

**Symposium**

# R pour ornithologue

**Points de vue des utilisateuRs aux les programmeRs**



# R for Ornithologists

**Perspectives from useRs to programmeRs (to birdeRs)**

**10:30-14:15 Salle des Plaines II**

**Stefanie E. LaZerte**



# R for Ornithologists

**How R can benefit the study of Ornithology**



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# What is R?

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A statistical programming language and environment

(free and open source!)

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A statistical programming language and environment

(free and open source!)

## R uses packages

- Packages extend R (i.e. nlme and lme4 add mixed modeling)
- Packages can be written by anyone
- Some are ok, some are good, some are AMAZING
- **Base R** is R without any extra packages (also good)

There are 1000's of packages!

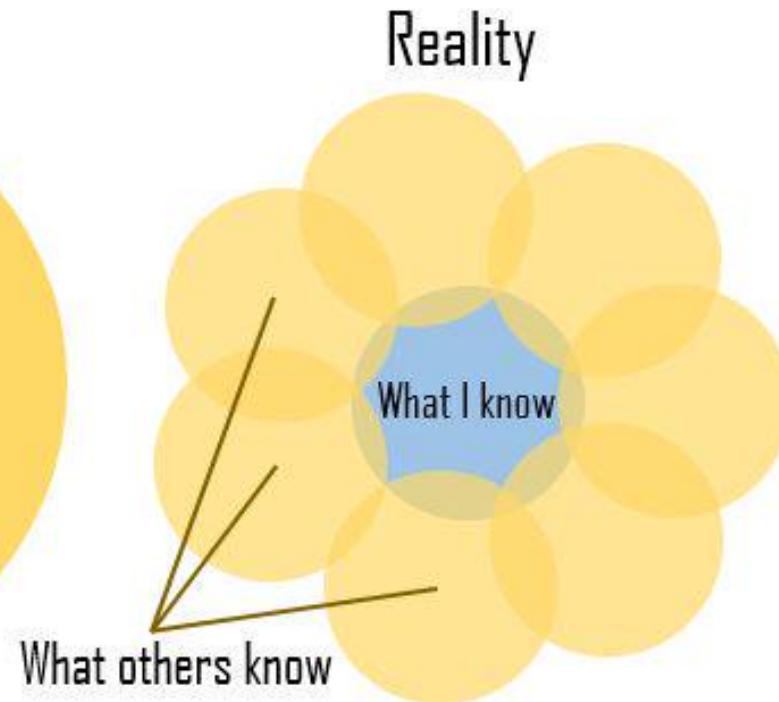
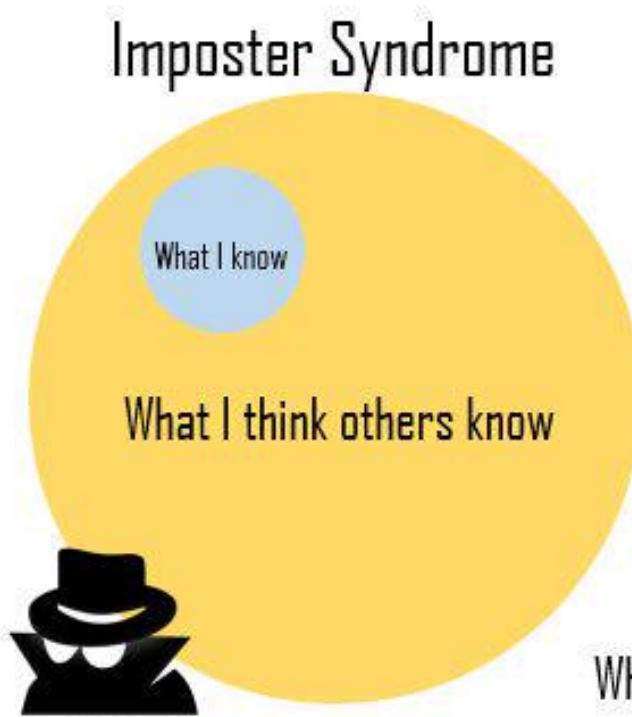
# R is hard

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# ImpostOR Syndrome

# ImpostR Syndrome

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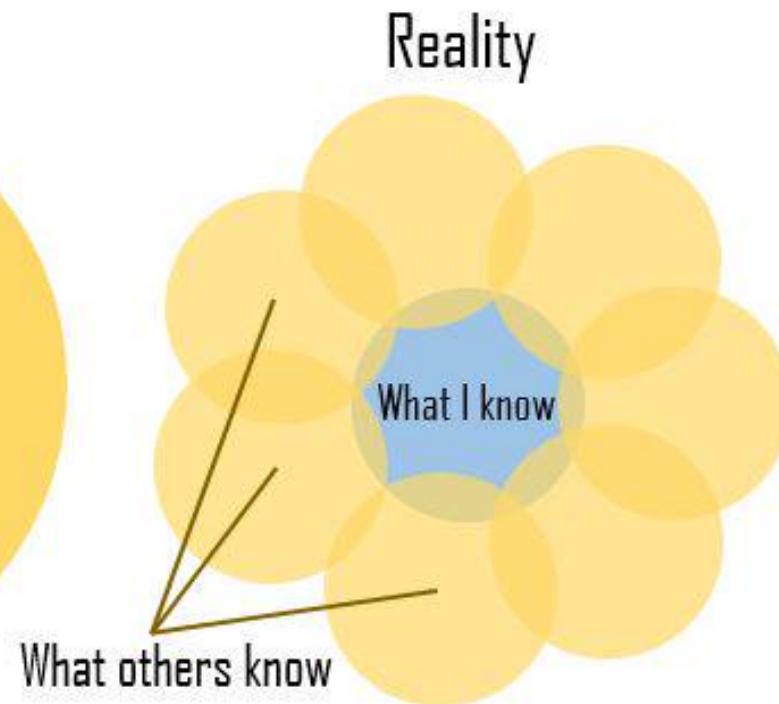
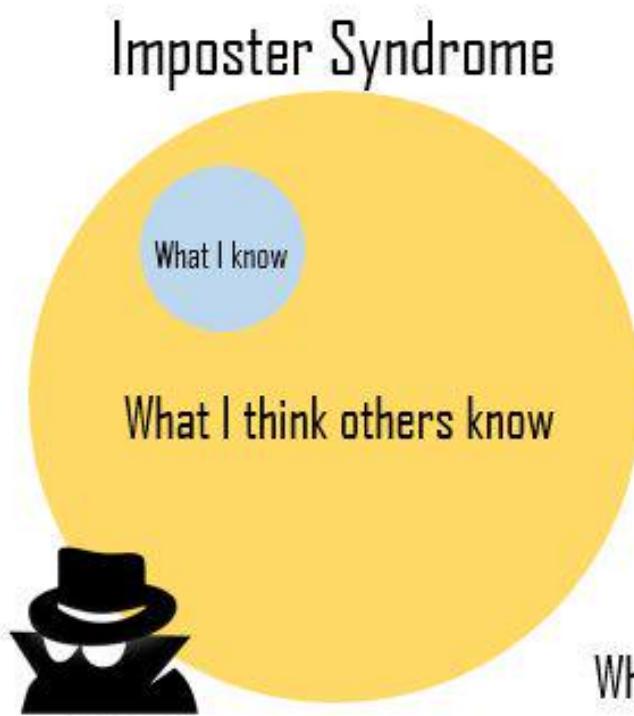


David Whittaker

ImpostR Syndrome

# ImpostR Syndrome

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David Whittaker

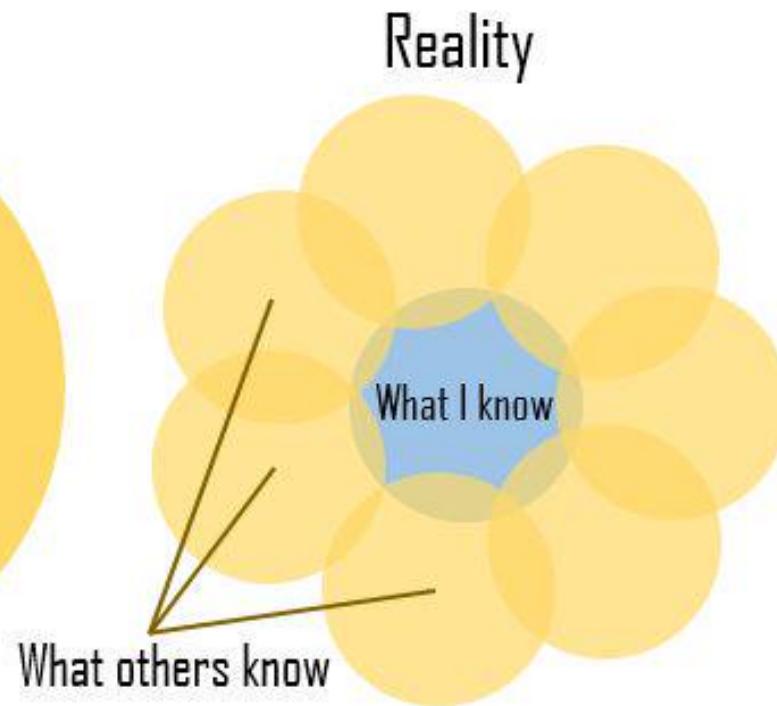
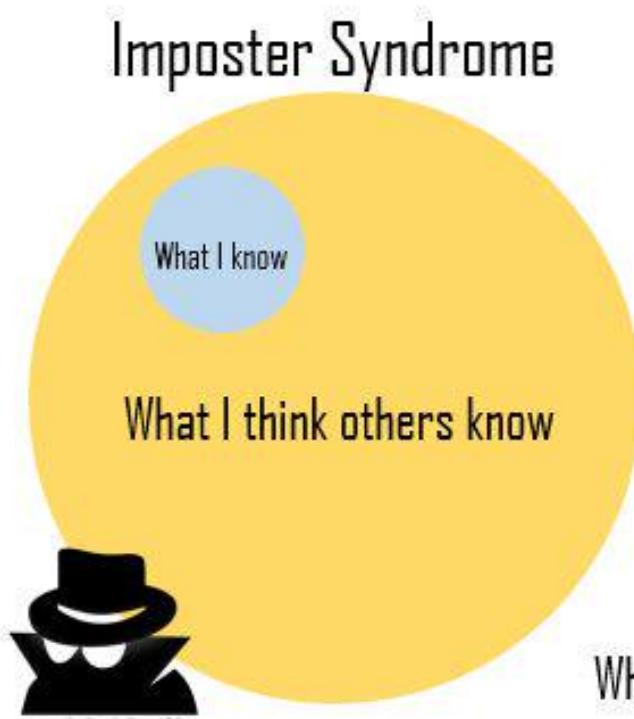
ImpostR Syndrome

**Moral of the story?**

Make friends, code in groups, learn together and don't beat yourself up

# ImpostR Syndrome

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David Whittaker

ImpostR Syndrome

Using R in the undergraduate biology classroom: Hurdles, hints, and aha moments  
[\(Here @ 1:45pm\)](#)

# Ornithologists and R

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## What I **am not** going to do

- Teach you R
- Talk about statistics



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## What I **am not** going to do

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## What I **am** going to do

- Explain how R can benefit ornithologists
- Showcase useful packages
- Give you resources to get started



# Ornithologists and R

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## What I **am not** going to do

- Teach you R
- Talk about statistics

## What I **am** going to do

- Explain how R can benefit ornithologists
- Showcase useful packages
- Give you resources to get started
- Inspire you to take your **R** to the next level!



# Why ornithologists should use R

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R is powerful!

The screenshot shows the R Global Environment window. It has three main sections: Data, Values, and Functions. The Data section contains two entries: 'fish' and 'telem\_total'. The 'fish' entry is described as '172 obs. of 13 variables'. The 'telem\_total' entry is described as '12950046 obs. of 10 variables'. A large green oval highlights the 'telem\_total' entry. The Values section contains one entry: 'tz' with the value '"Etc/GMT+8"'. The Functions section contains one entry: 'load\_data' with the definition 'function (x)'. Each entry has a small icon to its right.

Category	Object	Description	Type
Data	fish	172 obs. of 13 variables	
	telem_total	12950046 obs. of 10 variables	
Values	tz	"Etc/GMT+8"	
Functions	load_data	function (x)	

# Why ornithologists should use R

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R is powerful!

## **The blessing and curse of automated data collection:**

R and dealing with big data in a modern age

([Here @ 10:45am](#))

## **Super-computing with R:**

Harnessing the power of the cloud to analyze big-bird-data, or just run your simulations, models, and cross-validations faster

([Here @ 11:15am](#))

# Why ornithologists should use R

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## Reproducible Science

- Scripts are records of your work

```
m <- lm(mpg ~ cyl, data = mtcars)
summary(m)
```

# Why ornithologists should use R

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## Reproducible Science

- Scripts are records of your work

```
m <- lm(mpg ~ cyl, data = mtcars)
summary(m)
```

- Scripts can be compiled into pdf/html reports with [rmarkdown](#) and [knitr](#)  
(In RStudio: File > Compile Report)

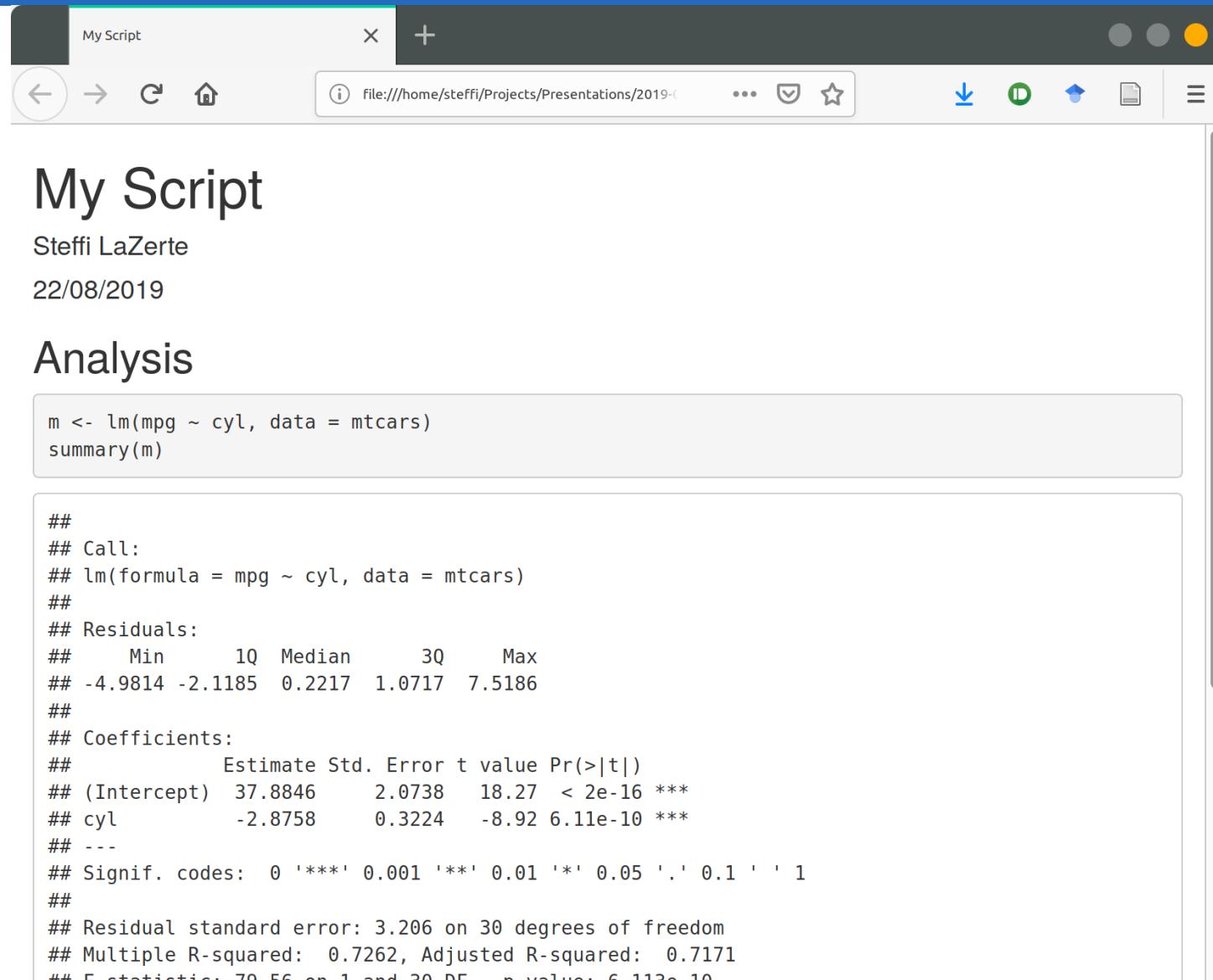


# Why ornithologists should use R

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## Reproducible Science

- Keep track of code AND output



My Script

Steffi LaZerte

22/08/2019

### Analysis

```
m <- lm(mpg ~ cyl, data = mtcars)
summary(m)
```

```
##
## Call:
## lm(formula = mpg ~ cyl, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.9814 -2.1185  0.2217  1.0717  7.5186
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 37.8846    2.0738   18.27 < 2e-16 ***
## cyl         -2.8758    0.3224   -8.92 6.11e-10 ***
## ---
## Signif. codes:  0 '****' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.206 on 30 degrees of freedom
## Multiple R-squared:  0.7262, Adjusted R-squared:  0.7171
## F-statistic: 79.56 on 1 and 30 DF, p-value: 6.113e-10
```

# Why ornithologists should use R

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## Reproducible Science

- Keep track of code AND output
- Keep track of data

The screenshot shows an R script titled "My Script" with the following content:

```
Reproducibility
```

```
Data
```

```
DT::datatable(mtcars, options = list(pageLength = 5))
```

The R Markdown document displays the first five entries of the mtcars dataset:

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21	6	160	110	3.9	2.62	16.46	0	1	4	4
Mazda RX4 Wag	21	6	160	110	3.9	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.32	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.44	17.02	0	0	3	2

Showing 1 to 5 of 32 entries

Previous 1 2 3 4 5 6 7 Next

## Software

```
devtools::session_info()
```

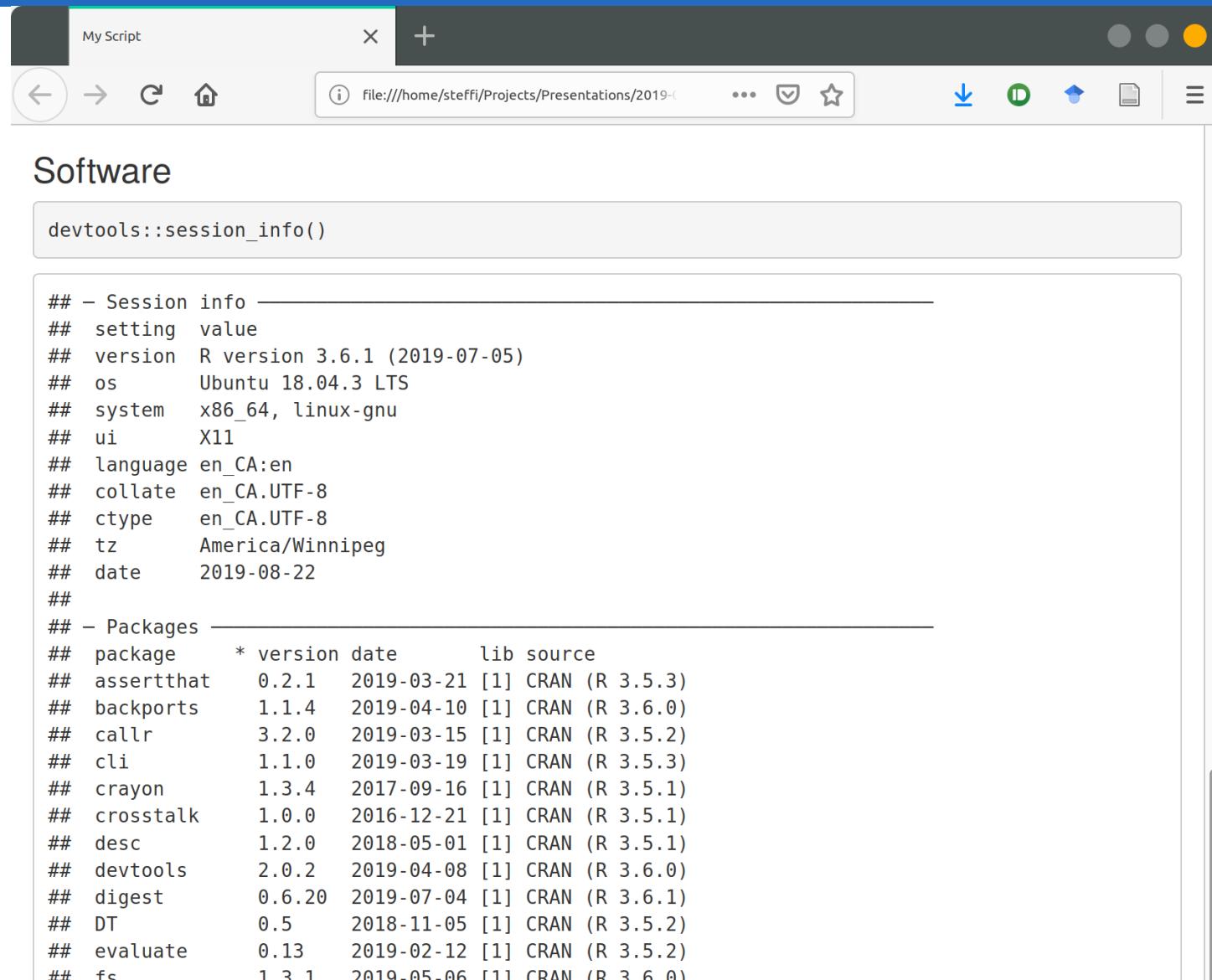
```
## - Session info -
## setting value
## version R version 3.6.1 (2019-07-05)
## os      Ubuntu 18.04.3 LTS
```

# Why ornithologists should use R

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## Reproducible Science

- Keep track of code AND output
- Keep track of data
- Keep track of software



The screenshot shows an R script editor window titled "My Script". The URL bar indicates the file is located at `file:///home/steffi/Projects/Presentations/2019-(...)`. The main area displays the following R code:

```
devtools::session_info()

## - Session info -----
## setting value
## version R version 3.6.1 (2019-07-05)
## os      Ubuntu 18.04.3 LTS
## system x86_64, linux-gnu
## ui      X11
## language en_CA:en
## collate en_CA.UTF-8
## ctype   en_CA.UTF-8
## tz      America/Winnipeg
## date   2019-08-22
##
## - Packages -----
## package * version date      lib source
## assertthat 0.2.1  2019-03-21 [1] CRAN (R 3.5.3)
## backports  1.1.4  2019-04-10 [1] CRAN (R 3.6.0)
## callr     3.2.0  2019-03-15 [1] CRAN (R 3.5.2)
## cli       1.1.0  2019-03-19 [1] CRAN (R 3.5.3)
## crayon    1.3.4  2017-09-16 [1] CRAN (R 3.5.1)
## crosstalk 1.0.0  2016-12-21 [1] CRAN (R 3.5.1)
## desc      1.2.0  2018-05-01 [1] CRAN (R 3.5.1)
## devtools  2.0.2  2019-04-08 [1] CRAN (R 3.6.0)
## digest    0.6.20 2019-07-04 [1] CRAN (R 3.6.1)
## DT        0.5    2018-11-05 [1] CRAN (R 3.5.2)
## evaluate  0.13   2019-02-12 [1] CRAN (R 3.5.2)
## fs        1.3.1  2019-05-06 [1] CRAN (R 3.6.0)
```

# Why ornithologists should use R

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## Find Data!

- Many online data sources are accessible through R
- Reproducible science includes data sources!

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- Observations from [ebird](#) with [auk](#)



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**warbleR**

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**warbleR**



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## Find Data!

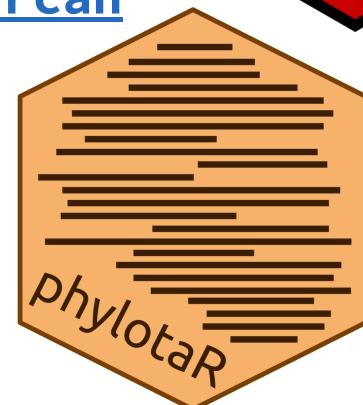
- Many online data sources are accessible through R
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**warbleR**



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## Find Data!

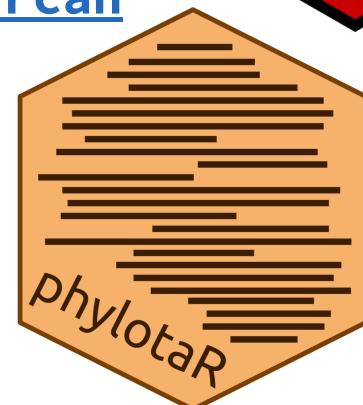
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- Taxonomic data with [taxize](#)



**warbleR**



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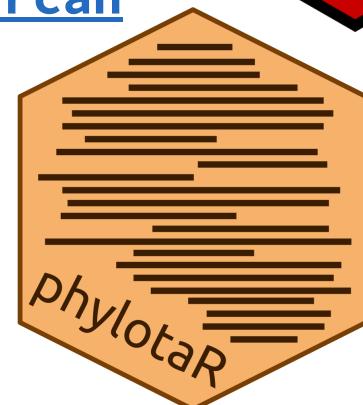
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- Taxonomic data with [taxize](#)
- IUCN Red Lists with [rredlist](#)



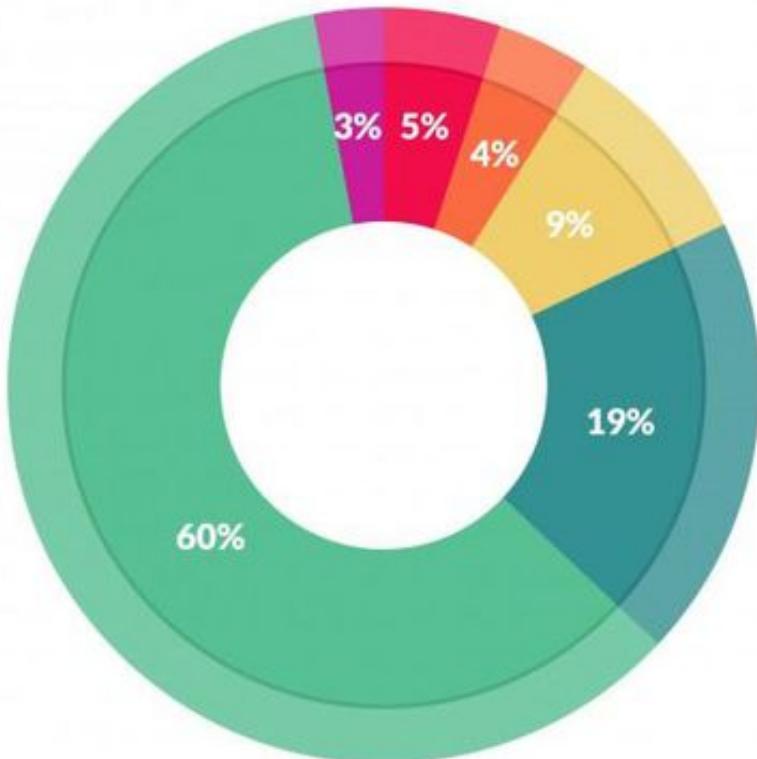
**warbleR**



# Why ornithologists should use R

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## Dealing with Data



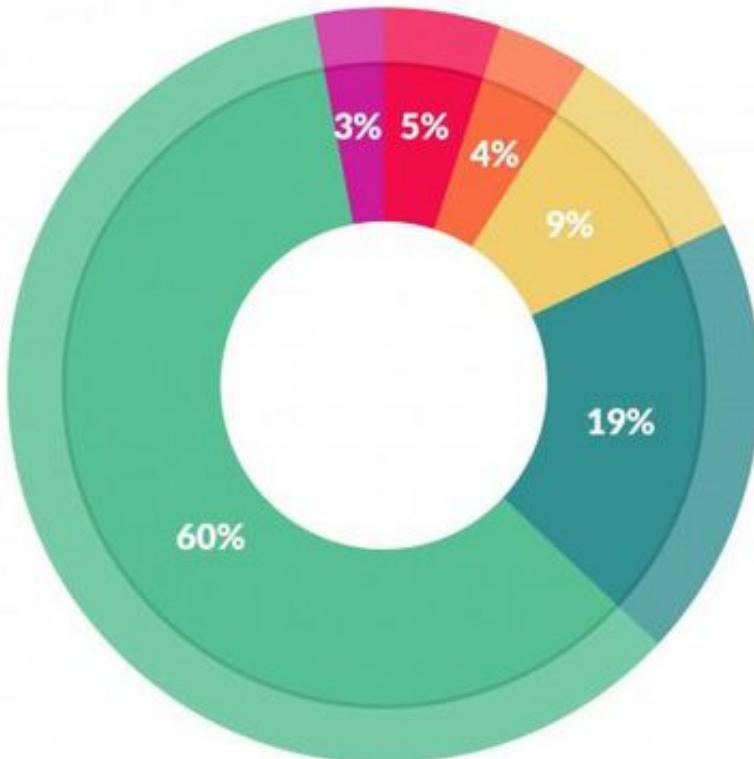
### What data scientists spend the most time doing

- *Building training sets: 3%*
- *Cleaning and organizing data: 60%*
- *Collecting data sets; 19%*
- *Mining data for patterns: 9%*
- *Refining algorithms: 4%*
- *Other: 5%*

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## Dealing with Data



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## Dealing with Data

- Reproducible!
- Cleaning
  - Fix typos
  - Fix/explore odd/missing values
- Filtering
- Summarizing
- Transforming
- Exploring

# Why ornithologists should use R

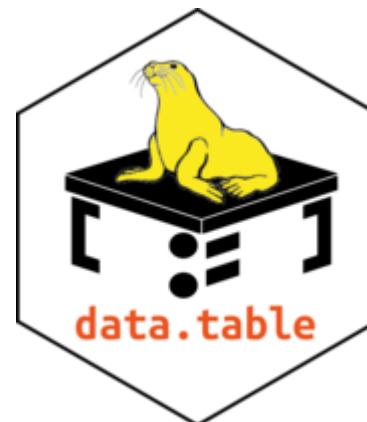
@steffilazerte

## Dealing with Data

- Reproducible!
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  - Fix typos
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## Packages to Use

- Base R (i.e. no special packages)
- [data.table](http://r-datable.com) (<http://r-datable.com>)
- [tidyverse](http://tidyverse.org) (<http://tidyverse.org>)
  - Suite of packages
  - Learn more: [R for Data Science](#)



# Why ornithologists should use R

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100's of Specialized packages

**For example...**

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**For example...**

- Phylogenetic comparative analyses [adephylo](#)

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- Phylogenetic comparative analyses [adephylo](#)
- Bioacoustic analyses with [seewave](#)

**seewave~**

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**seewave~**

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**seewave~**

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- Hierarchical Bayesian modelling of Breeding Bird Survey data with [bbsBayes](#) ([Here @ 11:30am](#))

**seewave**~



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100's of Specialized packages

For example...

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- Systematic reviews with [litsearchr](#) ([Here @ 1:30pm](#))

**seewave**~

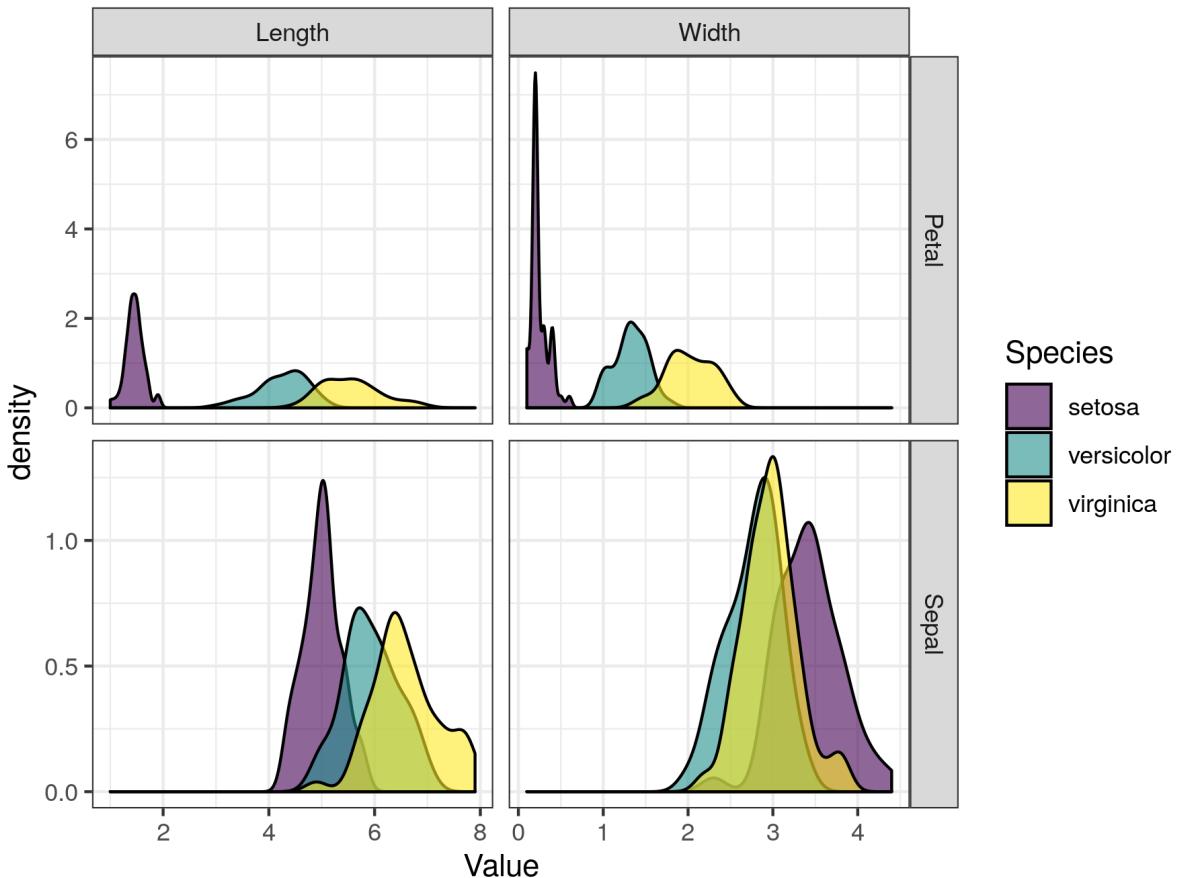
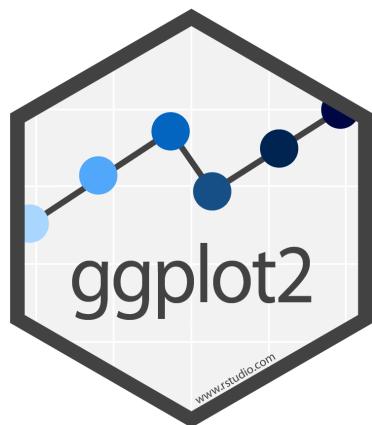


# Why ornithologists should use R

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## Dissemination and Visualizations

- Beautiful plots with [ggplot2](#)

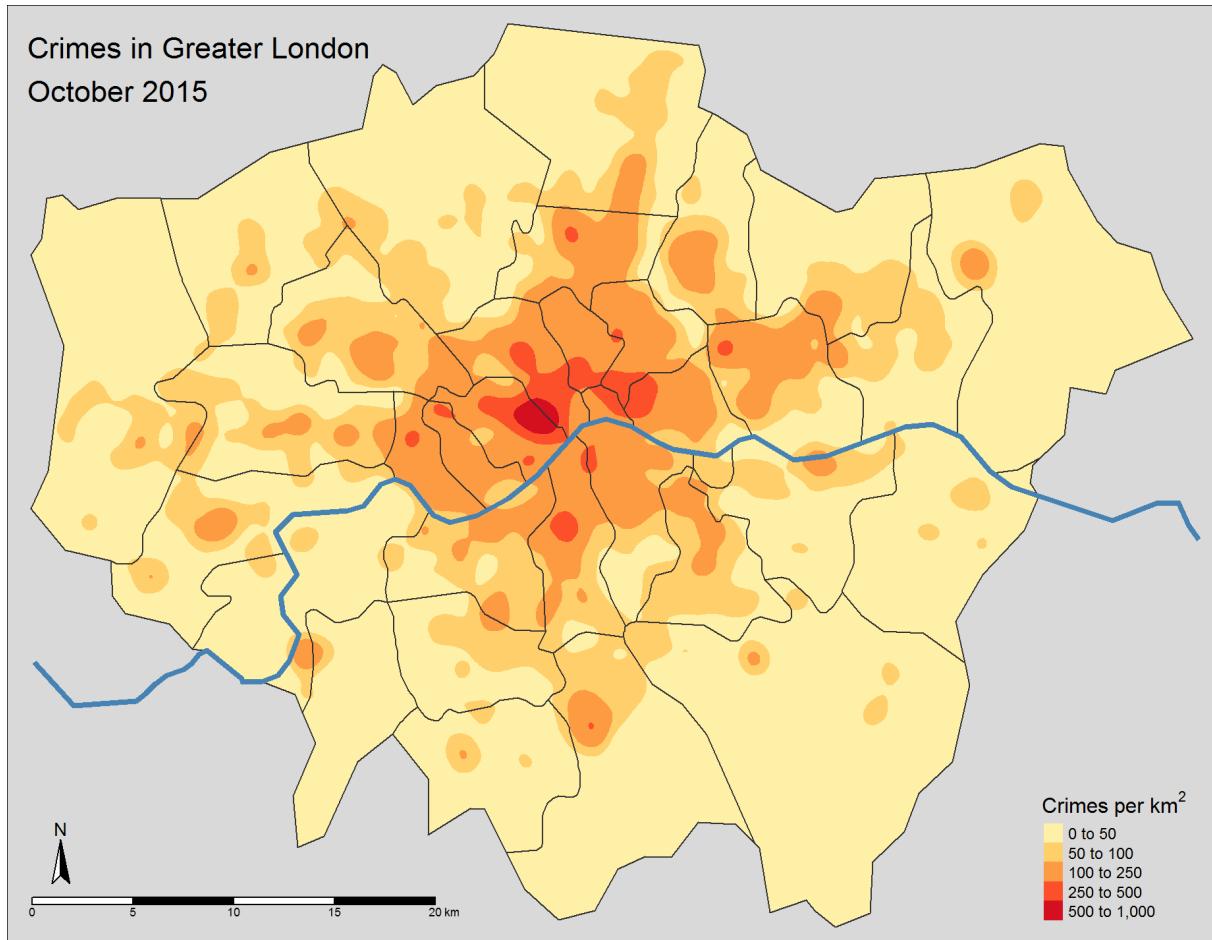
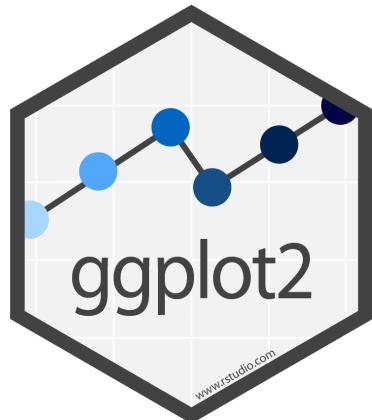


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## Dissemination and Visualizations

- Beautiful plots with [ggplot2](#)
- Complex maps with [sf](#), [tmap](#)



# Why ornithologists should use R

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## Dissemination and Visualizations

- Beautiful plots with [ggplot2](#)
- Complex maps with [sf](#), [tmap](#)
- Interactive visualizations with [shiny](#)



Instructions: ?

Summary over time

Cumulative  Instant

Select Individual

All

Summary type

Total sum  Average sum per individual

Time Range

2016-01-28 07:00:00 2016-01-29 18:00:00

016-01-28 00:00:00 2016-01-28 20:00:00 2016-01-29 16:00:00

Animation options

Resolution

5 min  15 min  30 min  1 hr  
 3 hr  6 hr  12 hr  24 hr

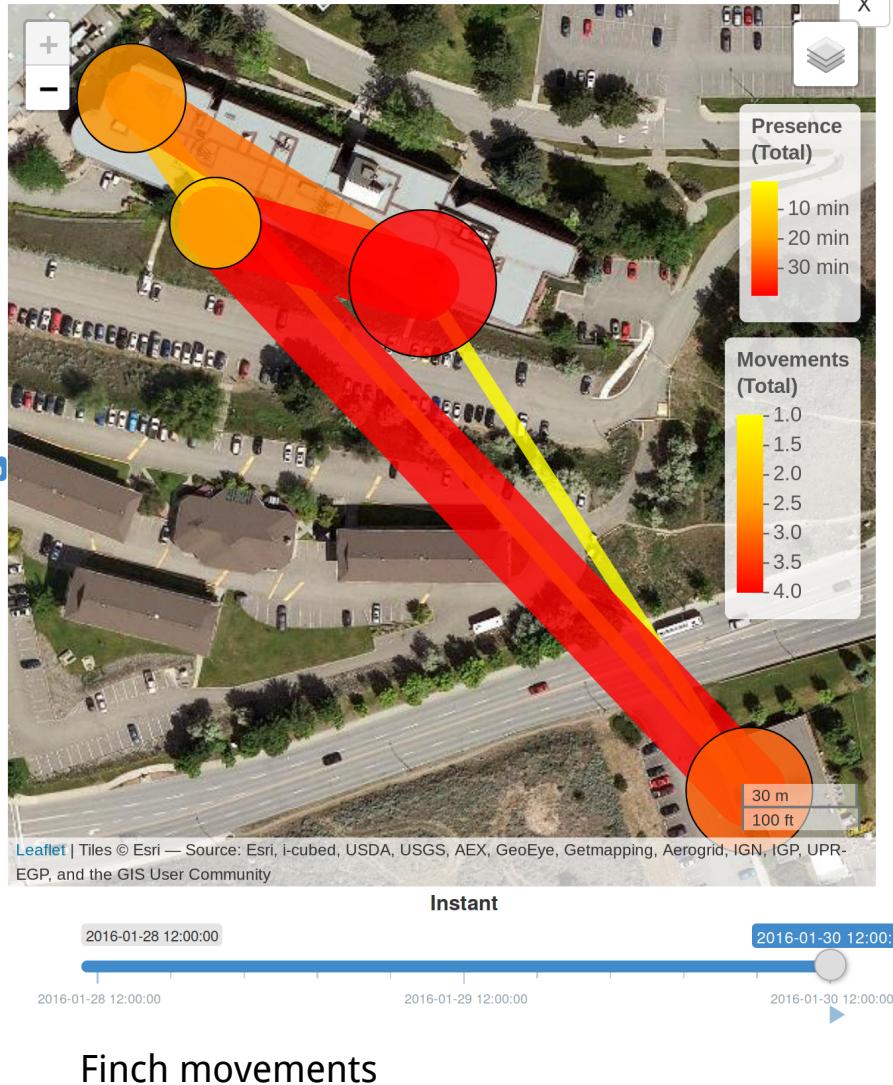
Animation speed

0% 50% 100%

0 10 20 30 40 50 60 70 80 90 100

Show sunrise/sunset?

Yes  No



# Why ornithologists should use R

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## Find More Packages!

- Not an exhaustive list!
- Check out package collections
  - [metaverse](https://rmetaverse.github.io/) (<https://rmetaverse.github.io/>)
  - [ropensci](https://ropensci.org/) (<https://ropensci.org/>)
  - [tidyverse](https://tidyverse.org/) (<https://tidyverse.org/>)
- Look in journals, i.e. Methods in Ecology and Evolution
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Always cite packages and package versions!

# Symposium: R for Ornithologists

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**Stay tuned for 6 more R-related presentations**

**2:00pm Round-Table Discussion on Ornithological perspectives on R**

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**Stay tuned for 6 more R-related presentations**

**2:00pm Round-Table Discussion on Ornithological perspectives on R**



## Thank you!



Presentation Available: <https://steffilazerte.github.io/Presentations/>

Slides created with the R package [xaringan](#), using [remark.js](#), [knitr](#), and [R Markdown](#)

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Dr. Steffi LaZerte



Analysis and Data Tools for Science

Compiled on 2019-08-26