Sage-Grouse Habitat Selection at the Southern Periphery of their Range

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Photo: K. Theule/USFWS
Habitat Selection

1\textsuperscript{st} Order
Species distribution

2\textsuperscript{nd} Order
Population distribution

3\textsuperscript{rd} Order
Within-home range

4\textsuperscript{th} Order
Choice of food items

Johnson 1980, Ecology
Motivation

• Effective management requires scale-appropriate information
Motivation

- Range-wide habitat selection estimates are not adequate to inform management decisions at finer scales.
Motivation

- Differences across scales can be even more striking at the periphery of the range
Motivation

• Differences across scales can be even more striking at the periphery of the range
Objective

Quantifying sage-grouse habitat selection in Utah to provide state managers and their partners with scale-appropriate information
Methods

• 2\textsuperscript{nd} order habitat selection (populations)

• Use/availability design

• 19,639 use locations from VHF telemetry (1998-2013)

• Breeding, summer, winter models (seasons defined in Dahlgren et al. 2016)

• Random forest algorithm to model habitat selection

• Spatial k-fold cross-validation

• Relative Selection Strength (RSS) to quantify responses
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Random Forest

Classification tree

Used    Avail.   Avail.   Avail.
Random Forest

Classification tree

Many trees = Forest
Spatial k-fold Cross Validation

- Withhold one site at a time
- Validate model results on the withheld site
- Accounts for spatial autocorrelation
- Avoids inflating model performance estimates
Relative Selection Strength

\[ RSS = \frac{w(x_1)}{w(x_2)} \]

- \( w(x) \) is the exponential habitat selection function
- \( x_1 \) are the points we want to predict over
- \( x_2 \) is a chosen set of reference conditions

Avgar et al. 2017, *Eco & Evo*
Relative Selection Strength

RSS

1

SELECTION

AVOIDANCE

Predictor

Avgar et al. 2017, Eco & Evo
Results

Photo: Rawlins Daily Times, Jarret Raffety
Seasonal Habitat Maps

SKFCV error rate = 0.07

SKFCV error rate = 0.19

SKFCV error rate = 0.29
Annual Habitat Map

- RSS > 1 in all seasons
Relative Importance of Predictors

A. Breeding
- Sagebrush
- Min. temperature
- Max. temperature
- Slope
- Elevation
- Precipitation
- Ruggedness
- Site
- % Sand
- Riparian
- Conifer
- Soil depth
- Secondary roads
- % Silt
- Available water capacity
- % Clay
- Agricultural
- Grassland
- Salinity
- Powerlines
- Highways and interstates
- Burned area
- Year
- Development
- Pipelines
- Communication towers

B. Summer
- Sagebrush
- Max. temperature
- Elevation
- Precipitation
- Site
- Min. temperature
- Riparian
- % Sand
- Slope
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C. Winter
- Sagebrush
- Precipitation
- Soil depth
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- Slope
- Min. temperature
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Responses to Habitat Variables

B.

Graph showing responses to different habitat variables with elevation in meters on the x-axis and RSS on the y-axis. The graph includes lines representing different seasons: breeding (green), summer (yellow), and winter (brown). The graph indicates a peak in RSS near an elevation of 2100 m.
Responses to Habitat Variables

![Graph showing responses to habitat variables with precipitation (mm) on the x-axis and RSS on the y-axis, with different colored lines representing different seasons: Breeding, Summer, and Winter.](image)

- **Seasons**:
  - Breeding
  - Summer
  - Winter

- **Graph Key**:
  - Breeding: Green
  - Summer: Yellow
  - Winter: Orange

- **Axes**:
  - X-axis: Precipitation (mm)
  - Y-axis: RSS
Responses to Habitat Variables

E.

![Graph showing responses to habitat variables with min. temperature in °C on the x-axis and RSS on the y-axis. Three seasons are represented: Breeding (green), Summer (yellow), and Winter (orange). The graph illustrates the influence of temperature on habitat variables across different seasons.](image)
Responses to Habitat Variables

The graph illustrates the responses to habitat variables in different seasons. The x-axis represents the maximum temperature in °C, while the y-axis shows the RSS (Relative Square Sum error). The seasons are color-coded: breeding season (green), summer (yellow), and winter (orange). The graph shows changes in response as temperature varies across these seasons.
Responses to Habitat Variables

- **G**: Powerlines (km/km²)
- **H**: Development (% in 5 km)
- **I**: Secondary roads (km/km²)
- **J**: Highways and interstates (km/km²)
- **K**: Communication towers (km⁻¹)
- **L**: Pipelines (km/km²)

Season:  
- **Breeding**
- **Summer**
- **Winter**
Takeaways

• Like elsewhere in their range, large and uninterrupted patches of sagebrush are important for sage-grouse in Utah
Takeaways

• Responses to other variables reflect the unique climatic and topographic characteristics of Utah
Takeaways

- Anthropogenic disturbance variables were ranked as *relatively* less important
  - Possibly because Utah is less impacted than other areas of the species range
  - Possibly because these responses emerge at coarser or finer scales
Next Steps

- 3rd order habitat selection for full characterization across scales
Related Projects

• HAF habitat modeling (led by Dr. M. Kohl)
  • GPS telemetry data
  • RAP data for fine-scale vegetation
  • Functional responses

• Prioritization tool for PJ treatments (led by Dr. J. Small)
  • Predicting ecological gains
  • Balancing economic cost
  • Directly compare candidate treatments and choose
Thank you! Questions?

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