Conservation Planning and Risk Assessment for Golden Eagles in the Western United States

Brian Woodbridge, Coordinator

Western Golden Eagle Conservation Team

U.S. Fish and Wildlife Service, Corvallis, OR

Western Golden Eagle Conservation Team

Established in 2013 by USFWS managers in four western Regions

In response to increased regulatory and conservation issues due to renewable energy development

Co-authors and collaborators

Todd Lickfett, Geoffrey Bedrosian, Gary Williams, Hillary White , David Leal, Jeremy Buck, Tom Dietsch, Katie Powell, and Greg Beatty USFWS – WGET

Jeffrey R. Dunk and Dan Hansen – Humboldt State University

Jason Tack and Barry Noon – Colorado State University

Jessi L. Brown – University of Nevada, Reno

Leo Salas and Sam Veloz – Point Blue Conservation Science

Dave LaPlante – Natural Resource Geospatial, CA

James Dwyer, Rick Harness and Elizabeth Mojica – EDM International

Julie Heath, Rob Spaul and Casey Pozzanhera – Boise State University

Jim Watson – Washington Dept. Fish and Wildlife

Charles Preston – Draper Natural History Museum

Dale Stahlecker and Zach Wallace – Eagle Environmental

Bryan Bedrosian – Teton Raptor Center

Todd Katzner, David Wiens, Karen Steenhof, Mike Kochert, Collin Eagles-Smith, and Garth Herring – USGS - FRESC

Todd Esque, and Matt Simes – USGS - WERC

Steve Slater and Neil Paprocki – Hawkwatch, International

Jason Carlisle – WEST, Inc.

Michael Collopy – University of Nevada, Reno

Ross Crandall – Craighead Beringia South

Brian Millasp, Robert Murphy, Emily Bjerre – USFWS, Div. Mig. Birds

Frank Isaacs – Oregon Eagle Foundation

Navajo Nation
Arizona Dept. Game & Fish
Nevada Dept. of Wildlife
Bureau of Land Management
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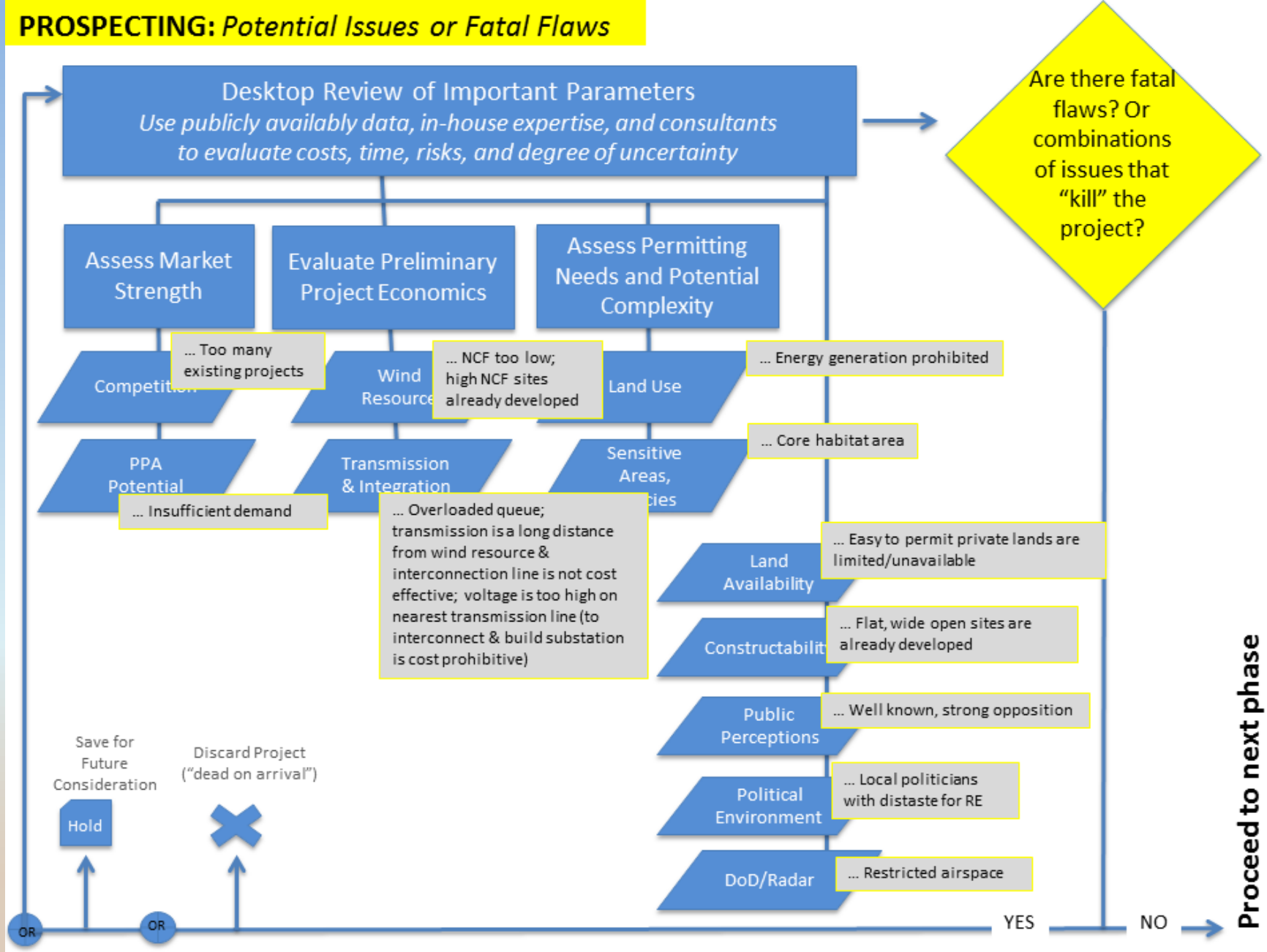
Powder River Electric Corp.
APLIC
University of Oklahoma
Utah Div. Wildlife Res.
Kent Keller
Montana State University
Colorado Breeding Bird Atlas
Southern Ute Nation
Kootenai Tribe
Colorado Parks & Wildlife

Goals and Objectives

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

Photo: Gary Williams, USFWS

CONTEXT



Source: NREL (2016) An Initial Evaluation of Siting Considerations on Current and Future Wind Deployment

Relationship to USFWS policy, regulations and guidance for wind development and eagle conservation

- **WGET's role is to develop a suite of science-based products for use in project siting (ECPG Stage 1) and strategic compensatory mitigation (Stage 4)**
- **WGET's relevant risk assessment and decision support tools *may be* incorporated into future versions of FWS' Eagle Conservation Plan Guidance**

Other Customers

- **Federal land management agencies:**
  Land Management Plans; NEPA compliance for energy, transmission development; recreation development
- **County, municipal, private landowners:**
  Habitat Conservation Plans, Conservation Easements
- **Nongovernmental organizations:**

  Land trusts, conservancies, landscape planning

Specific Objectives

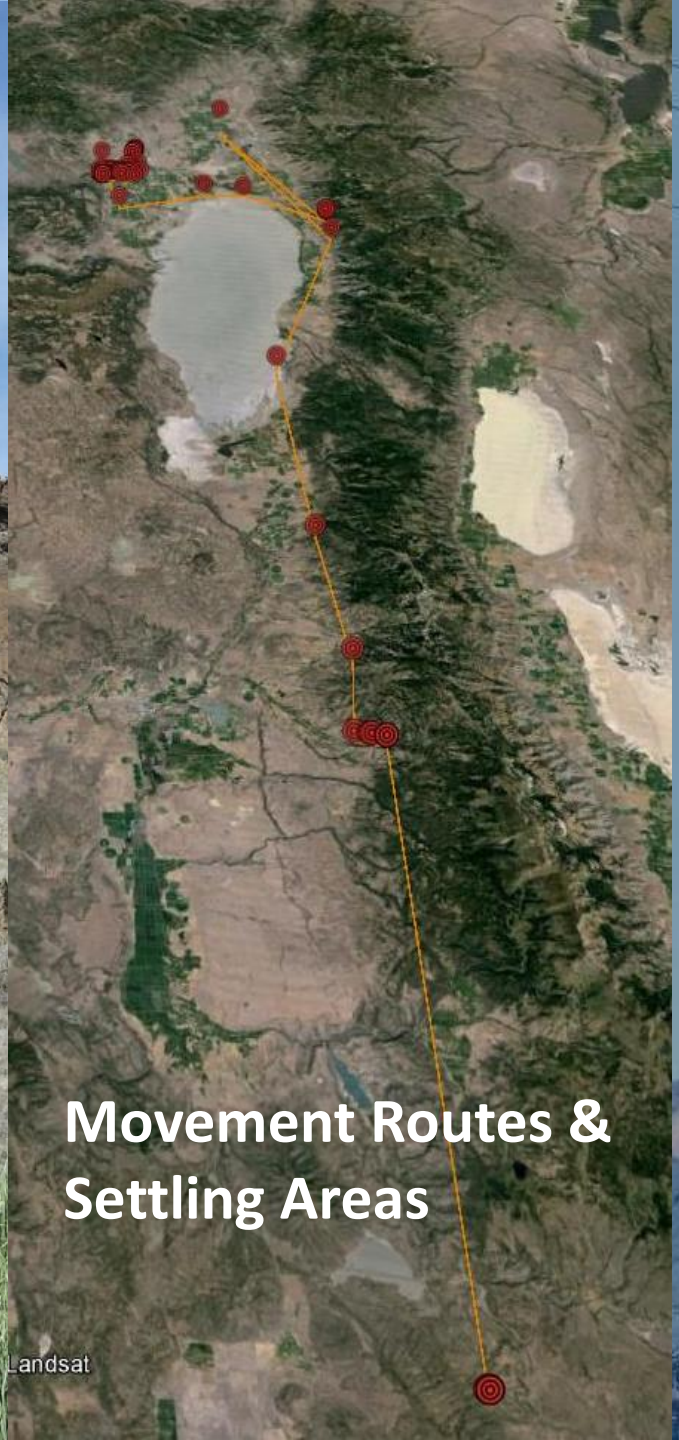
1. **Predictive Models of Golden Eagle distribution and relative abundance** during all seasons, life history stages
2. **Spatially explicit evaluation of risk factors** including exposure to contaminants, electrocution, collisions with vehicles, disturbance, and energy development
3. **Information Resources** to support management of Golden Eagles and their prey
4. **Incorporate 1-3 into Ecoregional Conservation Strategies**

Modeling for Conservation Planning

- **Objective –** Reliable spatial prediction of distribution and relative abundance of eagles
  Not quantification of *niche*!
- **Best available data (plus!) –** invest in data acquisition, then fill data gaps
- **Focus on evaluation of model performance** relative to objectives
- **Adaptive –** improvement of models through implementation and feedback

Breeding Areas

Photo: Brian Woodbridge



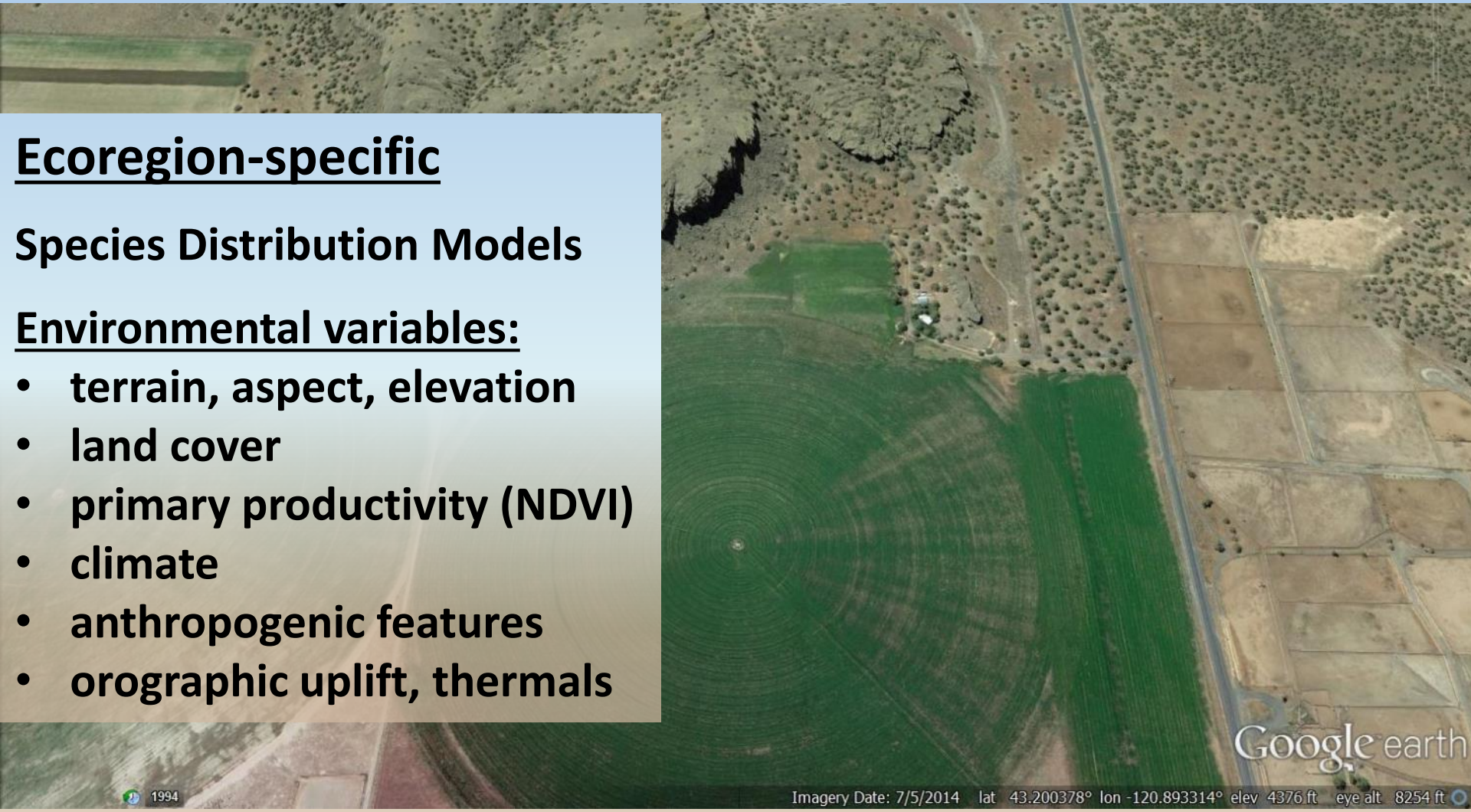
Wintering Areas

I. Predictive Models of Golden Eagle Breeding Habitat

Partners: Jeffrey Dunk & Dave LaPlante, Humboldt State University
Jason Tack & Barry Noon, Colorado State University

Modeling Approach

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

Spatial Data – Nest Sites

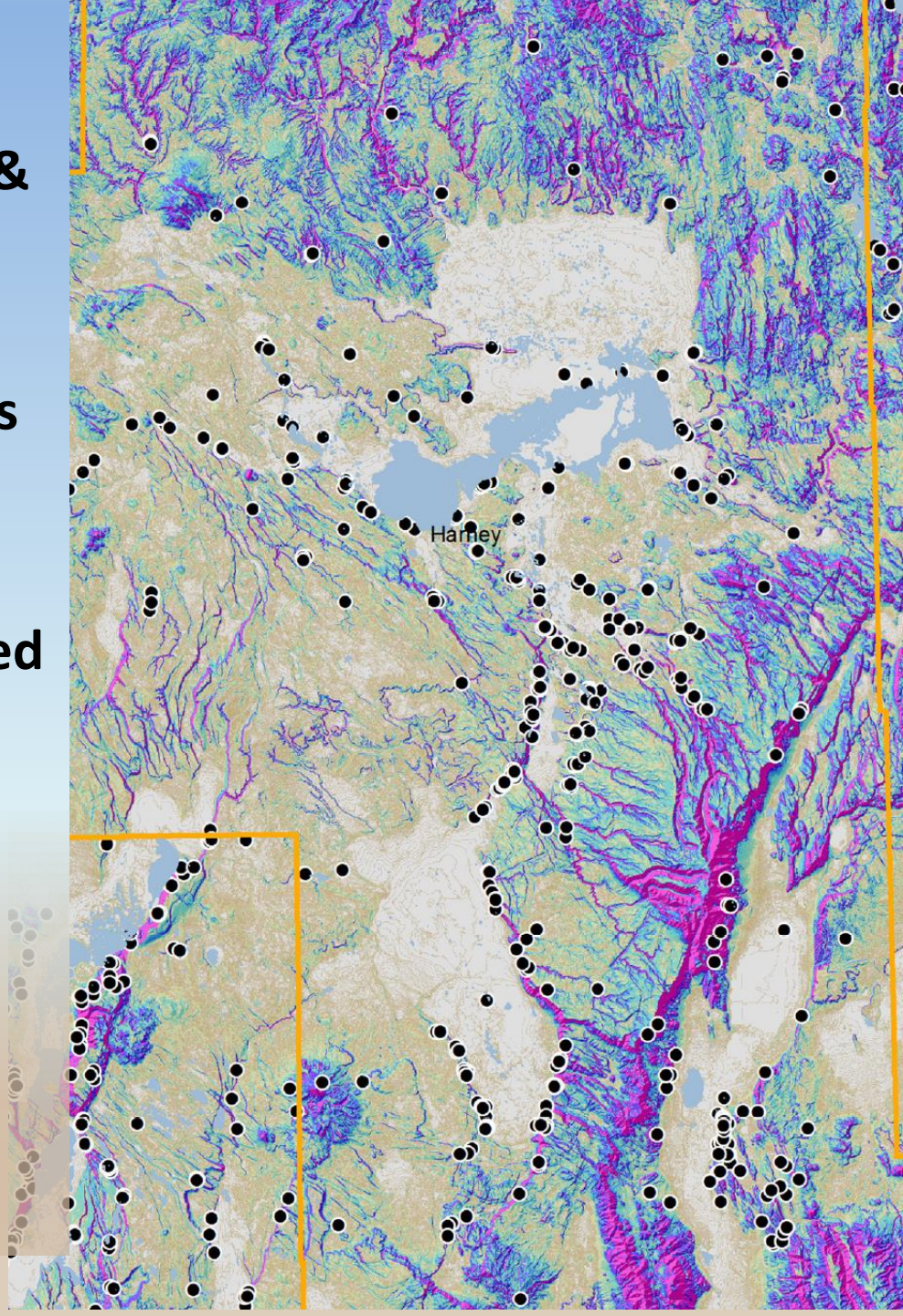
Compiled nest records from State & Federal agencies, NGOs, researchers, consultants

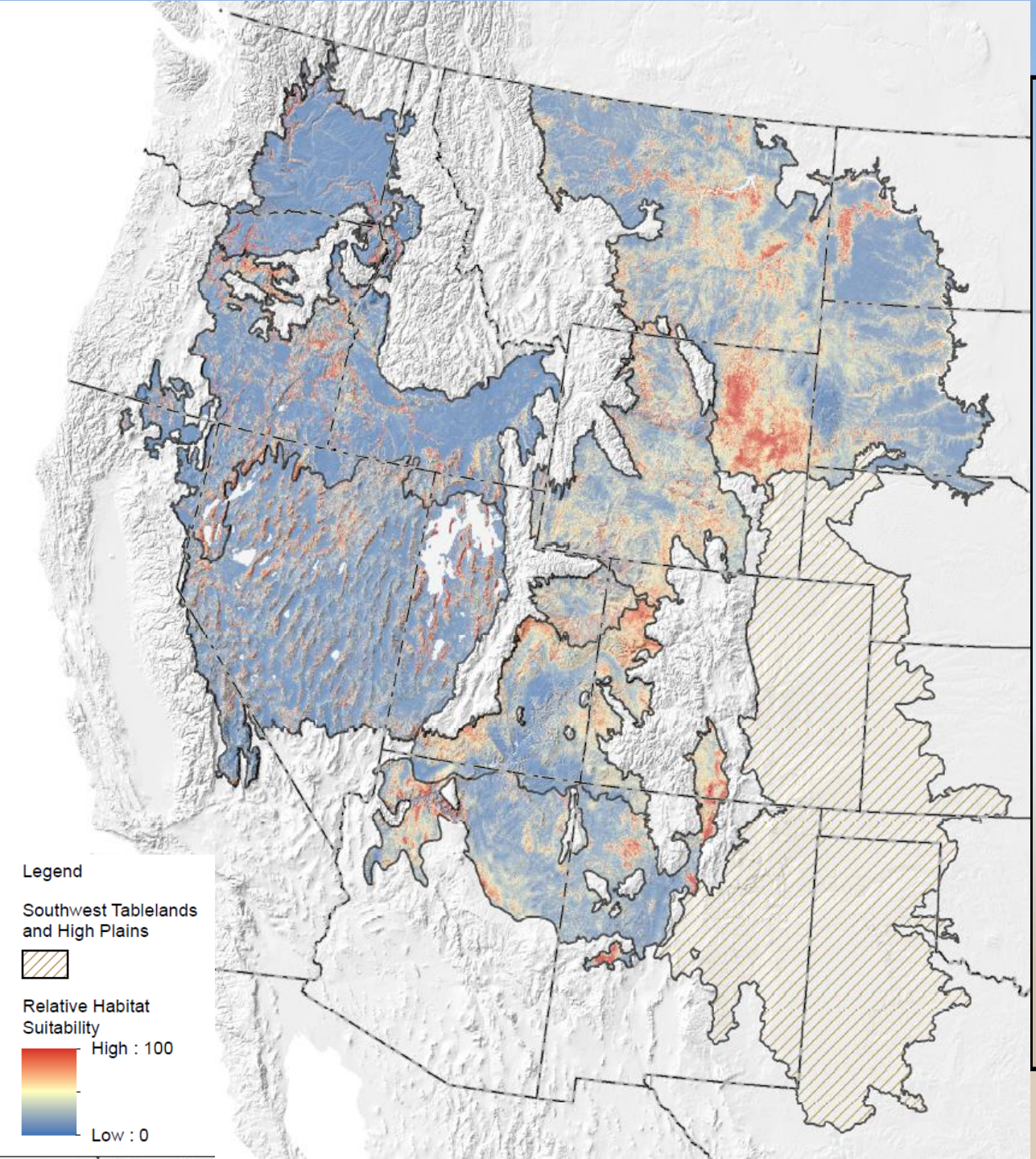
154 data sets; 107,604 nest records and counting…

Identified portions of ecoregions with few data, or poorly distributed data

In 2014 – 2016, WGET supported nest surveys in TX, OK, KS, MT, CA, OR, ID, UT, AZ, CO

Roughly 314 new nest locations were used to evaluate model performance





Composite of Ecoregional Models

Northwestern Great Plains

Wyoming Basin

Central Basin and Range

Northern Basin and Range

Columbia Plateau

Colorado Plateau*

Arizona/New Mexico Plateaus*

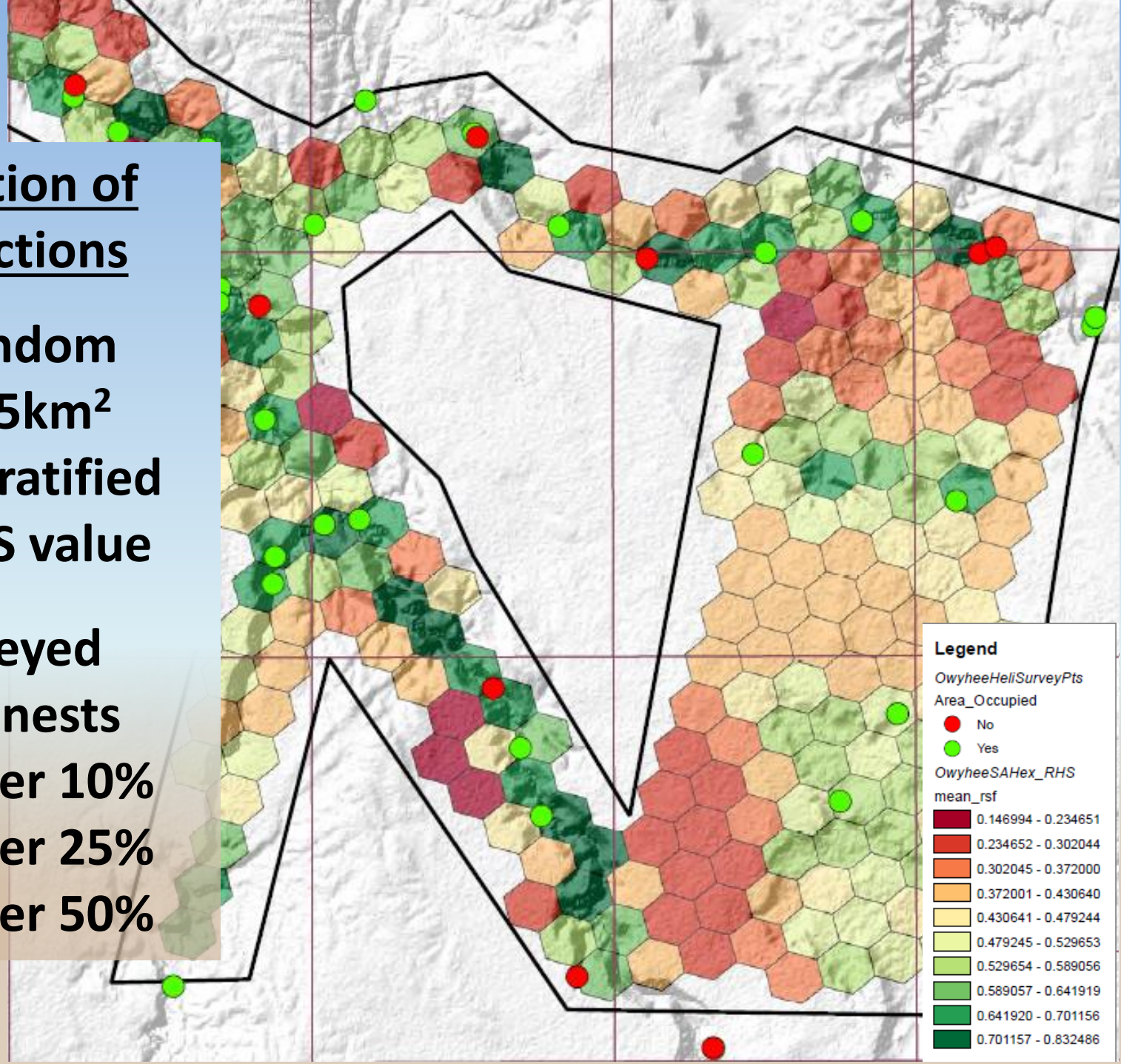
Western High Plains/ Southwestern Tablelands

Field evaluation of model predictions

Surveyed random sample of 2.5km² hexagons, stratified by mean RHS value

62 cells surveyed
37 occupied nests

- **29 in upper 10%**
- **33 in upper 25%**
- **37 in upper 50%**



II. Predictive Model of MID-WINTER Landscape Use by Golden Eagles

Partners: Leo Salas, Dennis Jongsomjit, Nathan Elliott & Sam Veloz
Point Blue Conservation Science

Eastern Cascades Audubon
Nevada Dept. of Wildlife
Hawkwatch International

Photo: Donna Delit

Modeling Approach

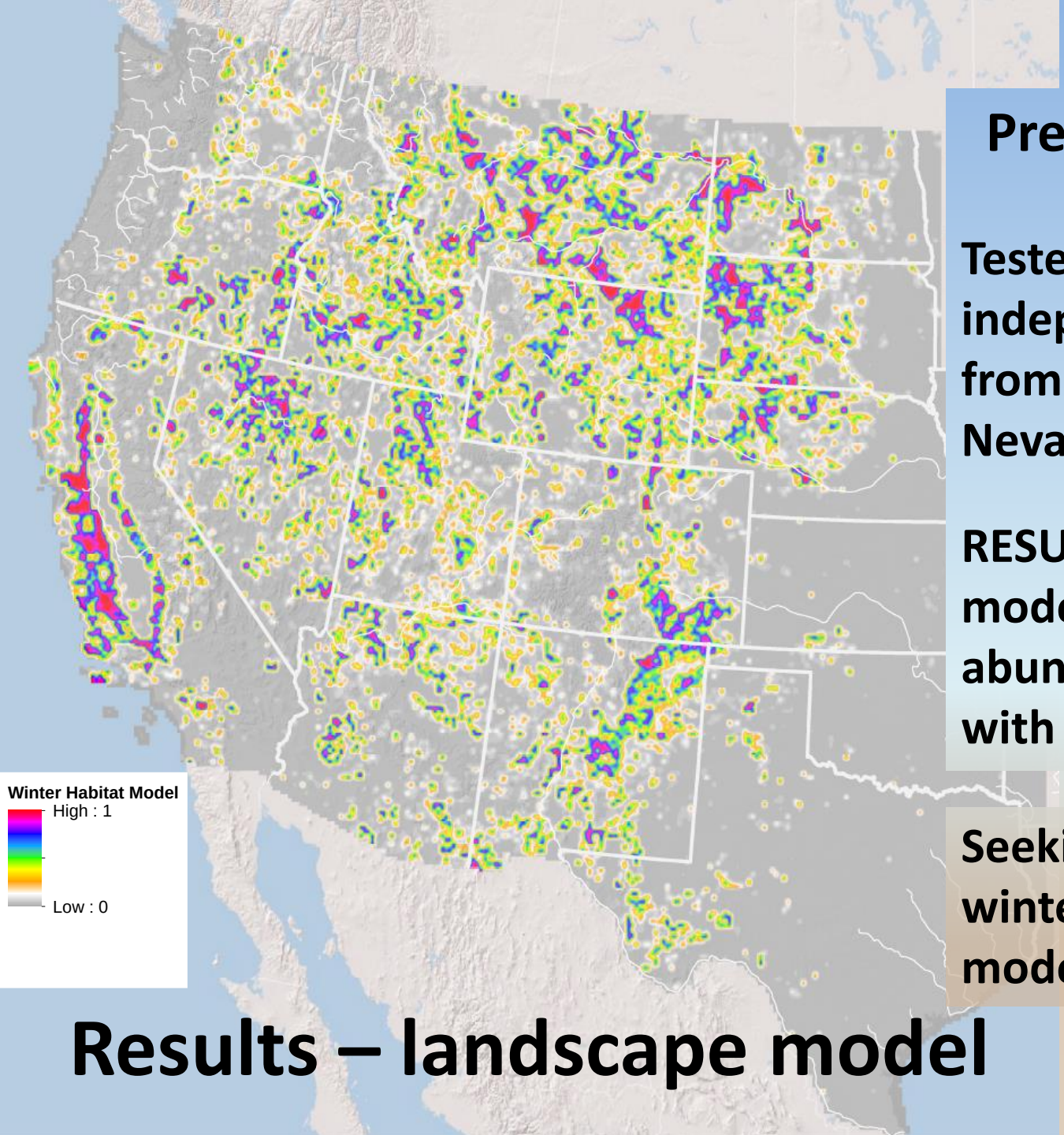
❑Data Sources:

- California Avian Data Center area searches
- Rocky Mountain Avian Data Center surveys
- eBird (AKN datasets - filtered appropriately)
- USFWS Mid-winter Bald Eagle survey

❑ Aggregated data by 10-km x 10-km cell to create survey history per cell

❑ Fit **Historic-Data Imperfect Detection Model** for mean occupancy rate

❑ Used **Boosted Regression Tree Model** to improve predicted occupancy model fit with environmental variables



Predictive Accuracy

Tested against independent datasets from Oregon, Idaho and Nevada

RESULT: the landscape models predict relative abundance (categorical) with 84% accuracy

Seeking additional winter survey data for model evaluation

Results – landscape model

III. Predictive Models of Golden Eagle Movements and Migration

Objectives -

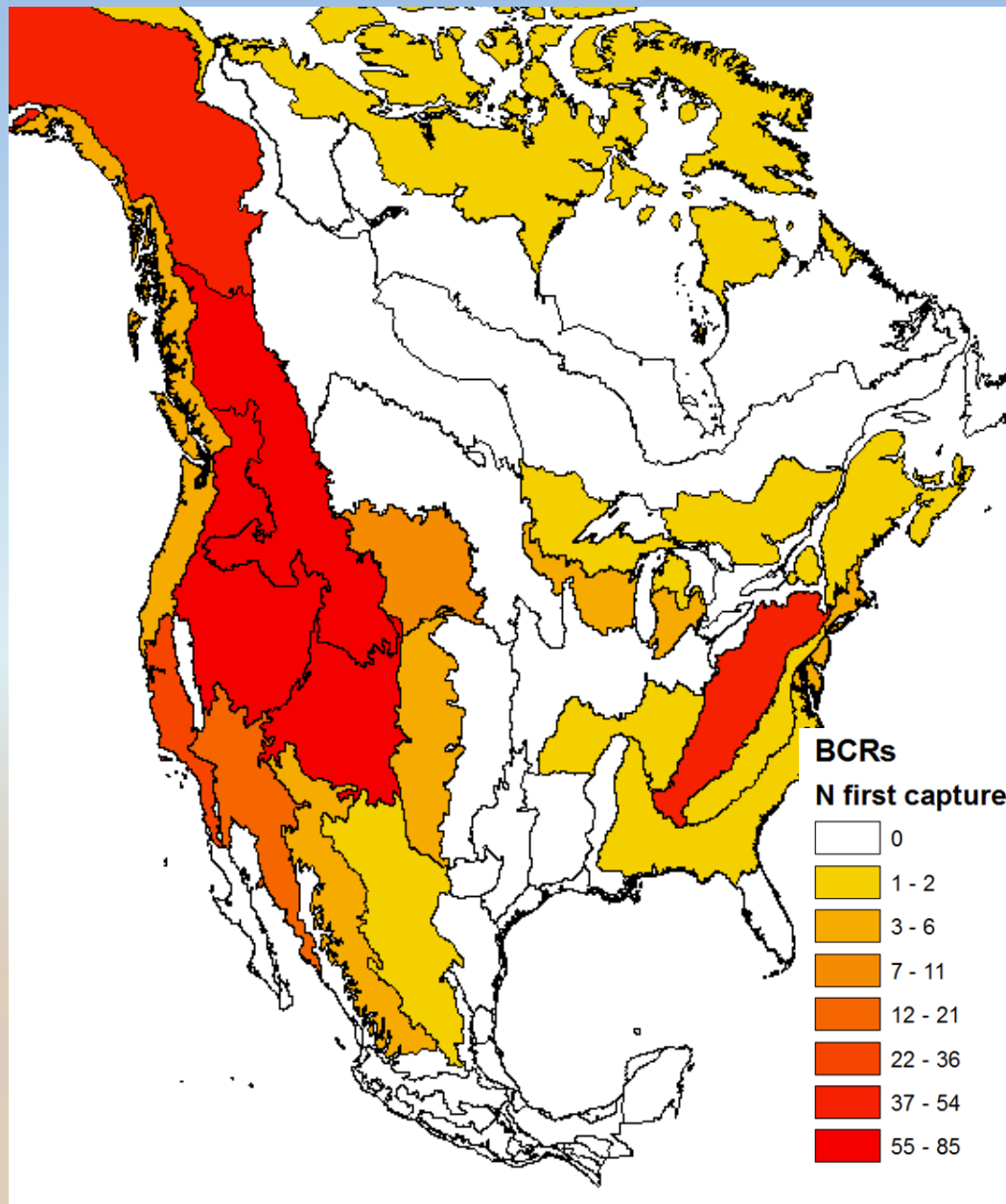
- ❑ **Step 1: Describe and map patterns of movement**
- ❑ **Step 2: Predictive model of movement 'habitat'**
- **Compile and analyze telemetry data (ARGOS, GPS, GSM) from cooperators throughout North America**
- **Focus on landscapes and ecological conditions disproportionately used for movement and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

Telemetry Meta-analysis…

- **Identified gaps in geographic distribution of satellite telemetry studies**
- **In 2014-2016 WGET deployed 72 GPS PTT on GOEA nestlings in WA, OR, CA, NV, AZ, ID, UT, MT**
- **FWS Regions 6 & 2 deployed 65 GPS PTT in CO, WY, MT, SD, NB, TX (2013, 2014)**

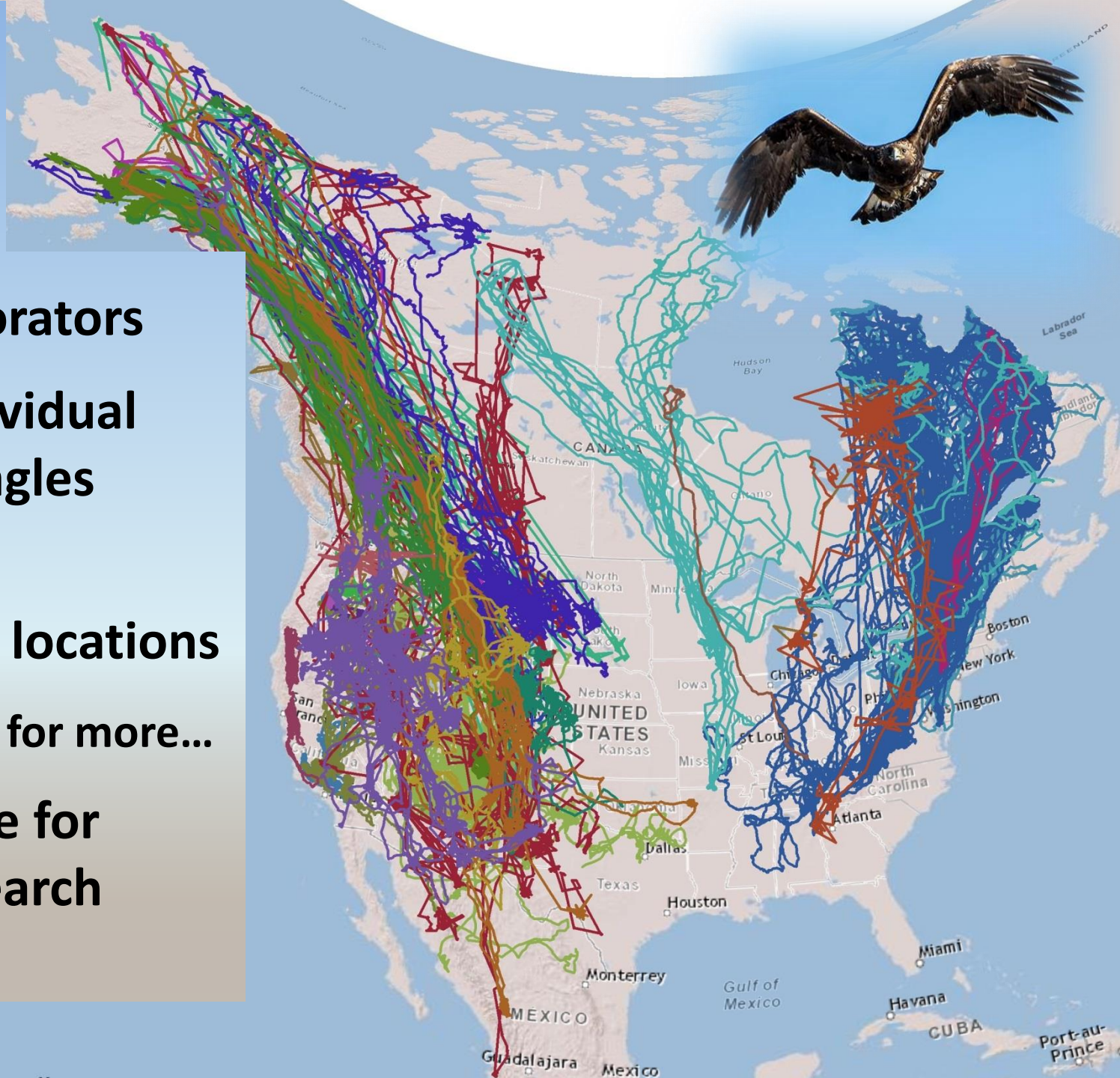


Current Status

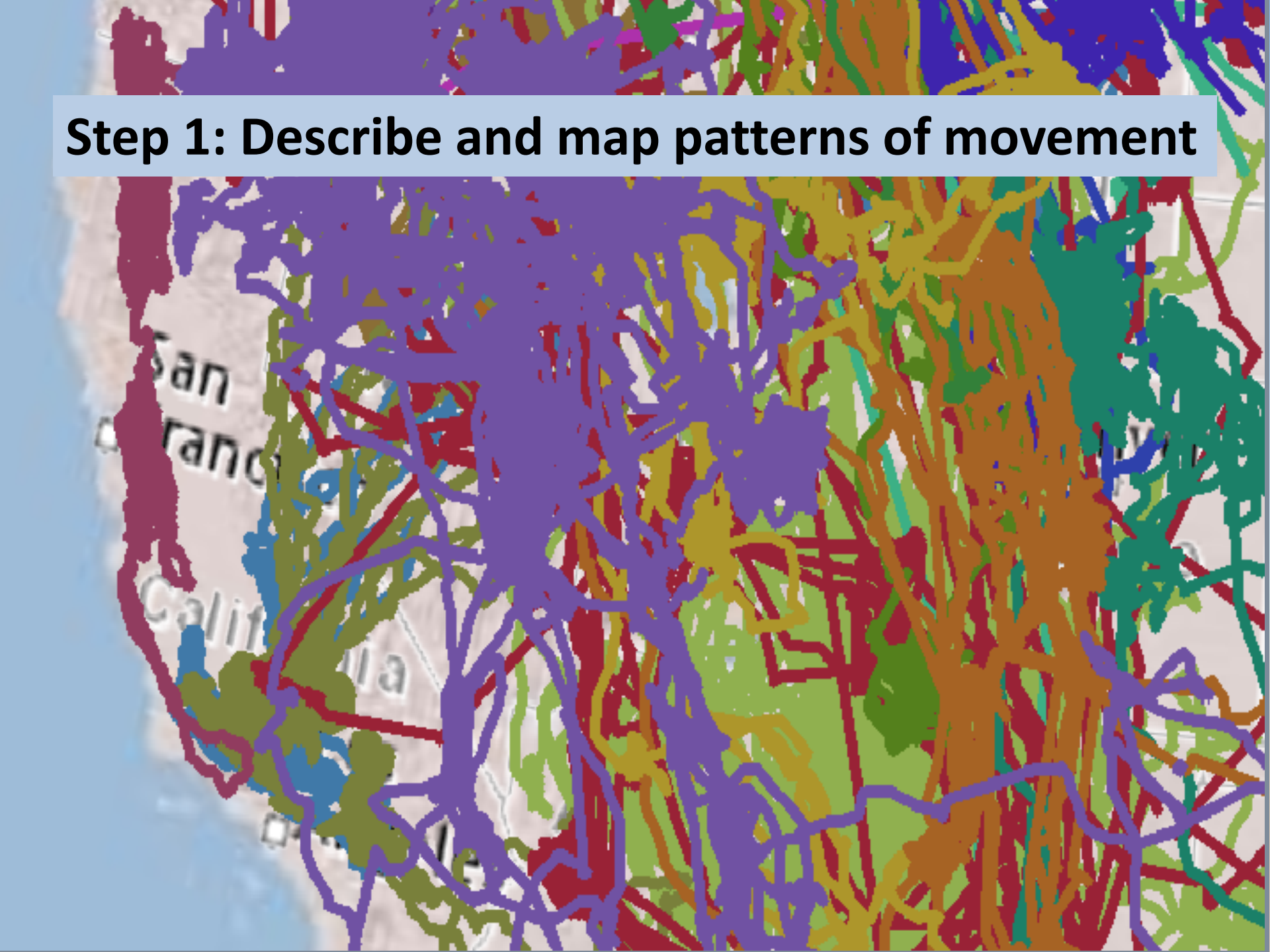
- 28 collaborators
- ~ 800 individual Golden Eagles tracked
- 4,960,946 locations

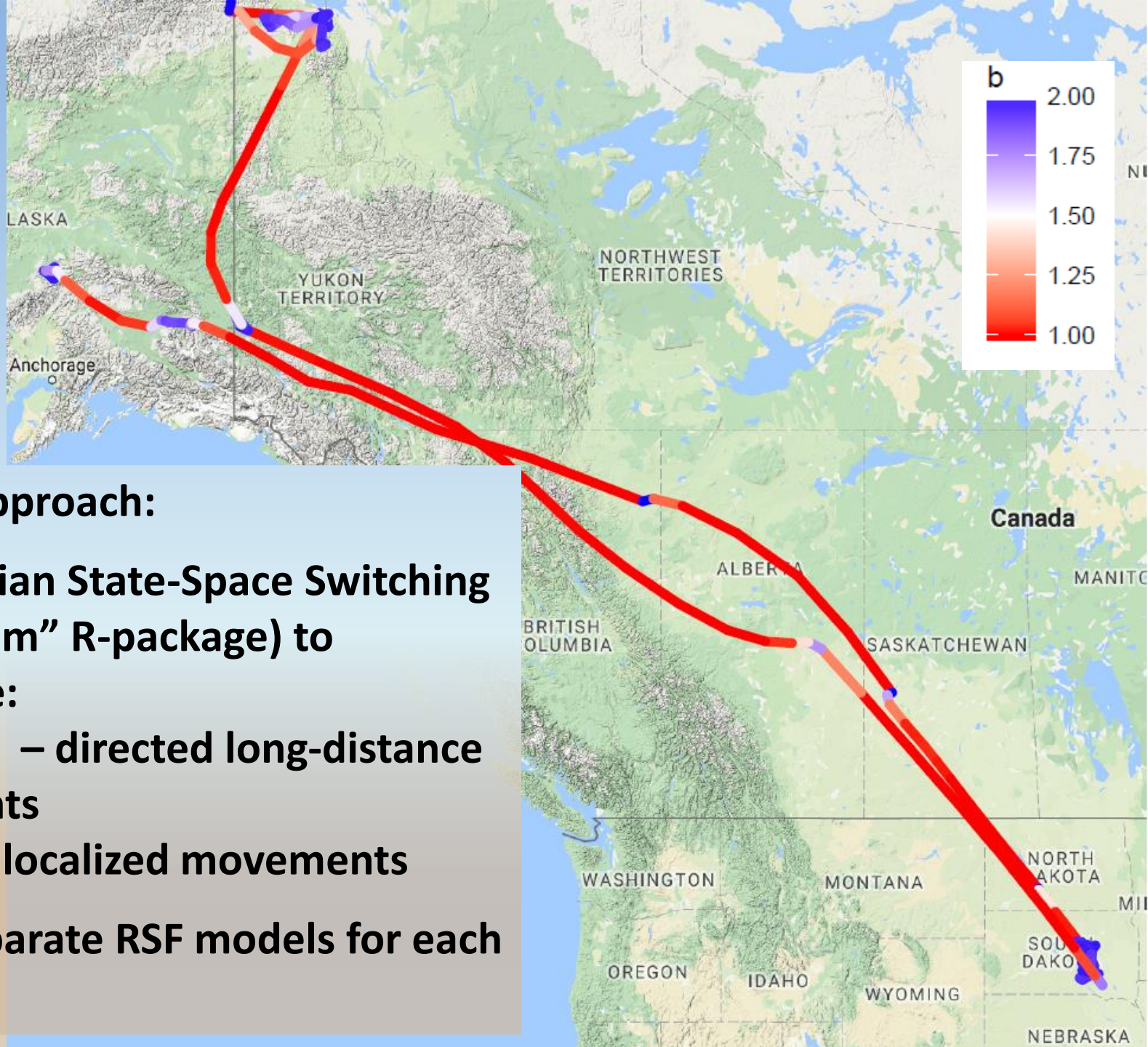
Always looking for more…

Data resource for multiple research projects



Step 1: Describe and map patterns of movement



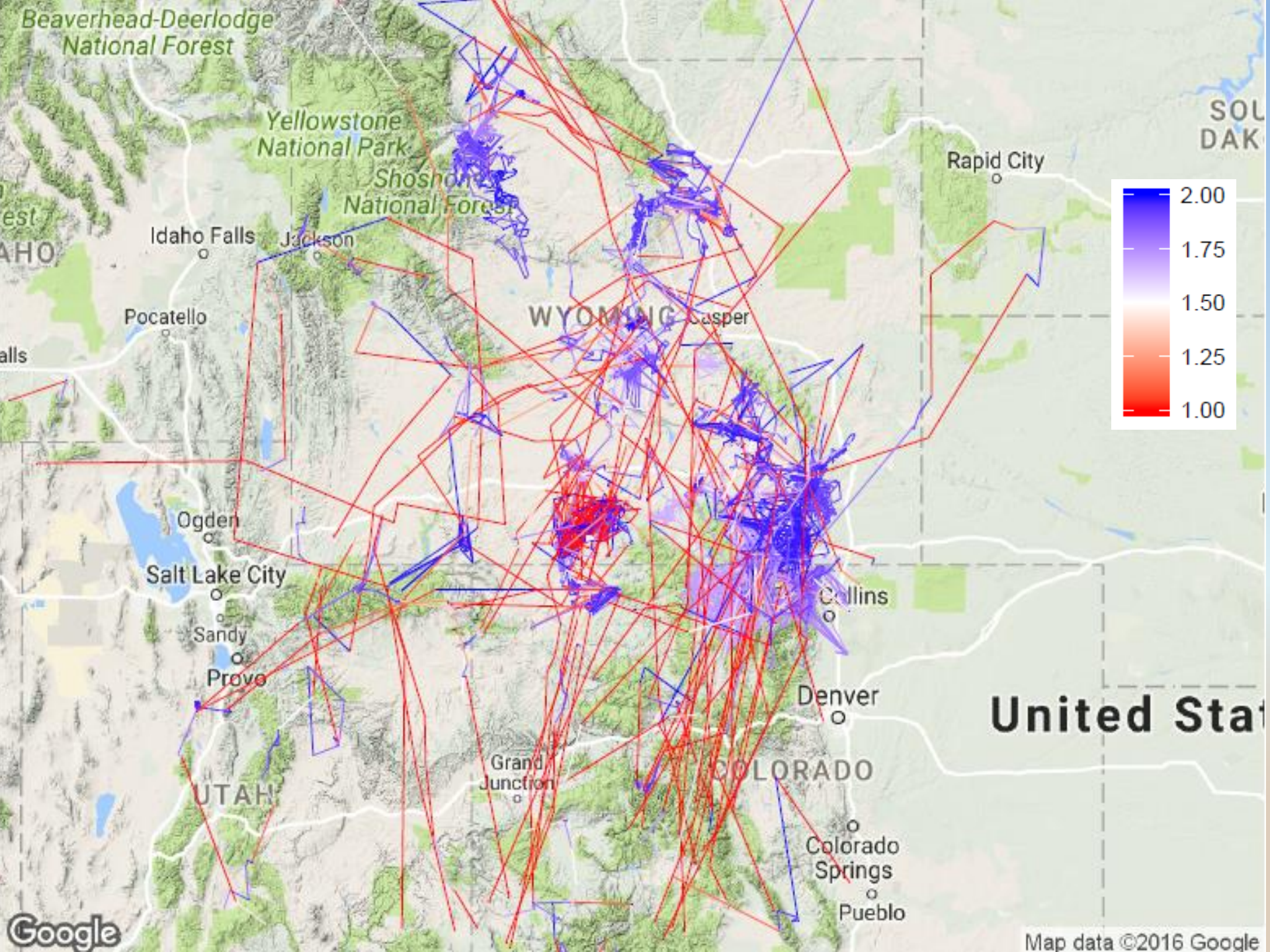


Modeling approach:

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

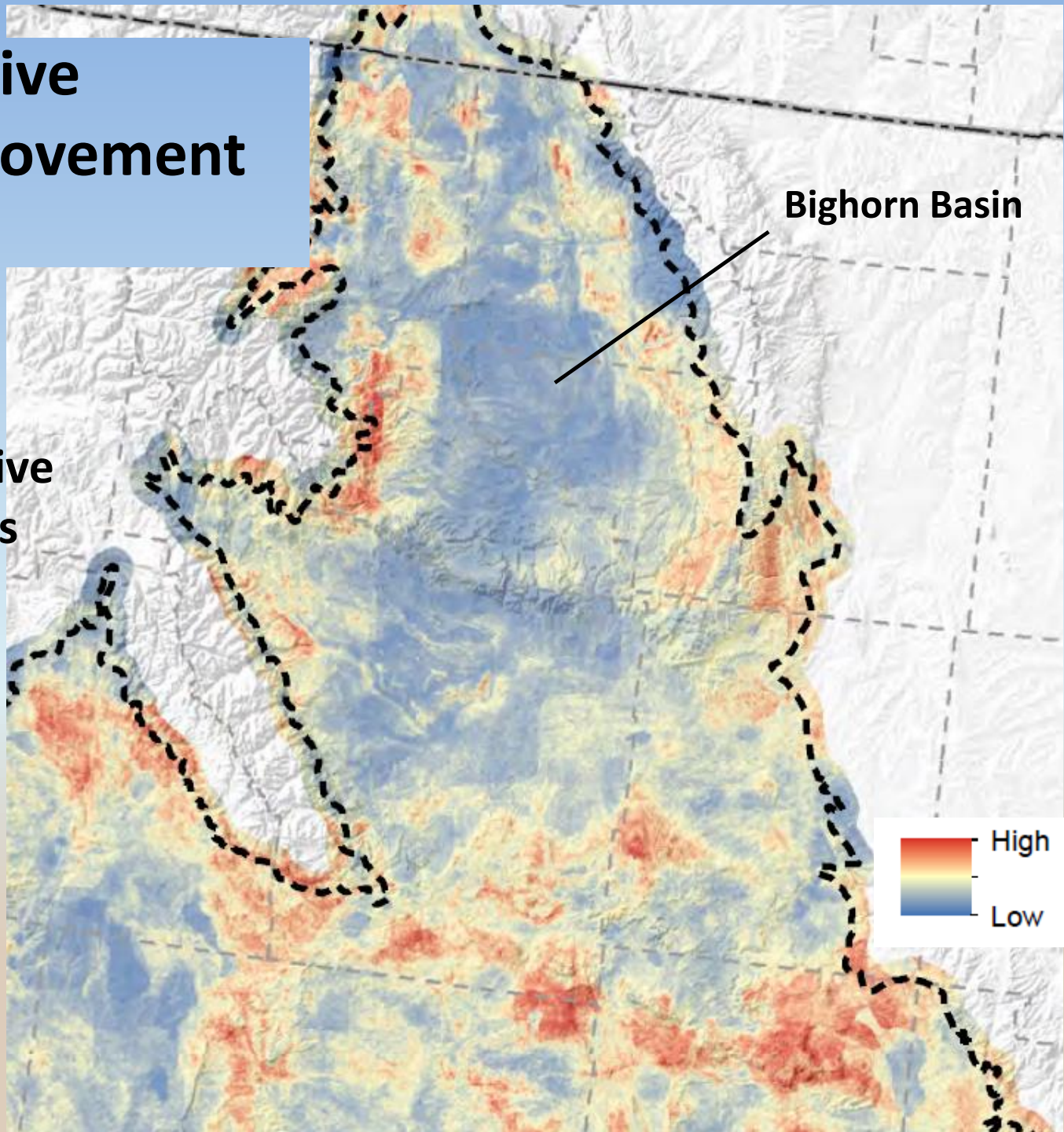
- **Transiting – directed long-distance movements**
- **Settling – localized movements**

Develop separate RSF models for each behavior


Beaverhead-Deerlodge
National Forest
Yellowstone
National Park
Shoshone
National Forest
Idaho Falls
Jackson
Pocatello
WYOMING
Casper
Rapid City
Ogden
Salt Lake City
Sandy
Provo
UTAH
Grand
Junction
COLORADO
Denver
Colorado
Springs
Pueblo
2.00
1.75
1.50
1.25
1.00
Google
Map data ©2016 Google

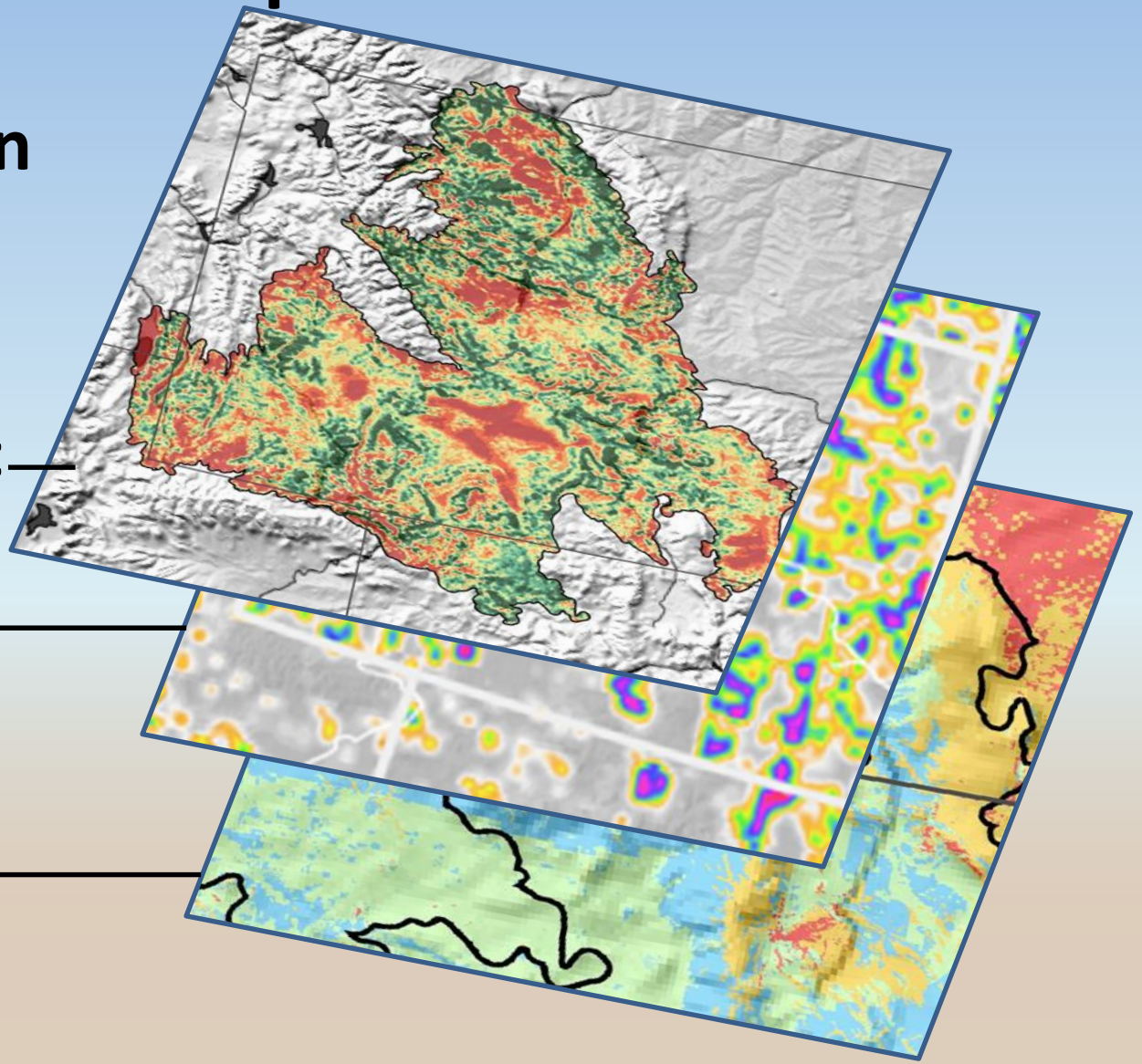
Step 2: Predictive modeling of movement areas

- Work in progress
- Compare alternative modeling methods
- Evaluate model performance with independent data from new deployments



Predicting Relative Risk of Golden Eagle Exposure to Development

Wyoming Basin



Breeding habitat

Winter habitat

Movement and Settling habitat

Spatially Explicit Evaluation of Risk Factors

Objective:

Support prioritization and effectiveness of mitigation efforts

Evaluation and predictive modeling of stressors:

- Electrocution
- Contaminants
- Collisions on roads
- Disturbance
- Disease and parasites

USFWS photo

Electrocution and Mitigation

- **Review and Synthesis of Research Investigating and Mitigating Golden Eagle Electrocutions**
  EDM International
- **Power Pole Density Informs Spatial Prioritization for Mitigating Avian Electrocution**
  Dwyer et al. 2016 Journal of Wildlife Management
- **Avian Electrocution Risk Assessment Predictive Model** *EDM International*
- **Avian Electrocutions on Incorrectly Retrofitted Power Poles** *Dwyer et al. (in prep.)*

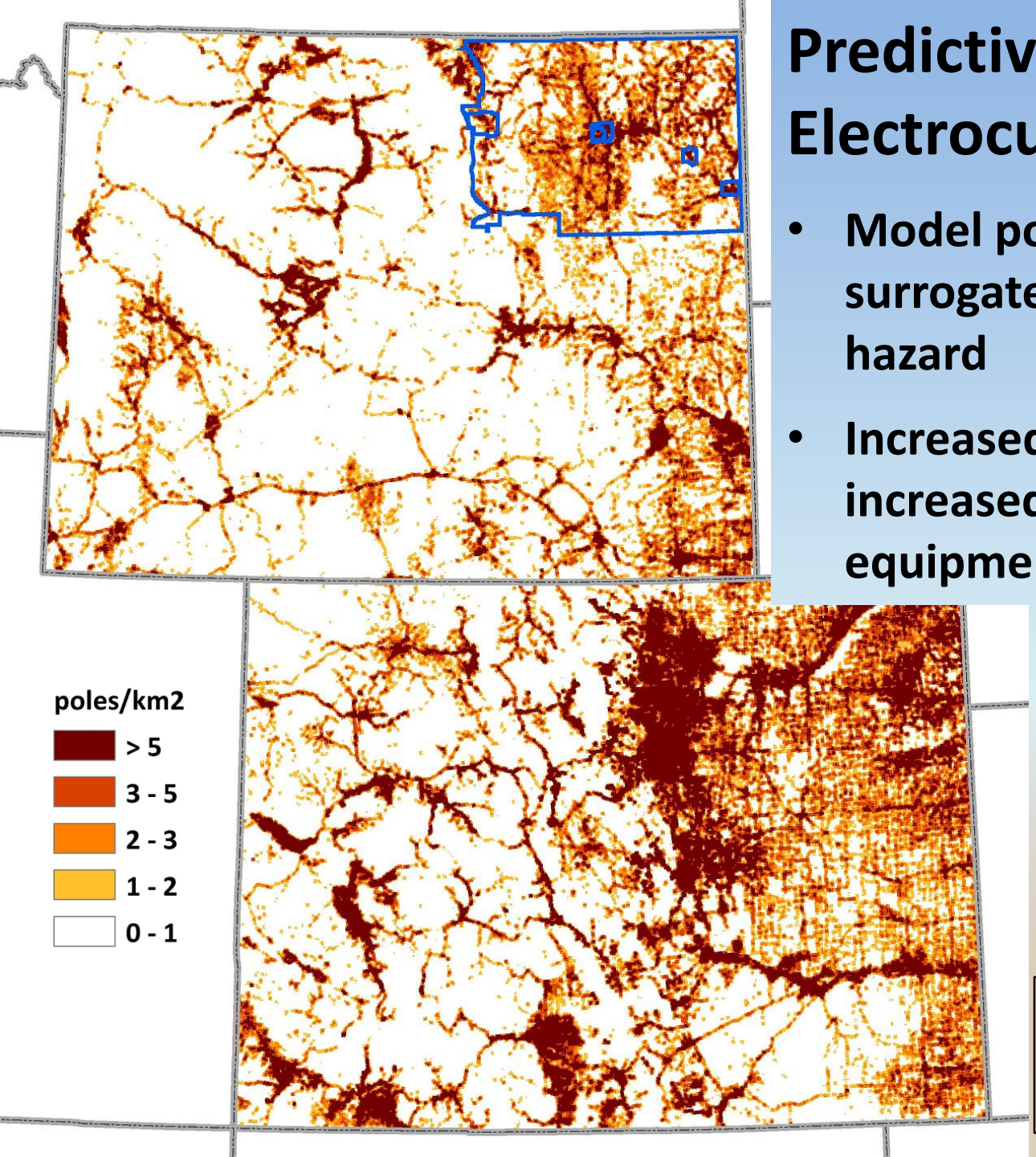
Partners: APLIC, Powder River Electric Corp.

Predicting Landscape-scale Electrocution Risk for Mitigation and Proactive Retrofit Planning: A Pilot Study

Photo: Sky Delite

Predictive Model of Electrocution Hazard

- Model power pole density as surrogate for electrocution hazard
- Increased PPD correlated with increased complexity of equipment (= hazard)



CO/WY Model accurately predicts pole density

Partner:
James Dwyer, Rick Harness
EDM International

Evaluation of Model Performance

NE Wyoming

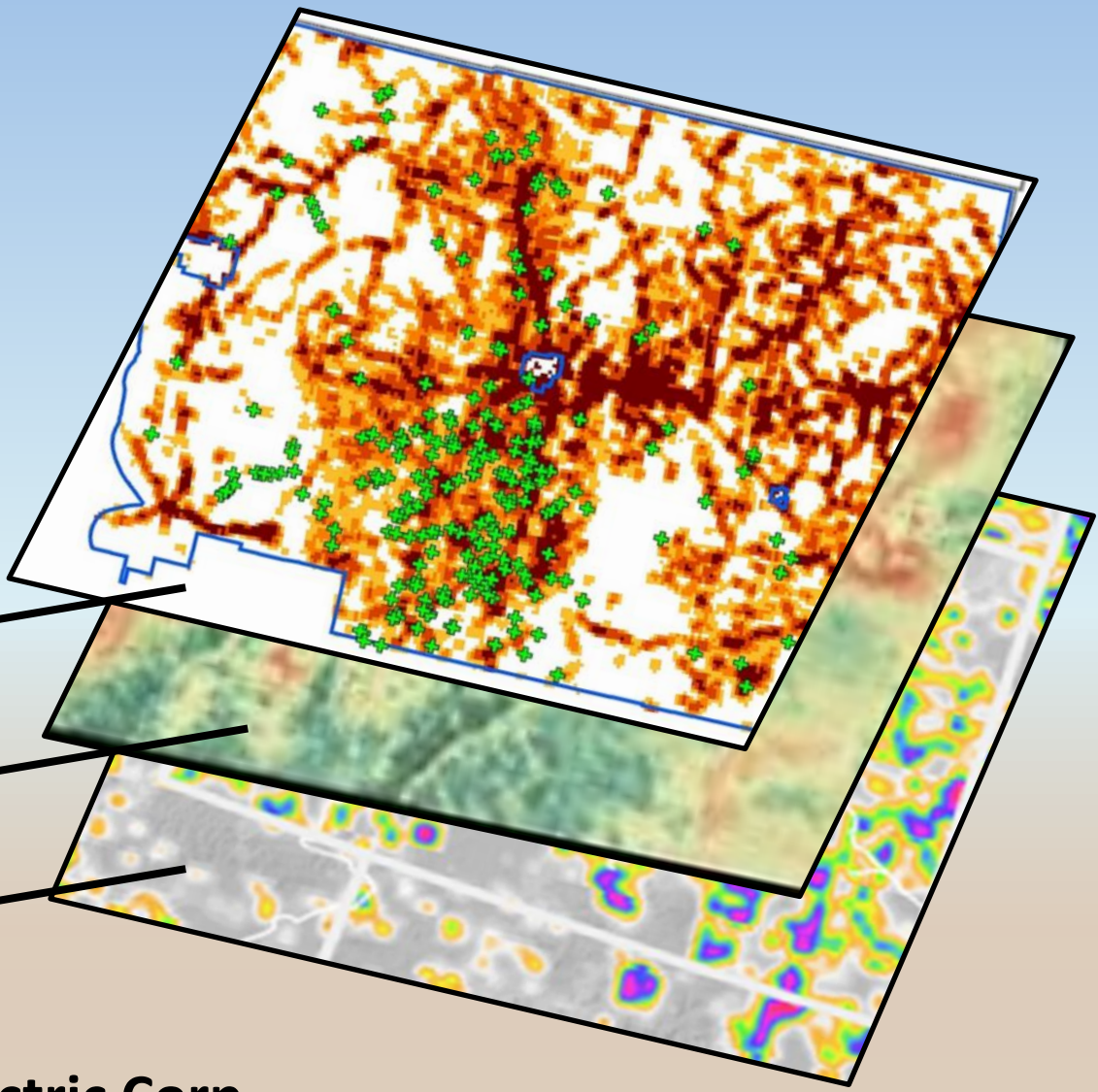
282 Golden Eagle electrocution mortalities ✚

Compared with:

Hazard model

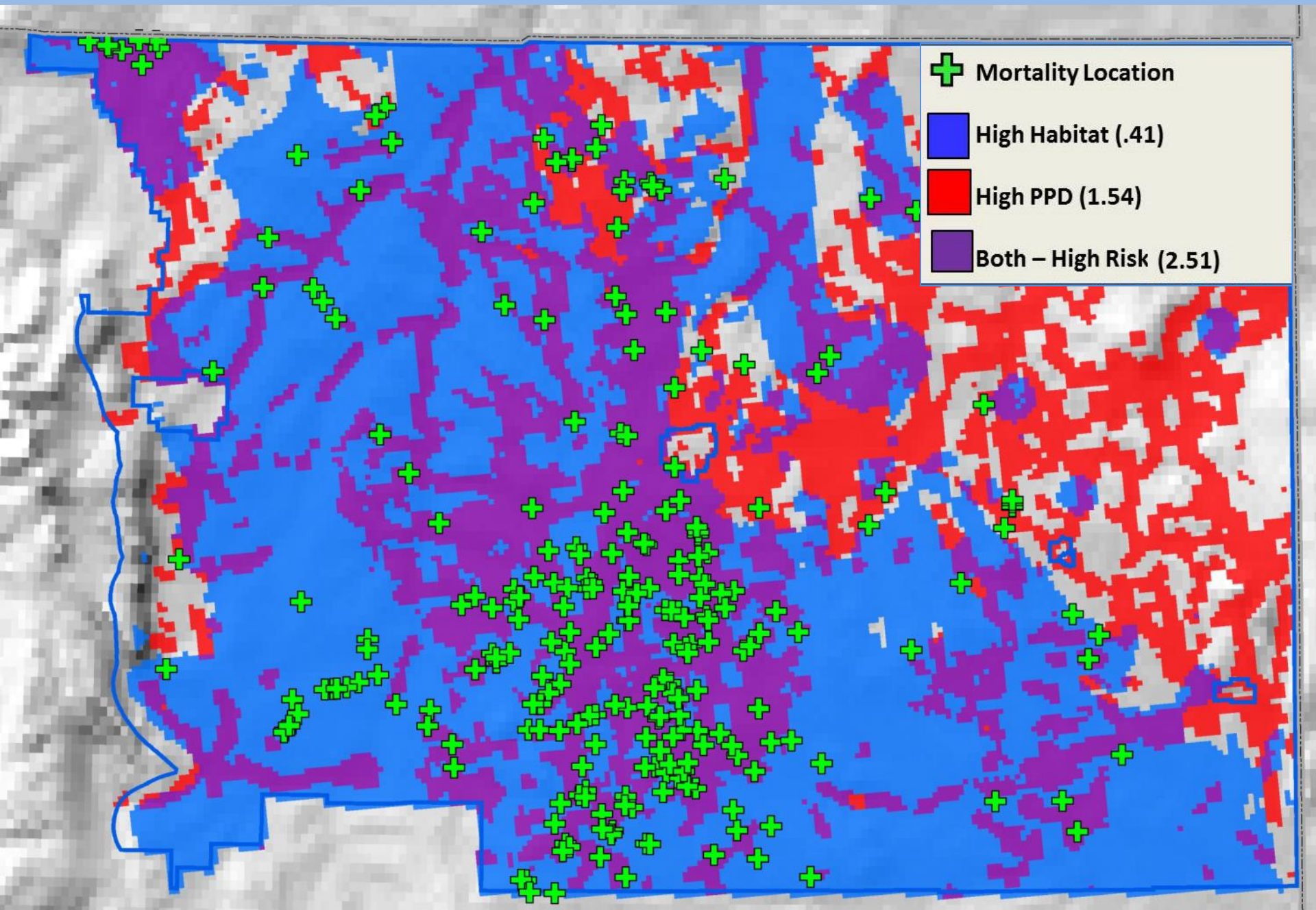
Breeding model

Winter model



Partner: Powder River Electric Corp.

Risk: Interaction of Exposure with Hazard



Contaminants and Mitigation

- **Role of contaminants in Golden Eagle populations: assessment report**

  USGS-FRESC, USFWS Contaminants Specialists

- **Evaluating exposure to lead, anticoagulant rodenticides and other contaminants in Golden Eagles**

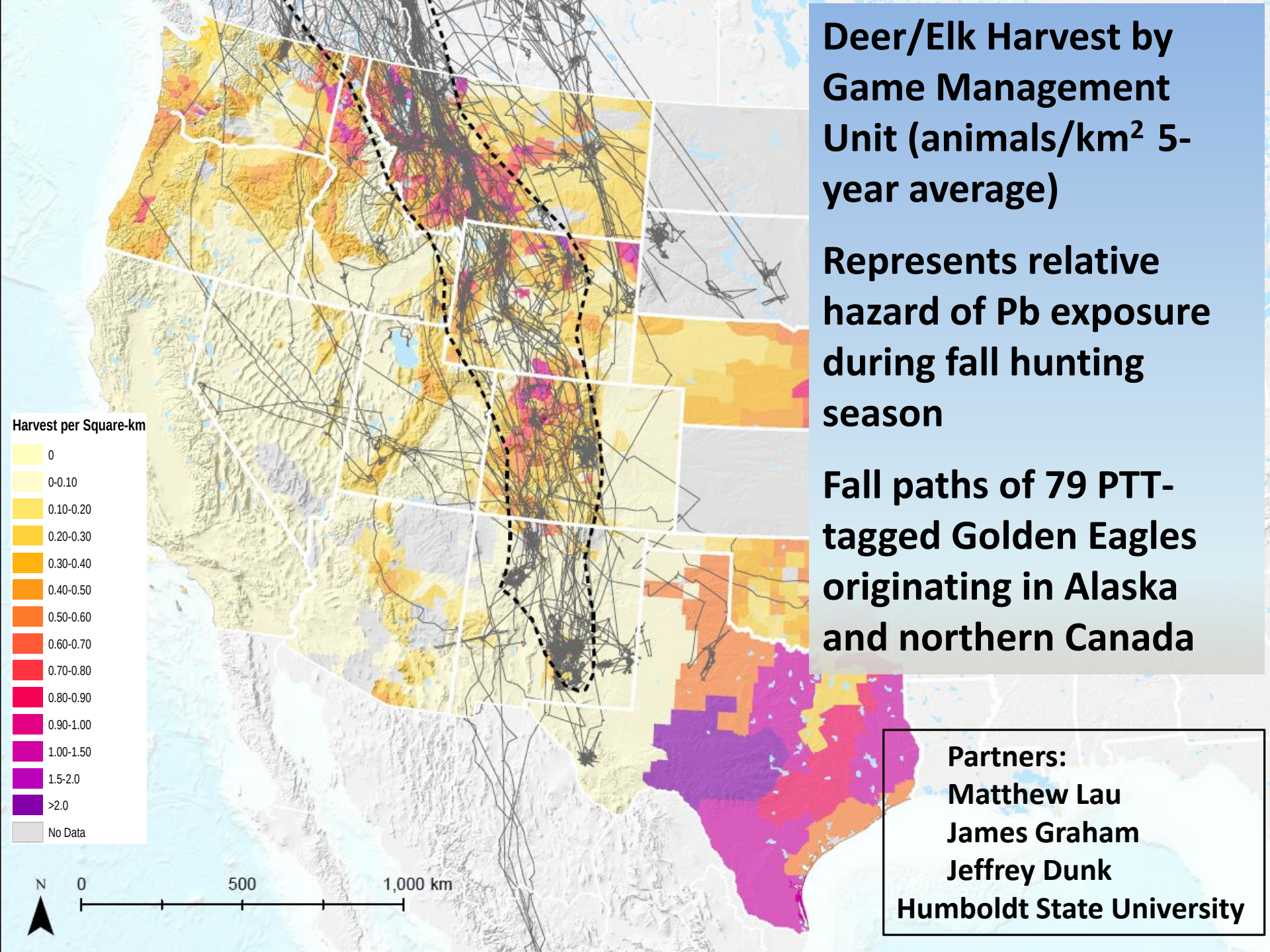
  USGS National Wildlife Health Center, USFWS Region 6 and USFWS Ashland Forensics Laboratory

- **Mapping relative availability of hunter-killed carrion and potential Pb exposure in Western U.S.**

  Humboldt State University

Predicting Potential Lead Exposure from Hunter-killed Big Game Remains

Photo: Todd Katzner, USGS



Deer/Elk Harvest by Game Management Unit (animals/km² 5-year average)

Represents relative hazard of Pb exposure during fall hunting season

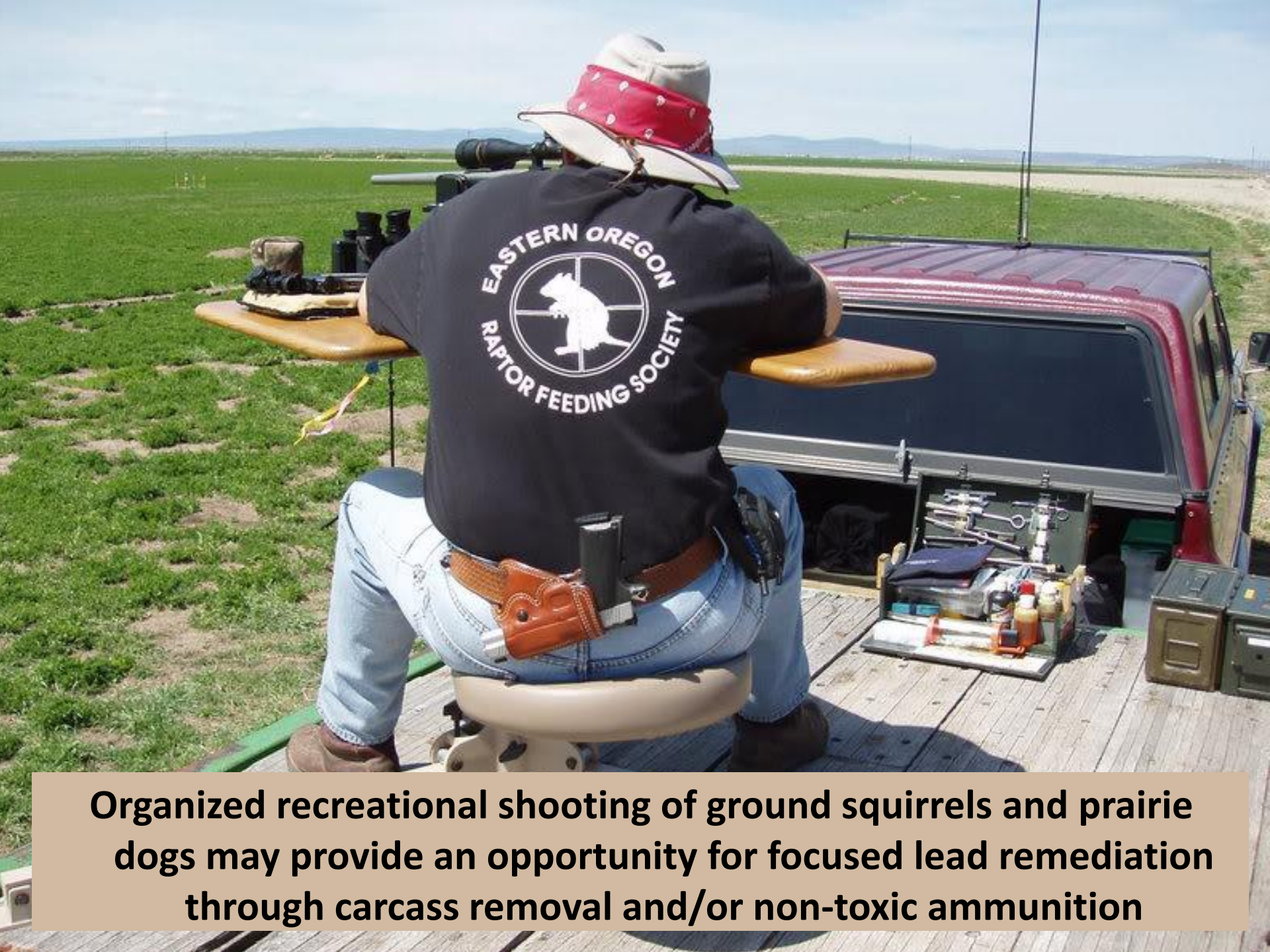
Fall paths of 79 PTT-tagged Golden Eagles originating in Alaska and northern Canada

Partners:
Matthew Lau
James Graham
Jeffrey Dunk
Humboldt State University

Quantifying GOEA exposure to lead at recreational ground squirrel shooting areas

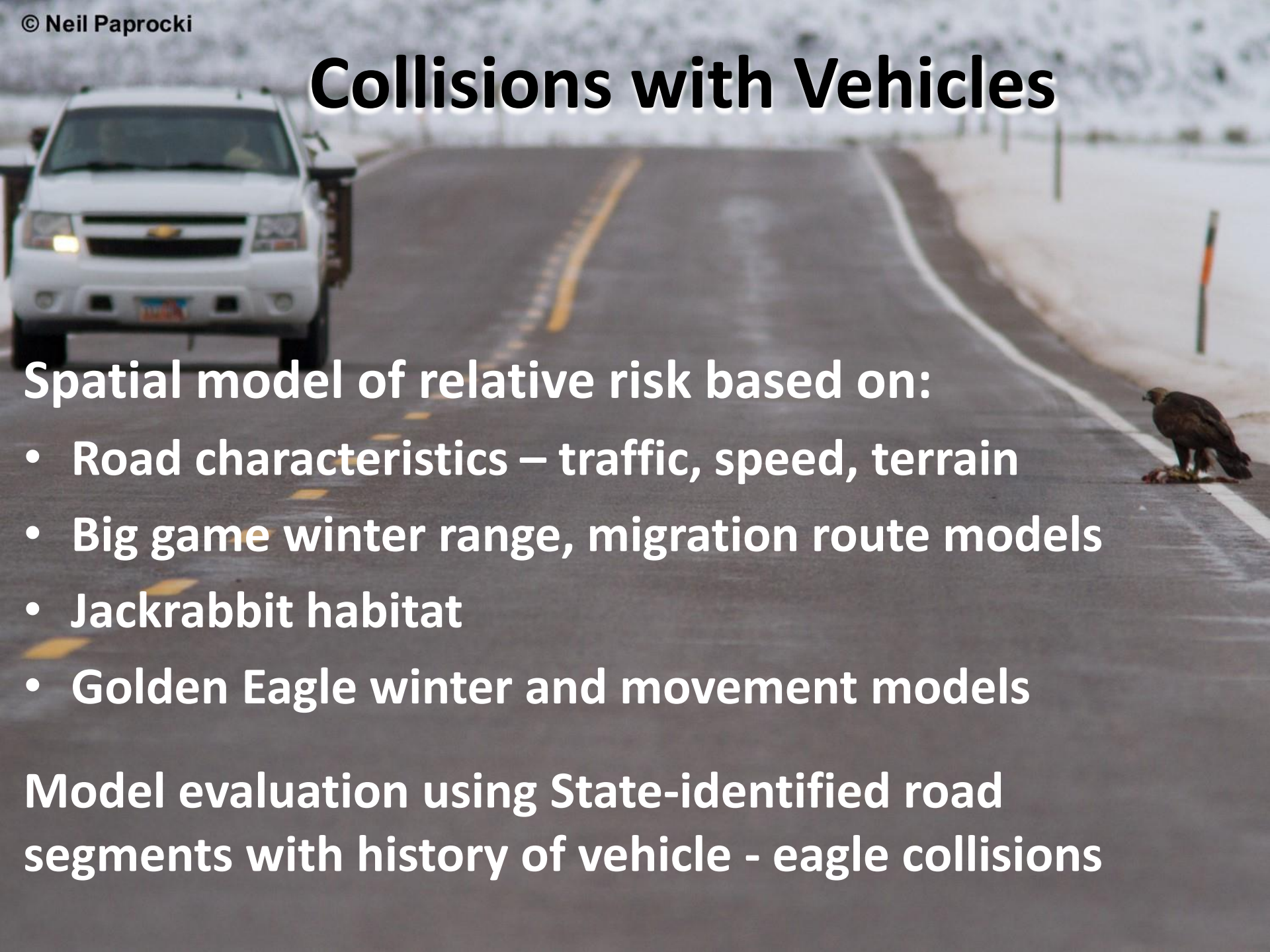
- Sample sites in E. Oregon (Harney Co.) and N. California (Siskiyou Co.)
- Analyzed 180 squirrel carcasses for Pb
- Blood samples from 209 raptors captured at shooting sites
- 150 blood samples from 90 GOEA nestlings at 60 nests
- 273 scavenger observation surveys

Partners: Collin Eagles-Smith and Garth Herring, USGS-FRESC
Oregon Eagle Foundation,
Oregon High Desert Museum



Organized recreational shooting of ground squirrels and prairie dogs may provide an opportunity for focused lead remediation through carcass removal and/or non-toxic ammunition

Collisions with Vehicles



Spatial model of relative risk based on:

- **Road characteristics – traffic, speed, terrain**
- **Big game winter range, migration route models**
- **Jackrabbit habitat**
- **Golden Eagle winter and movement models**

Model evaluation using State-identified road segments with history of vehicle - eagle collisions

Habitat Management and Mitigation

Information resources for landscape-specific management of Golden Eagles

- Prey resources
- Nest sites, nest survival, disturbance
- Mortality factors

Golden Eagle Diets, Prey Communities, and Prey Management

Information resources for habitat management and mitigation

Photo: Sky Delite

Information Resources for Prey Management

- **Spatial and Temporal Patterns in Golden Eagle Diets in the Western United States, with Implications for Conservation Planning** *USFWS - Bedrosian et al. In review*
- **Golden Eagle Dietary Responses to Habitat Alteration in the Morley Nelson Snake River Birds of Prey Area**
  USGS - Kochert et al. In press
- **A Retrospective Meta-analysis of Jackrabbit and Cottontail Populations in the Western United States**
  USGS - Esque et al. in review
- **Black-tailed and White-tailed Jackrabbits in the American West: History, ecology, ecological significance and survey methods** *USGS – Simes et al. 2015*

- **Prey Species Accounts:**

  Ecology, populations, habitat relationships, and management of key prey species

- **Golden Eagle Prey Enhancement Model**

  WGET collaboration with AWWI

- **The Influence of Greater Sage-grouse Management on Golden Eagles in the Wyoming Basin**

  WGET collaboration with Jason Carlisle & Trent McDonald, WEST, Inc.

Photos: Sky Delite

Nest Site Management

- **Moving nests, artificial nests**
- **Enhancing existing nests and nest sites to improve nest survival**
- ***Effect of Exposure and High Temperatures on Golden Eagle Nest Success in SE Idaho*** USGS & WGET

USFWS photo

Disturbance: Effects and Management

- **Expert elicitation, and review and synthesis of research on disturbance effects to Golden Eagles**
  Humboldt State University, USFWS Eagle Technical Assistance Team
- **Modeling population effects of disturbance to breeding Golden Eagles in SW Idaho**
  Pauli, Spaul and Heath, Boise State University
- **Recreation disturbance to Golden Eagles: Biological consequences, behavioral mechanisms, and management implications**
  Spaul and Heath, Boise State University

Ecoregional Conservation Strategies

- **Combine ecoregion-specific models, risk assessments and information resources**
- **Developed with collaboration by State and federal agencies, Flyways, research institutions, industry, Tribes, NGOs**
- ***In progress:*** **Northern Basin & Range, Wyoming Basin, Central Basin & Range, Northern Great Plains**
- ***When complete*****, available online through ECOS-IPAC , USFWS-WGET web site**

Take home message…