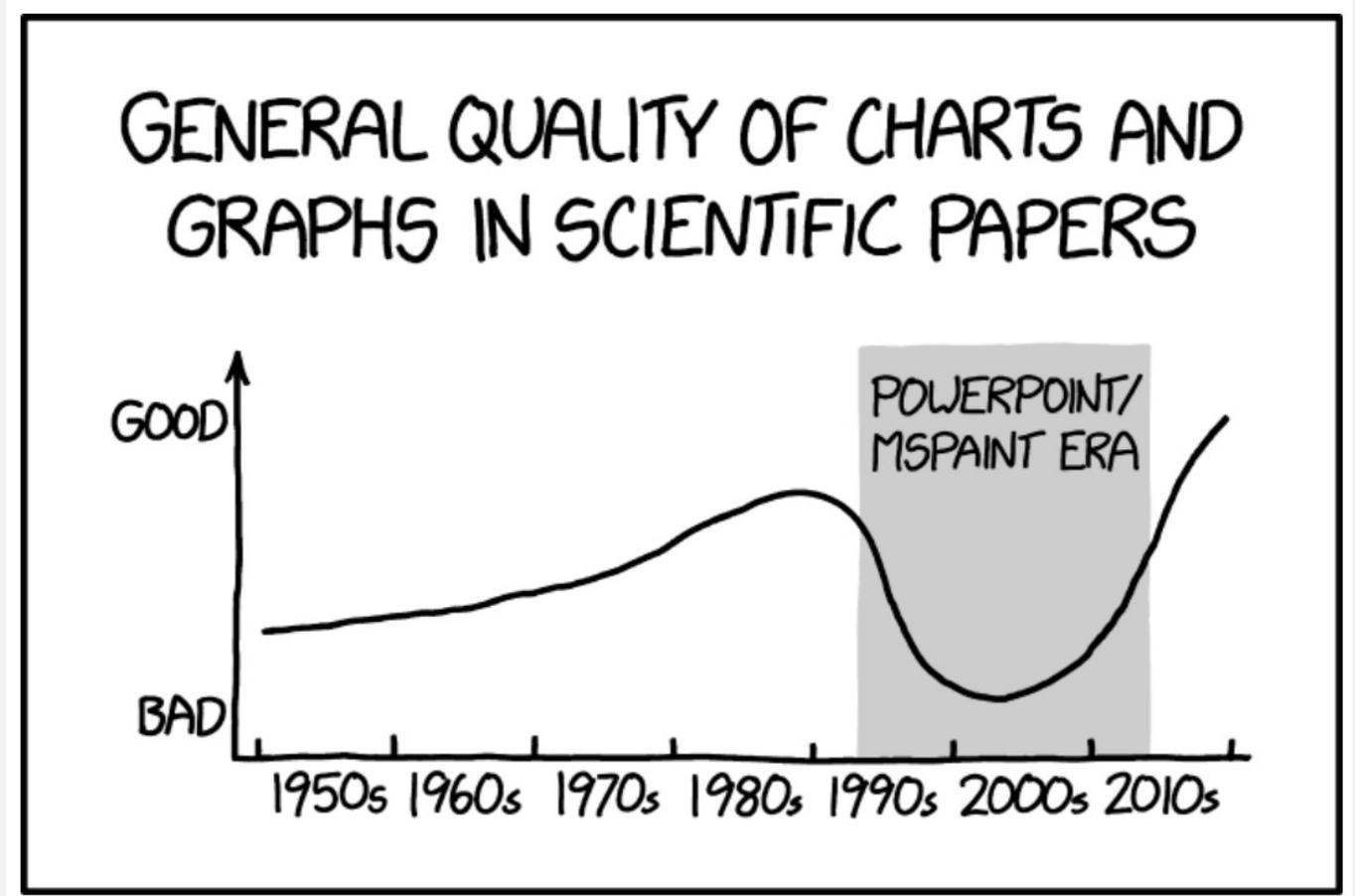


Visualizing Data

Biology 683

Week 3

Heath Blackmon

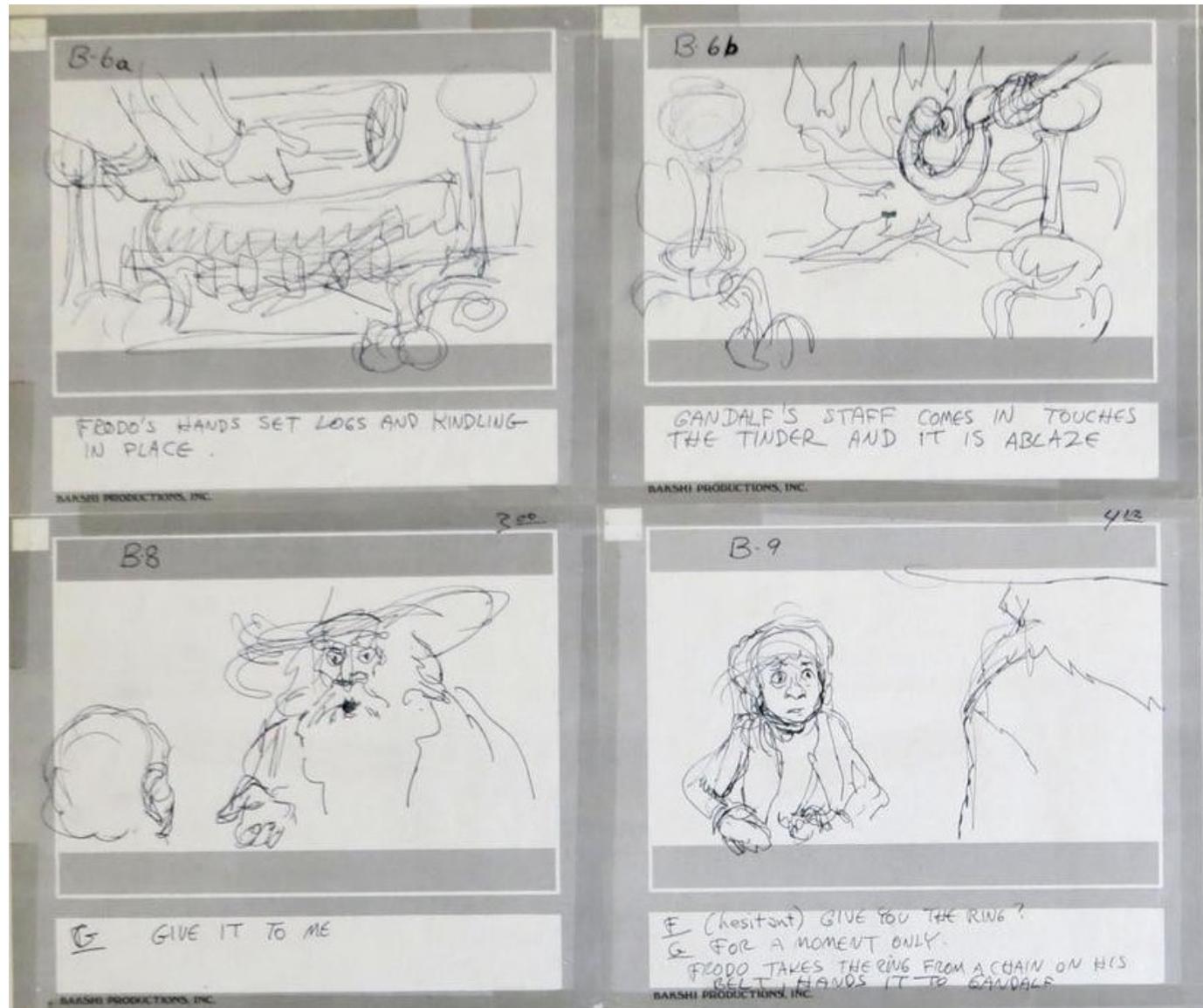


- What are some causes of the reproducibility crisis?
- What is a p-value
- Ways of messing up experiments (non-independence, bias, creating temporal patterns, etc.)

Plan for today

1. Importance of figures
2. General rules for making plots
3. Programs for plotting
4. Resources for plotting

Importance of figures



Serve a purpose



Meiotic drive shapes rates of karyotype evolution in mammals

Heath Blackmon,^{1,2}  Joshua Justison,³ Itay Mayrose,⁴ and Emma E. Goldberg³

¹*Department of Biology, Texas A&M University, College Station Texas 77843*

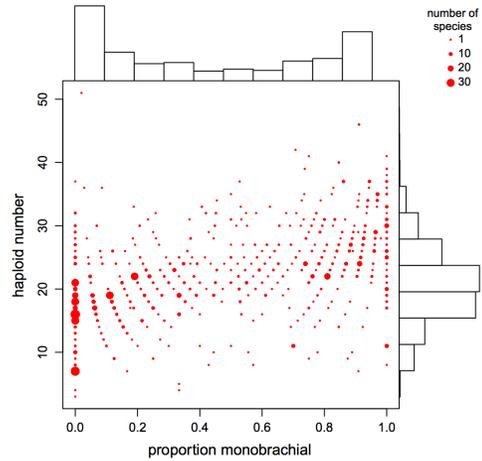
²*E-mail: coleoguy@gmail.com*

³*Department of Ecology, Evolution, and Behavior, University of Minnesota, Saint Paul Minnesota 55108*

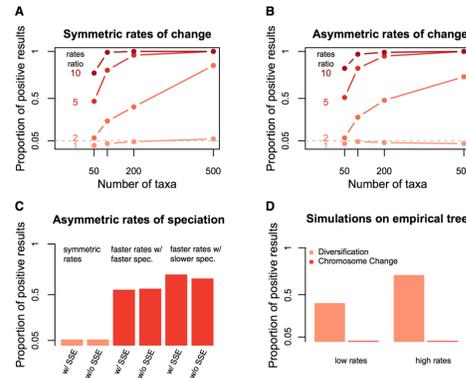
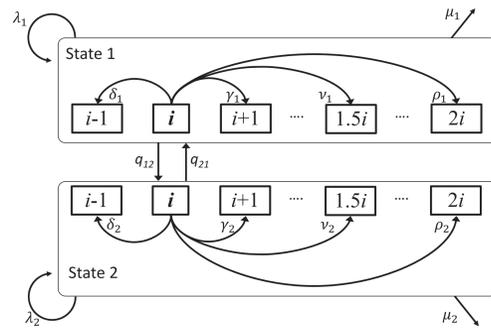
⁴*School of Plant Sciences and Food Security, Tel Aviv University Tel Aviv 69978, Israel*

Serve a purpose

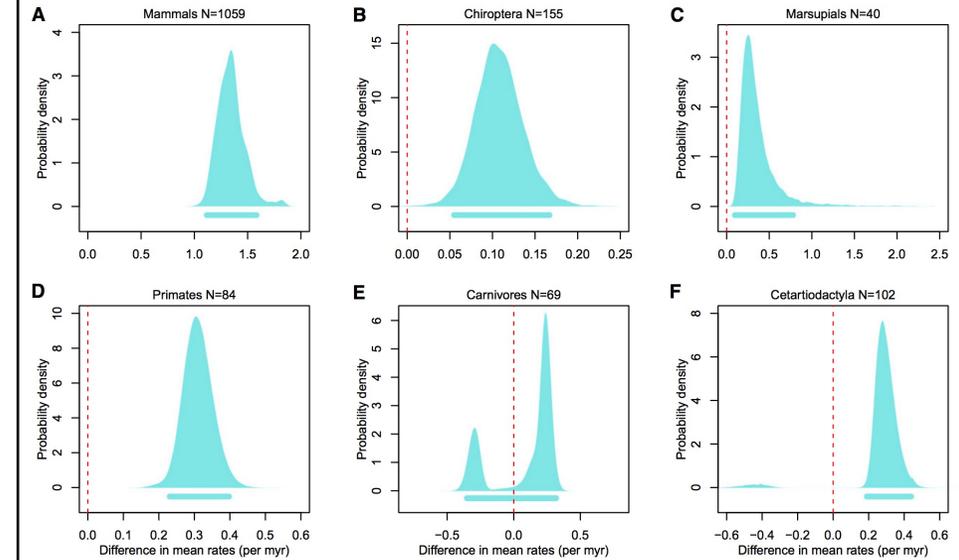
The Problem/Question



New tool and it works



The Answer



Mammals have a weird distribution of numbers and types of chromosomes

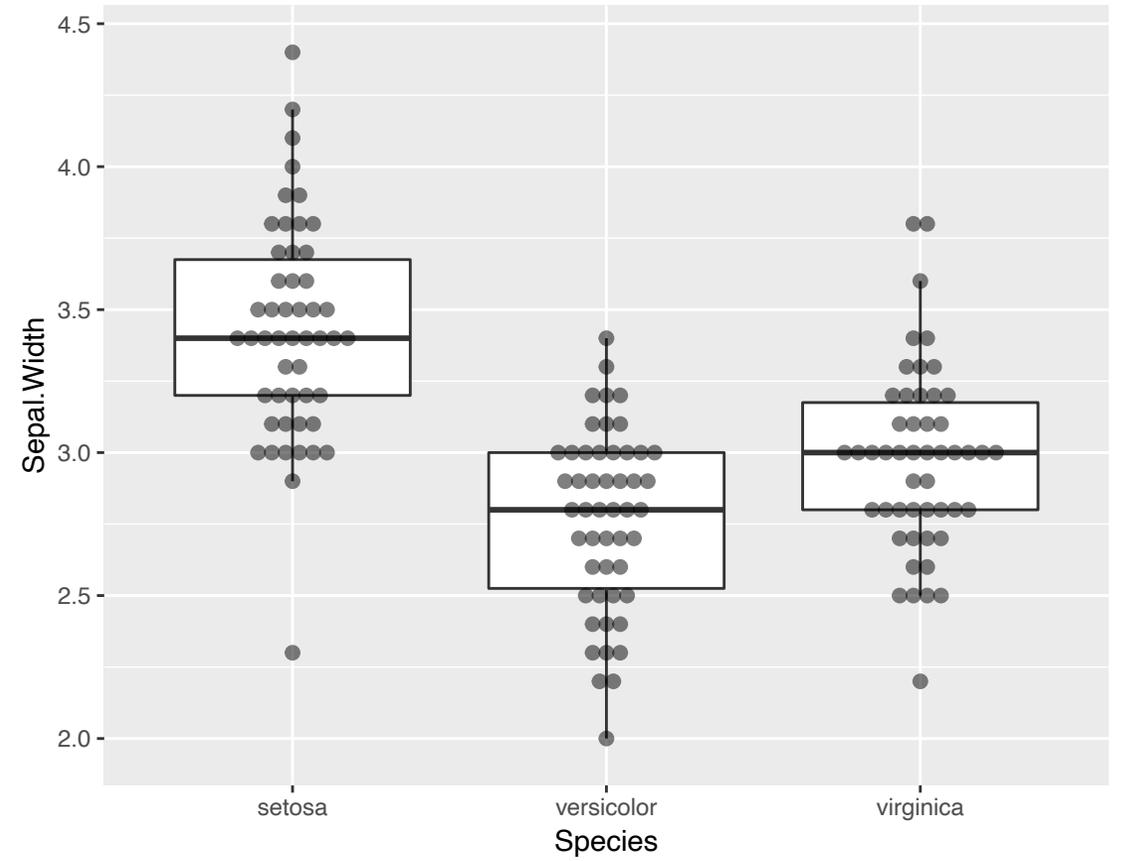
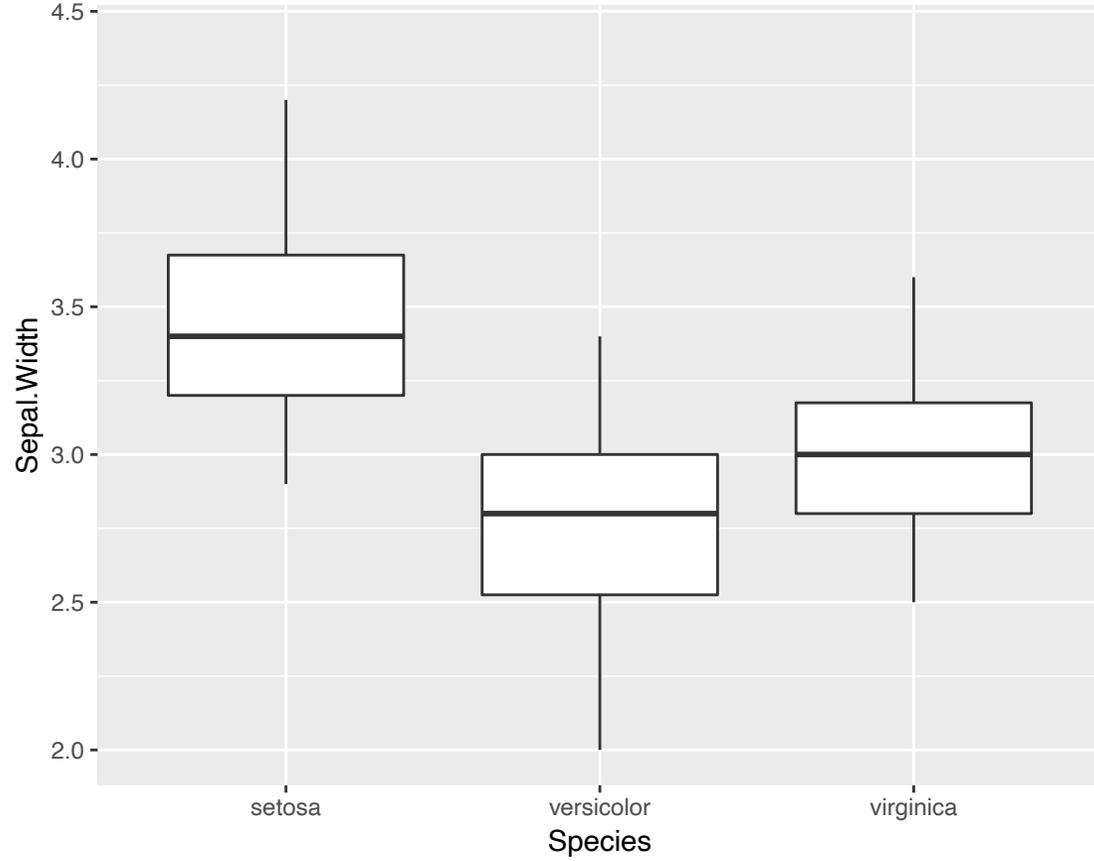
I made this new model and it can test this hypothesis and it works pretty good

For most groups of mammals I show strong support for the existing hypothesis we should assume it is right but maybe not in 1-2 groups.

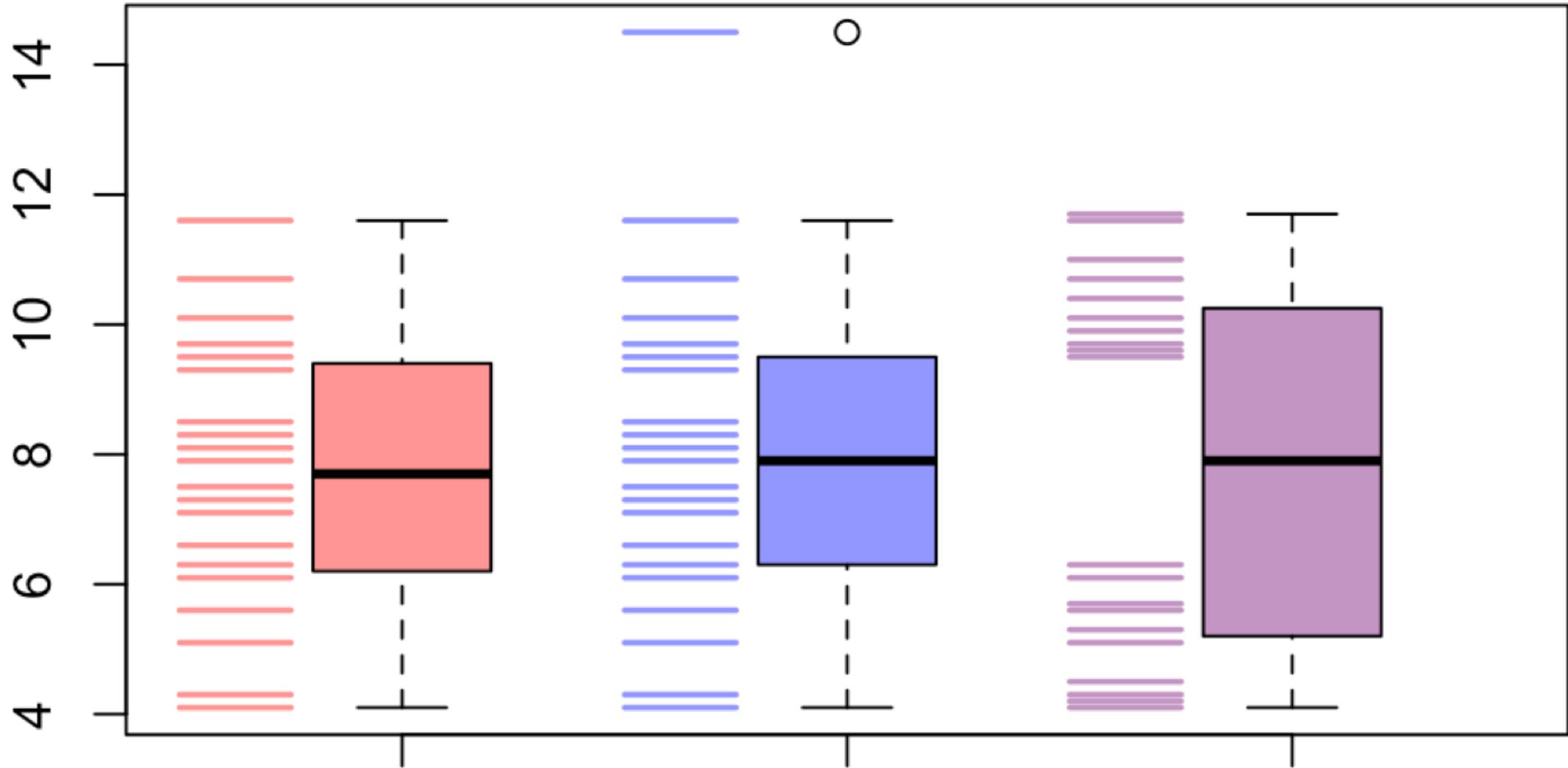
Rules for plots

1. Show the data

Show the data



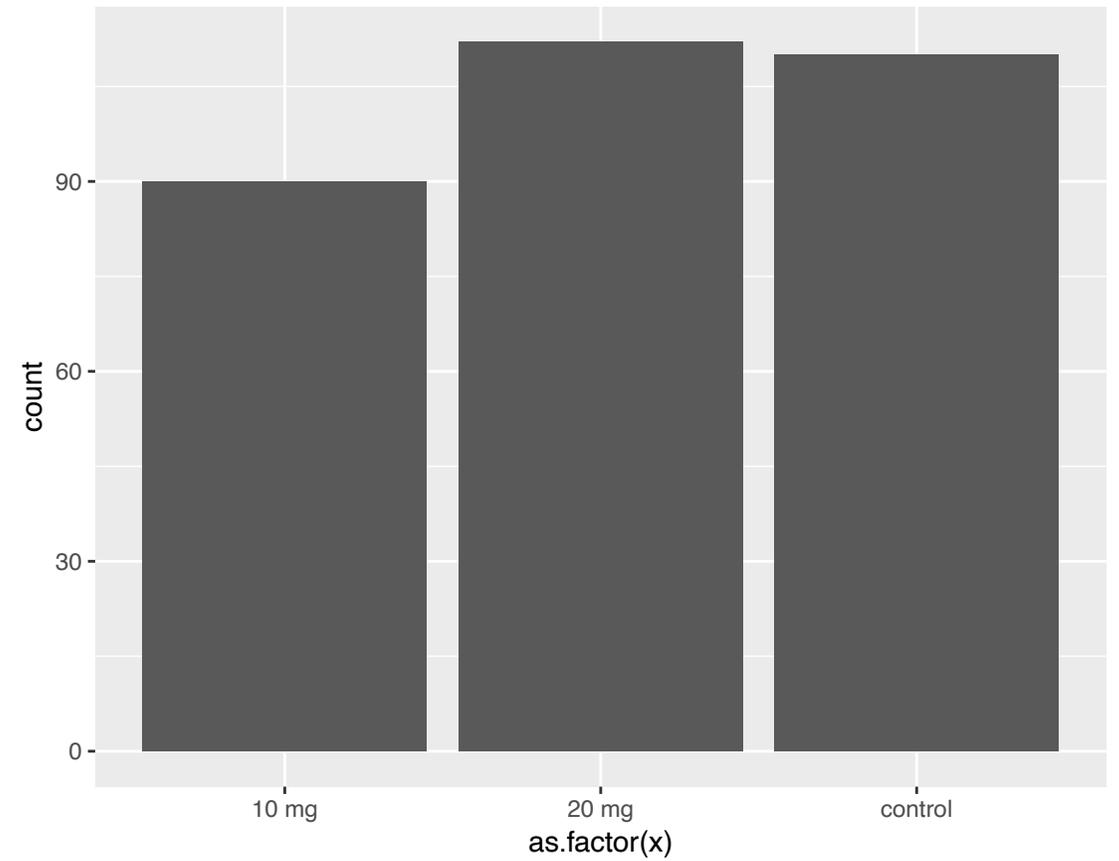
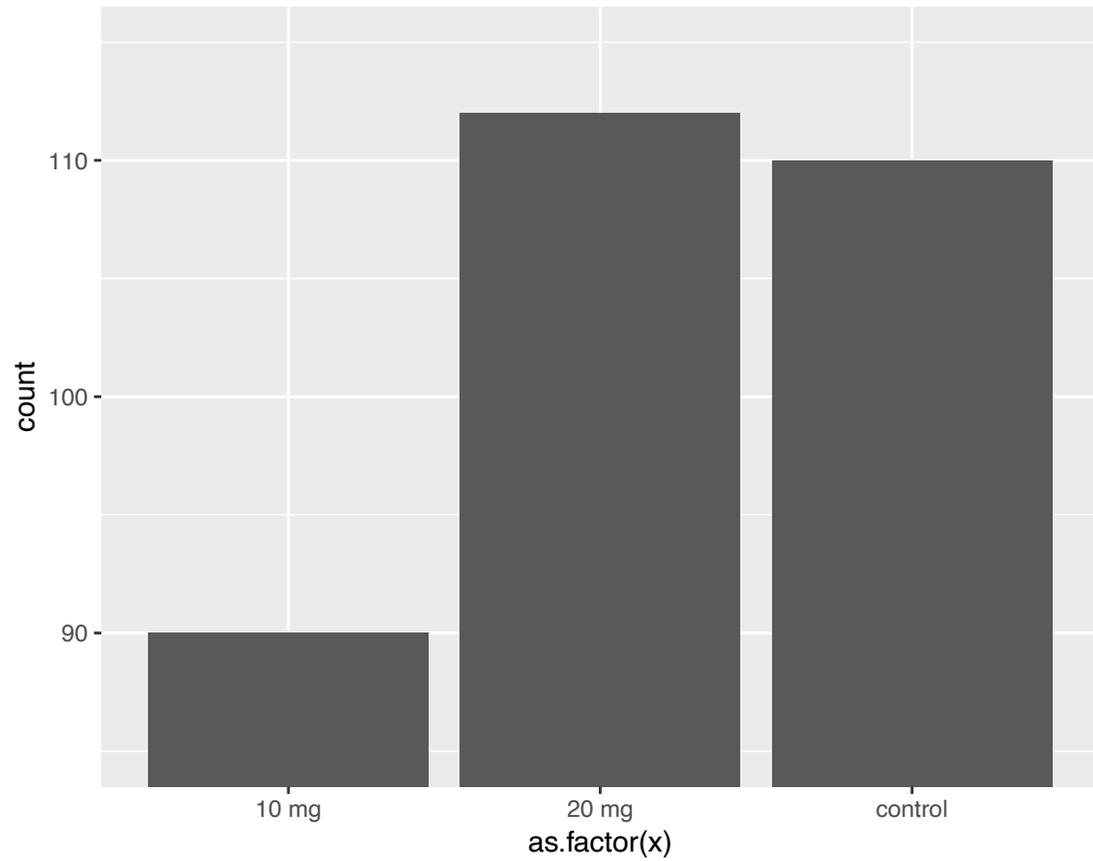
Showing the data can reveal patterns



Rules for plots

1. Show the data
2. Avoid distorting data

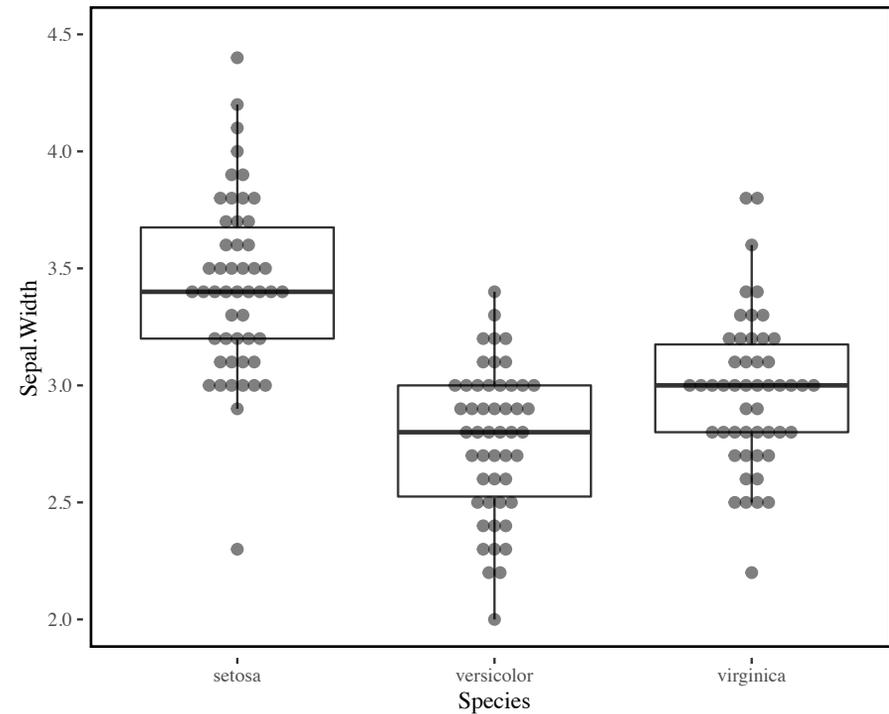
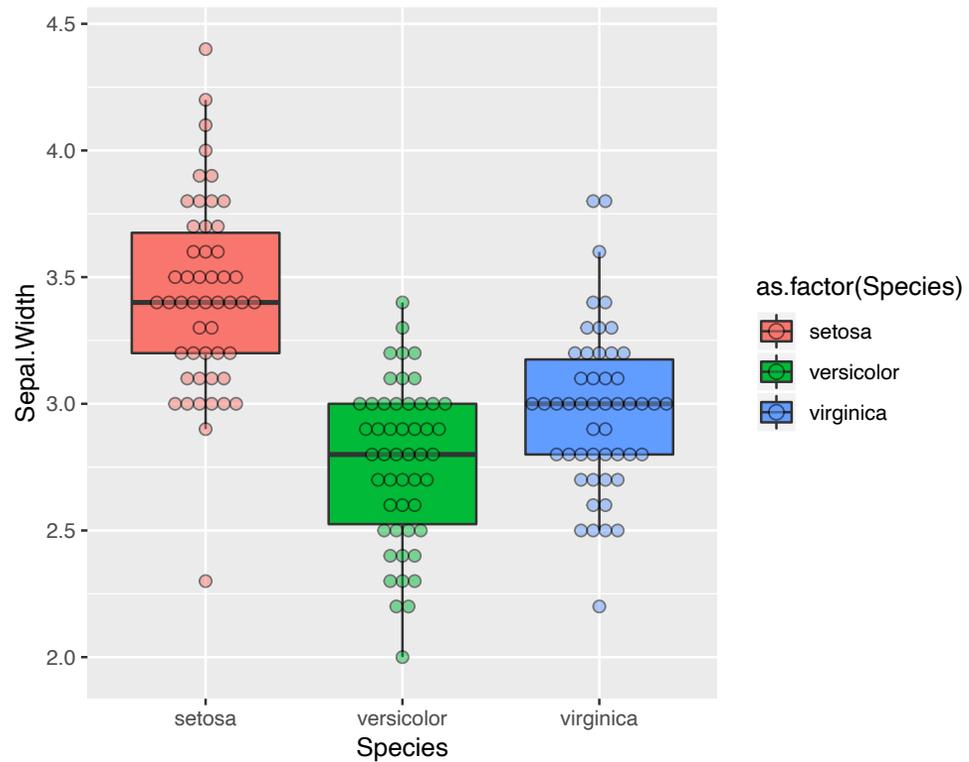
Avoid distorting data



Rules for plots

1. Show the data
2. Avoid distorting data
3. Avoid chart junk

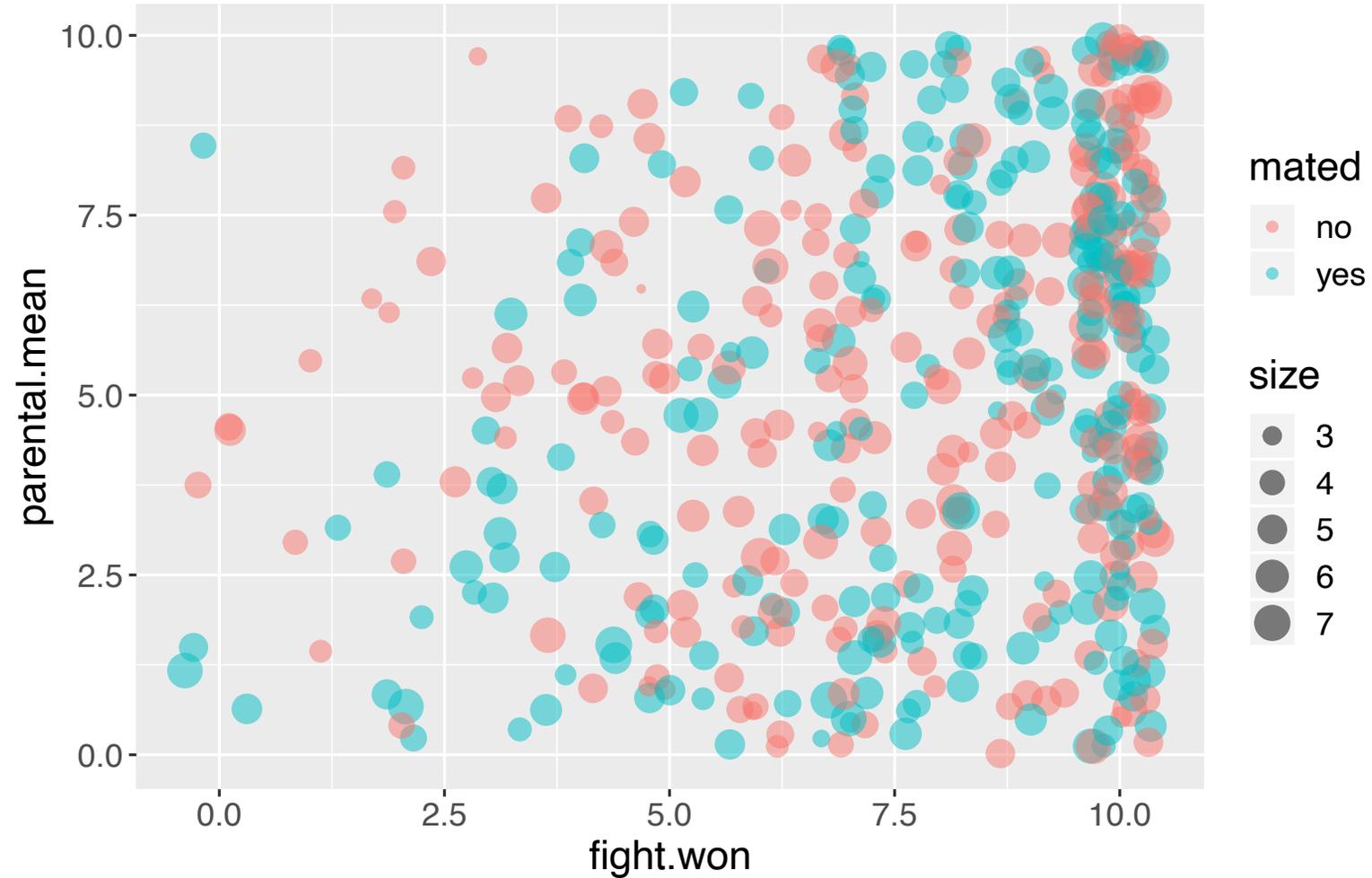
Avoid chart junk



Rules for plots

1. Show the data
2. Avoid distorting data
3. Avoid chart junk
4. Maximize data:ink ratio maximize information

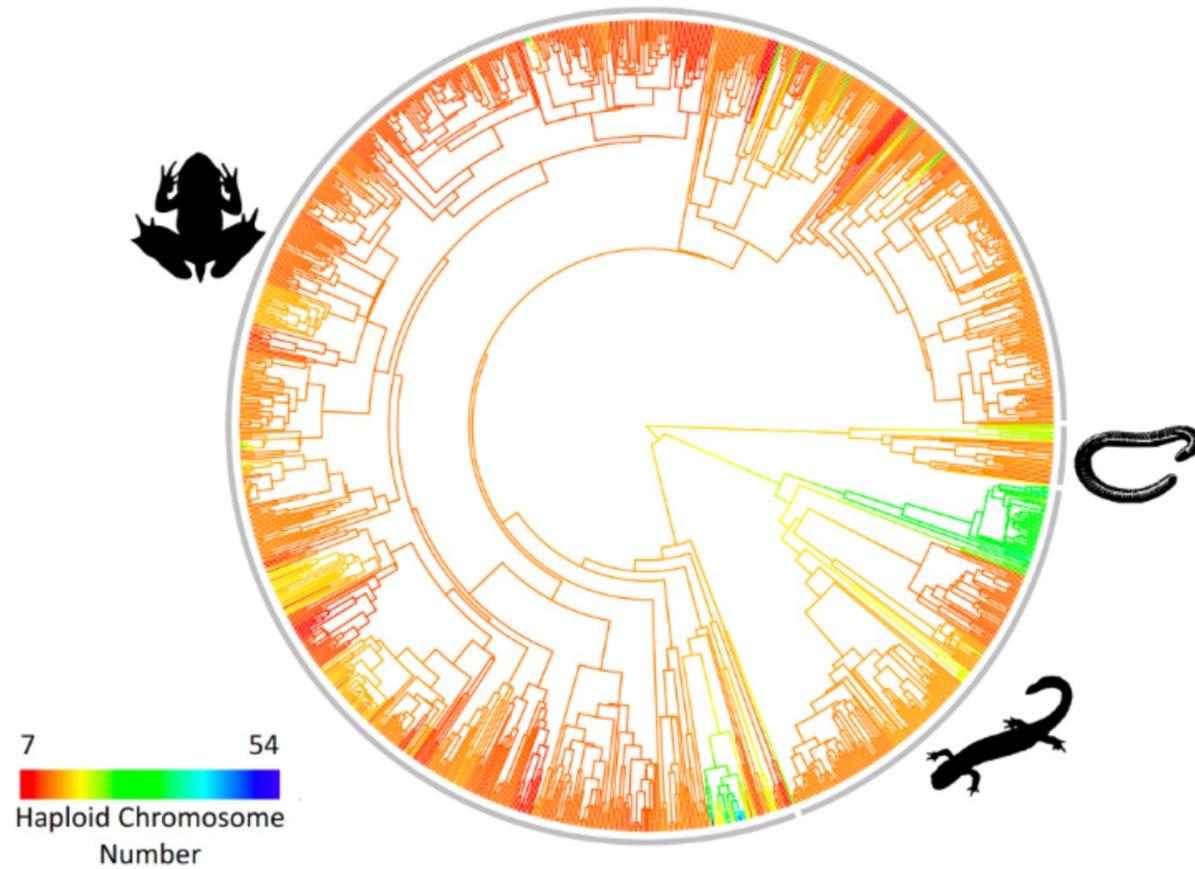
Maximize data:ink ratio maximize information



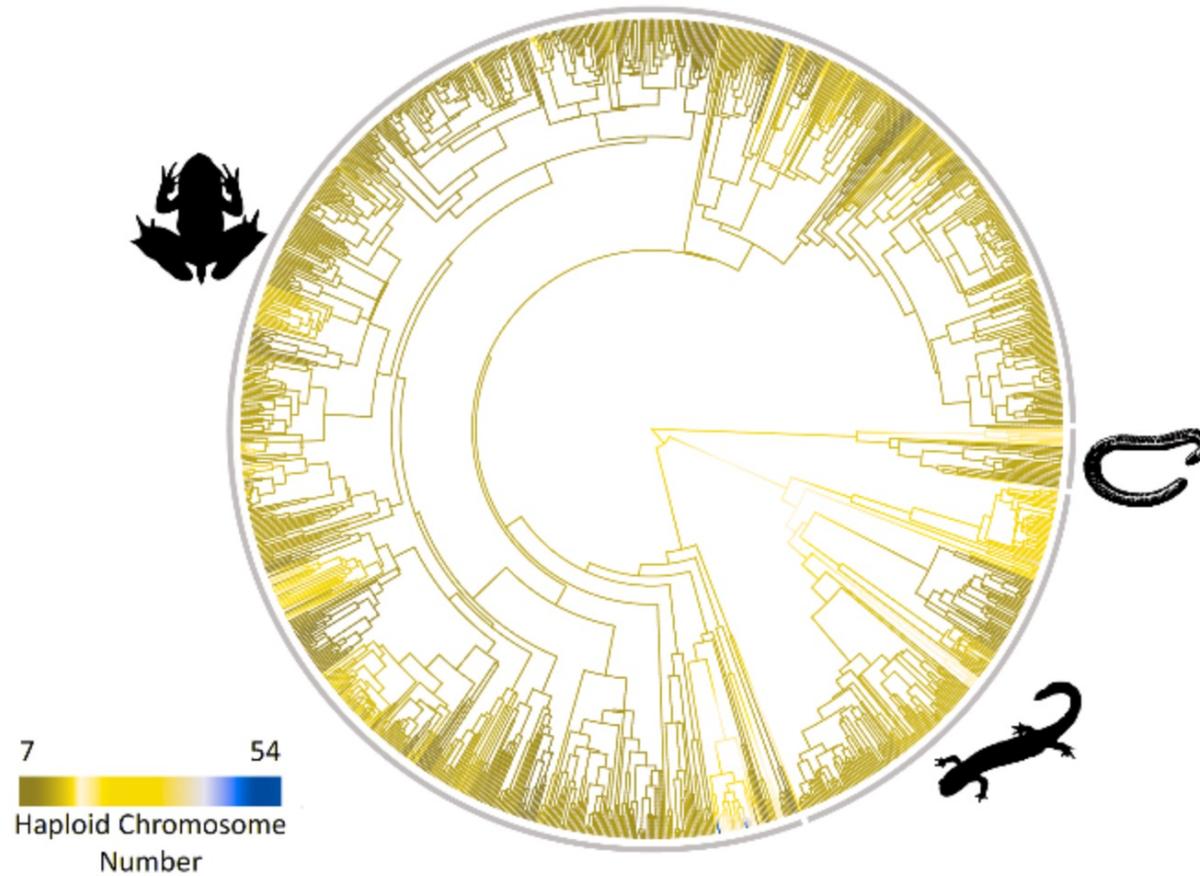
Rules for plots

1. Show the data
2. Avoid distorting data
3. Avoid chart junk
4. Maximize data:ink ratio maximize information
5. Make it accessible to all (5% color blind + BW prints).

Make it accessible to all



Make it accessible to all



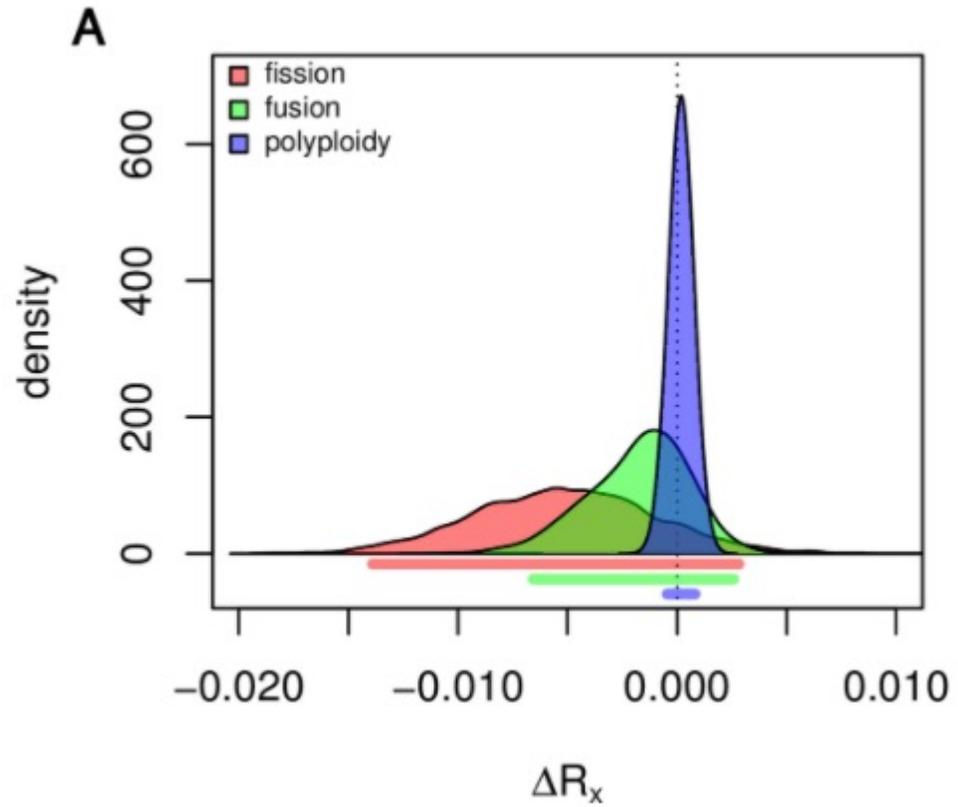
Use the viridis color palette

[Color blind simulator](#)

Rules for plots

1. Show the data
2. Avoid distorting data
3. Avoid chart junk
4. Maximize data:ink ratio maximize information
5. Make it accessible to all (5% color blind + BW prints).
6. Axes and legends that are informative and useful

Axes and legends

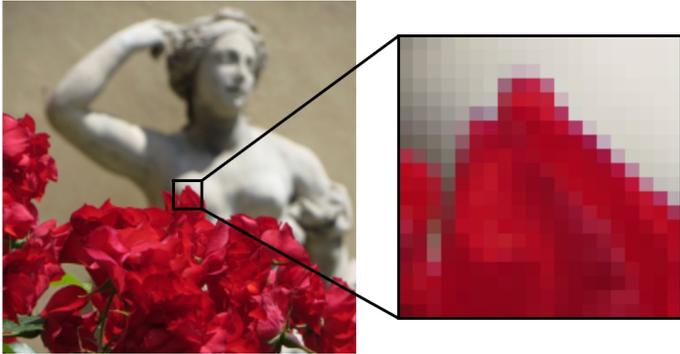


Rules for plots

1. Show the data
2. Avoid distorting data
3. Avoid chart junk
4. Maximize data:ink ratio maximize information
5. Make it accessible to all (5% color blind + BW prints).
6. Axes and legends that are informative and useful
7. Use vector art when possible

Types of images

Raster images



jpg, tiff, png, bmp, raw

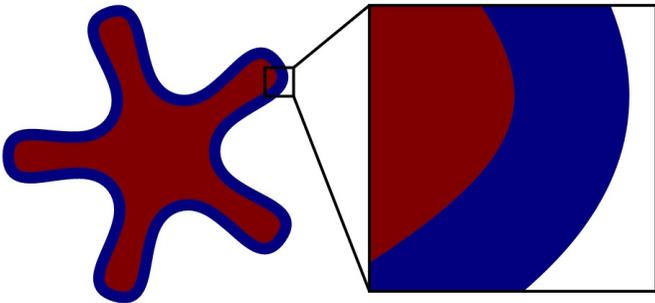
Example of journal requirements

Photos (edit in Adobe photoshop; gimp)

Plots (R; edit in inkscape; Adobe illustrator)

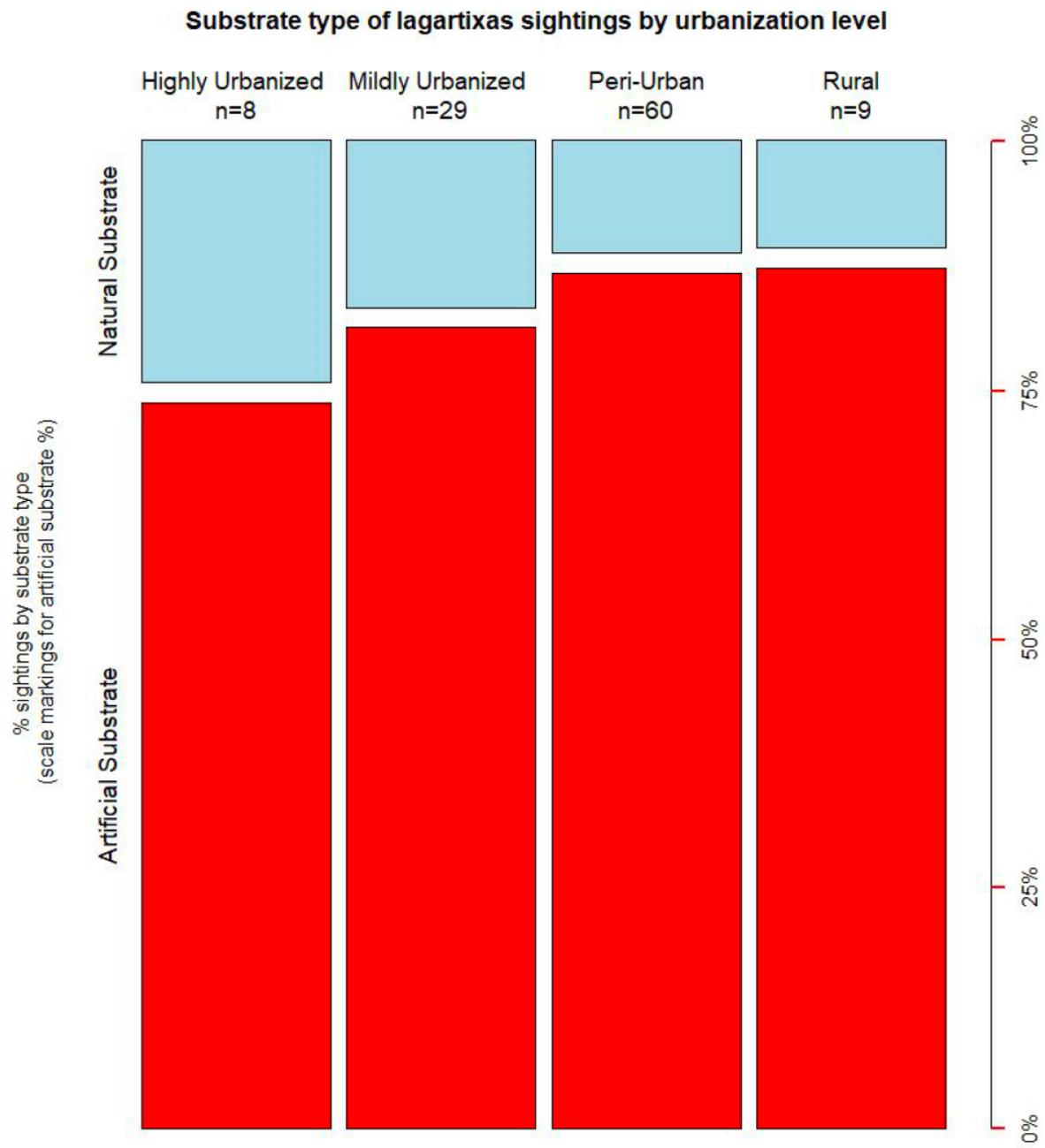
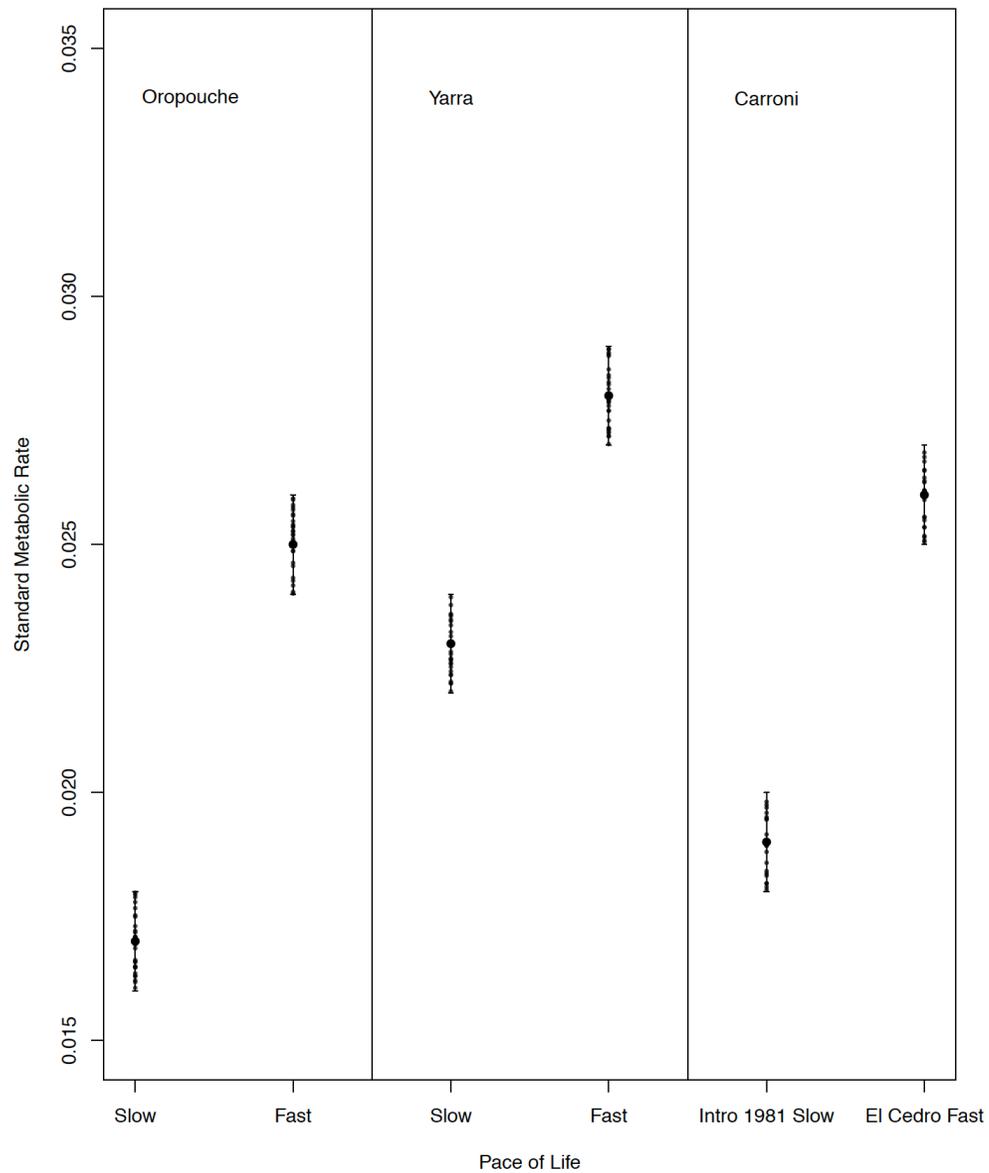
Complex plots (PPT; Adobe illustrator)

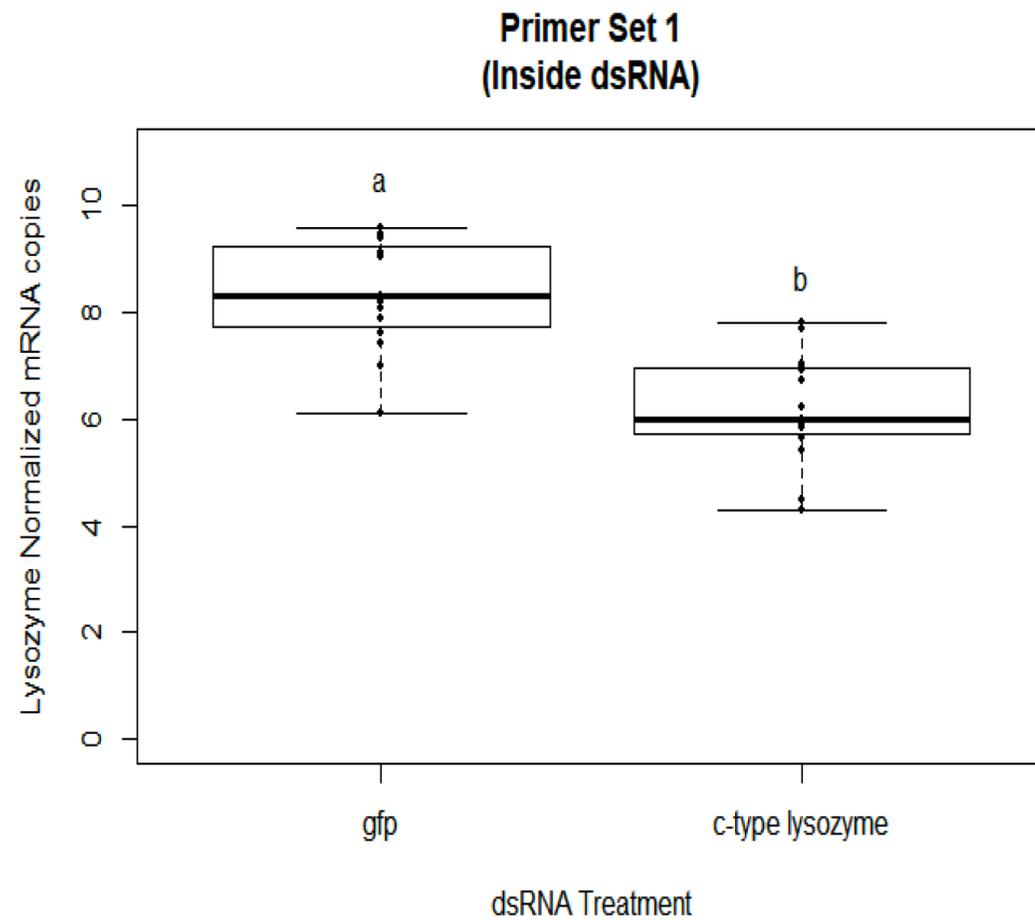
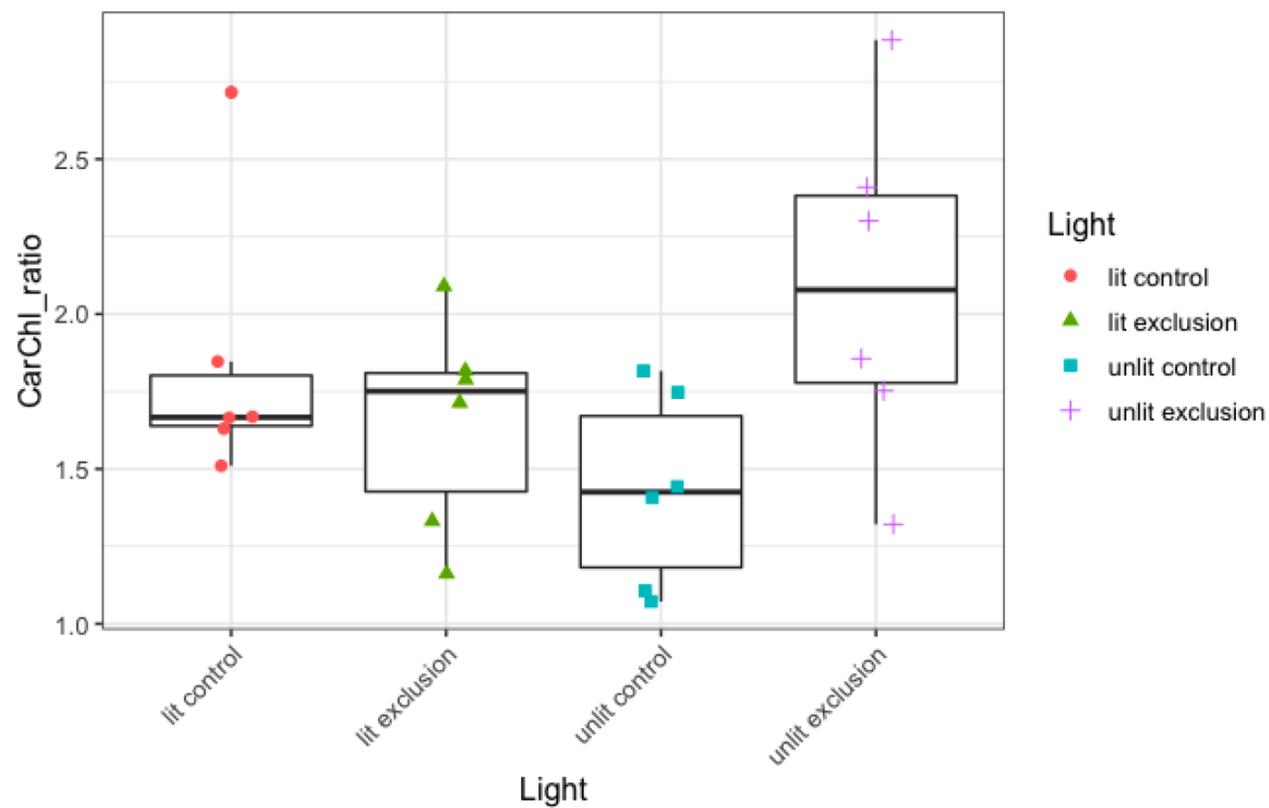
Vector images

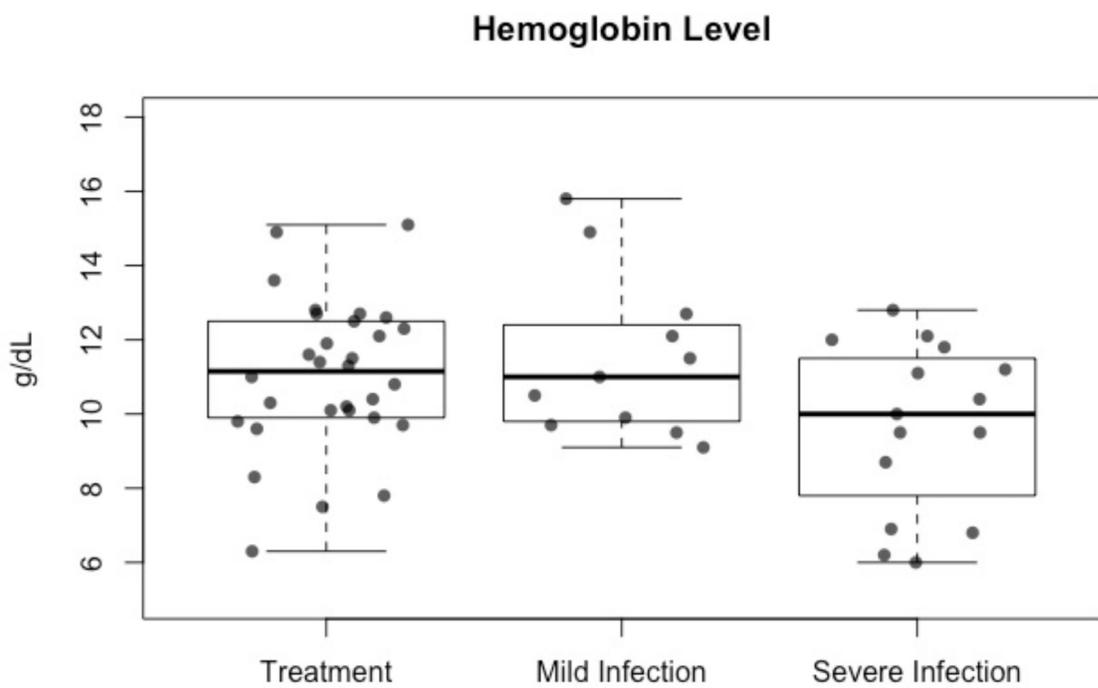


eps, pdf, svg

Plots with problems!

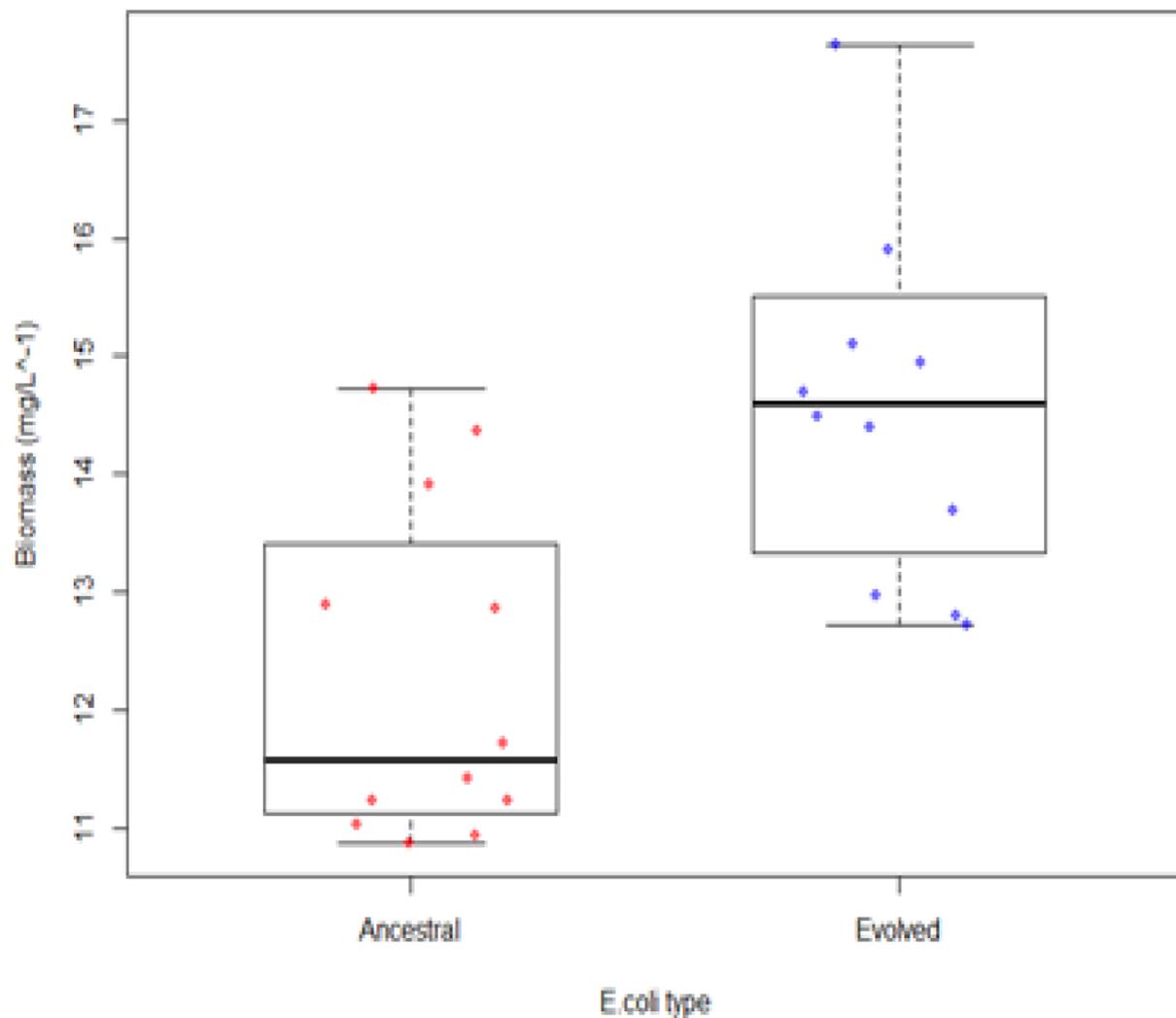




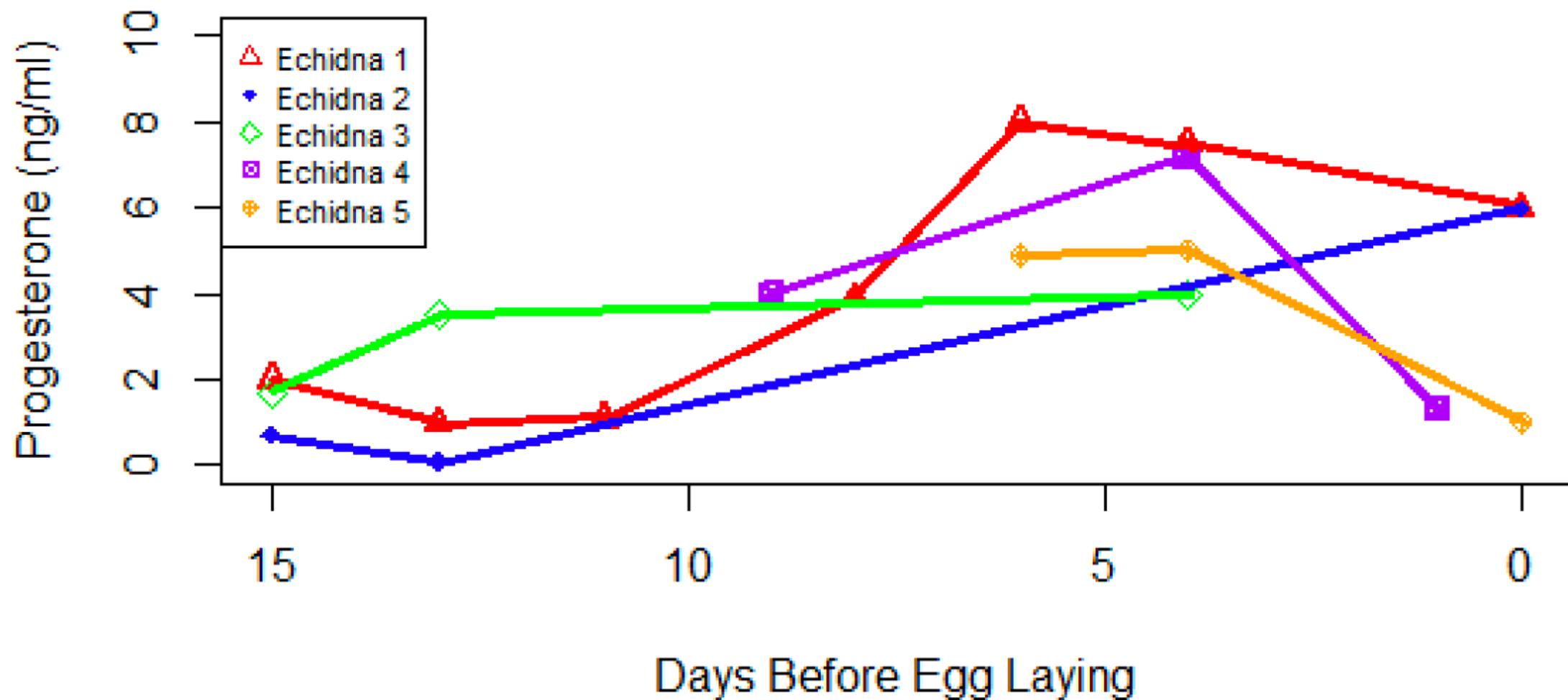


B.

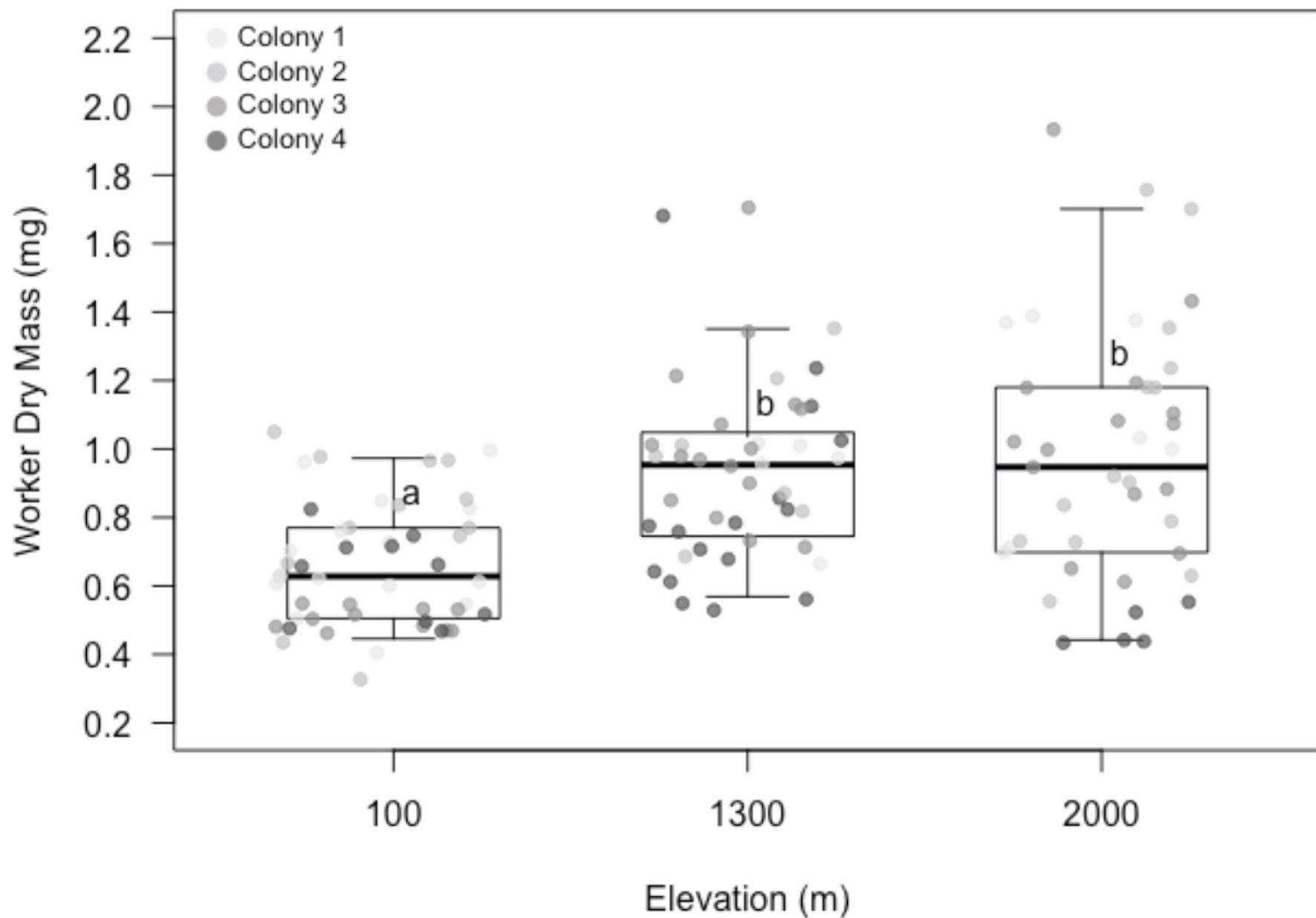
Biomass of Ancestral VS. Evolved bacteria



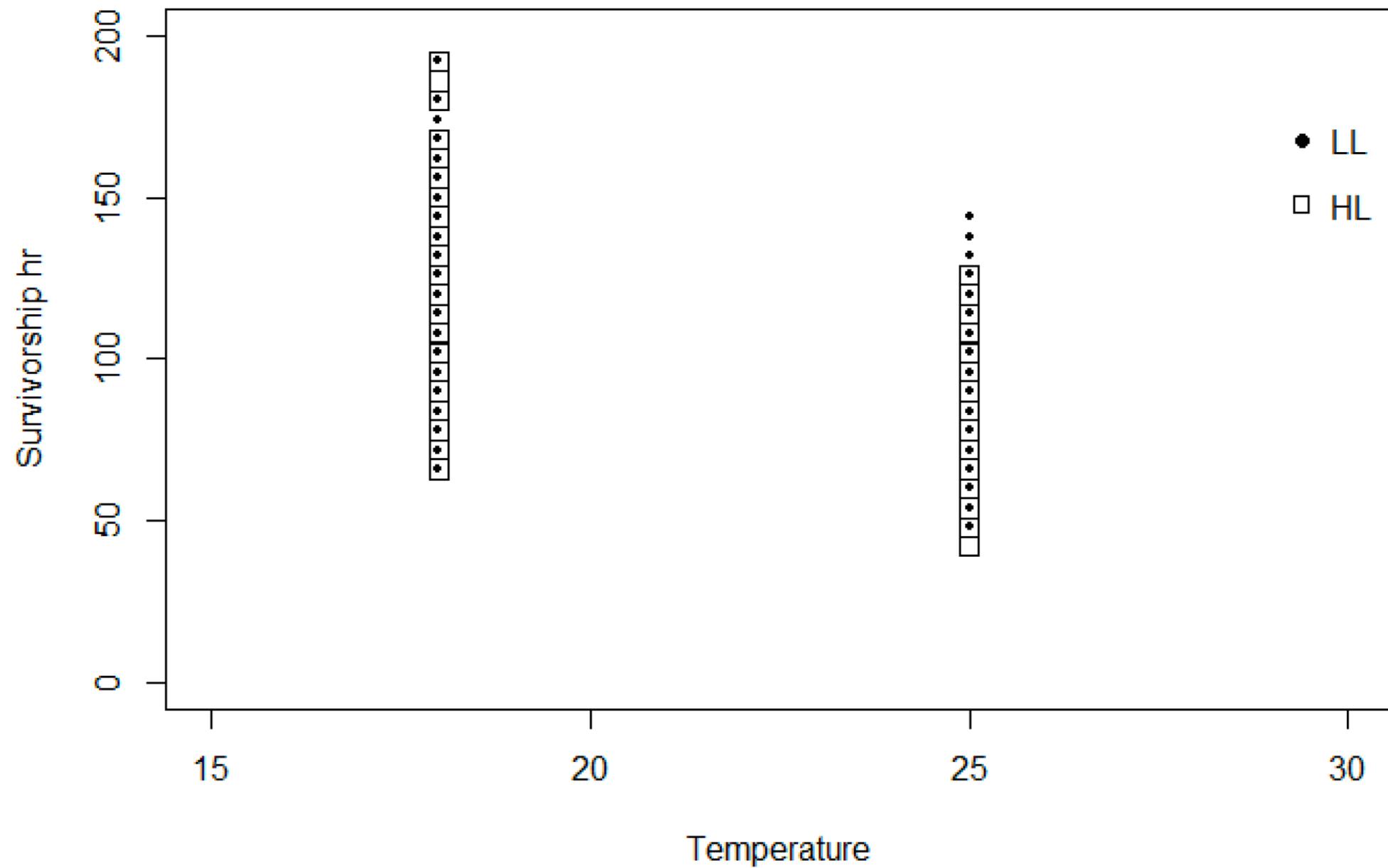
Echidna Progesterone Level VS. Days Before Egg Laying

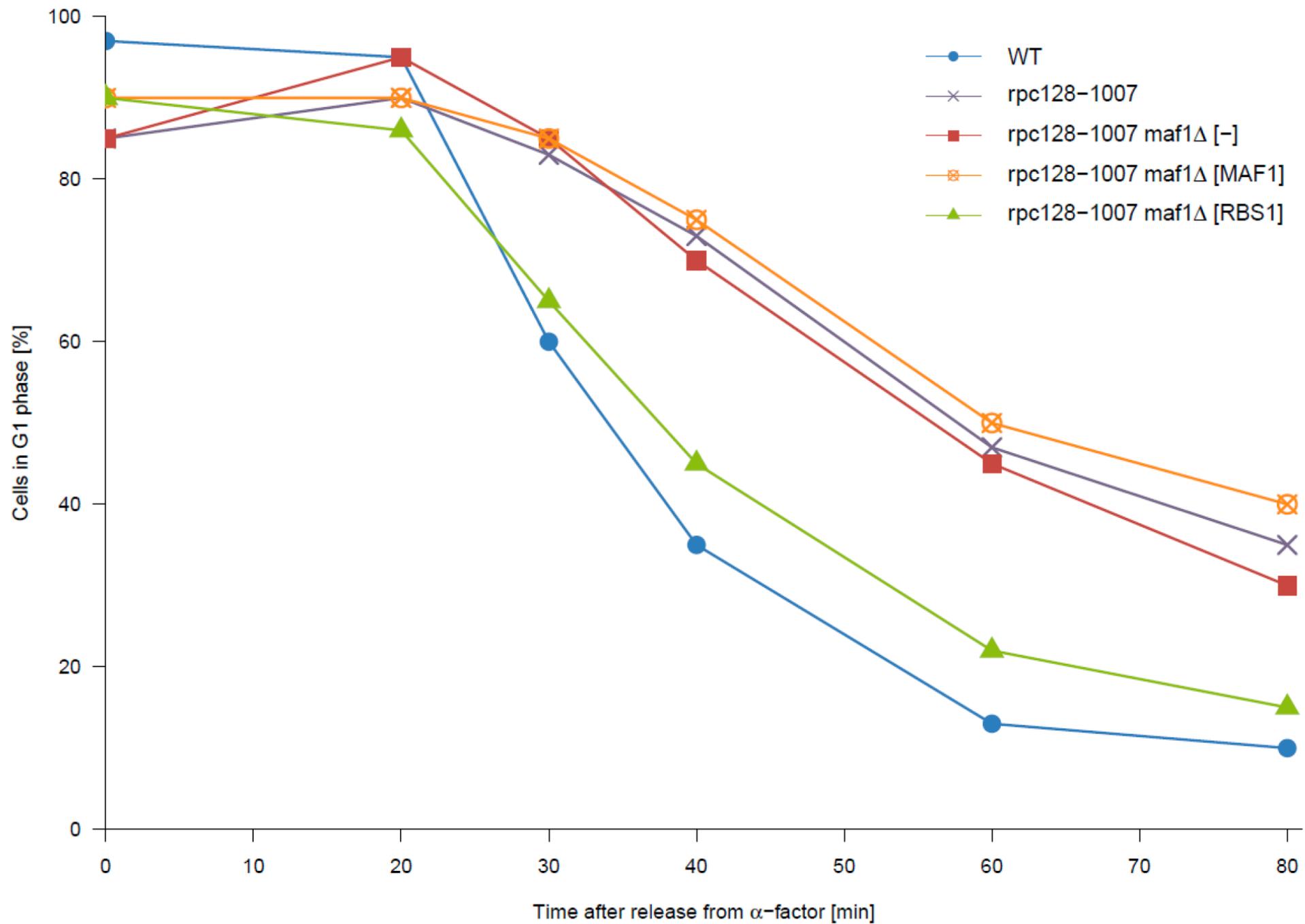


Worker Ant Mass At Increasing Elevation Levels

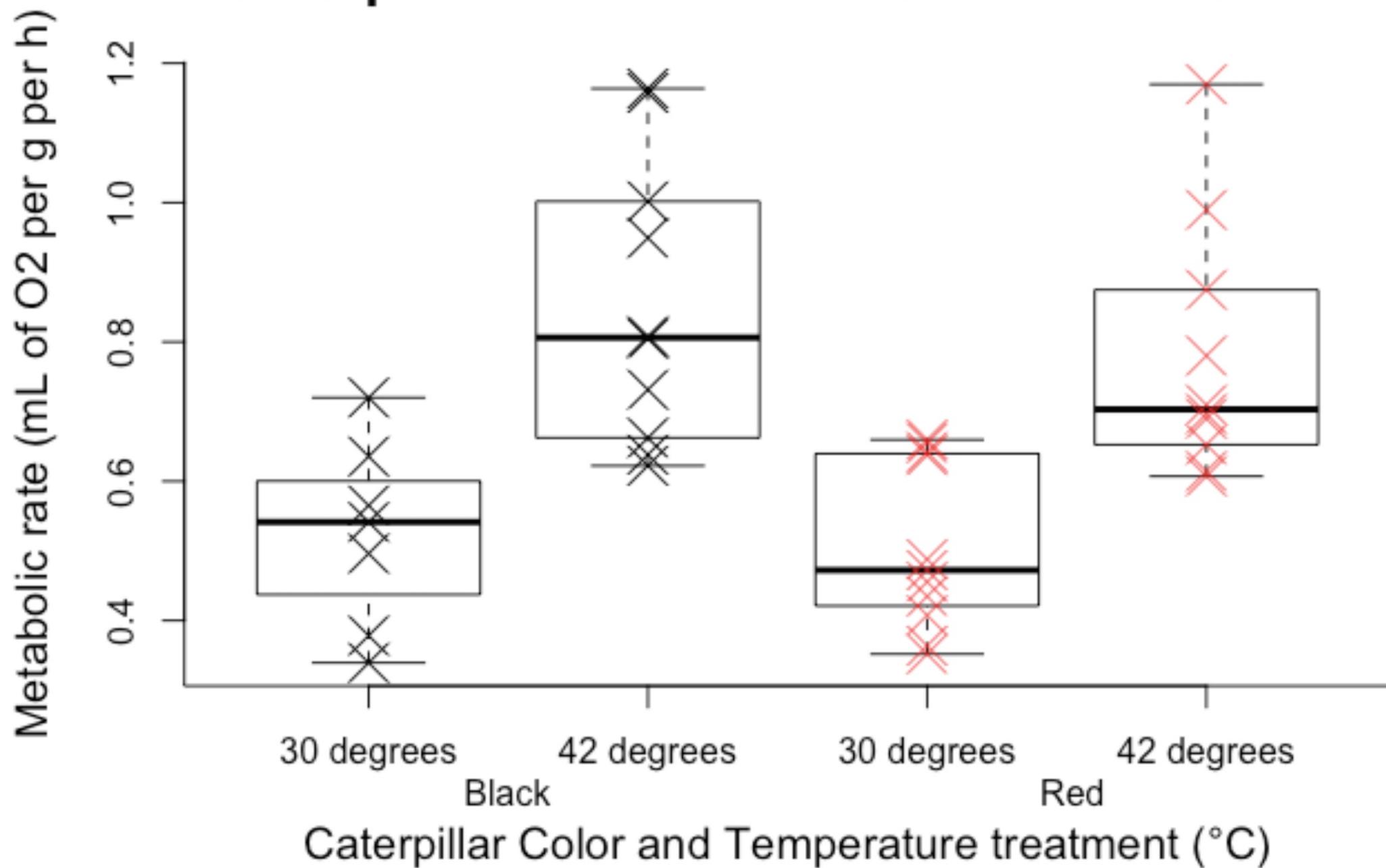


Sucrose Diet

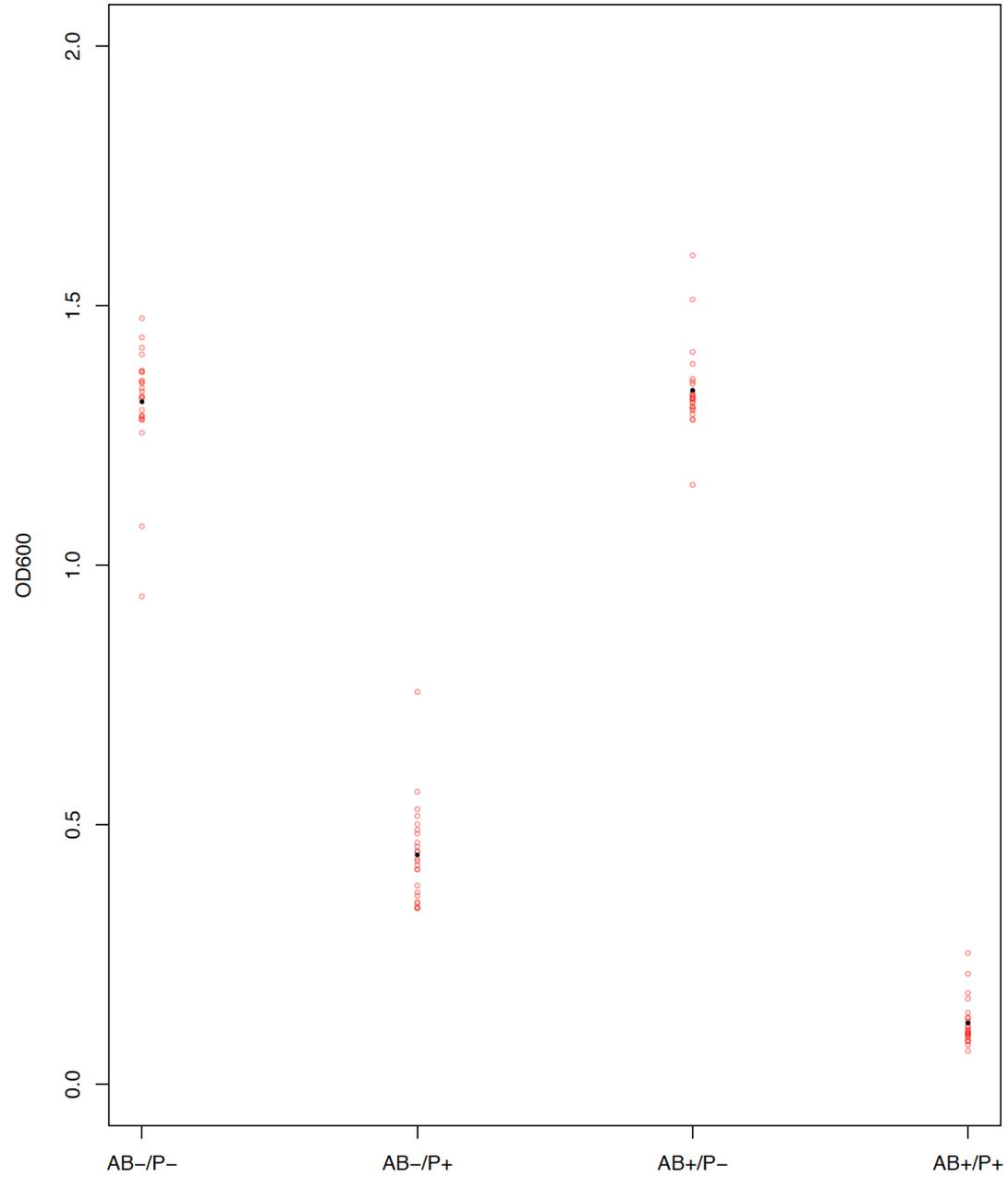




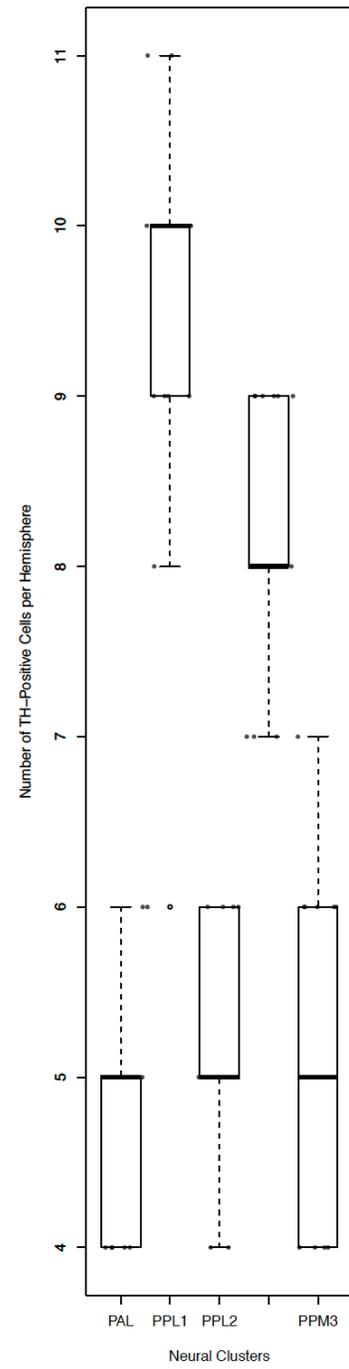
Caterpillar color influences metabolic rate



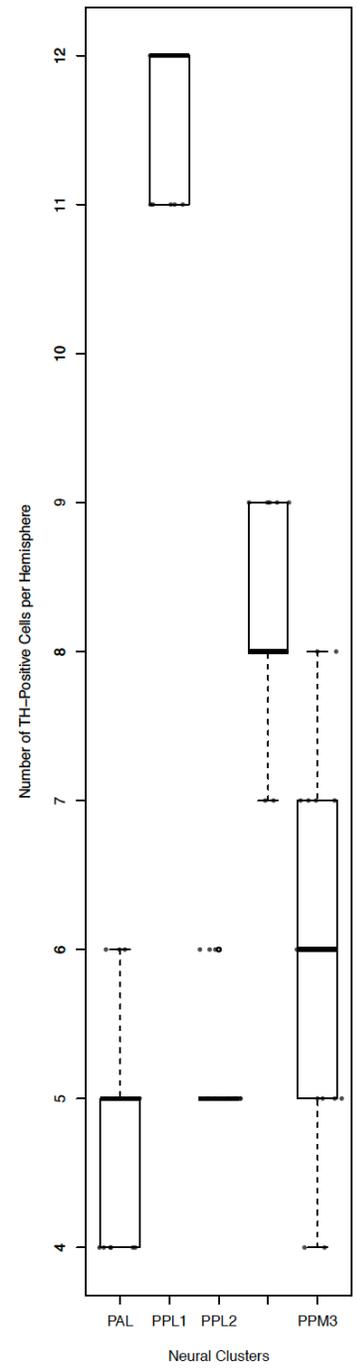
Density of bacteria in liquid culture after 24h
factorial antibiotic(AB) and phage(P)
treatment



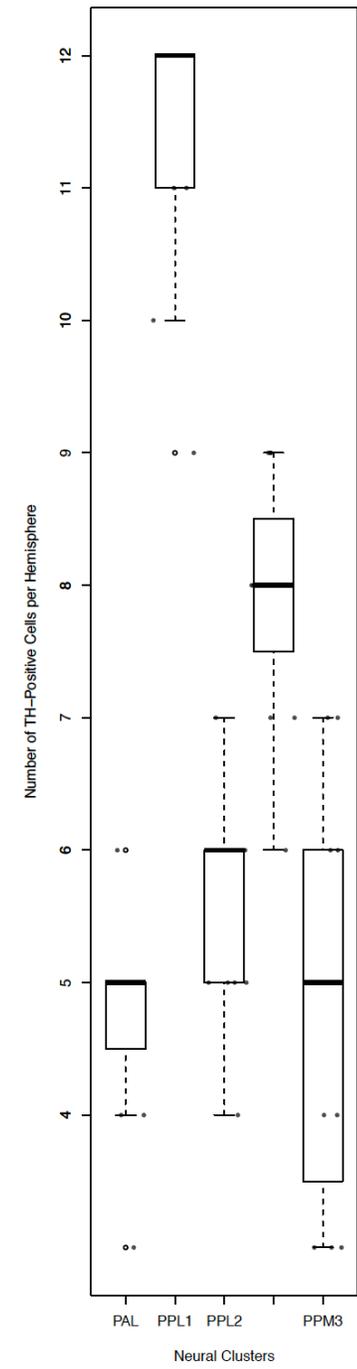
CikAR



han5304



han5304.CikAR



Use the right tool

Plotting continuous or discrete data

Matplotlib: is a python plotting library,

R: endless packages for plotting though base and ggplot2 are the most popular.

Inkscape: free vector graphics editor. Can read PDF and let you tweak things you couldn't quite fix in your script generated version.

Circos: created plots that compare genomes but can show connections between any large datasets.

Excel: it is possible but you have very limited options and control

Adobe Illustrator: Similar to inkscape particularly useful for building complex multipart figures

Image Manipulation

GIMP: Think of it as free photoshop. Steep learning curve but can do just about whatever you want

ImageJ: Similar to GIMP but with many packages for analyses of specific image types.

Photoshop: Image manipulation steep learning curve very powerful and definitely worth learning if your research includes figures of FISH results.

General Editing

Adobe acrobat: often the easiest way to tweak something small you couldn't get exactly right in your script.

Powerpoint: not elegant but often the easiest way to combine different elements into a single plot.

Bold = Free

Resources

[R graph gallery](#)

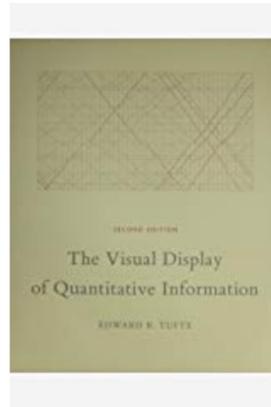
[Python graph gallery](#)

[Color Brewer](#)

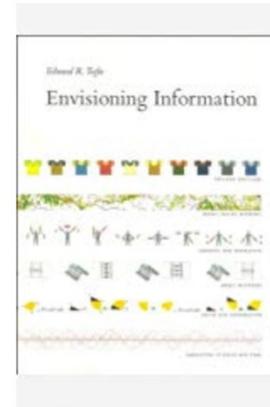
[Plotly](#)

[Data Visualization Catalog](#)

Philosophy of Data Visualization



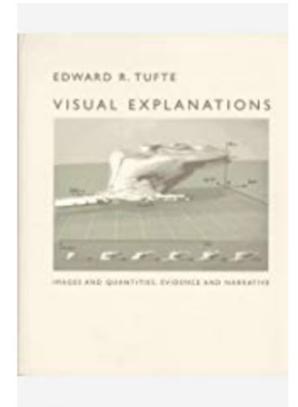
Hardcover
\$34.58



Hardcover
\$36.13



Hardcover
\$41.60



Hardcover
\$35.11

Steps in making a great figure

- 1) Figure out the purpose of the figure. Usually you will have a sentence in the paper or a point you want to make in a talk.

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CLADE	CHROM#	#SP	SCS
ORTHOPTERA	10-16		XO
BLATTARIA	7-12		XY
Phas.			Parth
9 groups	(7-50)	5-60+	3 states + missing data

Steps in making a great figure

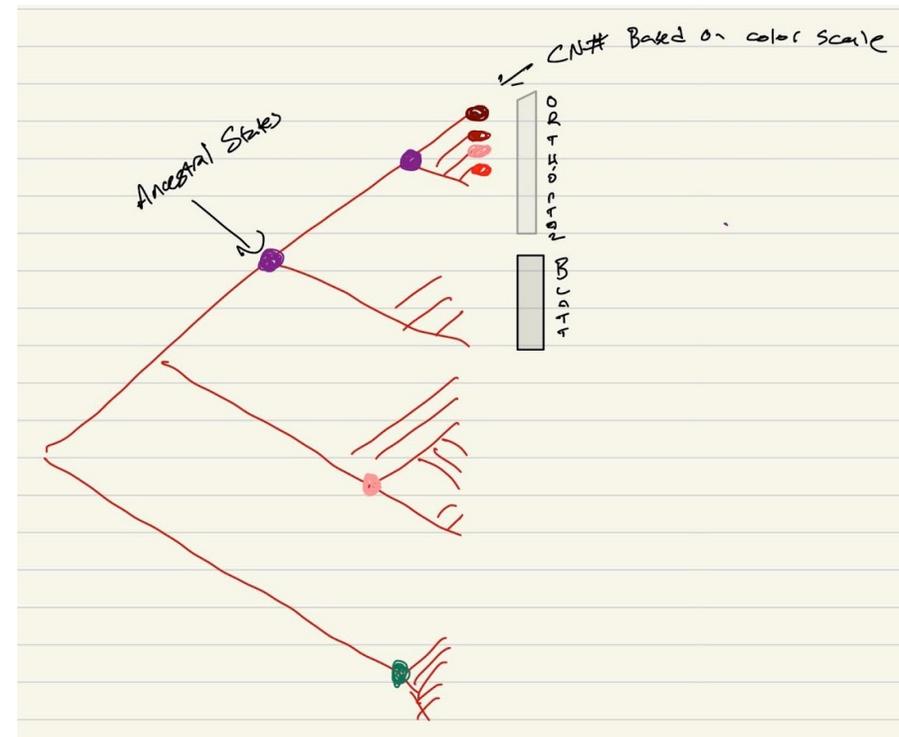
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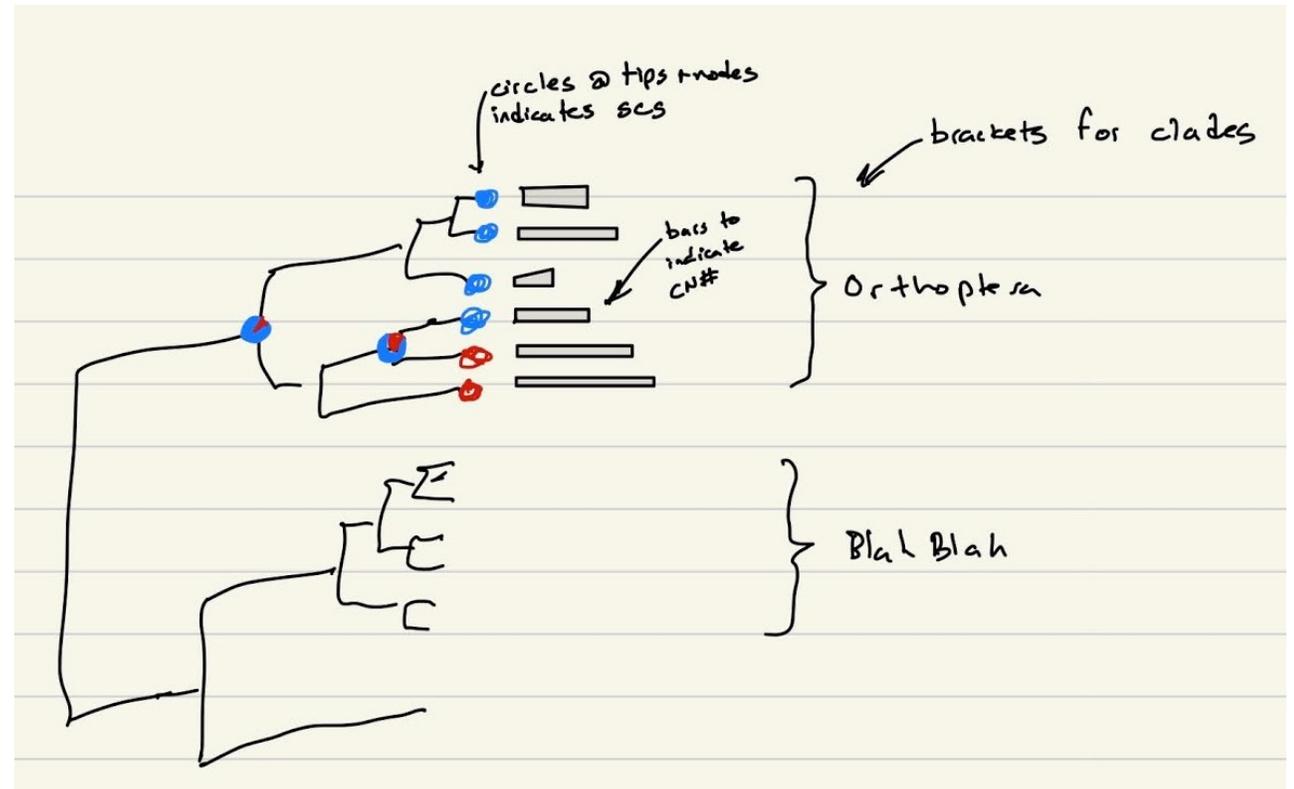
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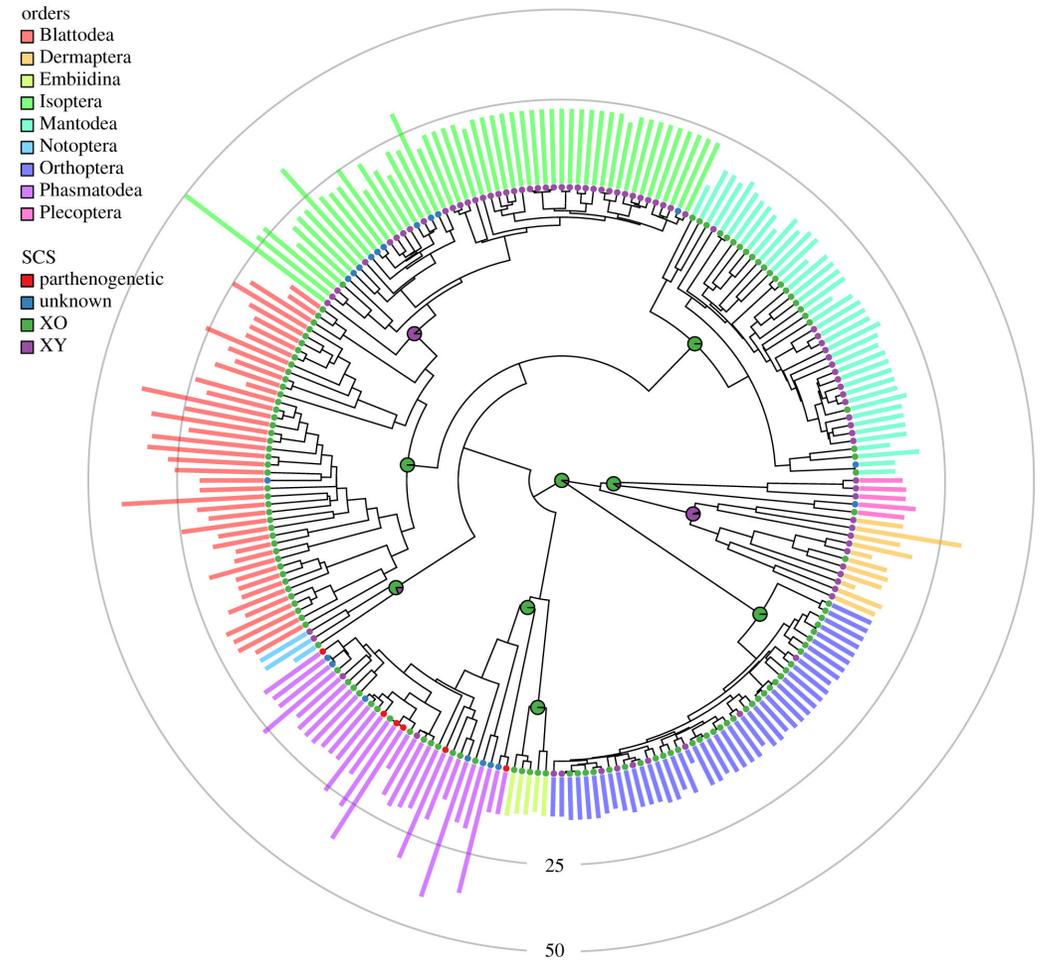
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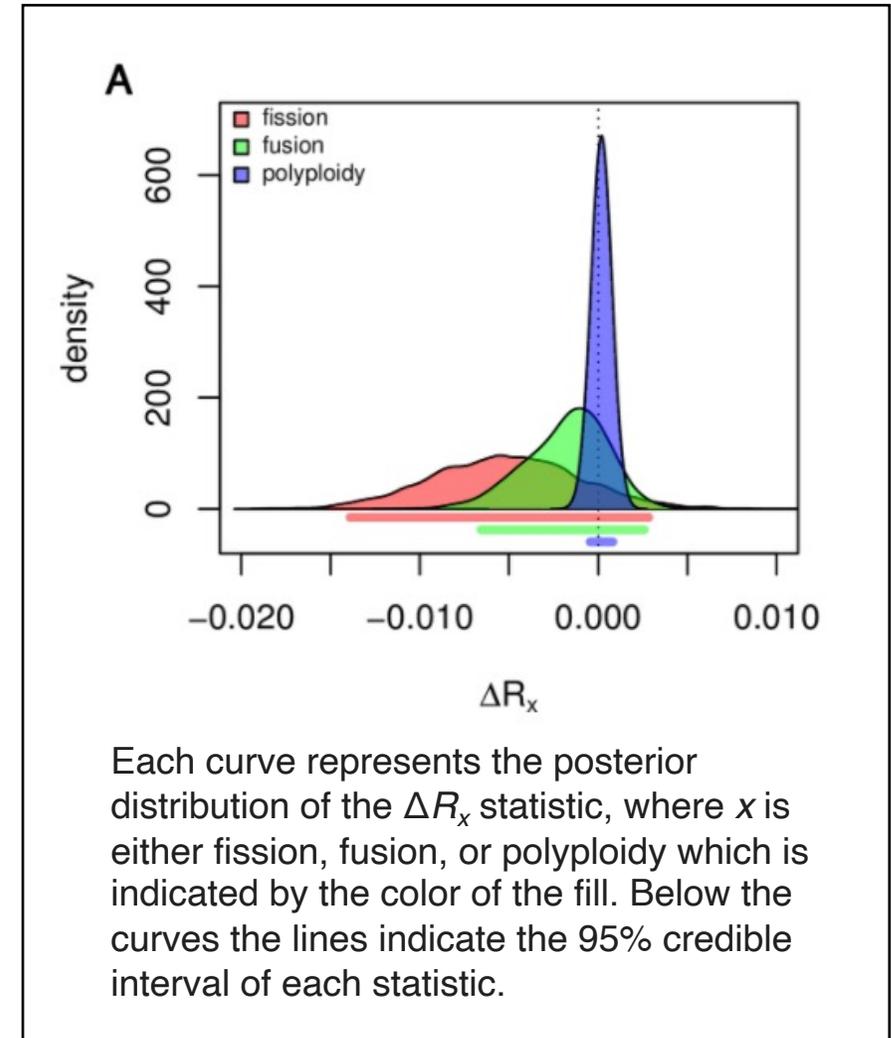
How I make a plot

1) Decide why you are making the plot. Often times you will have a sentence in your paper that demands a plot. On almost every project I've ever been involved in we have much more data than is ever included in a figure in the final paper.

The ΔR_x statistics for fusions, fissions and polyploidy had credible intervals that overlapped zero (Fig 2A).

	fission	fusion	polyploidy
1	1.924933e-02	6.691240e-03	1.194787e-02
2	8.055805e-03	-2.395435e-03	1.453424e-02
3	3.010314e-02	2.857327e-02	9.351597e-03
4	-7.035151e-03	2.745761e-02	8.345796e-03
5	5.011324e-04	-1.635201e-02	-1.280441e-02
6	2.711203e-02	-2.817951e-02	5.322630e-02
7	-4.188582e-03	2.202932e-02	-1.179885e-04
8	3.483755e-02	1.055559e-02	-1.843438e-02
9	3.550188e-02	-3.272404e-04	5.312943e-02
10	-1.145644e-02	2.068717e-03	2.317548e-02
11	1.620784e-02	1.637362e-02	1.869329e-03
12	-4.366205e-02	2.012690e-02	-2.899442e-02
13	3.398371e-03	2.127199e-03	-5.653567e-03
14	2.778317e-02	1.356907e-02	4.306500e-03
15	-6.903131e-03	5.692979e-02	3.769614e-03
16	2.218237e-02	8.972304e-05	1.469798e-02

10,000 rows



Plotting in this class

Over the course of the semester we will plot using several approaches (base, ggplot, custom packages)

Our next topic is intro to R and then we will come back to plotting once you have some tools in your toolbox.

1. Show the data
2. Avoid distorting data
3. Avoid chart junk
4. Maximize data:ink ratio maximize information
5. Make it accessible to all (5% color blind + BW prints).
6. Axes and legends that are informative and useful
7. Use vector art when possible



I will evaluate all the plots you make this semester on these criteria. Can you break these? Yes but only for really good reasons!