Breeding Habitat Requirements of Bendire’s Thrasher (*Toxostoma bendirei*)

Cody Bear, Martha Desmond, Peggy Darr, and Dawn VanLeeuwen
Background

• Arid land birds are among fastest declining avian group in the U.S.

• Three of the fastest declining aridland species are aridland obligates
  ➢ Bendire’s Thrasher
  ➢ Le Conte’s Thrasher
  ➢ Sage Thrasher
Estimated decline 4.4% annually
Fastest declining aridland bird
Majority of U.S. population AZ and NM

Potential causes of declines
• Habitat degradation & disturbance in SW, including shrub encroachment
• Competition with Curve-billed Thrasher
BETH Objectives

1. Determine average BETH territory size & if varies by vegetation communities.

2. Examine differences in BETH habitat selection among vegetation communities.

3. Compare multiscale characteristics within and surrounding BETH territories with randomly selected sites.
Methods: Study Area

Study Area
Southwestern NM and southern AZ
Based on MaxEnt model of BETH distribution in NM & eBird locations during breeding season for AZ

Stratify by vegetation type. Classifications will need to stay broad
• 1.) desert scrub, 2.) grassland, 3.) pinyon-juniper, and 4.) Sonoran-Paloverde.
Methods: BETH breeding surveys

- Used point counts & Area Search
  - NM: 2015 and 2016
  - AZ: 2016

- Mix of traditional point count and playback survey

- Survey length
  - 2015: 13.5 minutes
  - 2016: 7 minutes

- Modified area search around point counts
Methods: Breeding Territories

• Return to detection area
  • 4 days after initial detection

• Combination of spot-mapping and territory flush technique (Gregory et al. 2004 and Weins 1969) to map territories.

• GPS location of each perch

• Flushed BETH if needed

• Collected minimum of 20 locations
Methods: Territory Scale – Random Points

• We created random vegetation points for comparison

• Random vegetation points were the average size of the BETH territories

• 70 random sites plotted and surveyed in stratified vegetation communities throughout NM and AZ
Methods: Abiotic Scale

- Downloaded Rasters from OSU
- PRISM database (800m)
- SSURGO soil layer (100m)
- Topo data from NM RGIS and AZGEO database (10m)

Variables Produced:
- Year (YR)
- Elevation (ELV)
- Slope (SLP)
- Bioyear Precipitation (BYPT)
- Soil (SOIL)
Methods: Territory Scale – Vegetation Collection

- Randomly plot six 25m transects within mapped territories using GIS.

**Surveys:**
- Line intercept (species composition)
- Gap Intercept (bare ground)
- Belt Transect (Shrub density/height)
- Visual Obstruction
- Photo point
Variables Produced:
- Canopy gap 51-100 (CG1)
- Canopy gap >200 (CG2)
- Average Obstruction (AO)
- Shrub Density (PTD)
- Density of Tall Shrubs (PCD)
- Number of Tall Shrubs (NTS)
- Average Shrub Height (Shrubs over 1.5m) (ASH)
- Bare Ground (BG)
Methods: Landscape Scale

- Created 1000m (1km) buffer around Territory and Random Sites
- Hand digitized habitat within the buffer
- Categorized into same broad vegetation types from point counts
- Added Residential, Agriculture, Creosote.
- Used Patch Analyst in GIS to develop variables.
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Methods: Landscape Scale

Variables Produced:

- Mean Patch Size (MPS)
- Mean Perimeter-Area Ratio (MPAR)
- Mean Fractal Dimension (MFD)
- Richness (RIC)
- Dominance (DOM)
- Edge Density (ED)
Analysis: Territory Size

- Minimum Convex Polygons in GIS
- Generated Areas in Hectares
- Compared territory size among four vegetation types.
Results: Territory Size

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>N</th>
<th>Mean Size (Ha)</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrub</td>
<td>11</td>
<td><strong>1.29</strong></td>
<td>0.86</td>
<td>0.50</td>
<td>3.22</td>
</tr>
<tr>
<td>Grassland</td>
<td>26</td>
<td><strong>1.87</strong></td>
<td>0.81</td>
<td>0.51</td>
<td>3.54</td>
</tr>
<tr>
<td>Pinyon-Juniper</td>
<td>12</td>
<td><strong>1.63</strong></td>
<td>0.82</td>
<td>0.27</td>
<td>2.81</td>
</tr>
<tr>
<td>Sonoran-Paloverde</td>
<td>11</td>
<td><strong>1.62</strong></td>
<td>1.03</td>
<td>0.39</td>
<td>3.65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015_NM</td>
<td>25</td>
<td><strong>1.28</strong></td>
<td>0.60</td>
<td>0.27</td>
<td>2.60</td>
</tr>
<tr>
<td>2016_NM</td>
<td>18</td>
<td><strong>2.29</strong></td>
<td>0.87</td>
<td>0.58</td>
<td>3.54</td>
</tr>
<tr>
<td>2016_AZ</td>
<td>17</td>
<td><strong>1.59</strong></td>
<td>0.87</td>
<td>0.39</td>
<td>3.65</td>
</tr>
</tbody>
</table>

- Territory size varied sig between yrs. \( F_{2, 52} = 9.90, P = 0.0002 \) (NM)
- Did not vary among vegetation types \( F_{3, 52} = 2.53, P = 0.1931 \).
Analysis: Territory Differences Among Vegetation Types

• Compared differences in variables among 4 main vegetation types.

• Analyzed with ANOVAs in SAS with PROC GLM.

Varied among Veg type
• Slope
• Elevation
• VOR
• Bare G.
• Shrub Height
• Canopy Gaps
• Patch Richness
• Edge Density
Analysis: Multiscale Habitat Selection

Abiotic Scale
- ELV (Elevation)
- SLP (Slope)
- PBY (Precipitation Bioyear)
- YEAR

Territory Scale
- AO (Average Obstruction)
- NTS (Number of Tall Shrubs)
- ASH (Average Shrub Height)
- BG (Bare Ground)
- PTD (Total Plot Density - shrubs)
- CG2 (Canopy Gaps >200)
  - ASH*NTS
  - BG*PTD

Landscape Scale
- MPS (Mean Patch Size)
- MFD (Mean Fractal Dimension)
- RIC (Richness)
- DOM (Dominance)
- ED (Edge Density)

Conditional logistic regression examining occupied territories with random locations across vegetation types using a priori models and an $\text{AIC}_c$ approach.
<table>
<thead>
<tr>
<th>Model</th>
<th>-2 Log-likelihood</th>
<th>K&lt;sup&gt;a&lt;/sup&gt;</th>
<th>ΔAIC</th>
<th>w&lt;sub&gt;i&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year, Slope, Elevation</td>
<td>143.01</td>
<td>3</td>
<td>0</td>
<td>0.46</td>
</tr>
<tr>
<td>Elevation, Slope</td>
<td>146.23</td>
<td>2</td>
<td>1.22</td>
<td>0.25</td>
</tr>
<tr>
<td>Year, Slope, Elevation, Bioyear Precip</td>
<td>142.79</td>
<td>4</td>
<td>1.78</td>
<td>0.19</td>
</tr>
<tr>
<td>Elevation, Slope, Bioyear Precip</td>
<td>146.22</td>
<td>3</td>
<td>3.21</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Results: Abiotic Scale

- Slope and elevation had the strongest influence on territory selection.

- Selection decreased by:
  - ~7% with each 5% increase in the slope (odds ratio = 0.93)
  - ~9% with every 100m increase in elevation

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>95% CI</th>
<th>Scaled Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope (SL)</td>
<td>-0.016</td>
<td>-0.022 to -0.045</td>
<td>0.927</td>
</tr>
<tr>
<td>Elevation (EL)</td>
<td>-0.002</td>
<td>-0.003 to -0.002</td>
<td>0.905</td>
</tr>
<tr>
<td>Bioyear Precipitation (PB)</td>
<td>-0.001</td>
<td>-0.005 to 0.002</td>
<td>0.990</td>
</tr>
<tr>
<td>Year (YR)</td>
<td>-0.628</td>
<td>-0.944 to -0.312</td>
<td>0.880</td>
</tr>
</tbody>
</table>
## Results: Territory Scale

<table>
<thead>
<tr>
<th>Model</th>
<th>-2 Log-likelihood</th>
<th>K</th>
<th>ΔAIC</th>
<th>w_i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Obstruction, % Bare Ground, Average Shrub Height</td>
<td>145.85</td>
<td>3</td>
<td>0</td>
<td>0.37</td>
</tr>
<tr>
<td>Average Obstruction, % Bare Ground, Average Shrub Height, Number of Tall Shrubs</td>
<td>144.38</td>
<td>4</td>
<td>0.53</td>
<td>0.28</td>
</tr>
<tr>
<td>Average Obstruction, % Bare Ground, Average Shrub Height, Canopy Gaps &gt;200cm</td>
<td>145.2</td>
<td>4</td>
<td>1.36</td>
<td>0.19</td>
</tr>
<tr>
<td>Average Obstruction, % Bare Ground, Average Shrub Height, Number of Tall Shrubs, Canopy Gap &gt;200cm, Shrub Density</td>
<td>143.04</td>
<td>6</td>
<td>3.19</td>
<td>0.07</td>
</tr>
</tbody>
</table>
## Results: Territory Scale

Selection increased by:
- 37% with each 10% increase in average obstruction (odds ratio = 1.37)
- ~90% with each 10% increase in bare ground (odds ratio = 1.90)
- 257% with each 1m increase in average shrub height (odds ratio = 3.57)
- ~2% with each additional shrub above 1.5 m tall (odds ratio = 1.02).

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>95% CI</th>
<th>Scaled Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Obstruction (AO)</td>
<td>0.031</td>
<td>0.015 to 0.047</td>
<td>1.370</td>
</tr>
<tr>
<td>Bare Ground (BG)</td>
<td>0.070</td>
<td>0.040 to 0.099</td>
<td>1.895</td>
</tr>
<tr>
<td>Average Shrub Height (SH)</td>
<td>1.319</td>
<td>0.916 to 1.520</td>
<td>3.567</td>
</tr>
<tr>
<td>Number of Tall Shrubs (TS)</td>
<td>0.061</td>
<td>0.032 to 0.091</td>
<td>1.019</td>
</tr>
<tr>
<td>Canopy Gap (CG2)</td>
<td>-0.004</td>
<td>-0.013 to 0.005</td>
<td>0.923</td>
</tr>
<tr>
<td>Model</td>
<td>-2 Log-likelihood</td>
<td>$K^a$</td>
<td>ΔAIC</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>Mean Patch Size, Richness, Edge Density</td>
<td>152.88</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mean Patch Size</td>
<td>160.05</td>
<td>1</td>
<td>3.17</td>
</tr>
</tbody>
</table>
## Results: Landscape Scale

- **Mean patch size** was the most important variable based on odds ratios.
  - ~77% decrease in use with each 1 ha increase in the mean patch size (odds ratio = 0.23)

- **Patch richness** increased the odds of use by 58% with each additional vegetation community type within 1 km of a territory (odds ratio = 1.58)

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</tr>
</thead>
<tbody>
<tr>
<td>Mean Patch Size (PS)</td>
<td>-2.011</td>
<td>-2.821 to -1.202</td>
<td>0.229</td>
</tr>
<tr>
<td>Richness (RI)</td>
<td>0.342</td>
<td>0.088 to 0.596</td>
<td>1.580</td>
</tr>
<tr>
<td>Edge Density (ED)</td>
<td>-3.11E-07</td>
<td>-7.56E-07 to 1.33E-07</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Discussion

• Average territory size similar to that of other N.A. Thrashers.

• Territory sizes did not vary by broad vegetation community type suggesting structure plays a larger role. Did vary with precipitation.

• Preferred areas with taller shrubs, greater vegetation density (obstruction) but also more bare ground.

• Avoidance of uninterrupted brushy cover and continuous grasslands
Species Distribution Model of BETH in NM and AZ

- Predicting current breeding distribution and hot spots for BETH using presence only data
- Identify major land managers

SDM Variables

BS Max Temp -54%
Bioyr precip -32%
Elevation
Slope
% Cover

Private 29%
Tribal 26%
BLM 19%
State 17%

Private 34%
BLM 26%
State 19%
DOD 18%

n = 322 locations (after removal SC pts)
AUC 8.5 ± 0.04
Two Climate Projection models with two greenhouse gas Representative Concentration Pathways (RCP 2.6 & 8.5)

Model variables
Bioyear  Precip
BS Max Temp
Elevation
Slope

AUC values between 0.84-0.85
Acknowledgments

• Tucson Audubon Volunteers
• NM Audubon Volunteers
• Technicians:
  • Alison Salas
  • Odd Jacobson
  • Jasmine Johnson
• Daniel Horton
Bendire’s Thrasher (BETH)

- Secretive, cryptic, and territorial
- Understudied since first described in 1872
- Current population estimates vary
  - 20,000-170,000
- IUCN: Vulnerable (BirdLife International 2012)
- American Bird Conservancy U.S. WatchList
- 20-40% of population in NM
- Population declining 4.61% annually
  - Fastest declining aridland bird