

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



Shy do Eagle



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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

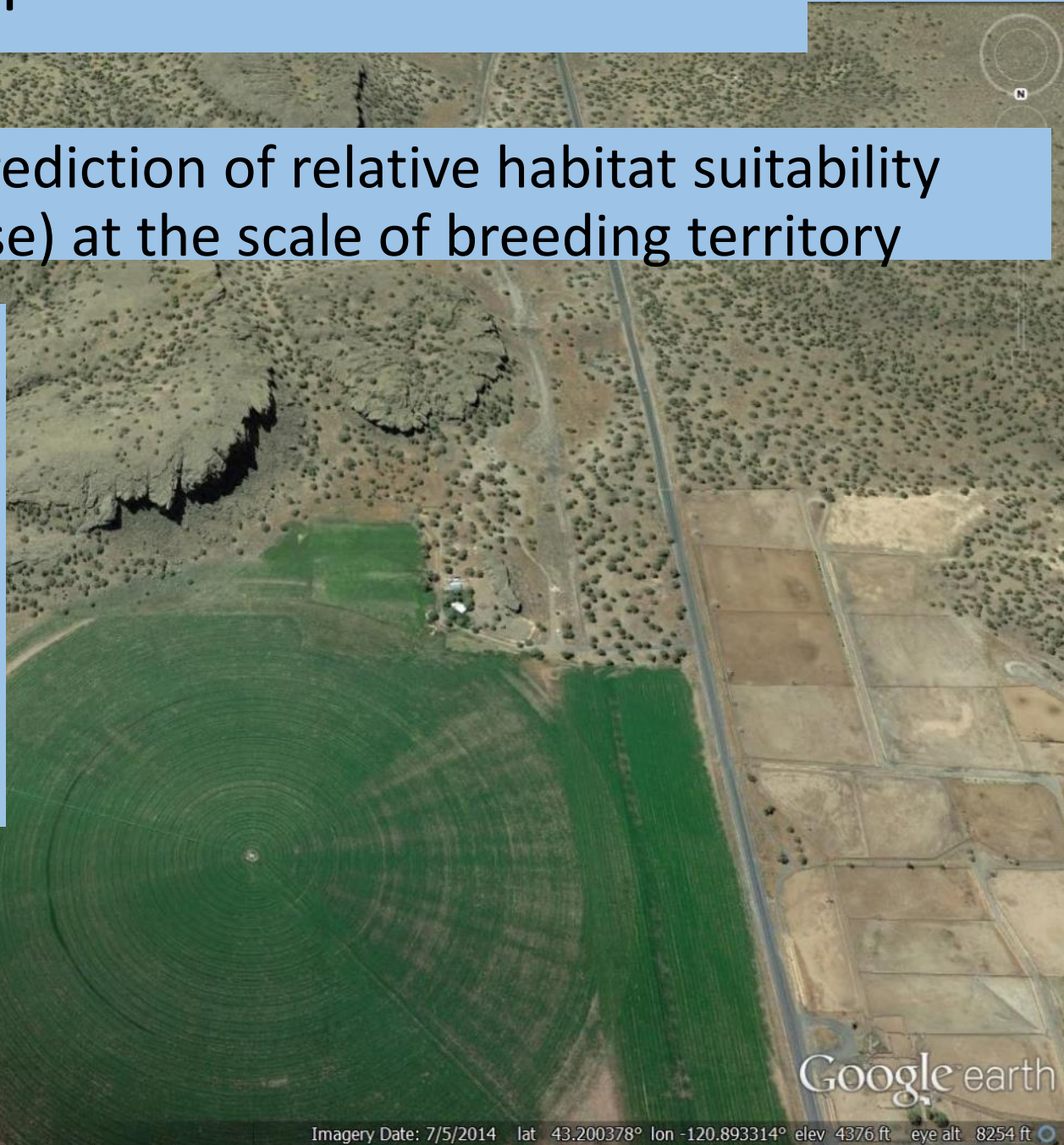
Objective: Reliable prediction of relative habitat suitability (relative density of use) at the scale of breeding territory

Ecoregion-specific

Species Distribution Models

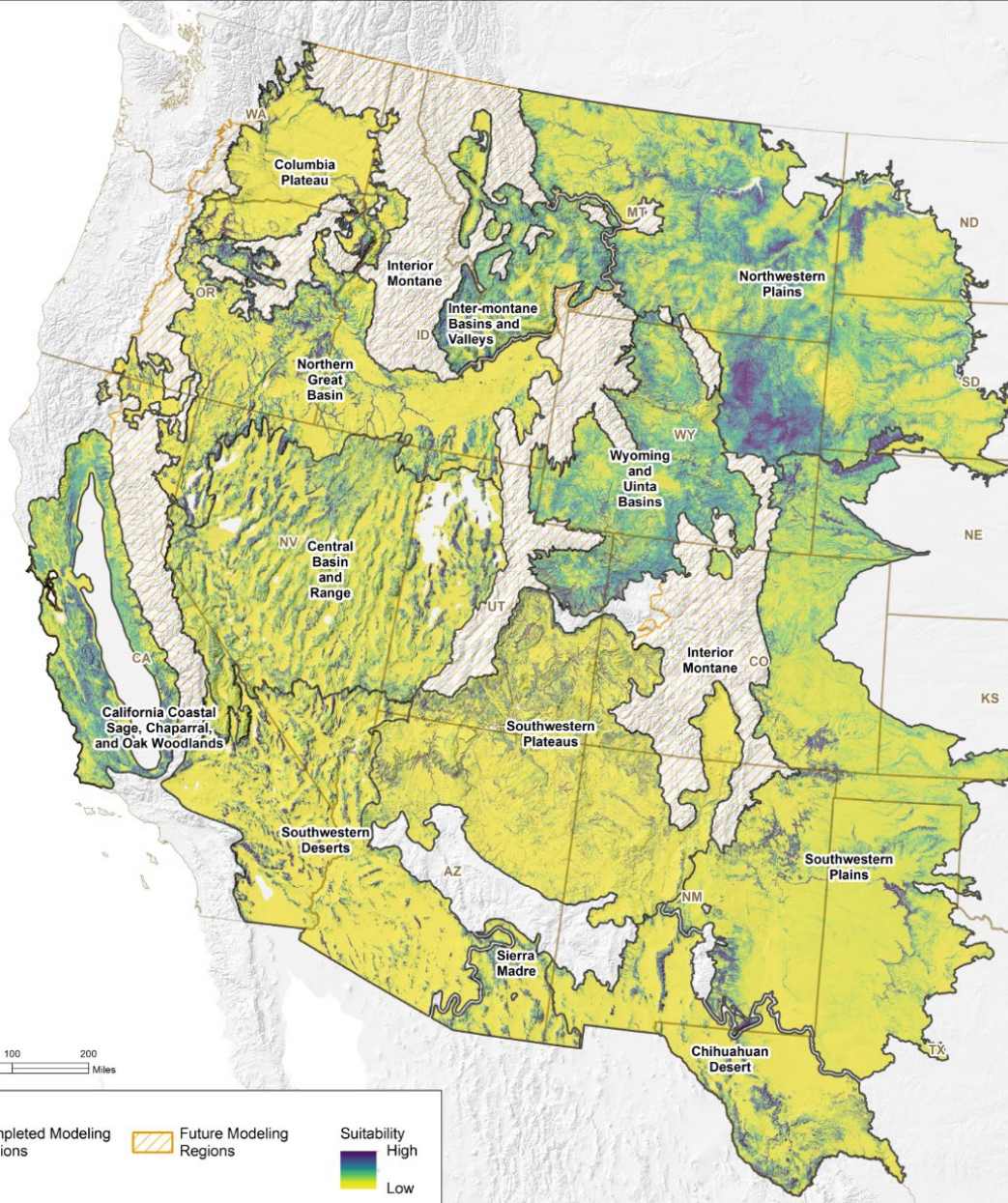
Environmental variables:

- 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

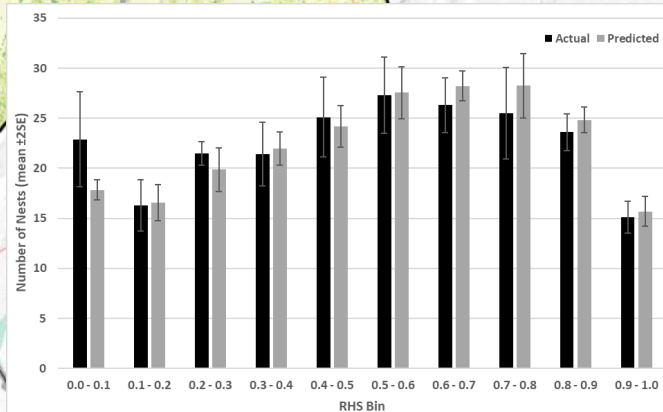
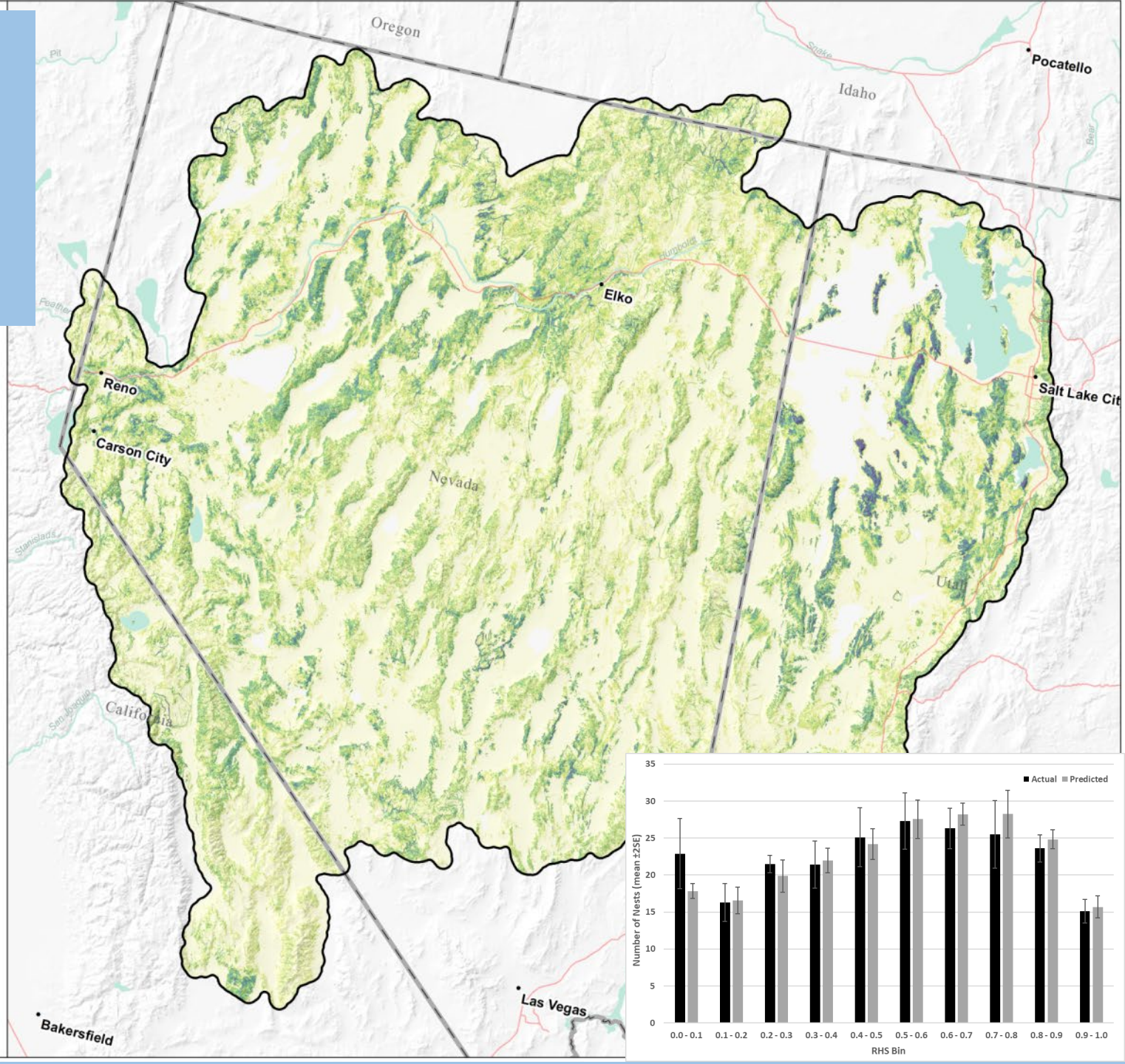
- 13,321 nest records
- 902 selected

LEGEND

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

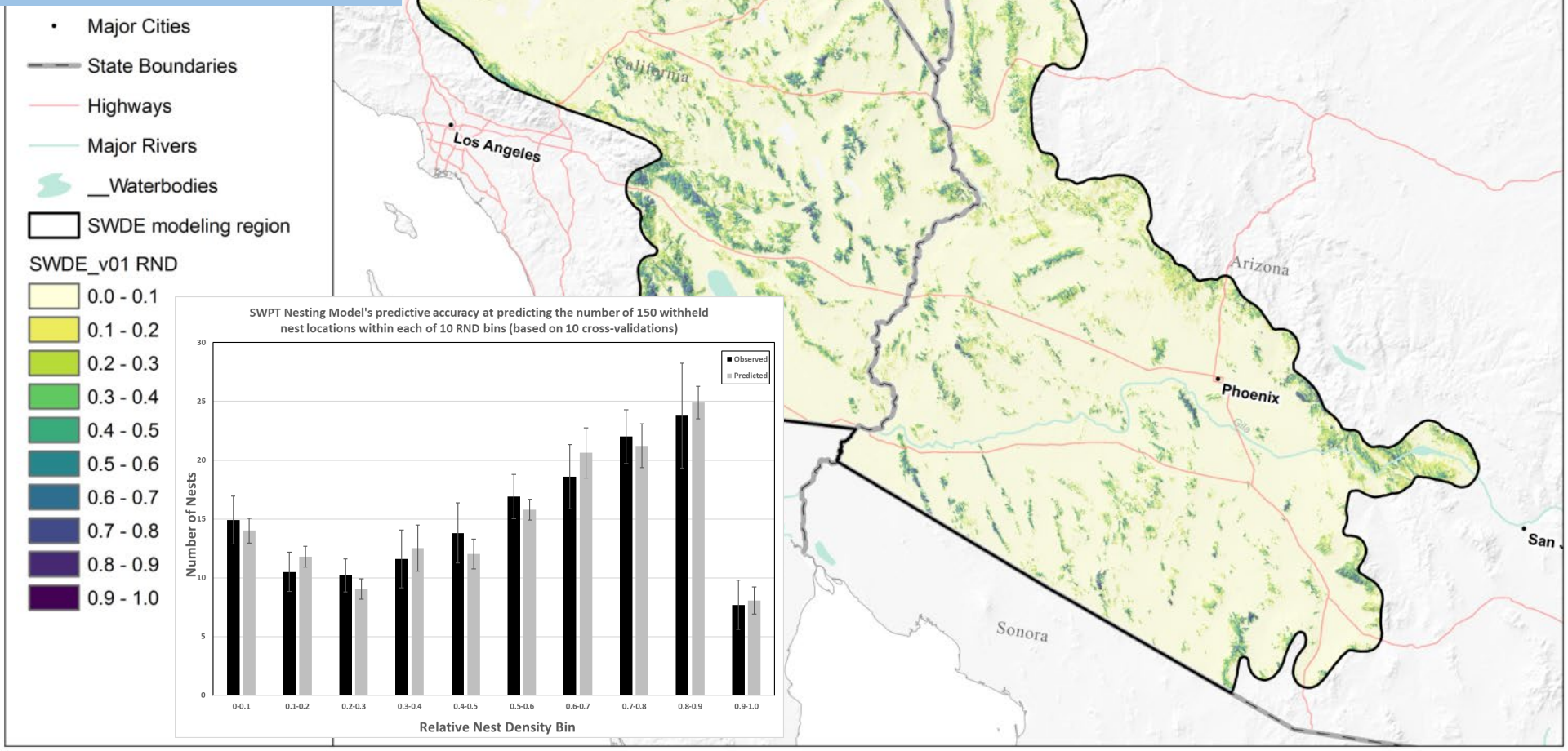
CBRA_v02 RND

- 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

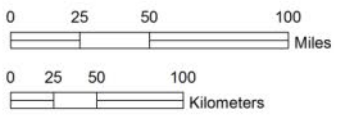


Southwestern Deserts

- 1,096 nest records
- 288 selected

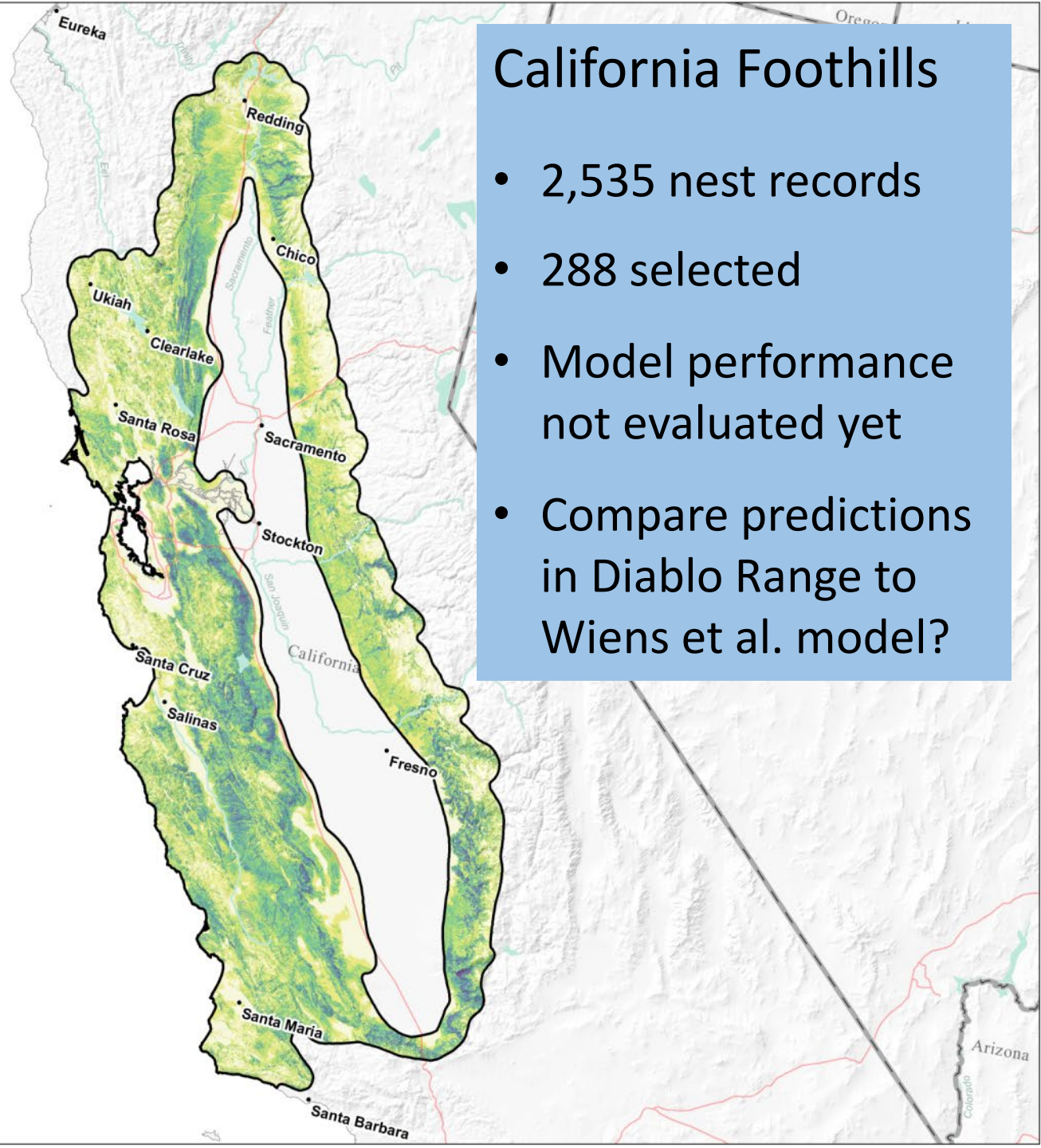
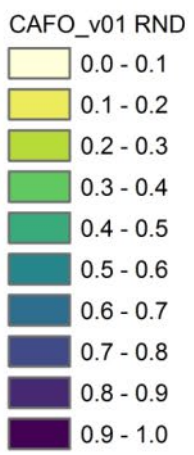


RELATIVE NEST DENSITY
CBRA
CENTRAL BASIN AND RANGE



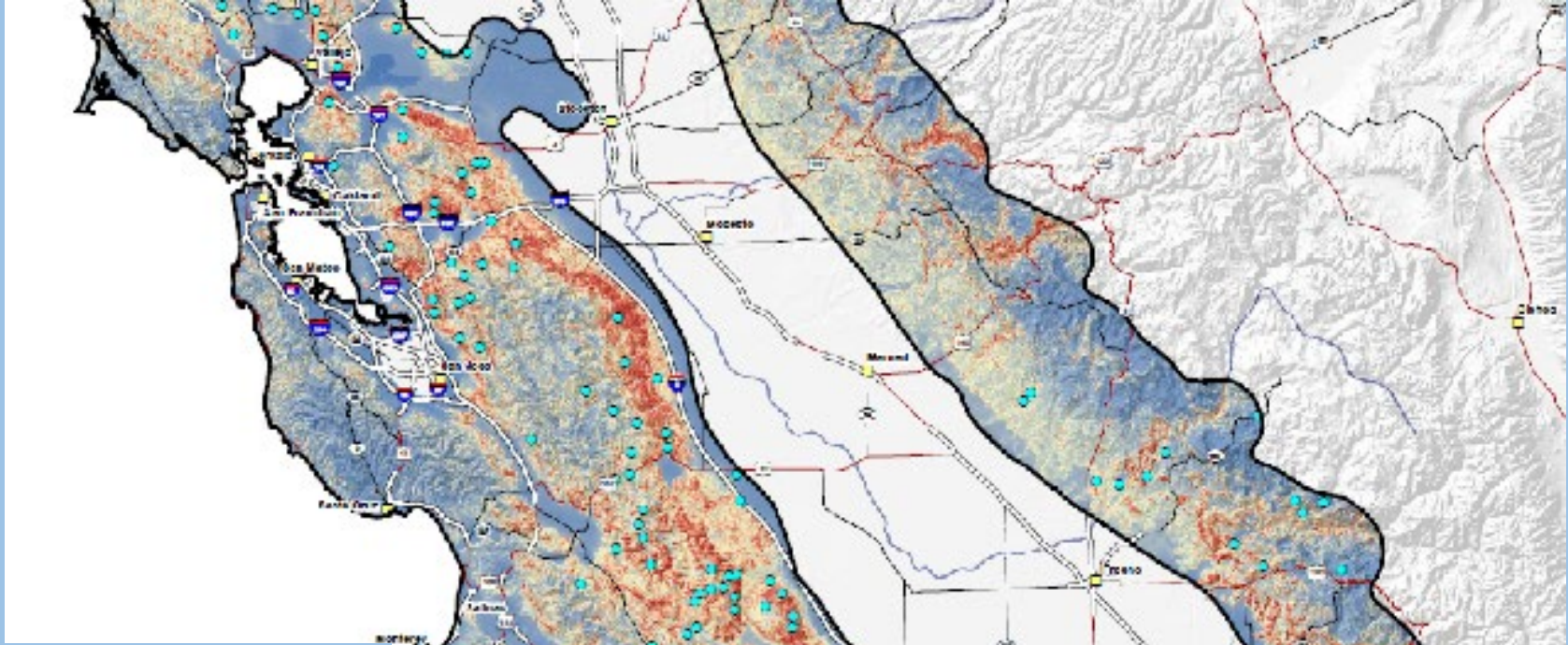
LEGEND

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



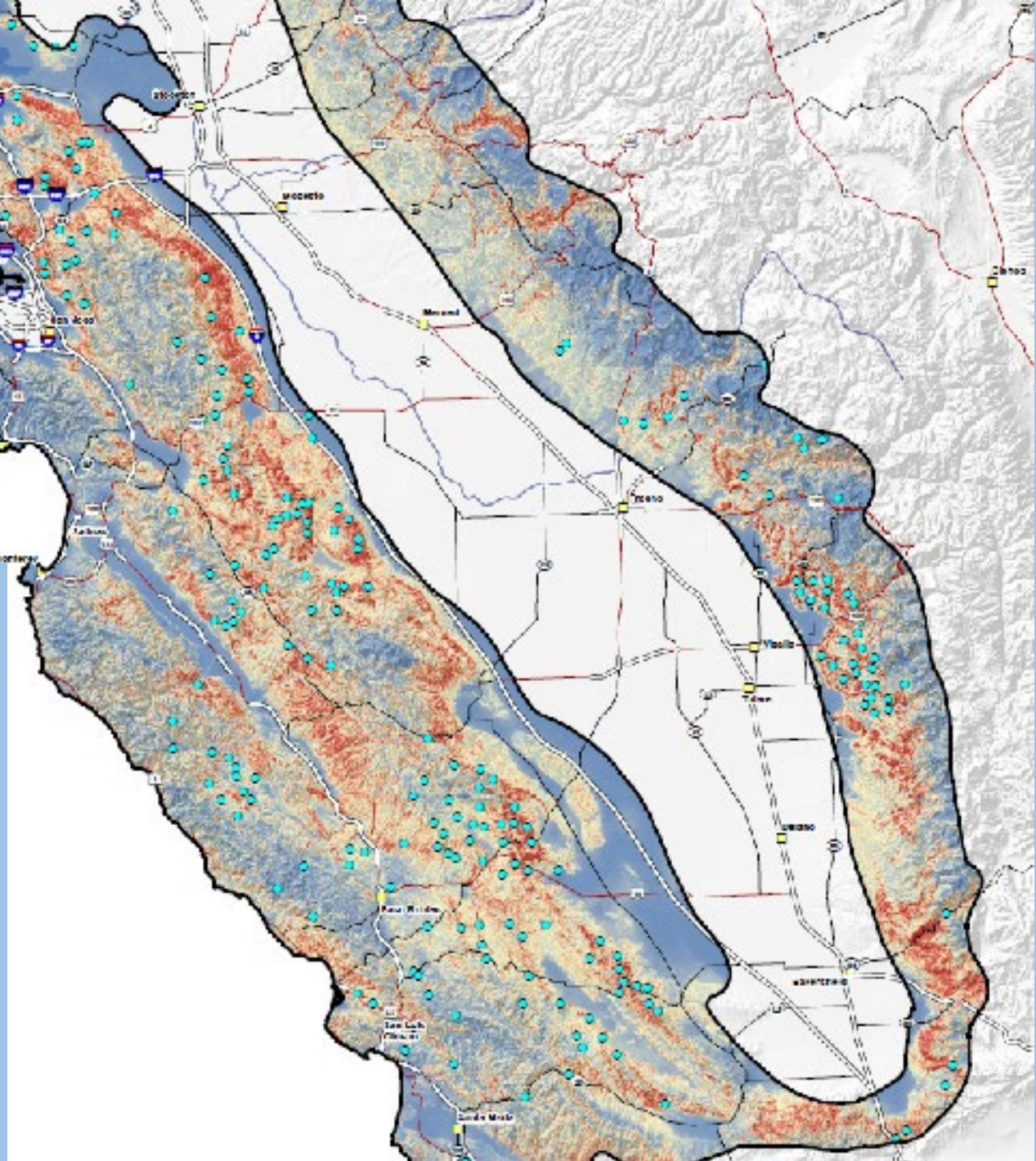
California Foothills

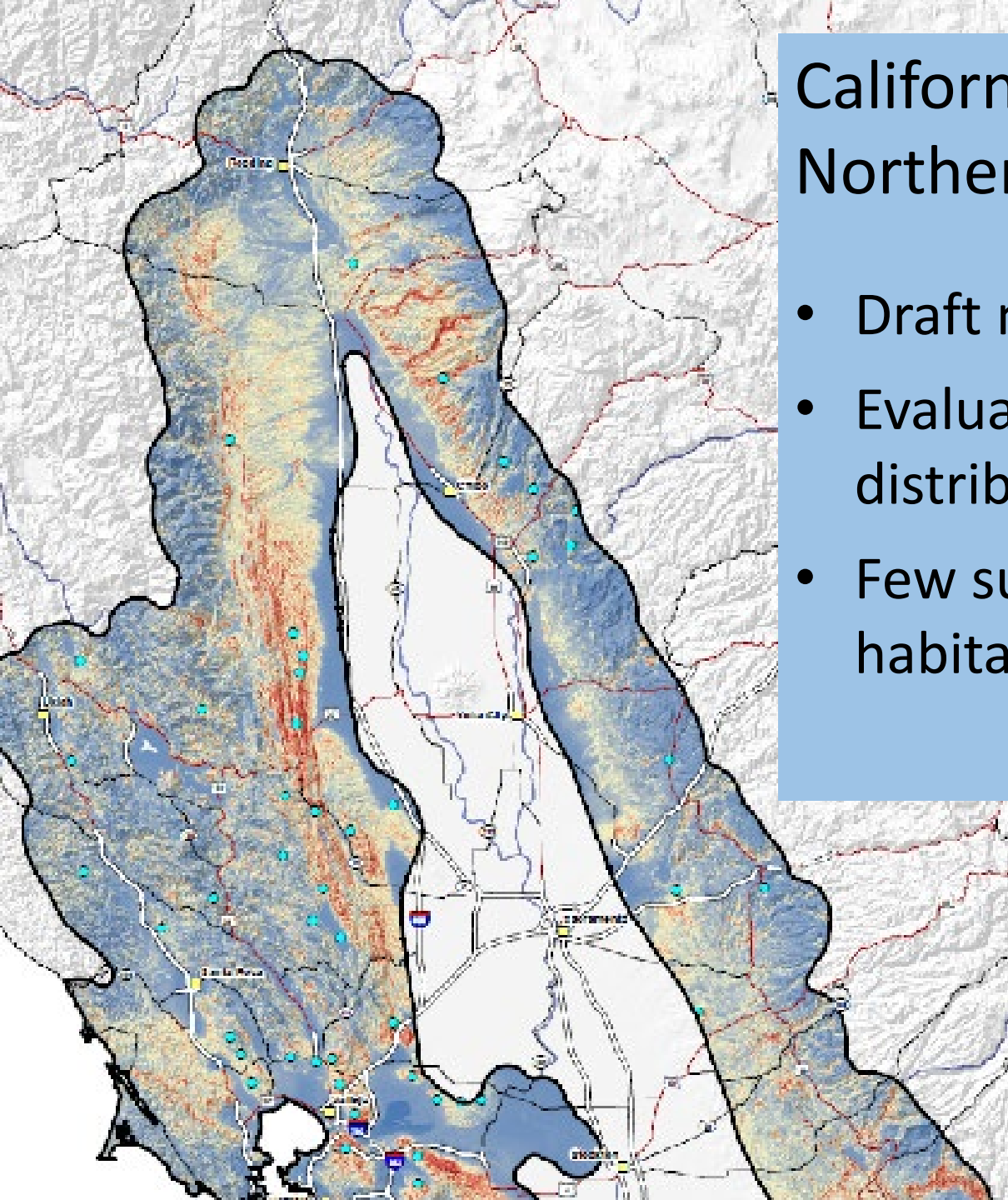
- 2,535 nest records
- 288 selected
- Model performance not evaluated yet
- Compare predictions in Diablo Range to Wiens et al. model?



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



Shy da Eagle

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

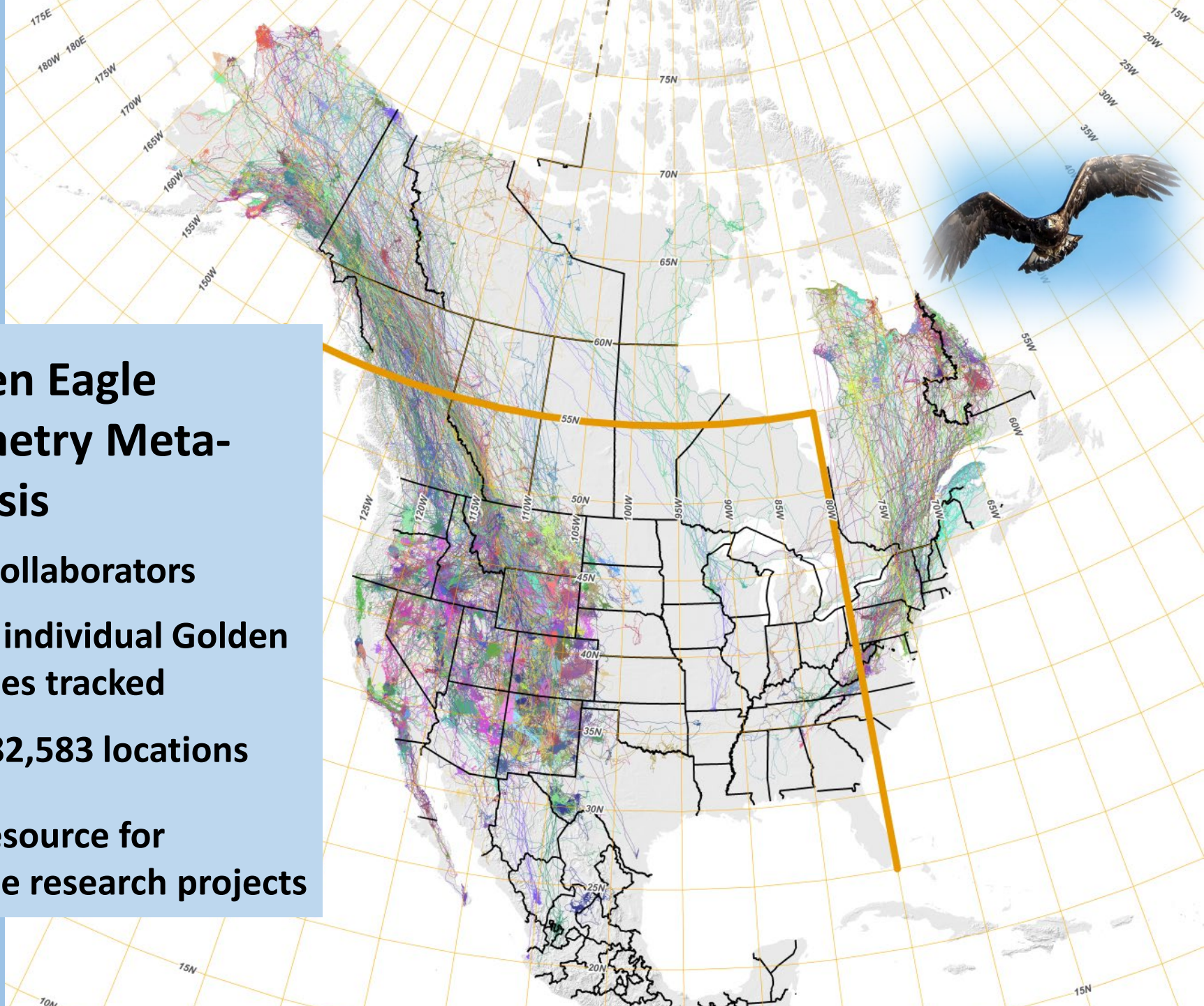
Core Team:

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

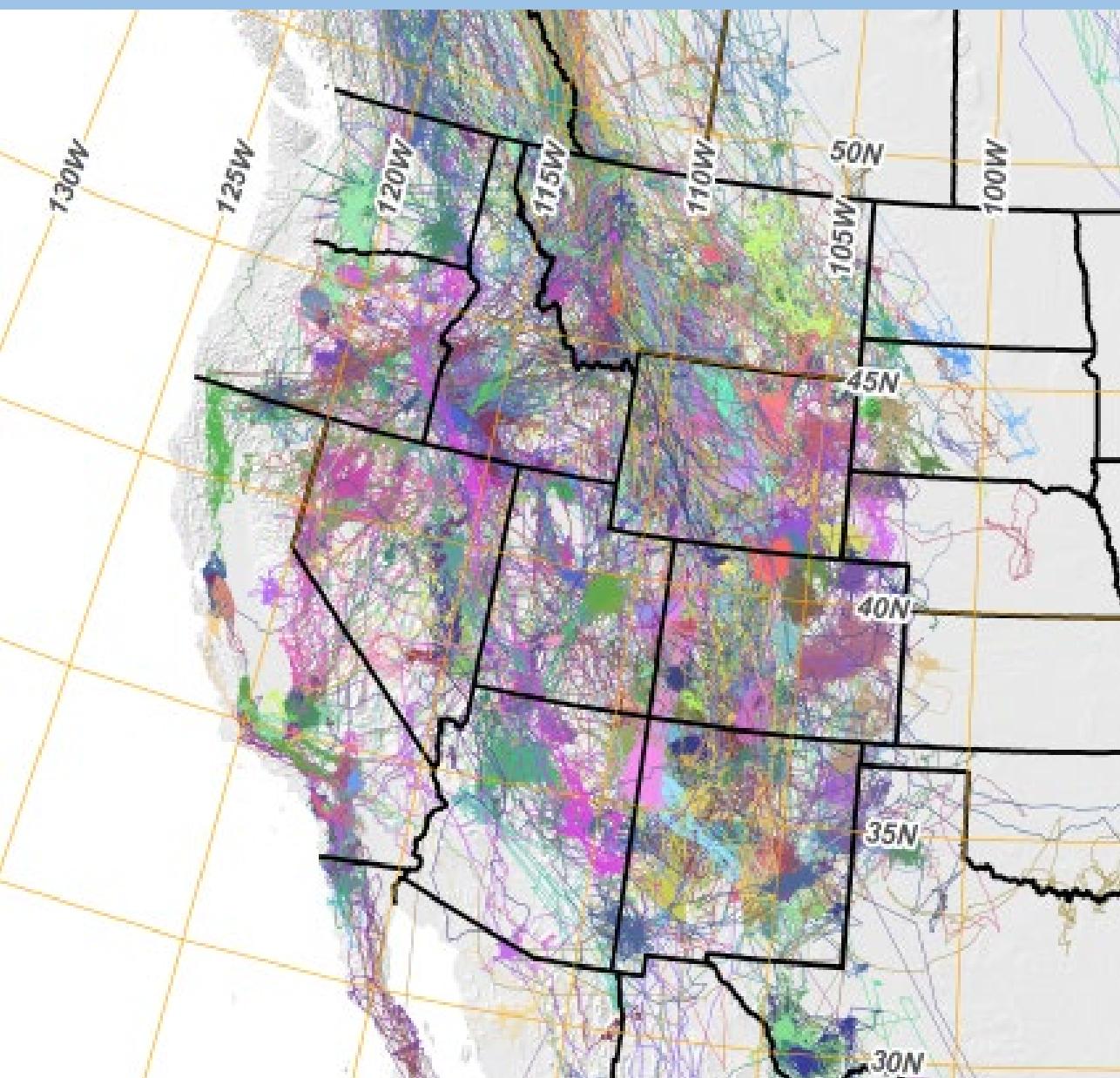
Eric Hollingstad - WEST

Ken Jacobson - Arizona Dept. Game & Fish

Amy Fesnock - BLM

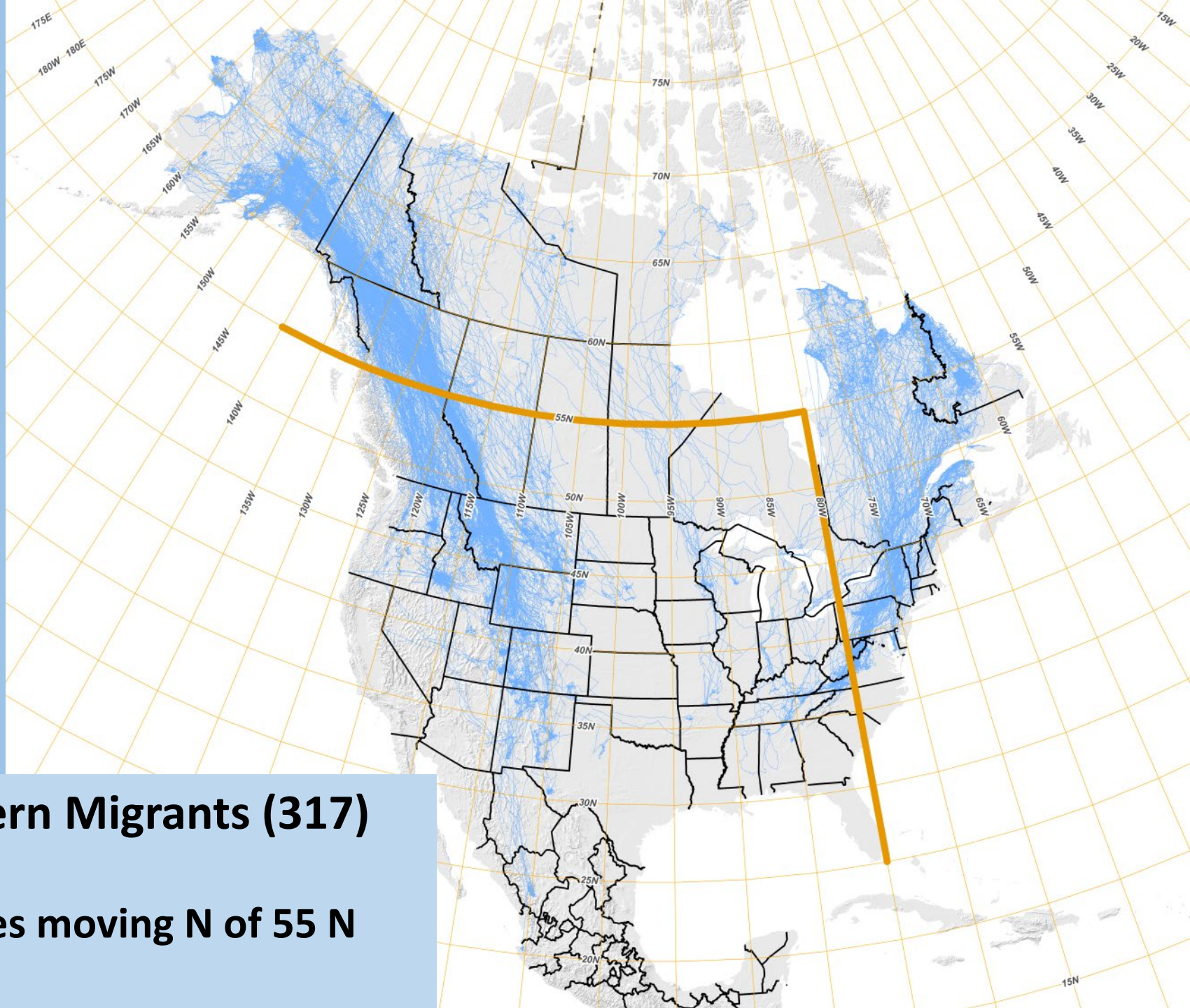
Mike Yates - Earth Span

Western Golden Eagle Team - USFWS



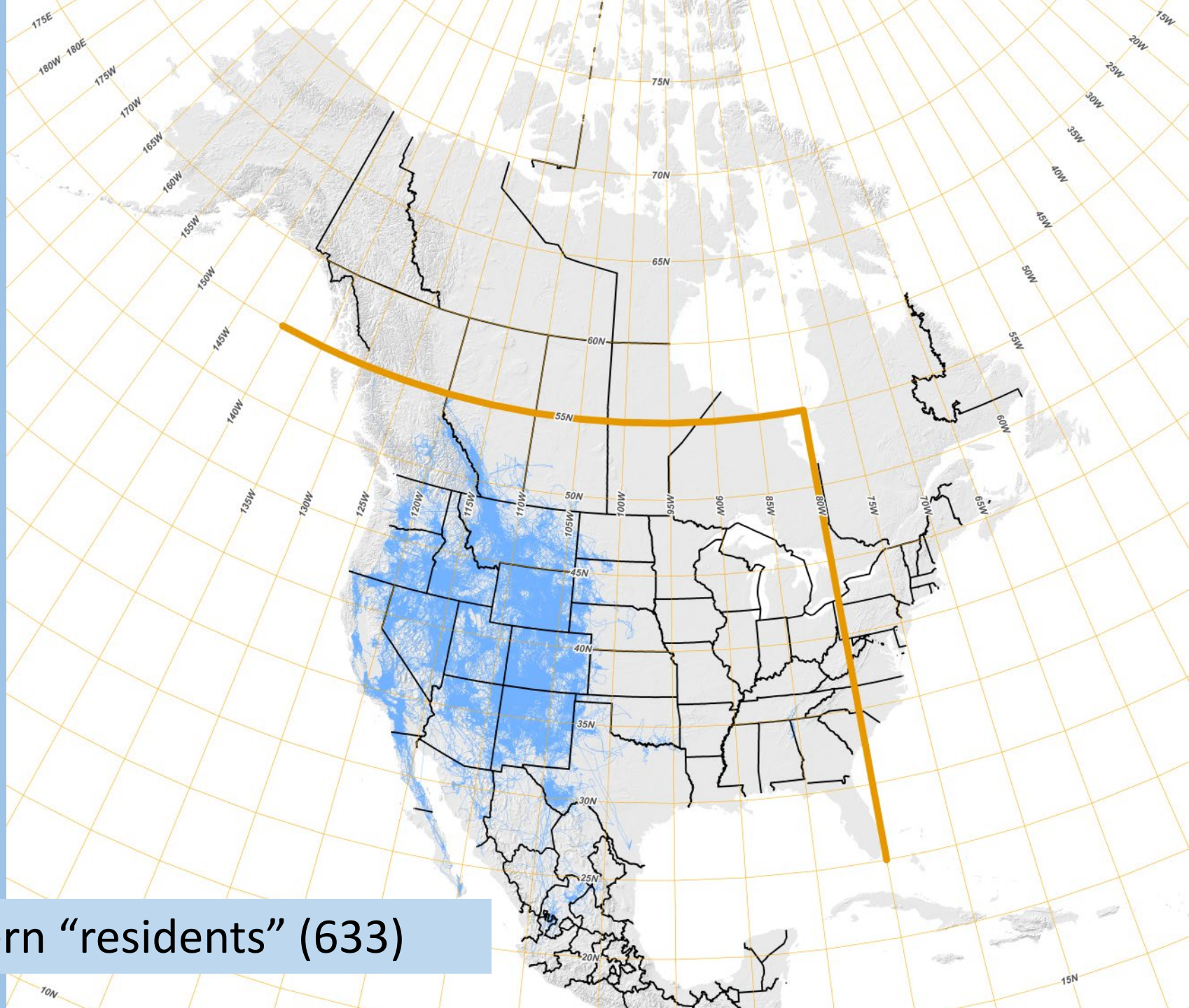
Factors influencing distribution and habitat use of Golden Eagles

Spatial	Temporal	Age Class	Behavioral
Ecoregions	Breeding Season	Adults	Territorial
	Post-breeding Period	Subadults	Nonterritorial
	Migration Period		Migratory
	Nonbreeding Season	Juveniles	Nonmigratory
			Dispersal



Northern Migrants (317)

- Eagles moving N of 55 N lat.



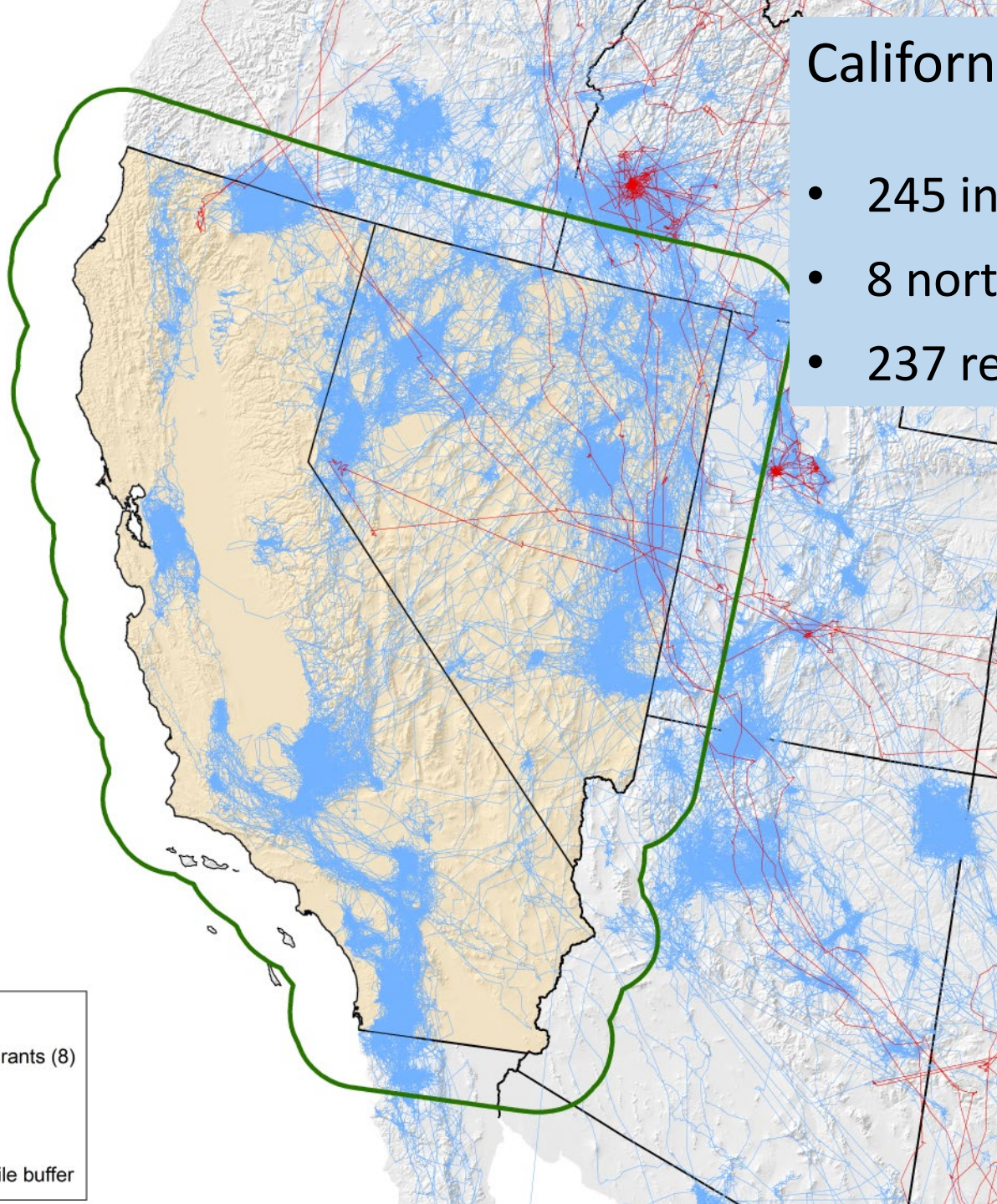
Southern “residents” (633)

California/Nevada (R8)

- 245 individuals tracked
- 8 northern migrants
- 237 residents

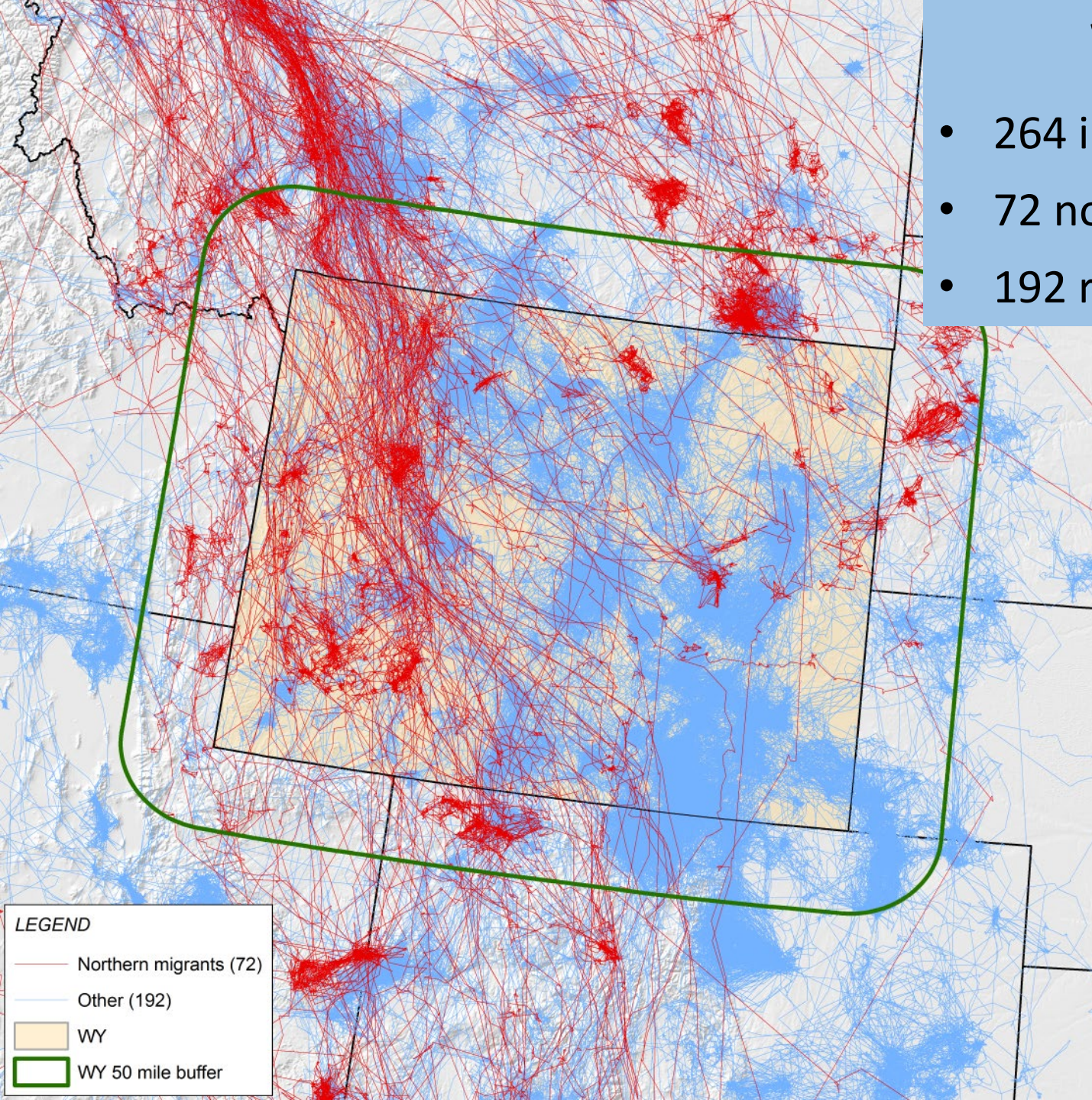
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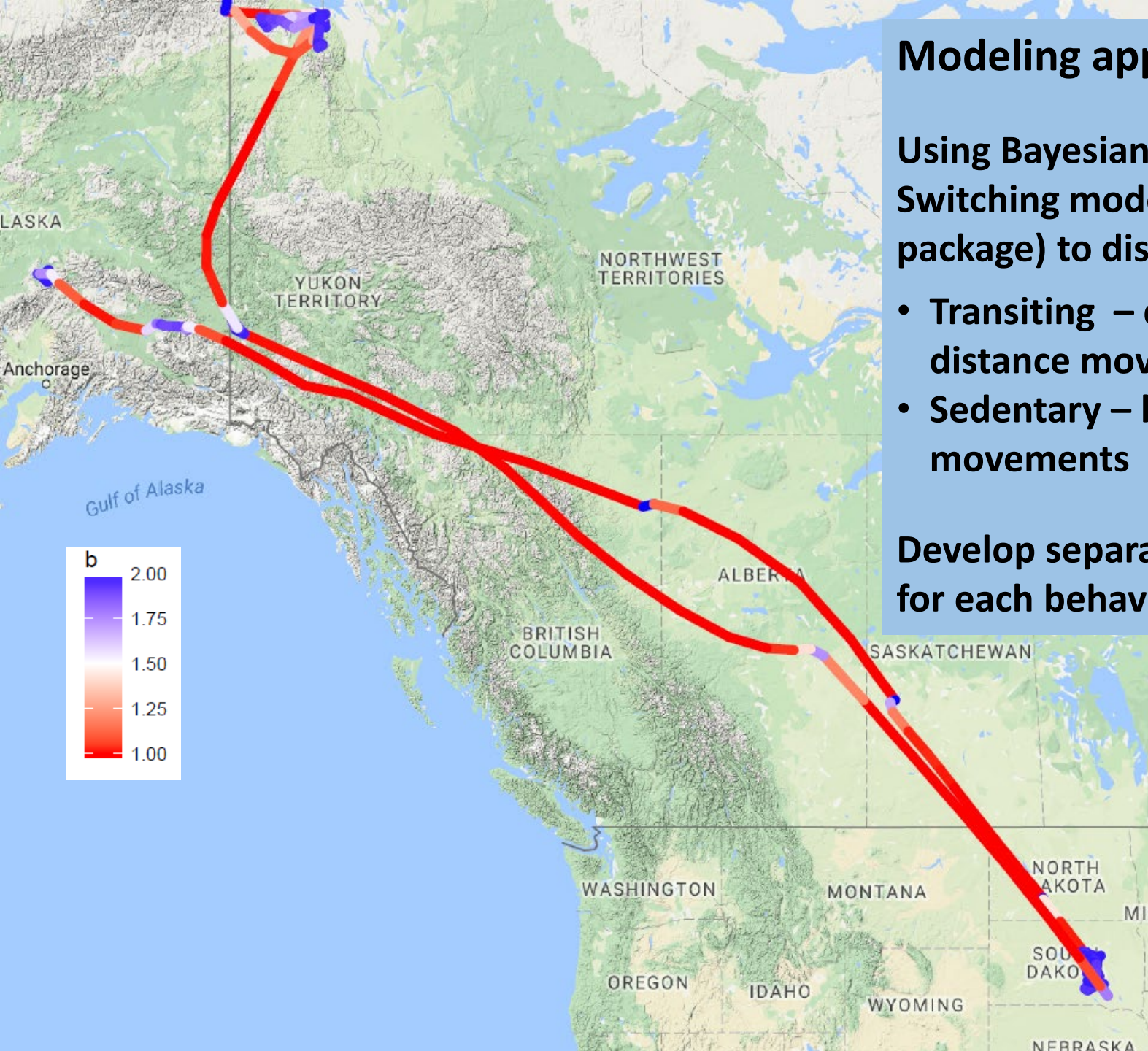
- Northern migrants (8)
- Other (237)
- CA-NV
- CA-NV 50 mile buffer



Wyoming

- 264 individuals tracked
- 72 northern migrants
- 192 residents





Modeling approach:

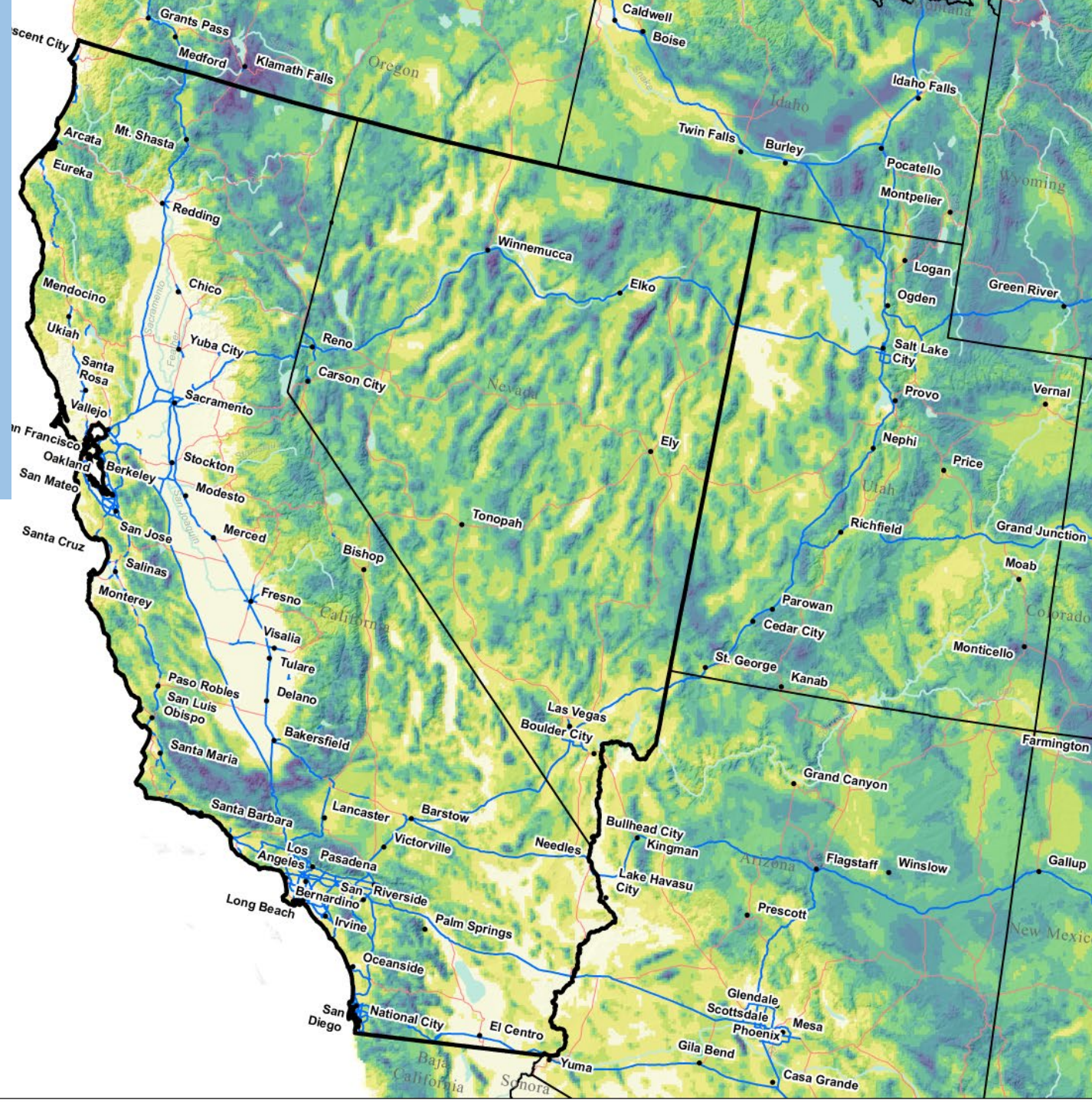
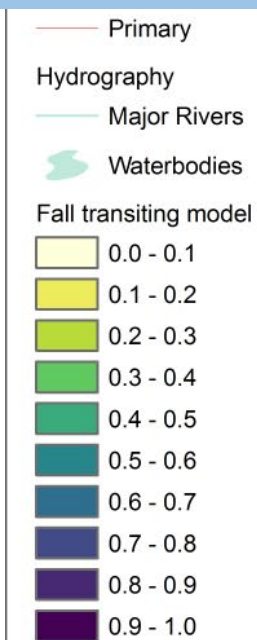
Using Bayesian State-Space Switching model (“bsam” R-package) to discriminate:

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

Develop separate RSF models for each behavior

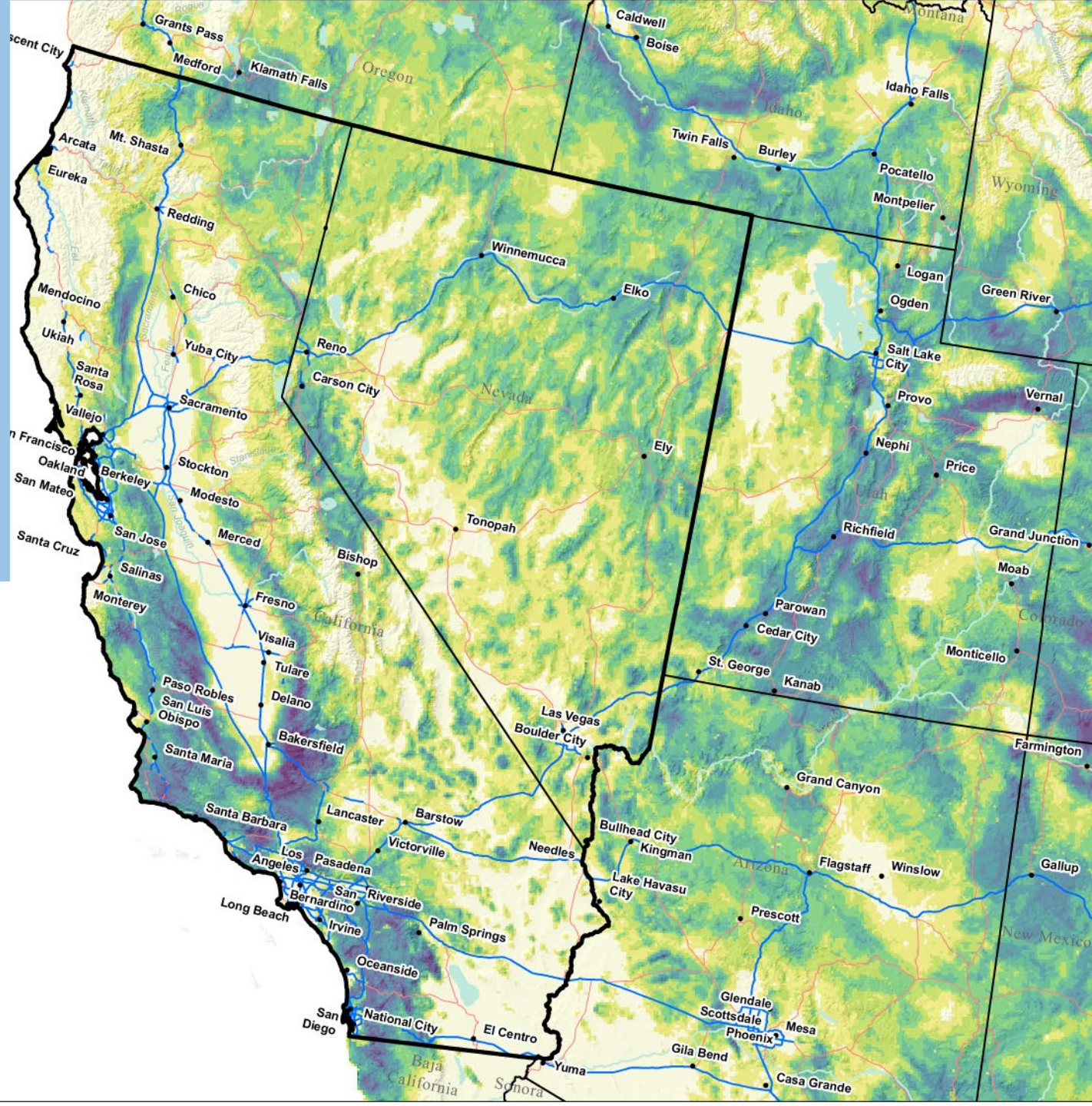
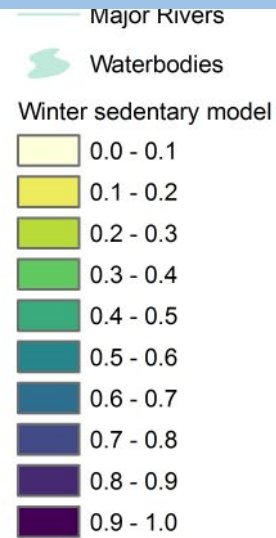
Fall Transiting Model

- General model includes all age and behavior classes

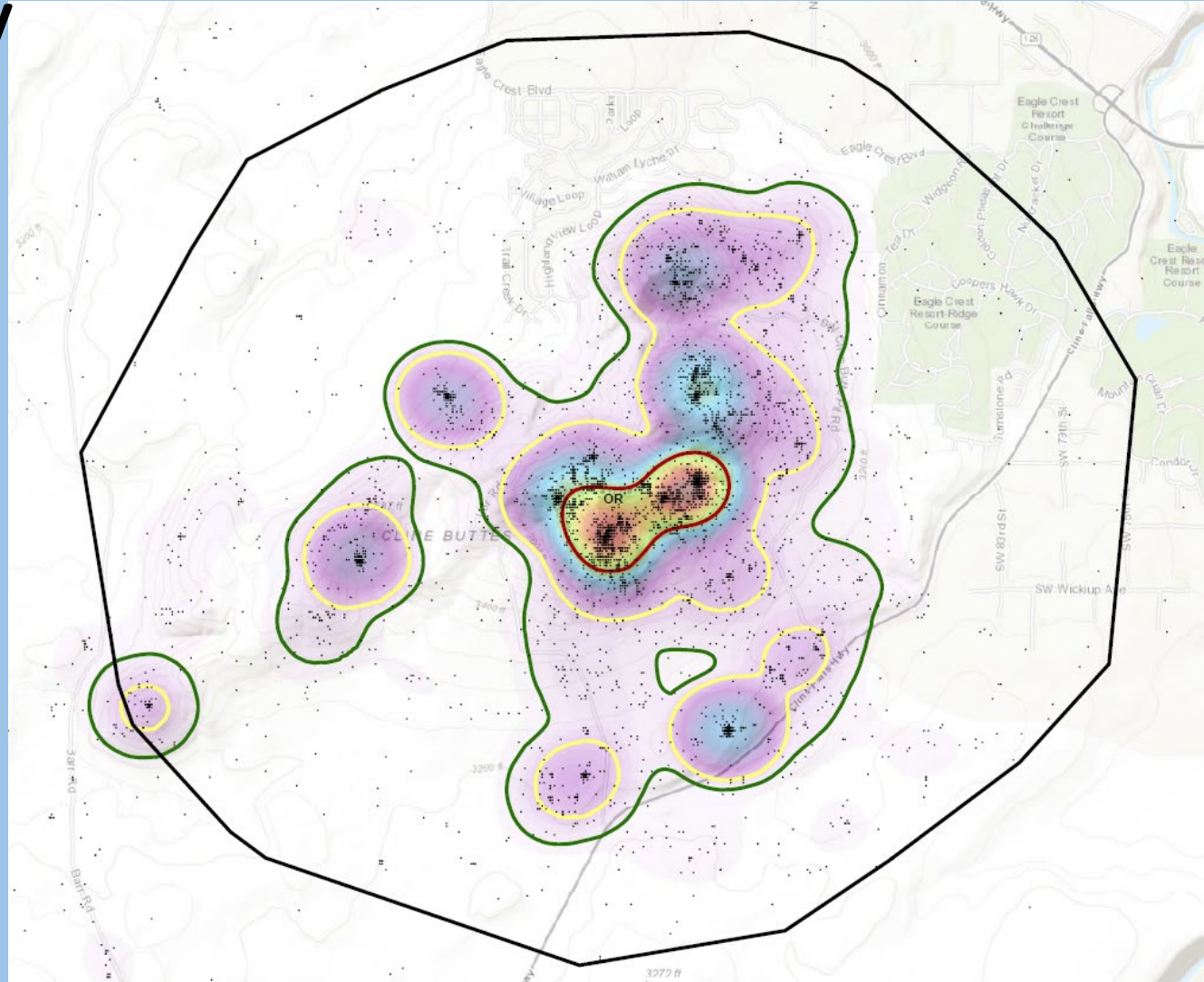


Winter Sedentary Model

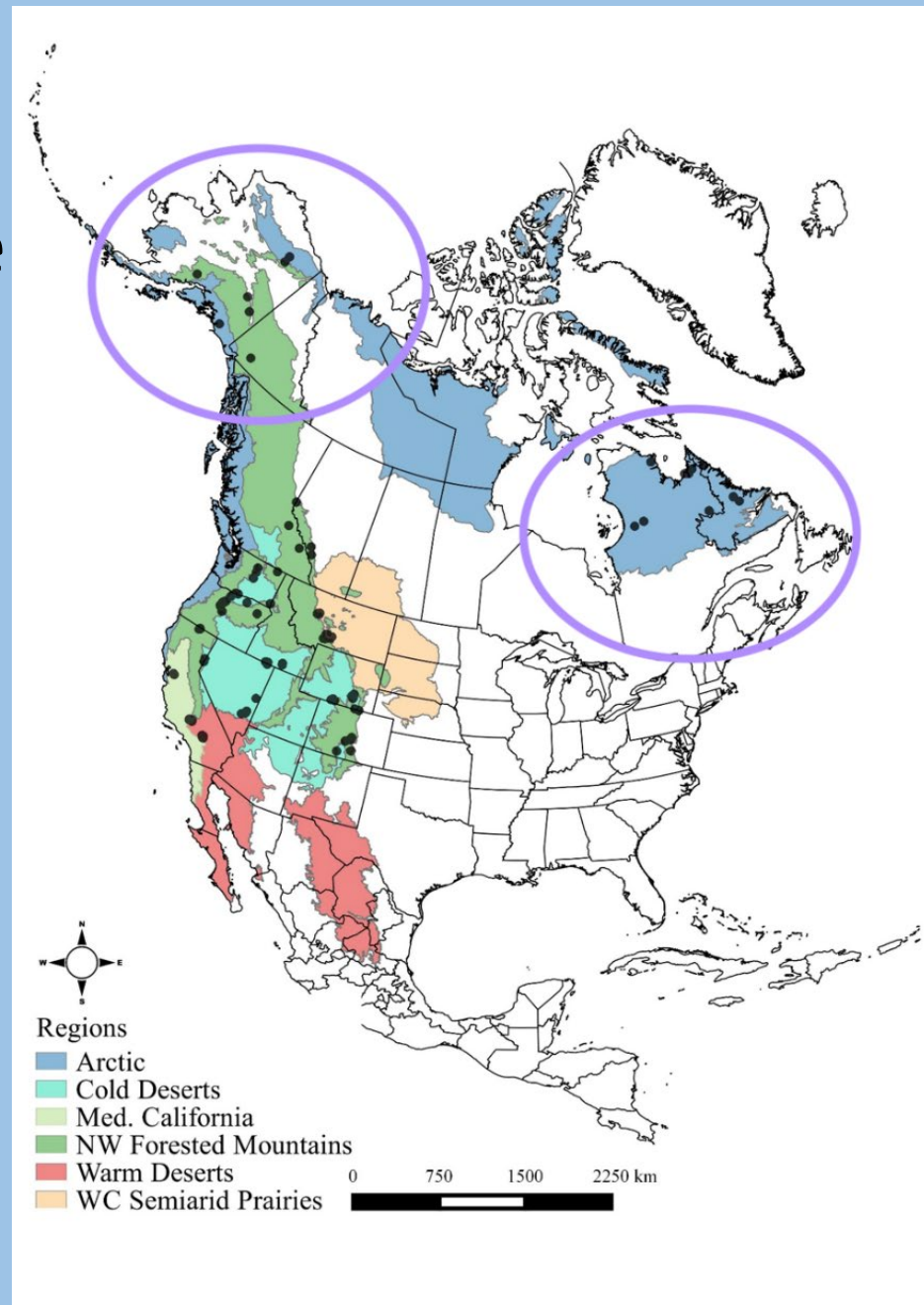
- General model includes all age and behavior classes



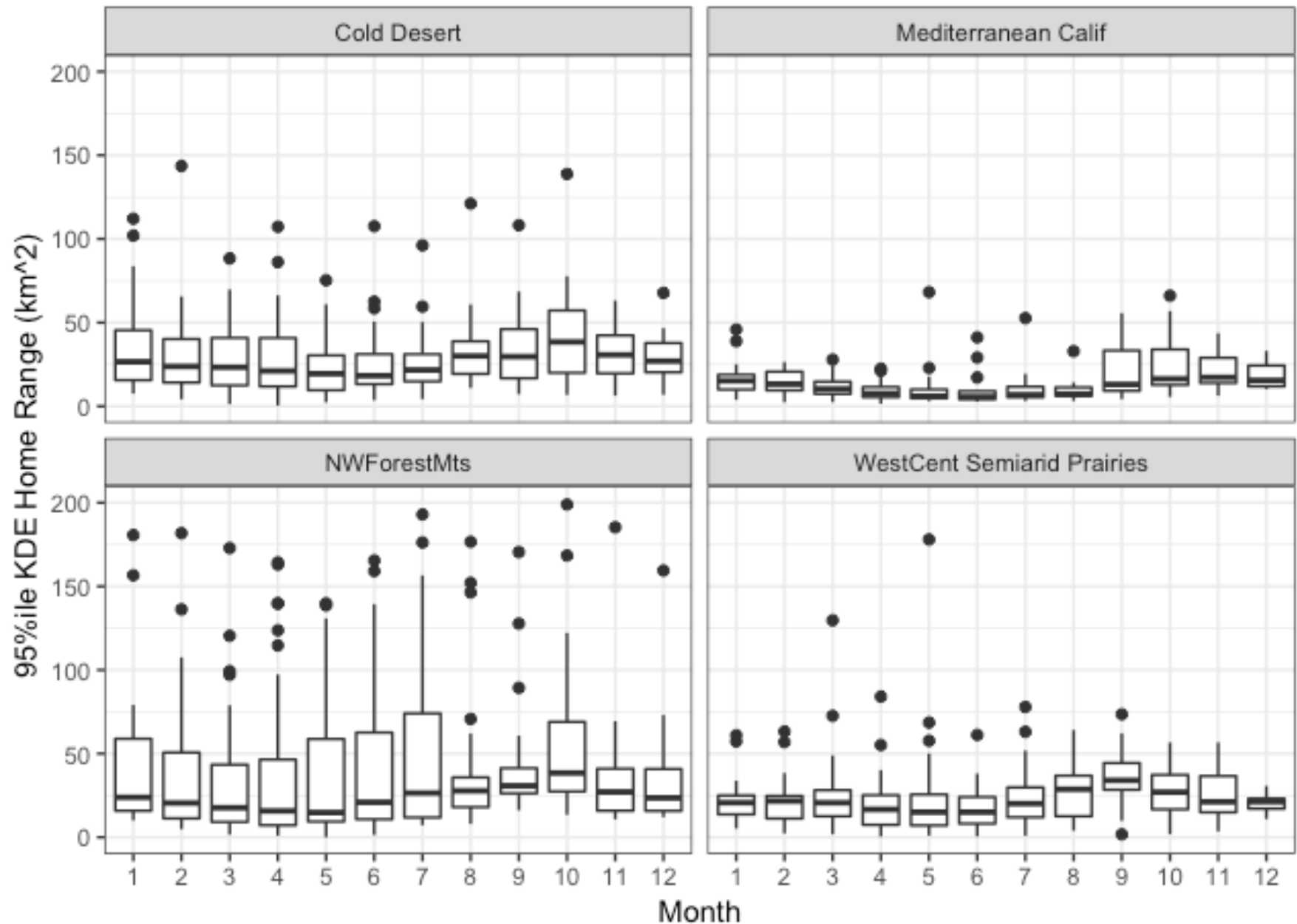
Space-use by Territorial Golden Eagles: a Meta- analysis



- 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

