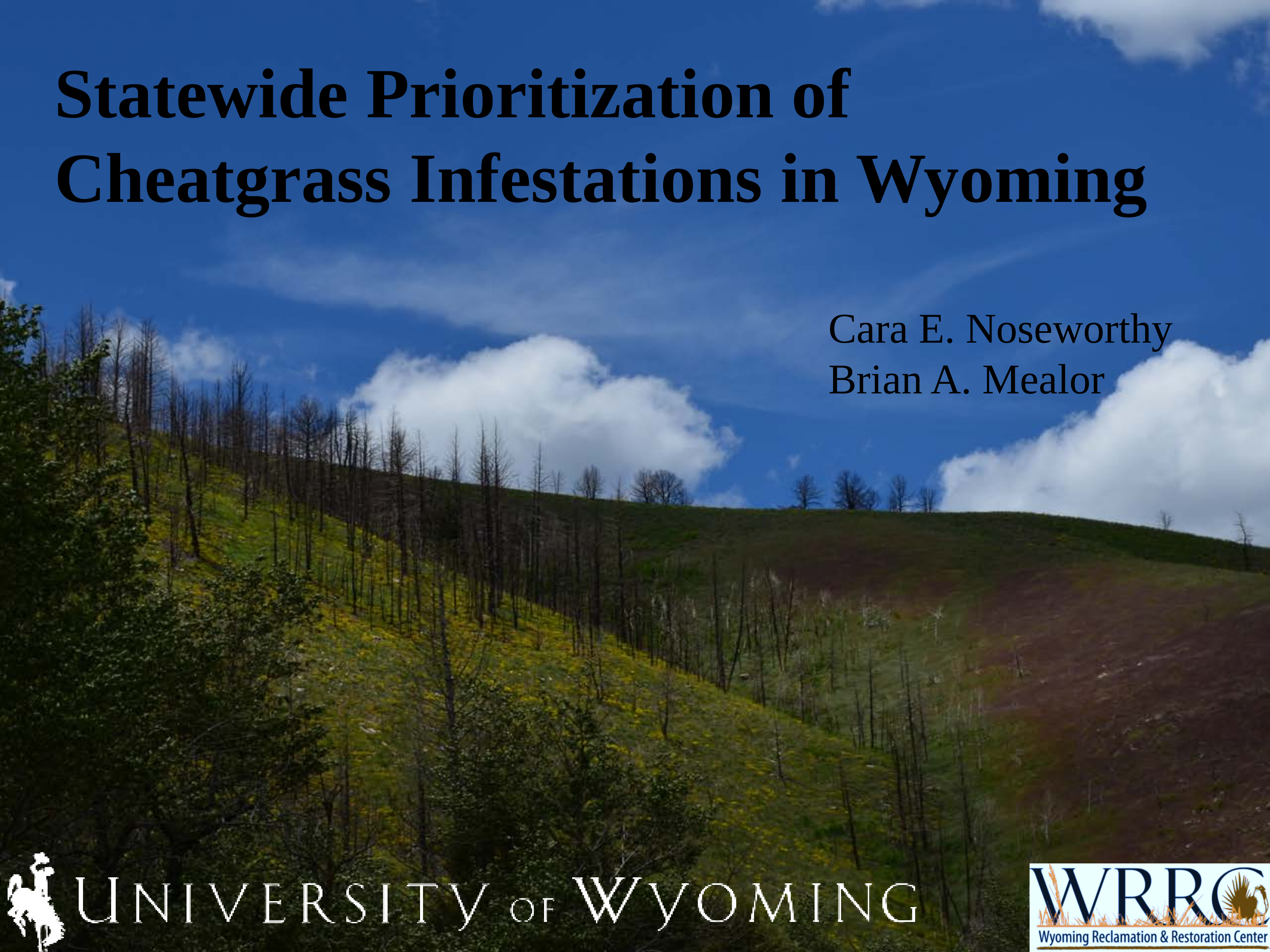
Statewide Prioritization of Cheatgrass Infestations in Wyoming

Cara E. Noseworthy
Brian A. Mealor



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WRRC
Wyoming Reclamation & Restoration Center

Introduction

- *Bromus tectorum* (Downy Brome, Cheatgrass)
  - Widespread/dominant in western North America by early 1900's (Mack 1981)
  - Exotic winter annual (Knapp 1996)
  - Favors disturbance (Knapp 1996, Stewart and Hull 1949)
- Why is it a problem?
  - Promotes fire (Knapp 1996) which can reduce sagebrush
  - Unreliable forage (Stewart and Hull 1949) and damaging to livestock when mature (Morrow and Stahlman 1983)
  - Displaces native perennials (Young and Allen 1997)

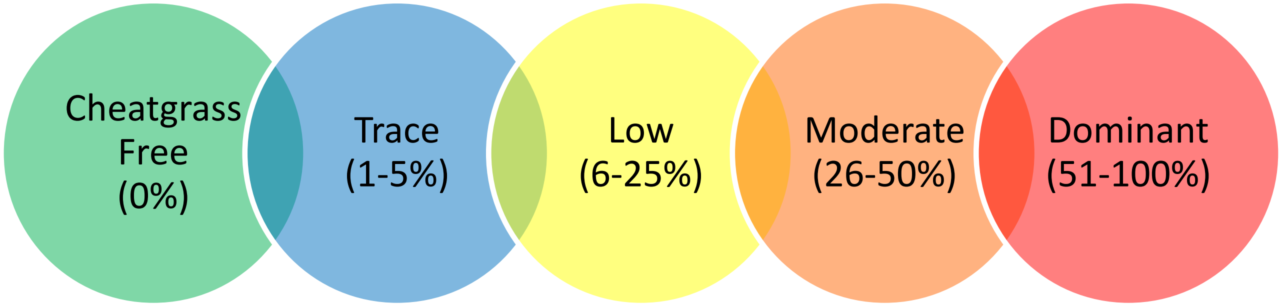
Introduction

- Management:
  - Approached on a case by case basis
- Two opportunities in Wyoming:
  - Potential to organize efforts (Cheatgrass Taskforce)
  - Potential to get ahead of the problem

- **Are isolated efforts effective or should this problem be approached on a larger scale?**

Objectives

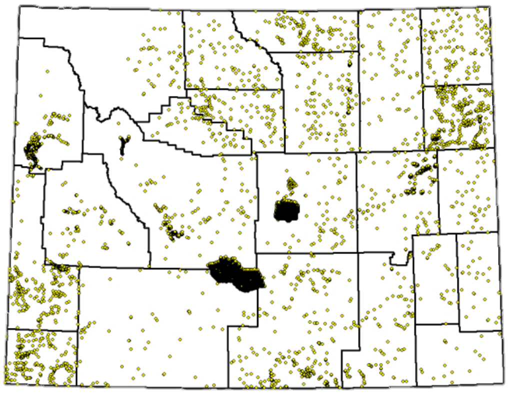
1. Develop a dataset that provides a better picture of the distribution of cheatgrass in Wyoming beyond presence/absence



2. Develop a distribution prediction model
3. Develop a statewide prioritization model based on invasion status and overlap with critical wildlife habitat

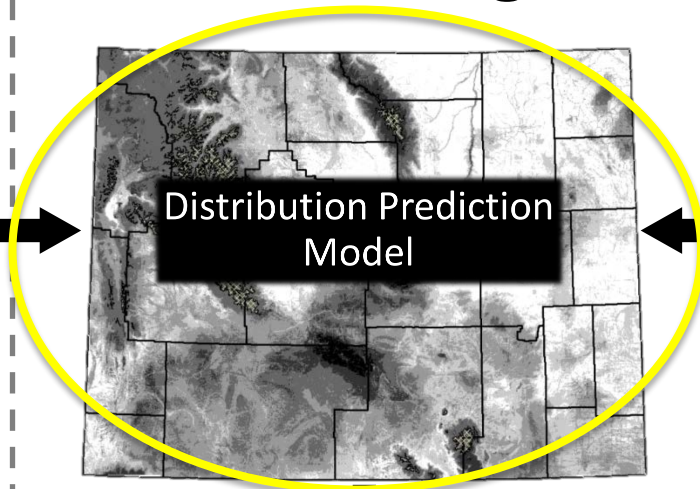
Methods

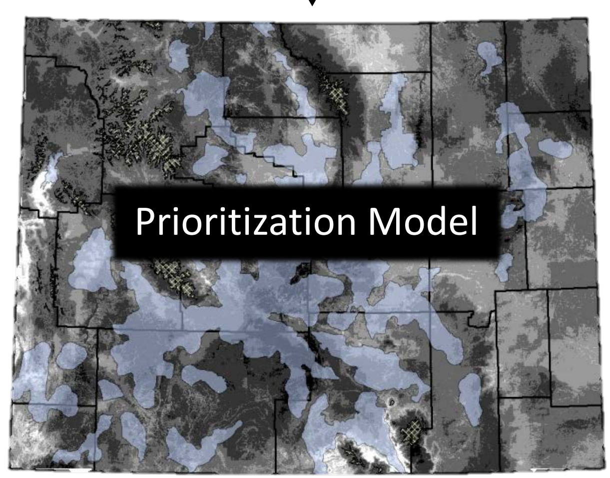
Data Collection



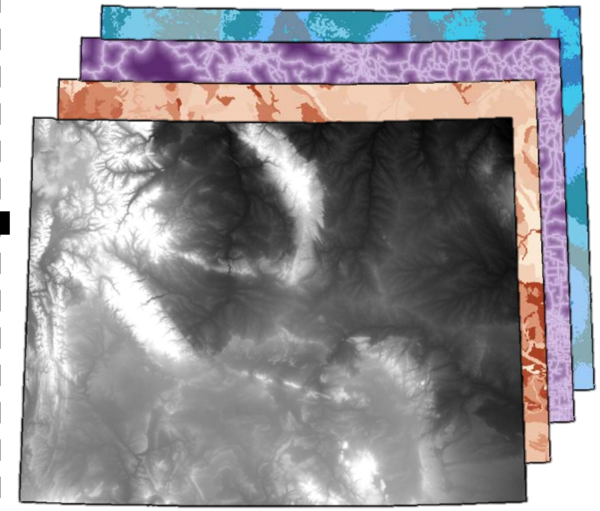
- Synthesize data from agencies
- Conduct field surveys

Modeling





Inputs



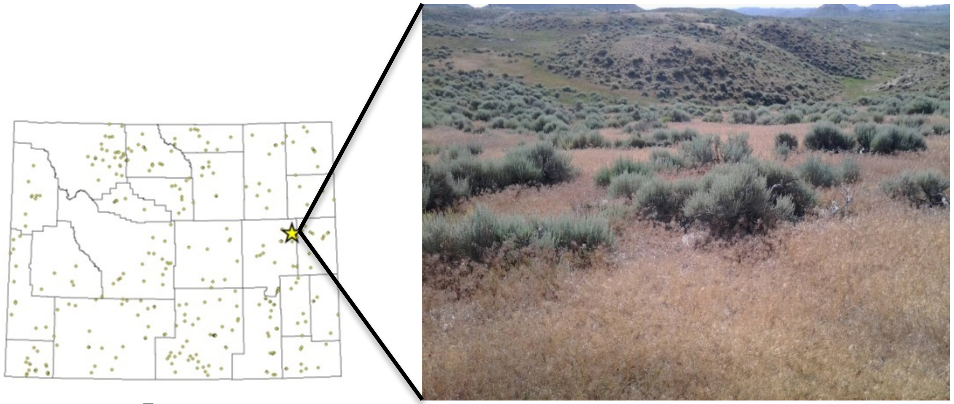
Predictor Variables

-Sage Grouse Core Areas

-Critical Winter Range

Methods

- Field Surveys:
  - Take a picture
  - Mark a point with GPS
  - Record:
    - Cover of natives, bare ground, cheatgrass, and shrubs (note most prevalent shrub species)
    - Size of infestation
  - Note other invasive grasses, disturbance

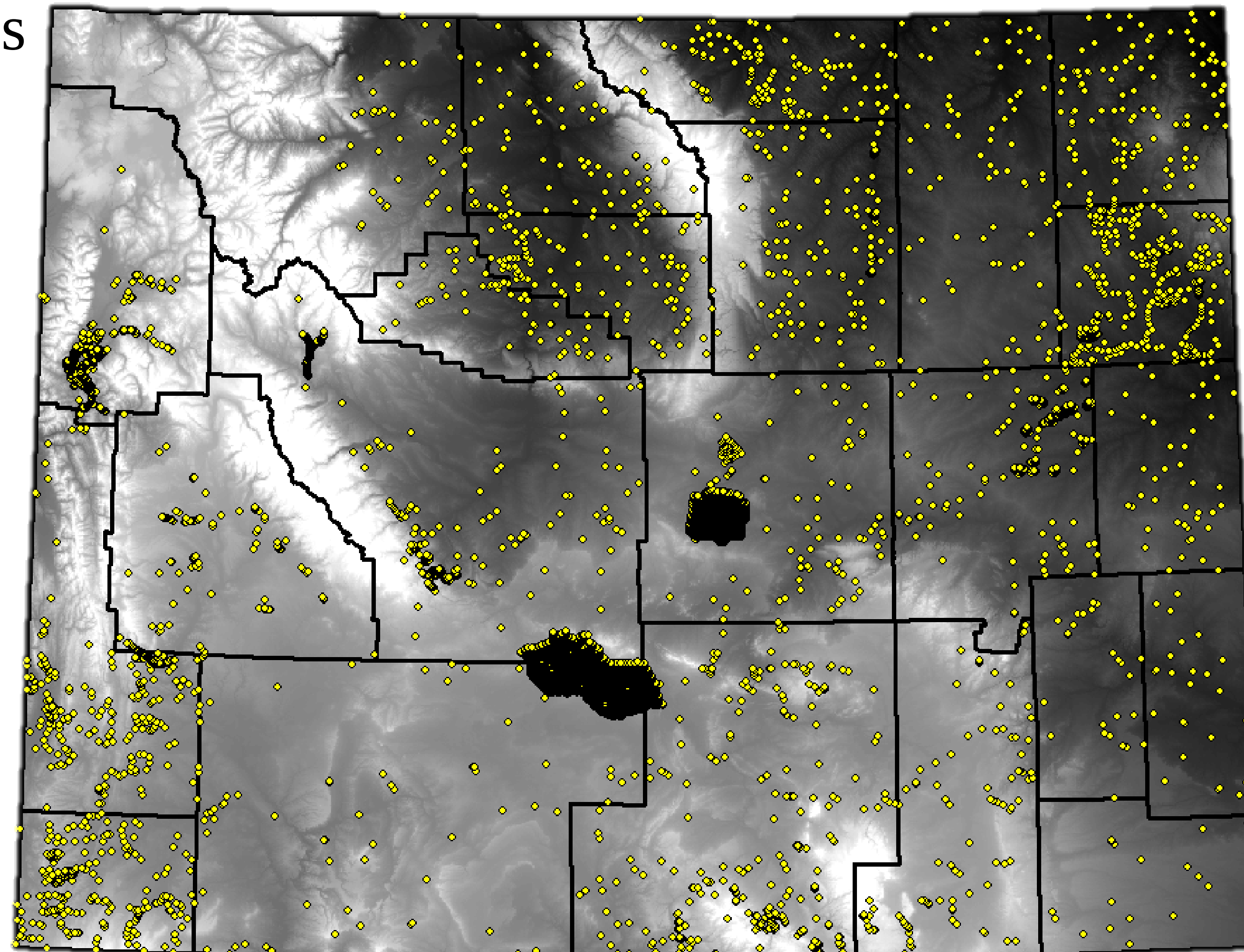


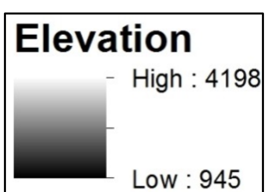
Cover Categories

- **None:** 0%
- **Trace:** Less than 5%
- **Low:** 5-25%
- **Moderate**: 25-50%
- **Dominant:** 50-100%

Methods

- Cheatgrass data available for model





Methods

- Distribution prediction models (habitat suitability models)
  - Popular tool for invasive species (Gallien et al. 2012; Crall et al. 2013)

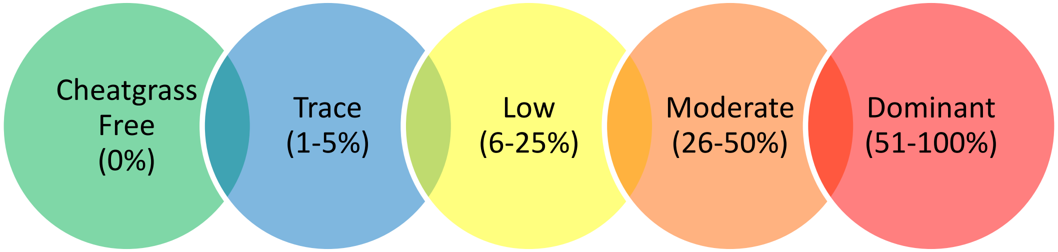
- Bradley (2013) suggests that models based on abundance may be more useful for management
  - "Establishment niche" → based on presence/absence data
  - "Impact niche" → based on abundance data
    - Assuming abundance is a good proxy for impact

Methods

- Distribution prediction models

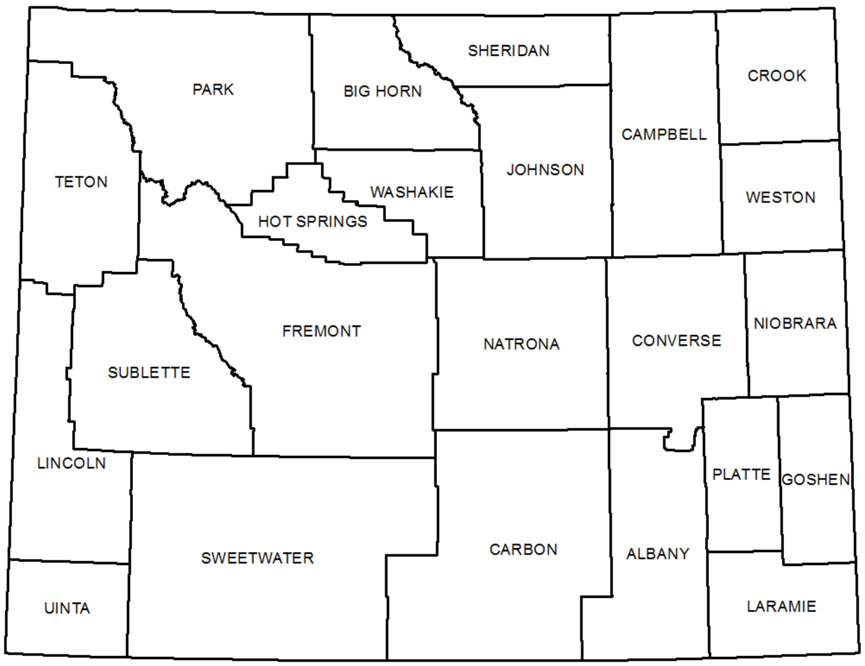
  – **Presence/Absence Model** (Establishment niche)

  – **Class Models** (Impact niche)
    - Absence vs. Dominance (51-100%)
    - Absence vs. Moderate (6-50%)
    - Absence vs. Trace (1-5%)

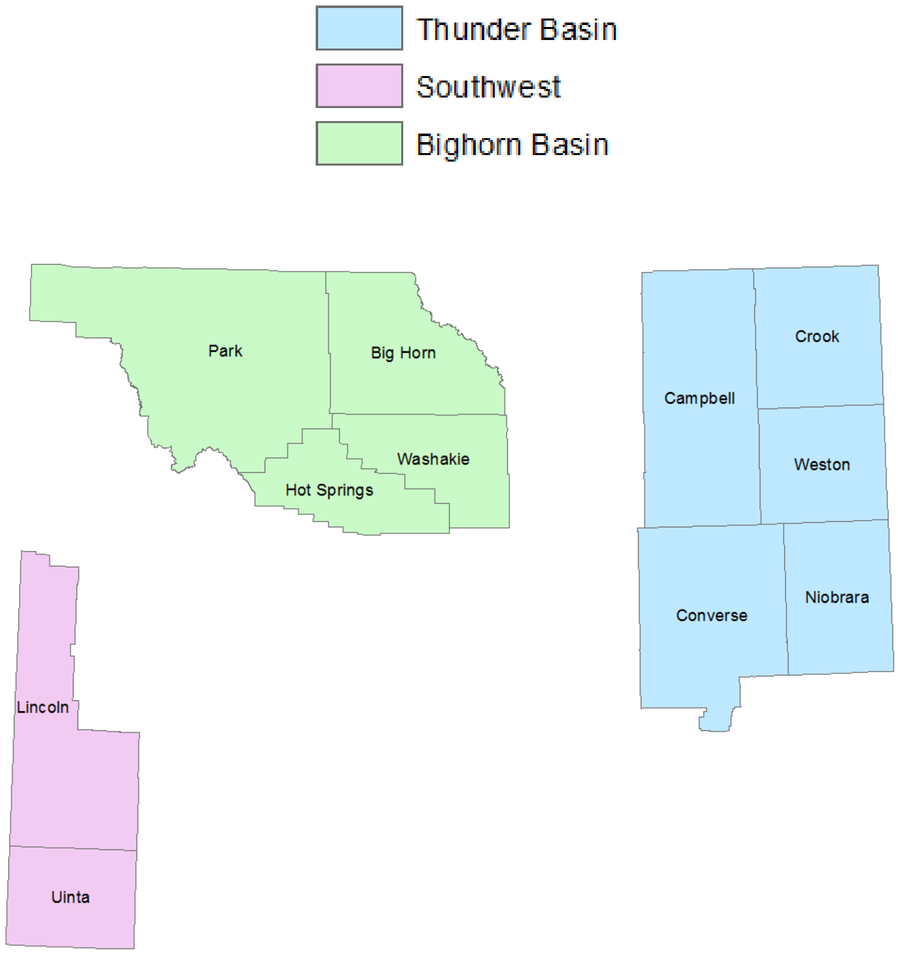


Methods

Statewide Model



Regional Models



Is there a difference if we model ecologically different areas?

Methods

- Distribution Prediction Model
  - Random forests in R statistical program*

Predictor Variables

Climate	Topography
-Temperature -Precipitation	-Elevation -Slope -Landforms

Disturbance	Soils/Productivity
-Disturbance layer (energy development, cities, roads, etc.) -Distance to roads -Fire	-Surface texture -Land cover -NDVI -Available water supply

*Evans and Cushman 2009, Murphy et al. 2010, Evans et al. 2011

Results

- Statewide pres/abs model

Model Statistics	
Out-of-Bag Error	14.6%
Accuracy	85.4%
Kappa	0.64
Sensitivity (Pres)	91.5%
Specificity (Abs)	71.2%
EXTERNAL VALIDATION	
Accuracy	84.9%
Kappa	0.65
Sensitivity (Pres)	85.8%
Specificity (Abs)	82.9%

*PRISM data
(Dec-Feb, June-Aug, Sept-Nov)

Predictor Variables

Climate

-Isothermality

-Max temp in warmest month

-Mean annual temp

-Min temp in coldest month

-Precip seasonality

-Precip in wettest month

-Winter, summer, & fall precip*

Topography

-Elevation

-Slope

-Roughness

Soils/Productivity

-NDVI (2013-2014)

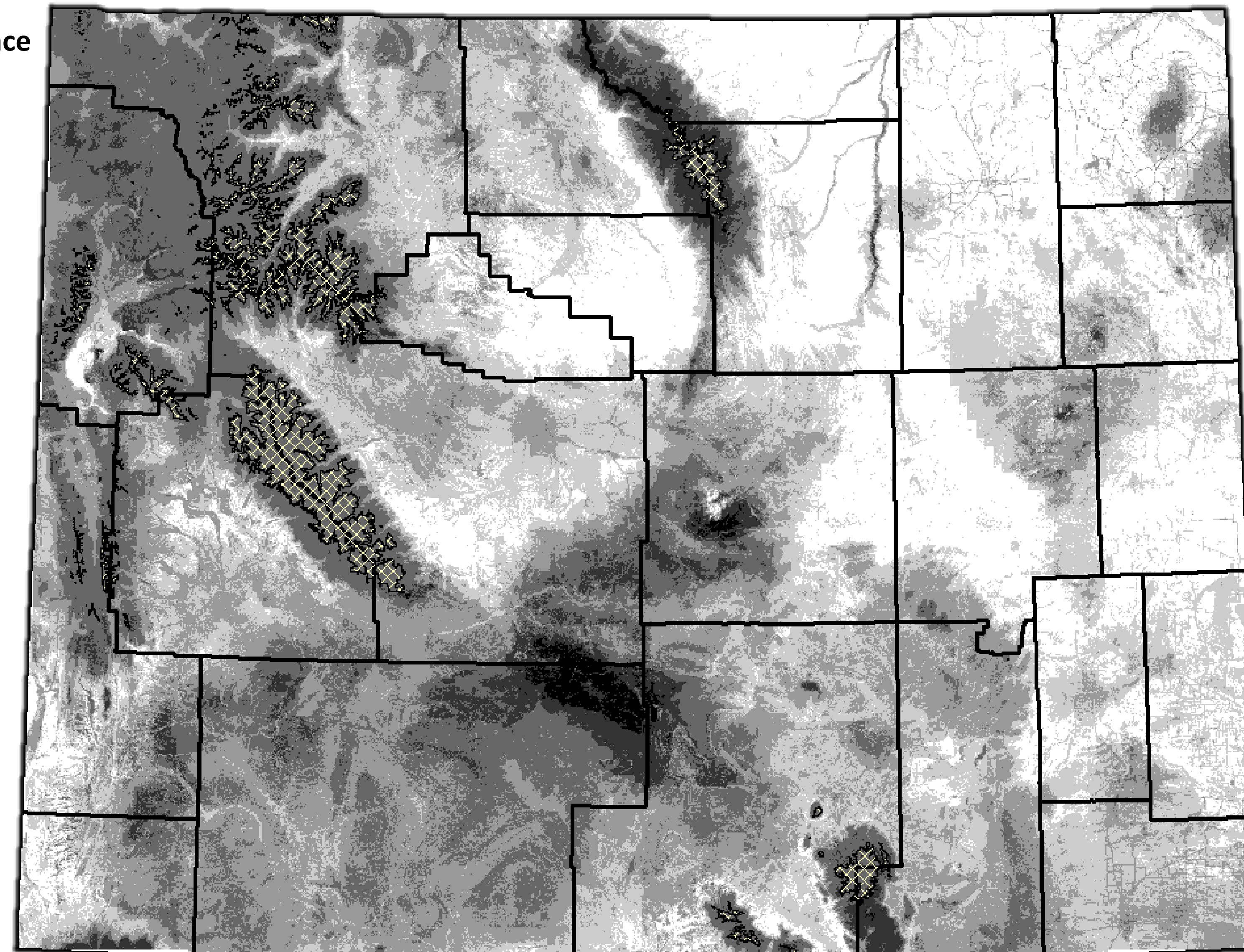
-Available water supply (50cm)

Disturbance

-Distance to major roads

Results

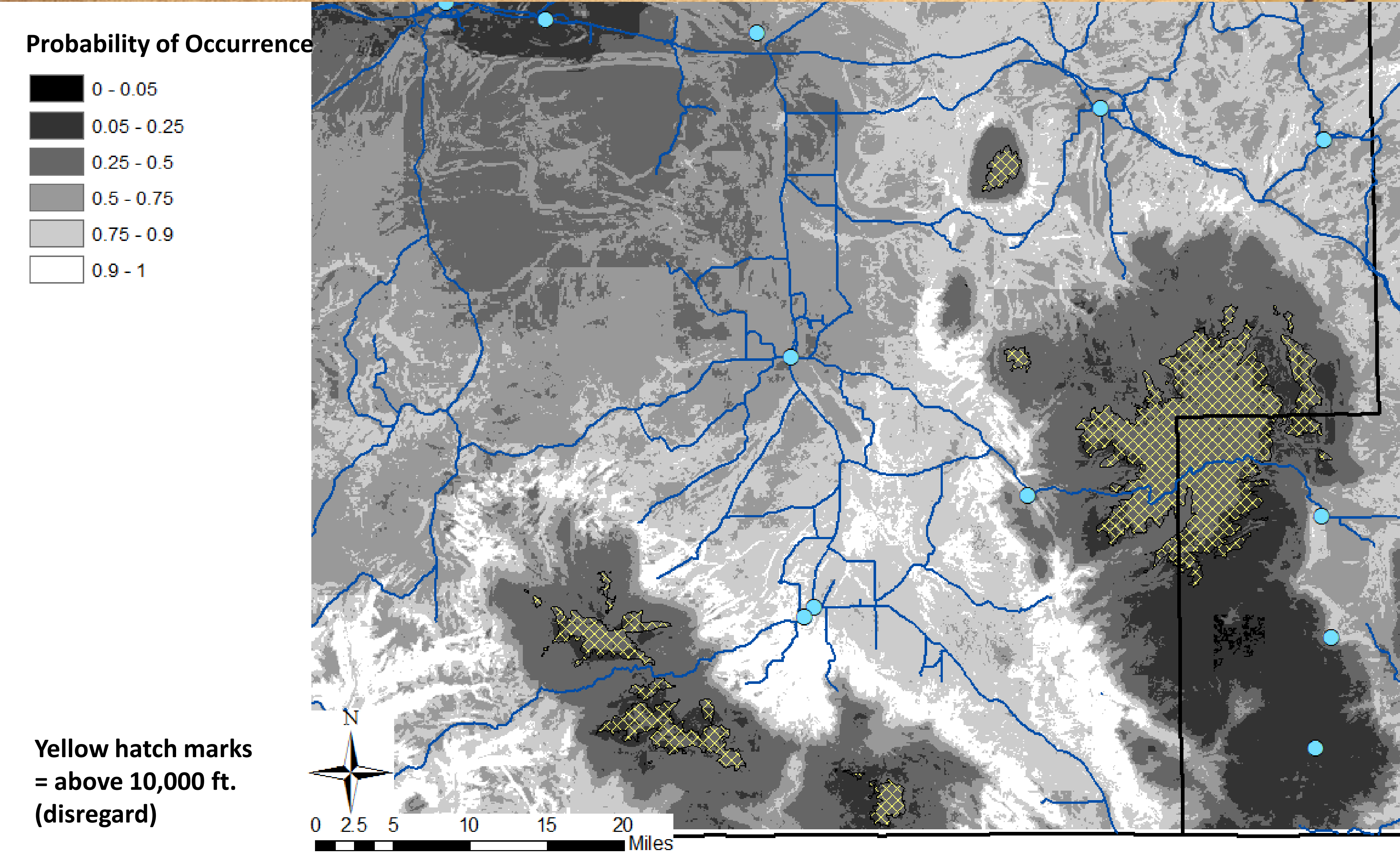
Probability of Occurrence



■	0 - 0.05
■	0.05 - 0.25
■	0.25 - 0.5
■	0.5 - 0.75
■	0.75 - 0.9
□	0.9 - 1

Yellow hatch marks = above 10,000 ft. (disregard)

Results

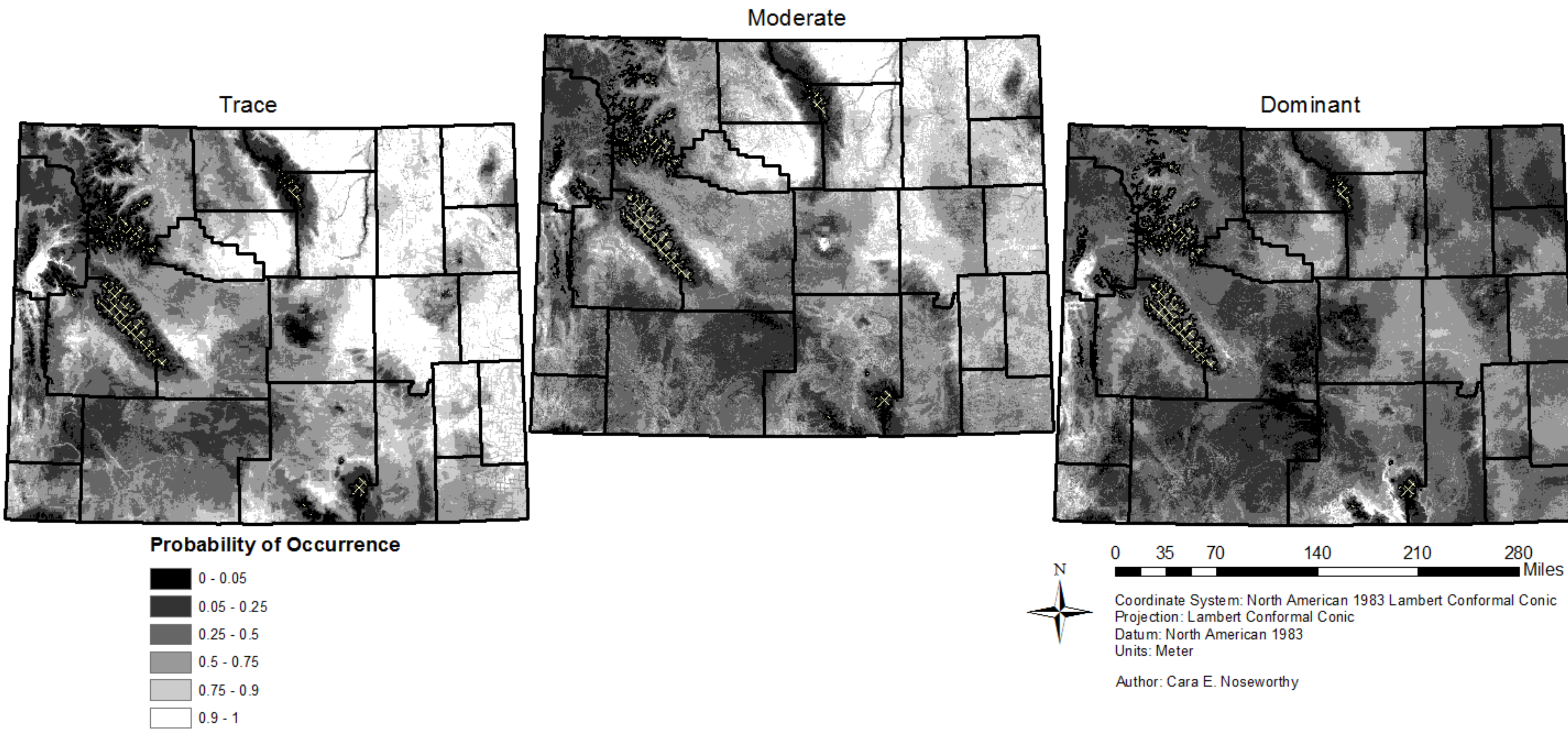


Yellow hatch marks = above 10,000 ft. (disregard)

Results

- Statewide class models

Model	Accuracy
Trace	82.9%
Moderate	92.2%
Dominant	87.7%



Results

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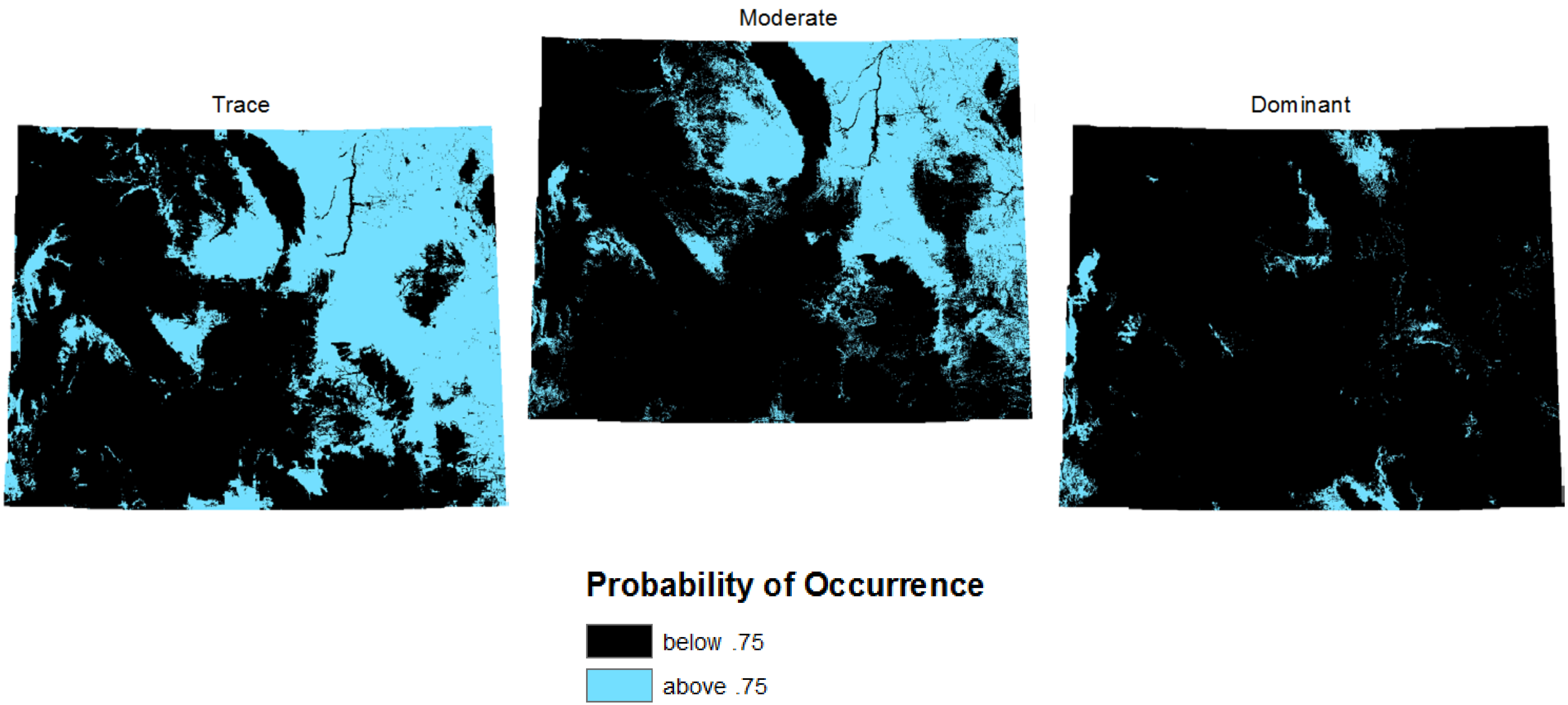
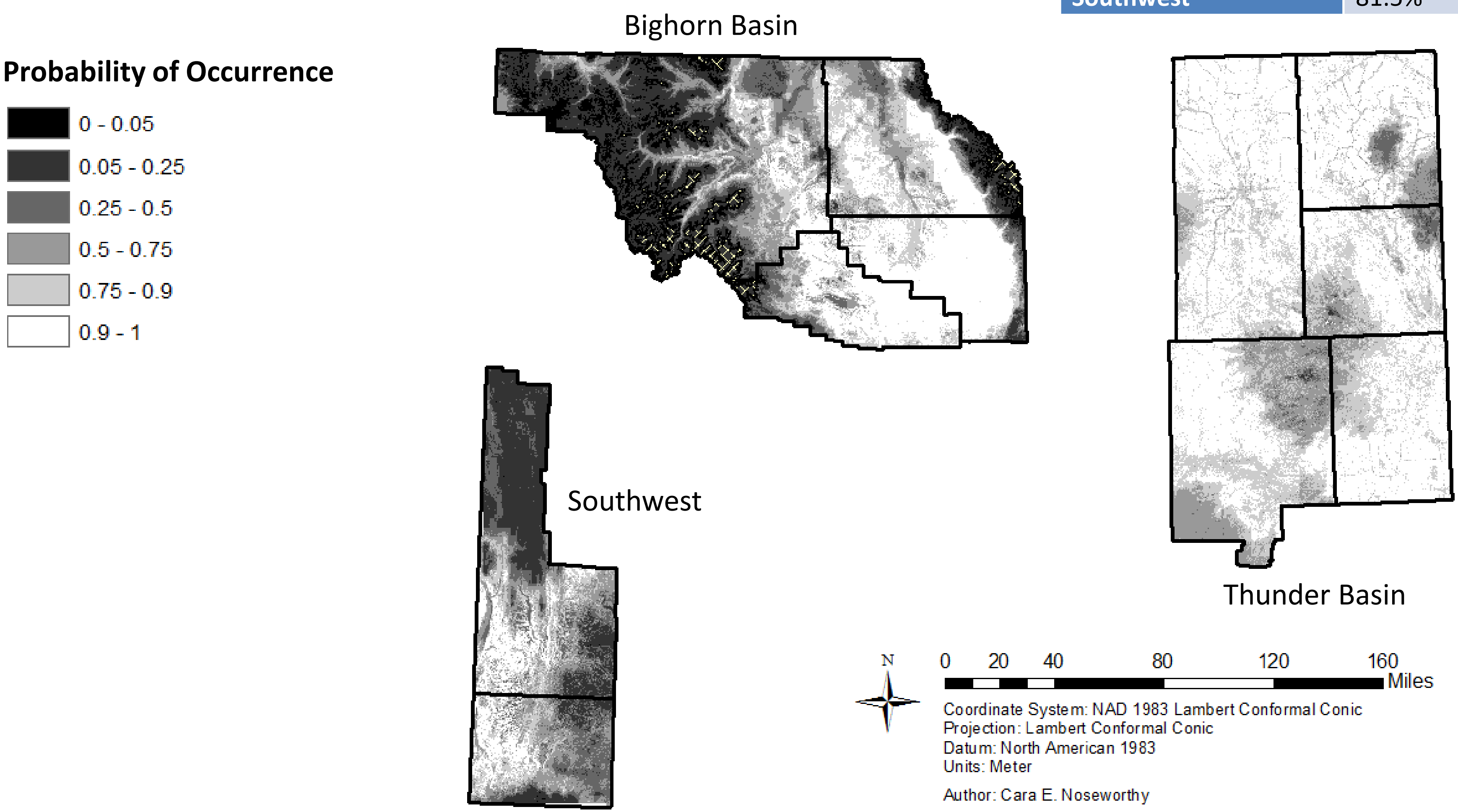


Results

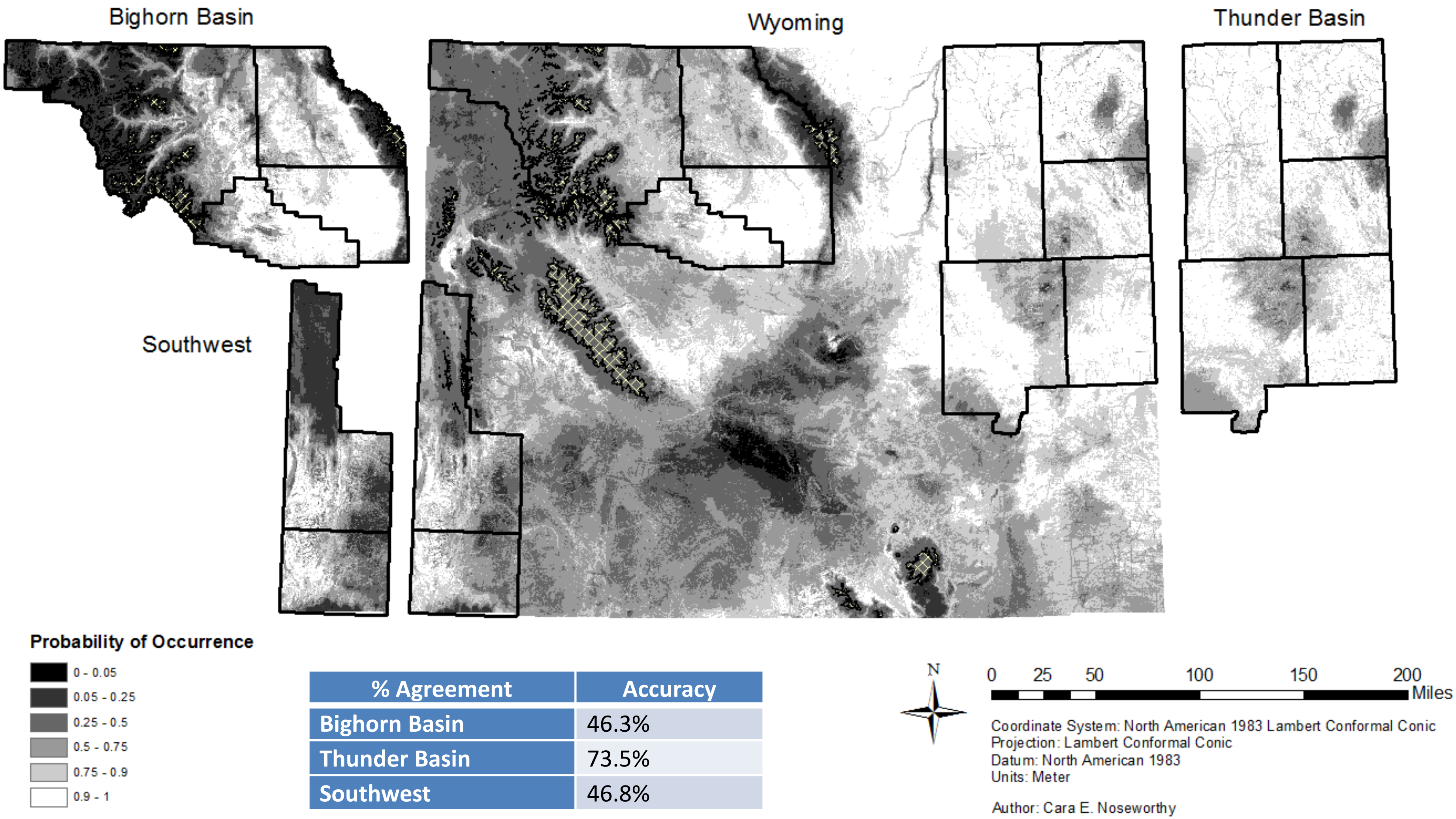
- Regional presence/absence models

Model	Accuracy
Bighorn Basin	87.4%
Thunder Basin	83.1%
Southwest	81.5%



Results

- Model comparison (presence/absence)



% Agreement	Accuracy
Bighorn Basin	46.3%
Thunder Basin	73.5%
Southwest	46.8%

Discussion

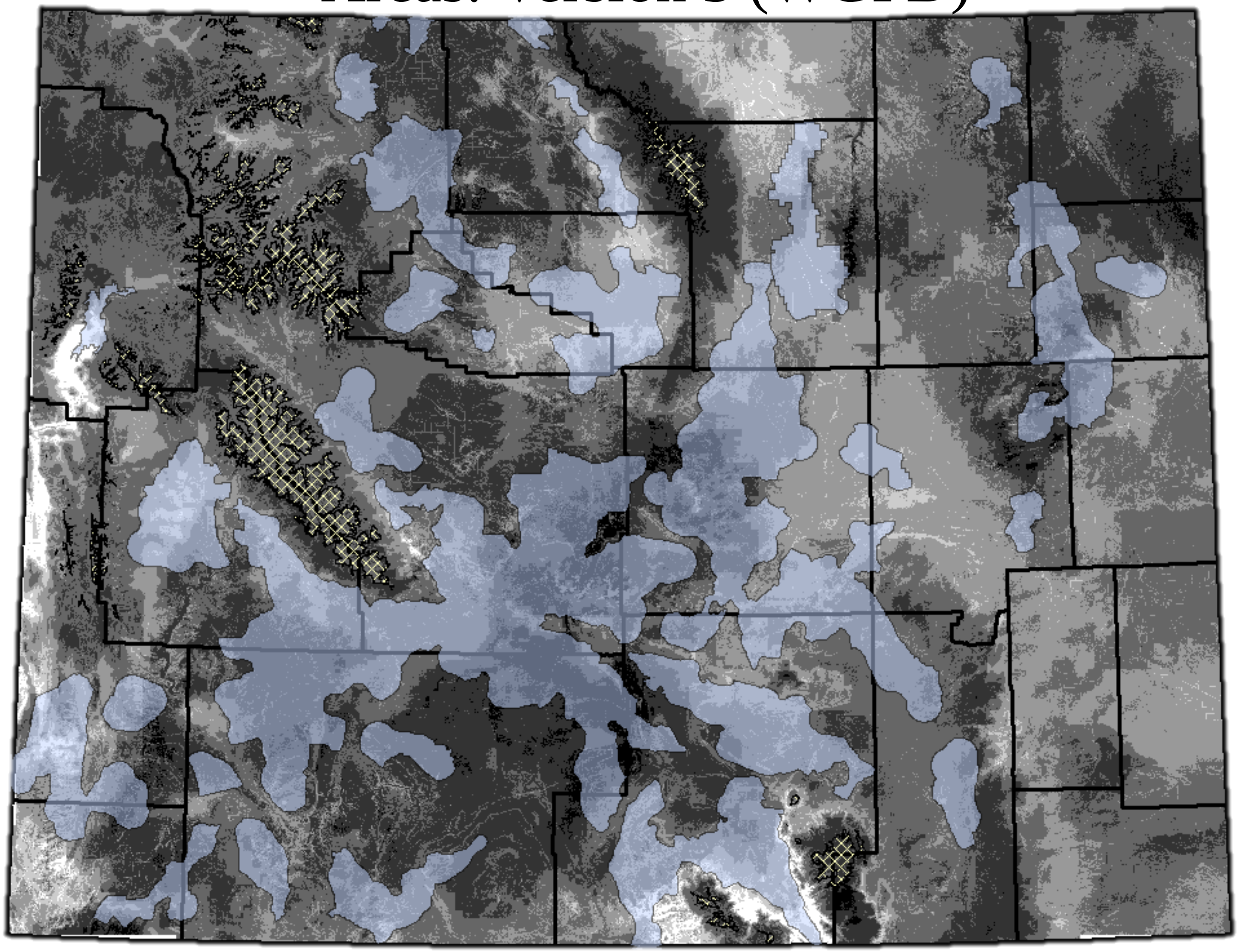
- Presence/absence models are important for determining establishment niche
  - Statewide: Climate plays a large role in invasion (Bradford and Lauenroth 2006; Compagnoni and Adler 2014)
  - Appears to fit with Smith and Enloe (2006)

- Class models useful in determining impact niche
  - Choosing one will likely depend on
    - Management objectives → prevention/eradication vs. restoration
    - Level of uncertainty → cheatgrass may not have fulfilled its niche in Wyoming

Discussion

- Prioritization Model
  - Overlap of invasion hot spots and critical habitat
  - Multiple models to guide management

Sage Grouse Core Management Areas: Version 3 (WGFD)



Discussion

- **Phase 1: Distribution and Modeling**
  - Provide a starting point for a statewide cheatgrass management strategy (a method for prioritizing)
  - Develop dataset for continued modeling efforts
- Phase 2: Site Selection and Implementation
  - Determine highest priority areas within the state
  - Coordinate management efforts
- Phase 3: Monitoring and Follow-Up
  - Continue to track changes in extent and severity over time

Phase 1 › Phase 2 › Phase 3

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