Volcan Mountain Foundation Wildlife Imaging Team

Presentation to SDMMP 04/24/2019 by

Bill Carter
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Presentation to SDMMP

- Brief History of VMF – Susan Carter
- Brief History, Organization and Goals of WITS – Bill Carter
- How the Images are Collected and Use of Google Sheets to enter Data – Susan Carter
- Example of Using R-Shiny Tables, Graphs and Charts – Bill Carter
- The Nuts and Bolts of Google Sheets and R-Shiny – Amy Eppert
- Future Capabilities for Google Sheets/R-Shiny – Bill Carter
- How You Can Work with R-Shiny on Your Projects

“Volcan Mountain – Not Your Ordinary Mountain”

- The Mission of the Volcan Mountain Foundation is conservation and stewardship of the Volcan Mountains complex, situated within the Peninsular Ranges of Southern California. It stretches 15 miles from Lake Henshaw basin southeast to 5 miles east of Julian, encompassing 18,000 acres.

- Why is Volcan Mountain important?
  - Headwaters for Four Watersheds
  - North-South linkage between preserved lands in Palomar Mountain and Cuyamaca/Laguna Mountains.
  - East-West linkage between preserved lands in the San Dieguito Park (Santa Ysabel Preserve) and Anza Borrego Desert State Park.
  - 30 different native vegetation community types, including mixed oak/coniferous/bigcone/Coulter pine forests, riparian woodlands, freshwater marshes, extensive meadows and annual grasslands.
  - Elevations to 5,850 feet.


Warner Springs
Borrego Springs
Lake Henshaw
76
Volcan Mountain
78
Julian
79
Poway

Volcan Mountain Foundation

- A 24-unit development was proposed in 1987 for a pristine area of the mountain by an entity called First Fruit, Inc. This proposal galvanized the citizens. Wearing t-shirts that said “Volcan, NOT your ordinary mountain” they made many trips down to the County Planning Commission to protest the development.
- The Volcan Mountain Foundation was formed in 1988.
- Looking for a win-win solution, the Foundation’s founders (notably Peter Bergstrom and John Horton) met with then County Parks Director Bob Copper, seeking funds to acquire the property.
- When California Parks Bond Act Proposition 70 was approved by the voters in November 1988, Bob Copper secured the funds to make that first purchase.

Lands Preserved Now on Volcan Mtn

Agency	Acres
San Diego County Parks & Recreation	2,645
Calif. Dept. of Fish & Wildlife (VM & San Felipe)	8,329
Julian Community Services District	19
San Dieguito River Park JPA	592
San Dieguito River Valley Conservancy	23
Volcan Mountain Foundation	380
TOTAL	11,988

Brief History, Organization and Goals of WITS

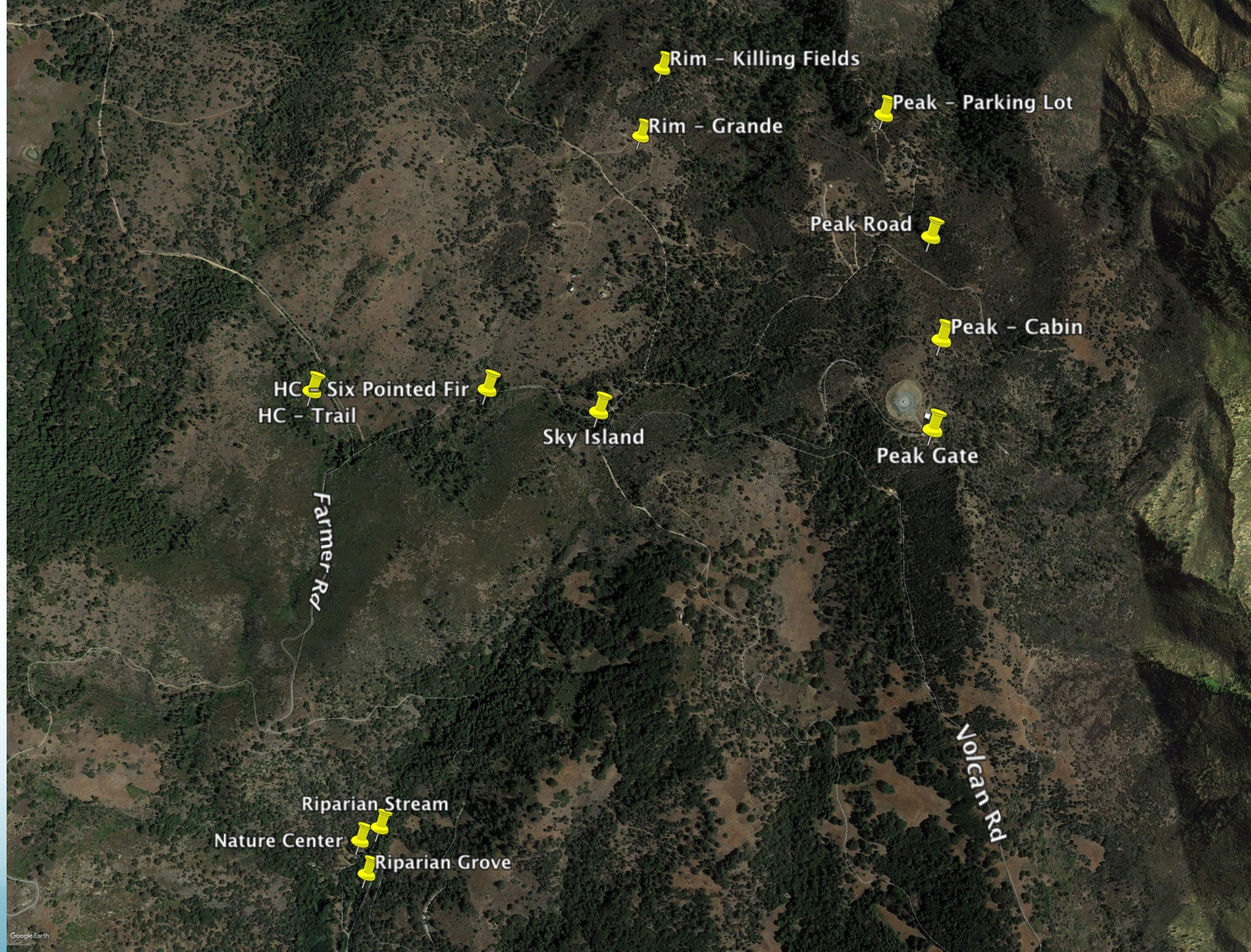
- Wildlife Imaging Teams (WITS) formed by the Volcan Mountain Foundation in 2014 – a totally volunteer effort initiated by Kathleen Beck and Sheana Fry.
- Formed alliance with Point Loma Nazarene University --Dr Mooring and Dr. Botts -- in 2015 using faculty supervised student intern projects.
- WITS Goals:
  - Document the presence of significant species on Volcan Mountain and monitor both the long-term health of these species and their habitats on the mountain.
  - Document the major wildlife corridors and trails used by the keystone, umbrella or indicator species. Partner with adjacent property owners, where possible, to monitor these wildlife corridors .
  - Assist the VMF in identifying additional critical land acquisitions.

Brief History, Organization and Goals of WITS

- Current Organization – 11 camera traps, 5 teams with two members each and one private land owner.
  - Developed written protocols for establishing sites, operating and updating camera traps, storing images and data entry.
- Limitations, Problems and Opportunities
  - First historical data gathered in 2015 because 2014 and 2015 data not compatible – wanted an integrated database.
  - Limited access to 380 acres owned by VMF – need more access to other habitats – means new sites and species.
  - Data management problems – inconsistent data entry and “too much data” –needed a way for each team to enter and validate data.
  - Need a way to link images to Google Sheet and R-Shiny analysis – currently manual “hyperlink”
  - Improve imaging technology to identify individuals (or at least gender) for key species.

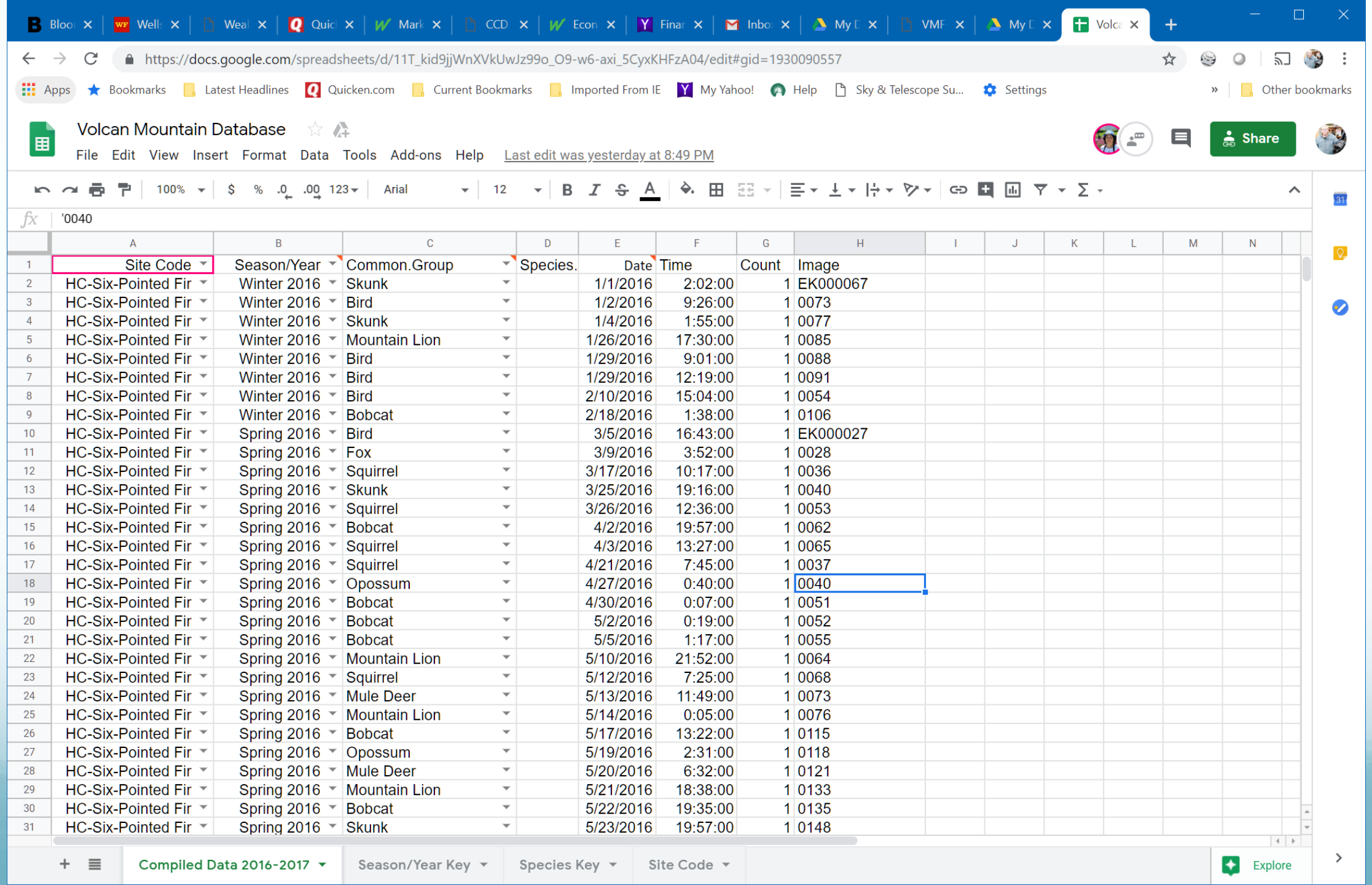
Camera Locations

Elevations:
HC-Trail 5072’
HC-Six ptd Fir 5127’
Rim-Grande 5034’
Rim – KF 4873’
Peak Cabin 5477’
Peak Road 5222’
Peak Gate 5529’
Peak Parking 5477’
Stream – 4250’
Grove – 4160’
Sky Island 5177’



How the Images are Collected and Use of Google Sheets to enter Data

- The volunteer teams collect their camera cards at least monthly, replacing them with a blank memory card and fresh batteries.
- Following protocol, they copy the images to the computer at the VMF Nature Center. They review the images, noting what species and how many are seen.
- They enter the new data for the cameras they are monitoring into a Google Sheet. Google Sheets allow different users to enter data at the same time from different locations. Google Sheets maintains an archive of changes made.
- The VMF Google Sheet is a database with a key for Site, Species, Season/Year. It is easy to add additional sites and species.



Volcan Mountain Database

File Edit View Insert Format Data Tools Add-ons Help Last edit was yesterday at 8:49 PM

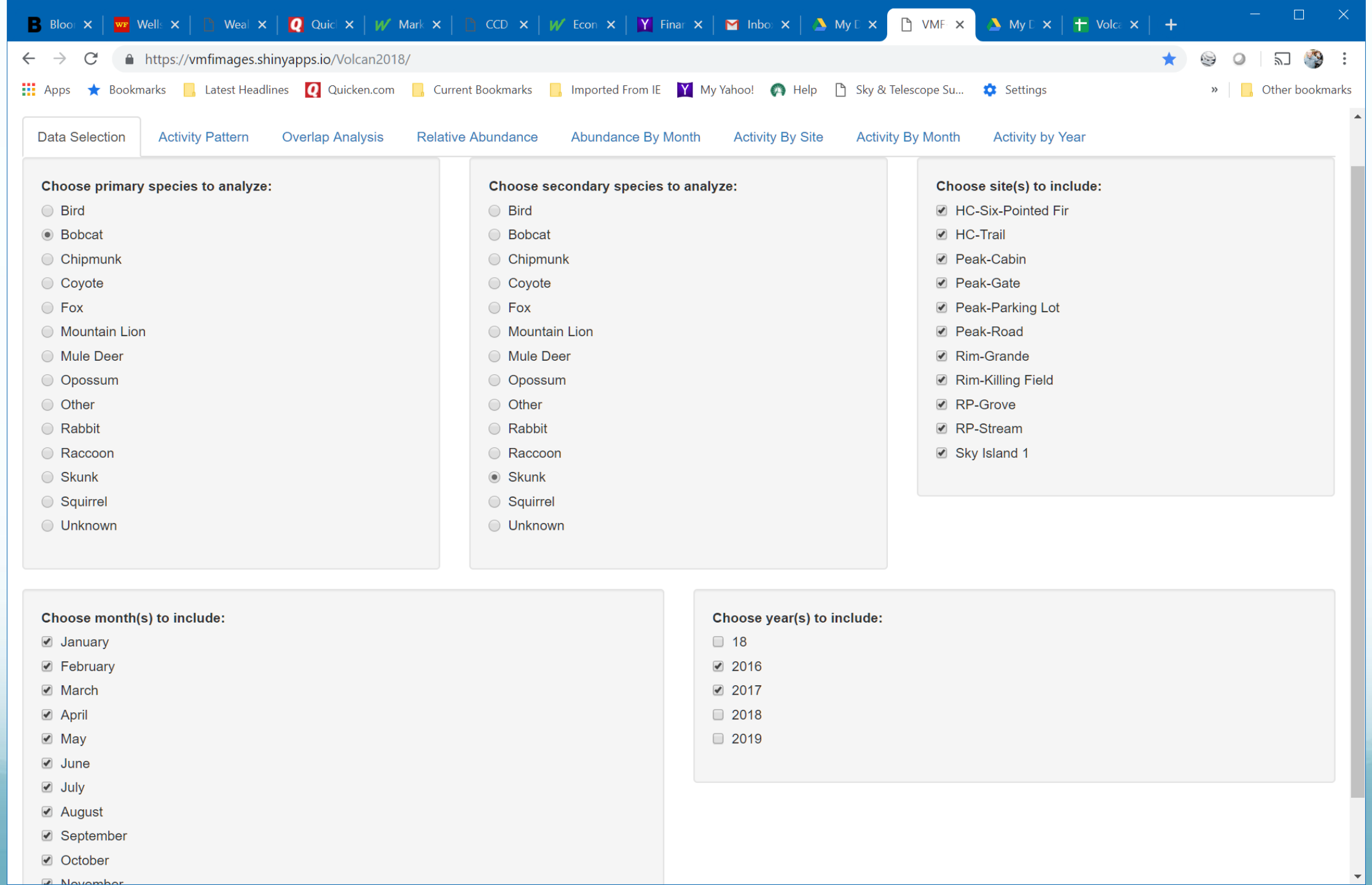
Share

'0040

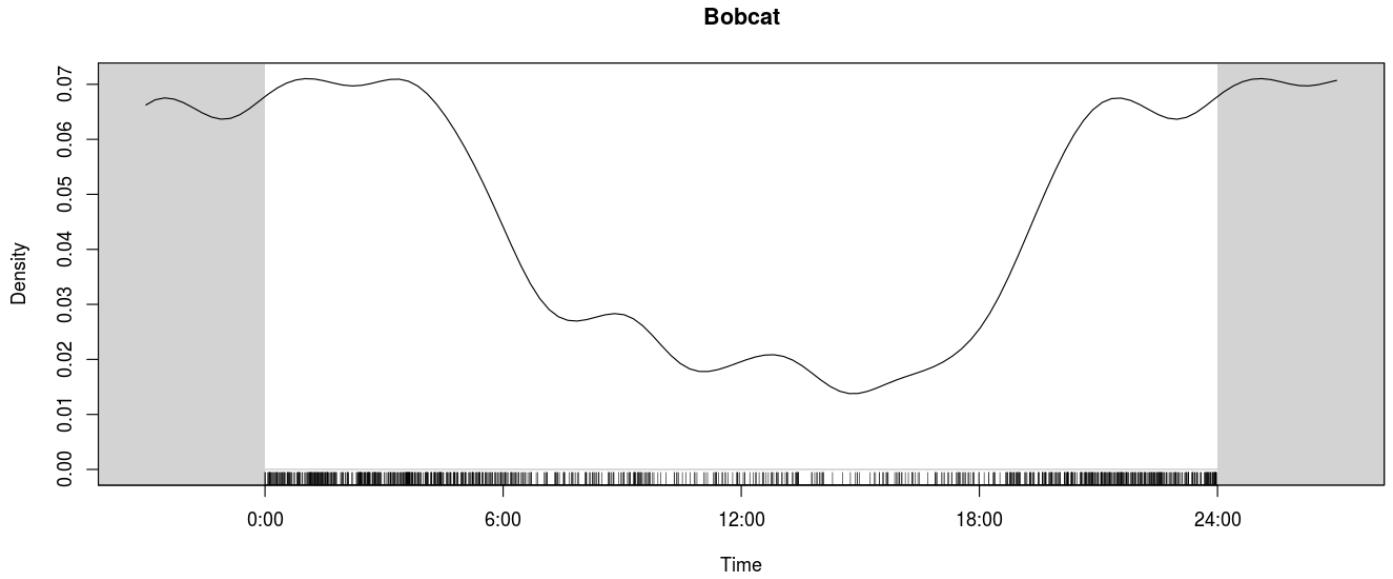
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Site Code	Season/Year	Common.Group	Species.	Date	Time	Count	Image						
2	HC-Six-Pointed Fir	Winter 2016	Skunk		1/1/2016	2:02:00	1	EK000067						
3	HC-Six-Pointed Fir	Winter 2016	Bird		1/2/2016	9:26:00	1	0073						
4	HC-Six-Pointed Fir	Winter 2016	Skunk		1/4/2016	1:55:00	1	0077						
5	HC-Six-Pointed Fir	Winter 2016	Mountain Lion		1/26/2016	17:30:00	1	0085						
6	HC-Six-Pointed Fir	Winter 2016	Bird		1/29/2016	9:01:00	1	0088						
7	HC-Six-Pointed Fir	Winter 2016	Bird		1/29/2016	12:19:00	1	0091						
8	HC-Six-Pointed Fir	Winter 2016	Bird		2/10/2016	15:04:00	1	0054						
9	HC-Six-Pointed Fir	Winter 2016	Bobcat		2/18/2016	1:38:00	1	0106						
10	HC-Six-Pointed Fir	Spring 2016	Bird		3/5/2016	16:43:00	1	EK000027						
11	HC-Six-Pointed Fir	Spring 2016	Fox		3/9/2016	3:52:00	1	0028						
12	HC-Six-Pointed Fir	Spring 2016	Squirrel		3/17/2016	10:17:00	1	0036						
13	HC-Six-Pointed Fir	Spring 2016	Skunk		3/25/2016	19:16:00	1	0040						
14	HC-Six-Pointed Fir	Spring 2016	Squirrel		3/26/2016	12:36:00	1	0053						
15	HC-Six-Pointed Fir	Spring 2016	Bobcat		4/2/2016	19:57:00	1	0062						
16	HC-Six-Pointed Fir	Spring 2016	Squirrel		4/3/2016	13:27:00	1	0065						
17	HC-Six-Pointed Fir	Spring 2016	Squirrel		4/21/2016	7:45:00	1	0037						
18	HC-Six-Pointed Fir	Spring 2016	Opossum		4/27/2016	0:40:00	1	0040						
19	HC-Six-Pointed Fir	Spring 2016	Bobcat		4/30/2016	0:07:00	1	0051						
20	HC-Six-Pointed Fir	Spring 2016	Bobcat		5/2/2016	0:19:00	1	0052						
21	HC-Six-Pointed Fir	Spring 2016	Bobcat		5/5/2016	1:17:00	1	0055						
22	HC-Six-Pointed Fir	Spring 2016	Mountain Lion		5/10/2016	21:52:00	1	0064						
23	HC-Six-Pointed Fir	Spring 2016	Squirrel		5/12/2016	7:25:00	1	0068						
24	HC-Six-Pointed Fir	Spring 2016	Mule Deer		5/13/2016	11:49:00	1	0073						
25	HC-Six-Pointed Fir	Spring 2016	Mountain Lion		5/14/2016	0:05:00	1	0076						
26	HC-Six-Pointed Fir	Spring 2016	Bobcat		5/17/2016	13:22:00	1	0115						
27	HC-Six-Pointed Fir	Spring 2016	Opossum		5/19/2016	2:31:00	1	0118						
28	HC-Six-Pointed Fir	Spring 2016	Mule Deer		5/20/2016	6:32:00	1	0121						
29	HC-Six-Pointed Fir	Spring 2016	Mountain Lion		5/21/2016	18:38:00	1	0133						
30	HC-Six-Pointed Fir	Spring 2016	Bobcat		5/22/2016	19:35:00	1	0135						
31	HC-Six-Pointed Fir	Spring 2016	Skunk		5/23/2016	19:57:00	1	0148						

Compiled Data 2016-2017 | Season/Year Key | Species Key | Site Code | Explore

Example of Using R-Shiny Tables, Graphs and Charts – Bill Carter


https://vmfimages.shinyapps.io/Volcan2018/
Apps
Bookmarks
Latest Headlines
Quicken.com
Current Bookmarks
Imported From IE
My Yahoo!
Help
Sky & Telescope Su...
Settings
Other bookmarks
Data Selection
Activity Pattern
Overlap Analysis
Relative Abundance
Abundance By Month
Activity By Site
Activity By Month
Activity by Year
Choose primary species to analyze:
Bird
Bobcat
Chipmunk
Coyote
Fox
Mountain Lion
Mule Deer
Opossum
Other
Rabbit
Raccoon
Skunk
Squirrel
Unknown
Choose secondary species to analyze:
Bird
Bobcat
Chipmunk
Coyote
Fox
Mountain Lion
Mule Deer
Opossum
Other
Rabbit
Raccoon
Skunk
Squirrel
Unknown
Choose site(s) to include:
HC-Six-Pointed Fir
HC-Trail
Peak-Cabin
Peak-Gate
Peak-Parking Lot
Peak-Road
Rim-Grande
Rim-Killing Field
RP-Grove
RP-Stream
Sky Island 1
Choose month(s) to include:
January
February
March
April
May
June
July
August
September
October
Choose year(s) to include:
18
2016
2017
2018
2019

Volcan Mountain Foundation's WIT Analysis

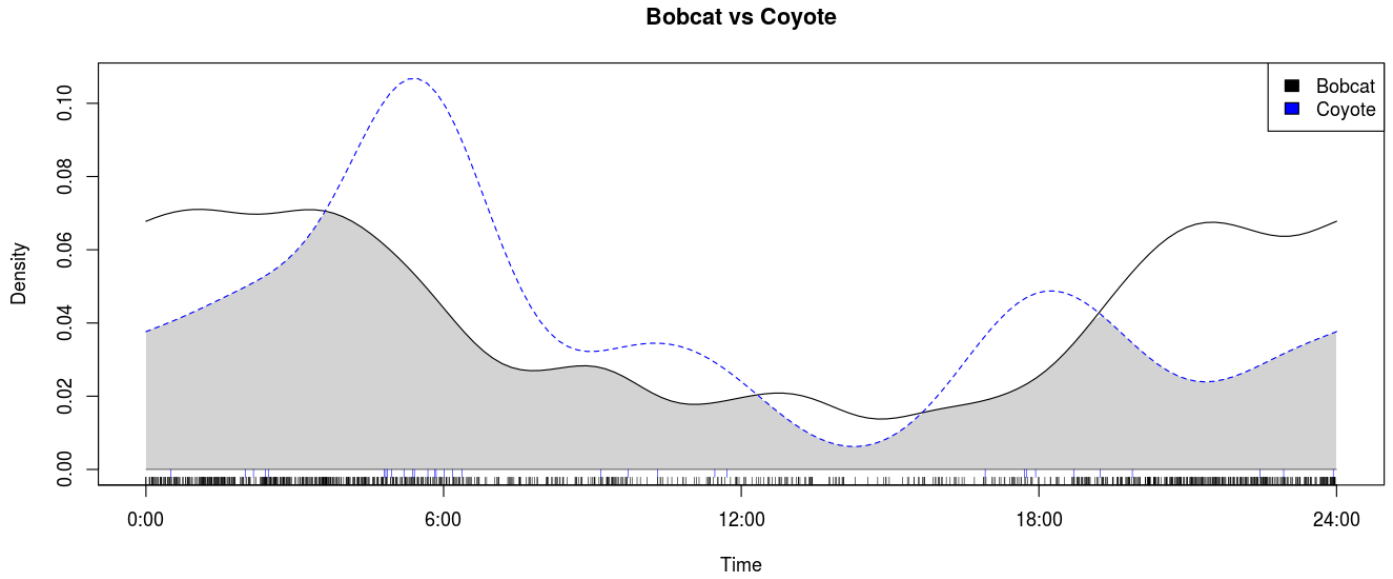


Statistics:
n = 1044

This plot shows the activity pattern of the (primary) selected species. The horizontal x-axis shows the time of day (in 24-hour time) with a rug plot (each tick mark represents an observation [photograph]). The vertical y-axis shows the *density* of observations. If a species is observed more often near a given time of day, the density value for that time of day will be higher. It is (roughly) similar to the "probability of observing the species" at each time of day.

Note that the x-axis is cyclic, so the grey regions on each side merely repeat the curve from the opposite side of the plot. They are there to emphasize that the curve "wraps around" cleanly from 23:59 to 00:00 the next day.

Volcan Mountain Foundation's WIT Analysis



Statistics:

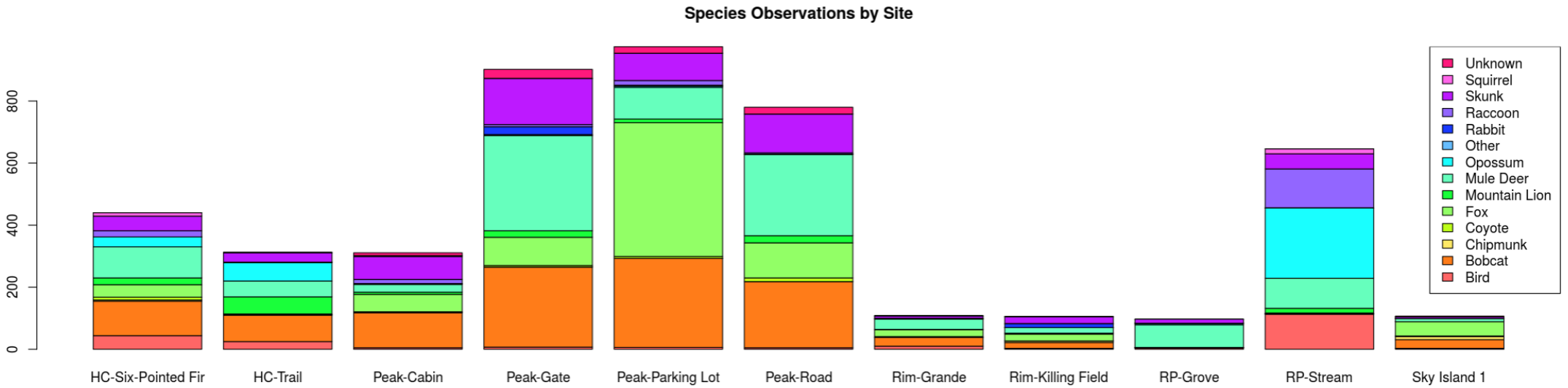
n_{Bobcat} = 1044

n_{Coyote} = 33

Overlap Coefficient Δ = 0.7378

This plot shows the activity patterns of the two selected species. The horizontal x-axis shows the time of day (in 24-hour time) with a rug plot (each tick mark represents an observation [photograph]). The vertical y-axis shows the *density* of observations. If a species is observed more often near a given time of day, the density value for that time of day will be higher. It is (roughly) similar to the "probability of observing the species" at each time of day.

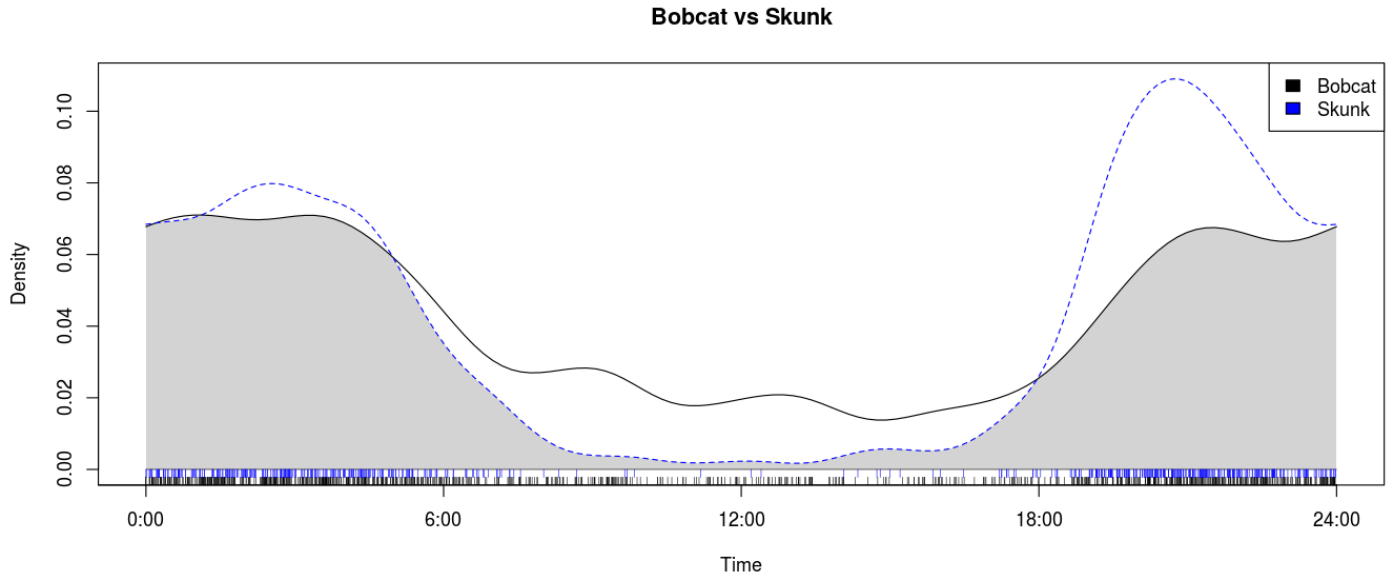
The overlap coefficient Δ estimates the amount of overlap between the two species' acitivty patterns, ranging from 0 (no overlap) to 1 (complete overlap), and is equal to the area of the shaded region below both density curves. For more on overlap, see this 2009 paper by Ridout and Linkie.



	HC-Six-Pointed Fir	HC-Trail	Peak-Cabin	Peak-Gate	Peak-Parking Lot	Peak-Road	Rim-Grande	Rim-Killing Field	RP-Grove	RP-Stream	Sky Island 1
Unknown	0	2	9	29	21	22	2	1	0	0	3
Squirrel	11	0	3	1	0	0	0	0	0	16	0
Skunk	47	30	74	148	88	125	7	22	13	49	5
Raccoon	20	1	13	7	15	4	2	1	0	125	0
Rabbit	0	0	1	25	2	0	0	12	0	1	0
Other	0	0	1	3	1	0	0	0	1	0	0
Opossum	32	60	1	0	4	1	0	0	4	226	0
Mule Deer	100	51	25	307	102	262	34	18	73	97	10
Mountain Lion	22	55	7	21	12	23	1	3	0	15	0
Fox	40	3	56	91	431	113	22	22	1	2	46
Coyote	9	0	3	5	6	12	3	0	0	1	2
Chipmunk	4	1	0	0	0	0	0	5	0	0	10

These bar plots give the number of observations (photographs) of each species at a given site, grouped by species (top) or by site (bottom). **Note that these plots only include data from the months and years enabled on the data selection tab.**

Volcan Mountain Foundation's WIT Analysis



Statistics:

n_{Bobcat} = 1044

n_{Skunk} = 588

Overlap Coefficient Δ = 0.8239

This plot shows the activity patterns of the two selected species. The horizontal x-axis shows the time of day (in 24-hour time) with a rug plot (each tick mark represents an observation [photograph]). The vertical y-axis shows the *density* of observations. If a species is observed more often near a given time of day, the density value for that time of day will be higher. It is (roughly) similar to the "probability of observing the species" at each time of day.

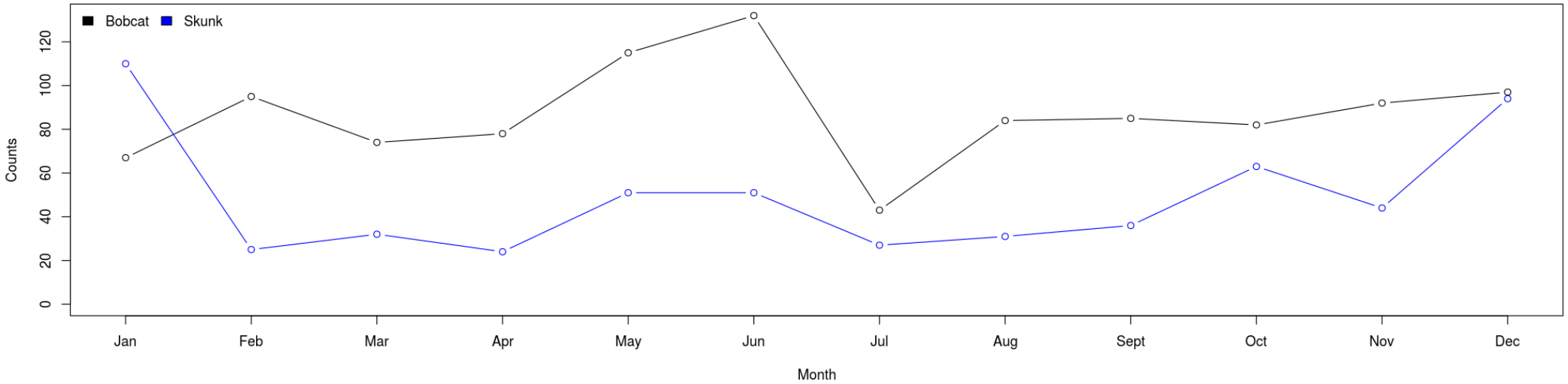
The overlap coefficient Δ estimates the amount of overlap between the two species' acitivty patterns, ranging from 0 (no overlap) to 1 (complete overlap), and is equal to the area of the shaded region below both density curves. For more on overlap, see this 2009 paper by Ridout and Linkie.

Volcan Mountain Foundation's WIT Analysis

Data Selection | Activity Pattern | Overlap Analysis | Relative Abundance | Abundance By Month | Activity By Site | Activity By Month | Activity by Year

☑ Compare Two Species?

Abundance During Each Month for Bobcat vs Skunk



This plot shows the abundance (number of observations) on the y-axis of the selected species during each month.

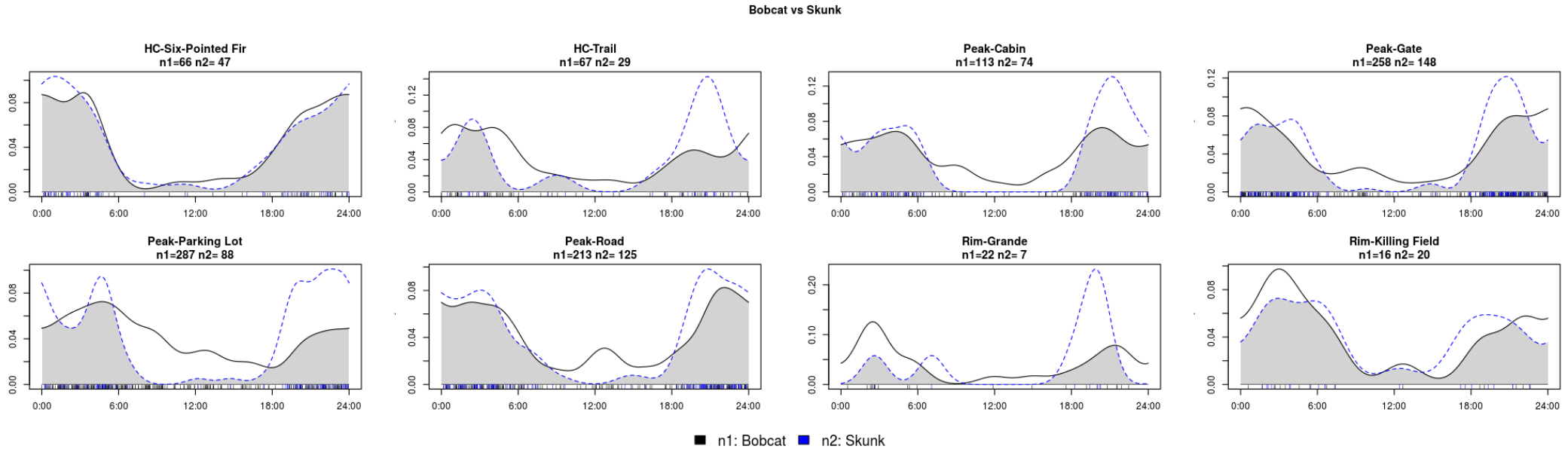
To look at the abundance across months for only **one species**, unselect the above **checkbox** titled *"Compare Two Species?"*. (The plots will be for the primary species selected in the *Data Selection* tab.) To look at the comparison between **two species**, ensure that the checkbox is selected.

The data included in these plots reflects only the **sites and years** selected in the *Data Selection* tab even though neither of these variables are under direct comparison in this tab. It does **NOT** include the **months** selected though.

Volcan Mountain Foundation's WIT Analysis

Data Selection | Activity Pattern | Overlap Analysis | Relative Abundance | Abundance By Month | Activity By Site | Activity By Month | Activity by Year

☑ Compare Two Species?



These plots show the activity pattern of the selected species at each site where more than one observation of the species was recorded. The horixontal x-axis shows the time of day (in 24-hour time) with a rug plot that shows the individual observations. The vertical y-axis shows the density of observations, which signifies the times when the species was most often observed. The title of each individual plot includes the number of observations for the species at that site. If the plots show the comparison between two species, "n1" and "n2" correspond to the species identified in the legend.

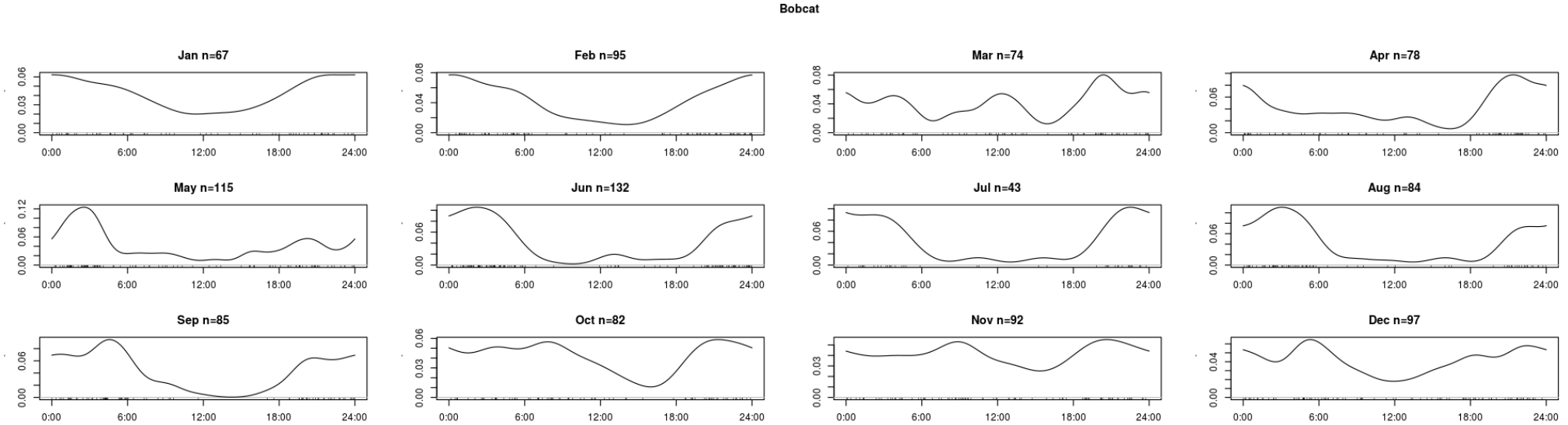
To look at the activity patterns between sites for only **one species**, unselect the above **checkbox** titled *"Compare Two Species?"*. (The plots will be for the primary species selected in the Data Selection tab.) To look at the comparison between **two species** across sites, ensure that the checkbox is selected.

The **sites** selected in the *"Data Selection" tab* control which sites are plotted in this tab. The data included in these plots also reflects the **months and years** selected even though niether of these variables are under direct comparison in this tab. For example, the activity patterns of Mountain Lions during January can be compared across sites.

If you get something like "Error in par: invalid value specified for graphical parameter "mfrow"", make sure you have selected two different (non-blank) species selected!

Volcan Mountain Foundation's WIT Analysis

Compare Two Species?



These plots show the activity pattern of the selected species during each month when more than one observation of the species was recorded. The horixontal x-axis shows the time of day (in 24-hour time) with a rug plot that shows the individual observations. The vertical y-axis shows the density of observations, which signifies the times when the species was most often observed. The title of each individual plot includes the number of observations for the species during that month. If the plots show the comparison between two species, "n1" and "n2" correspond to the species identified in the legend.

To look at the activity patterns across months for only **one species**, unselect the above **checkbox** titled *"Compare Two Species?"*. (The plots will be for the primary species selected in the Data Selection tab.) To look at the comparison between **two species**, ensure that the checkbox is selected.

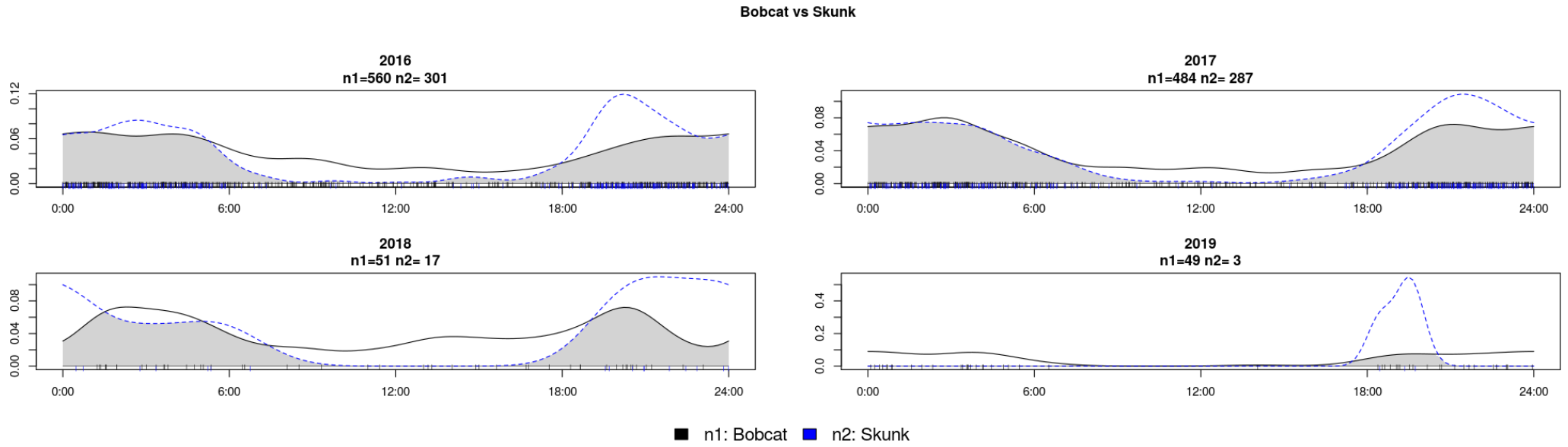
The **months** selected in the *"Data Selection" tab* control which months are plotted in this tab. The data included in these plots also reflects the **sites and years** selected even though neither of these variables are under direct comparison in this tab. For example, the activity patterns of Mountain Lions at HC-Trail can be compared across months.

If you get something like "Error in par: invalid value specified for graphical parameter "mfrow"", make sure you have selected two different (non-blank) species selected!

Volcan Mountain Foundation's WIT Analysis

Data Selection | Activity Pattern | Overlap Analysis | Relative Abundance | Abundance By Month | Activity By Site | Activity By Month | Activity by Year

☑ Compare Two Species?



These plots show the activity pattern of the selected species during each year when more than one observation of the species was recorded. The horixontal x-axis shows the time of day (in 24-hour time) with a rug plot that shows the individual observations. The vertical y-axis shows the density of observations, which signifies the times when the species was most often observed. The title of each individual plot includes the number of observations for the species during that year. If the plots show the comparison between two species, "n1" and "n2" correspond to the species identified in the legend.

To look at the activity patterns between years of only **one species**, unselect the above **checkbox** titled *"Compare Two Species?"*. (The plots will be for the primary species selected in the Data Selection tab.) To look at the comparison between **two species**, ensure that the checkbox is selected.

The **years** selected in the *"Data Selection" tab* control which months are plotted in this tab. The data included in these plots also reflects the **sites and months** selected even though neither of these variables are under direct comparison in this tab. For example, the activity patterns of Mountain Lions at HC-Trail can be compared across years.

If you get something like "Error in par: invalid value specified for graphical parameter "mfrow"", make sure you have selected two different (non-blank) species selected!

Future Capabilities for Google Sheets/R-Shiny

- Add “Initial Active Date” and “Last Update Date” for site selection.
- Add species relative abundance graphic by site to Google Maps.
- Add automated link between “Image” number on Google Sheet and the image database.

The Nuts and Bolts of Google Sheets and R-Shiny

- Introduce Amy
- What Exactly does Google Sheet and R-Shiny Do?

Google Drive:
https://drive.google.com/open?id=11T_kid9jjWnXVkUwJz99o_O9-w6-axi_5CyxKHFzA04

Rshiny Web Application:

https://vmfimages.shinyapps.io/Volcan2018/

Server Function: Analysis Run in R

```
#Activity Pattern UI ----
output$speciesPlot <- renderPlot({
  densityPlot(
    A = speciesData(),
    main = input$speciesName,
    rug = TRUE
  )
})

output$activityStats <- renderUI({
  HTML(
    paste0(
      "n = ",
      length(speciesData()),
      "<br>"

    )
  )
})
```

UI Function: Creates user interface

```
fluidPage(
  titlePanel(title = "Volcan Mountain Foundation's WIT Analysis", windowTitle = "VMF-WIT Analysis"),
  tabsetPanel(
    #Data Selection Tab
    #Activity Pattern Tab ----
    tabPanel(
      title = "Activity Pattern",
      fluidRow(
        column(8,
               plotOutput(
                 outputId = "speciesPlot"
               )),
        column(4,
               wellPanel(
                 HTML("<b>Statistics:</b><br>"),
                 uiOutput(
                   outputId = "activityStats"
                 )
               ),
               wellPanel( #explain what the plot shows
                 HTML("
                   This plot shows the activity pattern of the (primary) selected species. The horizontal x-axis shows the time of day
(in 24-hour time) with a rug plot (each tick mark represents an observation [photograph]). The vertical y-axis shows the <i>density</i>
of observations. If a species is observed more often near a given time of day, the density value for that time of day will be higher.
It is (roughly) similar to the \"probability of observing the species\" at each time of day. <br> <br> Note that the x-axis is cyclic,
so the grey regions on each side merely repeat the curve from the opposite side of the plot. They are there to emphasize that the curve
\"wraps around\" cleanly from 23:59 to 00:00 the next day.
                 ")
               ))
      )
    ),
```

How You Can Work with R-Shiny on Your Projects

- Dr. Mike Mooring - PLNU Biology – mmooring@pointloma.edu
- Dr. Ryan Botts – PLNU Associate Professor of Mathematics – rbotts@pointloma.edu
- Amy Eppert – aeppert98@hotmail.com