Greater Sage-Grouse Reproductive Habitat Selection and Survival in Response to Wind Energy Infrastructure

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December 1, 2016
Study Area
Field Methods

- Study 2009 – 2014
- Captured 346 females (160 treatment; 186 control)
- 22-g necklace-mounted VHF radio transmitter (666 days)
Covariate Data
Habitat Selection
Results – Nest Site Selection

![Graph showing average distance to turbine by year with error bars.]

![Map of nest site selection with different colored points and lines.]

- 2009: n=18
- 2010: n=24
- 2011: n=49
- 2012: n=21
- 2013: n=26
- 2014: n=16
Results – Nest Site Selection; No Effect

**Final Model**

- Distance to lek of capture (-)
- Bare ground (-)
- Litter (+)
- Wyoming big sagebrush (+)
- Distance to Transmission Line (+)
- \((\text{Distance to Transmission Line})^2\) (-)

![Map showing nest site selection with years 2009-2011 and 2012-2014]
Results – Brood-Rearing Habitat Selection
Results – Brood-Rearing Habitat Selection; Negative Effect

**Final Model**

- Distance to lek of capture (-)
- Wyoming big sagebrush (+)
- Elevation (+)
- Bare ground (-)
- SD shrub height (-)
- Distance to transmission line (+)
- (Distance to Transmission Line)$^2$ (-)
- Distance to major roads (+)
- (Distance to major roads)$^2$ (-)
- Percent of SWEF surface disturbance (-)
Results – Brood-Rearing Habitat Selection; Time Lag
Results – Summer Habitat Selection
### Final Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2009-2011</th>
<th>2012-2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to lek of capture (-)</td>
<td></td>
<td></td>
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<tr>
<td>Herbaceous (-)</td>
<td></td>
<td></td>
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<tr>
<td>TPI (-)</td>
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<tr>
<td>Shrub SD (+)</td>
<td></td>
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<tr>
<td>Slope (-)</td>
<td></td>
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<tr>
<td>Distance to major roads (+)</td>
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<tr>
<td>Percentage of SWEF Disturbance (-)</td>
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</tbody>
</table>
**Discussion – Habitat Selection**

- Turbine locations did not affect nest site selection patterns
- Females shifted selection patterns during the brood-rearing and summer period away from turbines
- Density of turbines was more important than proximity
- As percentage of disturbance increased brood-rearing and summer habitat selection decreased

<table>
<thead>
<tr>
<th>Habitat Selection</th>
<th>Turbine Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nest</td>
<td>No Effect</td>
</tr>
<tr>
<td>Brood-Rearing</td>
<td>Negative Effect (1.2 km)</td>
</tr>
<tr>
<td>Summer</td>
<td>Negative Effect (1.2 km)</td>
</tr>
</tbody>
</table>
Survival
Analysis Methods – Survival

- Combined all data
- Cox proportional hazards
- Nest survival – 28 days
- Brood survival – 37 days post hatch
- Female survival – capture through October
- Random effect of leks
Results – Nest Survival; No Turbine Effect

Final Model

- Shrub SD (-)
- TPI (-)
- Distance to major roads (+)
- \((\text{Distance to major roads})^2\) (-)
- Distance to transmission line (+)
Results – Brood-Rearing Survival; No Turbine Effect

Final Model

Terrain Ruggedness (-)
TPI (-)
Distance to Capture Lek (+)
Distance to Major Roads (+)
Distance to Transmission line (+)
Distance to Transmission line^2 (-)
Results – Summer Female Survival; Positive Effect

**Final Model**

- Bare ground (+)
- CTI (-)
- Herbaceous (+)
- Terrain Ruggedness (+)
- TPI (-)
- Distance to Capture Lek (+)

**Percentage of Disturbance (+)**
Results – Female Survival; Risk Lower within Facility
Discussion – Survival

- Lek of capture important for brood survival
  - “Bad neighborhood” not located near turbines

- Similarities to greater prairie-chicken
  - No turbine effect on nest survival
  - Positive effect on female survival
Conclusion

- 3% Disturbance
- 1.5%
- 0% = 1.2 km