Distribution and site selection of Le Conte’s and Crissal Thrashers in the Mojave Desert

Dawn Fletcher\textsuperscript{1, 2}, Jef Jaeger\textsuperscript{1, 2}, Cheryl Vanier\textsuperscript{2}, Dan Thompson\textsuperscript{2}, John Klicka\textsuperscript{3}

\textsuperscript{1}Public Lands Institute, \textsuperscript{2}School of Life Sciences, and \textsuperscript{3}Barrick Museum, University of Nevada, Las Vegas
Distributions

Le Conte’s thrasher occurs within the Sonoran, Mojave, and Peninsular deserts.

Crissal thrashers are more broadly distributed.
Background and Need for Project

- Low numbers and patchy distribution increase vulnerability to habitat change and local extinctions
- This problem is acute where urbanization is occurring rapidly
- Rare and elusive species and often undetected during point counts
- Current habitat models have limited predictive accuracy
Habitat Model from Southwest ReGAP for Le Conte’s Thrasher

Map appears to overestimate suitable habitat.

80% of Clark County predicted as suitable habitat.
Project Goal and Objectives

Goal
- Understand the distribution and habitat use to inform conservation planning

Objectives
- Identify site-specific environmental influences
- Develop models and maps of suitable habitat
Primary Field Method:
Call-broadcast Surveys

Recorded calls of thrasher species played from portable loudspeaker
453 Random survey locations within Clark County

Stratified:

- 70% in major vegetation types and within 400m of roads
- 10% outside 400m buffer
- 20% within rare habitats
Le Conte’s Thrasher Distribution

Map of positive observations

- 45 Random
- 24 Incidental
Crissal Thrasher Distribution

Map of positive observations

- 41 Random
- 28 Incidental
Main Analytical Approach Logistic Regression Analysis

Dependent variable – presence or absence of thrasher

Independent variables were fit using two models

1. Ecological model – created using site-specific data and data derived from digital spatial layers

2. Landscape model – created using data available or easily derived from digital spatial layers
Main Variable Groups

1. Plant assemblages
   – structure for nest sites, shelter, prey, etc.

2. Substrate
   – thrashers are ground foragers that excavate prey

3. Human Influence
   – thought to be sensitive to disturbance (assessed roads)
Main Variable Groups Continued

4. Physical landform features
   – increased vegetation in washes

5. Climatic Variables
   – impacts vegetation and bounds thrasher distribution
   – assessed through bioclimatic variables
   – reduced to 2 principal components representing patterns in elevation and latitude
Model Development and Selection
Information Theoretic Approach

- AIC$_c$ scores used to rank and select among models (a metric that penalizes additional variables relative to the amount of variation explained)
- For both species numerous models were in best-fit sets
- **Model-averaging** – best estimator of coefficients for datasets with more than one best model
  
  Averaged coefficients are calculated from entire sets of models – coefficients represent magnitude and affect of variables
Results of Le Conte’s Thrasher Modeling
Le Conte’s thrashers were never associated with these variables (features):

1. Slopes > 5 degrees \( (n=126) \)
2. Pinyon Juniper \( (n=29) \)
3. Black brush \( (n=42) \)
4. Mountainous areas \( (n=38) \)

These variables were removed prior to model fitting to allow identification of other ecologically important variables.
### Model-averaged coefficients from best-fit Ecological models for Le Conte’s thrasher

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake plains</td>
<td>3.6500</td>
<td>0.9347</td>
<td>6.3653</td>
</tr>
<tr>
<td>Cholla</td>
<td>3.2665</td>
<td>0.6121</td>
<td>5.9209</td>
</tr>
<tr>
<td>Mojave Mixed Scrub</td>
<td>3.4344</td>
<td>0.7308</td>
<td>6.1381</td>
</tr>
<tr>
<td>Saltbush</td>
<td>6.3152</td>
<td>2.8352</td>
<td>9.7953</td>
</tr>
<tr>
<td>Wash Habitat</td>
<td>3.0302</td>
<td>0.3367</td>
<td>5.7235</td>
</tr>
</tbody>
</table>

* Variables shown that have strong association with Le Conte’s thrasher presence (95 % confidence intervals do not including zero)
Results from model-averaging of best-fit **Landscape** models for Le Conte’s thrasher

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-4.9770</td>
<td>-8.2022</td>
<td>-1.7518</td>
</tr>
<tr>
<td>Distance to road 300m</td>
<td>0.0002</td>
<td>-0.0008</td>
<td>0.0011</td>
</tr>
<tr>
<td>Creosote bush-white bursage</td>
<td>1.6813</td>
<td>-0.4905</td>
<td>3.8531</td>
</tr>
<tr>
<td>Mojave Mixed Scrub</td>
<td>2.6032</td>
<td>0.3223</td>
<td>4.8841</td>
</tr>
<tr>
<td>Saltbush series</td>
<td>5.9064</td>
<td>2.7266</td>
<td>9.0862</td>
</tr>
<tr>
<td>Wash habitat</td>
<td>2.7841</td>
<td>0.5096</td>
<td>5.0587</td>
</tr>
<tr>
<td>Landform Lake plains</td>
<td>1.9777</td>
<td>0.4085</td>
<td>3.5468</td>
</tr>
<tr>
<td>Presence of wash 300m</td>
<td>0.9832</td>
<td>-1.4073</td>
<td>3.3738</td>
</tr>
<tr>
<td>Prin2</td>
<td>0.0264</td>
<td>-0.087</td>
<td>0.1398</td>
</tr>
</tbody>
</table>
Predictive Habitat Map for Le Conte’s thrasher

From the 9 landscape model-averaged coefficients

Identifies 4,000 km$^2$ as potential habitat out of 20,638 km$^2$
Results Crissal Thrasher

© Glen Tepke – http://www.pbase.com/gtepke/
Variables negatively associated with Crissal thrasher

1. Creosote Bursage (n=77)
2. Sparse Joshua Tree (n=33)
3. Shadscale (n=27)

These variables were removed prior to model fitting to allow identification of other ecologically important variables.
Results from model-averaging of Ecological models for Crissal thrasher

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-4.7846</td>
<td>-7.0834</td>
<td>-2.4858</td>
</tr>
<tr>
<td>Plant series Black brush</td>
<td>0.5999</td>
<td>-1.6674</td>
<td>2.8672</td>
</tr>
<tr>
<td>Plant series Joshua tree</td>
<td>0.4732</td>
<td>-1.4467</td>
<td>2.3931</td>
</tr>
<tr>
<td>Plant series Pinyon Juniper</td>
<td>-0.1495</td>
<td>-2.8912</td>
<td>2.5922</td>
</tr>
<tr>
<td><strong>Plant series Riparian Mesquite</strong></td>
<td><strong>8.1678</strong></td>
<td><strong>5.0153</strong></td>
<td><strong>11.3203</strong></td>
</tr>
<tr>
<td><strong>Plant_series Wash habitat</strong></td>
<td><strong>2.6367</strong></td>
<td><strong>0.8978</strong></td>
<td><strong>4.3754</strong></td>
</tr>
<tr>
<td>Dominant road class 300m</td>
<td>-0.0593</td>
<td>-0.2463</td>
<td>0.1278</td>
</tr>
<tr>
<td>Number of roads 100m</td>
<td>-0.0209</td>
<td>-0.1223</td>
<td>0.0806</td>
</tr>
<tr>
<td>Number of roads 300m</td>
<td>0.0149</td>
<td>-0.0586</td>
<td>0.0885</td>
</tr>
<tr>
<td>Presence/Absence of Wash 100m</td>
<td>0.3114</td>
<td>-0.8084</td>
<td>1.4312</td>
</tr>
<tr>
<td><strong>Principle Component 1</strong></td>
<td><strong>-0.3212</strong></td>
<td><strong>-0.5555</strong></td>
<td><strong>-0.087</strong></td>
</tr>
<tr>
<td><strong>Principle Component 2</strong></td>
<td><strong>0.6648</strong></td>
<td><strong>0.2289</strong></td>
<td><strong>1.1008</strong></td>
</tr>
<tr>
<td>Slope</td>
<td>0.0081</td>
<td>-0.0250</td>
<td>0.0412</td>
</tr>
<tr>
<td>Wash size 100m</td>
<td>0.0001</td>
<td>-0.0005</td>
<td>0.0008</td>
</tr>
<tr>
<td>Wash size 300m</td>
<td>0.0001</td>
<td>-0.0005</td>
<td>0.0007</td>
</tr>
</tbody>
</table>
Results of model-averaging of Landscape models for Crissal Thrasher

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-4.7531</td>
<td>-6.7034</td>
<td>-2.8028</td>
</tr>
<tr>
<td>Plant series: Black brush</td>
<td>0.5678</td>
<td>-1.6783</td>
<td>2.8138</td>
</tr>
<tr>
<td>Plant series: Joshua tree</td>
<td>0.5709</td>
<td>-1.3630</td>
<td>2.5049</td>
</tr>
<tr>
<td>Plant series: Pinyon Juniper</td>
<td>-0.1430</td>
<td>-2.8643</td>
<td>2.5784</td>
</tr>
<tr>
<td>Plant series: Riparian and Mesquite</td>
<td>8.2521</td>
<td>5.1261</td>
<td>11.3781</td>
</tr>
<tr>
<td>Plant series: Wash habitat</td>
<td>2.7759</td>
<td>1.0313</td>
<td>4.5205</td>
</tr>
<tr>
<td>Principle Component 1</td>
<td>-0.3150</td>
<td>-0.5434</td>
<td>-0.0865</td>
</tr>
<tr>
<td>Principal Component 2</td>
<td>0.6461</td>
<td>0.2214</td>
<td>1.0709</td>
</tr>
<tr>
<td>Slope</td>
<td>0.0197</td>
<td>-0.0473</td>
<td>0.0867</td>
</tr>
</tbody>
</table>
Predictive Habitat Map for Crissal Thrasher

Based on 9 landscape model-averaged coefficients

Identified 5,677 km$^2$ of 20,638 km$^2$
Conclusions: Crissal Thrasher Habitat Selection

- Prefers habitats dominated by riparian and wash vegetation
- Strong influence of elevation and latitude, indicated in relationship of PC1 and PC2
  - Follows patterns observed in arid-dwelling species that reach northern limits within the eastern Mojave Desert
- Negative association with creosote bursage and shadscale dominated habitats

Landscape and ecological models emphasizing the same variables
Conclusions: Le Conte’s Thrasher Habitat Selection

Species occurs in areas of little topographic relief, such as near dry lake beds (playas)

This pattern is strongly evidenced by:

- Negative relationship with slopes > 5 degrees, as well as upper elevation vegetation and landscape features
- Positive association with saltbush assemblages typically associated with the lower elevations

Joseph Hutcheson
General Conclusions

Both ecological and landscape models are important

- Ecological models captured habitat features not readily available as spatial data layers and inform broader-scale modeling

- Landscape models enable predictive habitat maps
  - Applied across broad scale for conservation planning
  - Identify areas that are likely to be occupied
  - Allows estimates of habitat loss or potential loss
## Acknowledgments

### Project Support
- Ross Haley
- Kent Turner

### GIS Support
- Joe Hutcheson
- Mark Sappington

### Soil Classification
- Doug Merkler

### Plant Identification
- Dianne Bangle

### Field Support
- Dorothy Crowe
- Joe Barnes
- Mitch Urban
Preferred habitat for the Le Conte’s thrasher tends to overlap places that are often highly disturbed and targeted for development (flat areas with little slope), including future solar energy plants.
Habitat Model for Le Conte’s Thrasher

- Based on broad habitat categories
- Similar probability throughout County: 11-25%
- Overestimates in north areas

From Nevada Bird Atlas, Great Basin Bird Observatory
Plant Assemblages

Presence of dominant plant species in the field
– Over 70 species recorded

Combined into plant assemblages for analysis
– based on previously classified vegetation communities for the Mojave Desert and assemblages perceived to be important
Plant Assemblages

1. Black Brush
2. Cholla series
3. Creosote Bursage
4. Joshua tree
5. Juniper series
6. Low Elevation Joshua tree
7. Mesquite Series
8. Mojave Mixed Scrub
9. Pinyon-Juniper
10. Riparian
11. Saltbush
12. Shadscale
13. Teddy-Bear Cholla series
14. Wash Vegetation
Soil Type Classification

Database of Soil Surveys in Clark County (USDA) – These third-order soil surveys did not provide the level of detail needed for site specific classifications. Landscape features (slope and aspect) from GIS and Google Earth to visualize landscapes allowed site specific classifications.
Soil Texture Classification

Could not use soils for modeling because of the large number of variables (n=130) relative to sample size (n=453)

Analyses were based on the smaller number of soil textures associated with (and derived from) the identified soil types

Categories: clay, silt, sand, loam, fine, gravel, cobble, and stone

* Although soil types were not modeled it should be noted that a few soil types showed promising associations with thrashers based on Fisher’s Exact tests
Landform Features

Landform features determined using soil survey database

- lake plain, flood plain, ballenas, fan remnants, mountains, hills, and drainageways

Washes were visually determined and classified using Google Earth

- average width of wash (if present)
- distance from survey location to wash
Human Influence

Human disturbance assessed from aerial images in Google Earth

- Number of roads
- Distance to largest road from survey location
- Classification of largest road
  1. Highway
  2. Secondary
  3. Major Unpaved
  4. Unpaved Maintained
  5. 4 x4 road
  6. ATV Track or Path
Call-broadcast may attract birds from distant locations where habitat might be different.

Habitat features measured at two spatial scales:

- 300 m buffer – thrasher typically first detected within this buffer
- 100 m buffer – vegetative site descriptions based at this scale
Main Variable Groups

1. Plant assemblages
   structure for nest sites, shelter, prey, etc.

2. Substrate
   thrashers are ground foragers that excavate prey

3. Physical landform features
   increased vegetation in washes, soil texture

4. Human influence
   thrashers thought to be sensitive to disturbance

5. Climatic variables
   impacts vegetation (and soils), bounds thrasher distributions
Bioclimatic Variables

- 19 Bioclimatic variables obtained from WorldClim database
- Variables represent annual trends, seasonality, and extreme
  - PCA used to reduce bioclimatic variables, and
  - elevation, latitude, and longitude
  - Two PCs explained 90% of the variation, and precipitation easily interpreted
  - PC 1 – as elevation increases, precipitation increases and temperature decreases
  - PC 2 – lower annual and diurnal temperature range and high seasonality of precipitation are related to latitude
Justification for Creating Two Models

Spatial Scales

Site-specific (Ecological) models:
– tend to capture more information about the species than landscape-level (coarser scale) data

Landscape level models:
– collection tends to cost less (less time intensive)
– useful for generating predictive habitat maps