USING LANDSCAPE SCALE ESTIMATES OF RELATIVE ELECTROCUTION RISK TO INFORM PRIORITIZATION OF RETROFITS:

AN EXAMPLE WITH GOLDEN EAGLES

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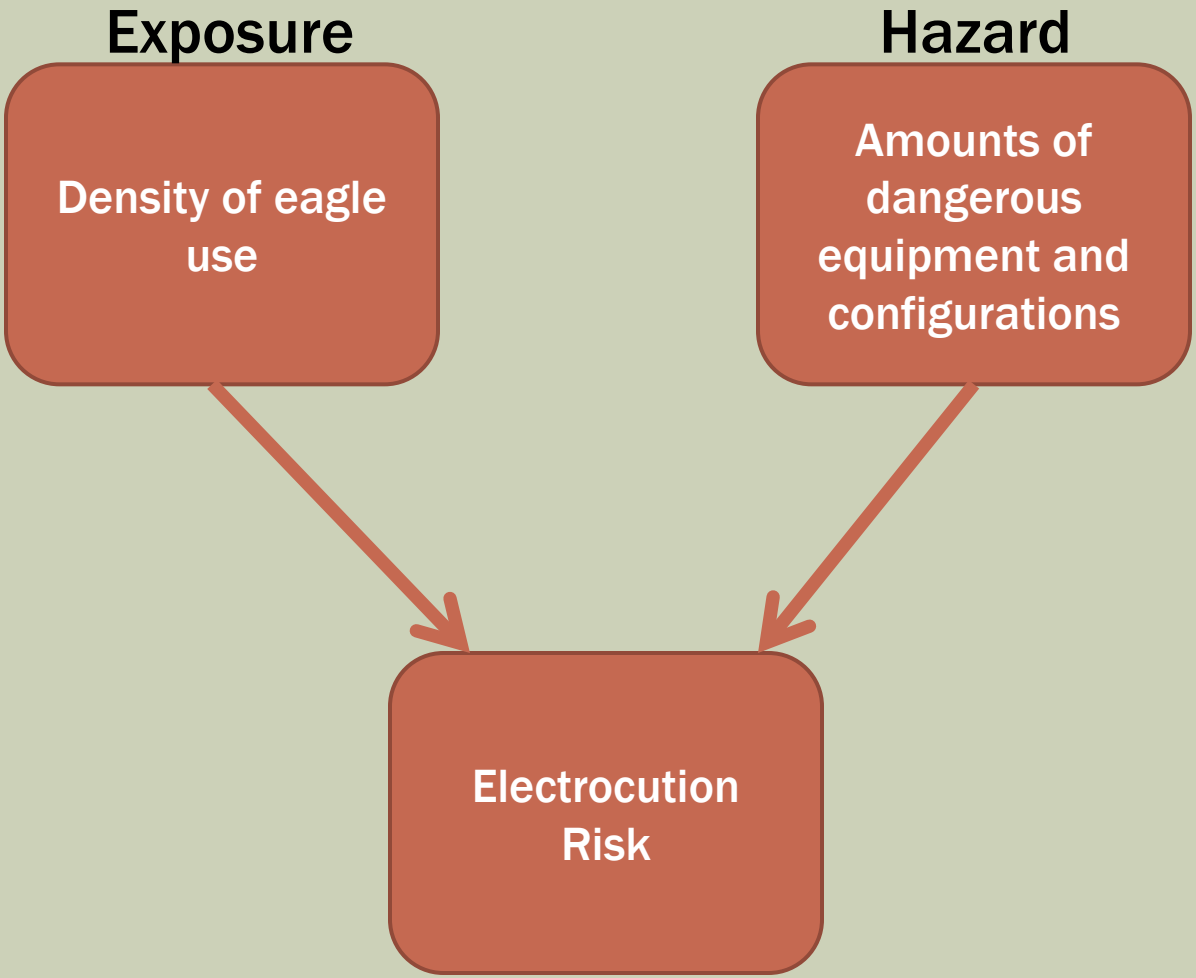
AVIAN ELECTROCUTION

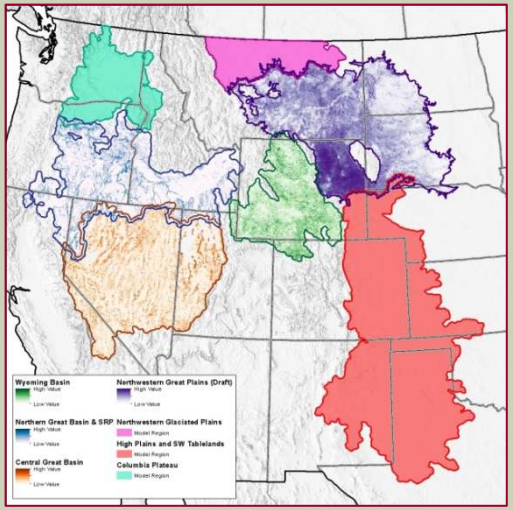
- Recognized problem since at least the 1970s
- Retrofitting is the most frequent solution and has been ongoing for decades
- Electrocution still among leading causes of death of golden eagles (Millsap, unpubl.)
- Retrofitting is often reactive rather than proactive

COMPONENTS OF ELECTROCUTION RISK

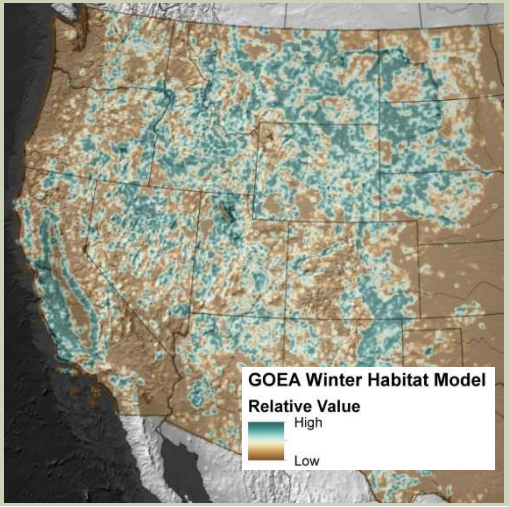


MODELS OF GOLDEN EAGLE HABITAT AND DISTRIBUTION

- Relative suitability of breeding habitat
  - Ecoregion-based

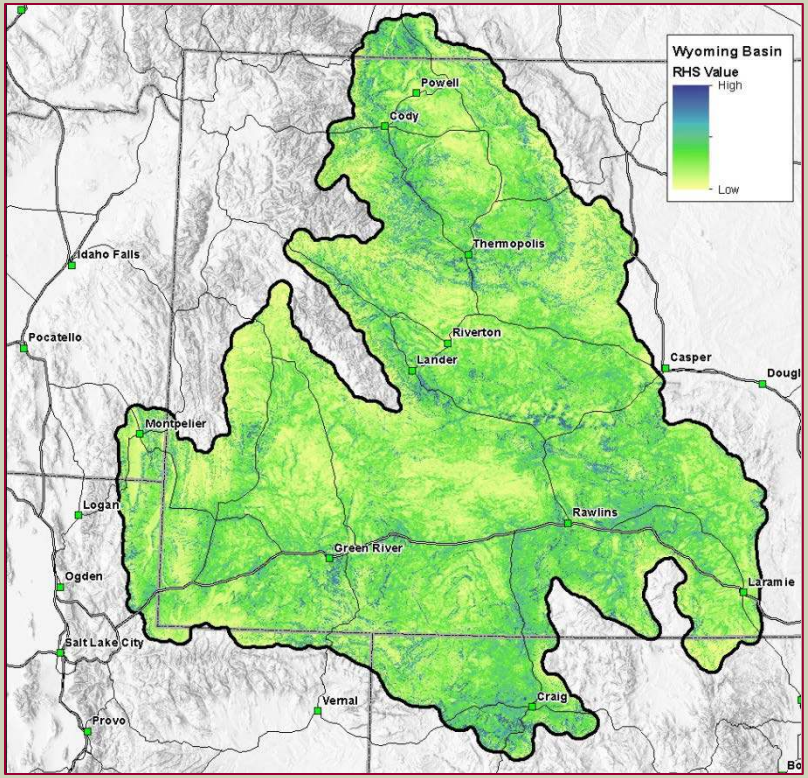


- Winter landscape occupancy model
  - West-wide



RELATIVE SUITABILITY OF BREEDING HABITAT

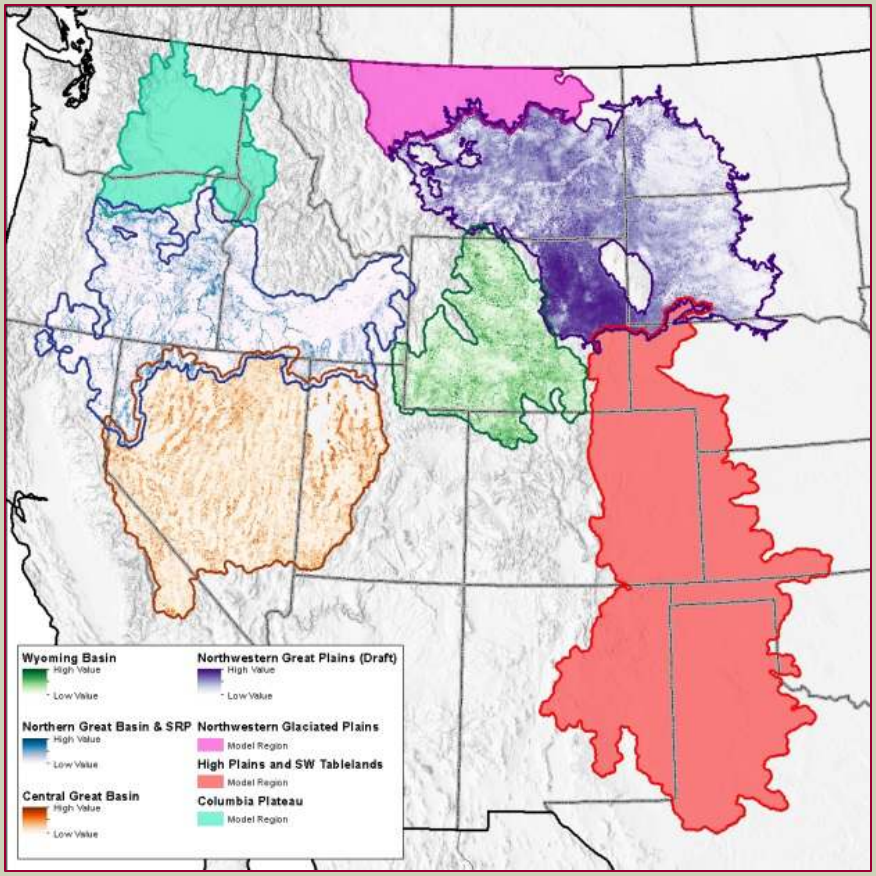
- Developed using known nest locations, climate, terrain, and land cover
- Presence-only data
  - Models developed using MaxEnt
- Models predict relative habitat suitability within the modeled ecoregion, not probability of presence
- Output grid = 120 m cells



Partner: Humboldt State Univ.

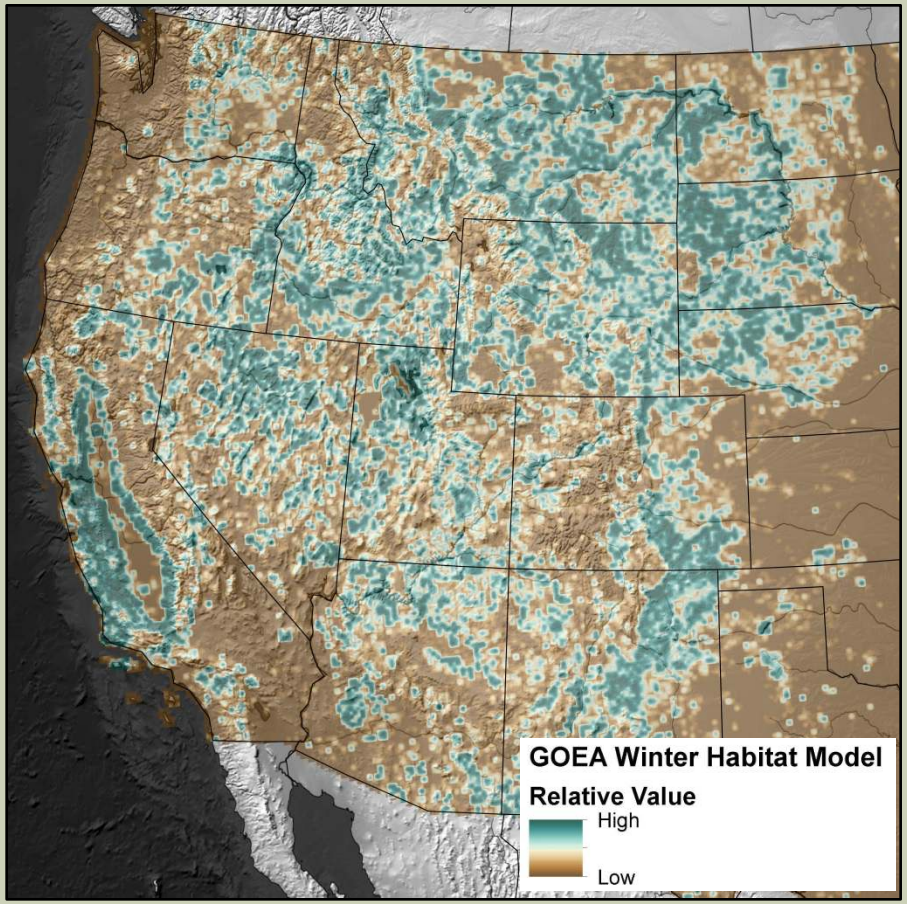
STATUS OF BREEDING HABITAT MODELS

- Models complete/near complete
  - Wyoming Basin
  - NW Great Plains
  - N. Great Basin/Snake River Plain
  - Central Great Basin
- Under development
  - Western High Plains/SW Tablelands
  - Columbia Plateau
  - NW Glaciated Plains



WINTER LANDSCAPE OCCUPANCY MODEL: DESCRIPTION AND STATUS

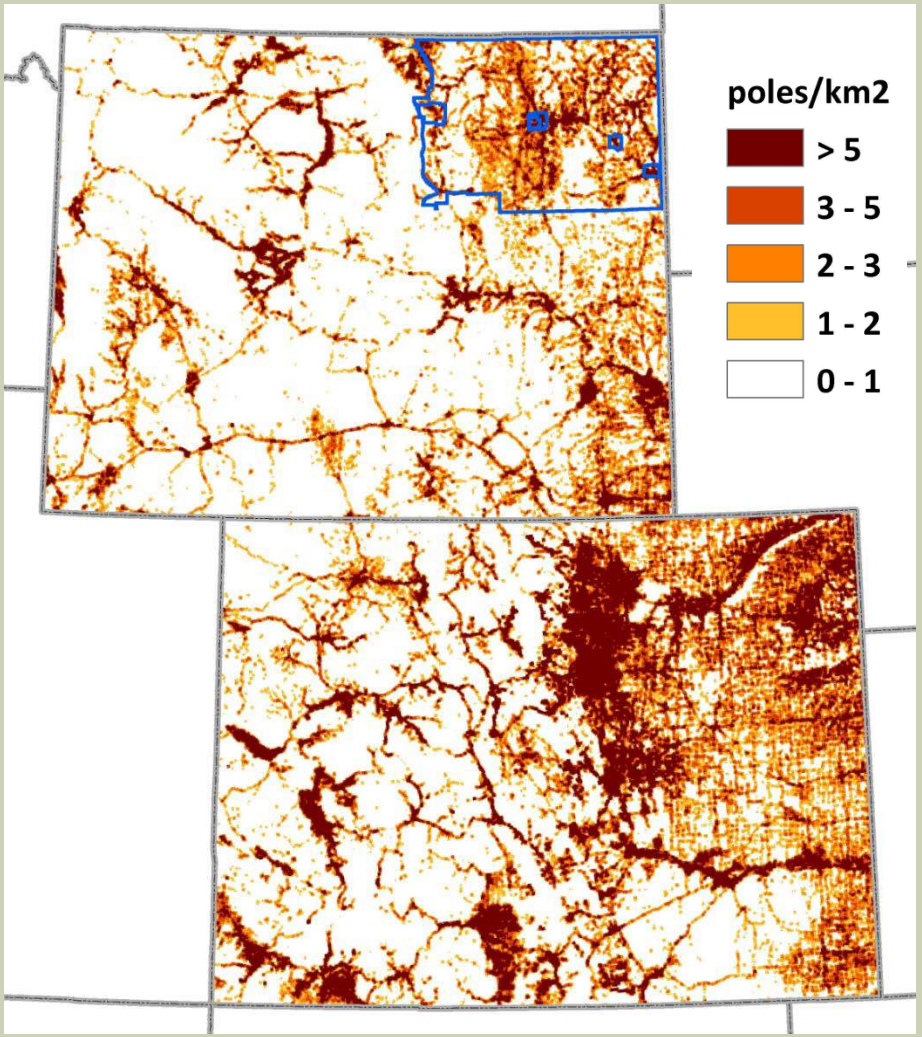
- Developed using golden eagle surveys from a variety of sources
- Occupancy model developed based on surveys
- Occupancy model refined based on landscape-scale environmental variables
- Model predicts relative level of landscape use during winter (Oct – Mar)
- Output grid = 10 km cells



Partner: Point Blue Cons. Science

MODEL OF ELECTROCUTION HAZARD

- Uses density of distribution power poles as a surrogate of electrocution hazard
  - Dwyer et. al 2016. Power pole density informs spatial prioritization for mitigating avian electrocution. J. Wild. Mgt. 80(4):634 - 642



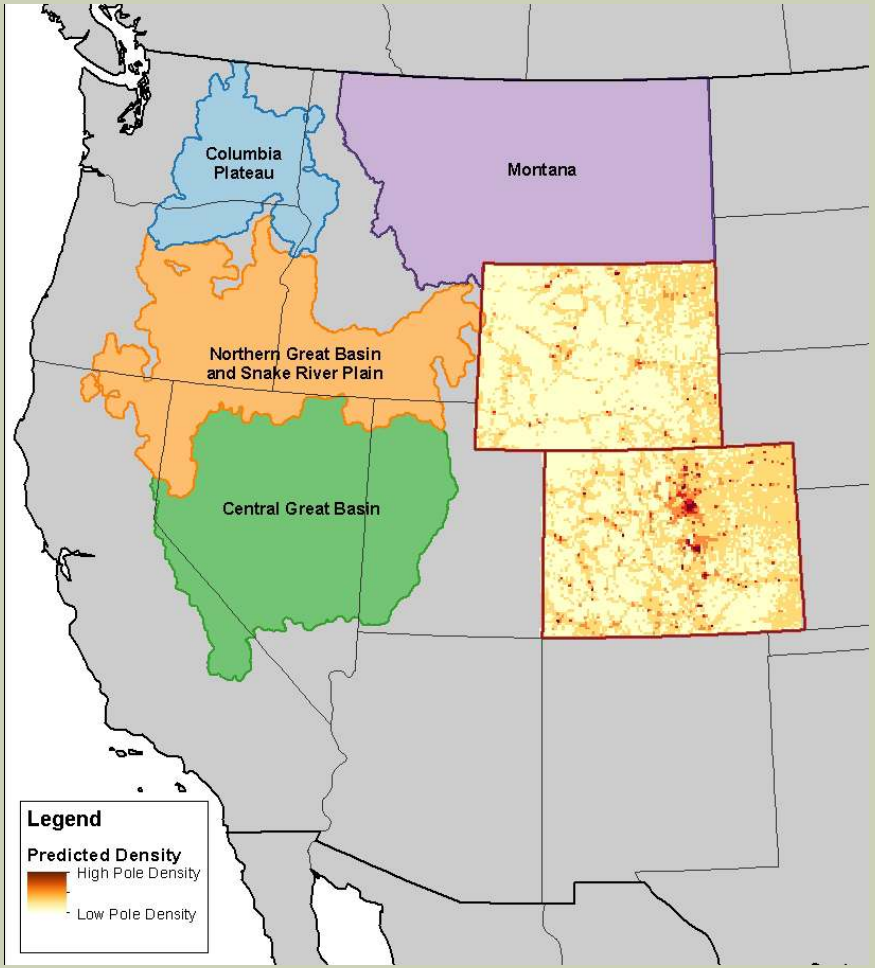
Partner: EDM International, Inc.

MODEL OF ELECTROCUTION HAZARD

- Grid cell size = 1 km
- Geographic scope: Colorado and Wyoming
- Pole locations obtained from 16 utilities representing 31% of Colorado and Wyoming
- Pole densities estimated using anthropogenic and natural land cover
- Random Forest machine learning classification

STATUS OF POLE DENSITY MODELS

- Colorado/Wyoming complete
- Additional models under development in 2016
- Models for rest of West in next 1 – 2 years



MODEL SCALING

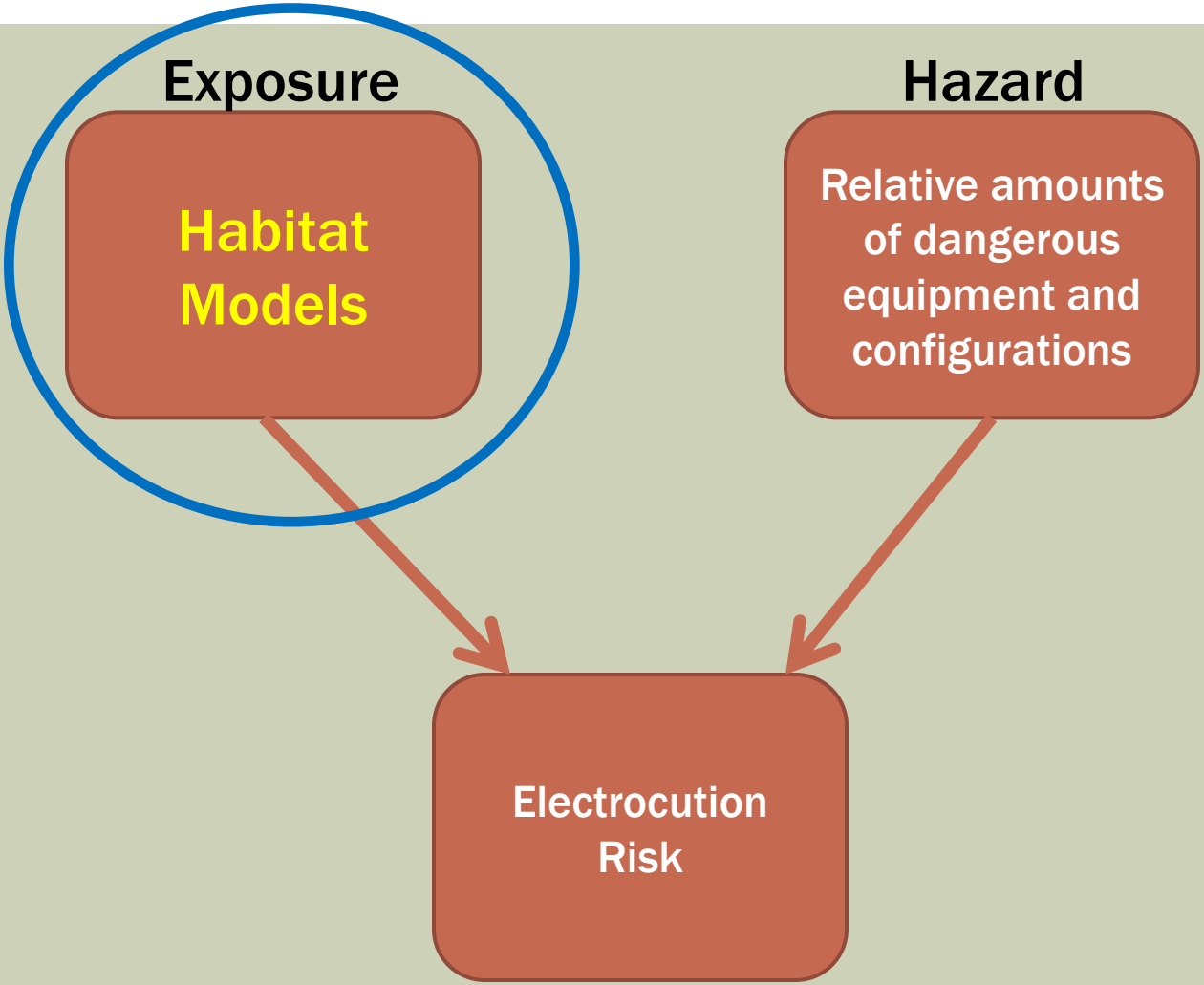
- Having a common scale among models allows efficient overlays and analyses
- Interpret model outputs at appropriate scales (i.e., scales at which GOEAs utilize landscape)
  - Calculate spatial mean in 9 km^2 neighborhood surrounding each cell

CLASSIFYING SCALED MODEL PREDICTIONS

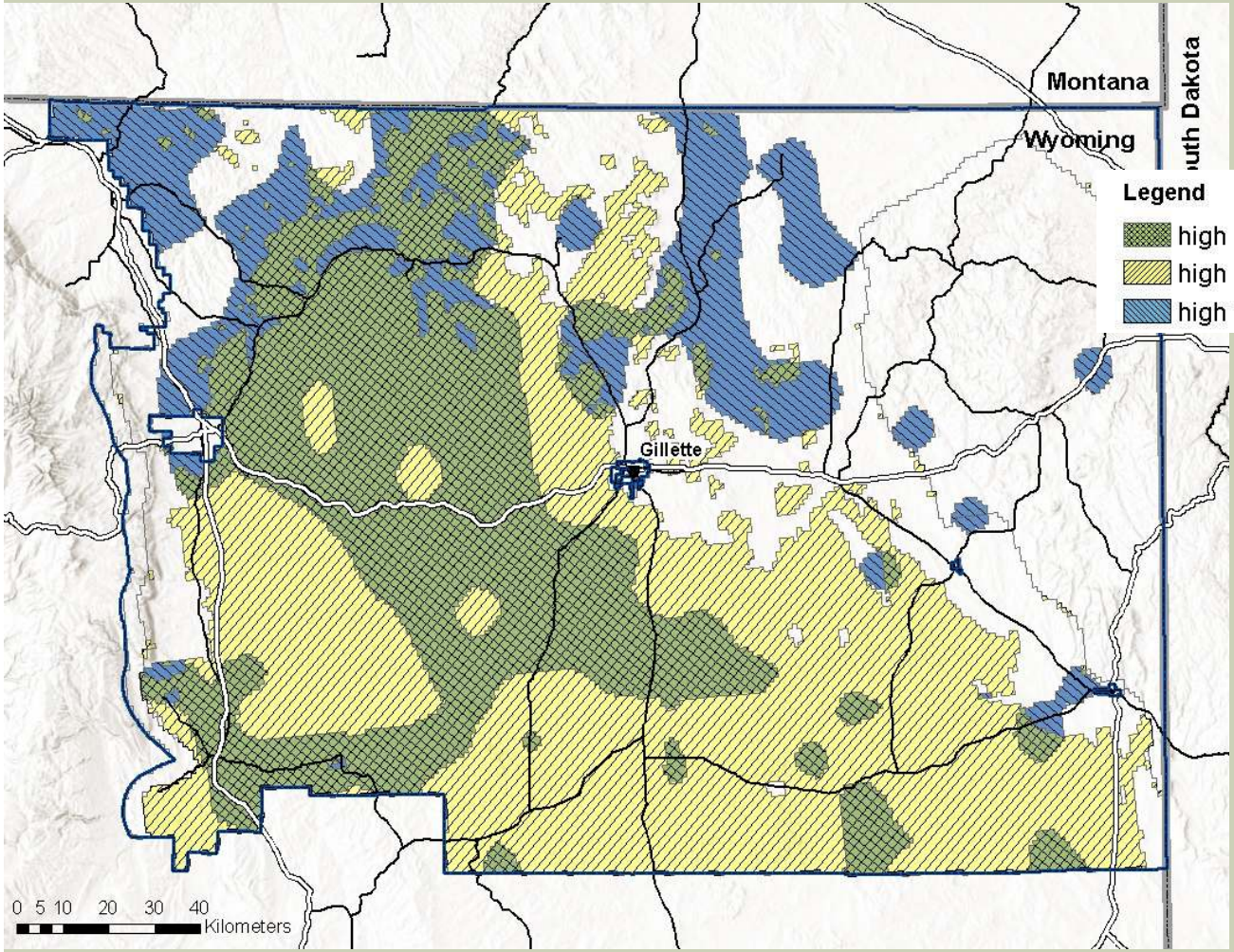
- Classified model output using simplified (high/low) output categories

1. High quality breeding: score > 0.7
2. High quality winter: score > 0.5
3. High quality winter and breeding: breeding score > 0.7 AND winter score > 0.5
4. Low quality winter and breeding: breeding score ≤ 0.7 AND winter score ≤ 0.5
5. High power pole density: > 2 poles/km2
6. Low power pole density: ≤ 2 poles/km2

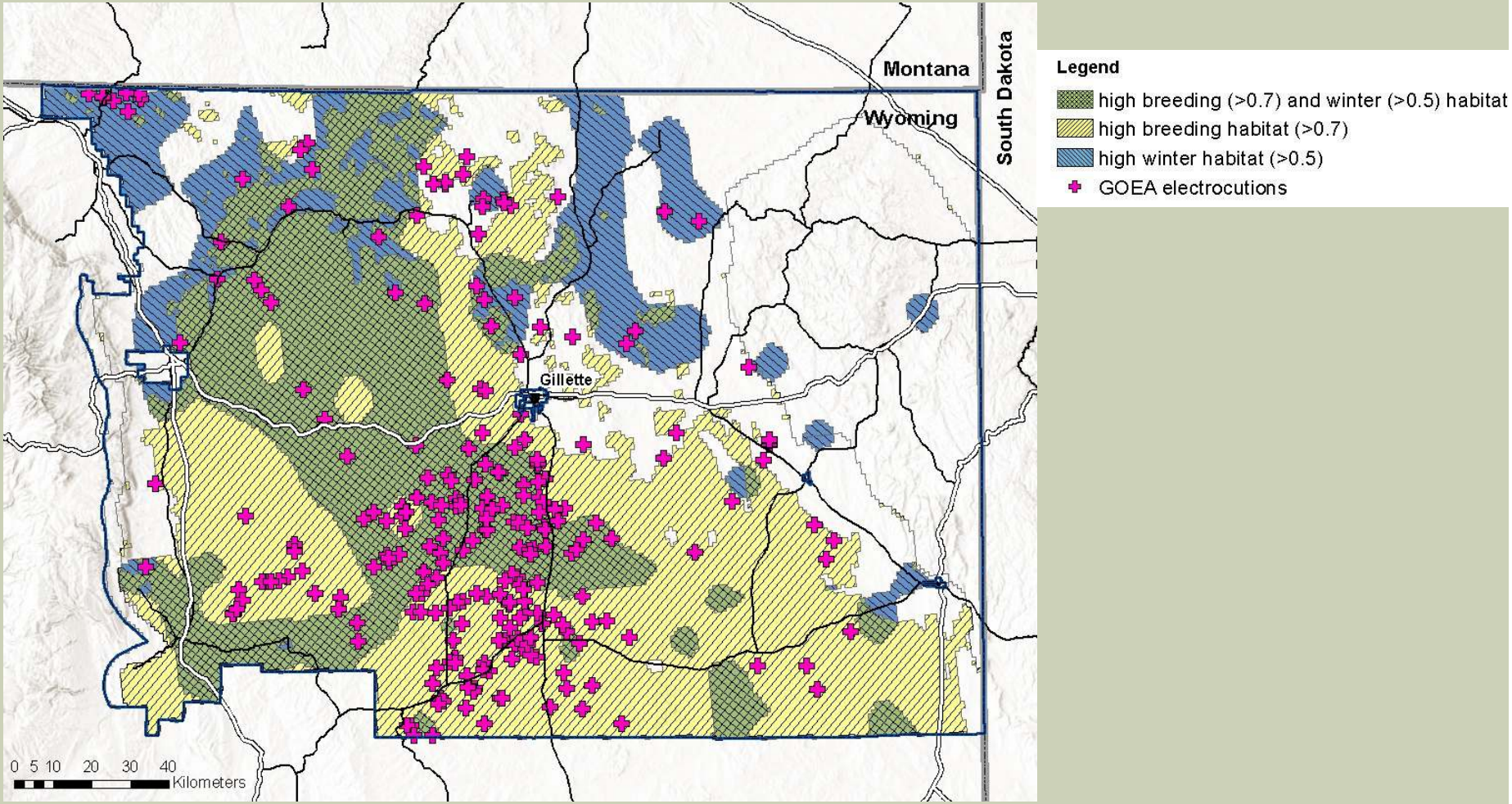
COMPONENTS OF ELECTROCUTION RISK



OVERLAY OF HIGH QUALITY BREEDING HABITAT WITH HIGH QUALITY WINTER HABITAT



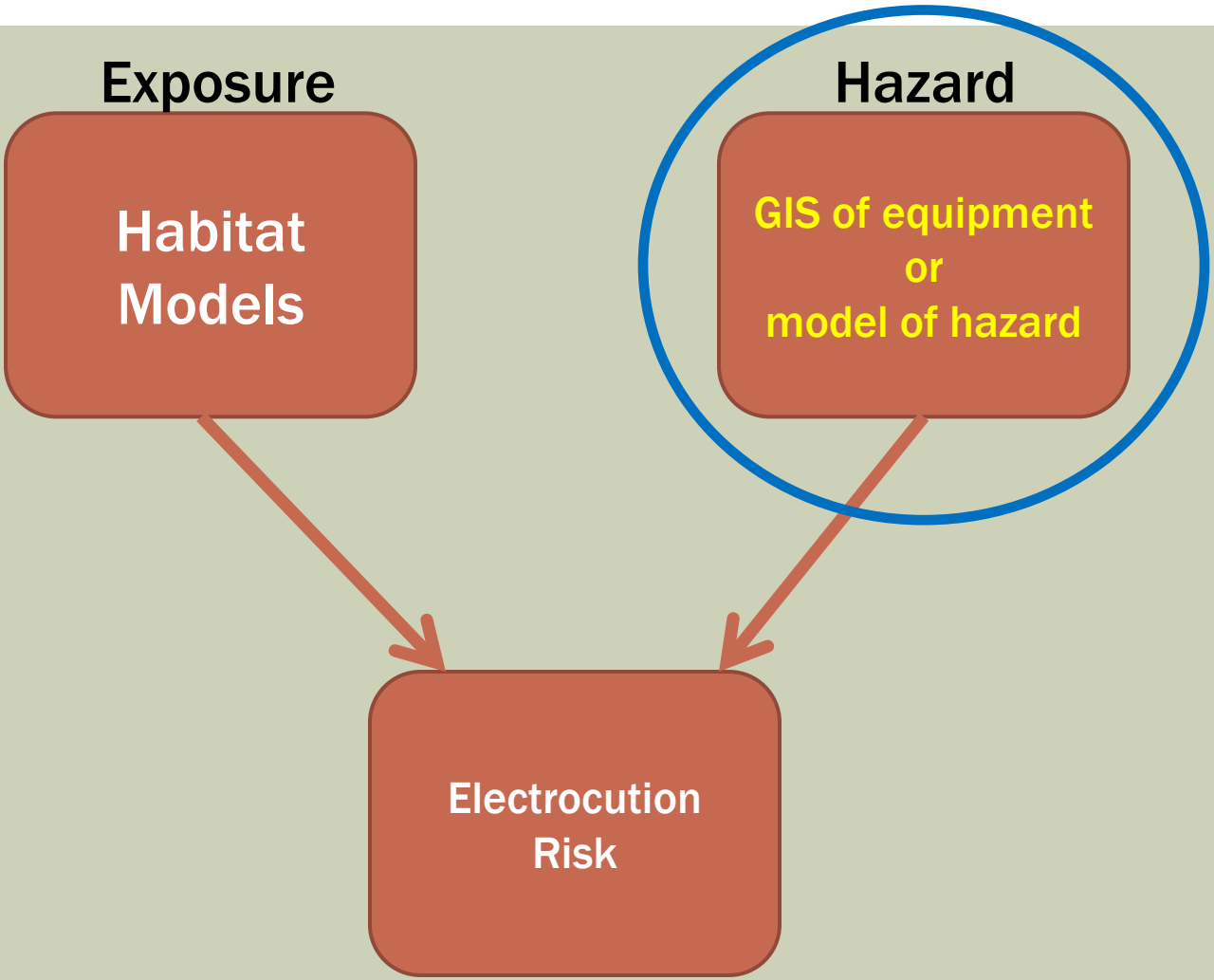
GOLDEN EAGLE MORTALITIES WITHIN PRECORP'S SERVICE AREA



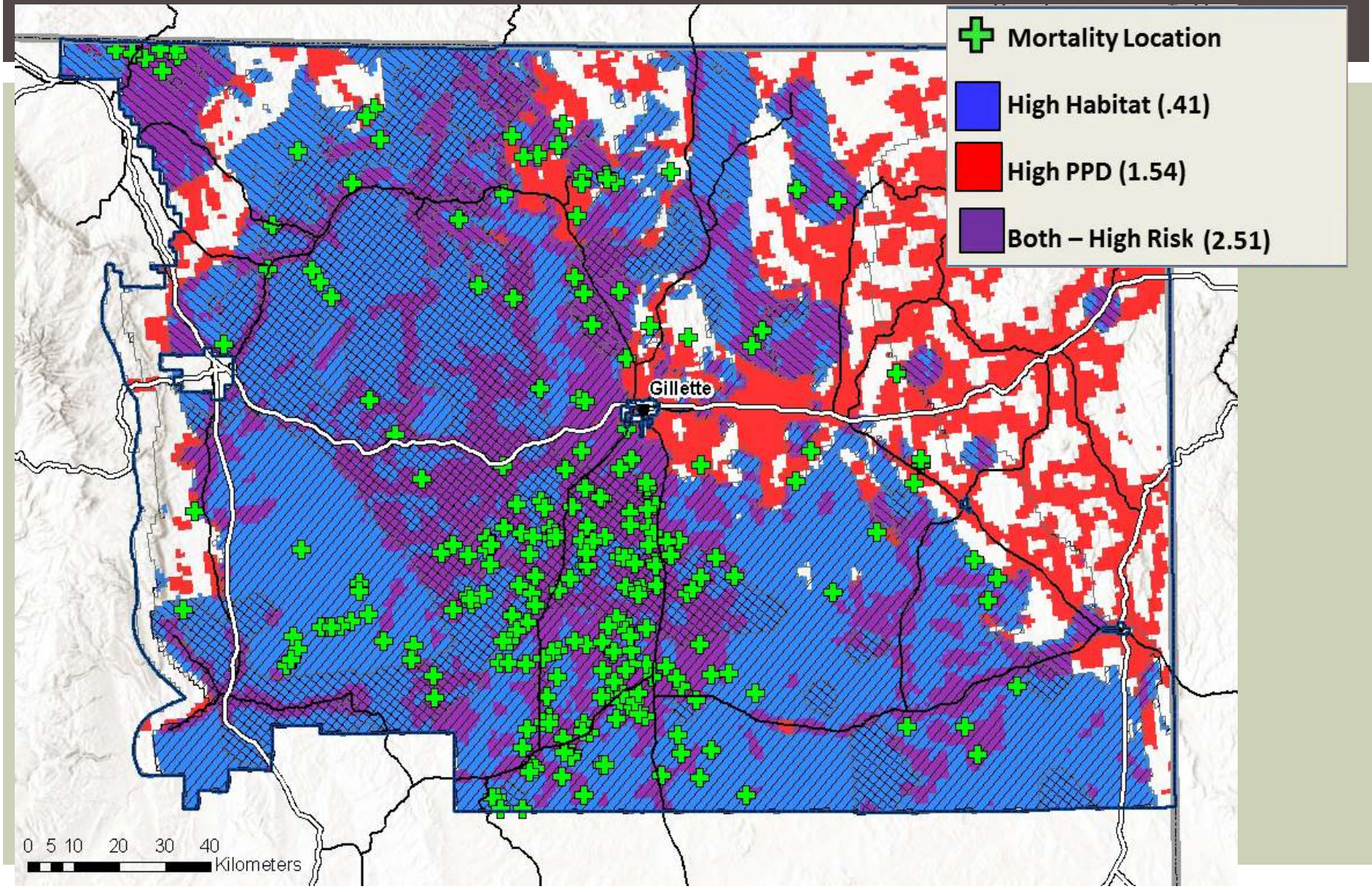
EXAMINING GOEA MORTALITY LOCATIONS IN RELATION TO PREDICTED HABITAT QUALITY

Category	Proportion of mortalities (number mortalities)	Proportion of service area*	Mortality to area ratio
High Both	0.34 (97)	0.23	**1.50**
High Either	0.58 (163)	0.42	**1.39**
Low Both	0.08 (22)	0.35	0.22

COMPONENTS OF ELECTROCUTION RISK



COMBINING HAZARD WITH EXPOSURE



SUMMARY

- Habitat models can be a useful aid in prioritizing retrofits
- Models should be interpreted at scales that are appropriate to GOEAs
- Combining habitat models (exposure) with estimates of hazard can help optimize the effectiveness of retrofitting programs