Using RStudio + spsurvey to Create A Spatially Balanced Survey Frame for Estimating Streaked Horned Lark Abundance in the Willamette Valley

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CUGOS Spring Fling
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Why Did We Do This?

The Streaked Horned Lark (*Eremophila alpestris strigata*) is listed as **Endangered** by Washington State and **Threatened** by the US Federal government.
Two Important Questions

**Where** are the larks?  
**How many** larks are there?
Roads clipped to study area

Removed interstates, state highways, and all roads within UGAs

Removed roads outside recovery zones

Limited to areas below 800' elevation

1 = North Willamette
2 = Southeast Willamette
3 = West Willamette

Roads

Recovery Zones

Remove UGAs

Distribute Points
Creating a *Spatially Balanced* Sampling Frame

- Random samples are not appropriate for extrapolation$^1$
- Larks have opinions about habitat! So we used *unequal inclusion probabilities* and selected sites *proportionally based on the probability of habitat suitability*
- In our case, least suitable = 0.01, most suitable = 0.99

$^1$See, for example, Perret et al, *Spatially balanced sampling methods are always more precise than random ones for estimating the size of aggregated populations*. 


Suitable Habitat
Unsuitable Habitat
How Do You Create a Spatially Balanced Sampling Frame?

- By using the Generalized Random Tessellation Stratified (GRTS)\(^1\) algorithm, which is available in the `spsurvey` package for RStudio.

\(^1\)Foundational paper by Stevens and Olsen, *Spatially Balanced Sampling of Natural Resources*
grts = Generalized Random Tessellation Stratified
How To use spsurvey and GRTS in RStudio

- Convert points to CSV and load into RStudio
  - `srv_pts_v1_df <- read.csv("zone_1_survey_points_v1.csv",header=TRUE,sep="","`)"
How To use spsurvey and GRTS in RStudio

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- Load spsurvey
  - library(spsurvey)
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- Create a geo object from the CSV, being sure to specify your CRS
  - `srv_pts_v2_geo <- st_as_sf(srv_pts_v2_df, coords = c("X_coord", "Y_coord"), crs = 4326)`
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- Transform GCS coordinates to UTM
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- Transform GCS coordinates to UTM
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- Select sites using GRTS and the habitat suitability value as the weight
  - `selected_sites_srv_pts_v2 <- grts(srv_pts_v2, n_base = 118, aux_var = "max_2021_scaled")`
How To use spsurvey and grts in RStudio, continued

- Display the results
  - `sp_plot(selected_sites_srv_pts_v2, srv_pts_v2, key.width = lcm(3))`
How To use spsurvey and grts in RStudio, continued

- Display the results
  - `sp_plot(selected_sites_srv_pts_v2, srv_pts_v2, key.width = lcm(3))`

- Combine rows from the GRTS sample
  - `proprob_sites_v2 <- sp_rbind(selected_sites_srv_pts_v2)`
How To use spsurvey and grts in RStudio, continued

- Display the results
  - `sp_plot(selected_sites_srv_pts_v2, srv_pts_v2, key.width = lcm(3))`

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  - `proprob_sites_v2 <- sp_rbind(selected_sites_srv_pts_v2)`

- Finally, export to shapefile
  - `st_write(proprob_sites_v2, "S:/Projects/WV_STHL/data/analysis/GRTS_processing/proprob_zone_2.shp")`
Recap & Results

The recovery zones were used as geographic strata:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Survey Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Willamette</td>
<td>28</td>
</tr>
<tr>
<td>West Willamette</td>
<td>118</td>
</tr>
<tr>
<td>Southeast Willamette</td>
<td>118</td>
</tr>
</tbody>
</table>

grts = Generalized Random Tessellation Stratified
Larks were detected at 28 points (13%) - 55 individuals

Lark Survey Results 2022
Number of Birds Detected
- 0
- 1
- 2
- 3
- 4

No. of points

No. of larks detected at point

Larks detected | Percent
---|---
0 | 87%
1 | 6%
2 | 4%
3 | 2%
4 | 1%
Questions?