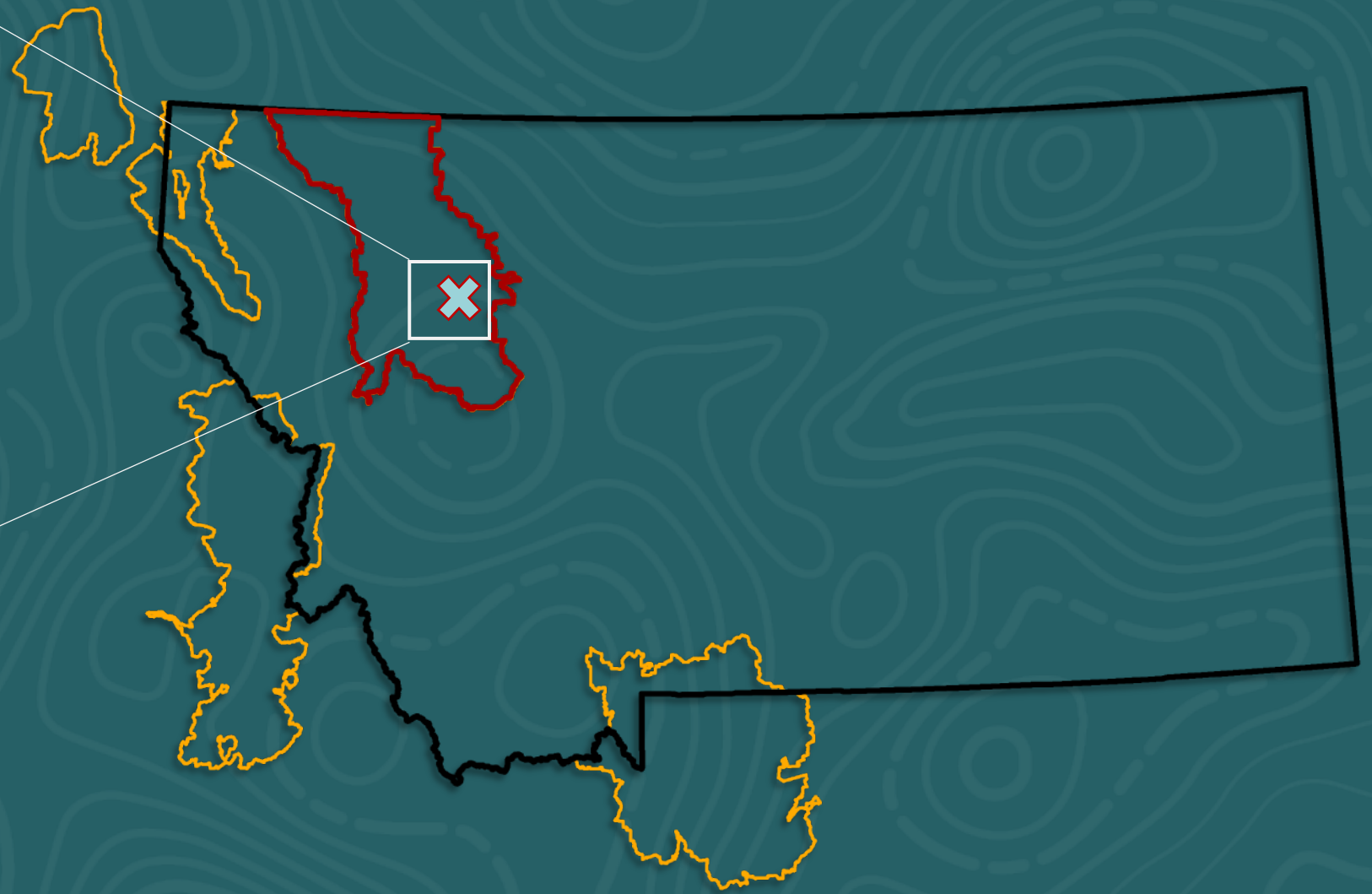
Simulating Spatial Behavior

- Simulate individual's movements



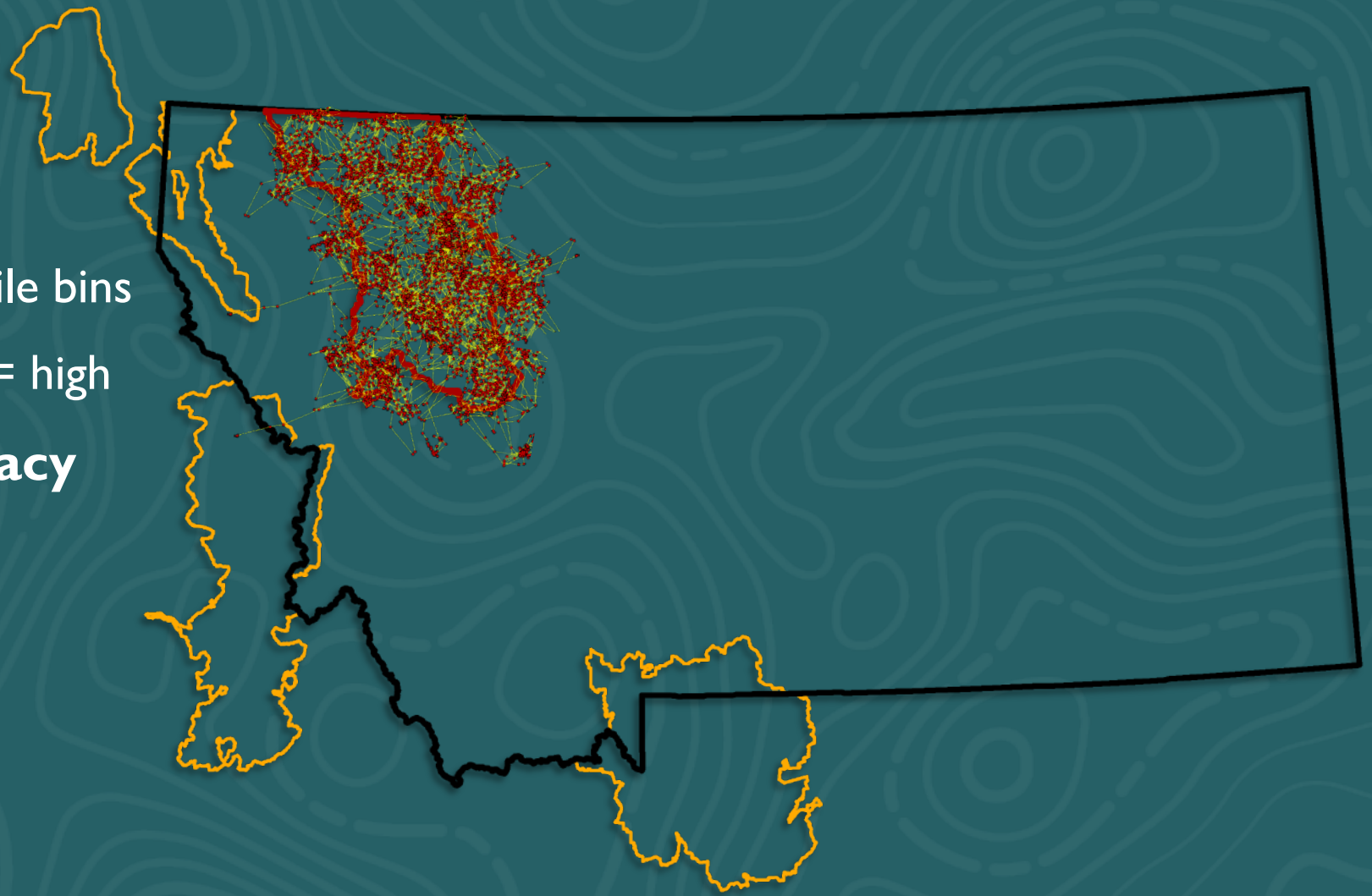
Simulating Spatial Behavior





Simulating Spatial Behavior

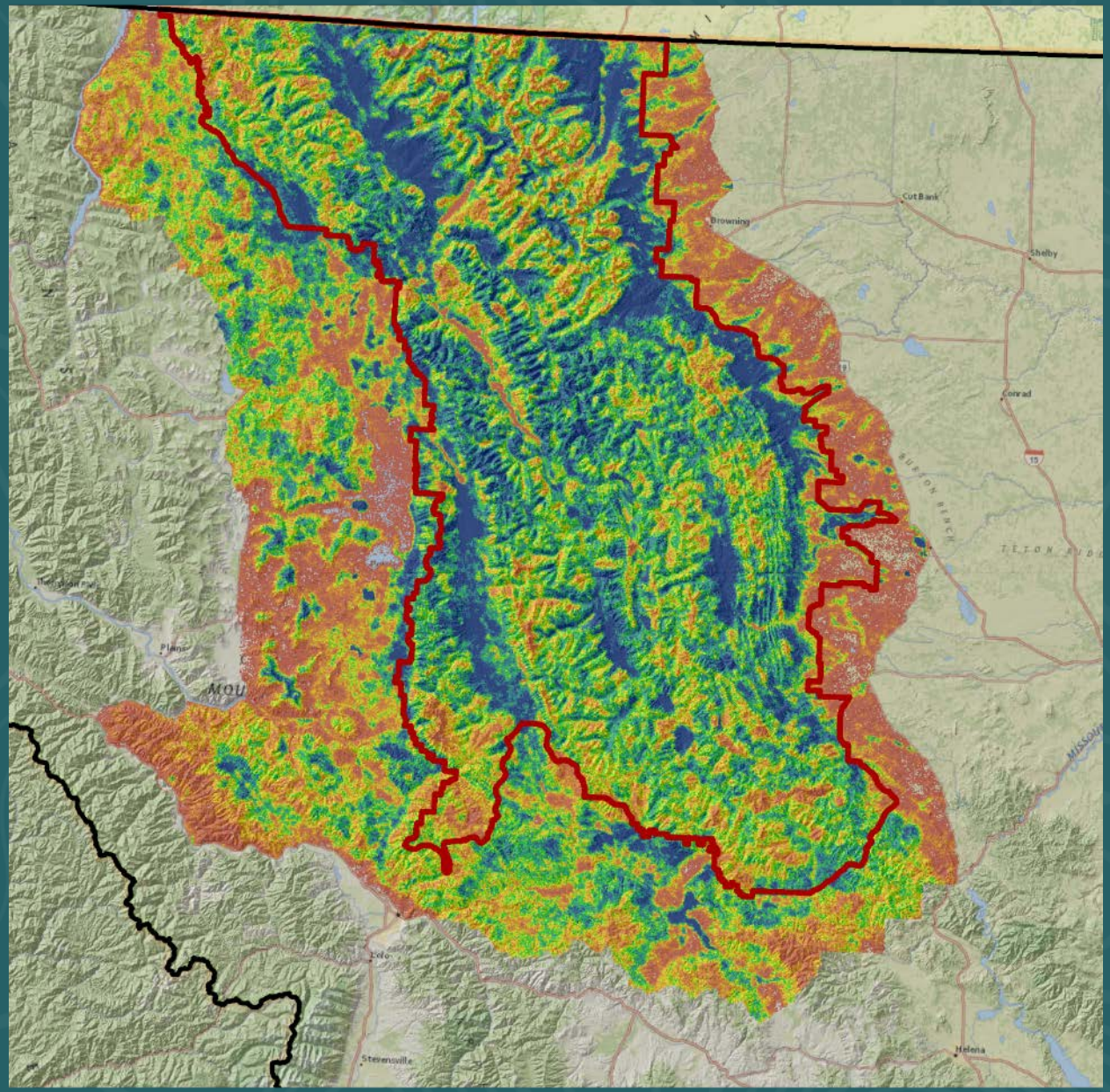
- **Repeat**
- **Summarize results**
  - # of steps/cell → 10 quantile bins
  - iSSF class: 1 = low use, 10 = high
- **Assess predictive accuracy**

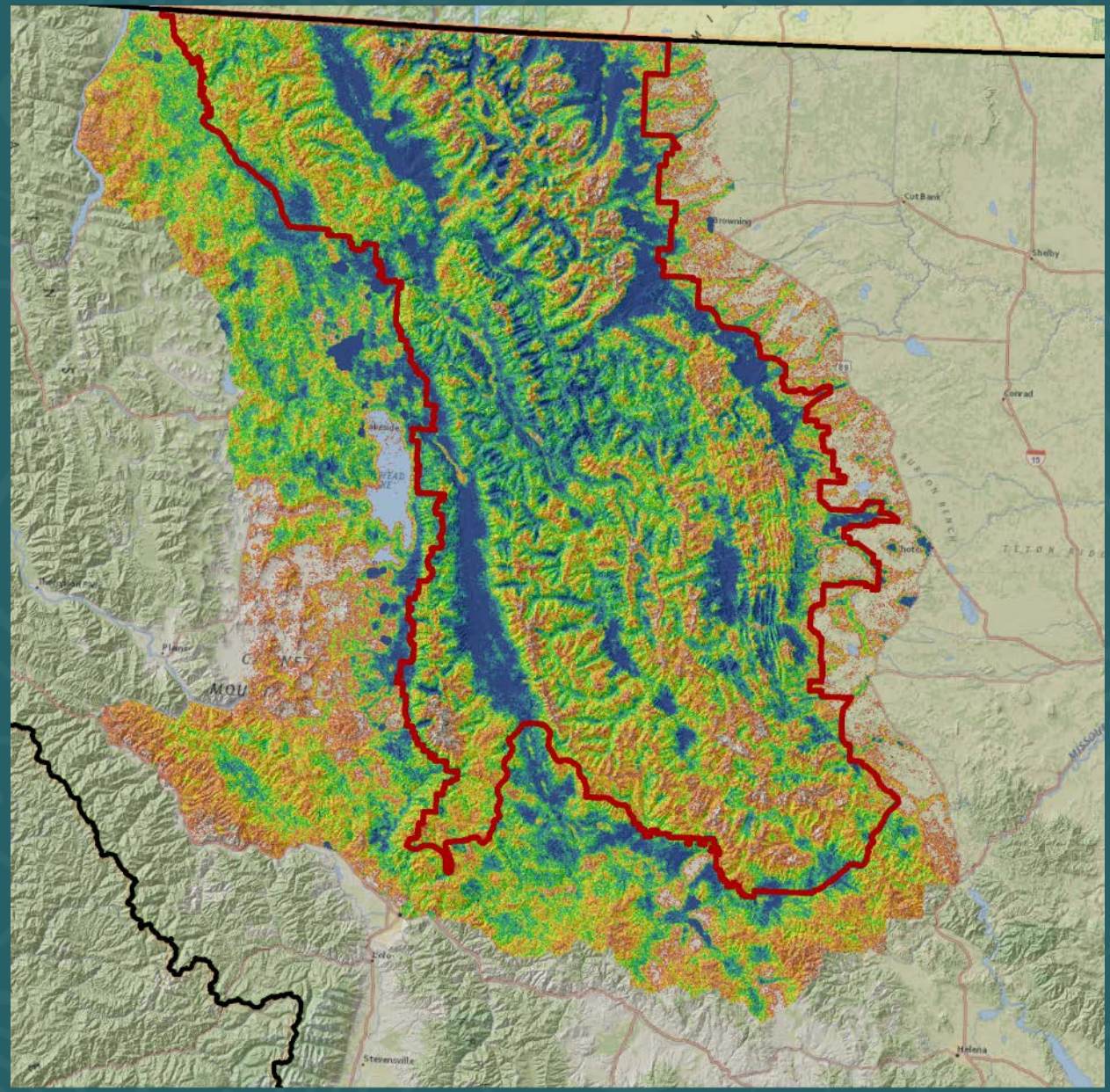


Females

Low iSSF Class *High*

Males





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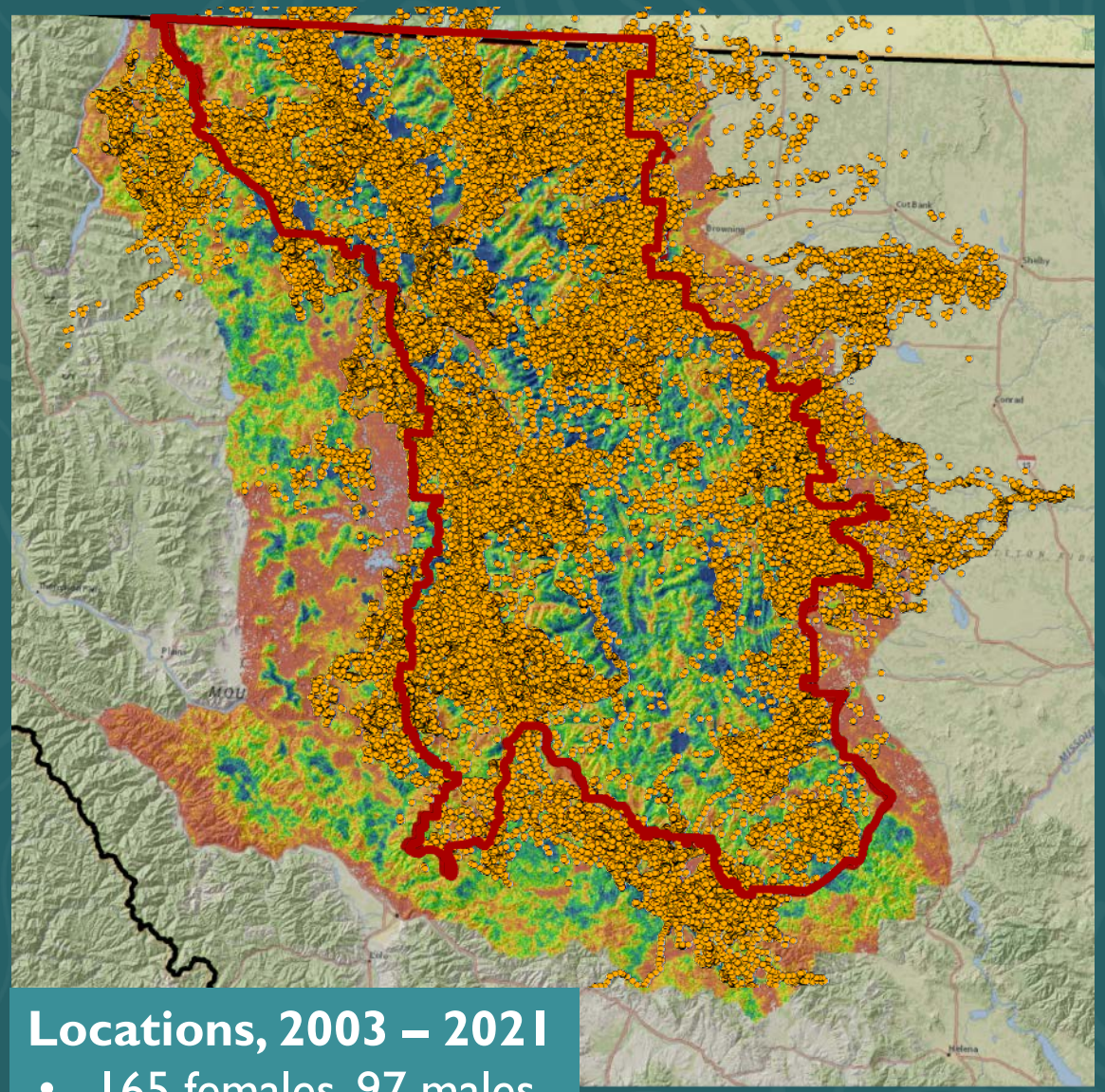
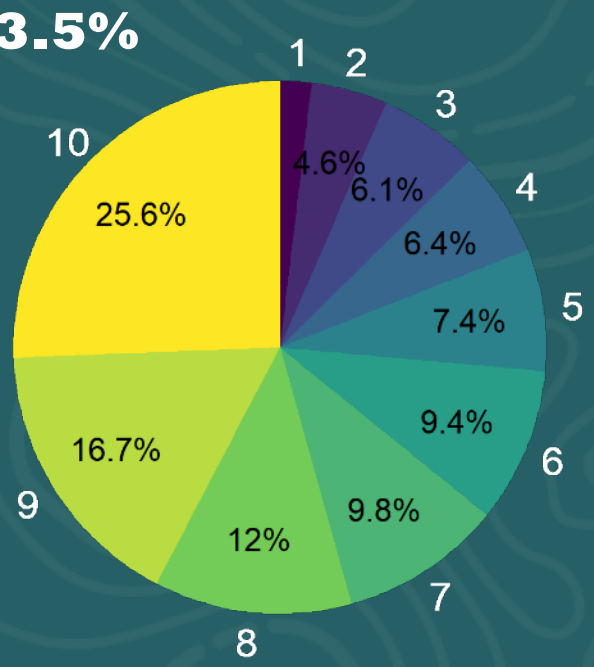


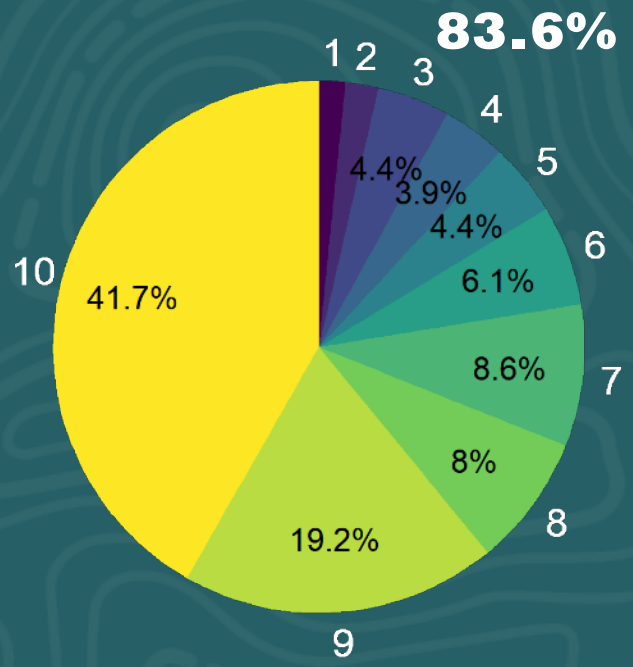
Locations, 2003 – 2021

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

Females:
% fixes per class



Males:
% fixes per class



Highly predictive across season & years

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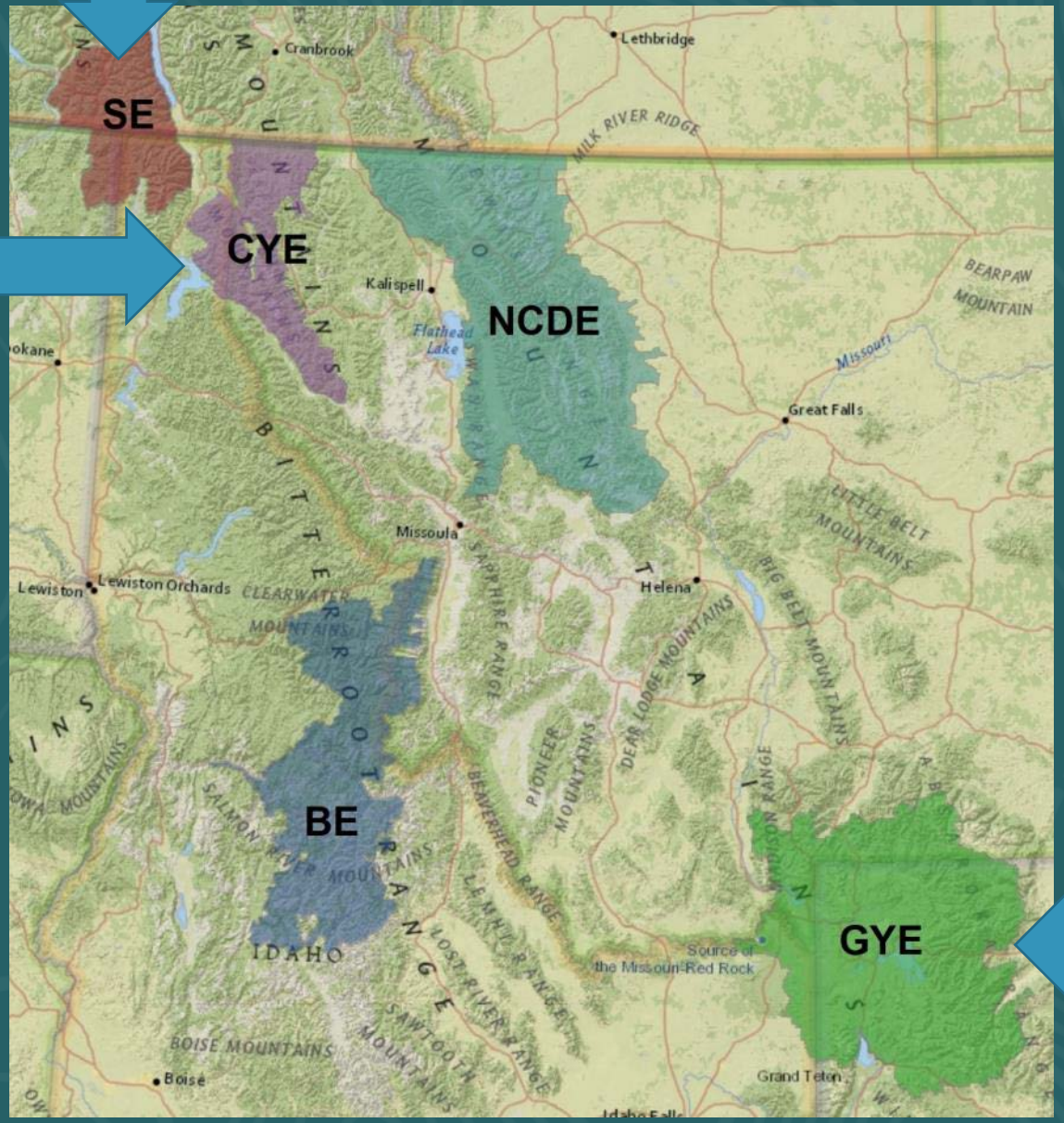
Model Application: Phase 2



- Simulate for other populations
- Evaluate transferability of results

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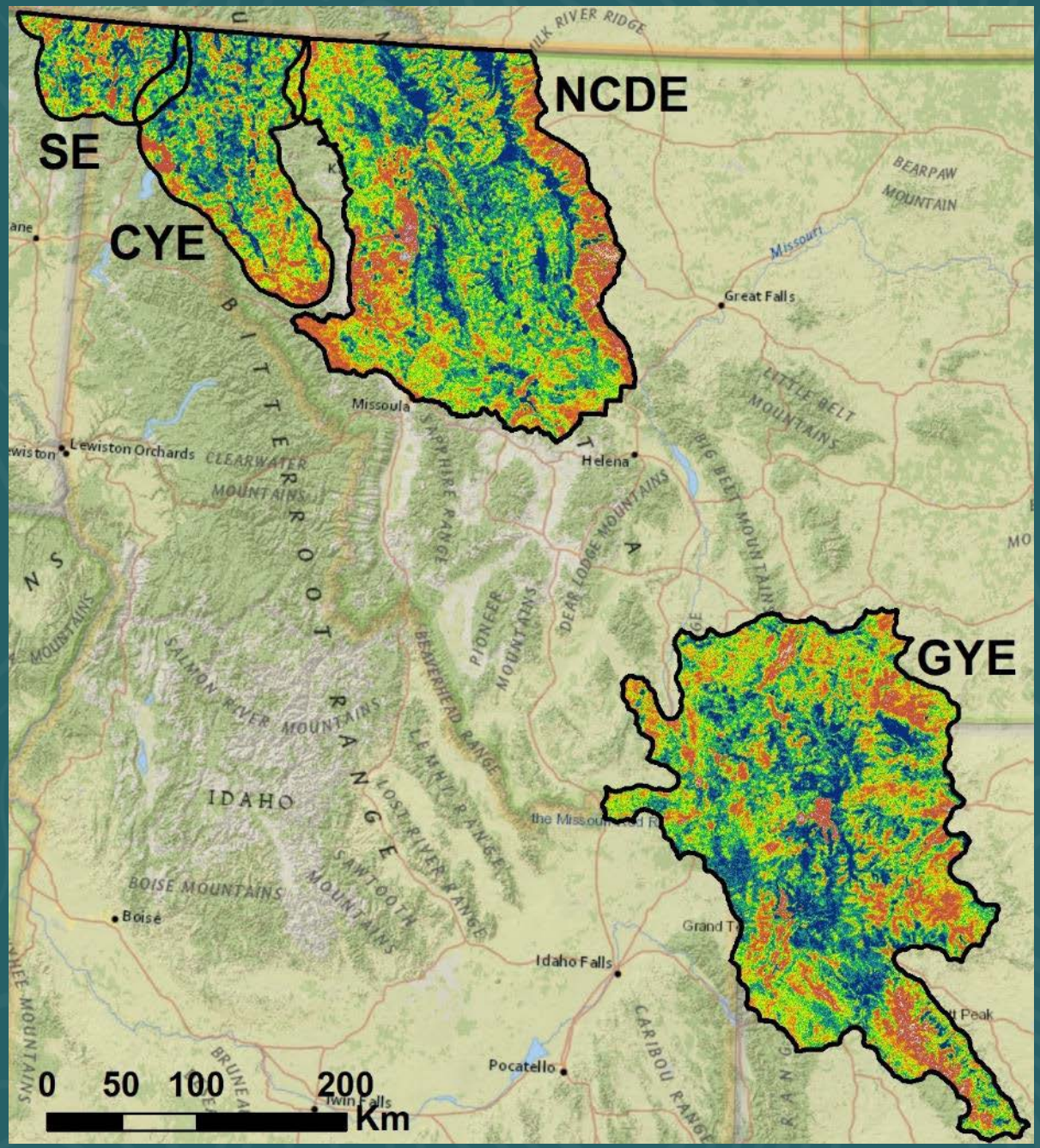
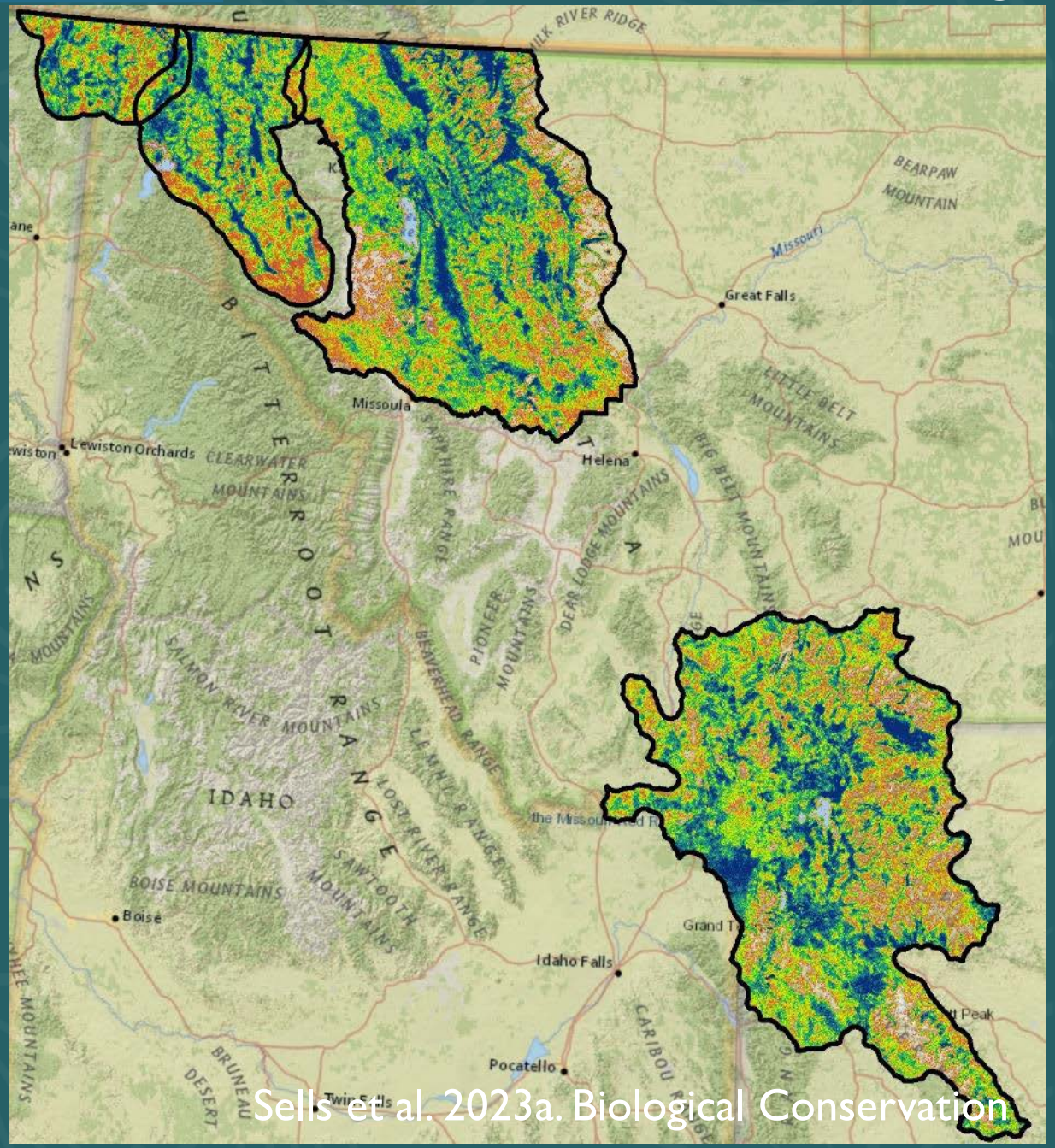
Females

Low iSSF Class *High*

Males





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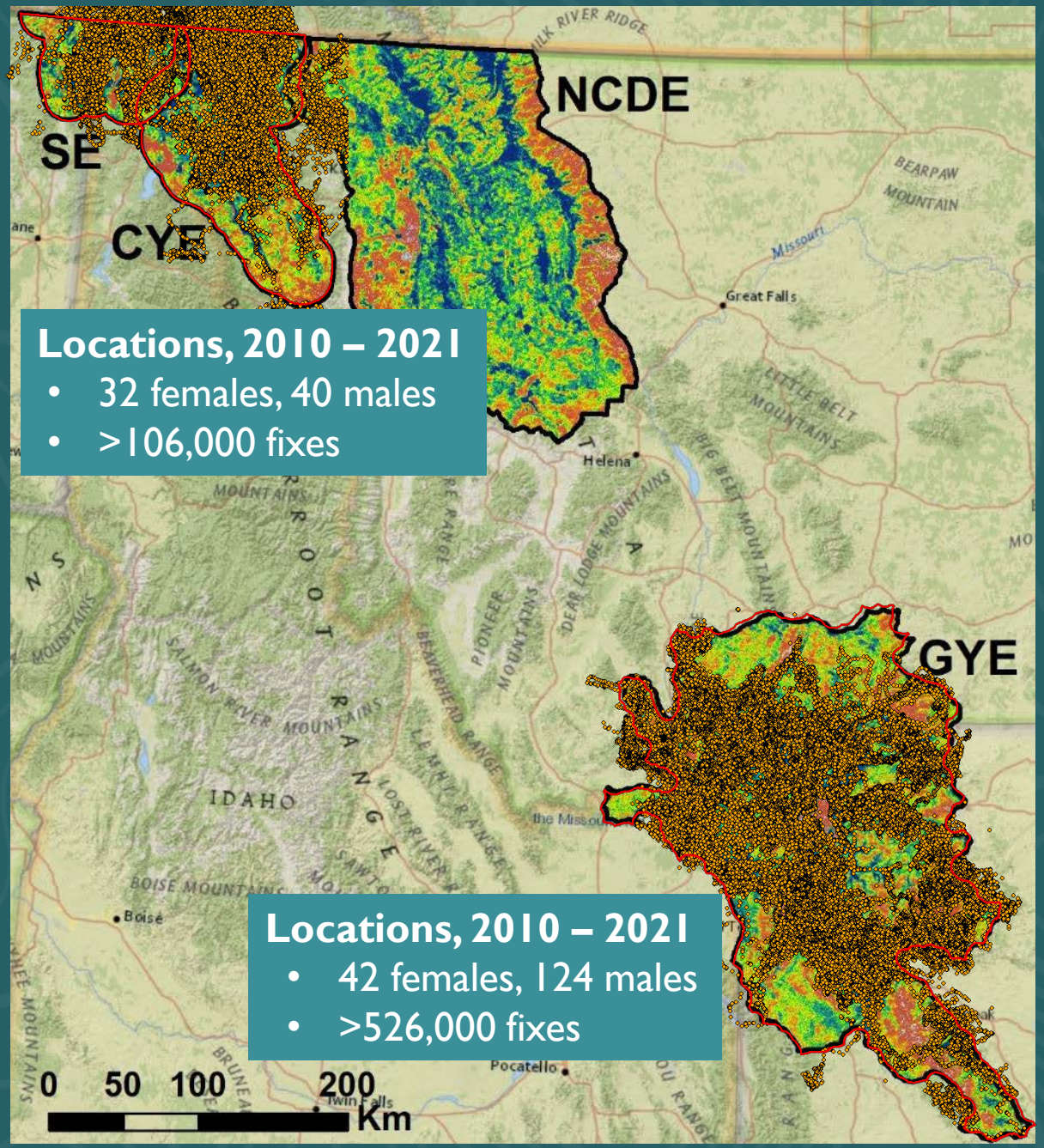
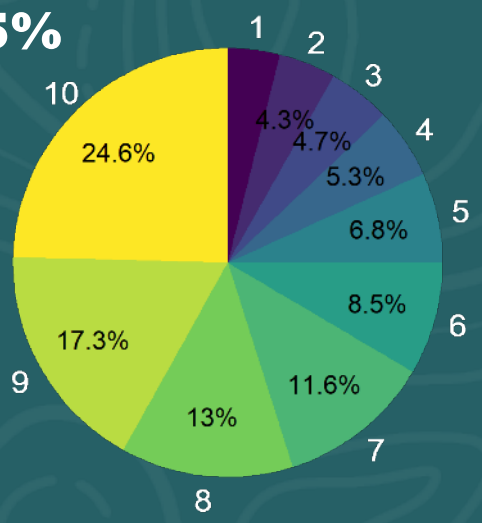


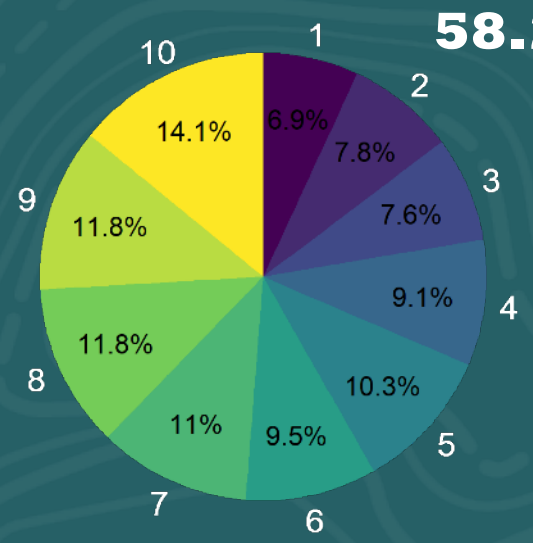
Locations, 2010 – 2021
- 32 females, 40 males
- >106,000 fixes

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

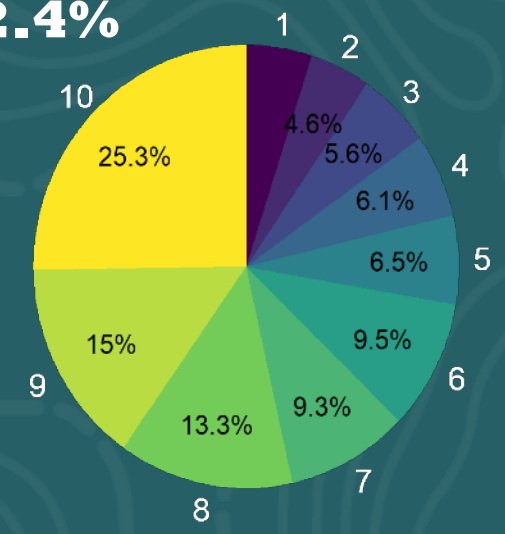
SE/CYE Females: 75%



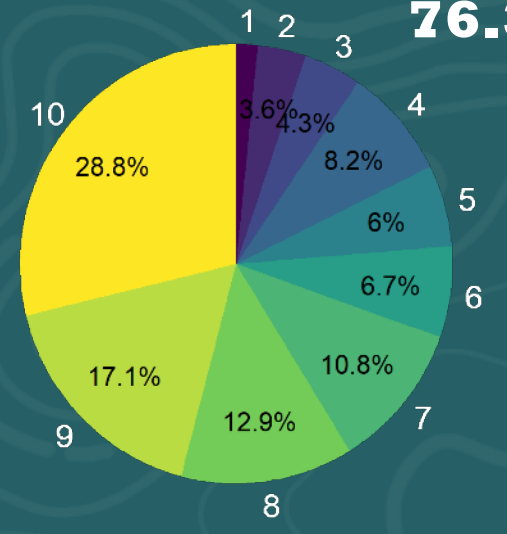
SE/CYE Males: 58.2%



GYE Females: 72.4%



GYE Males: 76.3%



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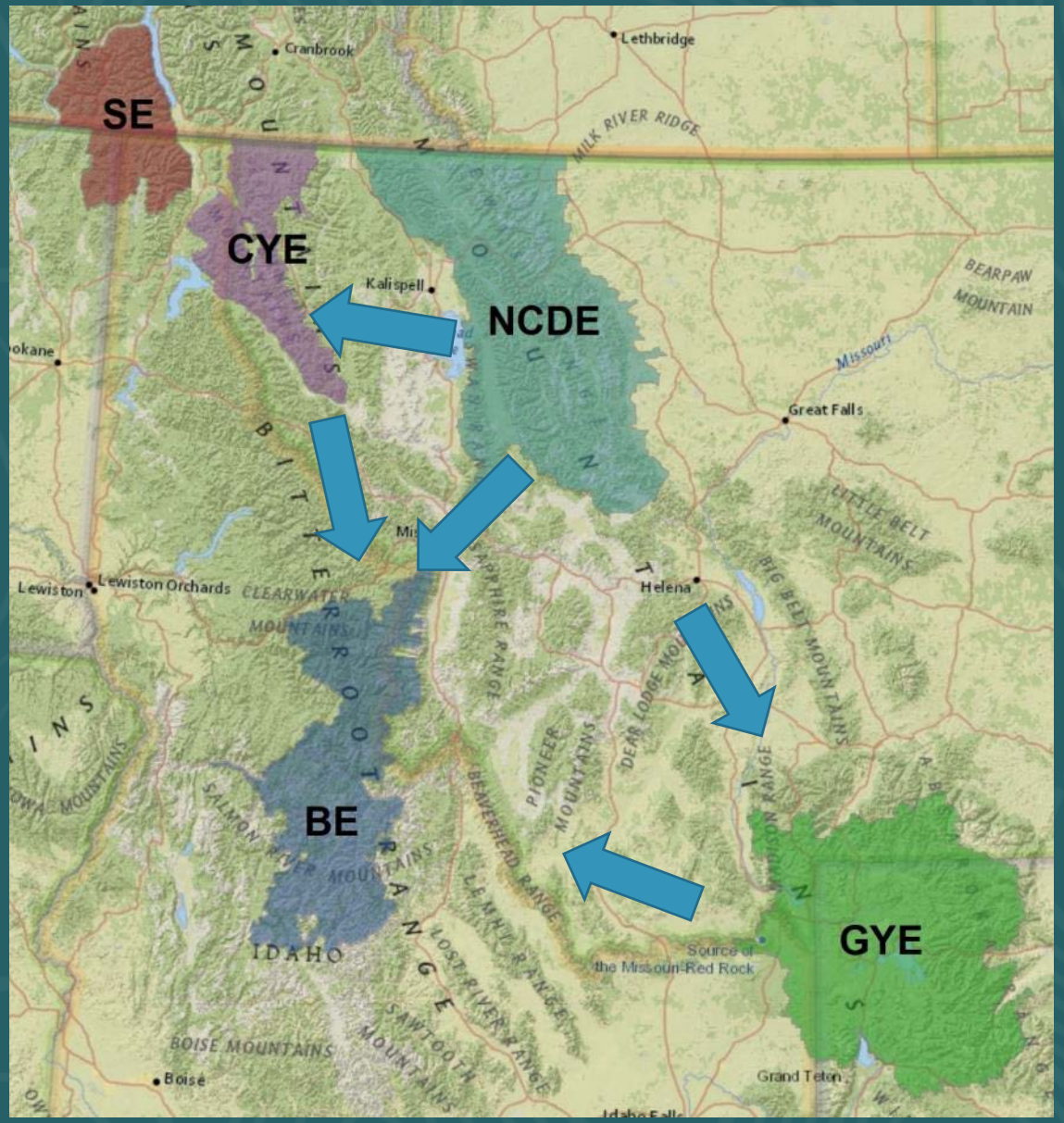
Model Application: Phase 3



- **Simulate connectivity paths**
  - Start & end nodes
    - Randomized shortest paths
  - Start nodes only
    - Simulations using methods in Phases 1 & 2

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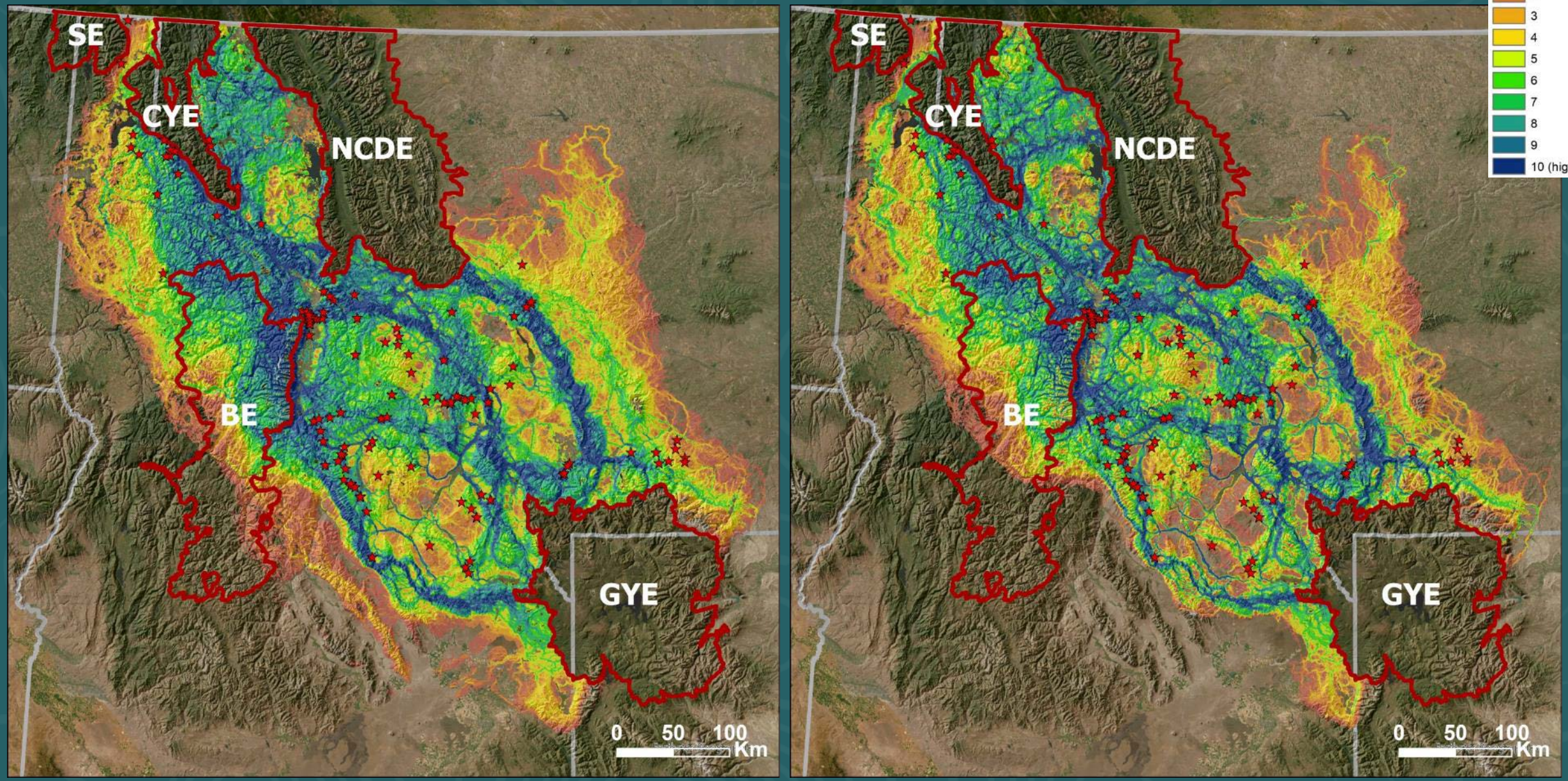
Females

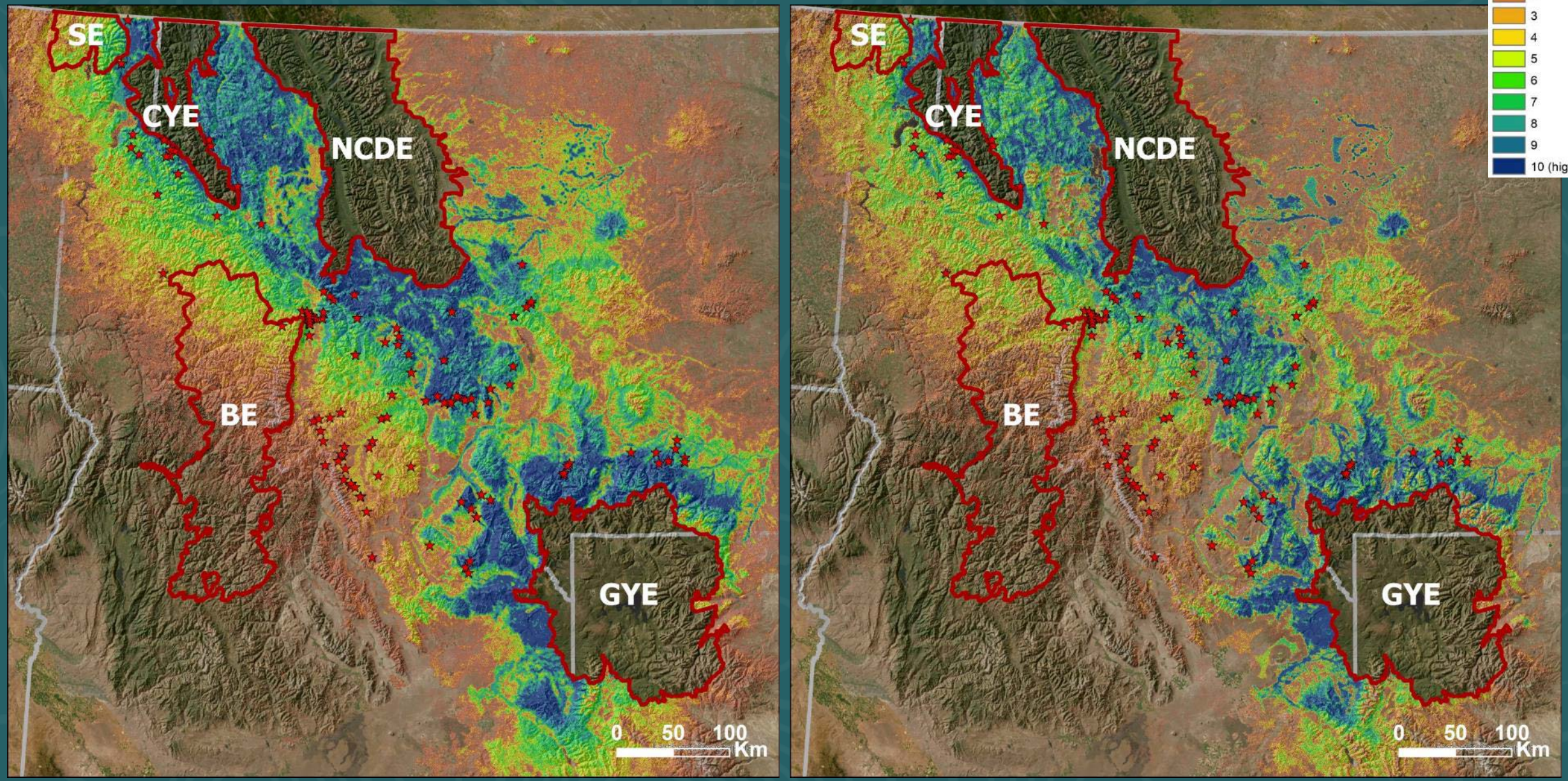
Males



Sells et al. 2023b. Biological Conservation

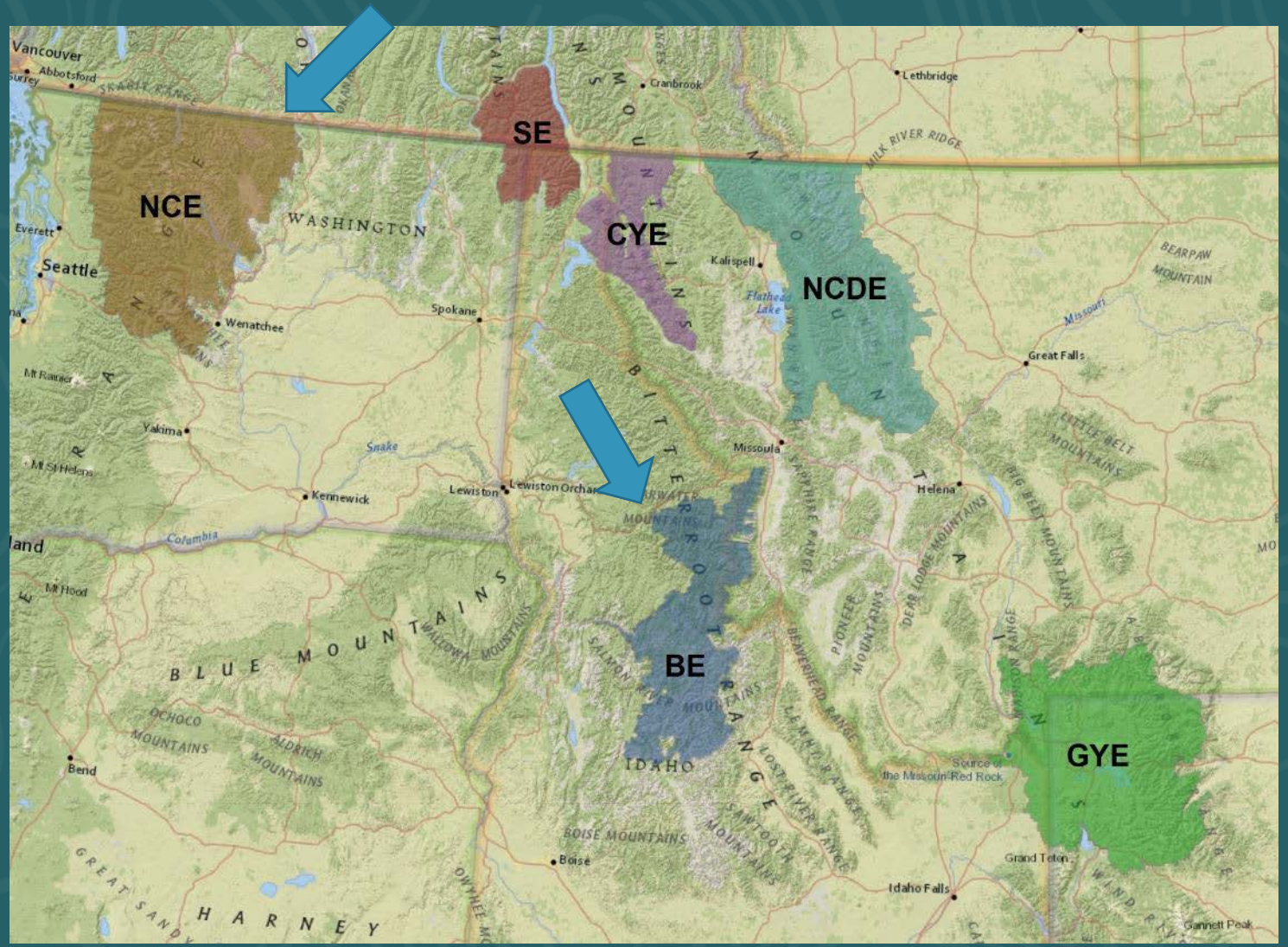
Females

Males



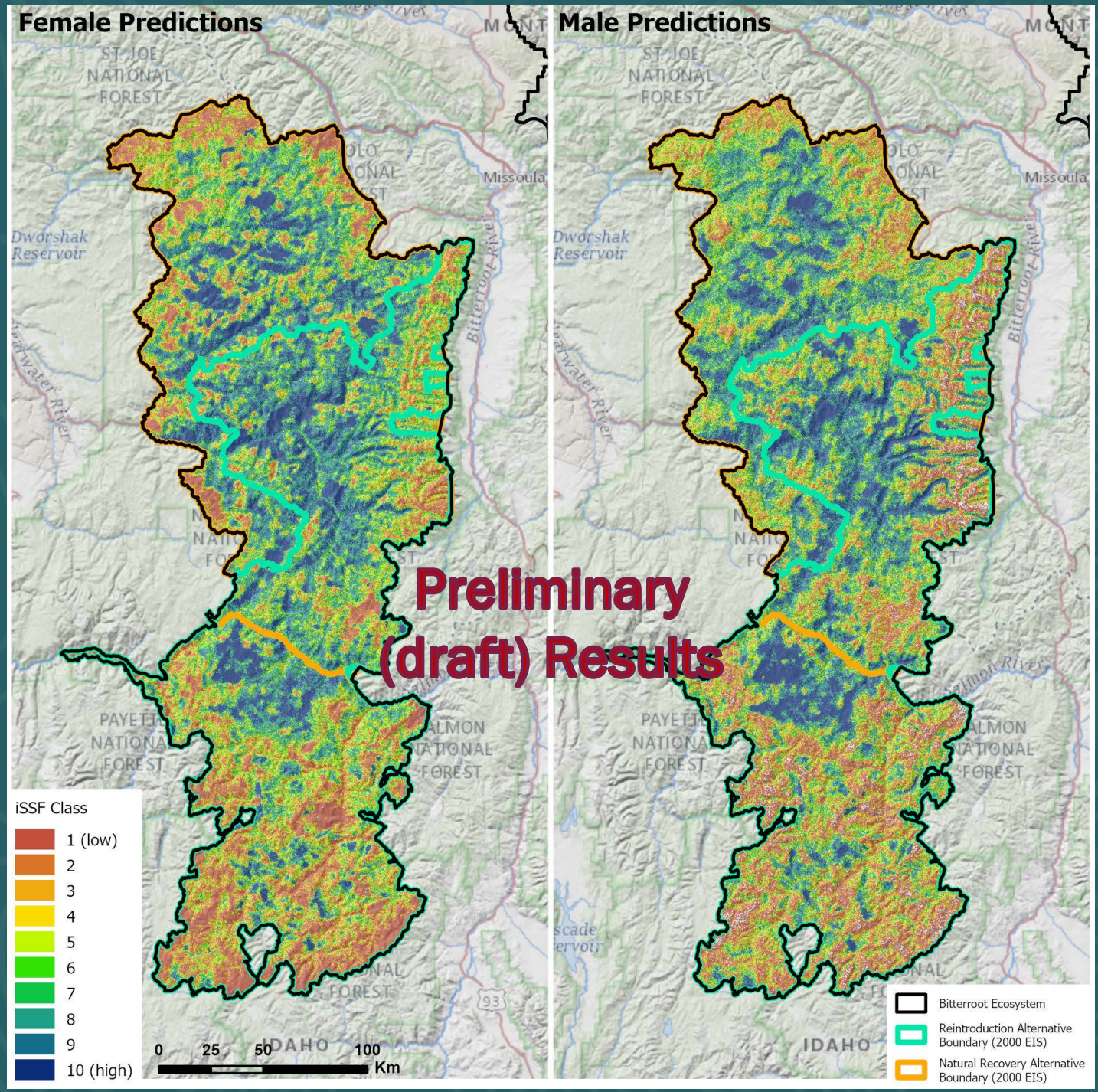
Sells et al. 2023b. Biological Conservation

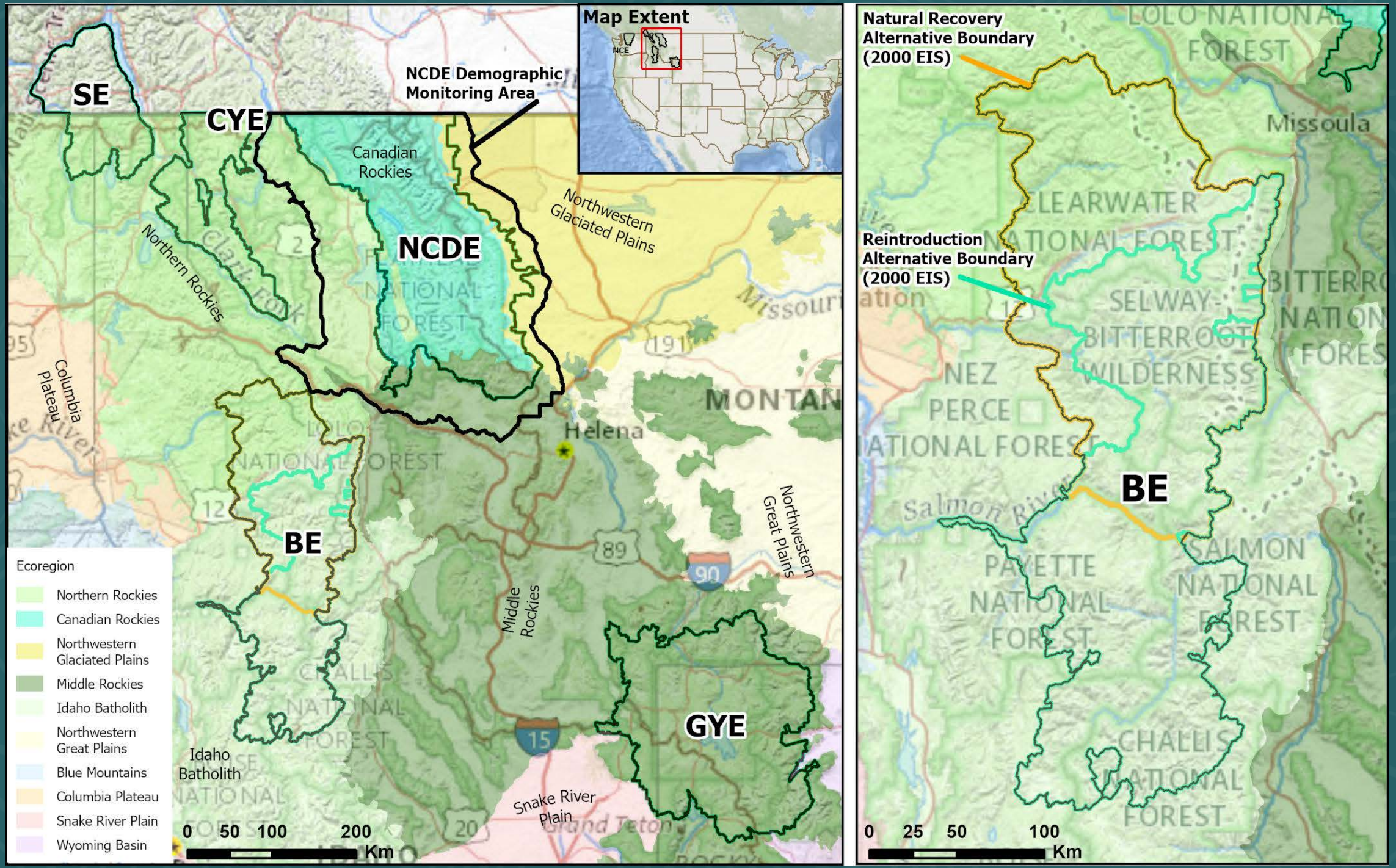
Model Application: Phase 4

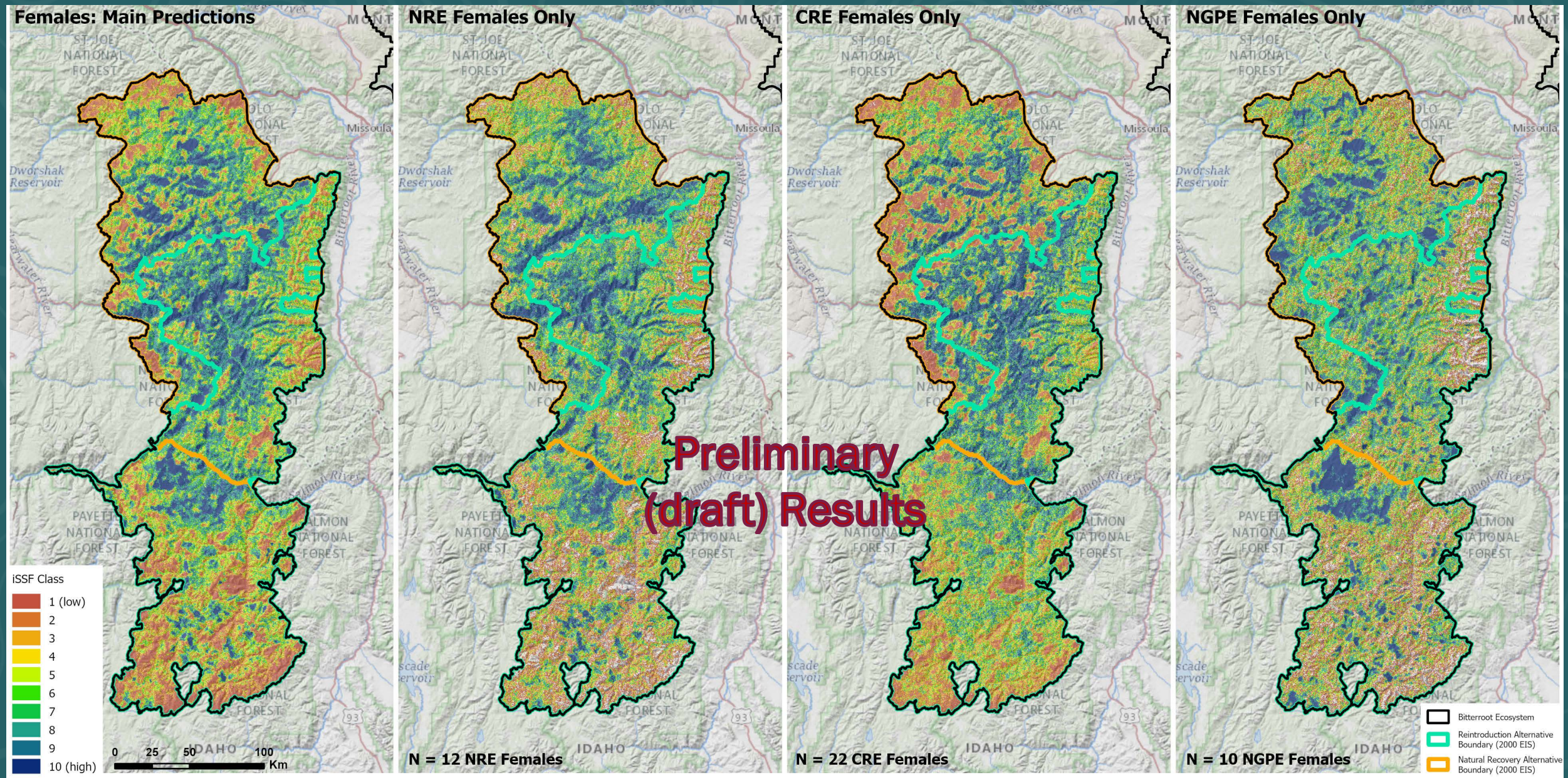


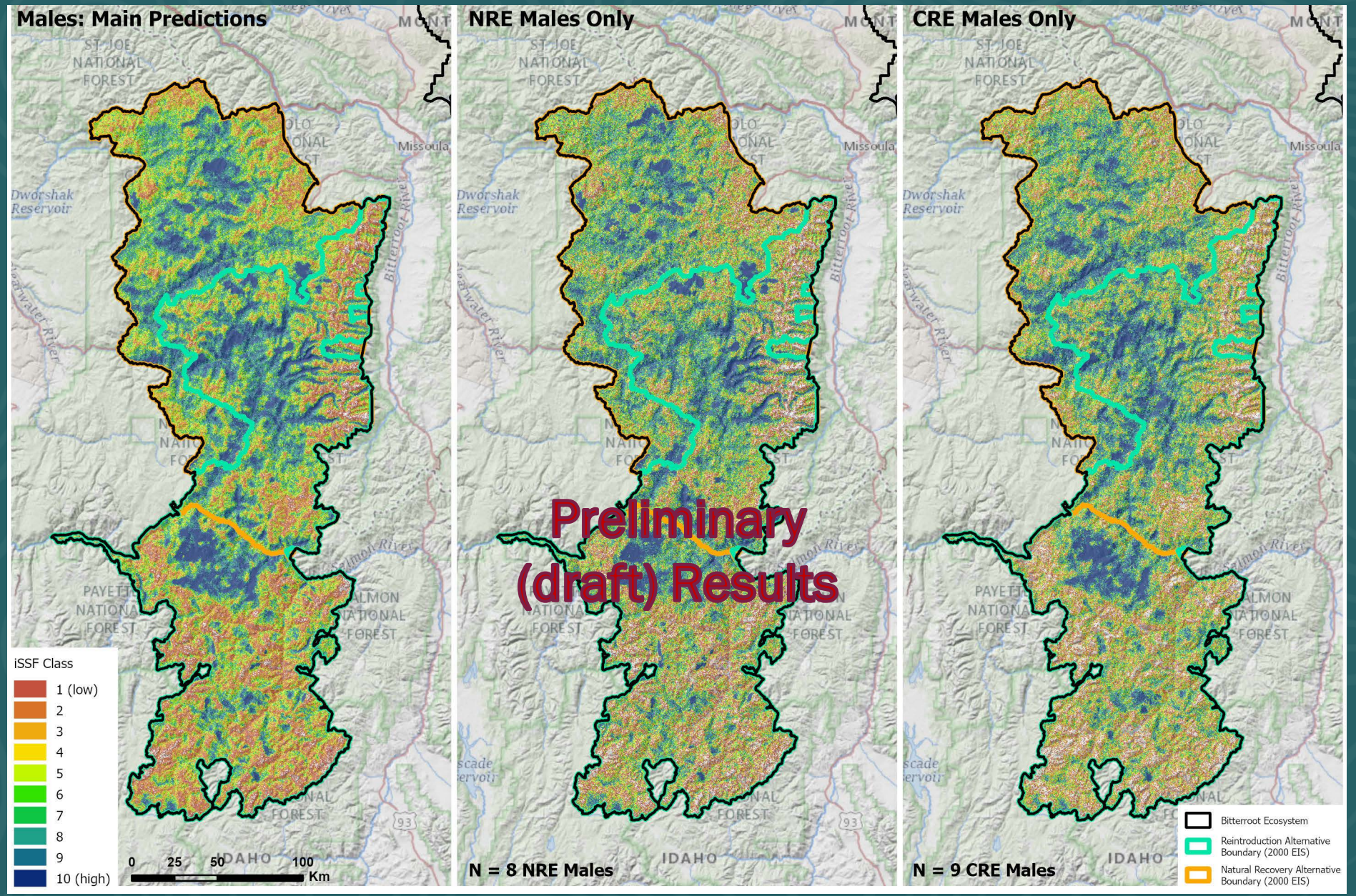
- Simulate habitat use in remaining ecosystems
  - NCE & BE

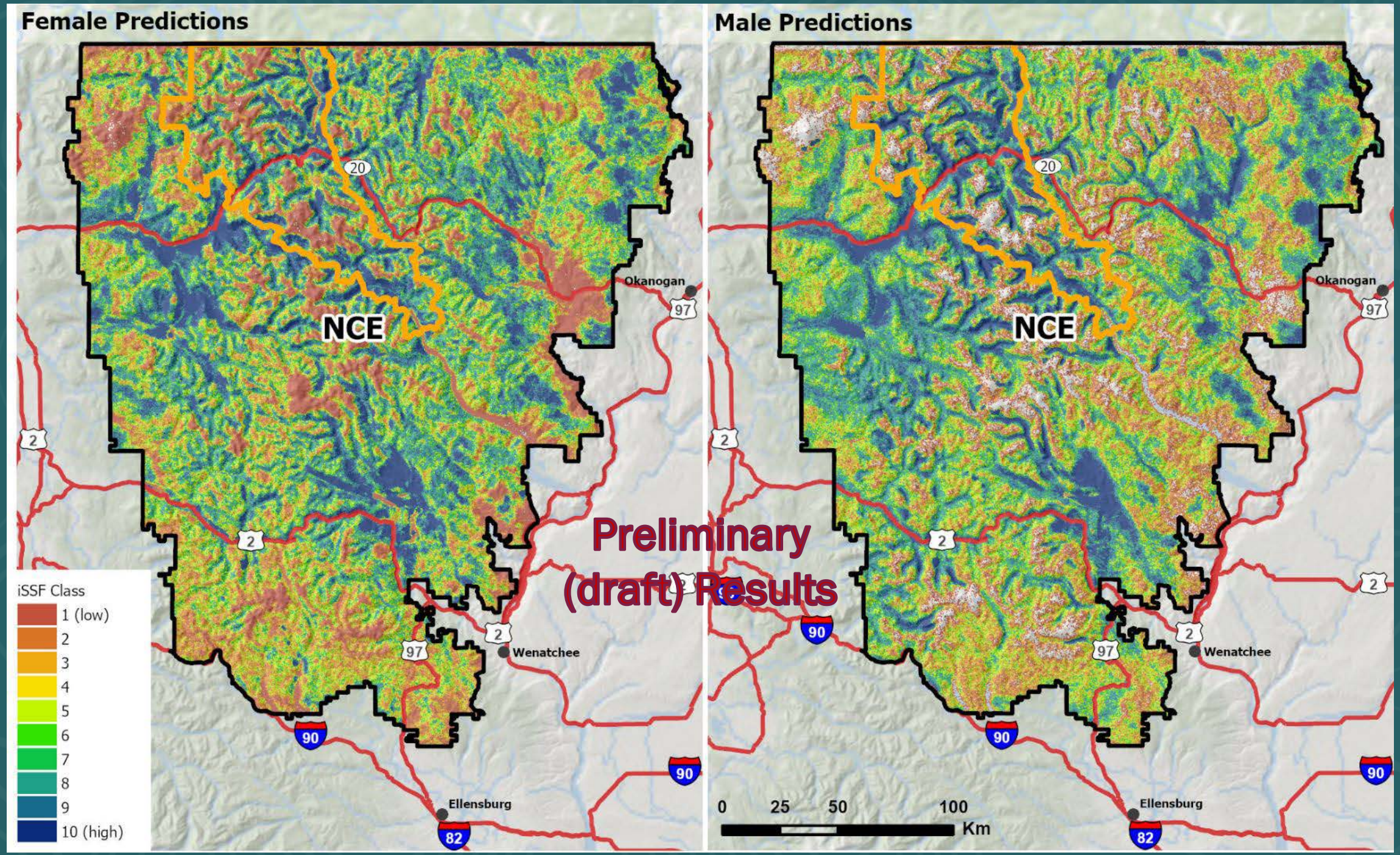
Sells et al. In Prep.

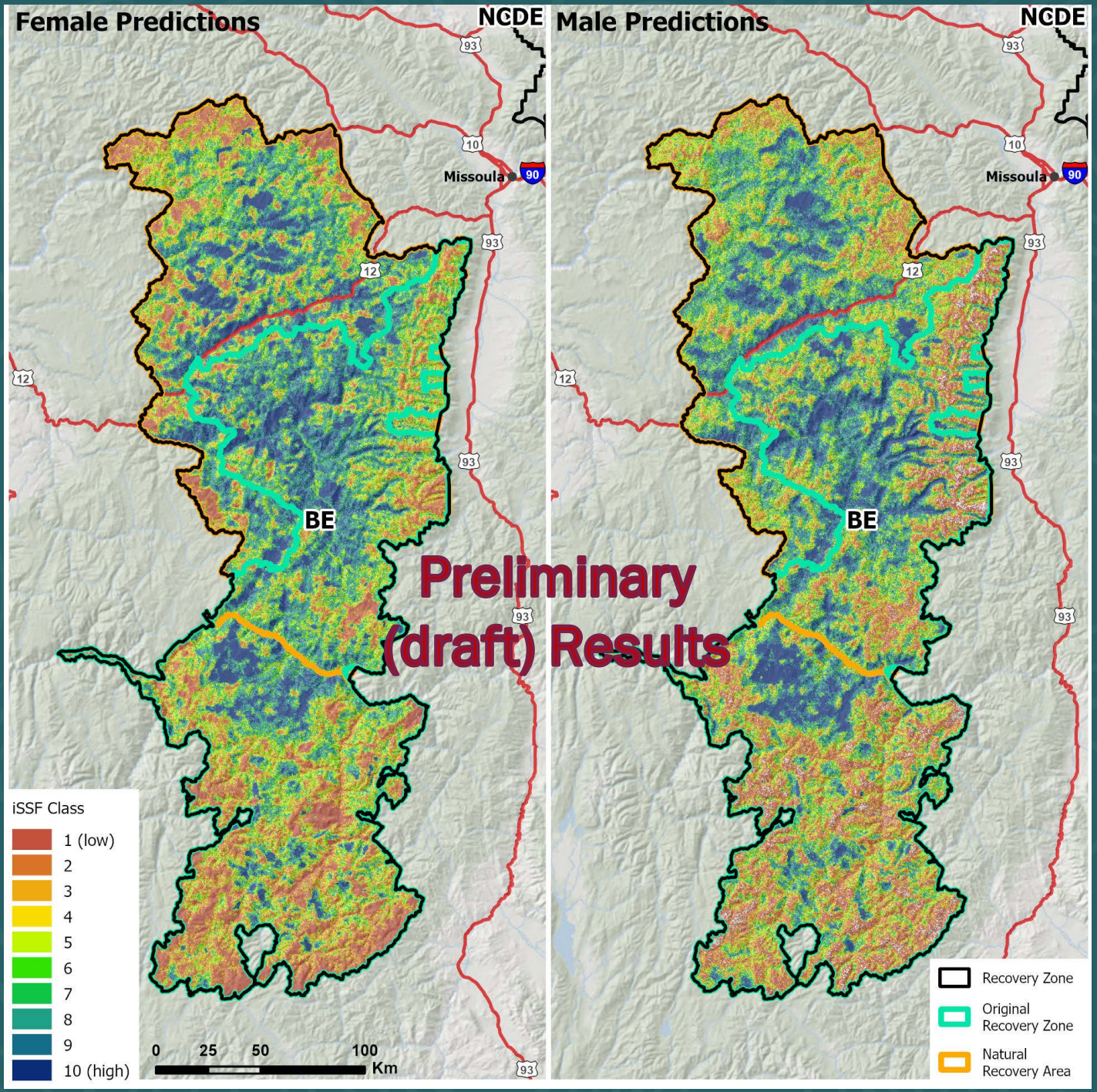

Female Predictions
Male Predictions
Preliminary
(draft) Results
iSSF Class
1 (low)
2
3
4
5
6
7
8
9
10 (high)
0 25 50 100
Km
Bitterroot Ecosystem
Reintroduction Alternative Boundary (2000 EIS)
Natural Recovery Alternative Boundary (2000 EIS)
Missoula
Dworshak Reservoir
IDAHO


Map Extent
NCE
NCDE Demographic Monitoring Area
SE
CYE
NCDE
BE
GYE
Canadian Rockies
Northwestern Glaciated Plains
Northern Rockies
Columbia Plateau
Middle Rockies
Northwestern Great Plains
Idaho Batholith
Snake River Plain
Helena
Missoula
Ecoregion
Northern Rockies
Canadian Rockies
Northwestern Glaciated Plains
Middle Rockies
Idaho Batholith
Northwestern Great Plains
Blue Mountains
Columbia Plateau
Snake River Plain
Wyoming Basin
0 50 100 200 Km
Natural Recovery Alternative Boundary (2000 EIS)
Reintroduction Alternative Boundary (2000 EIS)
0 25 50 100 Km


Females: Main Predictions
NRE Females Only
CRE Females Only
NGPE Females Only
Preliminary
(draft) Results
iSSF Class
1 (low)
2
3
4
5
6
7
8
9
10 (high)
0 25 50 100
Km
N = 12 NRE Females
N = 22 CRE Females
N = 10 NGPE Females
Bitterroot Ecosystem
Reintroduction Alternative Boundary (2000 EIS)
Natural Recovery Alternative Boundary (2000 EIS)
Missoula
Dworshak Reservoir
Bitterroot River
Clearwater River
Salmon River
IDAHO
MONT
ST JOE NATIONAL FOREST
PAYETTE NATIONAL FOREST
93


Males: Main Predictions
NRE Males Only
CRE Males Only
Preliminary
(draft) Results
iSSF Class
1 (low)
2
3
4
5
6
7
8
9
10 (high)
0 25 50 100
Km
N = 8 NRE Males
N = 9 CRE Males
Bitterroot Ecosystem
Reintroduction Alternative Boundary (2000 EIS)
Natural Recovery Alternative Boundary (2000 EIS)
Missoula
IDAHO


Female Predictions
Male Predictions
NCE
NCE
Okanogan
Wenatchee
Ellensburg
20
97
2
90
82
iSSF Class
1 (low)
2
3
4
5
6
7
8
9
10 (high)
Preliminary
(draft) Results
0
25
50
100
Km



- **Next:**
  - **Summarize by land ownership in each class (USFS, private, etc.)**
  - **Summarize by wilderness status**
  - **Other requests or recommendations?**

Application

- **Decision-making, e.g.,**
  - Conservation strategies
  - Habitat management
  - Monitoring design

Next Steps

- **Complete NCE & BE manuscripts**
- **Model survival**
  - Work with USFWS and cooperating agencies in the EIS process with data needs
- **Model home ranges**
  - Understand range expansion

Phase 1

Biological Conservation 276 (2022) 109813

Contents lists available at ScienceDirect

Biological Conservation

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Grizzly bear habitat selection across the Northern Continental Divide Ecosystem

Sarah N. Sells [a,*], Cecily M. Costello [b], Paul M. Lukacs [c]

[a] Montana Cooperative Wildlife Research Unit, Wildlife Biology Program, University of Montana
[b] Montana Fish, Wildlife and Parks, 490 N Meridian Rd, Kalispell, MT 59901, USA
[c] Wildlife Biology Program, W.A. Franke College of Forestry and Conservation, University of M

Phase 2

Biological Conservation 279 (2023) 109940

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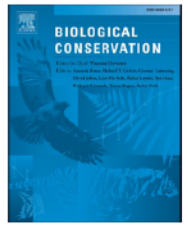

Grizzly bear movement models predict habitat use for nearby populations

Sarah N. Sells [a,*], Cecily M. Costello [b], Paul M. Lukacs [c], Frank T. van Manen [d], Mark Haroldson [d], Wayne Kasworm [e], Justin Teisberg [e], Milan A. Vinks [b], Dan Bjornlie [f]

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[d] U.S. Geological Survey, Northern Rocky Mountain Science Center, Interagency Grizzly Bear Study Team, 2327 University Way, Suite 2, Bozeman, MT 59715, United States of America
[e] U.S. Fish and Wildlife Service, Grizzly Bear Recovery Program, 385 Fish Hatchery Road, Libby, MT 59923, United States of America
[f] Wyoming Game and Fish Department, Lander, WY 82520, United States of America

Phase 3

Biological Conservation xxx (xxxx) 110199

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Predicted connectivity pathways between grizzly bear ecosystems in Western Montana

Sarah N. Sells [a, *], Cecily M. Costello [b], Paul M. Lukacs [c],

[a] US Geological Survey, Montana Cooperative Wildlife Research Unit, University of Montana, Missou
[b] Montana Fish, Wildlife and Parks, 490 N Meridian Rd, Kalispell, MT 59901, United States of Amer
[c] Wildlife Biology Program, W.A. Franke College of Forestry and Conservation, University of Montan

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Dates

Publication Date : 2023-06-30
Start Date : 2003-05-01
End Date : 2023-07-15

Citation

Sarah N. Sells, and Cecily M. Costello, 20230630, Grizzly Bear Space Use in the US Northern Rocky Mountains: , https://doi.org/10.5066/P91EWUO8.

Summary

Over the past two centuries, persecution and habitat loss caused grizzly bears (Ursus arctos) to decline from a population of approximately 50,000 individuals to only 4 fragmented populations within the continental United States. In recent decades, these populations have increased and expanded in size and range due to collaborative conservation efforts and protections under the Endangered Species Act. Today, population estimates exceed 1000 animals each in the Northern Continental Divide Ecosystem (NCDE) and Greater Yellowstone Ecosystem (GYE). The Selkirk Ecosystem (SE) has approximately 50 grizzly bears, and augmentations into the Cabinet-Yaak Ecosystem (CYE) helped boost the population to an estimated 50 – 60 animals. To date, the Bitterroot (BE) and North Cascades Ecosystems (NCE) lack any known permanent residents. Eventual connectivity between populations is a conservation goal, as is establishment of populations in currently unoccupied recovery areas. An understanding of habitat selection by grizzly bears within existing populations is crucial for predicting potential linkage zones and suitable habitat. A

Map »

Spatial Services

ScienceBase WMS : https://www.sciencebase.gov/catal

Communities

- Cooperative Fish and Wildlife Research Units

umt.edu/coop-unit/sellslab

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MFWP & USGS

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