

# Modeling Seasonal Distribution and Density of Golden Eagles in the Western U.S. to Support Conservation Planning and Risk Assessment



*Step da Right*



**Brian Woodbridge, Coordinator**  
**Western Golden Eagle Conservation Team**  
**U.S. Fish and Wildlife Service, Corvallis, OR**

# Goals and Objectives

- **Provide risk assessment and decision support tools for renewable energy development and mitigation**
- **Develop landscape-scale strategies for Golden Eagle conservation**



# Breeding Areas



# Movement & Migration Routes

# Wintering Areas



Photo: Brian Woodbridge

# I. Predictive Models of Golden Eagle Breeding Habitat



# Modeling Approach

10/12/2014

11/6/2014

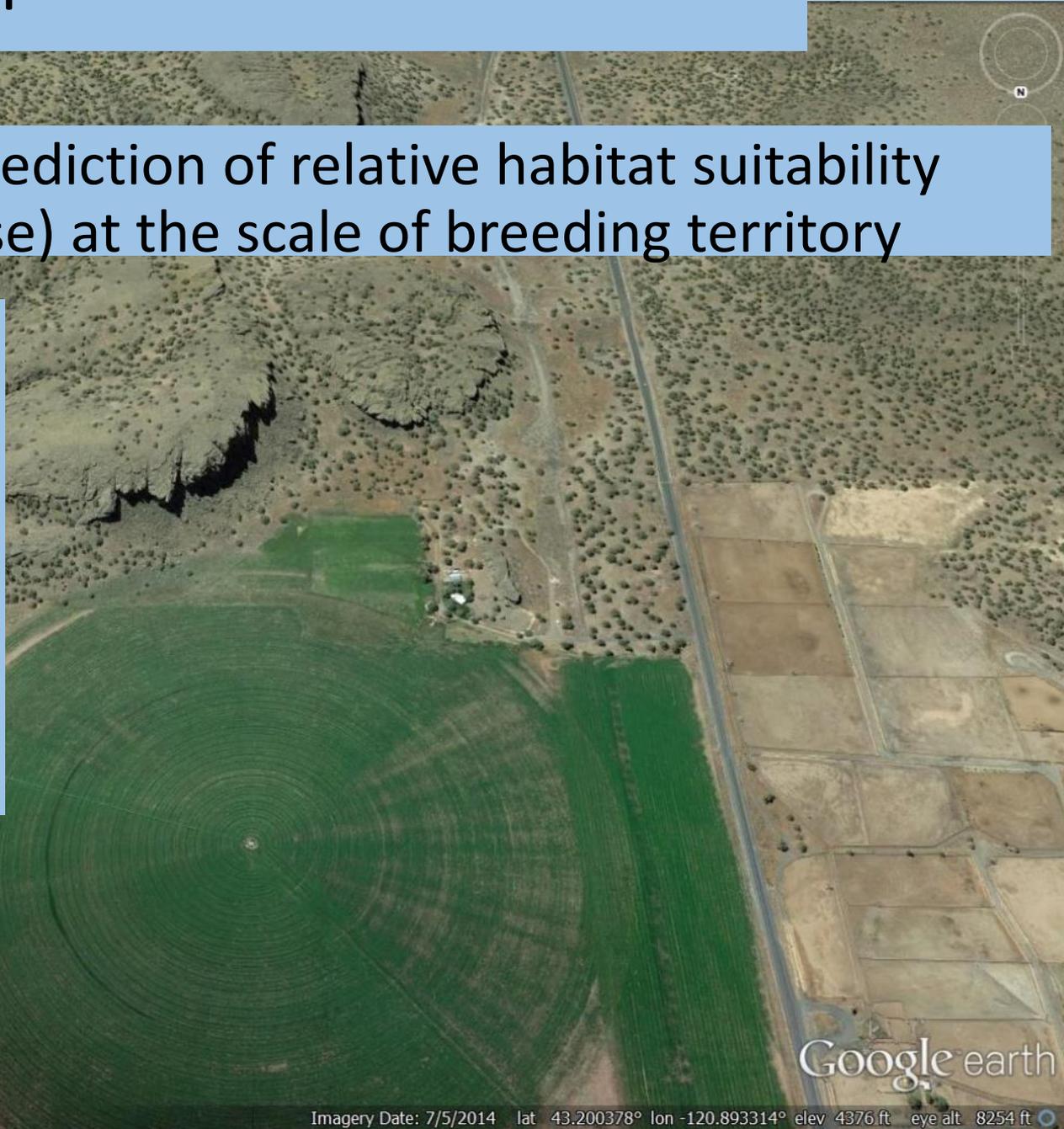
Objective: Reliable prediction of relative habitat suitability (relative density of use) at the scale of breeding territory

## Ecoregion-specific

### Species Distribution Models

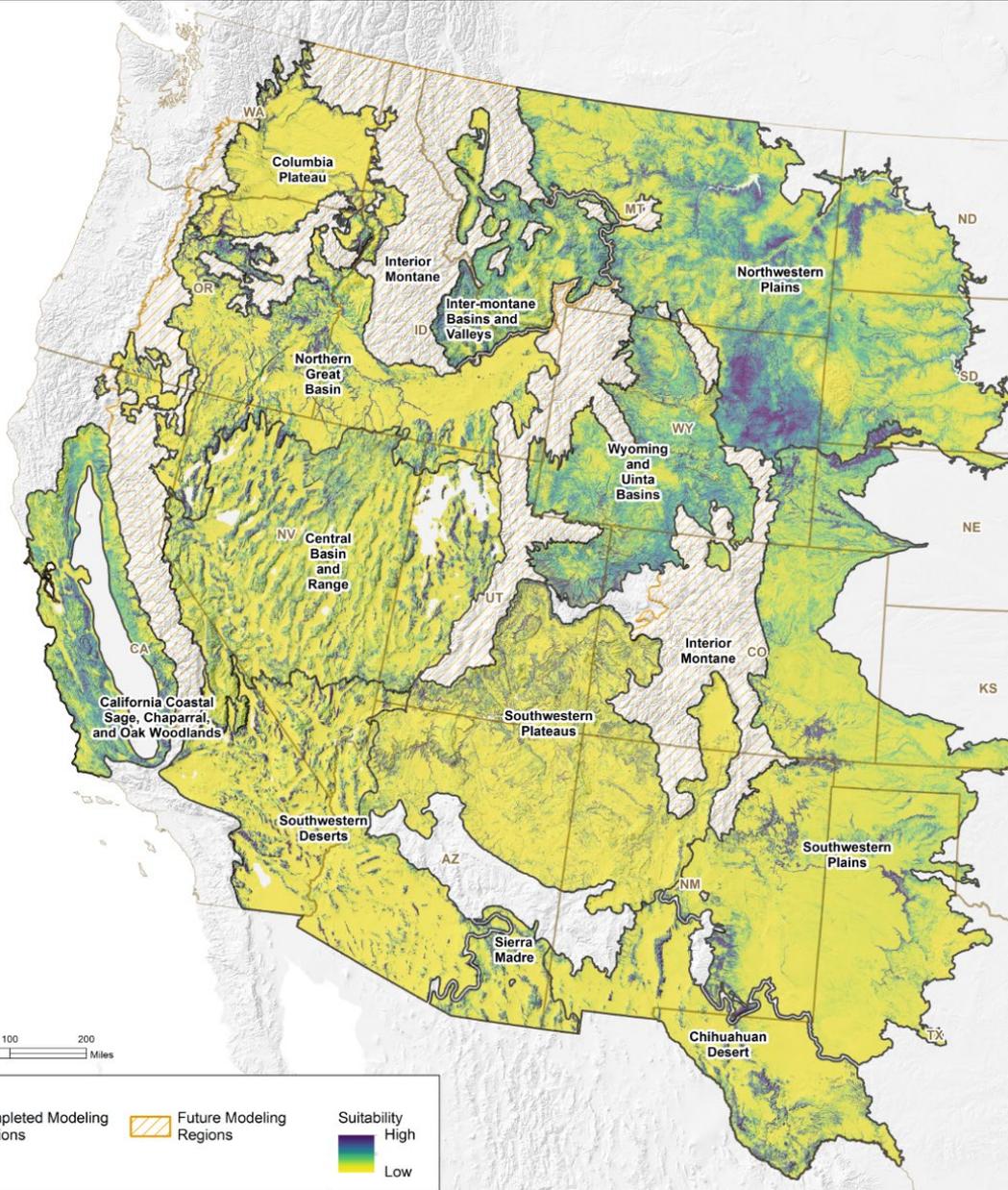
#### Environmental variables:

- terrain, aspect, elevation
- land cover
- primary productivity (NDVI)
- climate
- anthropogenic features
- orographic uplift, thermals



# Golden Eagle Breeding Habitat

## Model Regions



- Northwestern Plains
- Wyoming and Uinta Basins
- Central Basin and Range
- Northern Great Basin
- Columbia Plateau
- Southwestern Plains
- Southwestern Deserts
- Intermontane Basins and Valleys
- California Foothills
- Southwestern Plateaus
- Chihuahuan Desert\*
- Forested Montane\*

\*In development

# Central Basin and Range

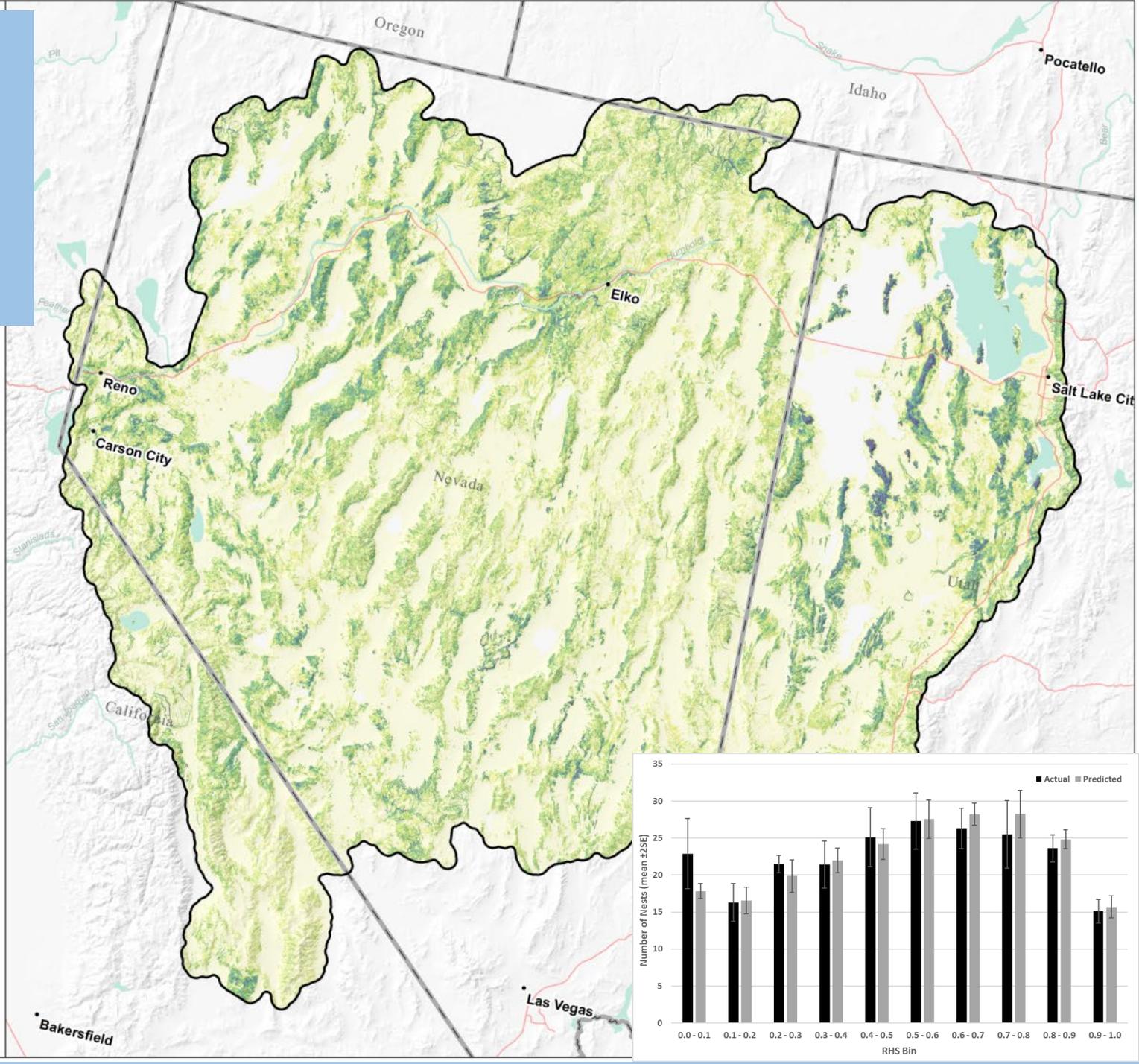
- 13,321 nest records
- 902 selected

## LEGEND

- Major Cities
- State Boundaries
- Highways
- Major Rivers
- Waterbodies
- ▭ CBRA modeling region

## CBRA\_v02 RND

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1.0



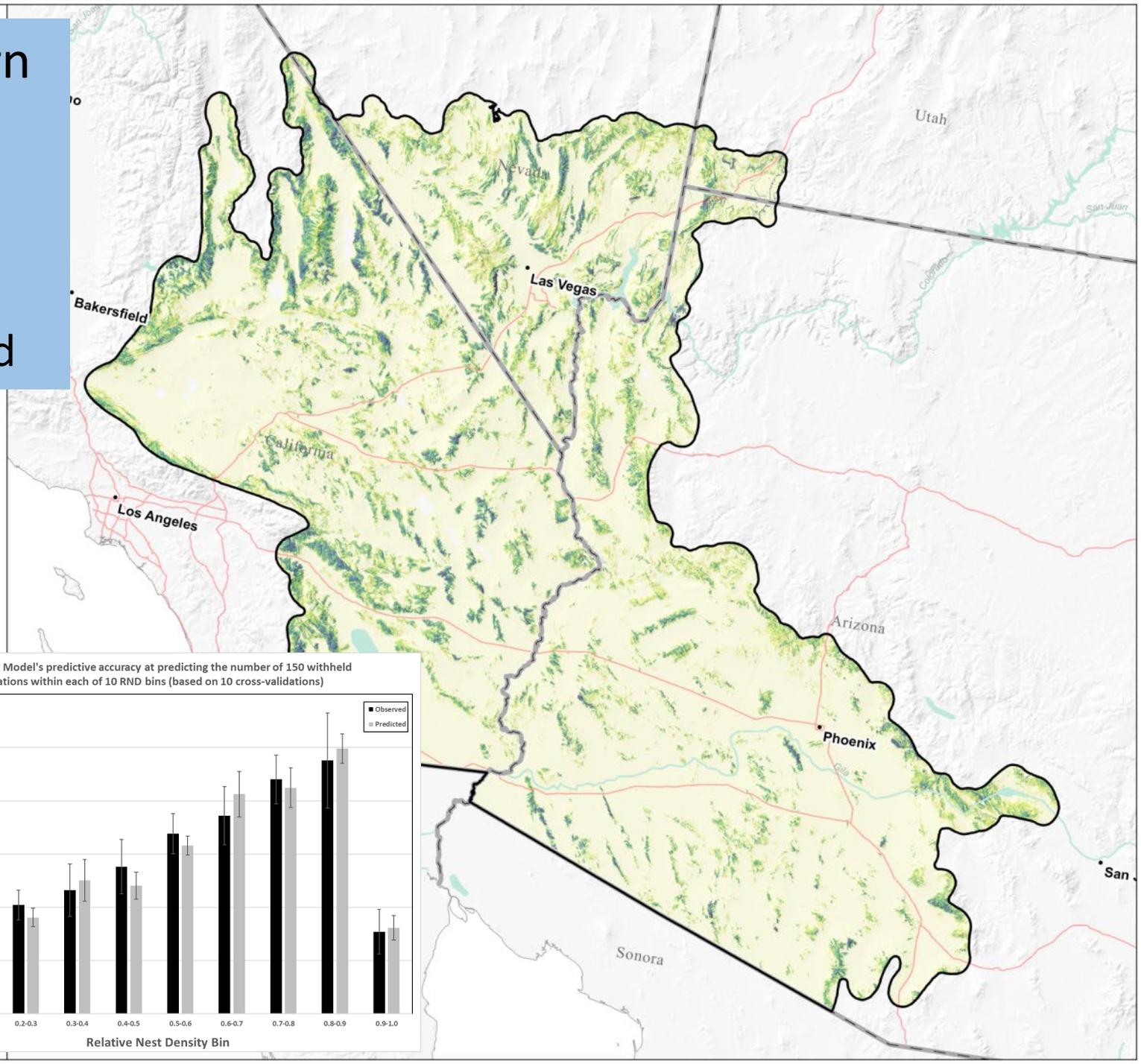
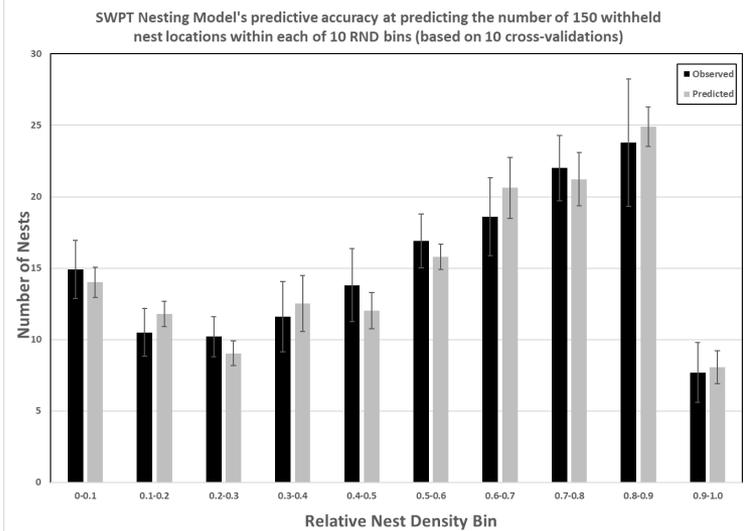
# Southwestern Deserts

- 1,096 nest records
- 288 selected

- Major Cities
- State Boundaries
- Highways
- Major Rivers
- Waterbodies
- SWDE modeling region

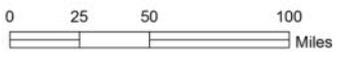
## SWDE\_v01 RND

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1.0



RELATIVE NEST DENSITY

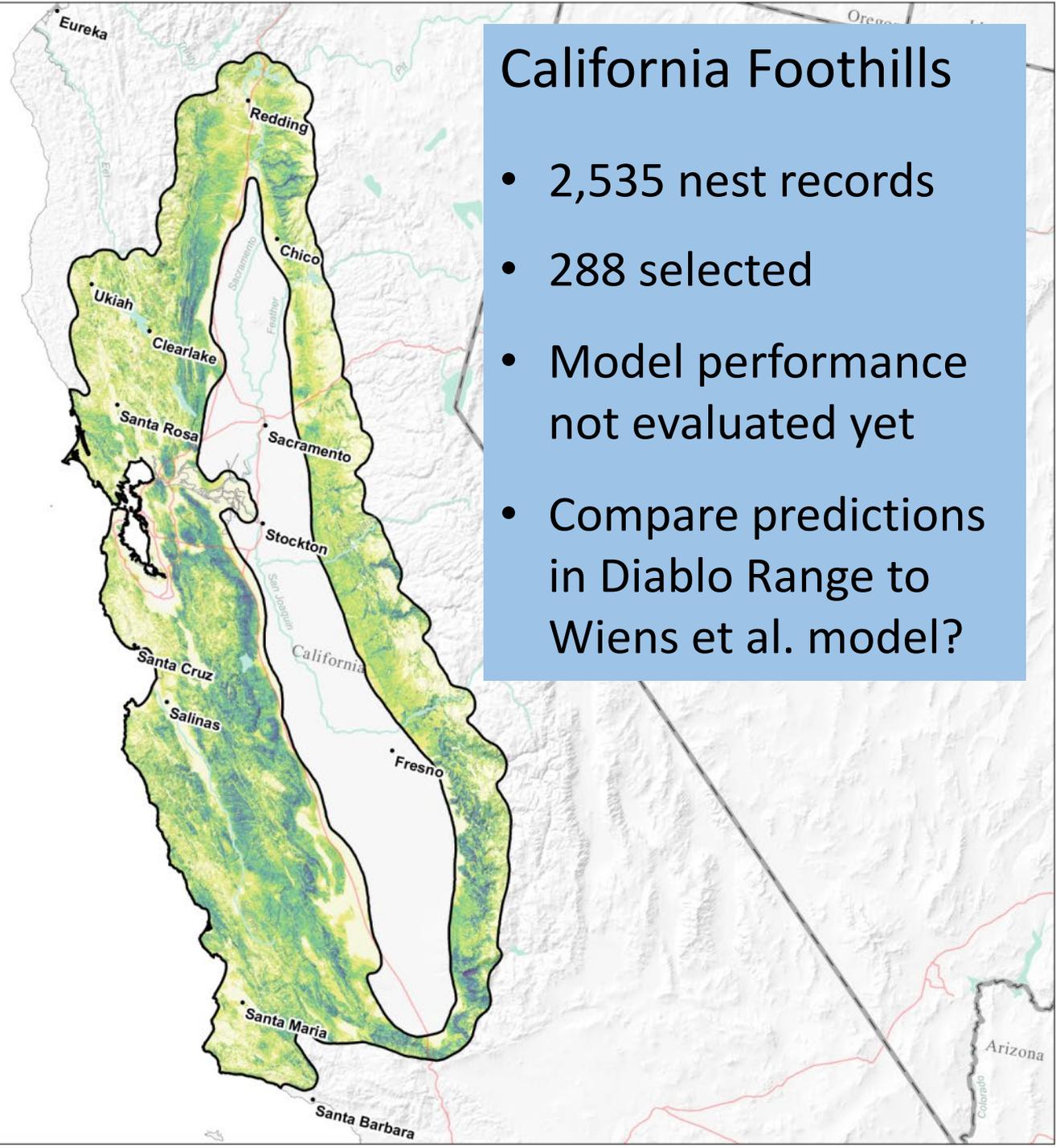
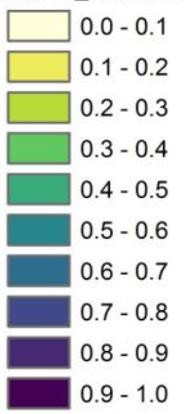
CBRA  
CENTRAL BASIN AND RANGE



LEGEND

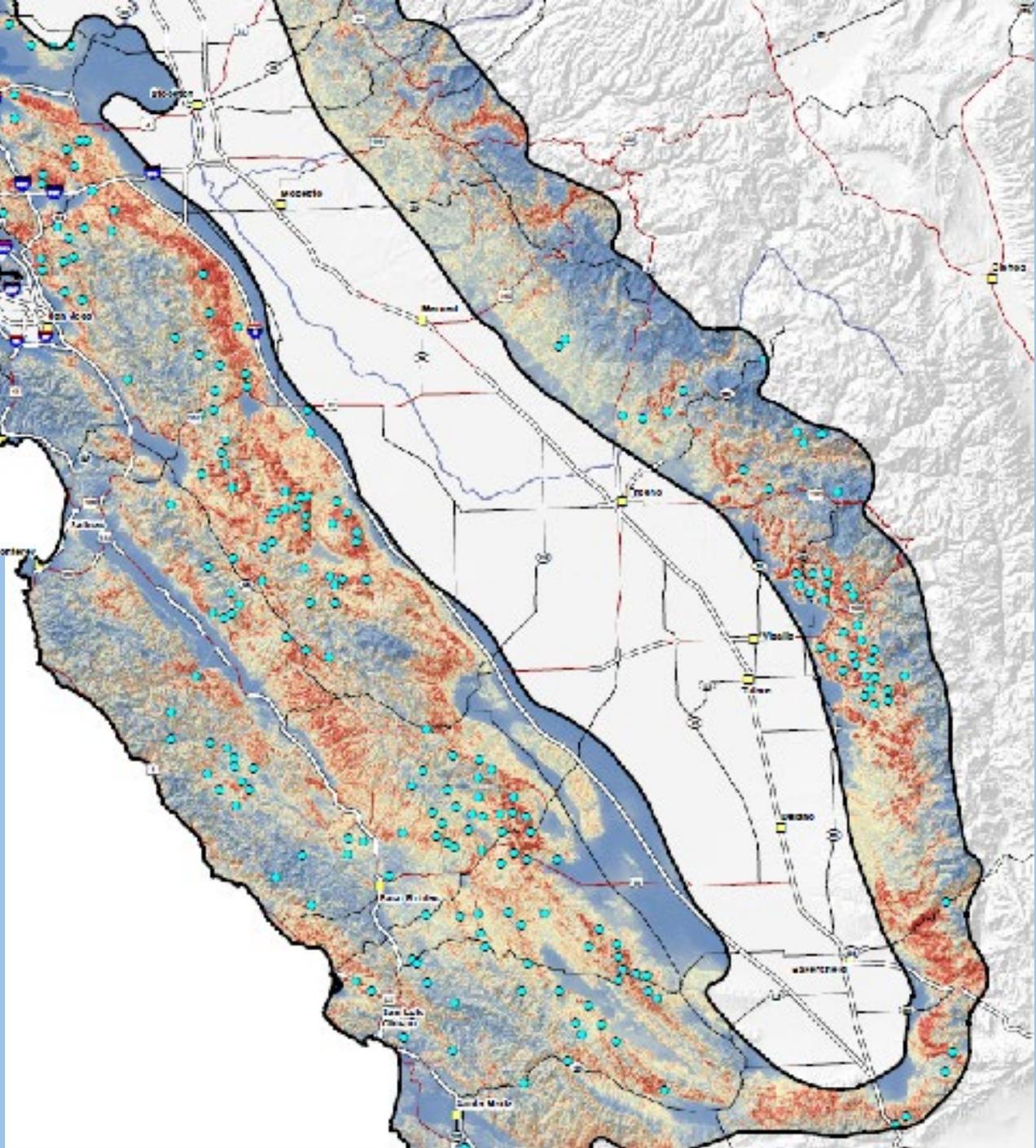
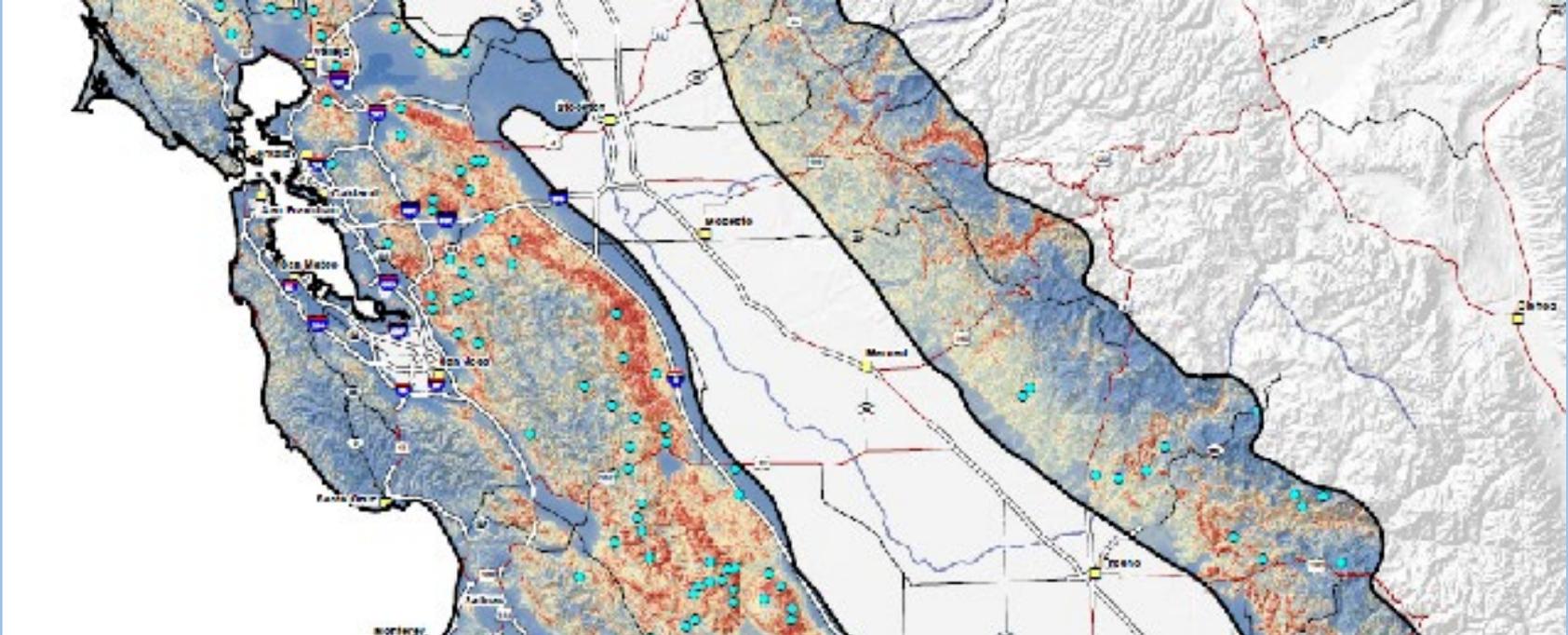
- Major Cities
- State Boundaries
- Highways
- Major Rivers
- Waterbodies
- CAFO modeling region

CAFO\_v01 RND



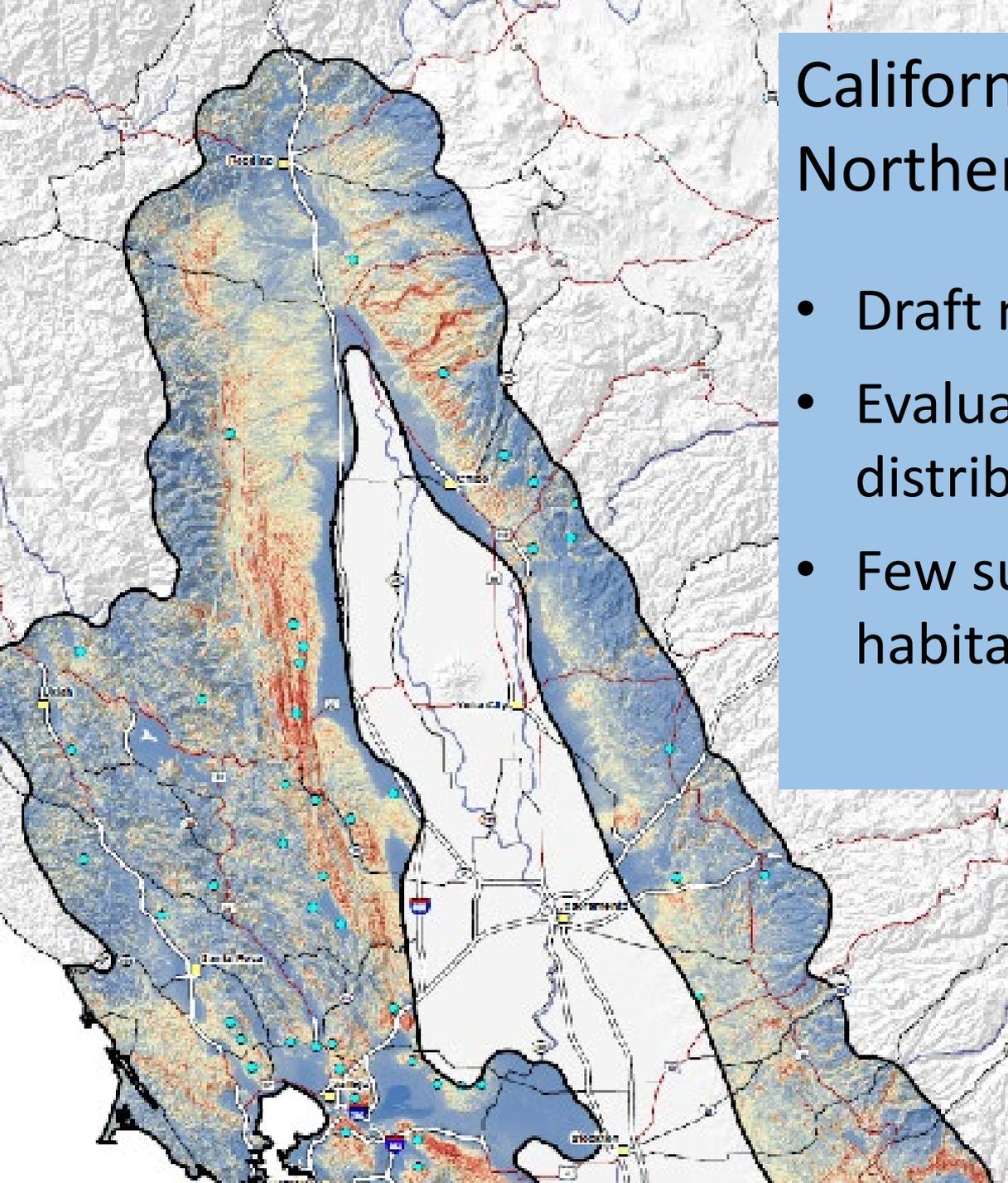
# California Foothills

- 2,535 nest records
- 288 selected
- Model performance not evaluated yet
- Compare predictions in Diablo Range to Wiens et al. model?



## California Foothills Southern portion

- Draft model under review
- Nest data distribution clumped in project survey areas



## California Foothills Northern portion

- Draft model under review
- Evaluate nest data distribution
- Few surveys in forested habitats



*Sky de Light*

# Predictive Models of Golden Eagle Movements and Migration

# Objectives -

- ❑ **Step 1: Compile and analyze telemetry data (ARGOS, GPS, GSM) from cooperators throughout North America**
- ❑ **Step 2: Predictive models of movement ‘habitat’**
  - Describe and map patterns of movement
  - Focus on landscapes and ecological conditions disproportionately used for movement and migration



Photo: Sky Delite

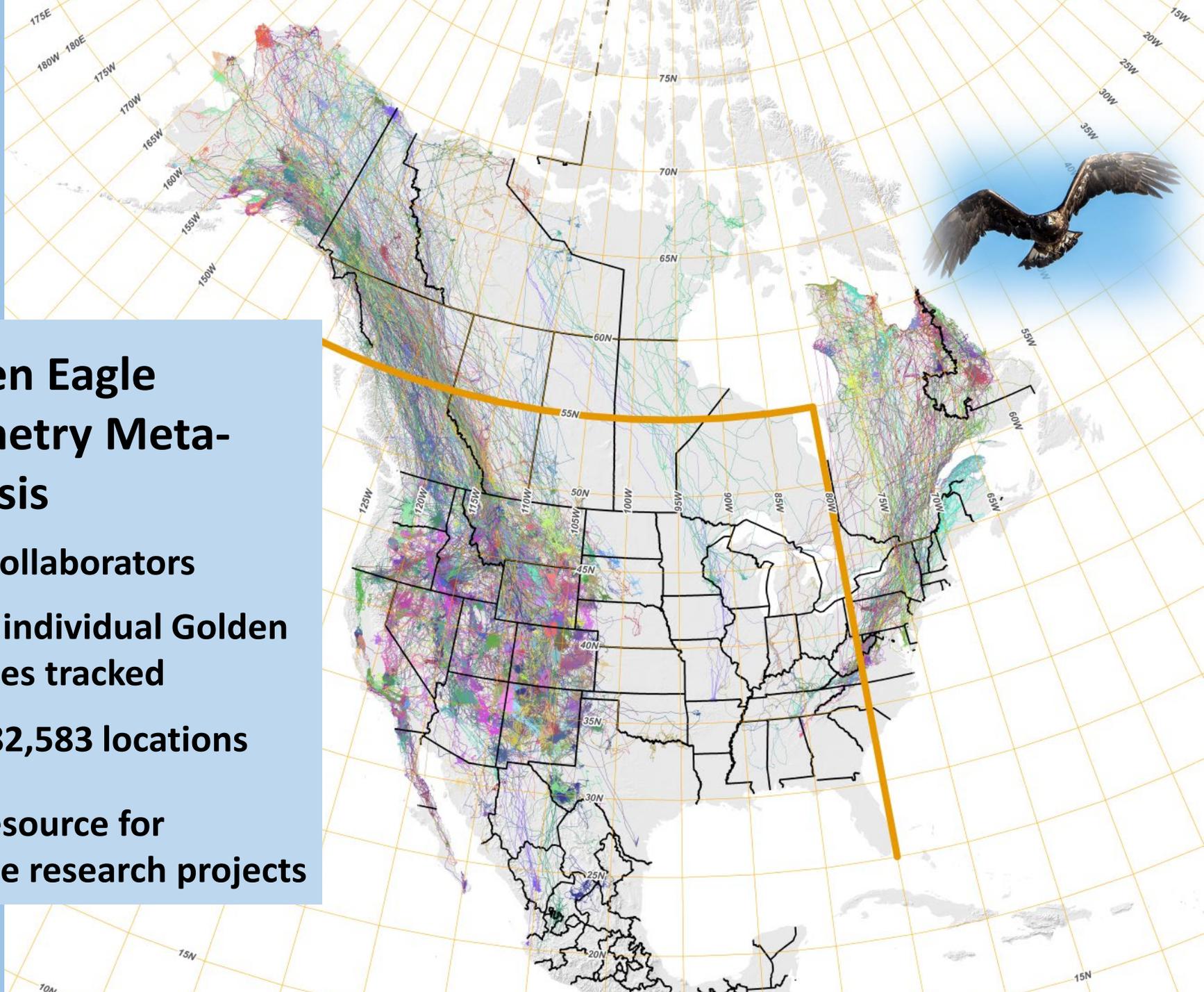
## **Core Team:**

Jessica Brown – U. Nevada, Reno  
Dave LaPlante – NRG  
Todd Katzner – USGS  
Robert Murphy – USFWS  
Todd Lickfett – USFWS  
Carol McIntyre – NPS  
Brian Woodbridge – USFWS

# Golden Eagle Telemetry Meta- analysis

- 32 collaborators
- 950 individual Golden Eagles tracked
- 7,782,583 locations

Data resource for  
multiple research projects



## **Collaborators** (AKA “Circle of Heroes”; Kochert 2015)

### **CA/NV area -**

Doug Bell - East Bay Parks

Todd Katzner - USGS

Robert Fisher - USGS

Mark Fuller - USGS

Steve Slater - Hawkwatch Int.

Steve Lewis - Alaska Dept. Fish & Game

Joe Barnes - Nevada Dept. of Wildlife

Dave Bittner - WRI

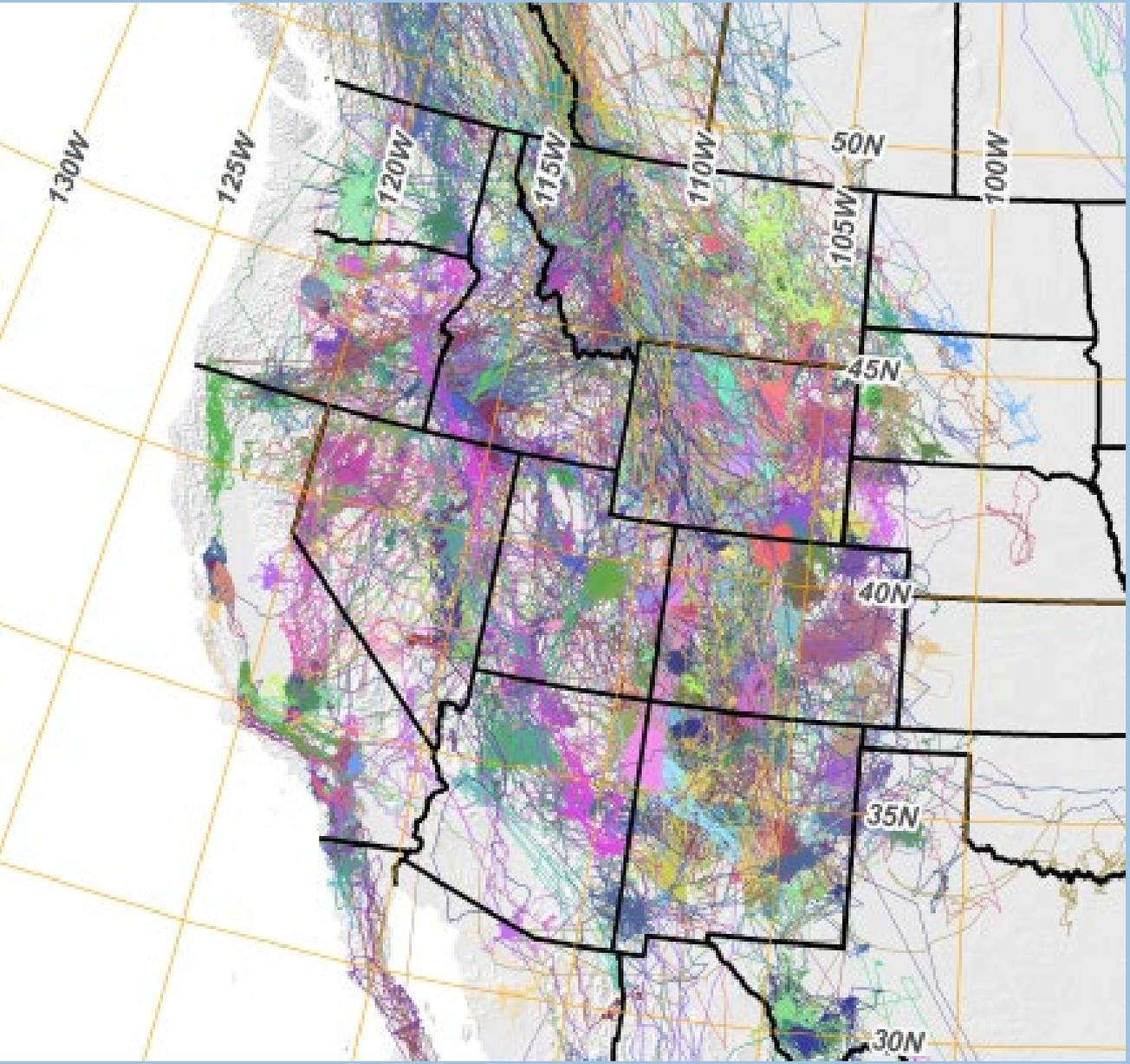
Eric Hollingstad - WEST

Ken Jacobson - Arizona Dept. Game & Fish

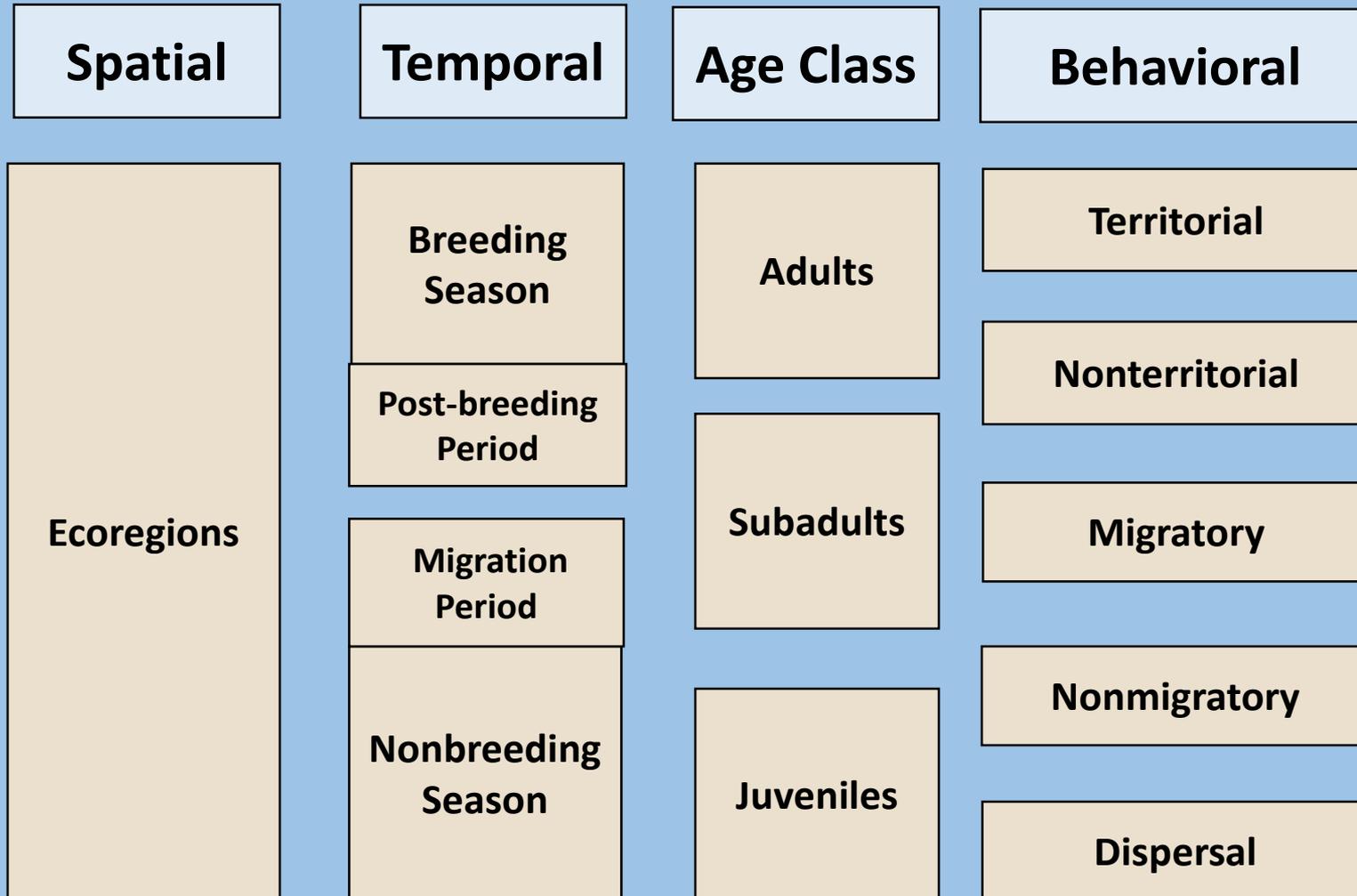
Amy Fesnock - BLM

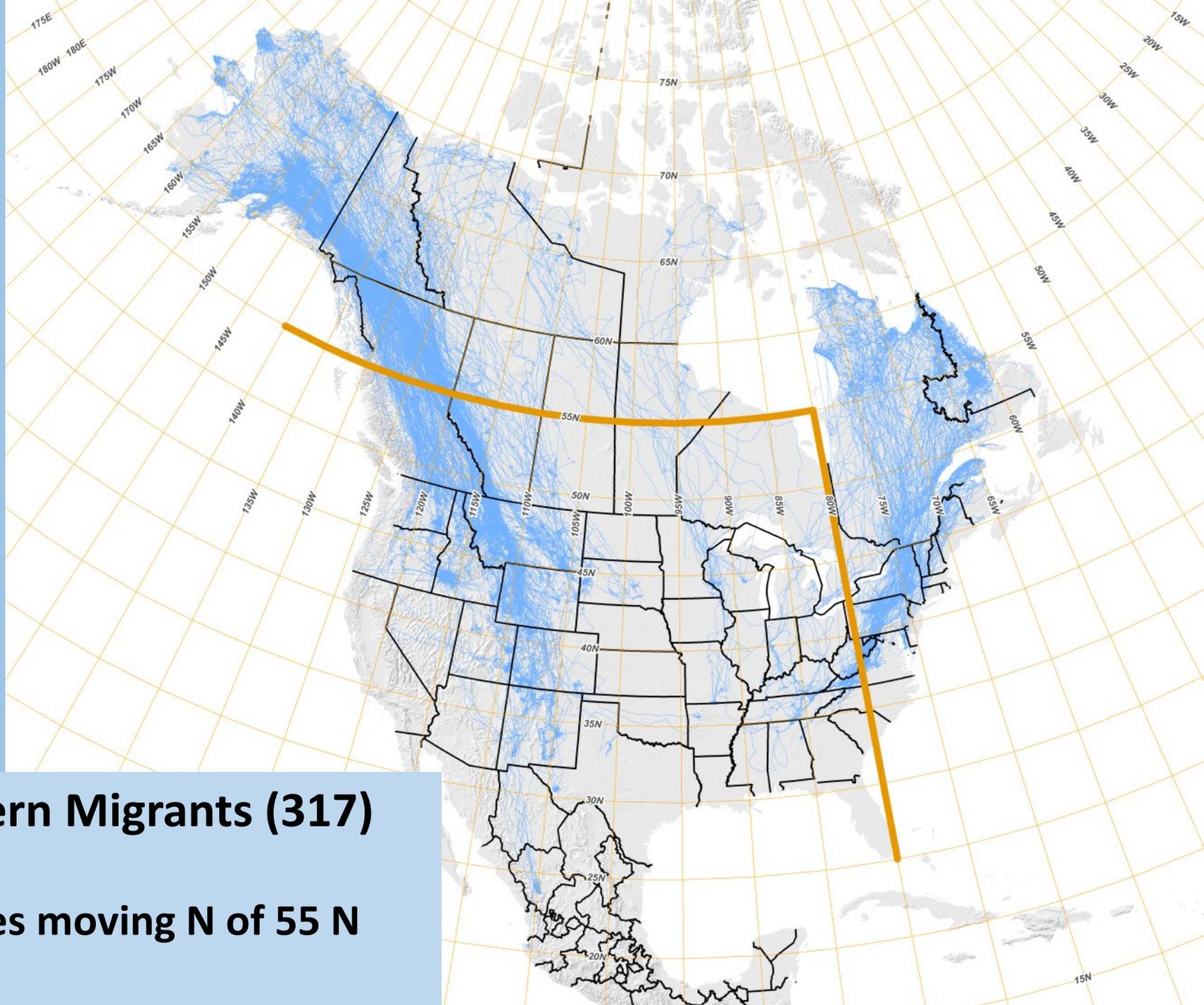
Mike Yates - Earth Span

Western Golden Eagle Team - USFWS



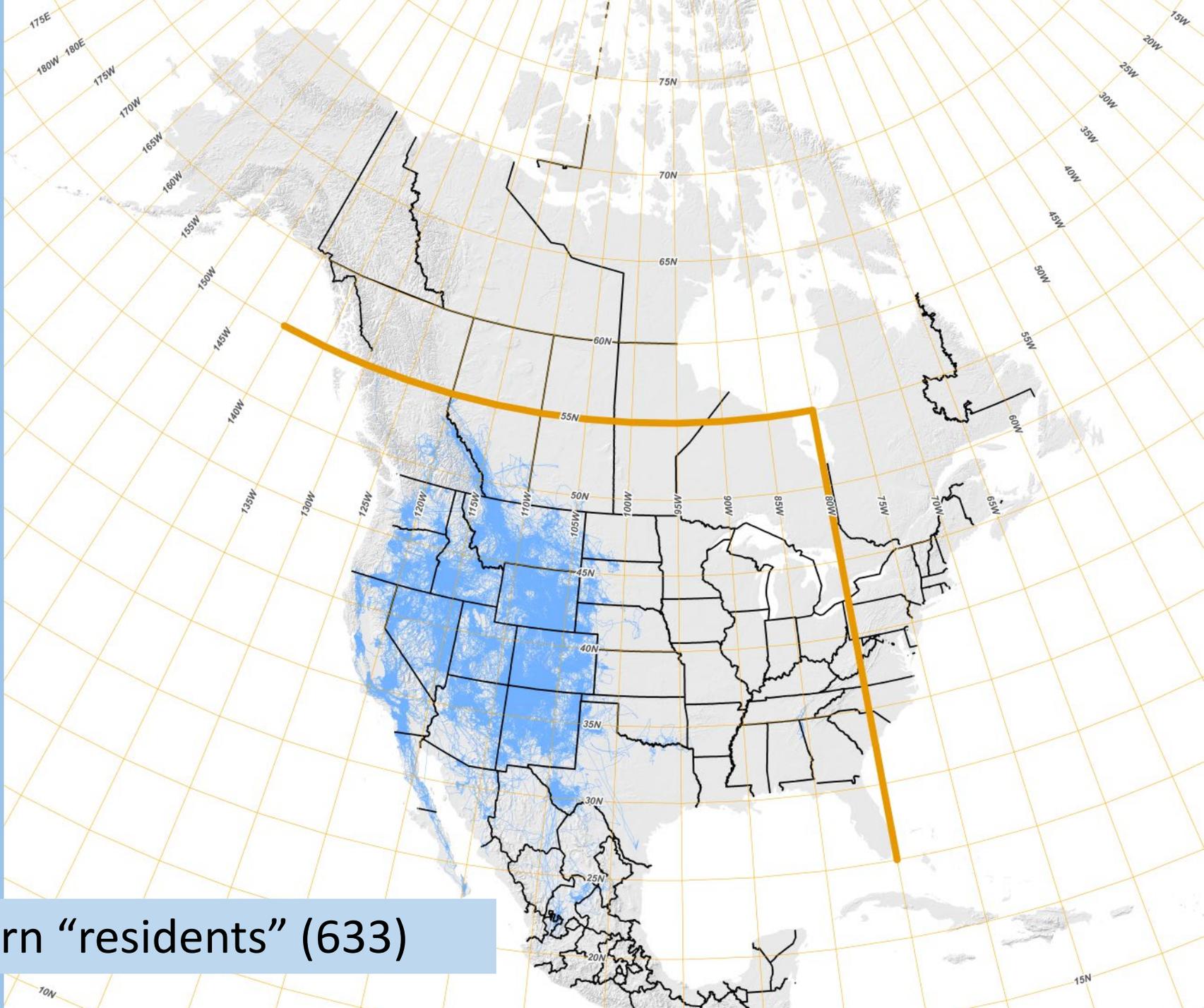
# Factors influencing distribution and habitat use of Golden Eagles





## Northern Migrants (317)

- Eagles moving N of 55 N lat.



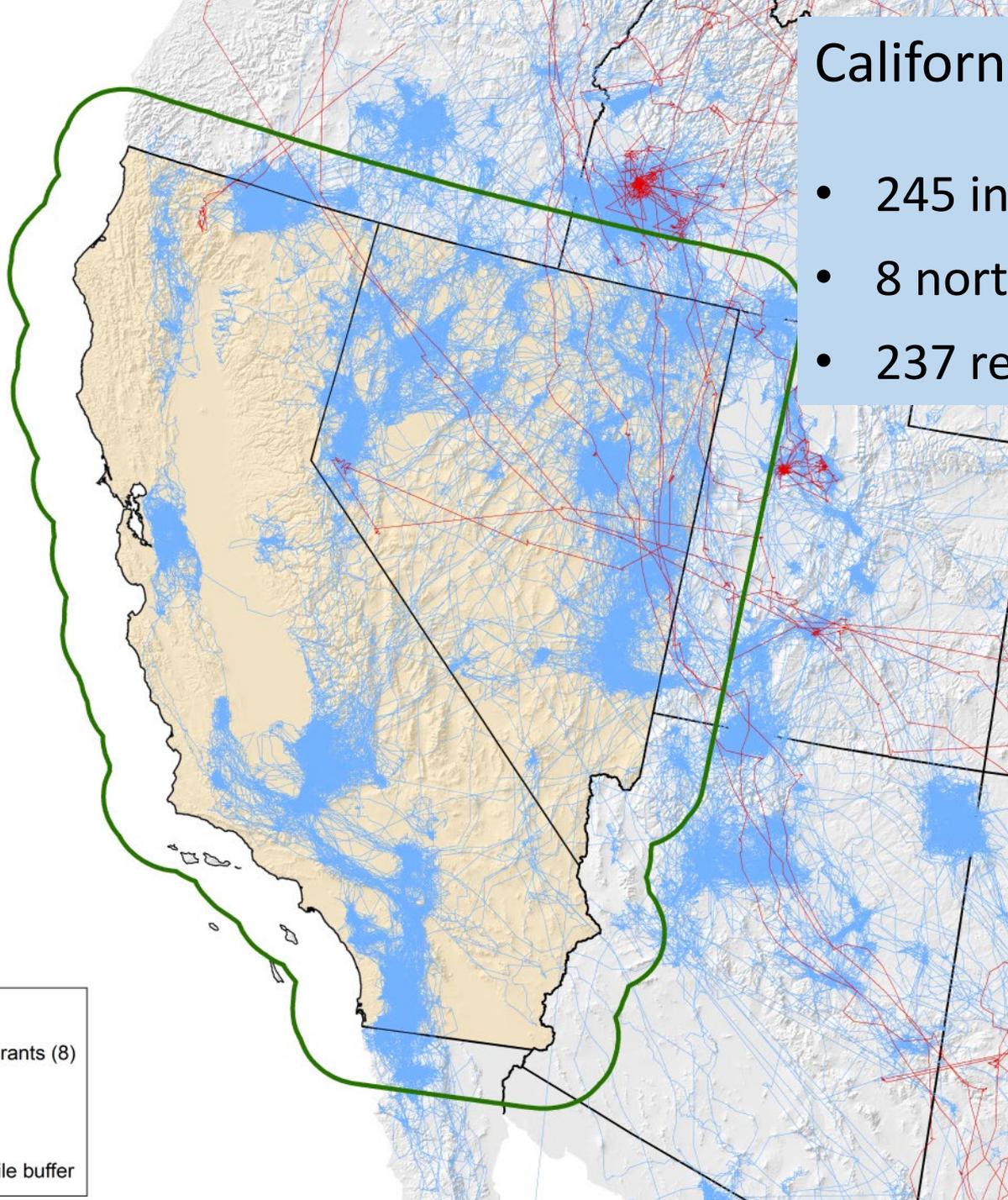
Southern “residents” (633)

## California/Nevada (R8)

- 245 individuals tracked
- 8 northern migrants
- 237 residents

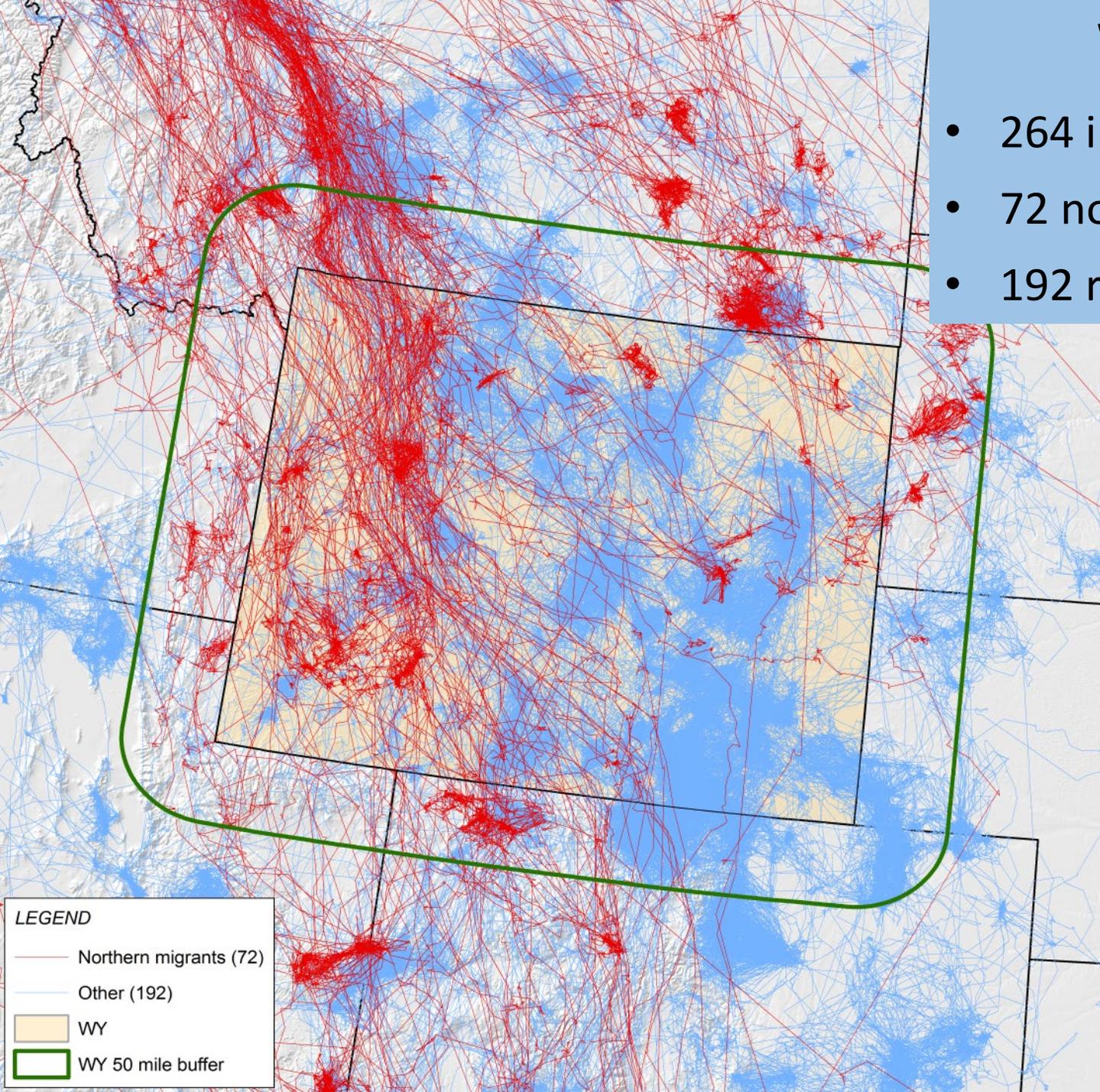
### LEGEND

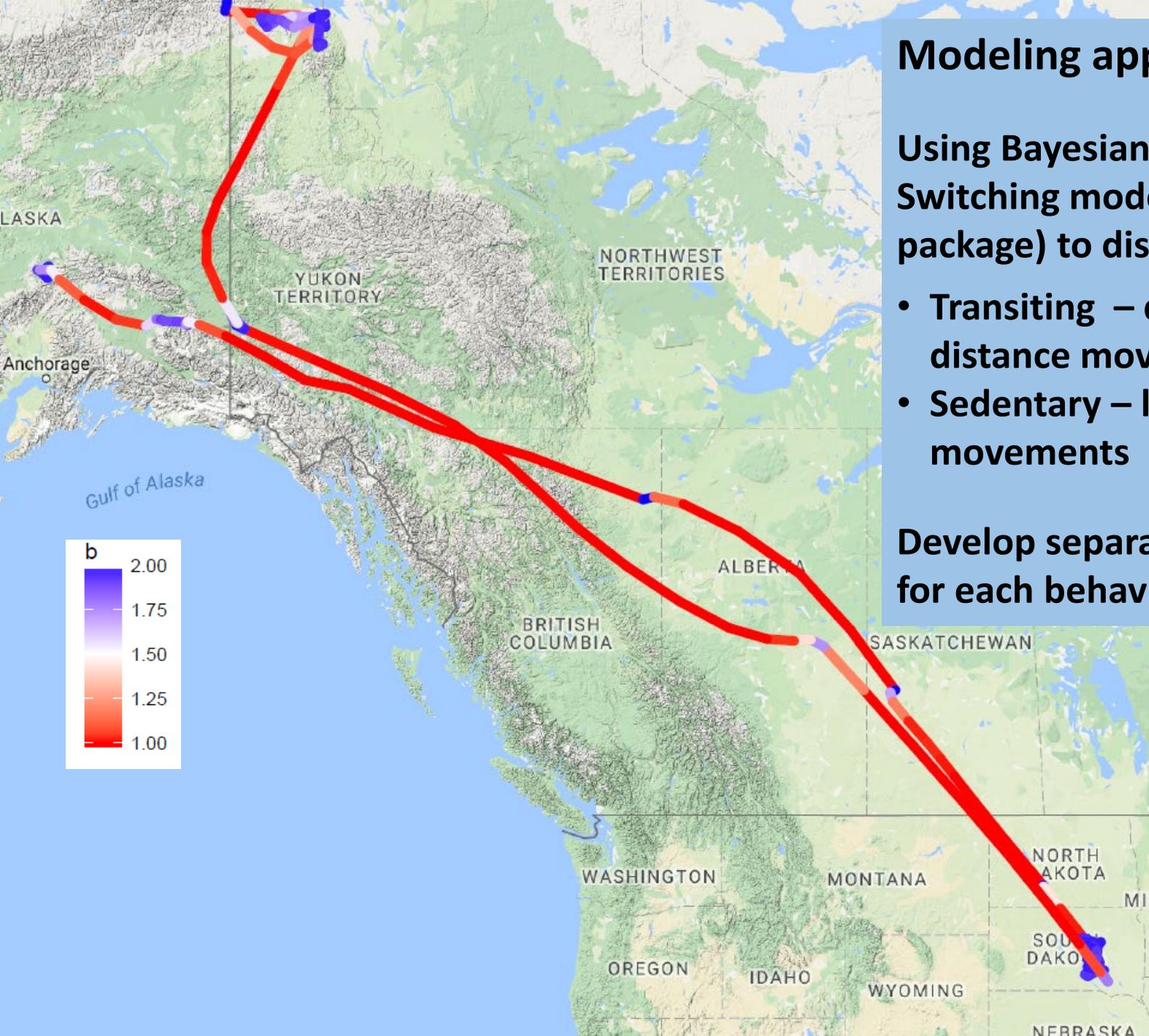
- Northern migrants (8)
- Other (237)
- CA-NV
- CA-NV 50 mile buffer



# Wyoming

- 264 individuals tracked
- 72 northern migrants
- 192 residents





## Modeling approach:

Using Bayesian State-Space Switching model (“bsam” R-package) to discriminate:

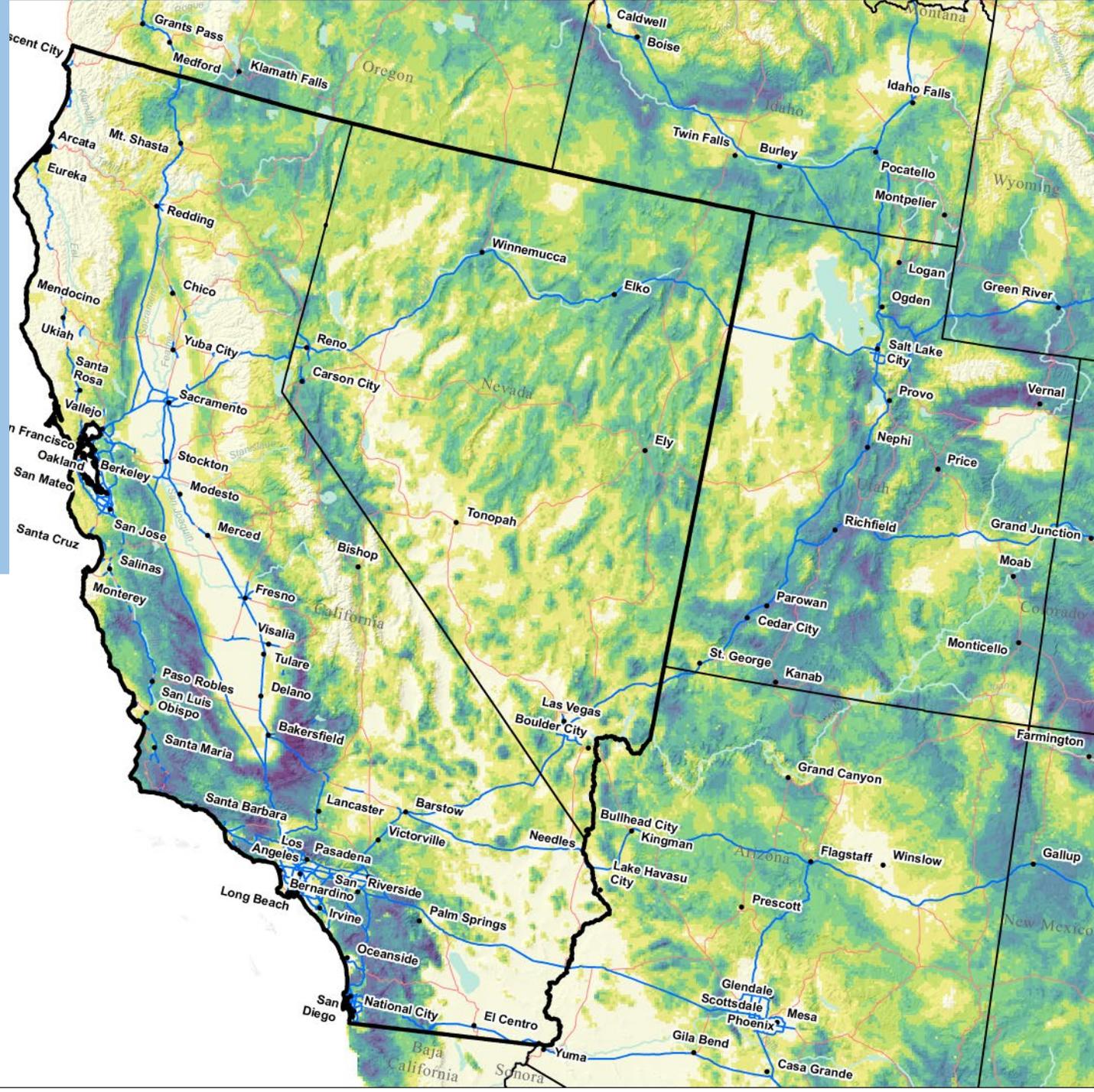
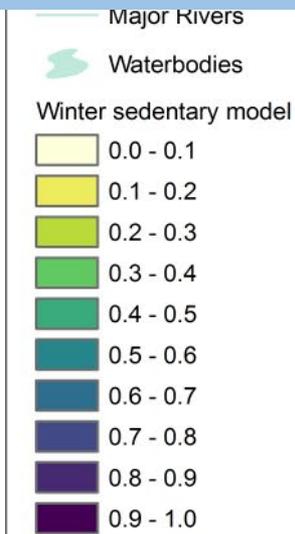
- Transiting – directed long-distance movements
- Sedentary – localized movements

Develop separate RSF models for each behavior

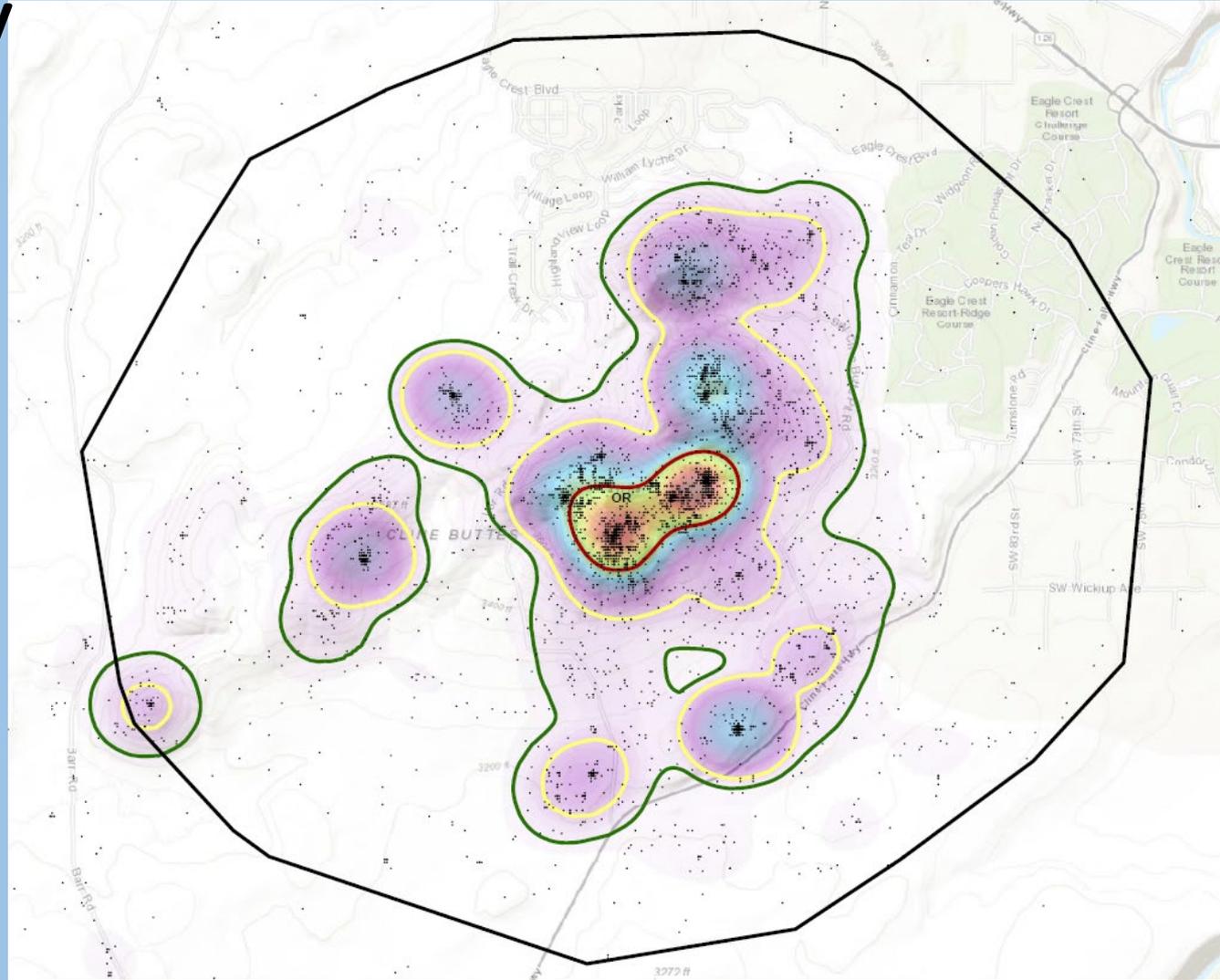


# Winter Sedentary Model

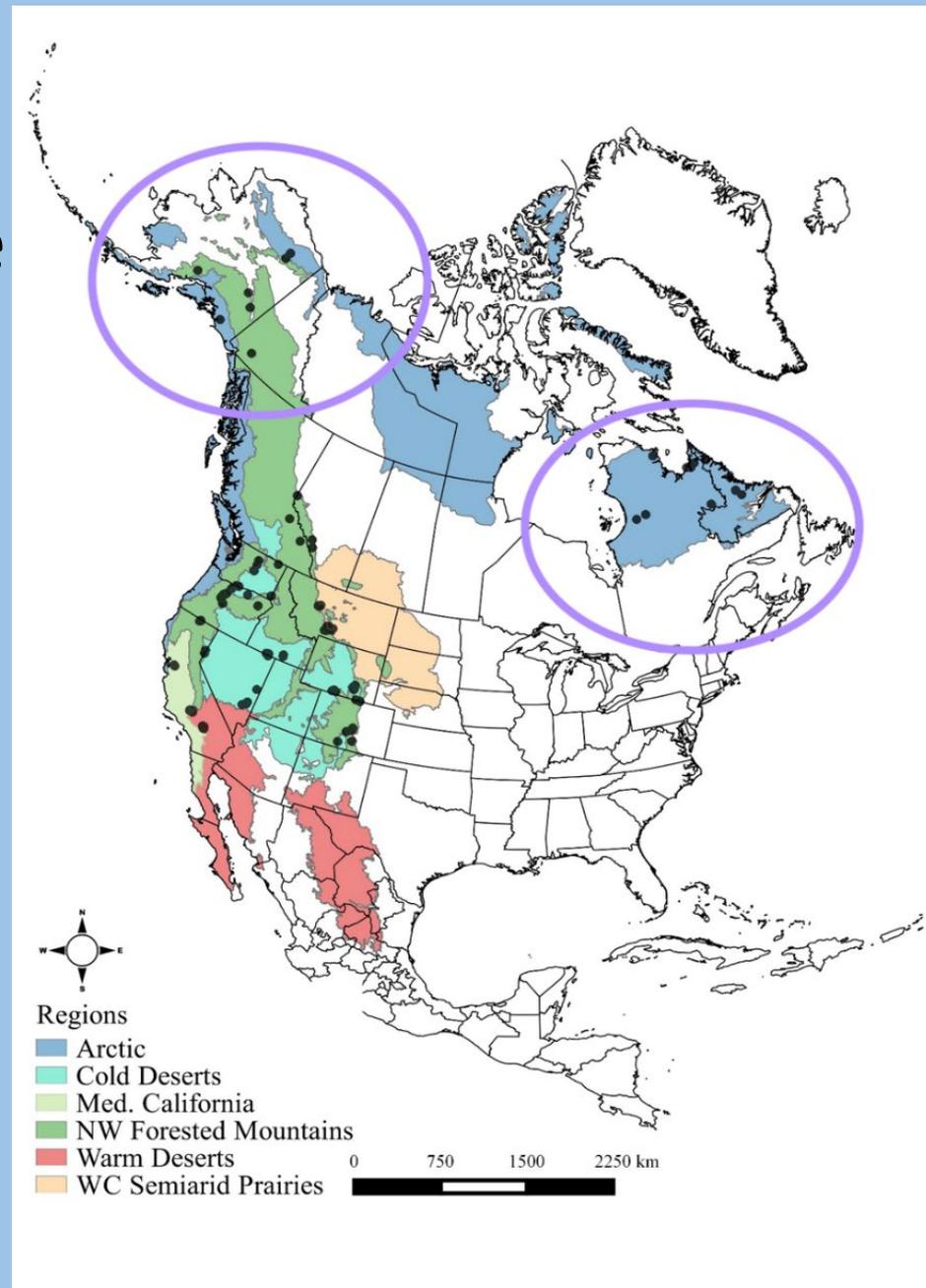
- General model includes all age and behavior classes



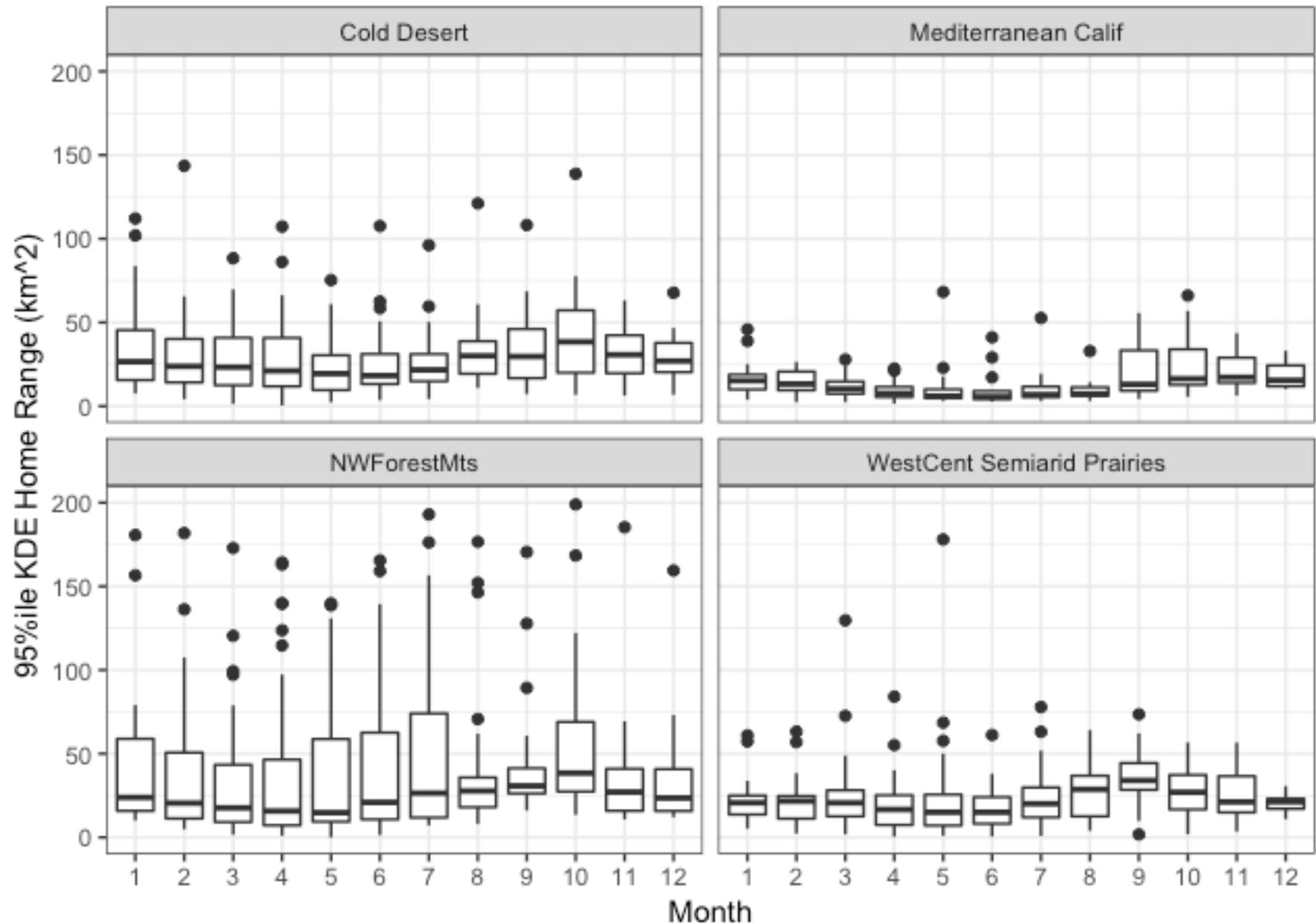
# Space-use by Territorial Golden Eagles: a Meta- analysis



- Screened 192 candidate adult (AFY) eagles
- 109 had adequate data and exhibited territorial behavior
- Used consistent methods to estimate home range and core areas



# Home range size - Geographic variation



# Core Area\* size - Geographic variation

