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

Presented by
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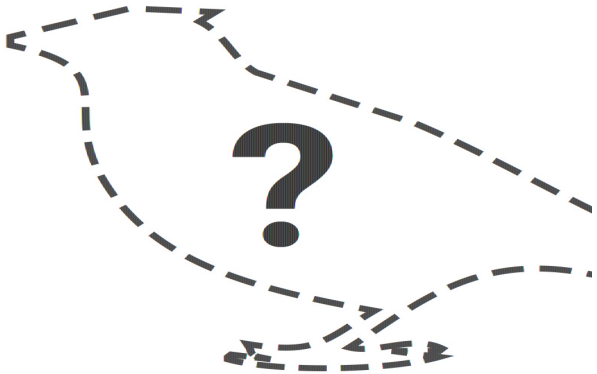
CORE GIS
CUGOS Spring Fling
April 21, 2023

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

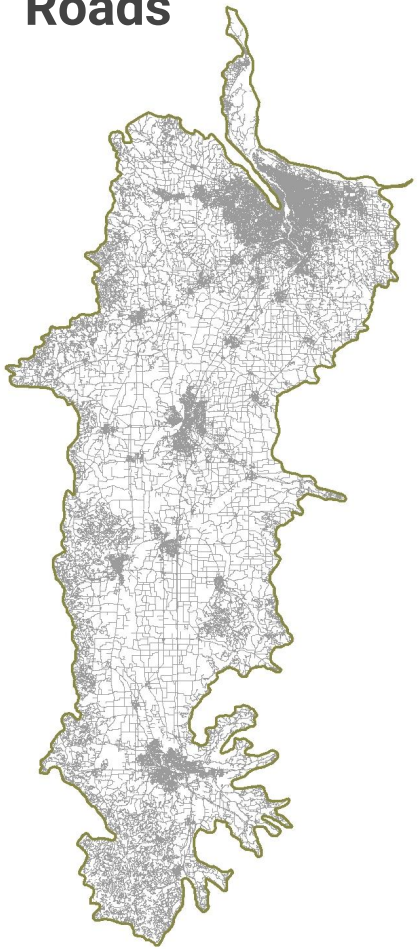
Two Important Questions



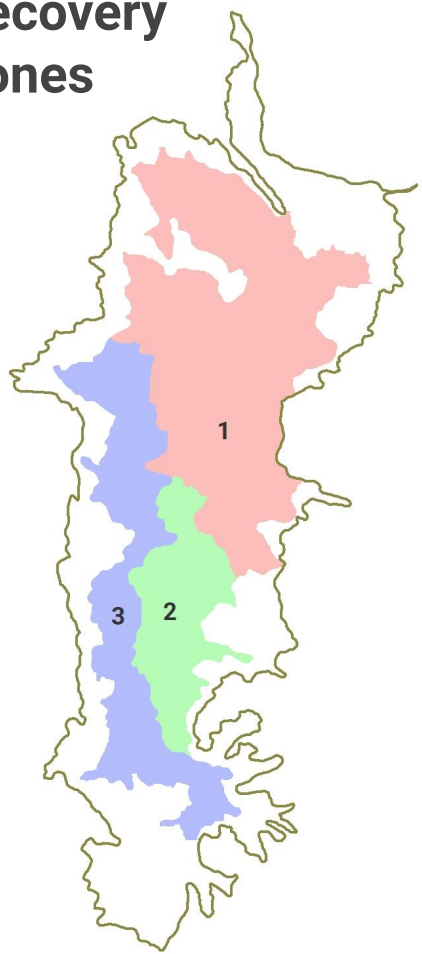
Where are the larks?

How many larks are there?

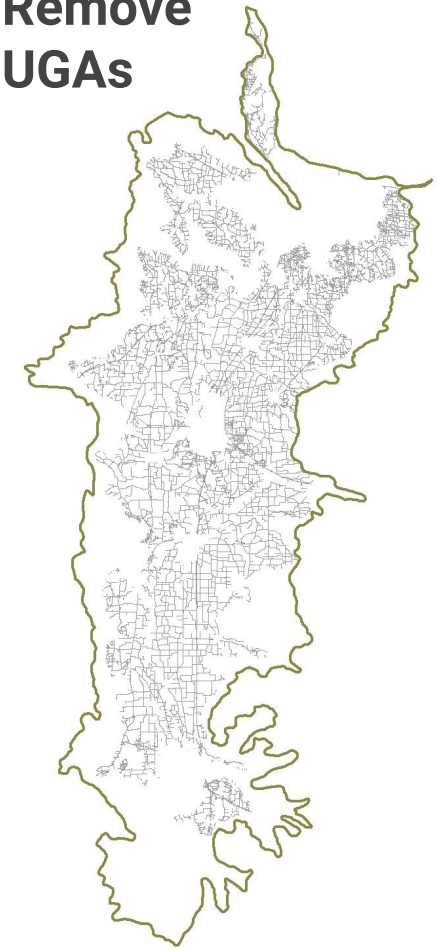
Roads



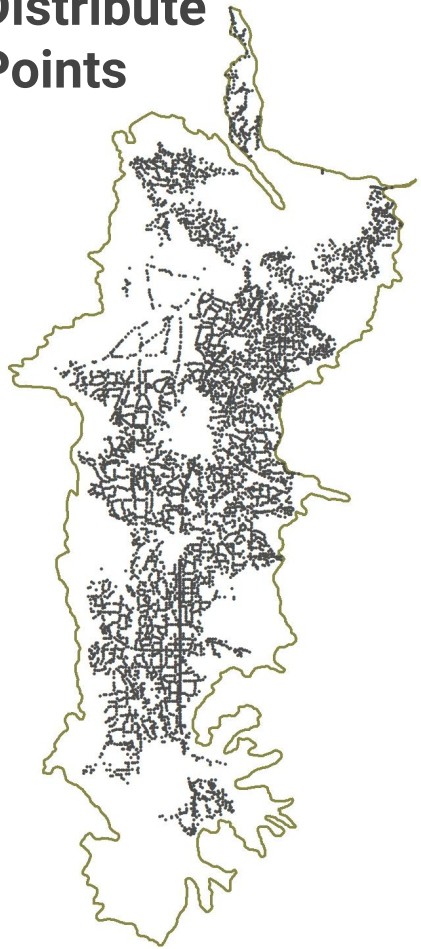
Recovery Zones



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_06_23_2022 - RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function | Addins | grts_06_23_2022

Console | Terminal | Jobs

R 4.1.3 · S:/Projects/WV_STHL/data/analysis/GRTS_processing/

```
> srv_pts_v2_df <- read.csv("zone_2_survey_points_v1.csv",hea
der=TRUE,sep=",")
> library(spsurvey)
Loading required package: sf
Linking to GEOS 3.9.1, GDAL 3.2.1, PROJ 7.2.1; sf_use_s2() is
 TRUE
Loading required package: survey
Loading required package: grid
Loading required package: Matrix
Loading required package: survival

Attaching package: 'survey'

The following object is masked from 'package:graphics':

    dotchart

spsurvey version 5.0.0 introduced significant changes to the
 inputs and outputs of many functions. Please review the upda
ted materials, vignettes, and documentation by visiting
 https://cran.r-project.org/package=spsurvey
> srv_pts_v2_geo <- st_as_sf(srv_pts_v2_df, coords = c("X_coo
rd", "Y_coord"), crs = 4326)
> srv_pts_v2 = st_transform(srv_pts_v2_geo, crs = 6855)
> selected_sites_srv_pts_v2 <- grts(srv_pts_v2, n_base = 94,
 aux_var = "max_2021_scaled")
> sp_plot(selected_sites_srv_pts_v2, srv_pts_v2, key.width =
 lcm(3))
>
```

Environment | History | Connections | Tutorial

Import Dataset | 248 MiB | List

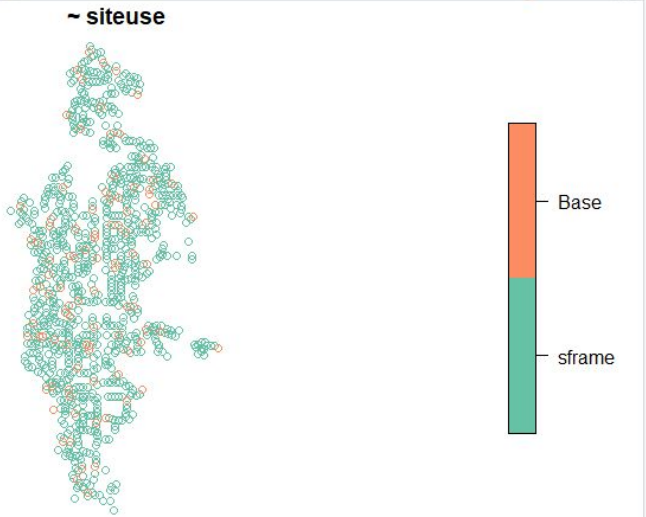
R | Global Environment

Data

selected_sites_srv_pts…	List of 5
srv_pts_v2	987 obs. of 4 variables
srv_pts_v2_df	987 obs. of 5 variables
srv_pts_v2_geo	987 obs. of 4 variables

Files | Plots | Packages | Help | Viewer

Zoom | Export | Publish



grts = Ge

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=",")

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- **Transform GCS coordinates to UTM**
  - srv_pts_v2 = st_transform(srv_pts_v2_geo, crs = 6855)

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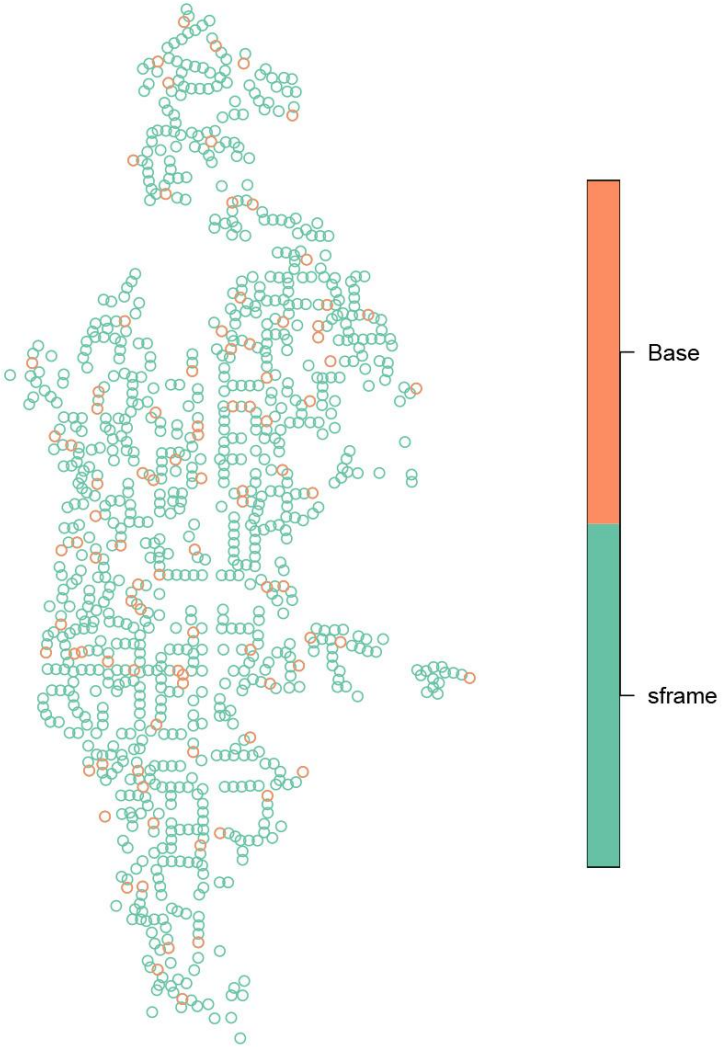
- **Transform GCS coordinates to UTM**
  - srv_pts_v2 = st_transform(srv_pts_v2_geo, crs = 6855)
- **Select sites using GRTS and the habitat suitability value as the weight**
  - selected_sites_srv_pts_v2 <- grts(srv_pts_v2, n_base = 118, aux_var = "max_2021_scaled")

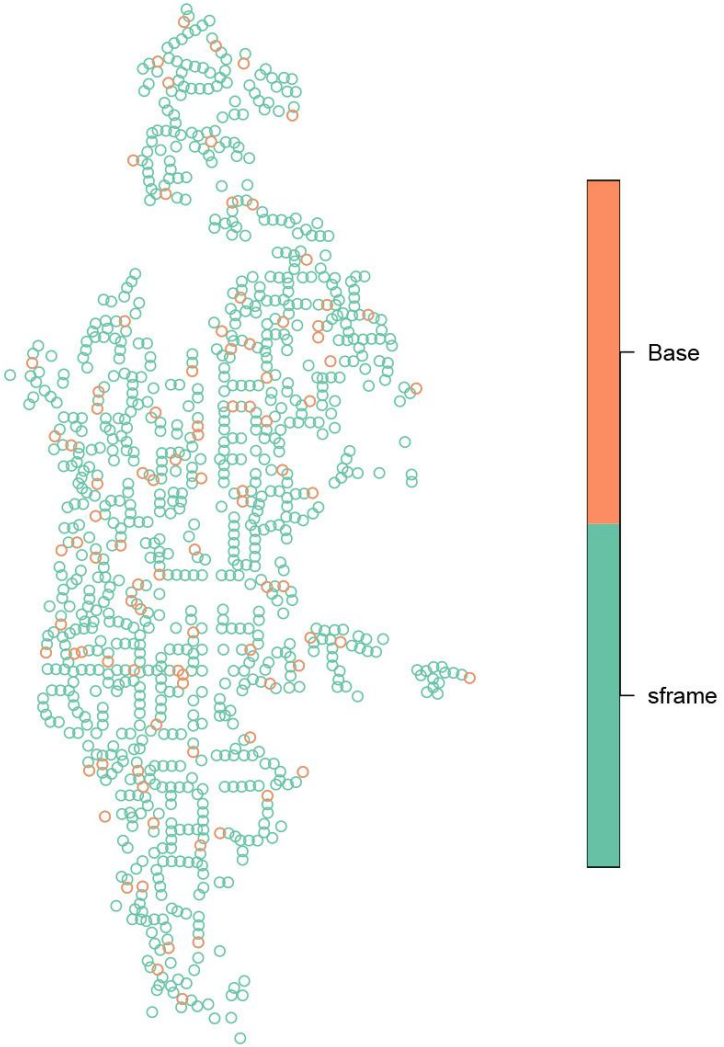
How To use spsurvey and grts in RStudio, continued

- **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

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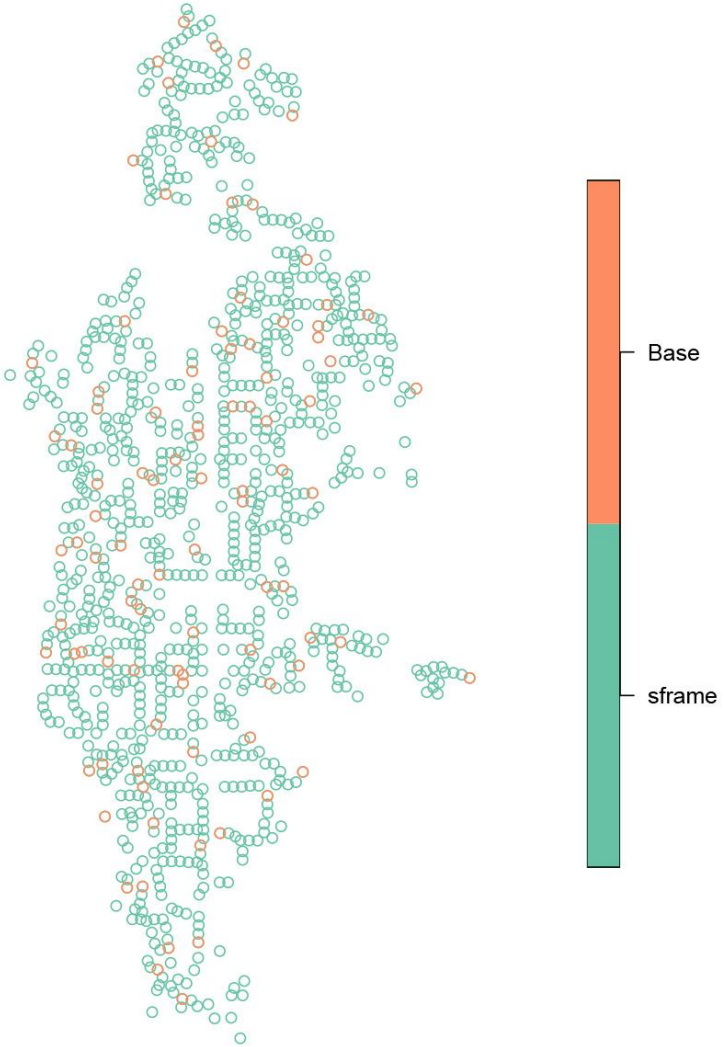
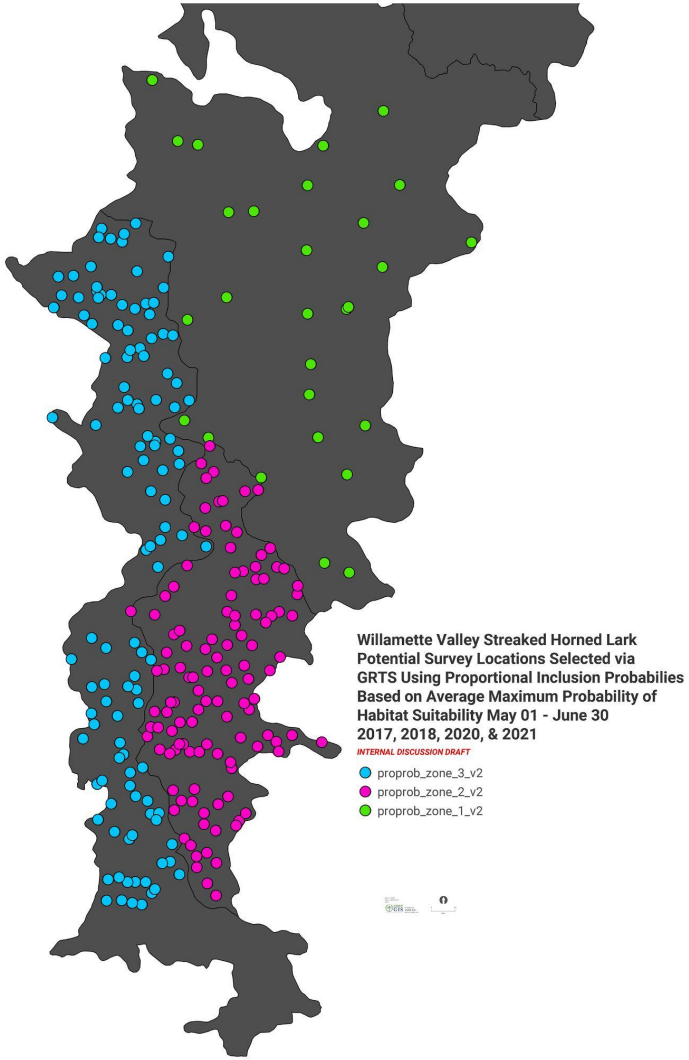
  - sp_plot(selected_sites_srv_pts_v2, srv_pts_v2, key.width = lcm(3))
- **Combine rows from the GRTS sample**
  - proprob_sites_v2 <- sp_rbind(selected_sites_srv_pts_v2)
- **Finally, export to shapefile**
  - st_write(proprob_sites_v2, "S:/Projects/WV_STHL/data/analysis/GRTS_processing/proprob_zone_2.shp")



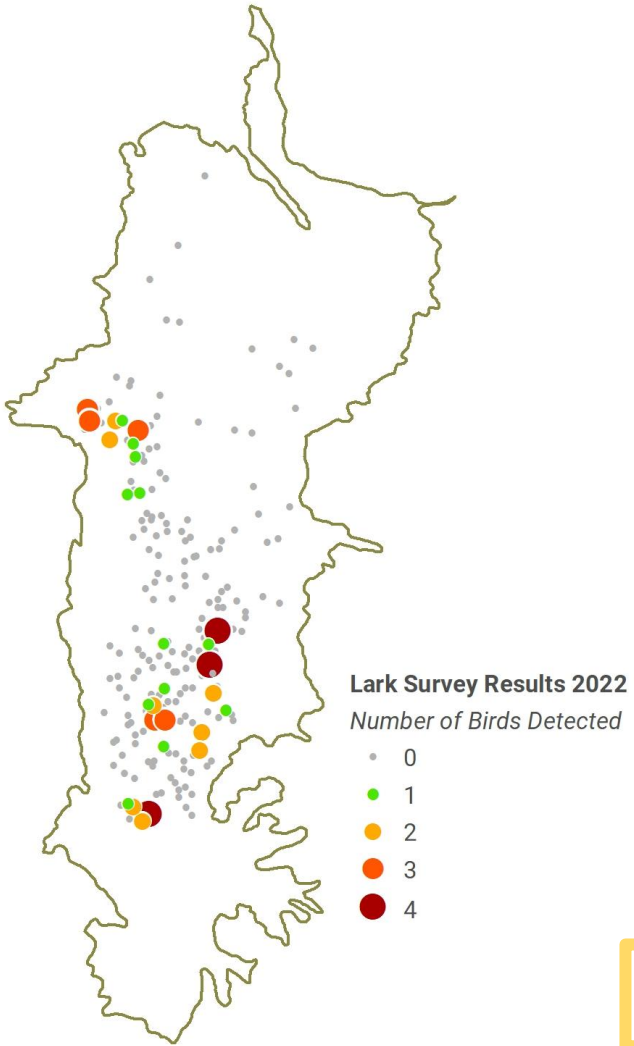
Recap & Results

The recovery zones were used as geographic strata:

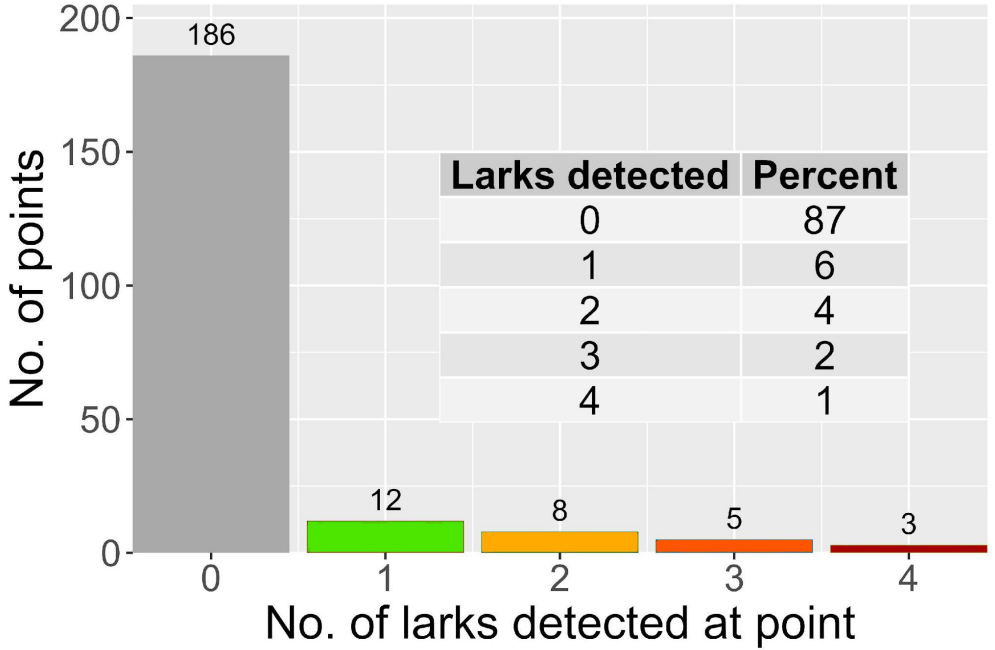
Zone	Survey Points
North Willamette	28
West Willamette	118
Southeast Willamette	118



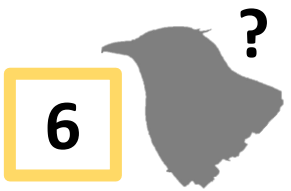
grts = Generalized Random Tessellation Stratified



Larks were detected at 28 points (13%) - 55 individuals



Larks detected	Percent
0	87
1	6
2	4
3	2
4	1




Questions?