GOLDEN EAGLE MIGRATION CORRIDORS AND SEASONAL HABITAT SELECTION IN THE ROCKY MOUNTAINS AND WESTERN GREAT PLAINS

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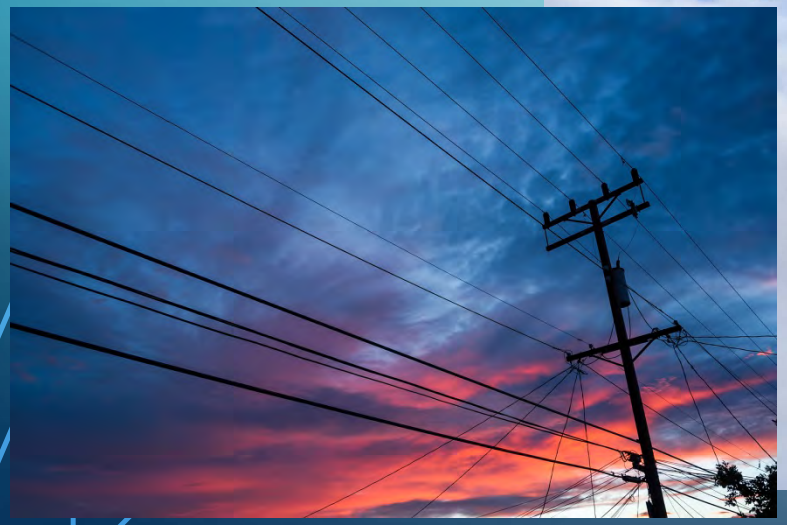
1 teton raptor center

2 RESEARCH RAPTOR VIEW INSTITUTE MISSOULA • MONTANA

3 U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

4 Lone Pine Analytics



- Breeding Adults (>5)
- Sub-Adults (2-5)
- Hatch-year (1)

- Conterminous US
- Canada/AK

- Spring/Summer
- Fall/Winter
- Migration

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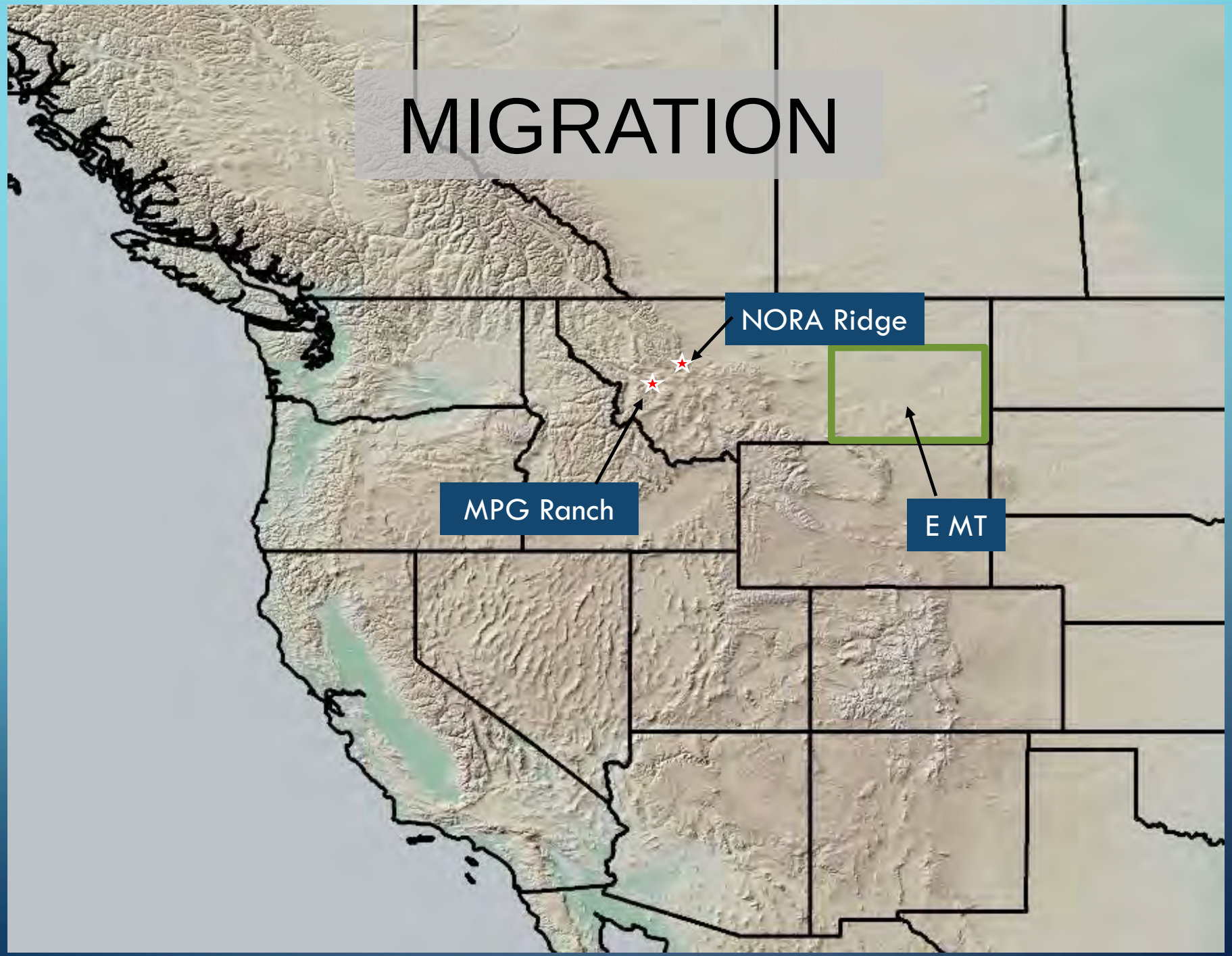
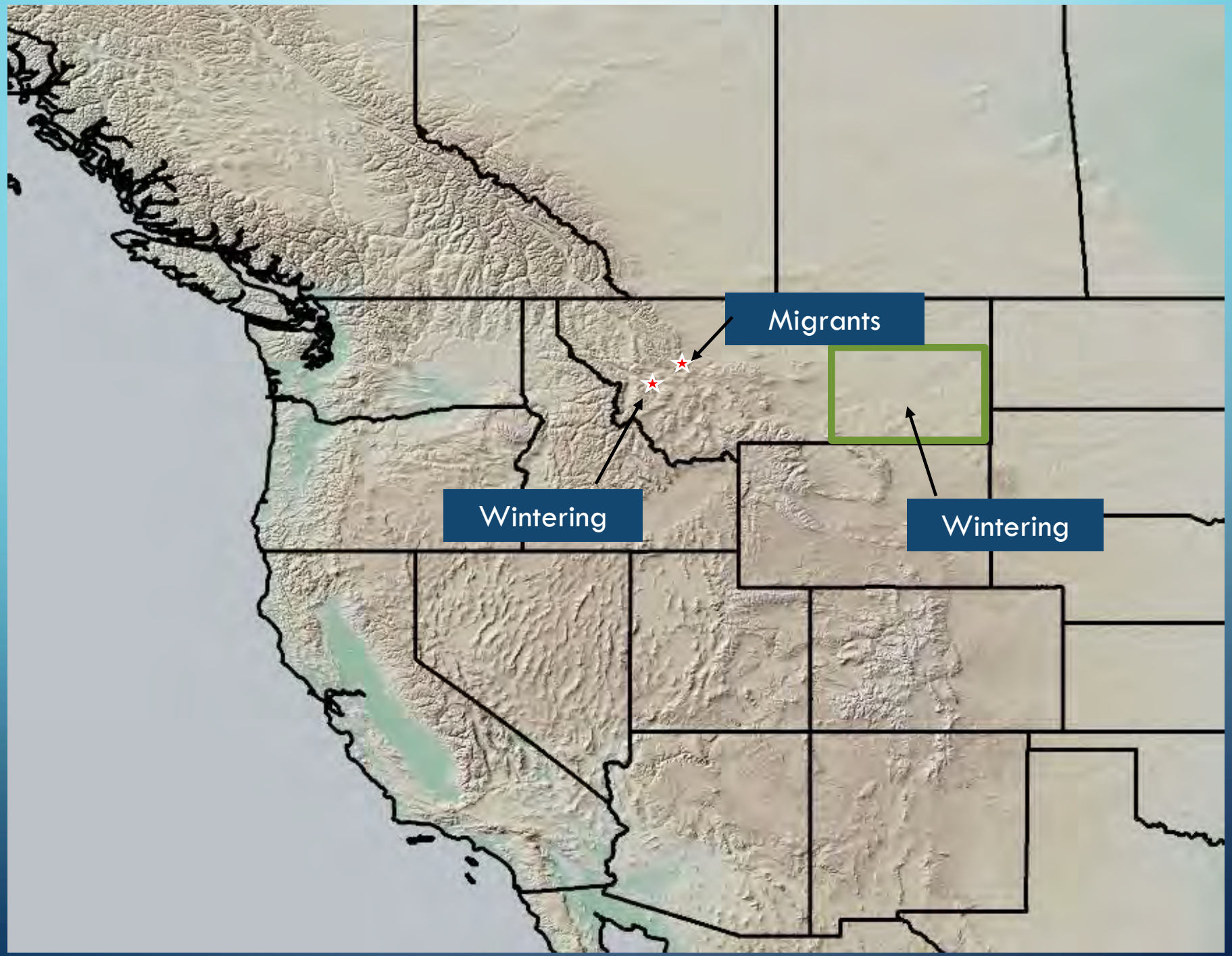
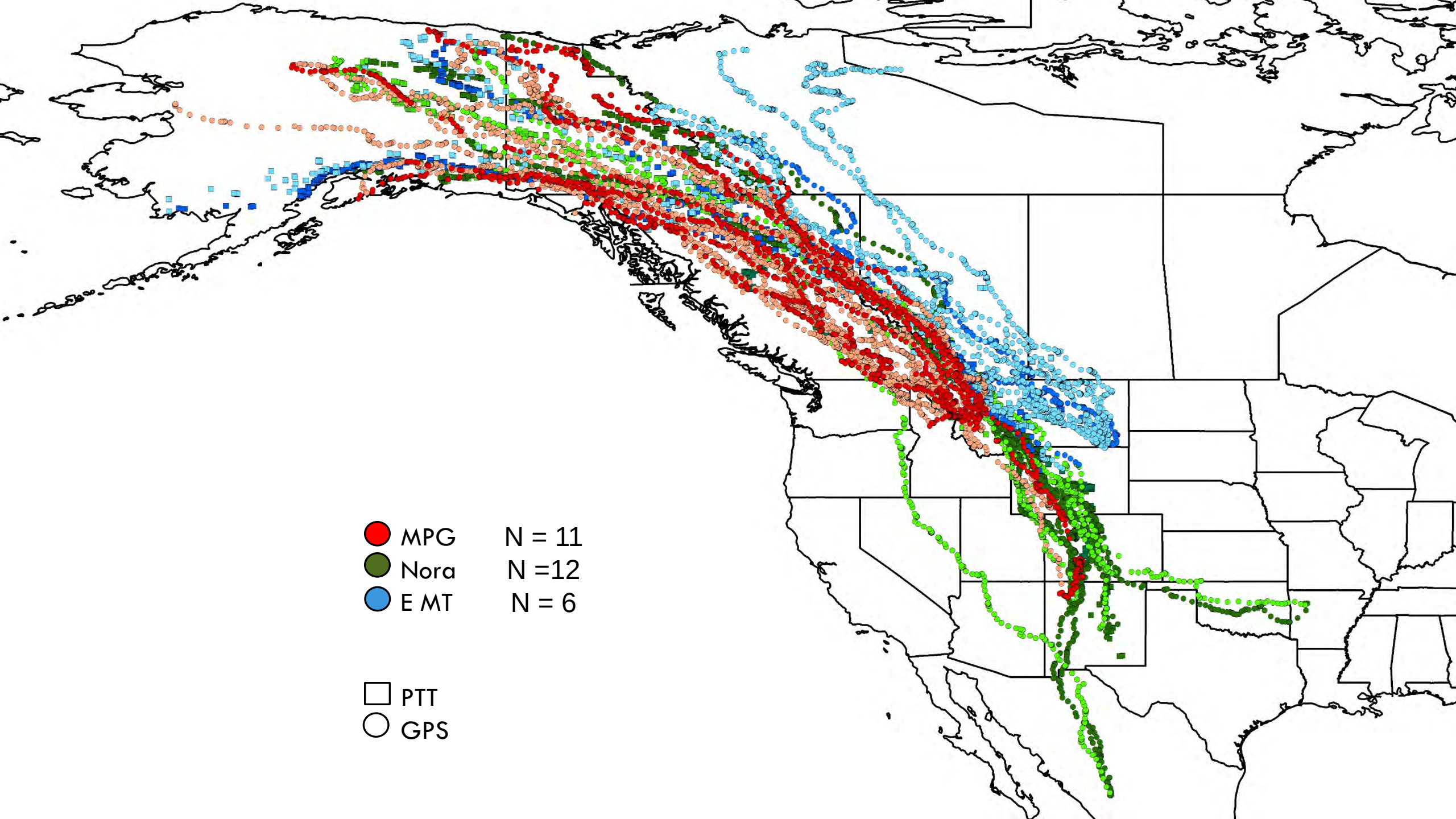
MIGRATION



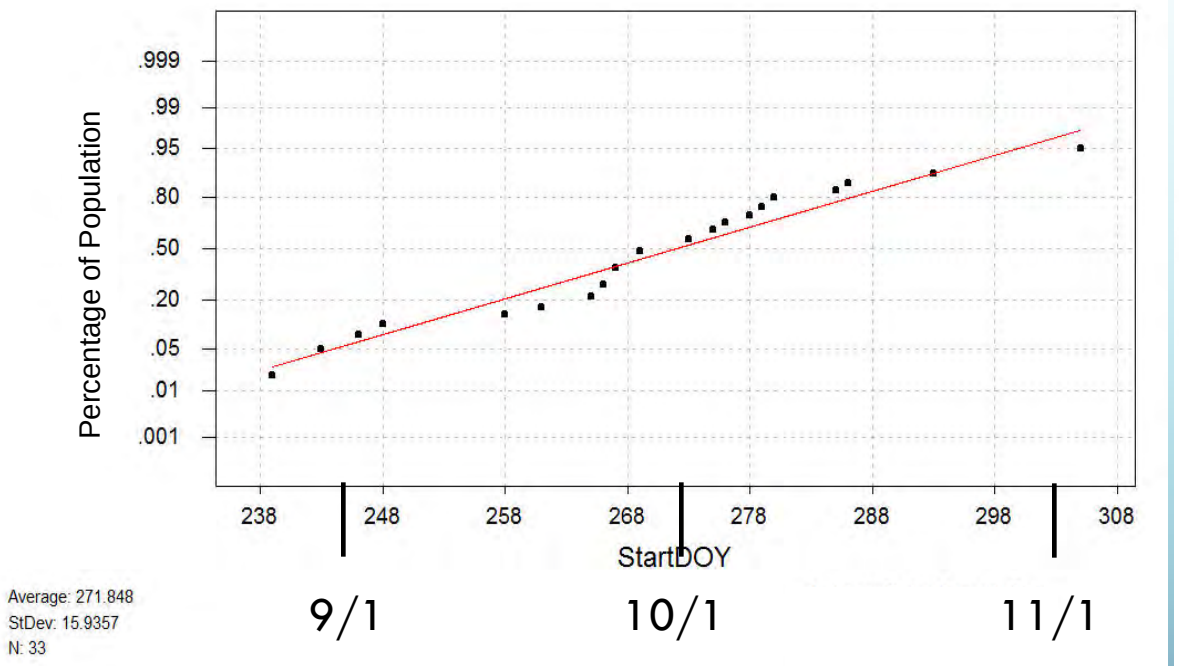

Migrants
Wintering
Wintering

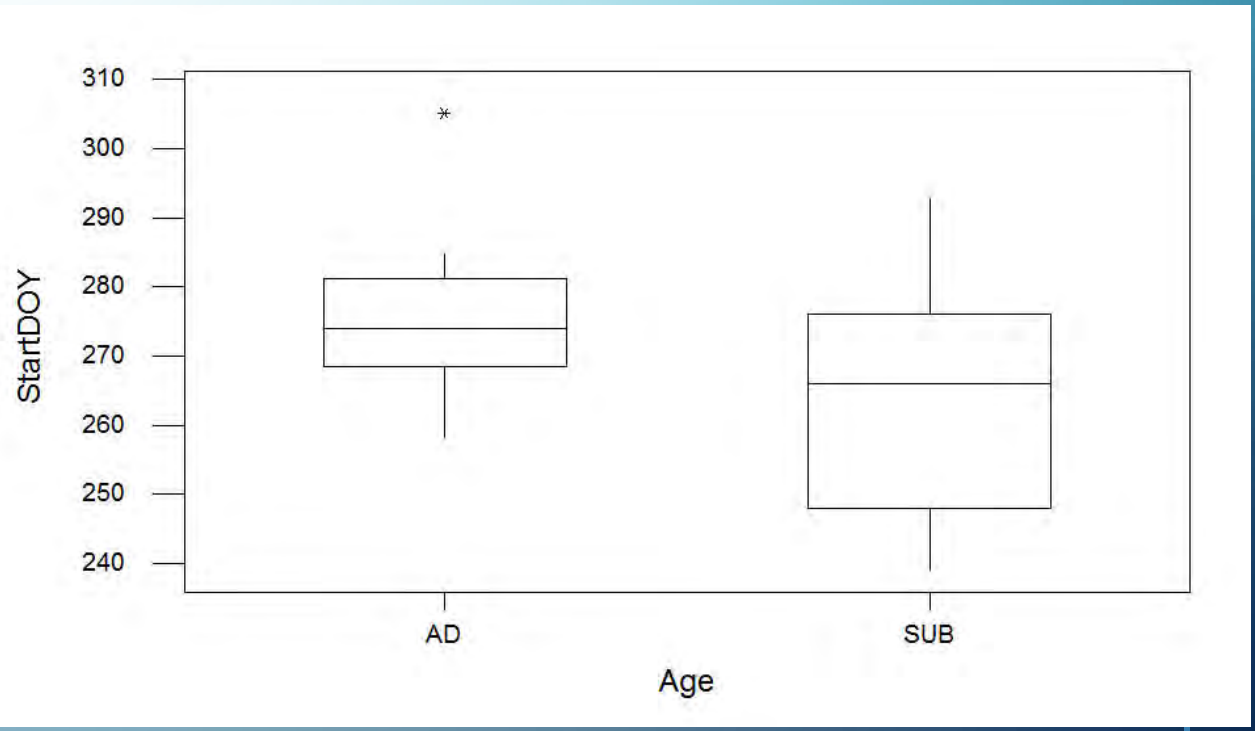

MPG N = 11
Nora N =12
E MT N = 6
PTT
GPS

MOVEMENT METRICS

AUTUMN MIGRATION

START DATES – *PTT & GPS, FULL MIGRATIONS*

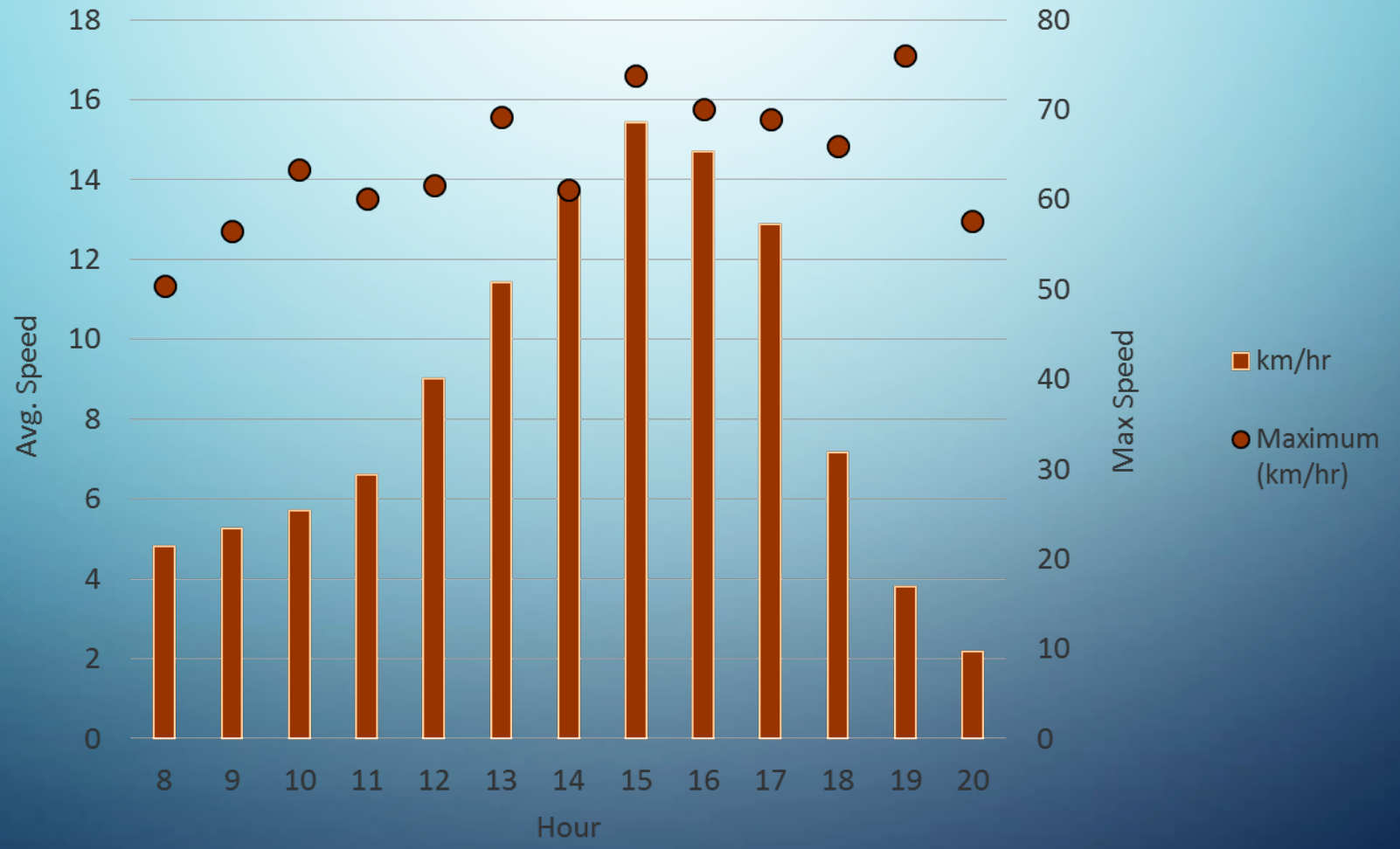




- Sub-adults significantly earlier (median = 8 days earlier; p = 0.008)
- No difference in gender, year or study area

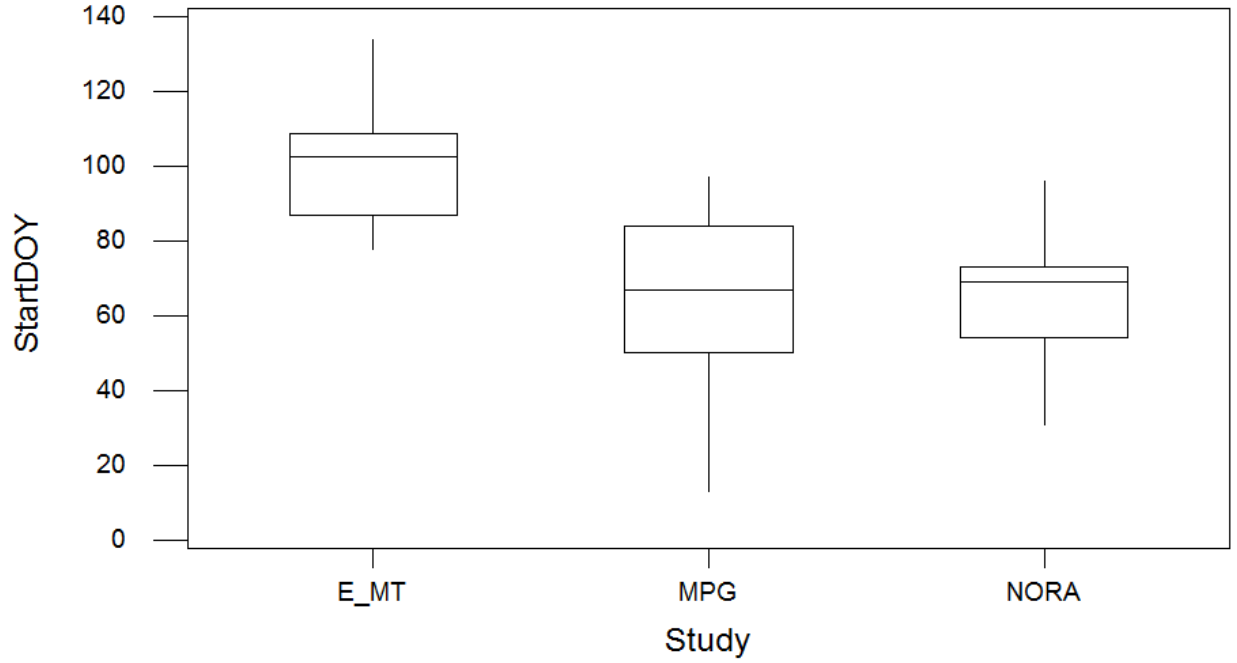
AUTUMN MIGRATION

HOURLY SPEED – *GPS ONLY*



SPRING MIGRATION

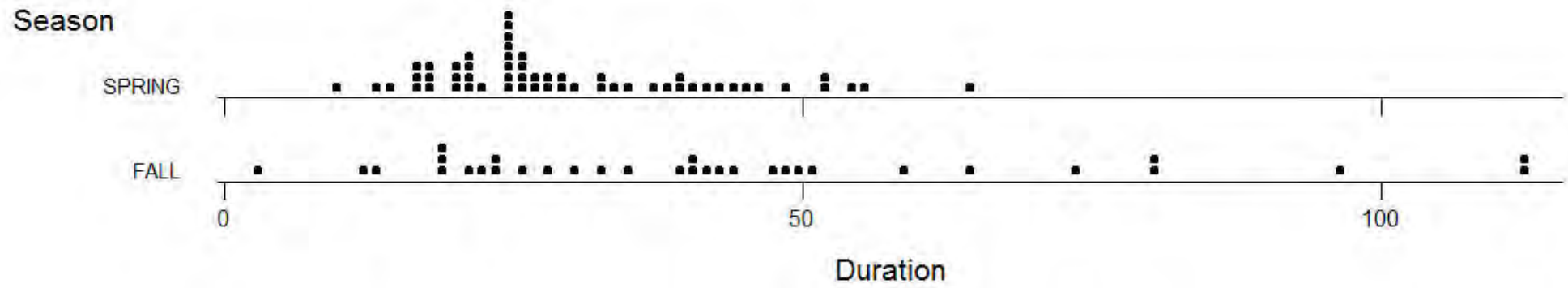
START DATES – *PTT & GPS*



Study Area	Mean	SD (d)	Range
E MT	10-Apr	16	18-Mar - 27-May
MPG	3-Mar	22	13-Jan - 7-Apr
NORA	3-Mar	15	31-Jan - 6-Apr

SPRING MIGRATION

DURATION– *PTT & GPS*



Spring significantly shorter duration p = 0.0261

Spring median = 26 days
Fall median = 41 days

MIGRATION CORRIDORS

UTILIZATION DISTRIBUTION OF MIGRATORY MOVEMENTS

- Brownian Bridge Movement Models incorporate space and time

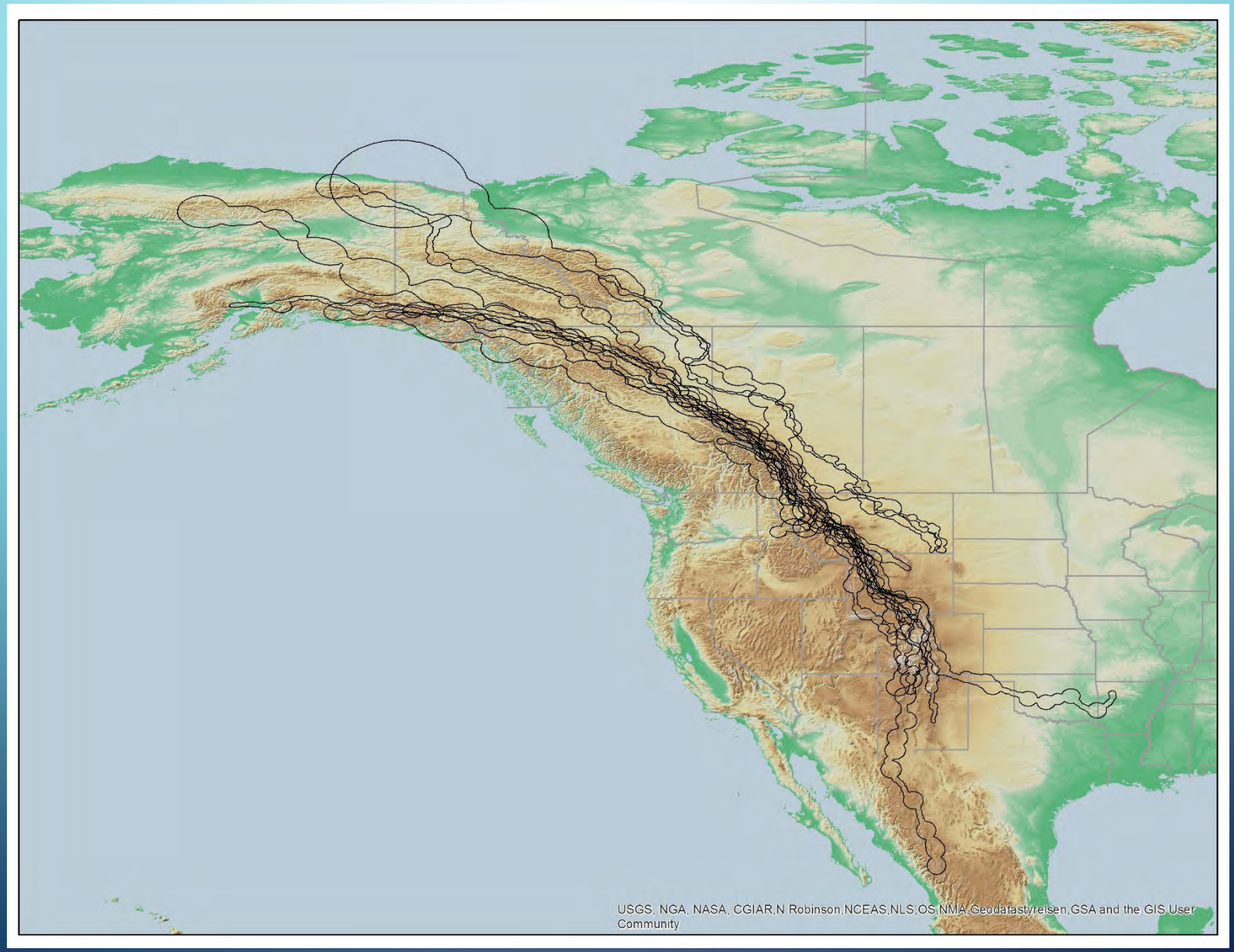
- Probability of the animal occurrence between subsequent locations depends on:
  - Distance between points
  - Time between points
  - Speed of movement

- Only migration movement data included in all analyses
- Only GPS transmitters used in determining key flyways
- Dataset reduced to one migration/individual

  One exception where an eagle took different spring routes in subsequent years
- We used 25-40% population level use to define key corridors

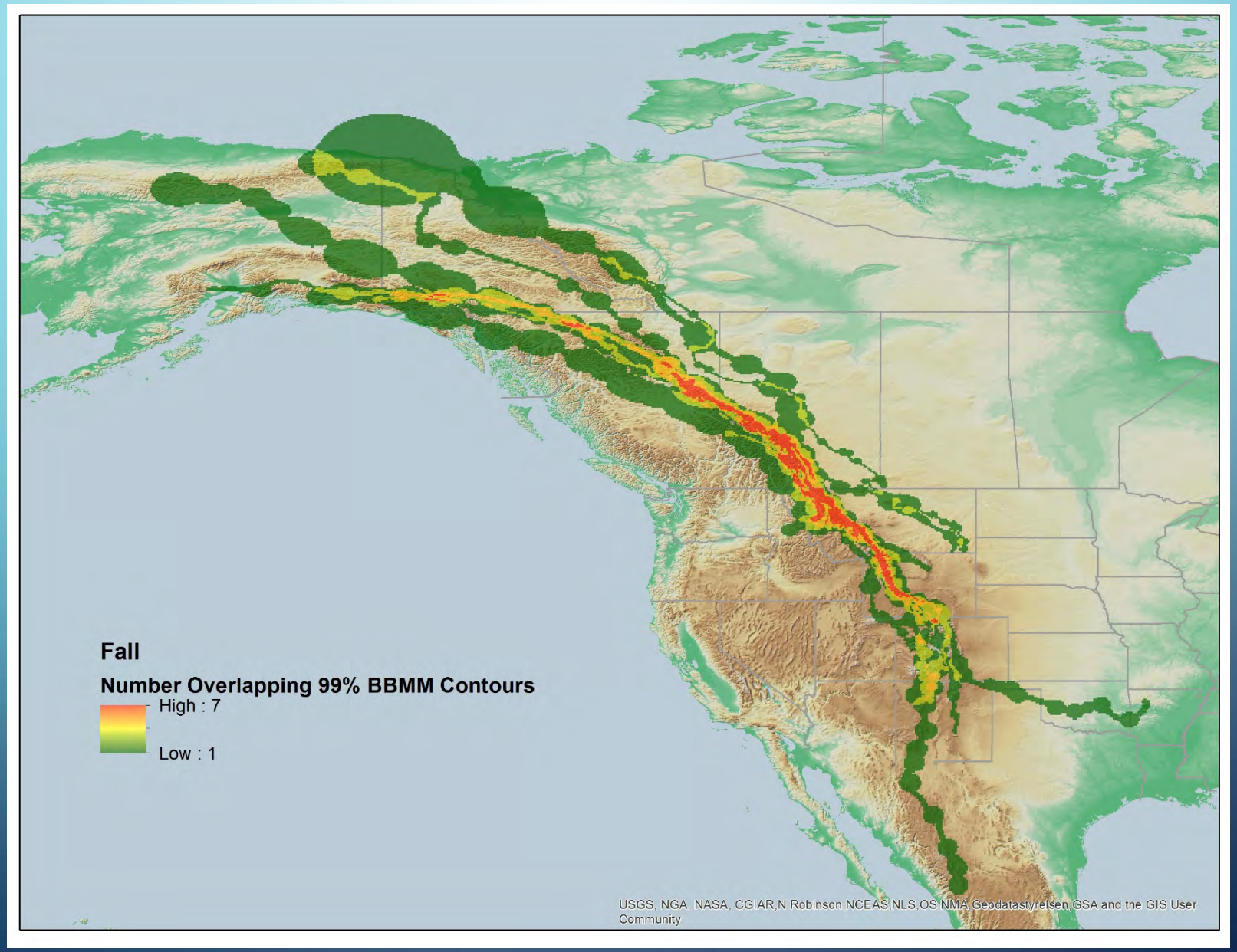
  based on sample size

BBMMS – AUTUMN



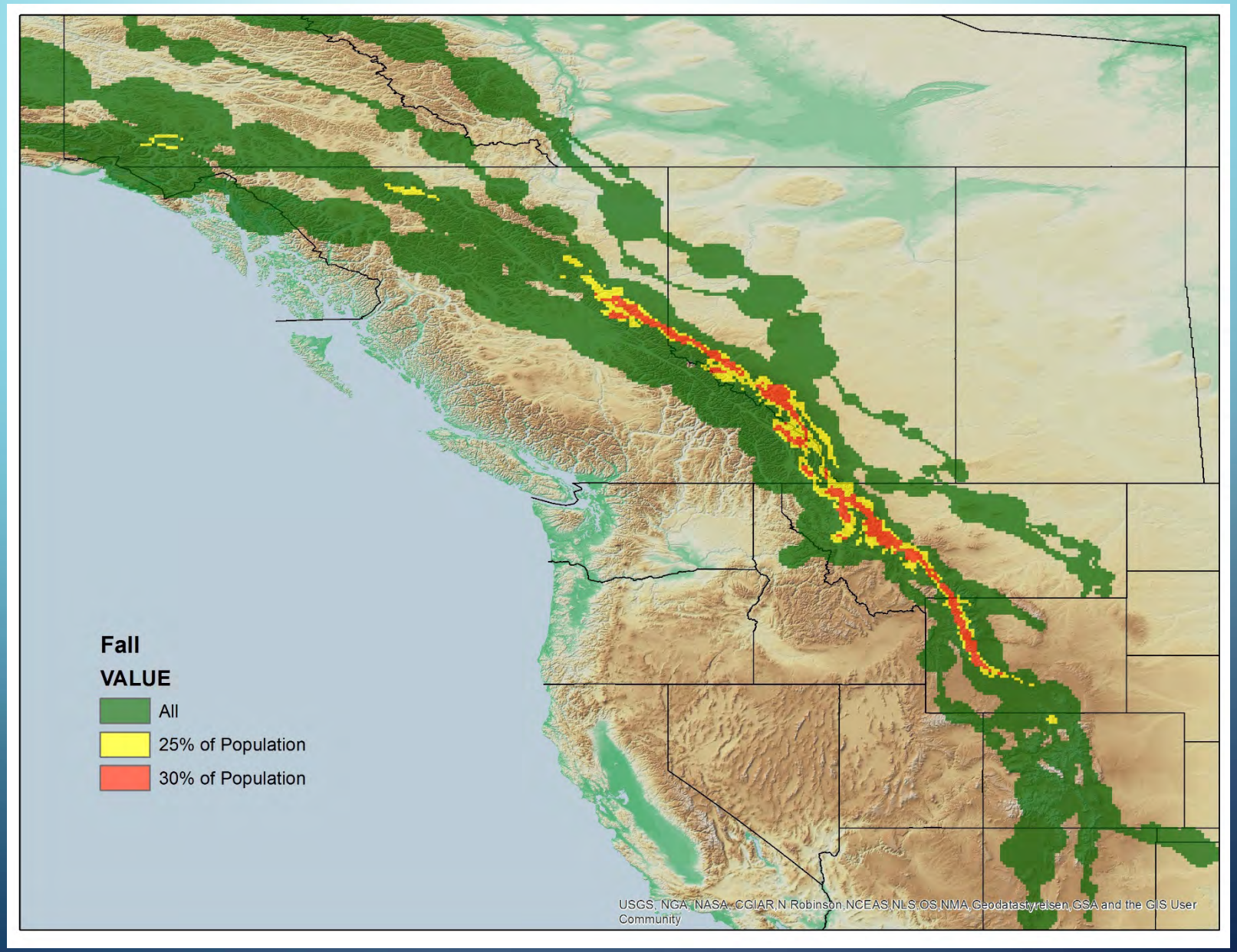
BBMMS – AUTUMN

Count Overlapping Contours to ID Corridors



BBMMS – AUTUMN

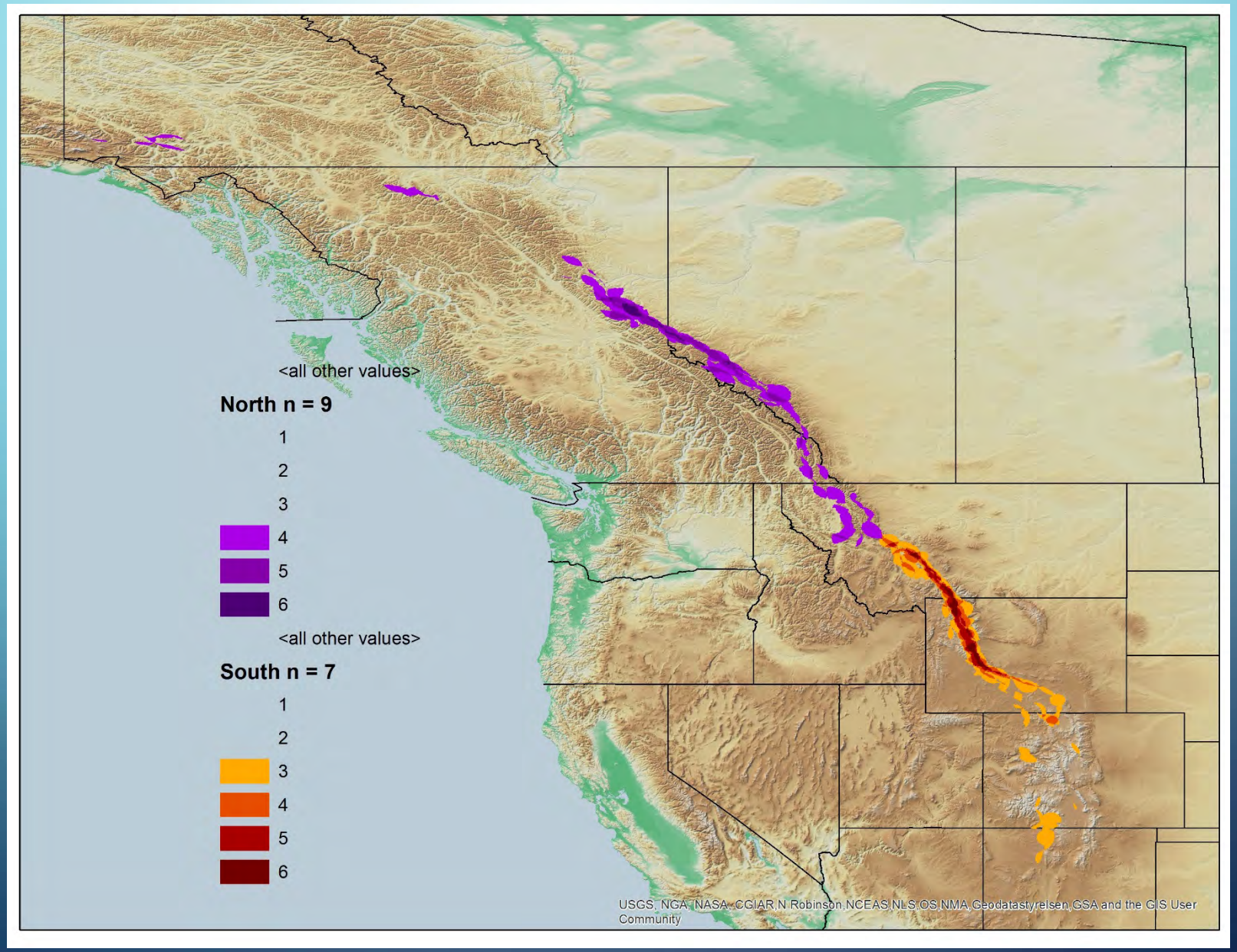
Key Fall Migration Corridors



BBMMS – AUTUMN

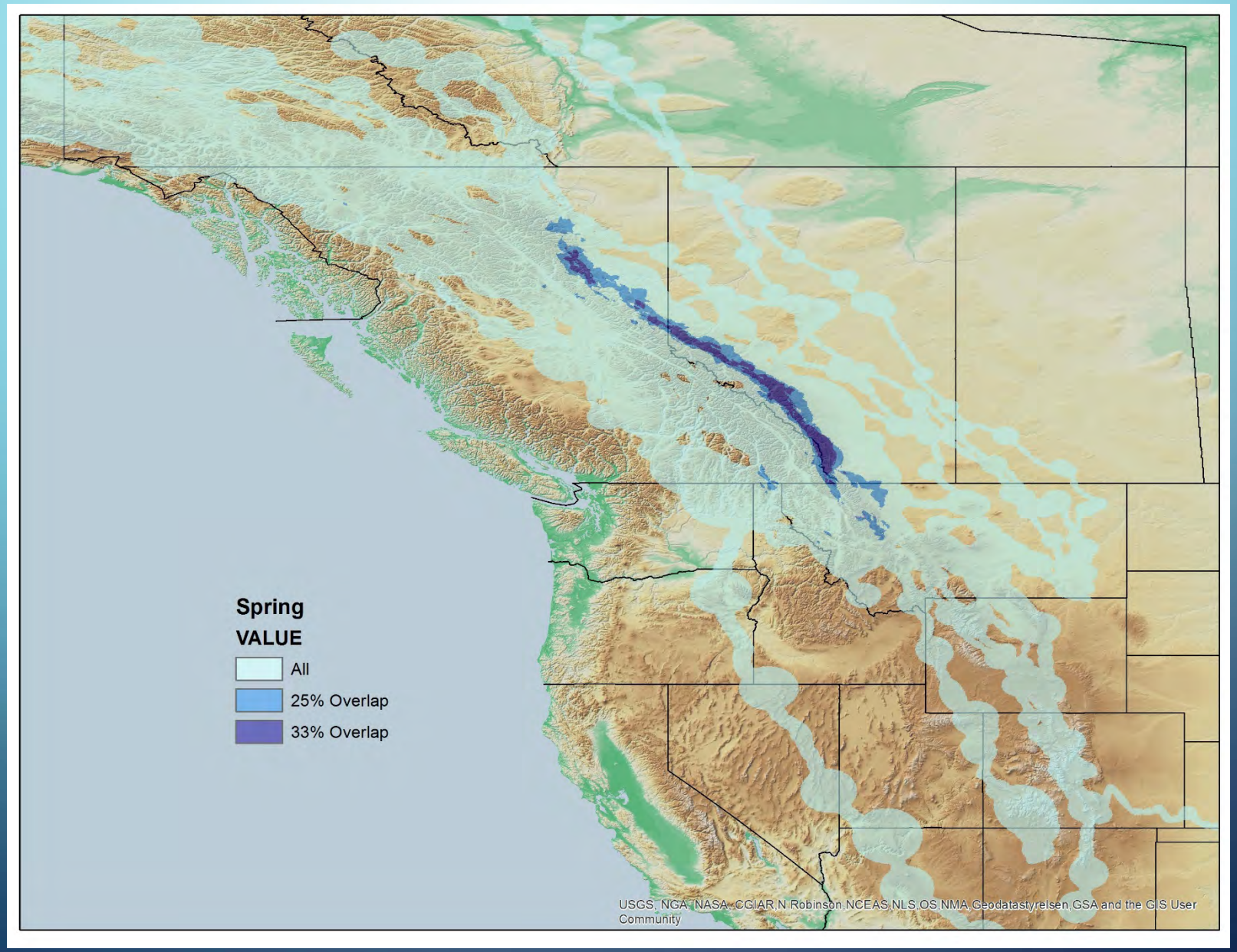
Separating eagles that stop in MT and those who continue south

40% population overlap



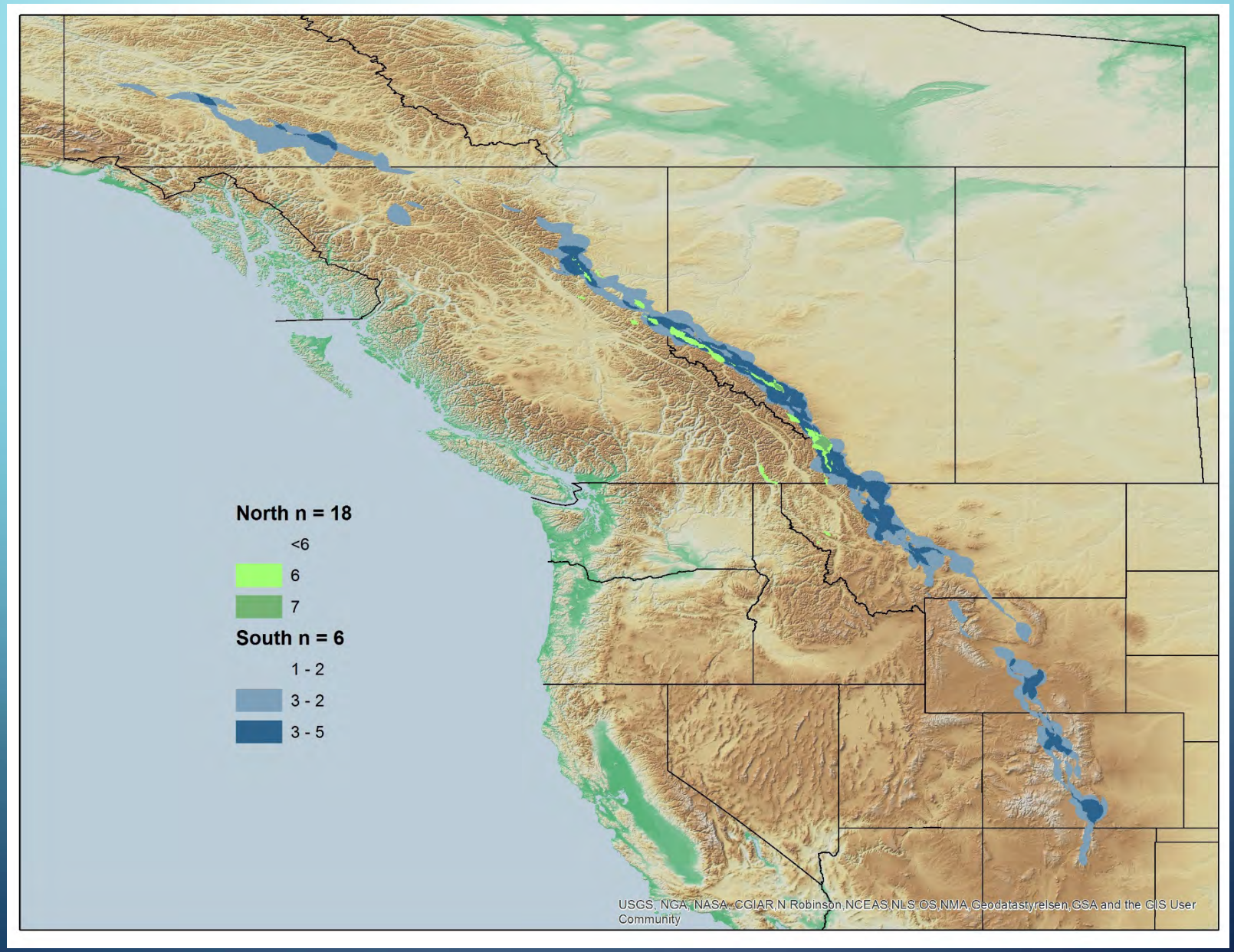
BBMMS – SPRING

Key Spring Corridors

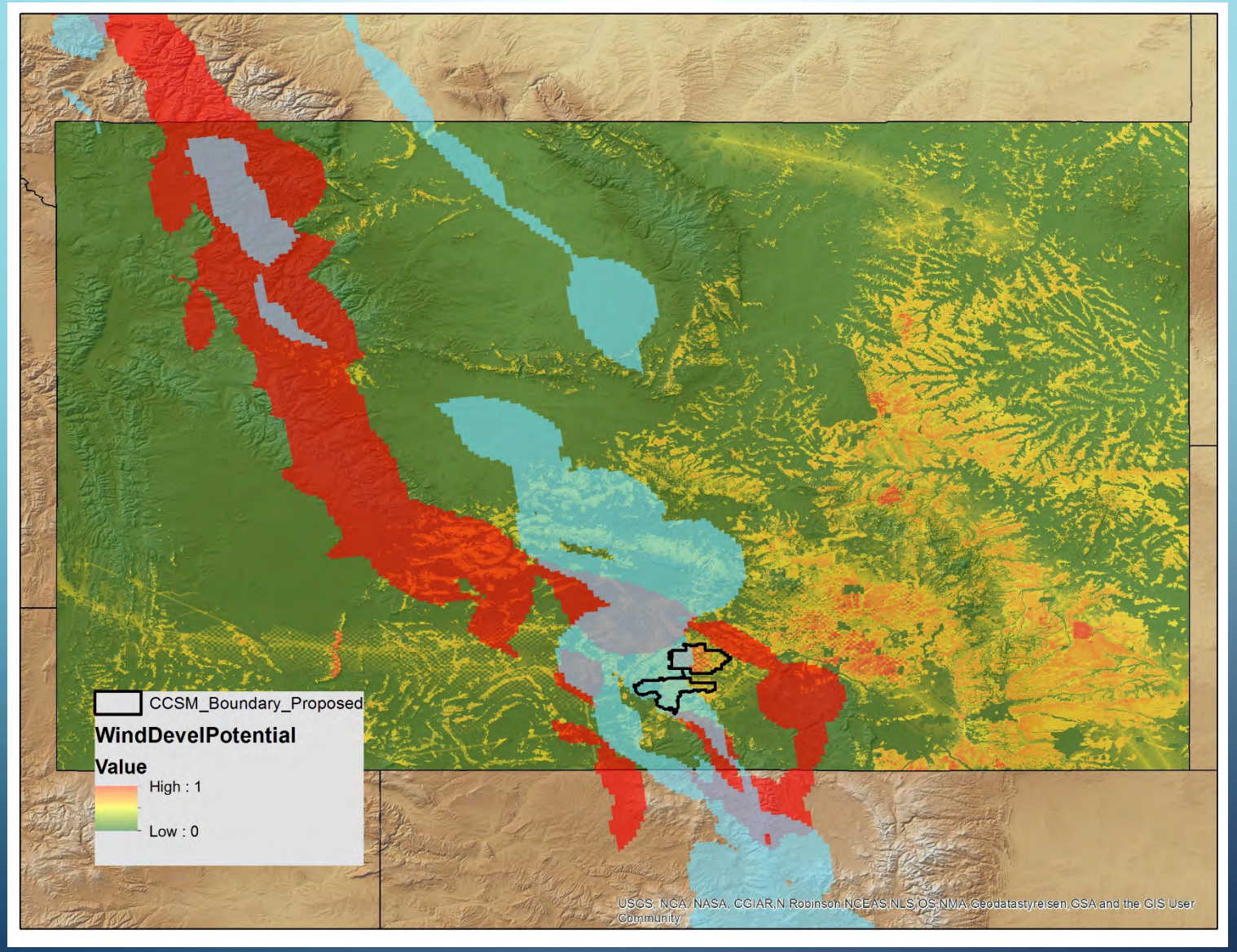


BBMMS – SPRING

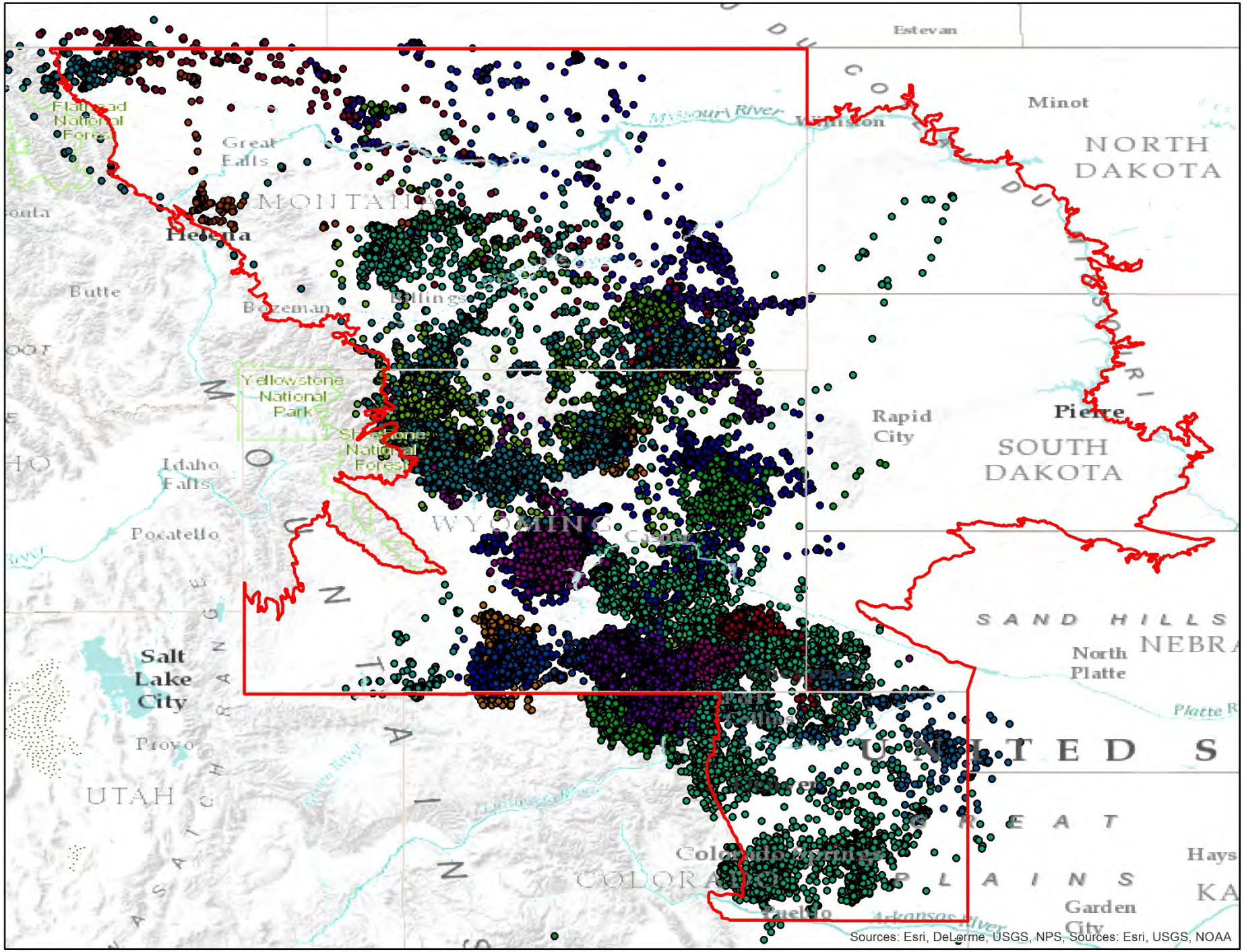
Separating eagles wintering in MT and those south of Wyoming



MANAGEMENT IMPLICATIONS



MOVEMENTS OF YOUNG EAGLES

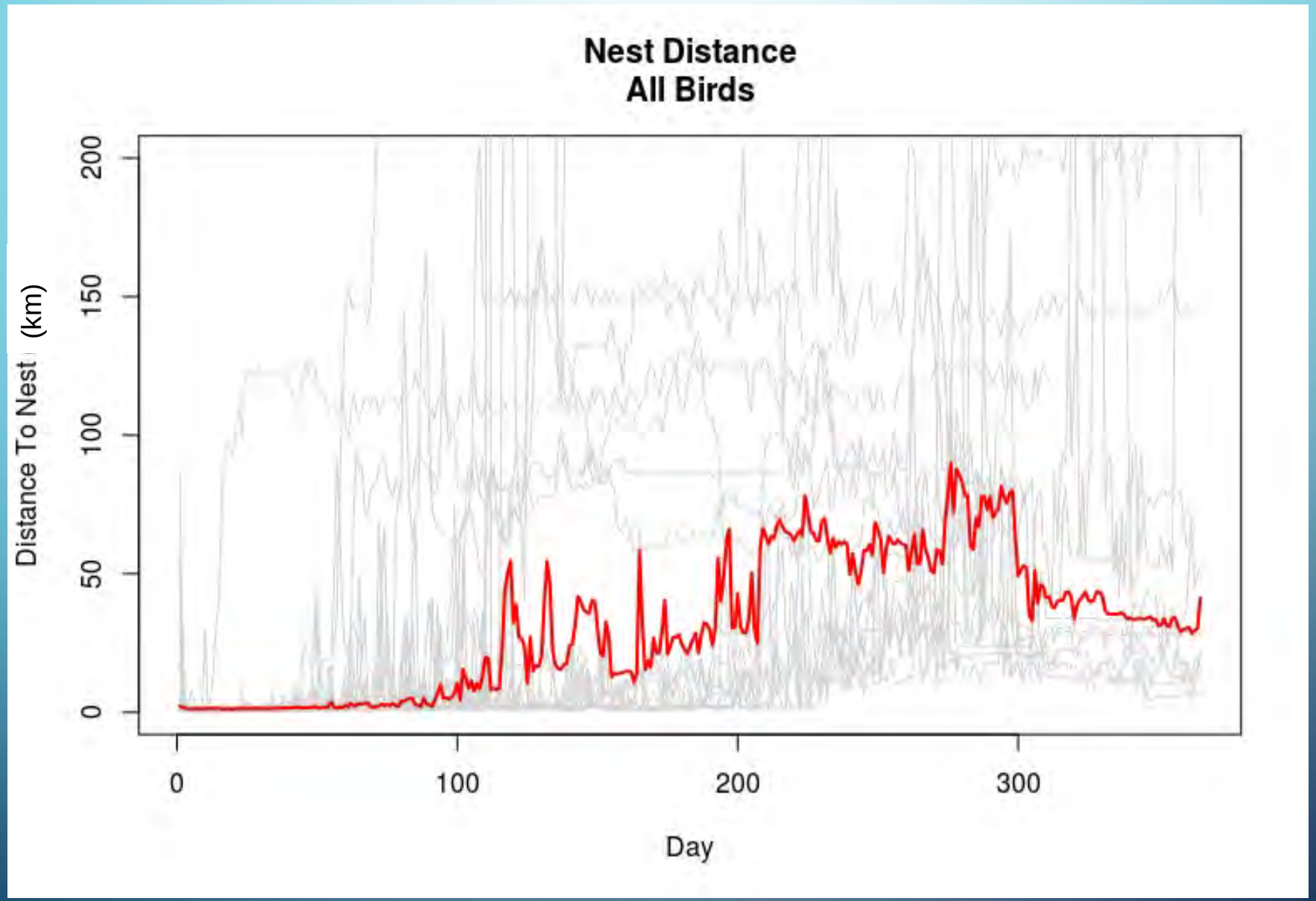


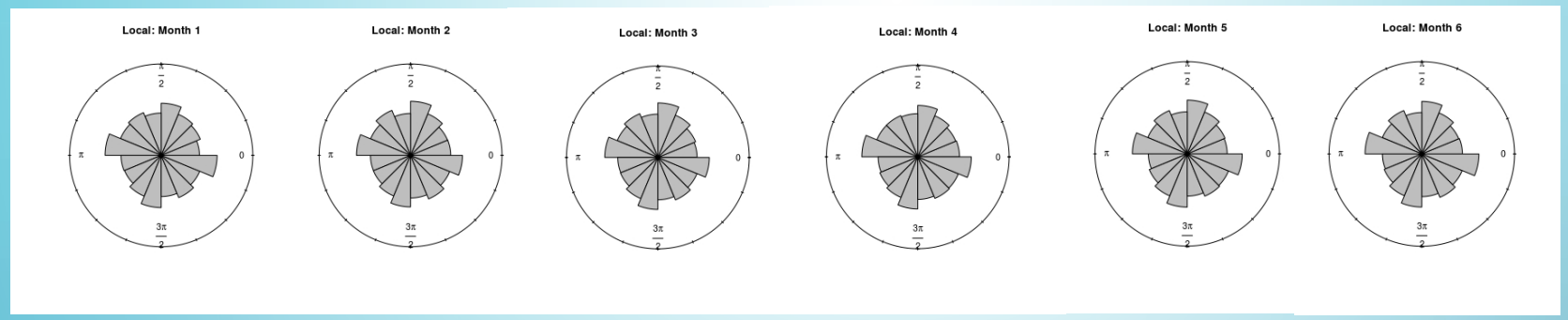
30 USFWS B. Smith
(most nestlings)

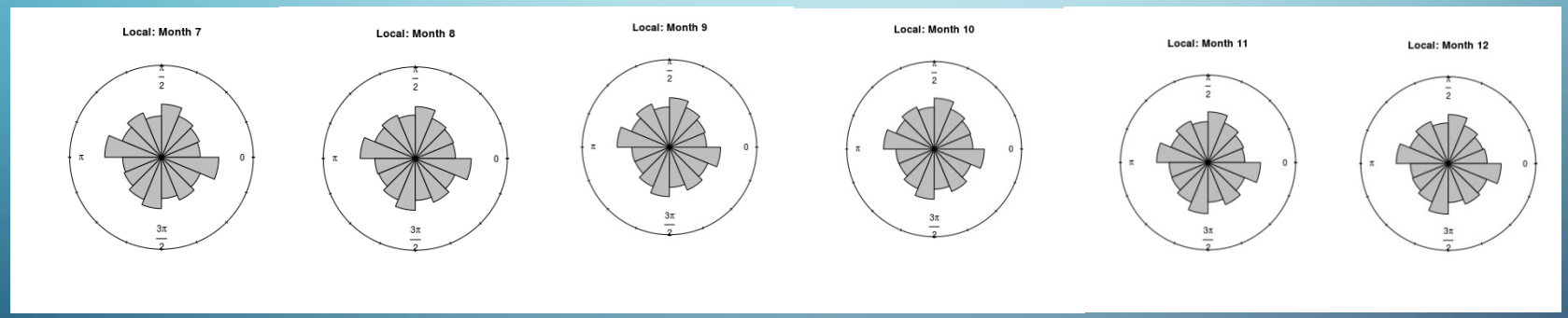
13 E MT
(wintering 1-4yr olds)

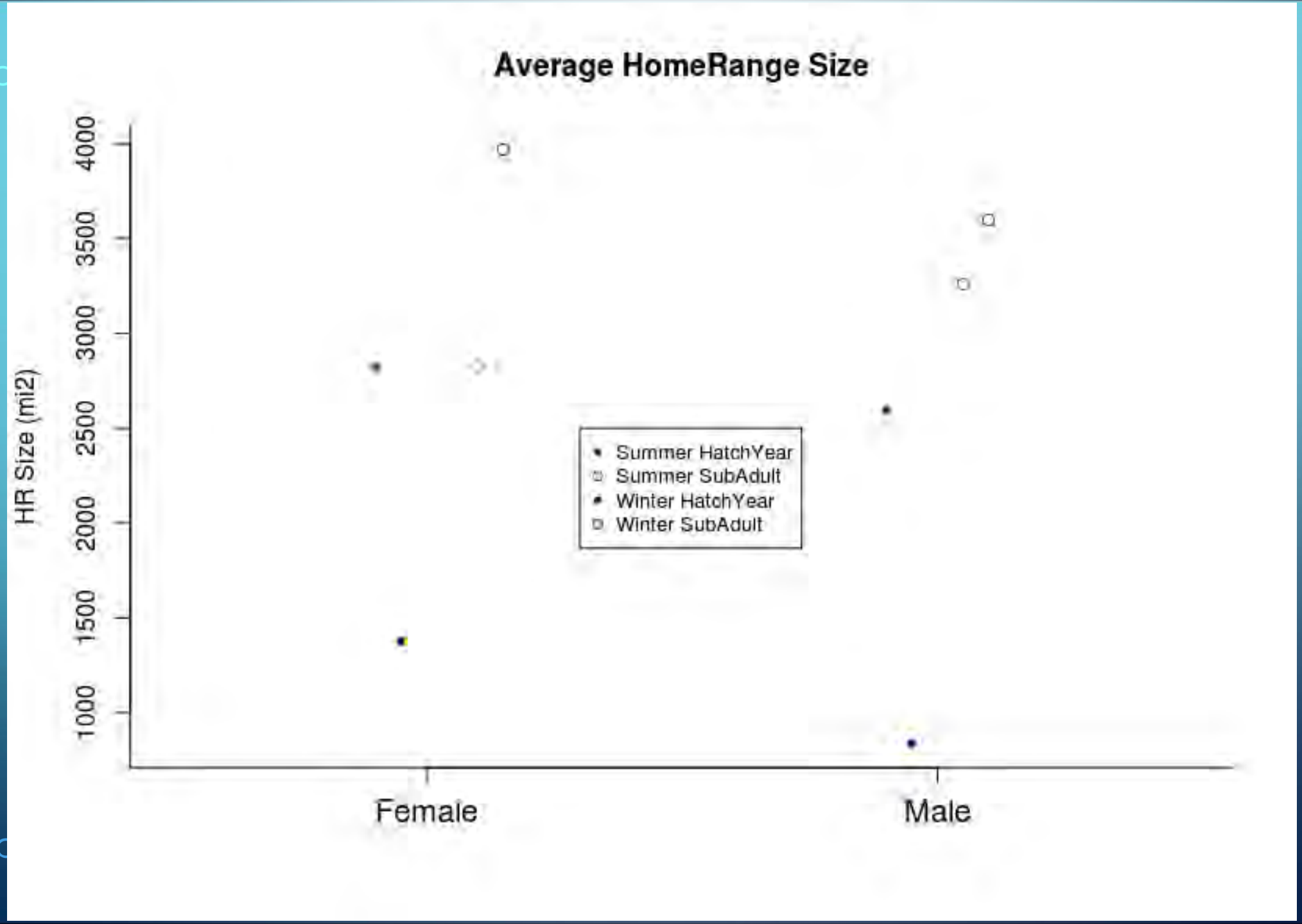
AGE AND SEASON EFFECTS

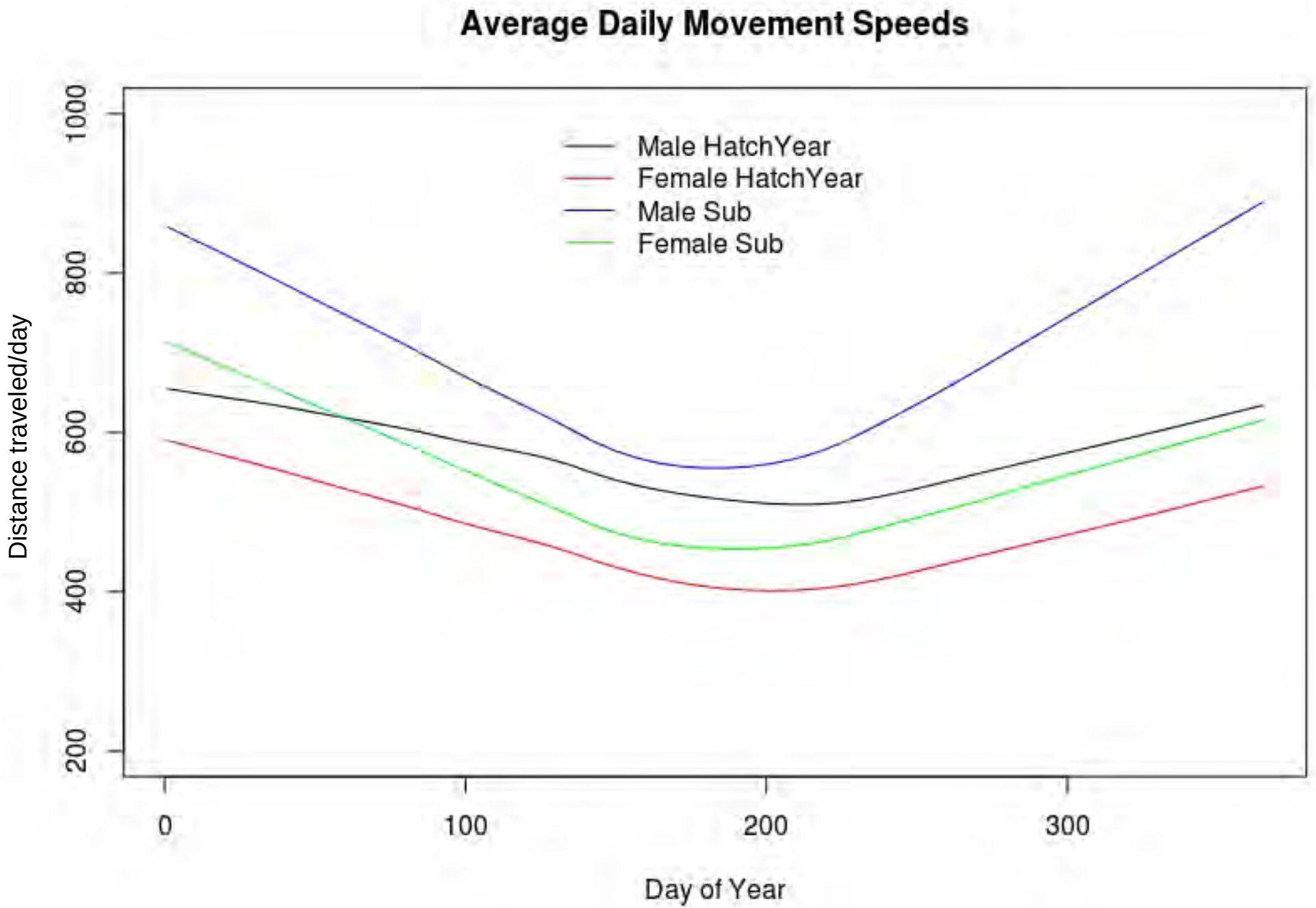
NO DIFFERENCE IN GENDER


Nest Distance
All Birds
Distance To Nest (km)
0
50
100
150
200
0
100
200
300
Day


Local: Month 1
Local: Month 2
Local: Month 3
Local: Month 4
Local: Month 5
Local: Month 6


Local: Month 7
Local: Month 8
Local: Month 9
Local: Month 10
Local: Month 11
Local: Month 12


Average HomeRange Size
HR Size (mi2)
1000
1500
2000
2500
3000
3500
4000
Summer HatchYear
Summer SubAdult
Winter HatchYear
Winter SubAdult
Female
Male


Average Daily Movement Speeds
Male HatchYear
Female HatchYear
Male Sub
Female Sub
Distance traveled/day
200
400
600
800
1000
0
100
200
300
Day of Year

Resource Selection Modeling

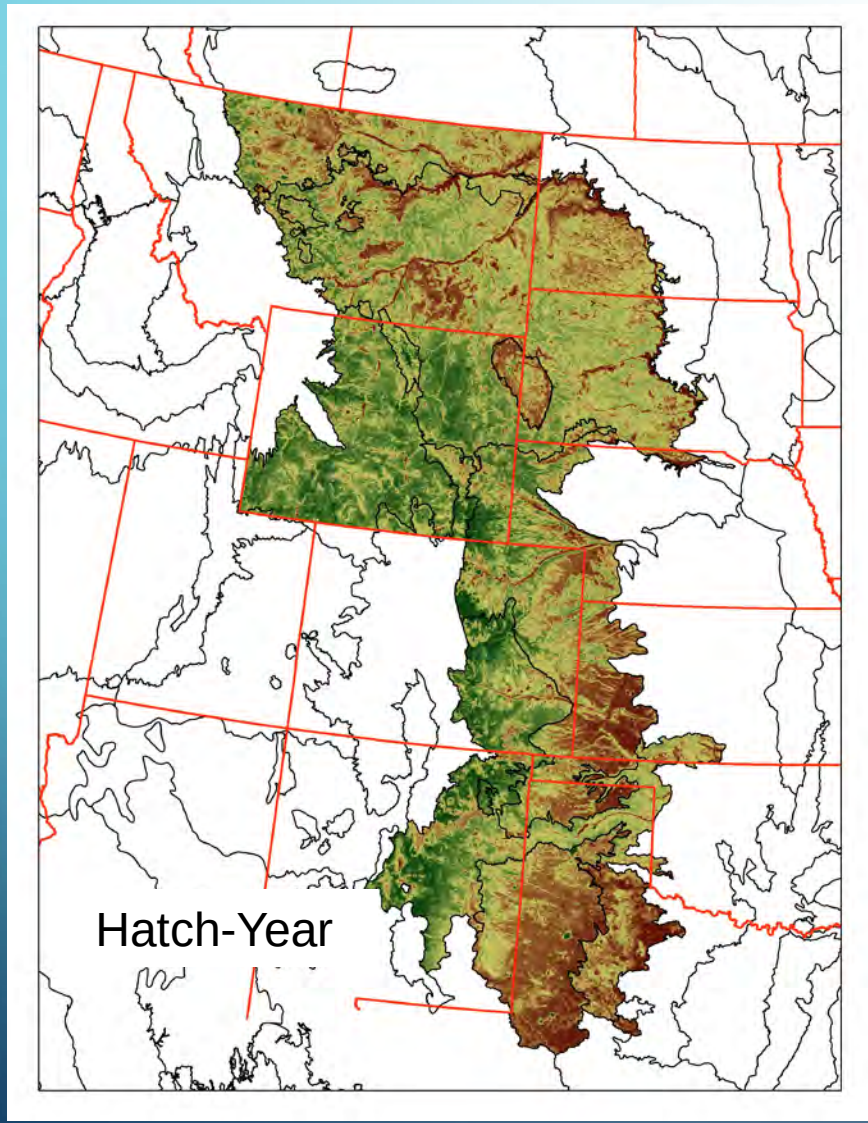
Use-availability Design

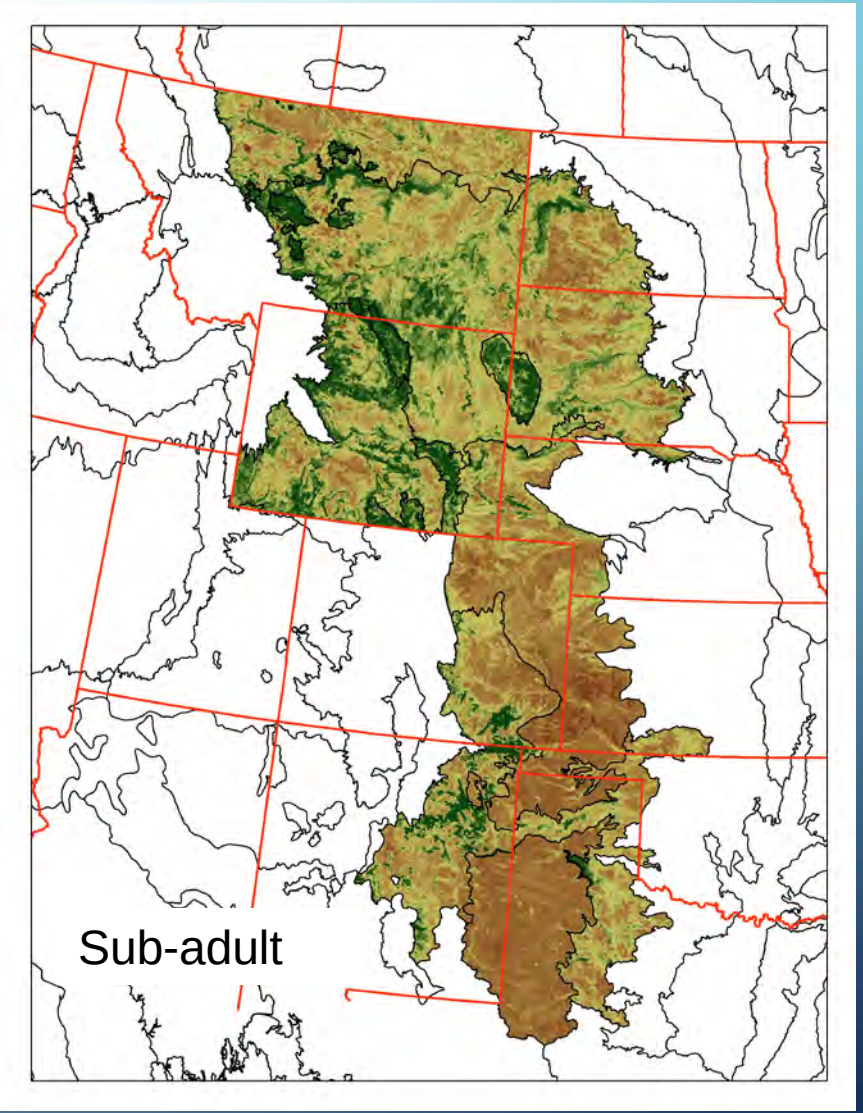
Cross-fold Validation

>100 potential covariates

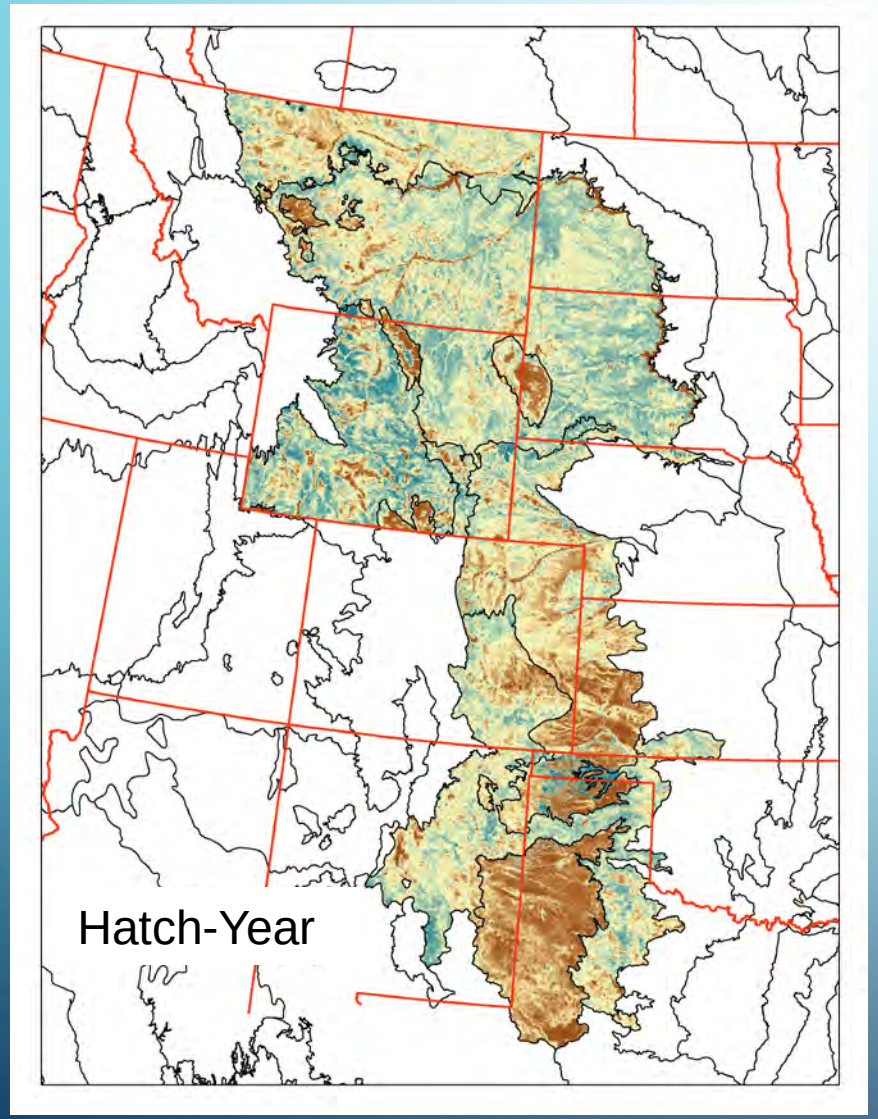
30m, 120m, 1000m, 2000m, scales

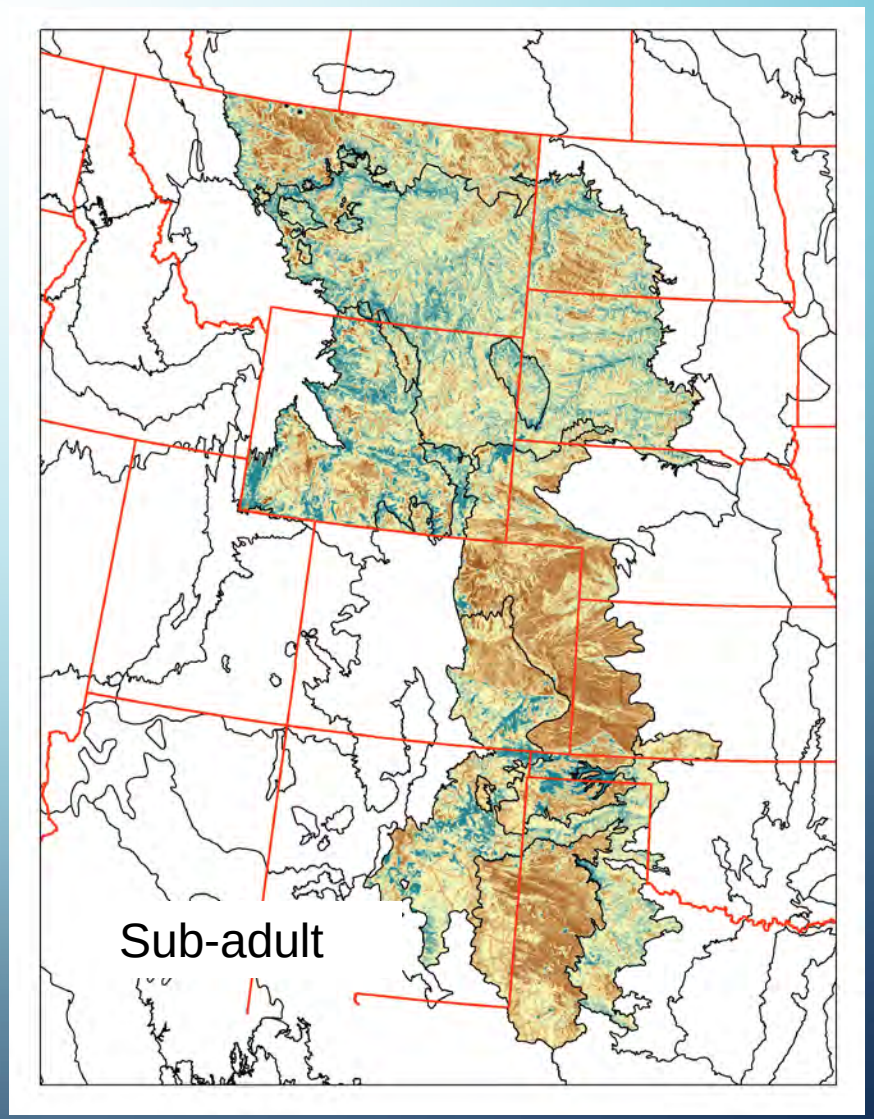
Summer Models



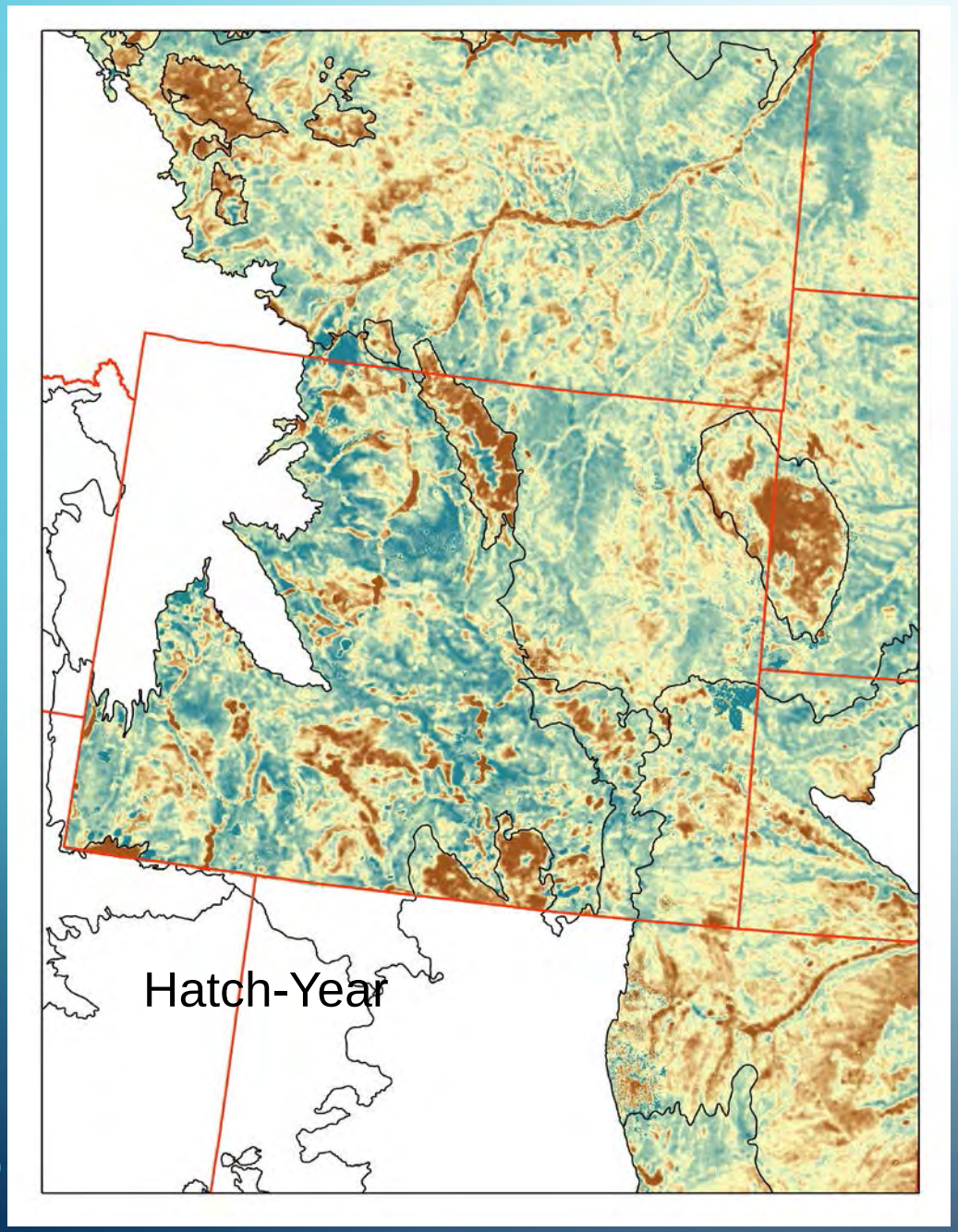


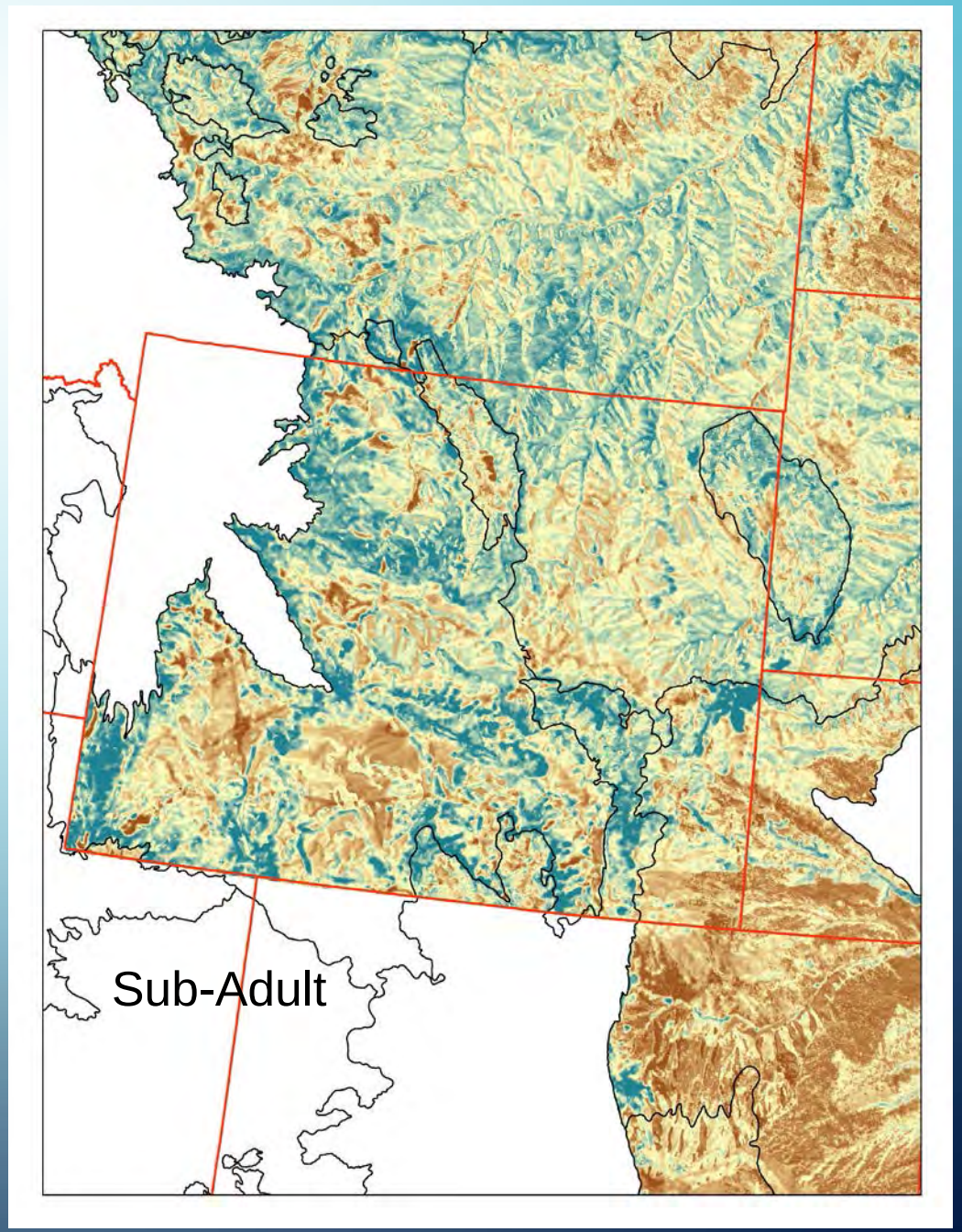
Winter Model

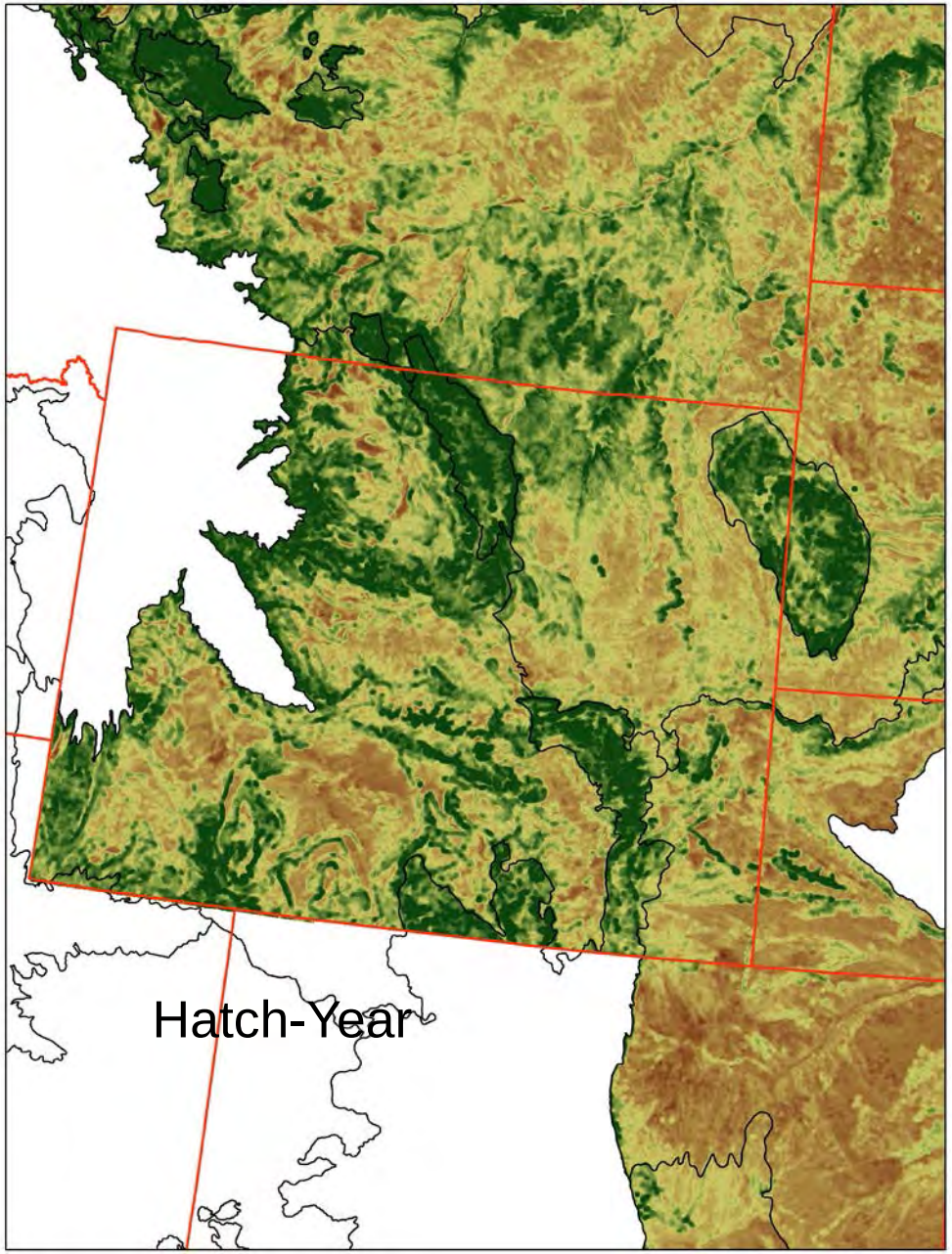


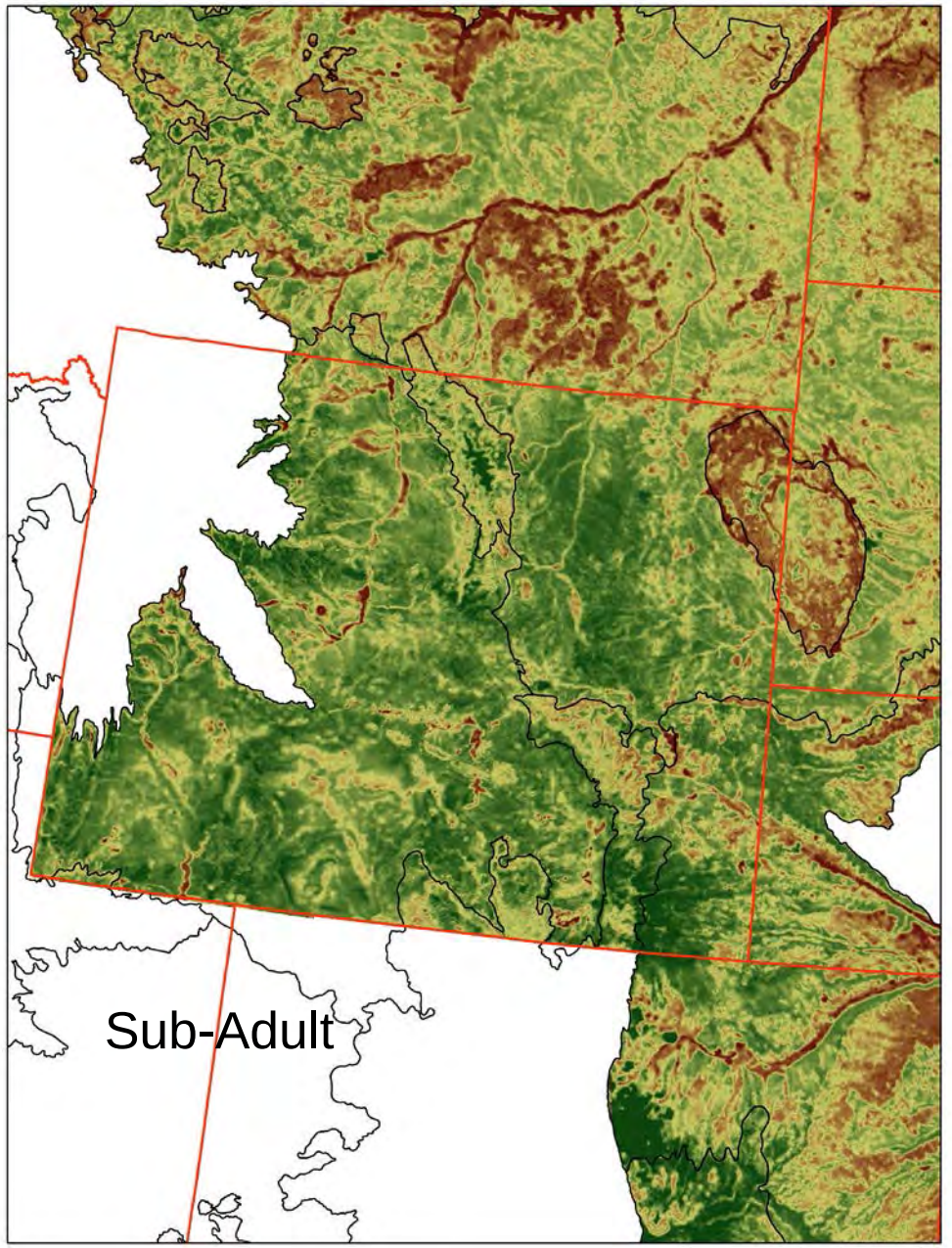


Model Covariates


Hatch-Year


Sub-Adult


Hatch-Year


Sub-Adult

Acknowledgments

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Ross Crandall

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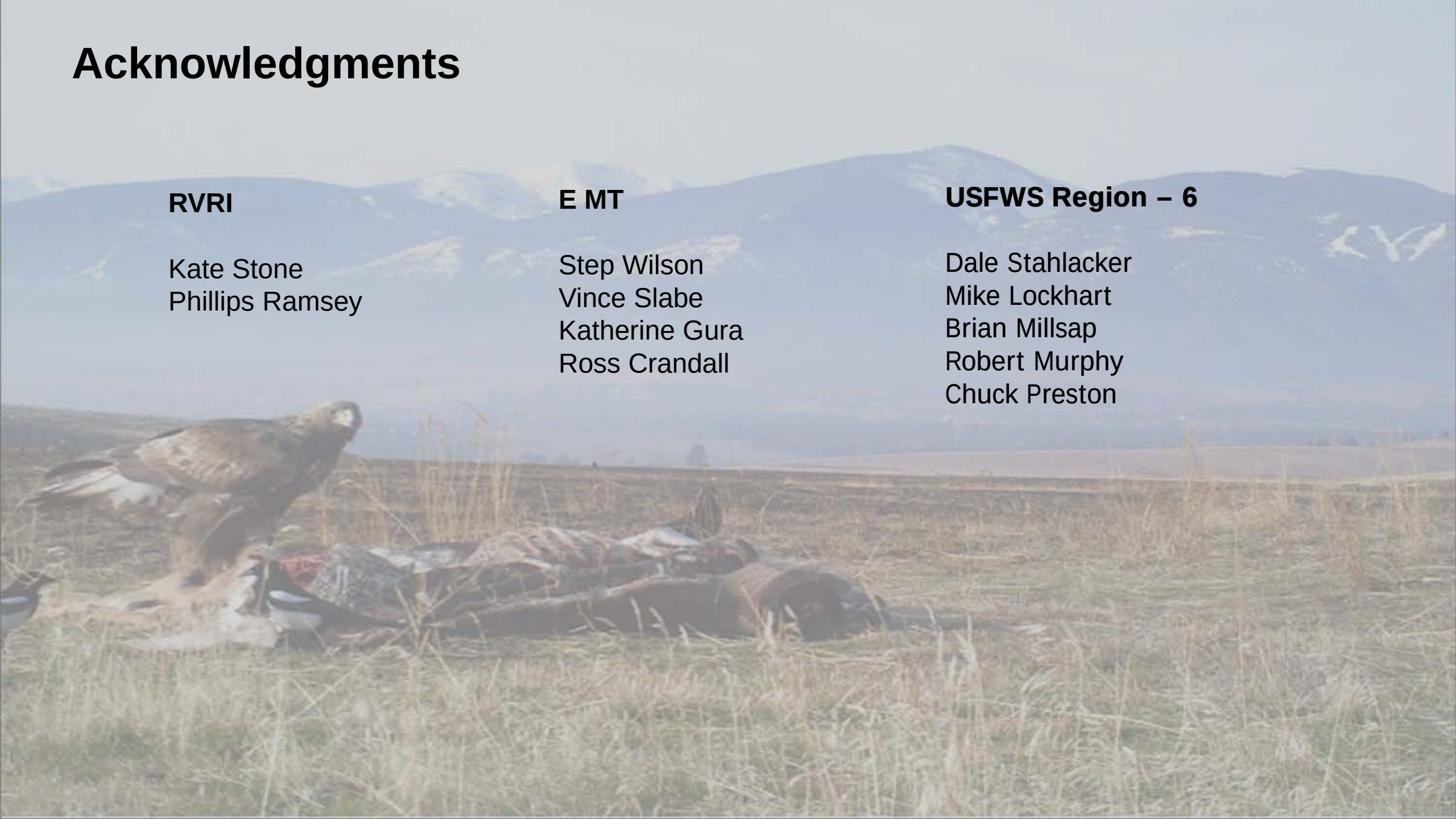
Robert Murphy
Chuck Preston



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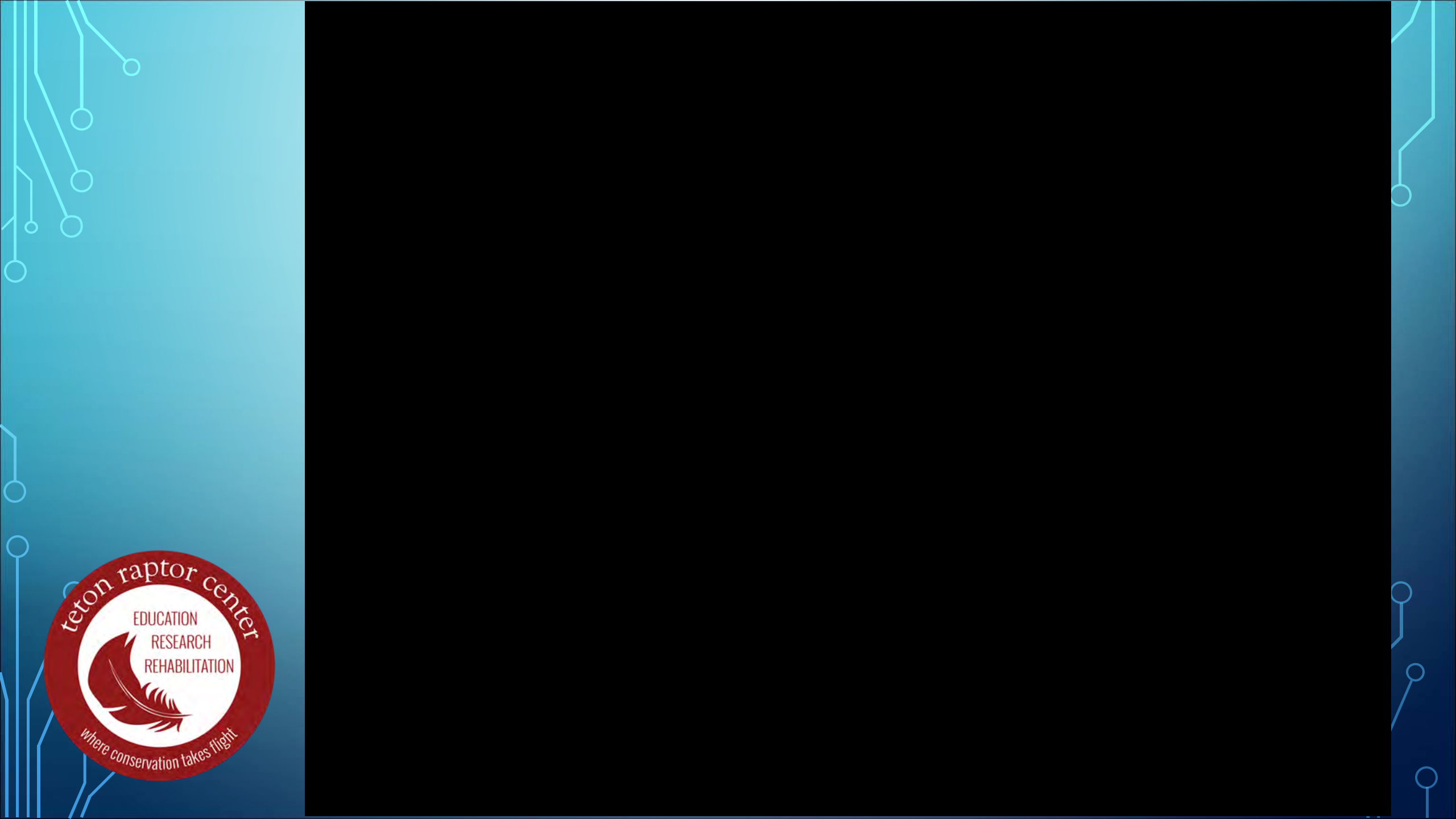
Bird Conservancy of the Rockies
BLM
Charlotte Martin Foundation
Cinnabar Foundation
Craighead Beringia South
Denver International Airport
Duke Energy Renewables
Fanwood Foundation
Five Valleys Audubon
Fledgling Fund
Helena National Forest
Koret Foundation
LCAO Foundation
Llwellyn Foundation
Maki Foundation
Montana Fish, Wildlife and Parks Mountaineers Foundation
Nebraska Game & Parks Commission
Oklahoma State University
Patagonia
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Sirtrack
Nature Conservancy
MPG Ranch
Thunder Basin National Grasslands
University of Montana
USDA Wildlife Services
USDA-ARS Central Plains Experimental Range
USFWS
Walker Family Trust
Yellowstone to Yukon