



# Data viz in R and beyond

TIPS AND TRICKS TO PUBLISH AND  
COMMUNICATE YOUR SCIENCE

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Solene Derville - GEMM Lab - MMI - OSU

# Briefly presenting myself...

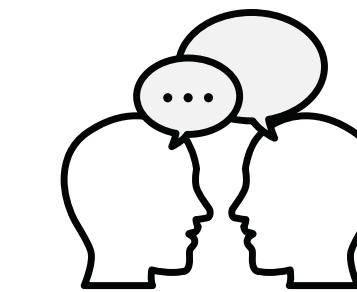
POSTDOC IN THE GEOSPATIAL ECOLOGY OF MARINE  
MEGAFauna LAB (MMI - OSU)



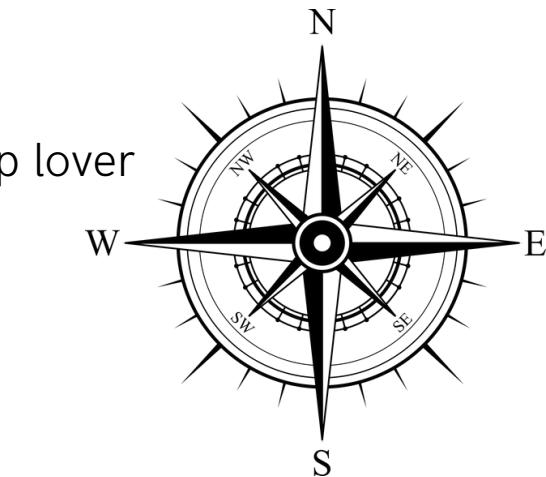
PhD in whale spatial  
ecology in Oceania



Experience in statistical  
modeling applied to marine  
ecology and animal behavior

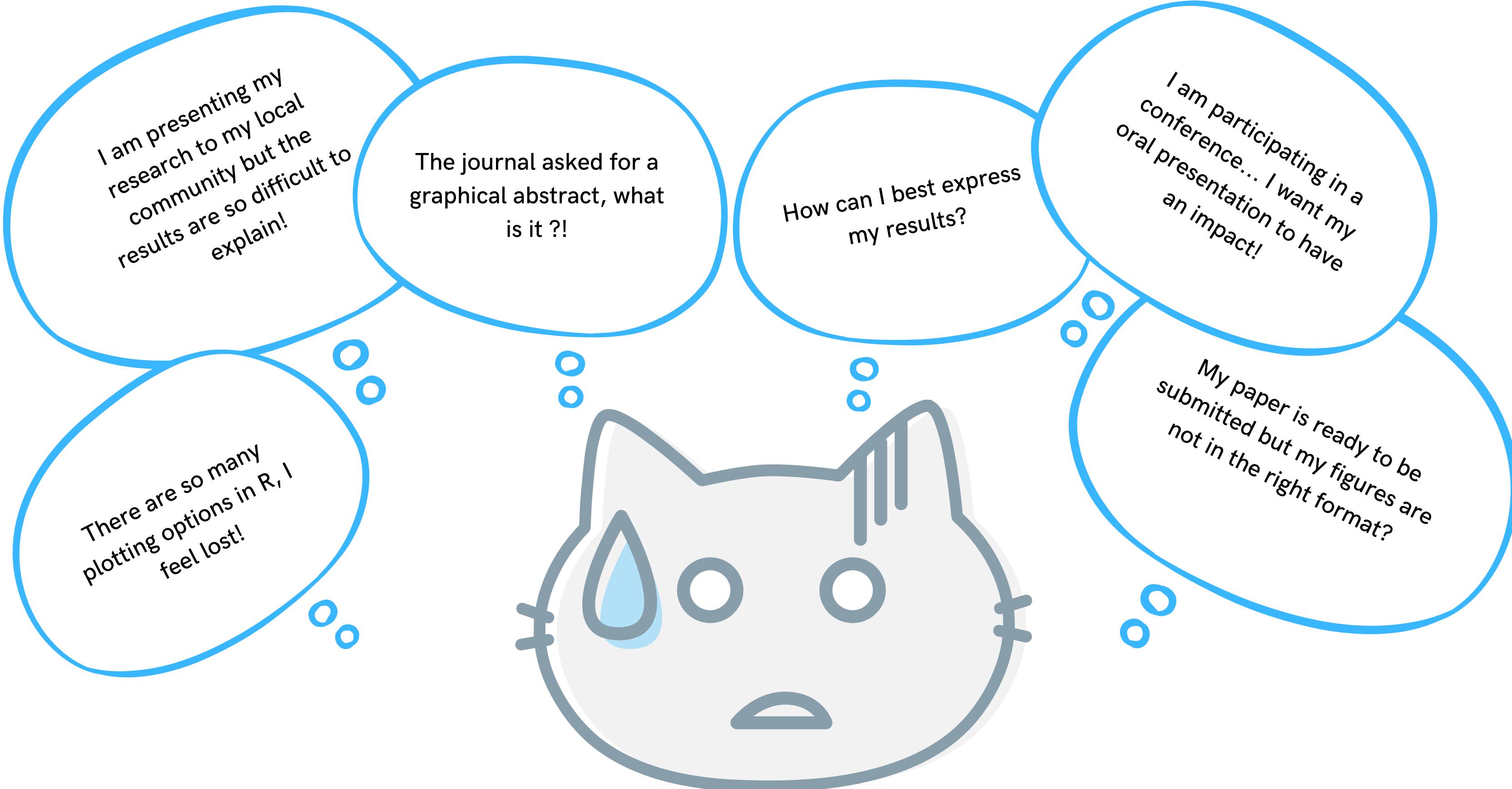


Interest for  
outreach and  
sci com



Map lover

Not an expert!



# Workshop outline

WHAT WE ARE GOING TO DO FOR TWO HOURS



## MESSAGE AND AUDIENCE

- Adapt to your audience
- Choose your weapon

## PEER-REVIEW PUBLICATIONS

- Publishing rules
- Resolution and formats

## R TIPS AND TRICKS

- ggplot2
- patchwork
- other ggplot2 extensions

## COMMUNICATION & OUTREACH

- Basic design rules
- Colors
- Fonts

## GRAPHICAL ABSTRACTS

- Graphical abstracts
- Working with canva





Message and  
Audience



# Who?

Adapting to your audience

## Publication

Scientists in your field

Scientists in other fields

General public

Kids

## Outreach

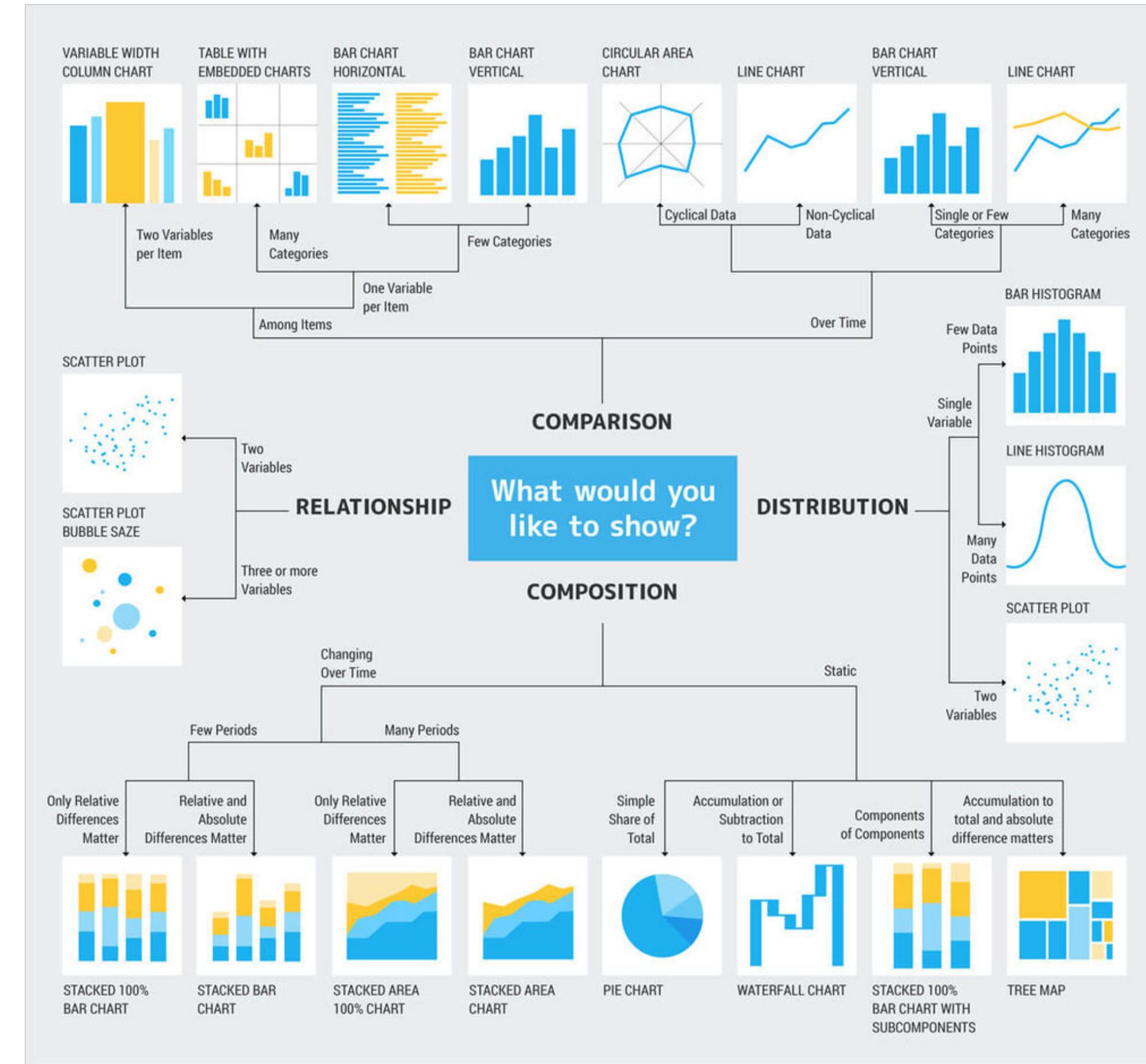


2

# What?

**"What is the underlying message and how can a figure best express this message"**

Rougier et al. 2014  
PlosOne



credit: Andrew Abela - modified by Crazyegg team

# Peer-review publications



# WHY INVEST TIME IN GOOD FIGURES?



threatening ~30% of species with extinction in recent decades. ...

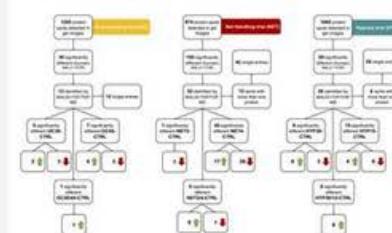
Published on 05 May 2021  
Front. Mar. Sci. doi:  
10.3389/fmars.2021.619695

154 total views Almetric 2

**Metabolic Plasticity of Gilthead Seabream Under Different Stressors: Analysis of the Stress Responsive Hepatic Proteome and Gene Expression**

Cláudia Raposo de Magalhães, Denise Schrama, Chatsirin Nakharuthai, Surintorn Boonanuntasarn, Dominique Revets, Sébastien Planchon, Annette Kuehn, Marco Cerqueira, Raquel Carrilho, Ana Paula Farinha and Pedro M. Rodrigues

Naoto F. Ishikawa, Nanako O. Ogawa, Yoshito Chikaraishi, Moto-omi Yamaguchi, Katsunori Fujikura, Yusuke Miyairi, Yusuke Yokoyama, Toshi Nagata and Naohiko Ohkouchi



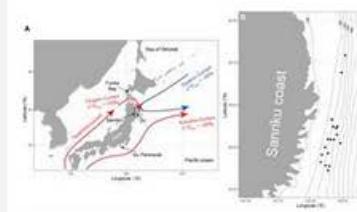
**Original Research** Hepatic metabolic adjustments are key adaptive



Accepted on 05 May 2021  
Front. Mar. Sci. doi:  
10.3389/fmars.2021.665716

**Influences of Ocean Currents on the Diets of Demersal Fish Communities in the Western North Pacific Revealed by Their Muscle Carbon and Nitrogen Isotopic Compositions**

Naoto F. Ishikawa, Nanako O. Ogawa, Yoshito Chikaraishi, Moto-omi Yamaguchi, Katsunori Fujikura, Yusuke Miyairi, Yusuke Yokoyama, Toshi Nagata and Naohiko Ohkouchi



**Original Research** To study the influence of different ocean currents on the trophic spectra found in a sympatric fish community, we analyzed the radiocarbon contents ( $\Delta^{14}\text{C}$ ) and stable carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) isotopic compositions



## 2- Peer-review publications

Nature 15.4K Tweets Follow

**Nature** @nature · 11h Sea level rise from the Antarctic Ice Sheet will rapidly accelerate around 2060 if global warming reaches 3 °C, which is the warming trajectory consistent with current fossil fuel emissions, according to a study published in Nature. [go.nature.com/3tnZ9uy](https://go.nature.com/3tnZ9uy)

**A Novel Method for Using Small Unoccupied Aerial Vehicles to Survey Wildlife Species and Model Their Density Distribution**

Christophe Cleguer, Natalie Kelly, Julian Tyne, Martin Wieser, David Peel and Amanda Hodgson

**Influences of Ocean Currents on the Diets of Demersal Fish Communities in the Western North Pacific Revealed by Their Muscle Carbon and Nitrogen Isotopic Compositions**

Naoto F. Ishikawa, Nanako O. Ogawa, Yoshito Chikaraishi, Moto-omi Yamaguchi, Katsunori Fujikura, Yusuke Miyairi, Yusuke Yokoyama, Toshi Nagata and Naohiko Ohkouchi

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Nature Search Twitter

**nature** nature nature nature

**You might like**

- Science News Follow
- Nature Medicine Follow
- Nature News & C... Follow

**Trends for you**

J. Biogeography 1,462 Tweets

**Journal of Biogeography**

**J. Biogeography** @JBiogeography

Journal of Biogeography. Sharing research to grow understanding & societal relevance of spatial, ecological & historical biogeography; global in scope.

**Frontiers of Biogeog...** @newbiogeo Follow

Miguel Araujo @Araujo\_lab Follow

**Trends for you**

**Frontiers of Biogeog...** @newbiogeo Follow

Miguel Araujo @Araujo\_lab Follow

**Trends for you**

**J. Biogeography** @JBiogeography · May 3 Is the difference in species richness between two similar Mediterranean-type biodiversity hotspots explained by differences in environmental heterogeneity? A study comparing the Greater Cape in South Africa and the Australia Southwest @rvanmazijk

[onlinelibrary.wiley.com/share/author/W...](https://onlinelibrary.wiley.com/share/author/W...)

(a) QDS ( $R^2 = 0.13$ ) (b) HDS ( $R^2 = 0.22$ ) (c) DS ( $R^2 = 0.49$ )

**Tweets** **Tweets & replies** **Media** **Likes**

Sports - Trending Ramos 133K Tweets

Trending in France #feminicide 8,499 Tweets

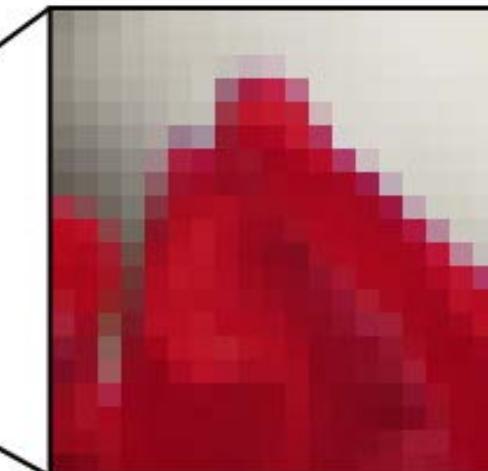
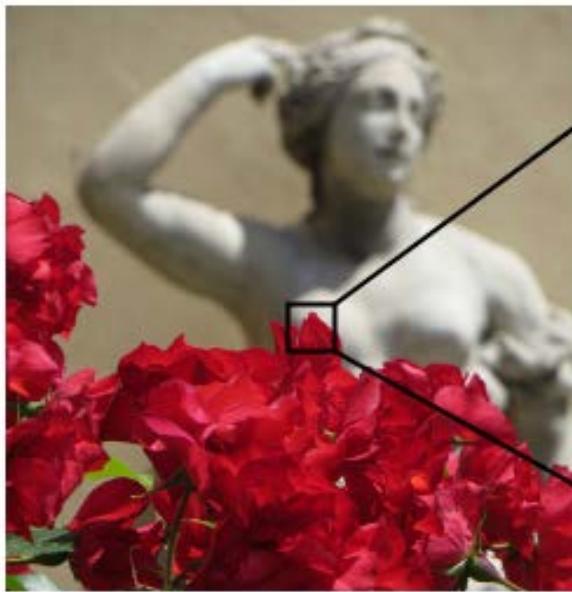
Sports - Trending #ChampionsLeague 44.6K Tweets

Trending in France #Avignon 31.6K Tweets

Trending in France Archie

# 1

## Get the right format from the start



### IMAGES

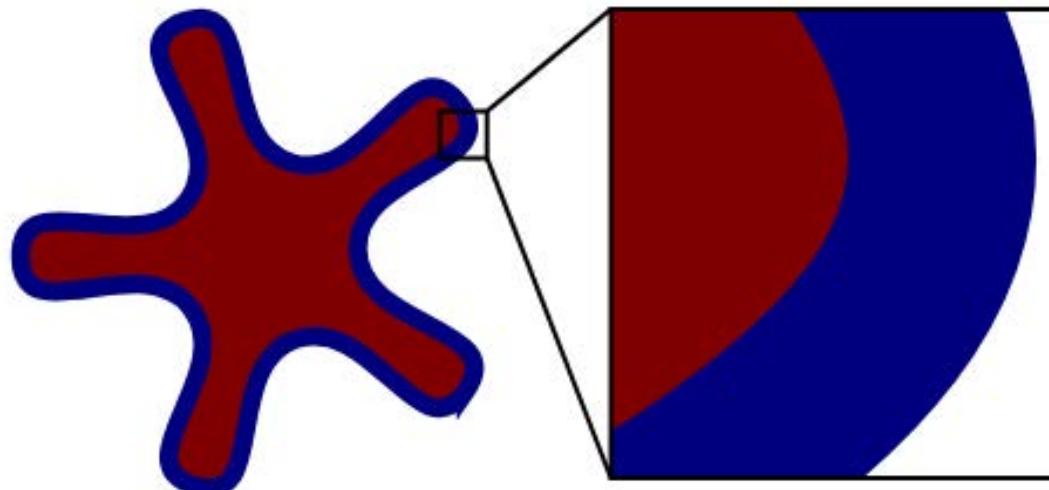
Preferred format: TIFF (high quality and is lossless)

Resolution: 300 dpi



DPI = Dots Per Inches

Pixels = DPI (resolution) x Print size (in inches)



### LINE ART

Preferred format: EPS, PDF or TIFF

Resolution: 600 dpi to 1000 dpi if in TIFF

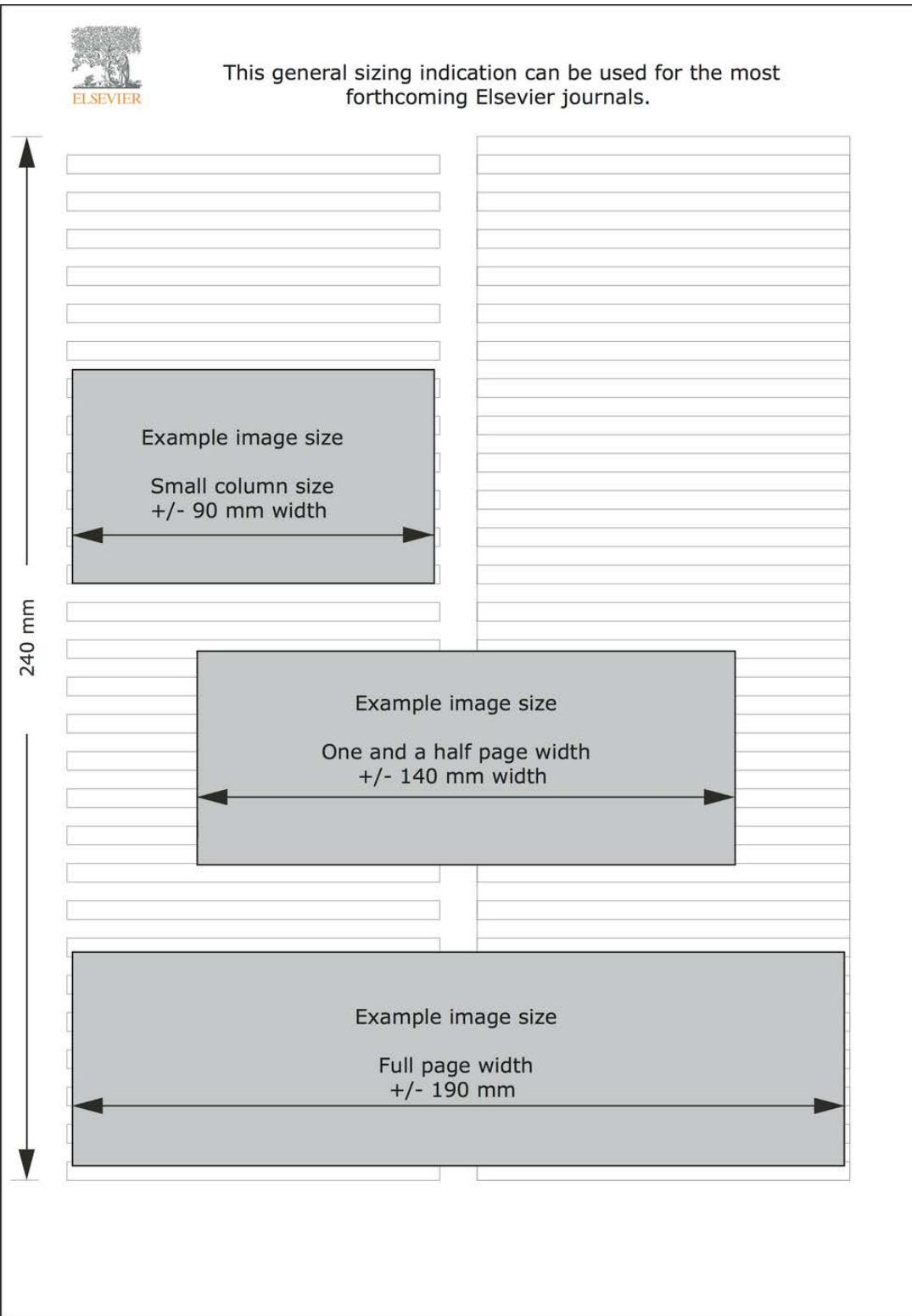
<https://b.nanes.org/figures/>

Based on Elsevier and Wiley author guidelines

# 1

## Get the right format from the start

Half page width or full page width



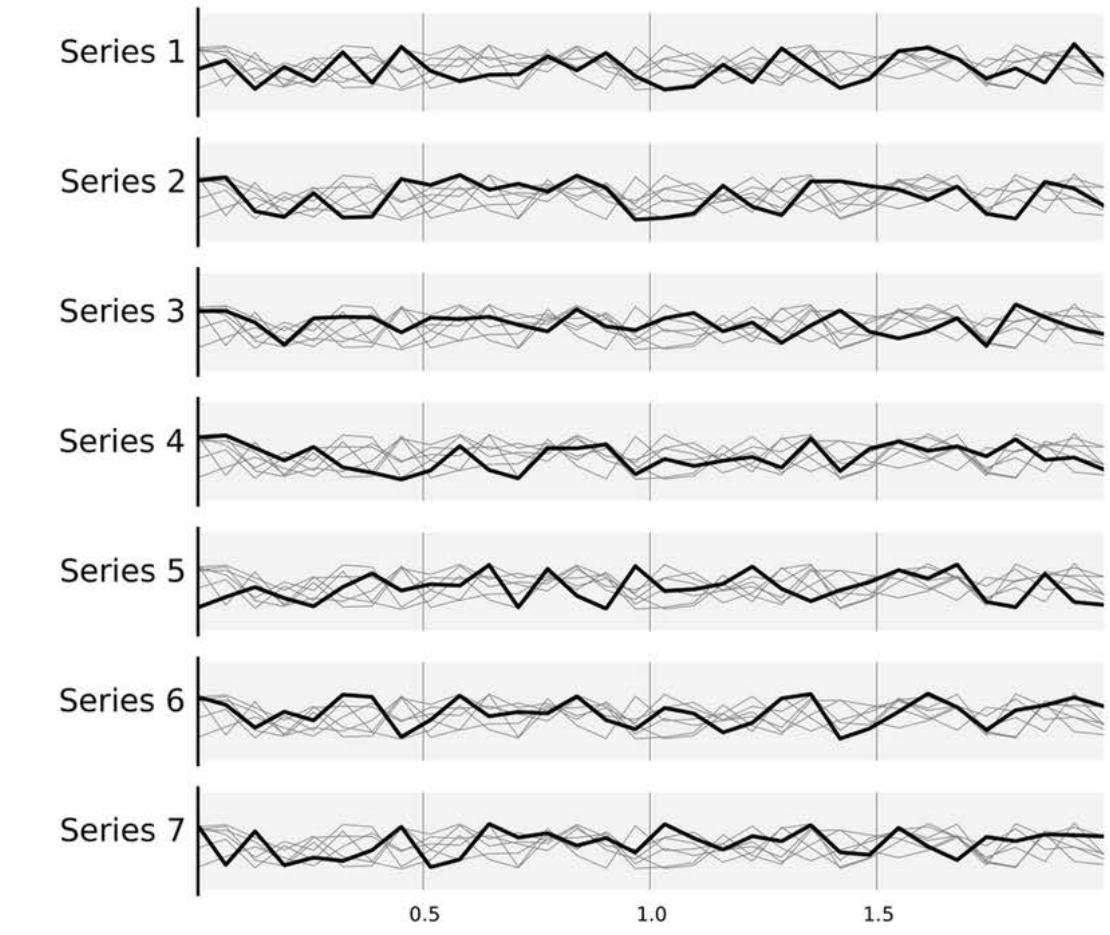
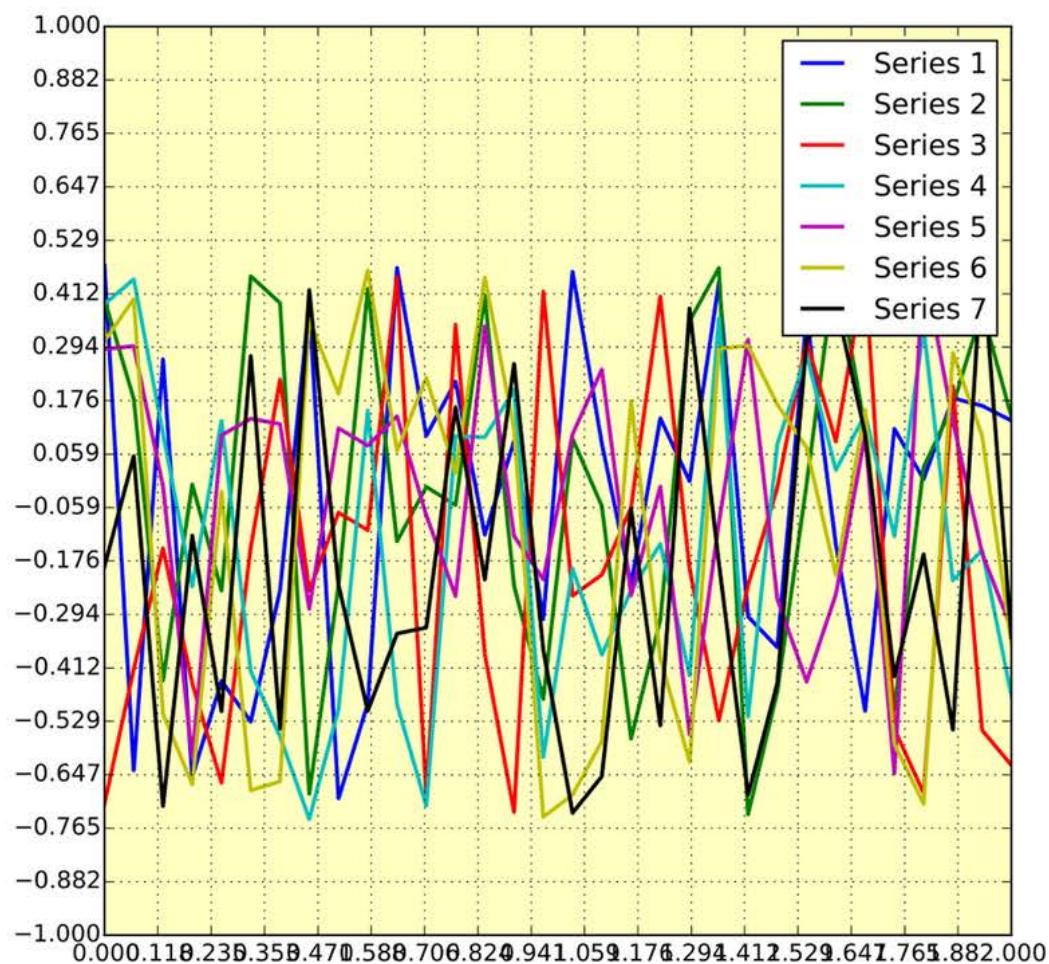
# 2

## Make it fit

- Limited number of figures
- Illustrate major results avoiding redundancy
- Avoid "chartjunk"

**"Above all else  
show the data"**

Tufte, 1983



Rougier et al. 2014 PlosOne

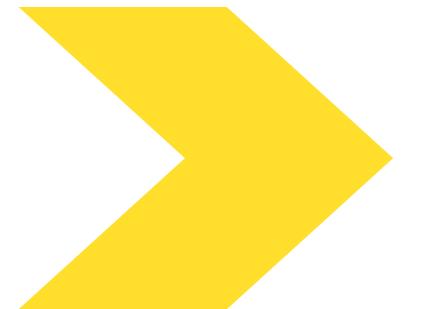
DATA-INK RATIO CONCEPT



# 3

## Make it reproducible

Through the publication and revision process, be ready to reproduce your figures a thousand times



IF YOU CAN CODE IT,  
CODE IT

```
3 require File.expand_path('../config/environment', __FILE__)
4 # Prevent database truncation if the database needs
5 # abort("The Rails environment is running in production mode")
6 require 'spec_helper'
7 require 'rspec/rails'

8 require 'capybara/rspec'
9 require 'capybara/rails'

10 Capybara.javascript_driver = :webkit
11 Category.delete_all; Category.create!
12 Shoulda::Matchers.configure do |config|
13   config.integrate do |with|
14     with.test_framework :rspec
15     with.library :rails
16   end
17 end
18
19 # Add additional requires below this line if needed
20
21 # Requires supporting ruby files with custom matchers and
22 # helpers with special methods under spec/support/
# run as spec files by default. You can change this
# in _spec.rb
23 # in _spec.rb will both be required and run
24 # run twice. It is recommended that you do not
25 # end with _spec.rb. You can configure this
26 # using also the --require option on the command line.
27 # No results found for 'mongoid'
28
# mongoid
# huffer
```



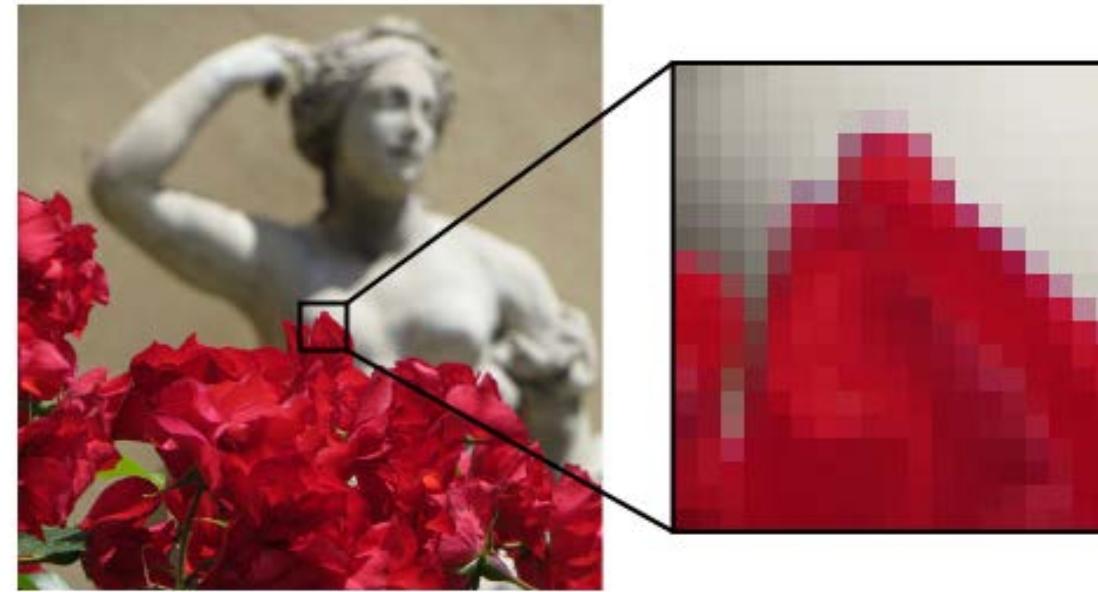
# OPEN-SOURCE TOOLS FOR FIGURES EDITING



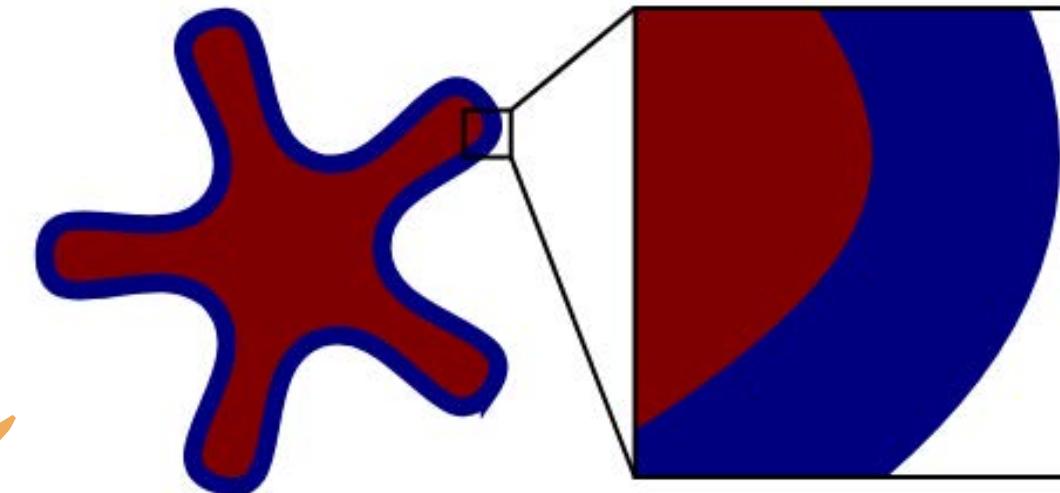
**INKSCAPE**

Vector images

e.g., pdf, eps, svg



<https://b.nanes.org/figures/>



**GIMP**

Raster images

e.g., jpeg, tiff, png  
(transparent  
background)

A wide-angle photograph of a mountainous landscape. In the foreground, dark evergreen trees are silhouetted against a bright sky. To the left, a large, gnarled tree branch extends across the frame. The middle ground features a deep blue lake with a small, densely forested island in the center. The background is dominated by a range of mountains, their peaks partially covered in snow and ice, under a sky filled with soft, scattered clouds.

# R tips and tricks

# ggplot2



**"All packages share an underlying design philosophy, grammar, and data structures"**

Data visualization package created by Hadley Wickham in 2005  
based on Leland Wilkinson's "Grammar of graphics"

Today one of the most downloaded package in R

Breaks up graphs into semantic components  
(scales, layers, themes etc.)

Part of the Tidyverse package collection

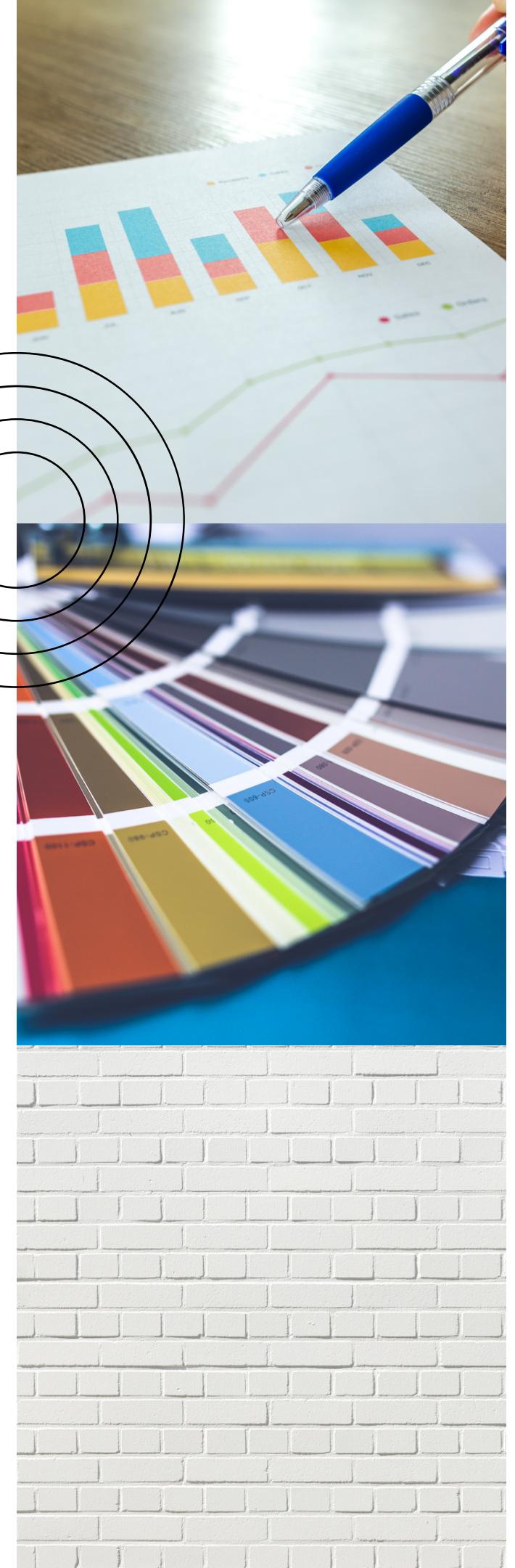
# Walking through the main features

All the syntax in:

<https://ggplot2.tidyverse.org/reference/index.html>

extensions:

<https://exts.ggplot2.tidyverse.org/gallery/>



L A Y E R S

`geom_...()`

S C A L E S

`scale_...()`

T H E M E S

`theme_...()`

R TIP: Personalized  
theme

```
my_theme <-  
  theme(...)  
or theme_set()
```

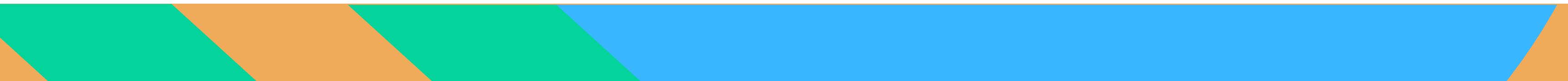
# A plot is made of layers



THE FUNDAMENTALS OF GG PLOTS



`ggplot(ToothGrowth, aes(x = dose, y = len)) +`



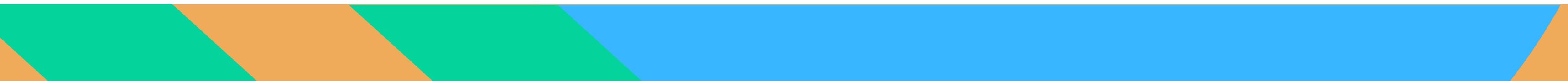
# A plot is made of layers



THE FUNDAMENTALS OF GG PLOTS



```
ggplot(ToothGrowth, aes(x = dose, y = len)) +  
  geom_boxplot(aes(color = dose)) +
```



# A plot is made of layers



THE FUNDAMENTALS OF GG PLOTS



```
my3cols <- c("#E7B800", "#2E9FDF", "#FC4E07")  
  
ggplot(ToothGrowth, aes(x = dose, y = len)) +  
  geom_boxplot(aes(color = dose)) +  
  scale_color_manual(values = my3cols) +
```

# A plot is made of layers

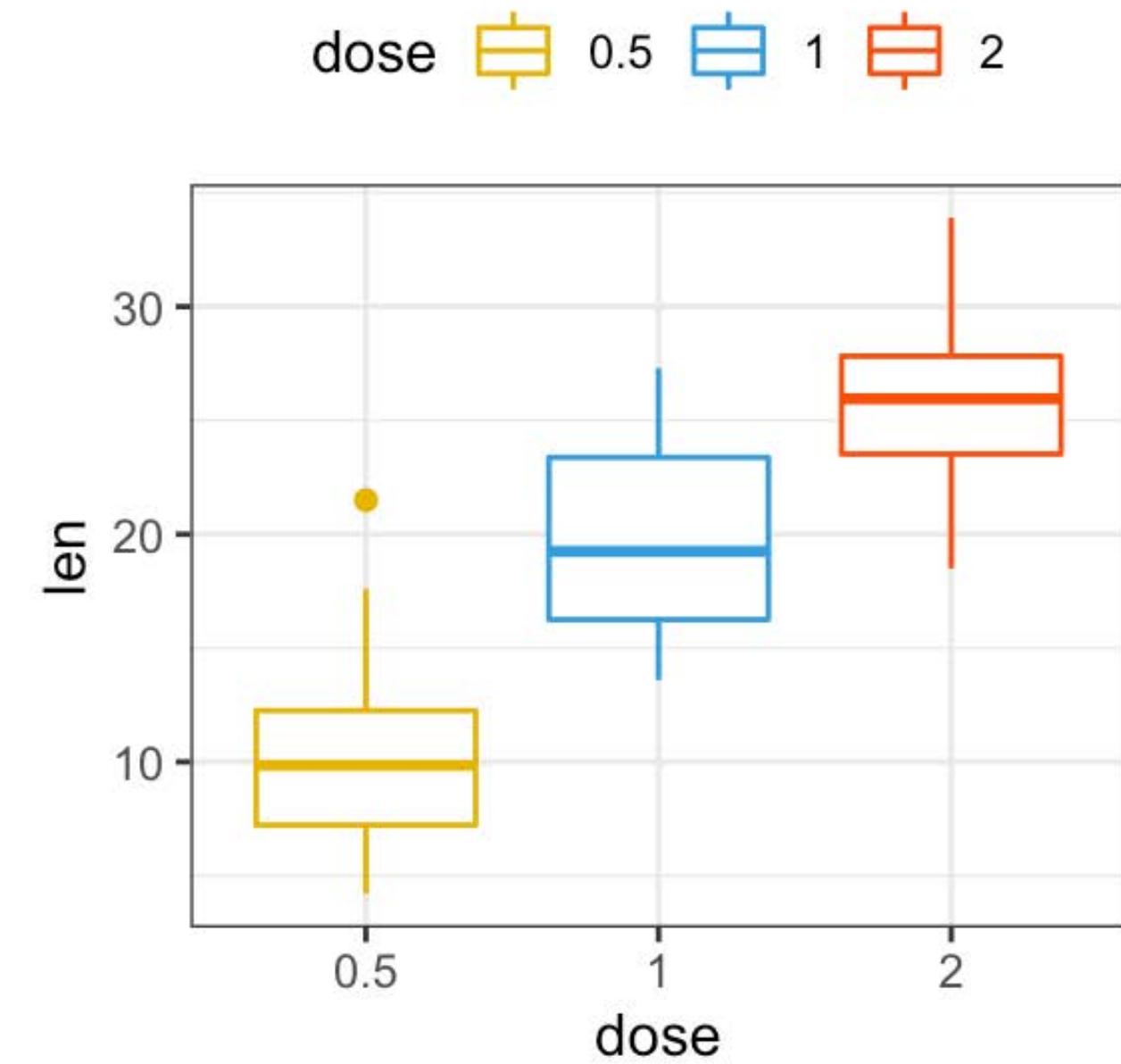


THE FUNDAMENTALS OF GG PLOTS

- Indicate dataset and variables with aes()
- Chart layers with geom\_ or stat\_
- Color and axis scales with scale\_
- Overall theme



```
my3cols <- c("#E7B800", "#2E9FDF", "#FC4E07")  
  
ggplot(ToothGrowth, aes(x = dose, y = len)) +  
  geom_boxplot(aes(color = dose)) +  
  scale_color_manual(values = my3cols) +  
  theme_bw() +  
  theme(legend.position = "top")
```



# Combining plots



## PATCHWORK PACKAGE

- Simple syntax with operators `+, -, | & //`

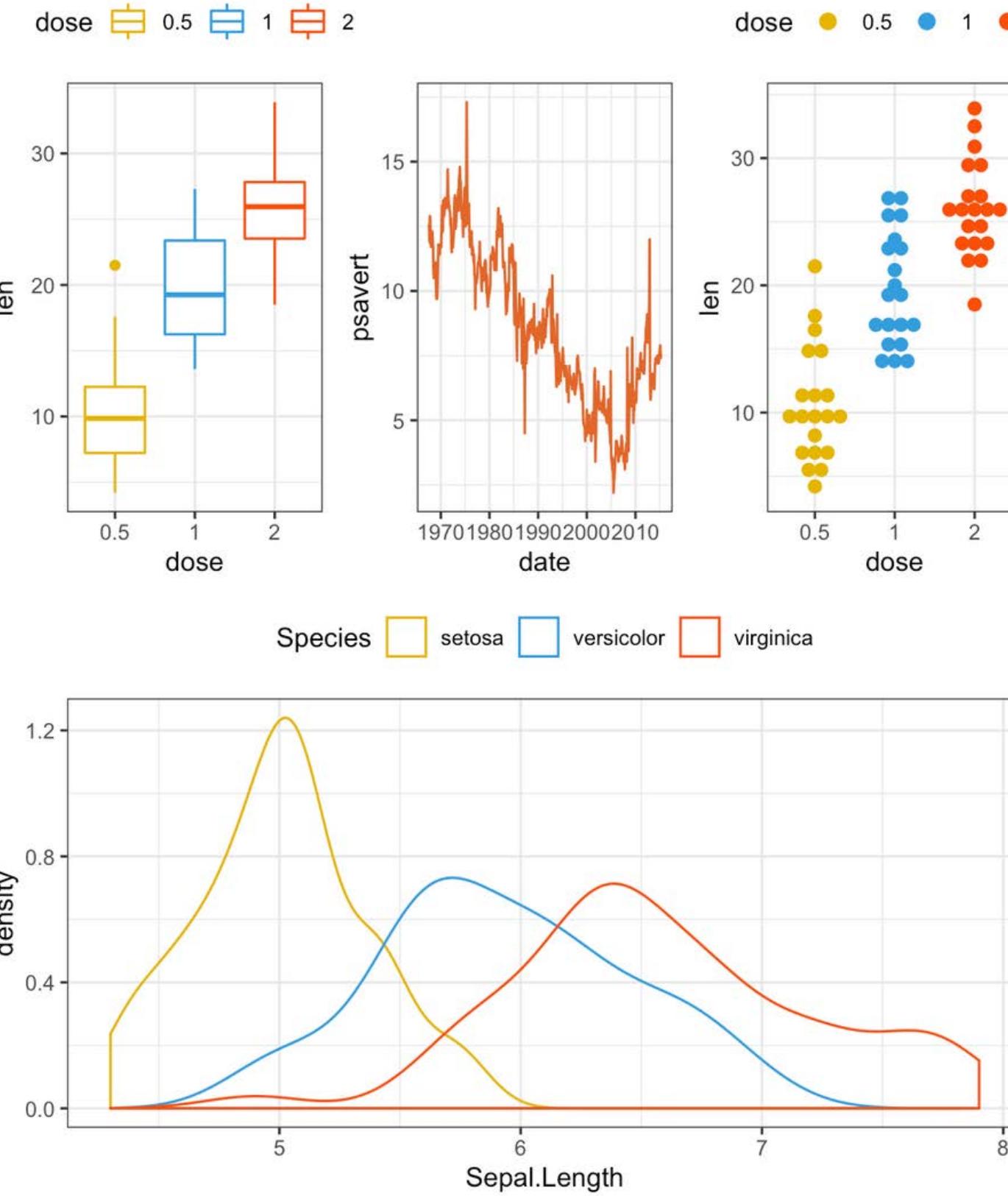
`(a|b|c)/d`

- Complex layouts with full alignments

- Adding annotations, grouping legends etc.

`((a|b|c)/d)&`

```
plot_annotation(title = ..., tag_levels = "A") &
plot_layout(guides = "collect") &
my_theme
```



source: datanovia.com - Alboukadel 2021

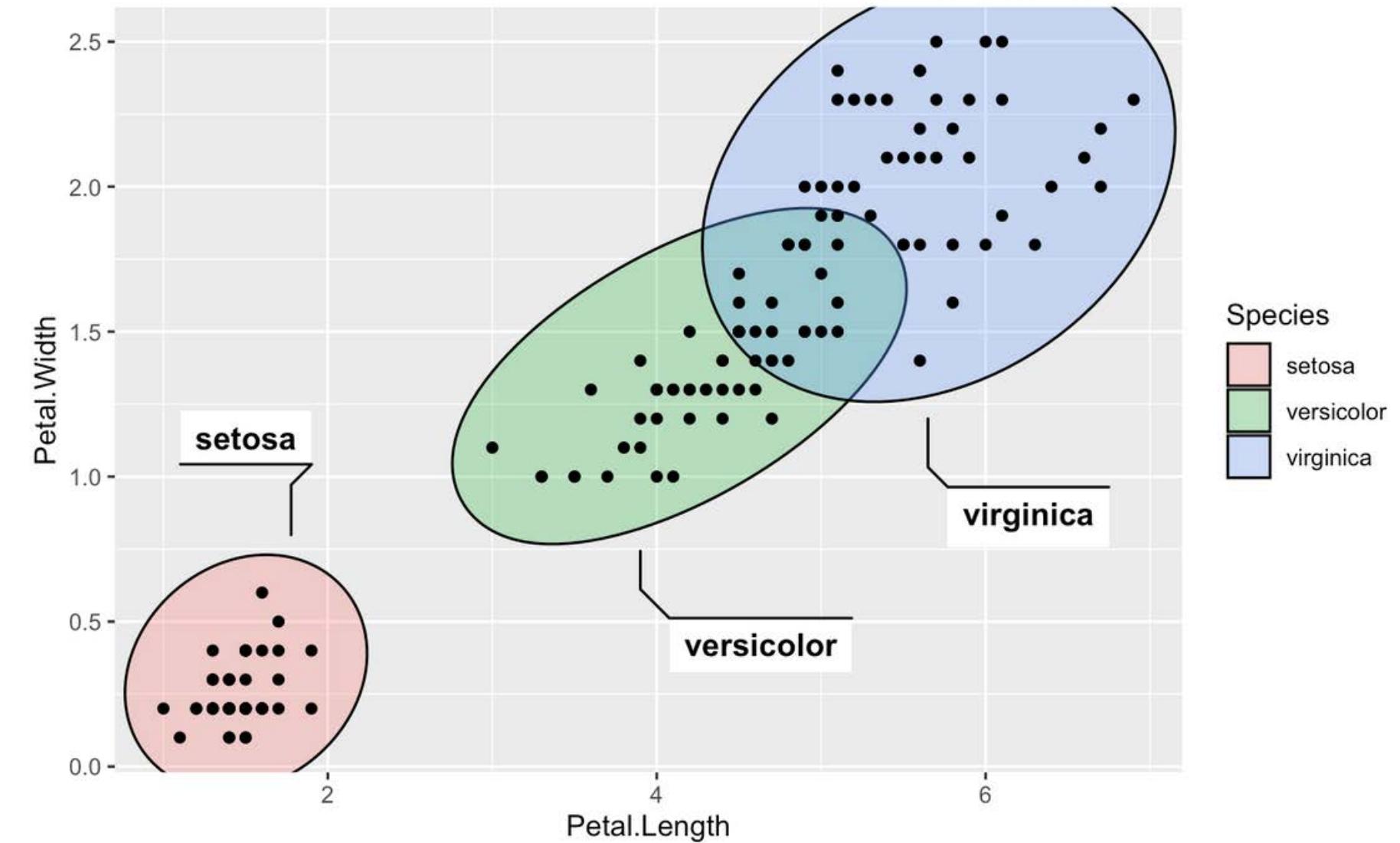
# Annotations



GGFORCE & GGREPEL PACKAGES

- Add and label ellipses with ggforce

```
ggplot(iris, aes(Petal.Length, Petal.Width)) +  
  geom_mark_ellipse(aes(fill = Species, label = Species)) +  
  geom_point()
```



[https://ggforce.data-imaginist.com/reference/geom\\_mark\\_ellipse.html](https://ggforce.data-imaginist.com/reference/geom_mark_ellipse.html)

# Annotations



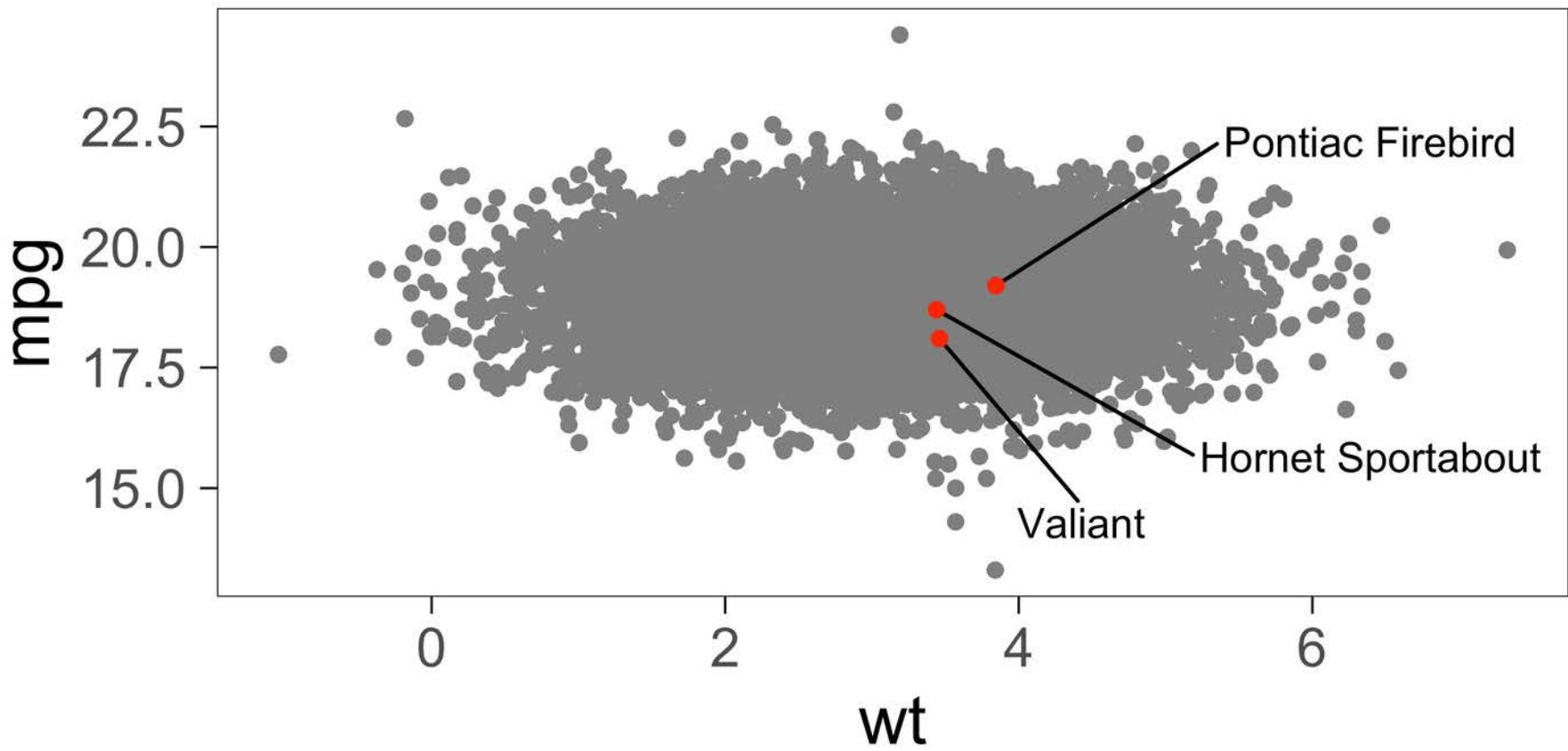
GGFORCE & GGREPEL PACKAGES

- Add and label ellipses with ggforce

```
ggplot(iris, aes(Petal.Length, Petal.Width)) +  
  geom_mark_ellipse(aes(fill = Species, label = Species)) +  
  geom_point()
```

- label elements in plot with ggrepel (better than ggtext!)

```
ggplot(dat3, aes(wt, mpg, label = car)) +  
  geom_point(data = dat3[dat3$car == "",], color = "grey50") +  
  geom_text_repel(box.padding = 0.5, max.overlaps = Inf) +  
  geom_point(data = dat3[dat3$car != "",], color = "red")
```



<https://ggrepel.slowkow.com/articles/examples.html>

# Colors

GGTHEMES & VIRIDIS PACKAGES



## 04. Crisp & Dramatic

#505160 Thunder Cloud  
#68829E Waterfall  
#AEBD38 Moss  
#598234 Meadow

Use this template

**100 color combination ideas and examples**  
Examples of 100 color combinations, how to apply them and a color wheel to show you what colors go well together.

Learn / Aug 16, 2021

# Colors

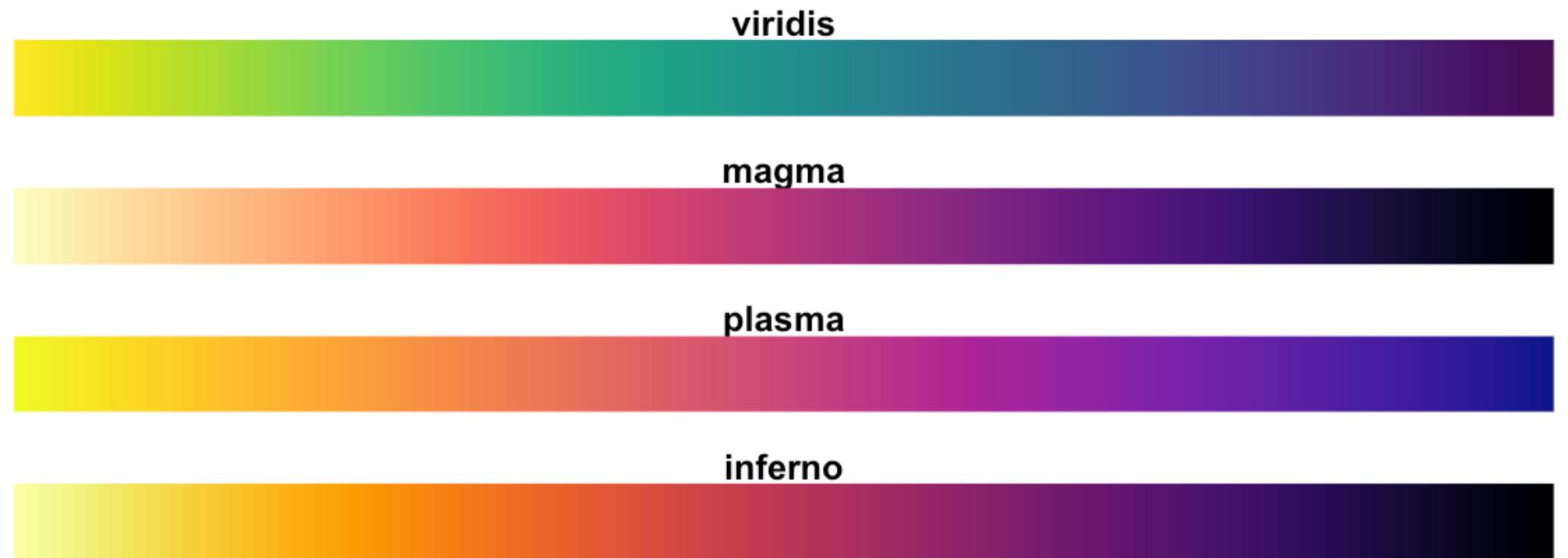


GGTHEMES & VIRIDIS PACKAGES

- Copy other software styles and color schemes with ggthemes

`scale_color_canva(palette = "Crisp and dramatic")`

- Use a popular, color-blind friendly palette: viridis



# Colors



## GGTHEMES & VIRIDIS PACKAGES

- Copy other software styles and color schemes with ggthemes

`scale_color_canva(palette = "Crisp and dramatic")`

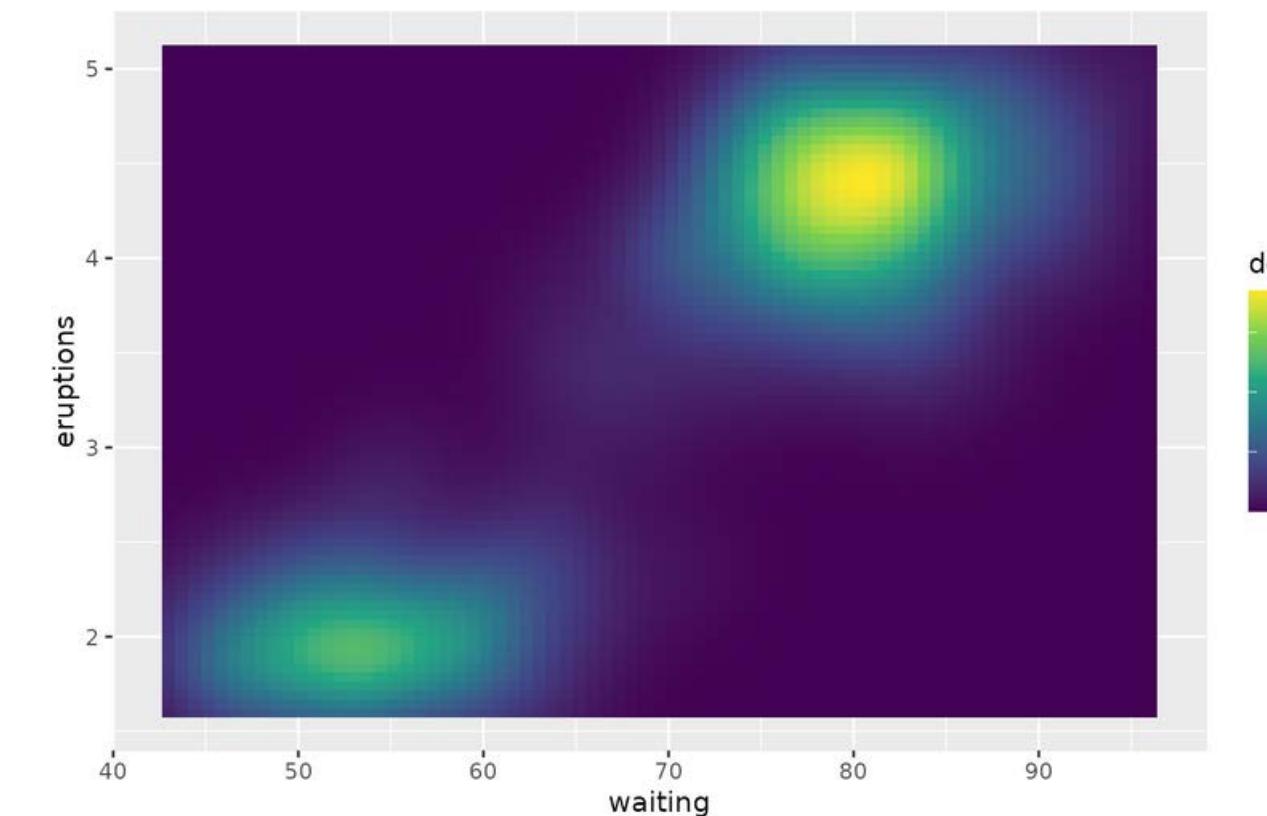
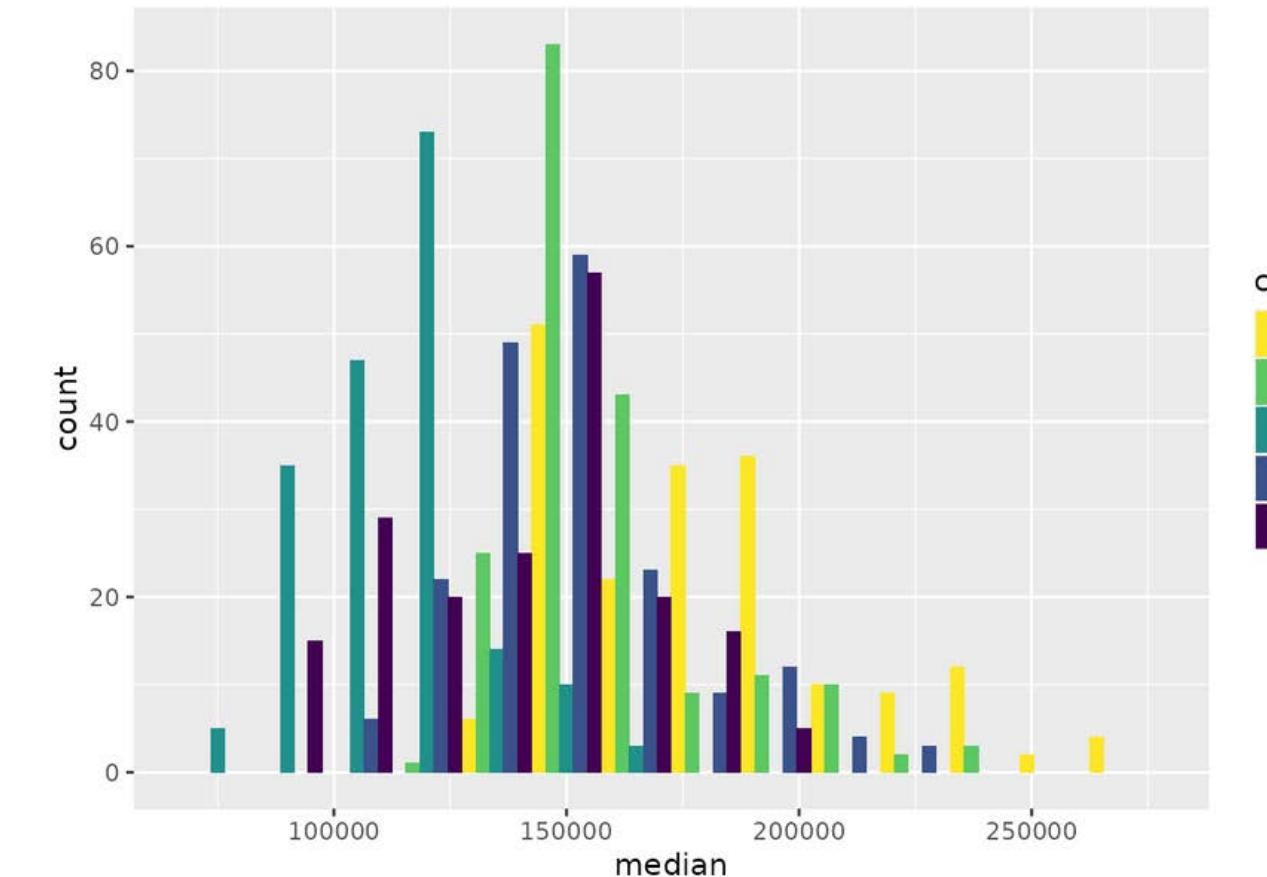
- Use a popular, color-blind friendly palette: viridis

`ggplot(...) + scale_fill_viridis_d()`

pay attention to "fill" vs "color" and "d" vs "c"

`ggplot(...) + scale_fill_viridis_c()`

[https://ggplot2.tidyverse.org/reference/scale\\_viridis.html](https://ggplot2.tidyverse.org/reference/scale_viridis.html)



# Stats



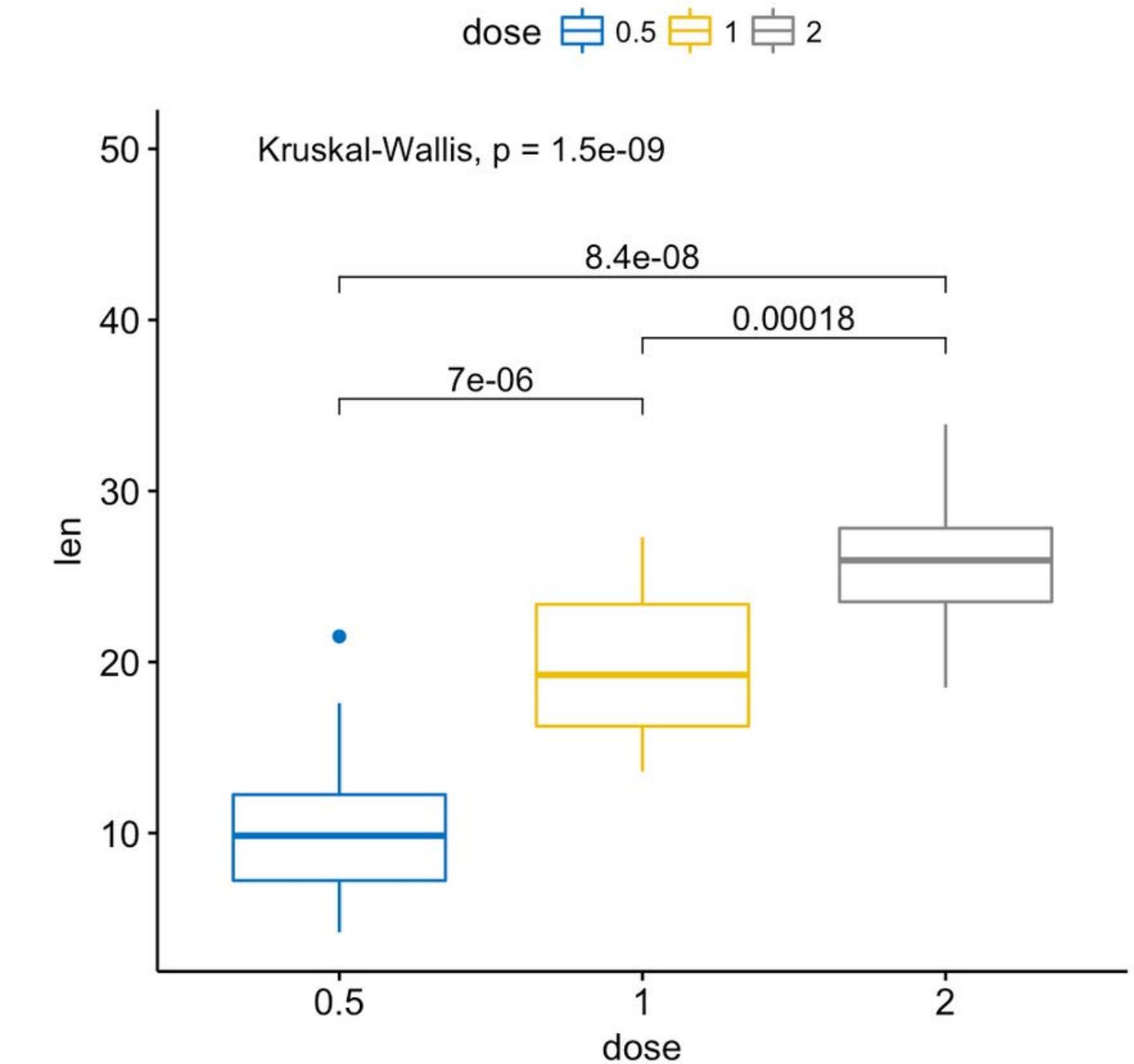
## GGPUBR PACKAGE

- Simplify ggplot() codes...
- Add statistics to your plots

Example for adding p-value of comparison test (global and pairwise)

```
# Specify the comparisons you want
my_comparisons <- list( c("0.5", "1"), c("1", "2"), c("0.5", "2") )

# Make boxplot
ggboxplot(ToothGrowth, x = "dose", y = "len",
          color = "dose", palette = "jco") +
  stat_compare_means(comparisons = my_comparisons) + # pairwise
  stat_compare_means(label.y = 50) # global p-value
```



# Saving plots



## THE FUNDAMENTALS OF GGPLOTS

- Save to different formats, dimensions etc.
- Possible to make png with transparent background for future exportation in canvas or else

```
ggsave(g, file = "my_amazing_figure.png", width = 88, height = 88,  
dpi = 300, units = "mm", bg = "transparent")
```

```
ggsave(g, file = "my_amazing_figure.tiff", width = 88, height = 88,  
dpi = 1000, units = "mm")
```

R TIP:

`ggsave()`

tiff, png, pdf etc.

# What makes a good map

Insert a key map

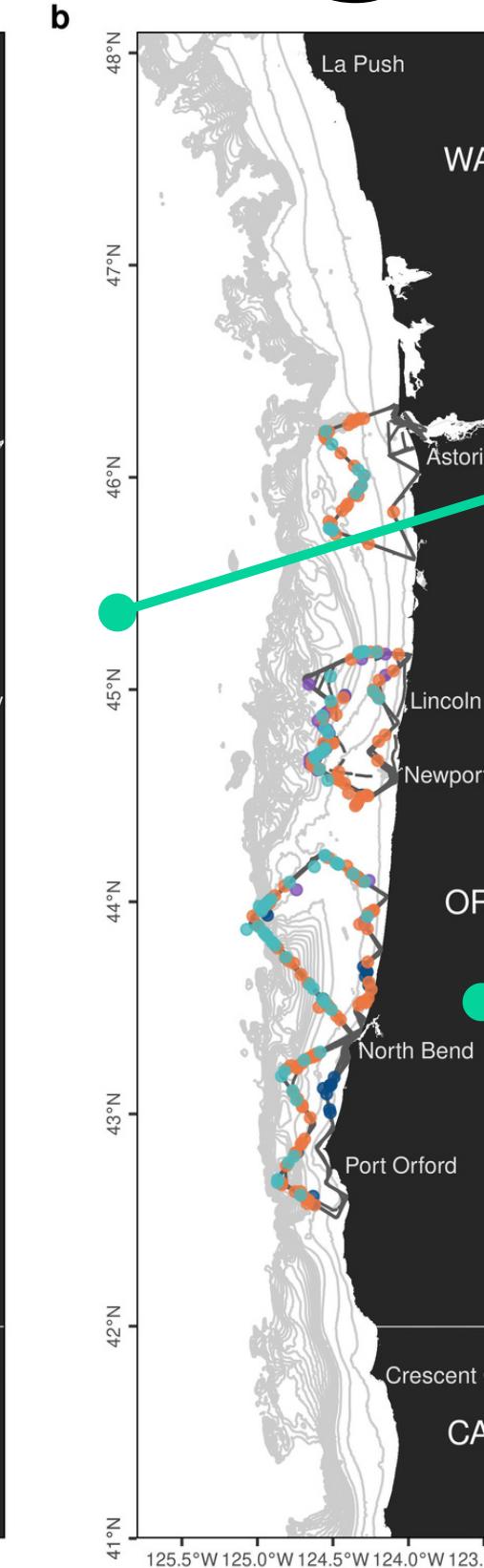
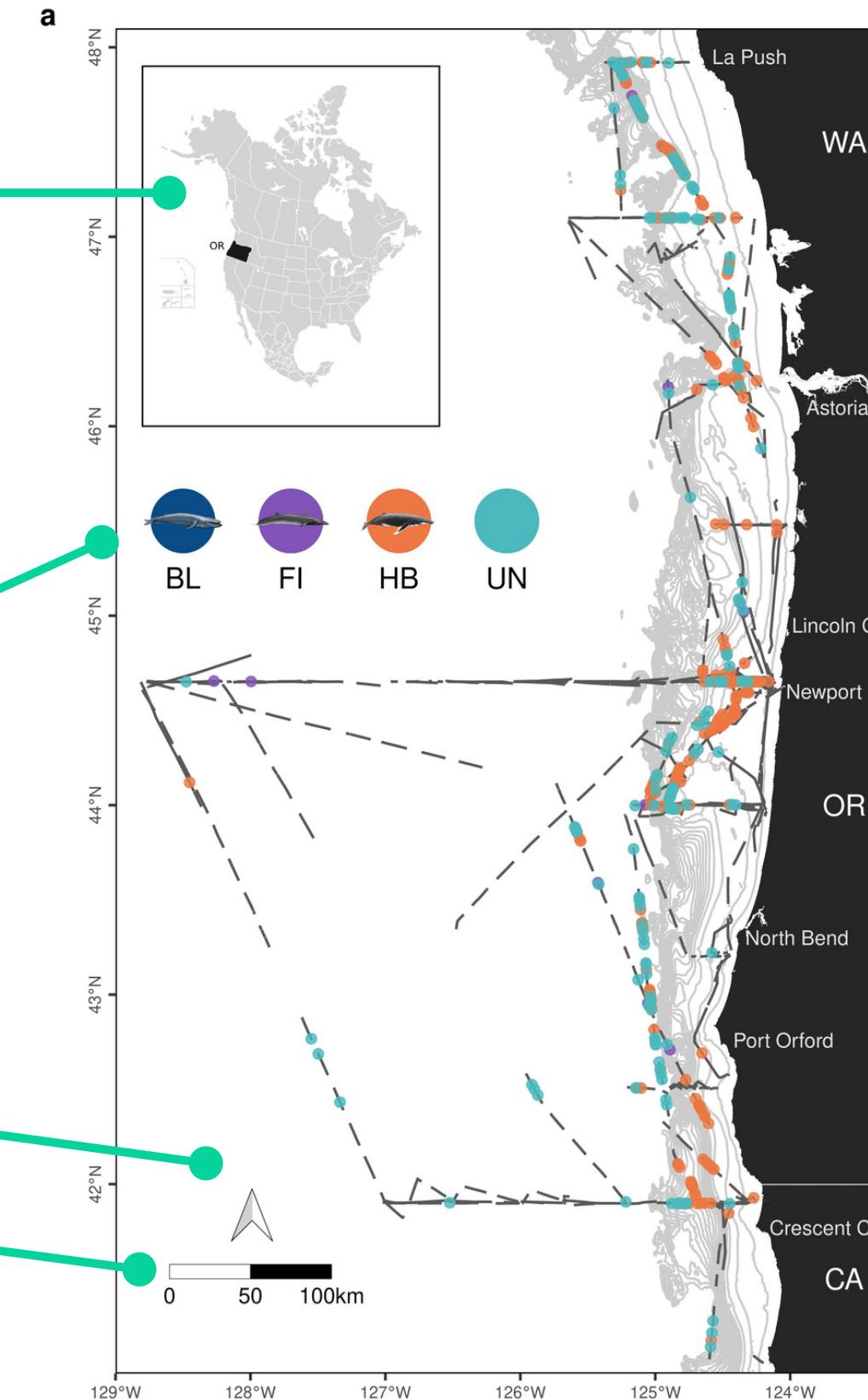
```
annotation_custom(  
  rasterGrob(...))
```

Select Colors that Reflect a  
Theme and Purpose

North arrow `ggsn::north()`

Scale bar `ggsn::scalebar()`

3- R tips and tricks



Graticules in lat/lon (but  
appropriate projection)

```
ggsf::geom_sf(), coord_sf()
```

Carefully add labels and  
annotations

```
geom_label(), geom_text(),  
ggsflabel::
```

+ Describe abstract symbols  
in legend or caption (all of  
them! all!)

+ Date of production, data  
source and author

# **Communication and outreach**

A wide-angle photograph of a coastal landscape. In the foreground, there's a field of tall, golden-brown grass. To the right, a large, gnarled tree stands prominently. The middle ground features a sandy beach where several people are walking or sitting. Large, dark rock formations rise from the ocean, with one particularly large one on the right. In the background, a range of mountains covered in green forests stretches across the horizon under a sky filled with soft, white and grey clouds.

# 1

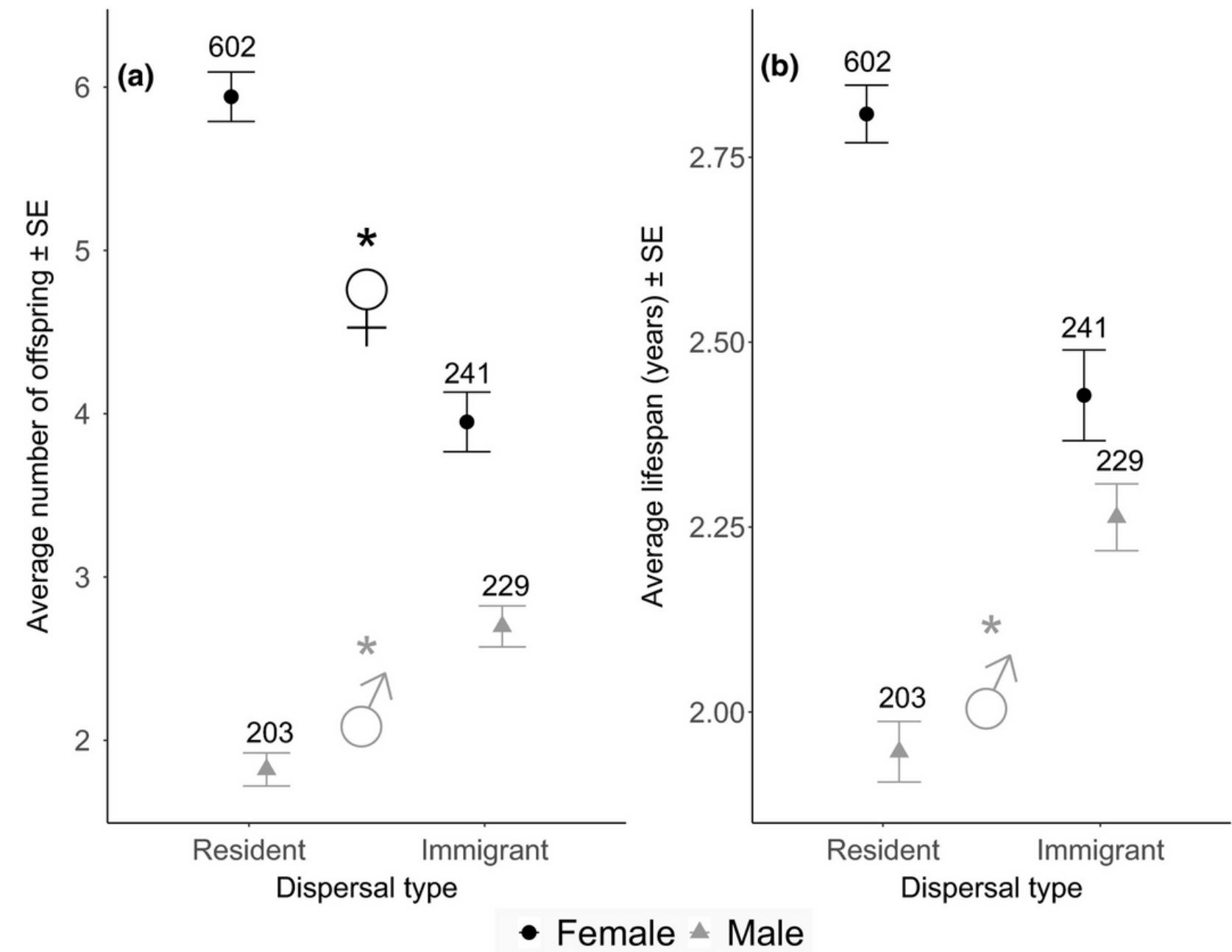
## Clarity rather than precision

It's ok to use approximate data to convey a message to a broad audience



# 1

## Clarity rather than precision



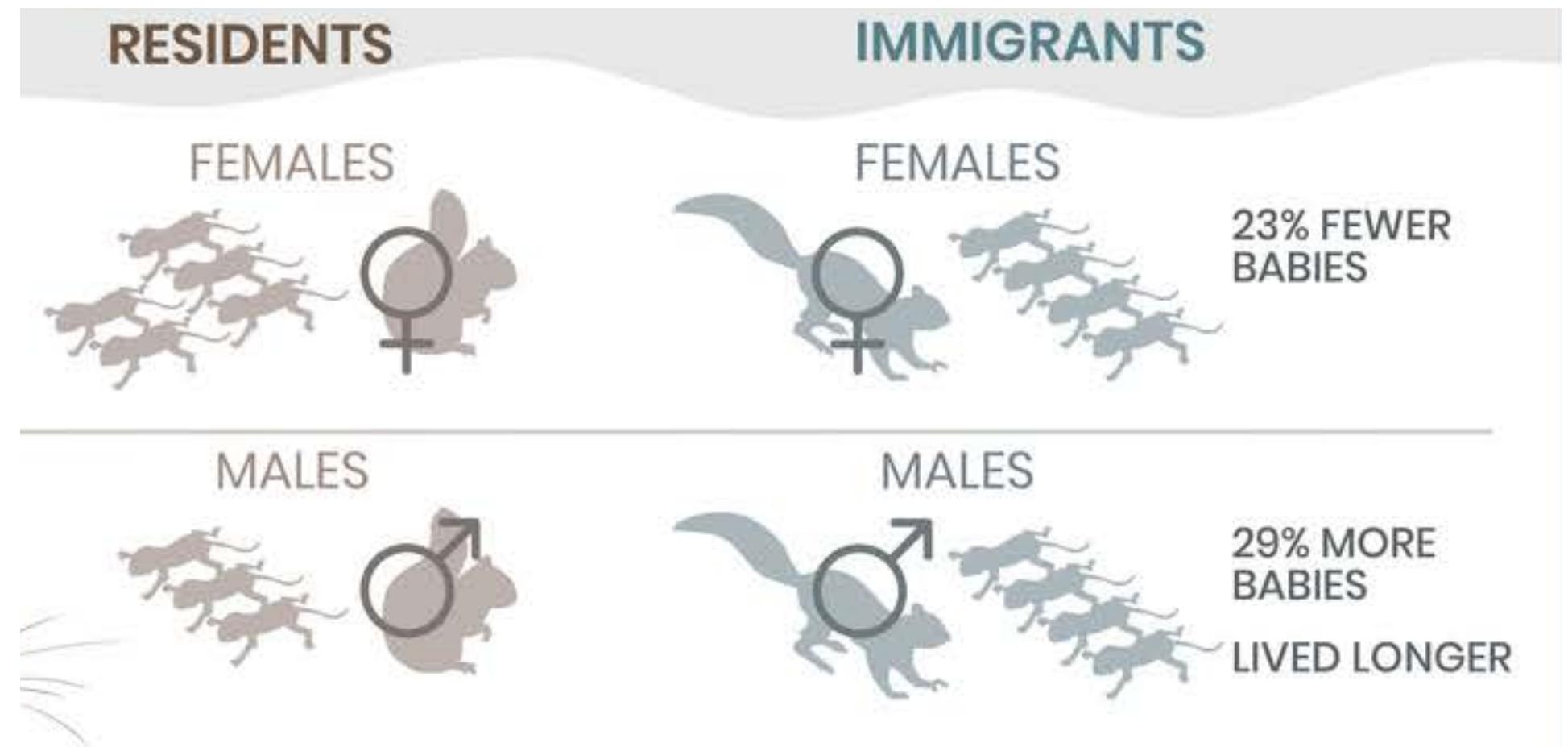
source: Martinig et al. 2019 <https://doi.org/10.1111/ele.13436>

The new kid on the block: immigrant males win big whereas females pay fitness cost after dispersal



# 1

## Clarity rather than precision



source: Martinig et al. 2019 <https://doi.org/10.1111/ele.13436> - graphical abstract (Fuse consulting)  
The new kid on the block: immigrant males win big whereas females pay fitness cost after dispersal



# 2

## Without misleading the audience!

- Missing labels
- Data is left out
- Y-axis not starting at zero, log-transformed, with a break

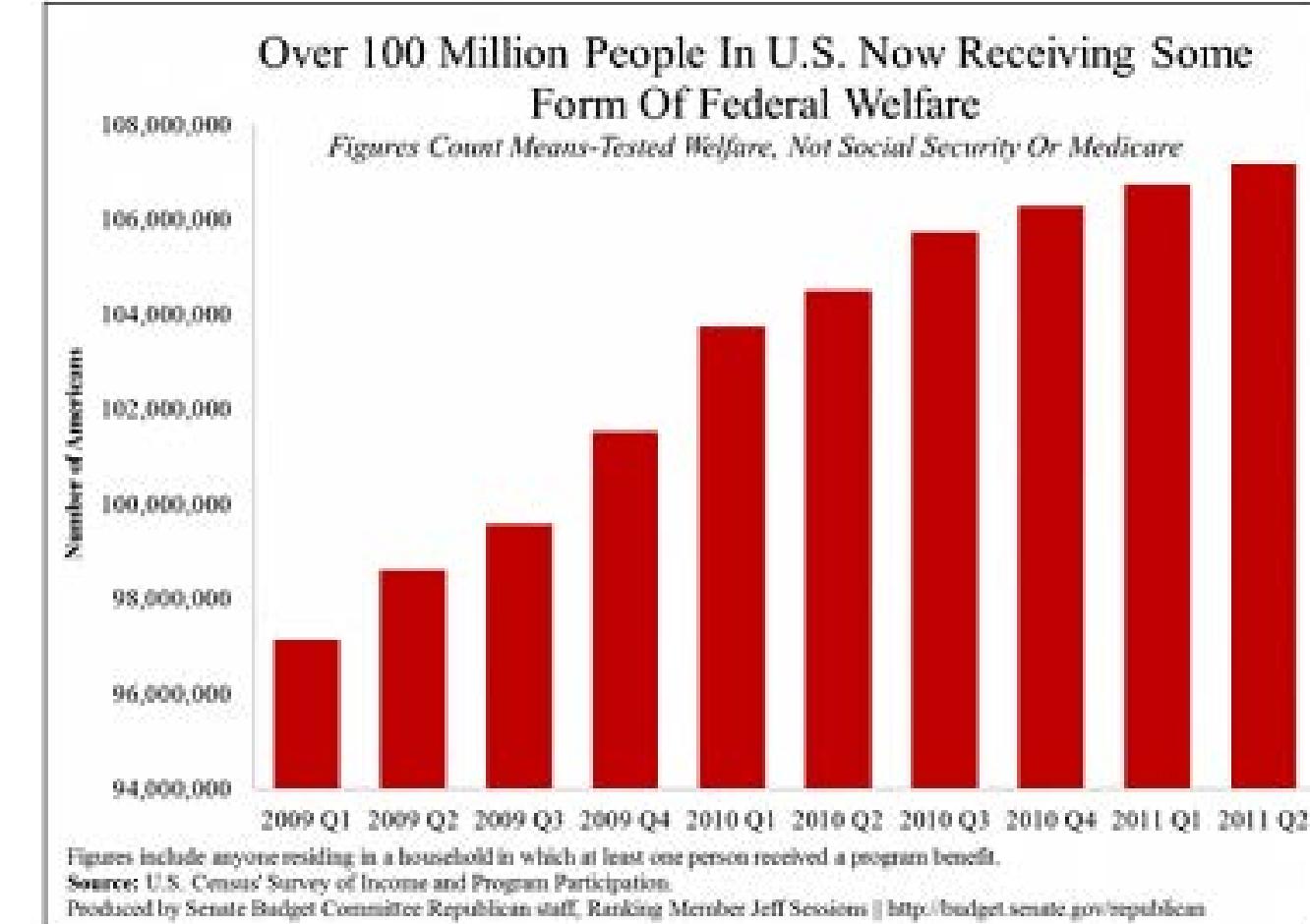
### THE BLOG

#### Over 100 Million Now Receiving Federal Welfare

2:40 PM, AUG 8, 2012 • BY DANIEL HALPER 

A new chart set to be released later today by the Republican side of the Senate Budget Committee details a startling statistic: "Over 100 Million People in U.S. Now Receiving Some Form Of Federal Welfare."

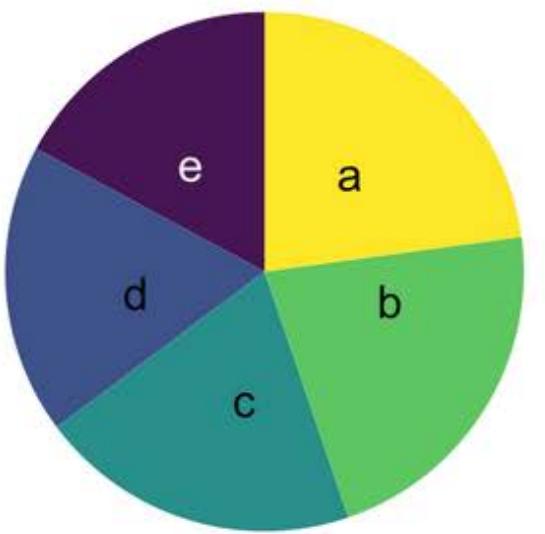
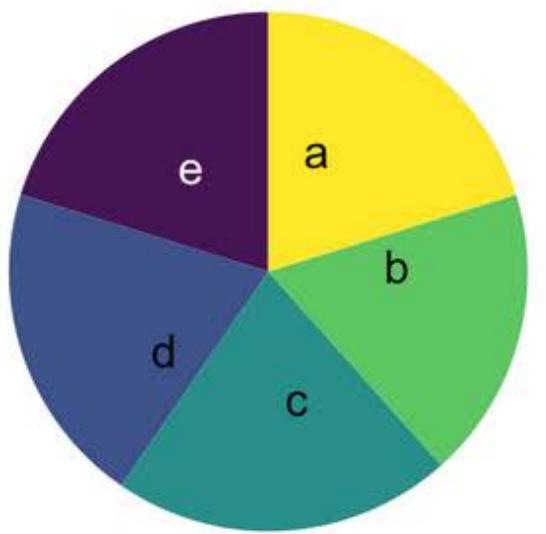
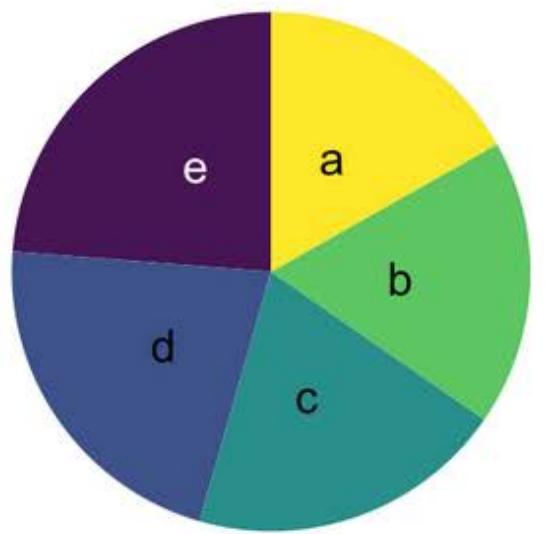


source: USA today reported in [www.statisticshowto.com](http://www.statisticshowto.com)

# 2

## Without misleading the audience!

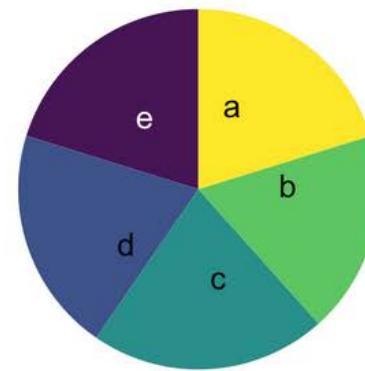
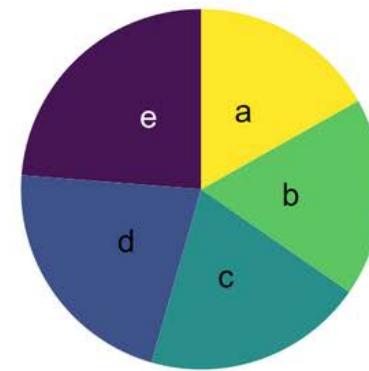
- Missing labels
- Data is left out
- Y-axis not starting at zero, log-transformed, with a break
- Misleading types of charts (ex: pie charts)



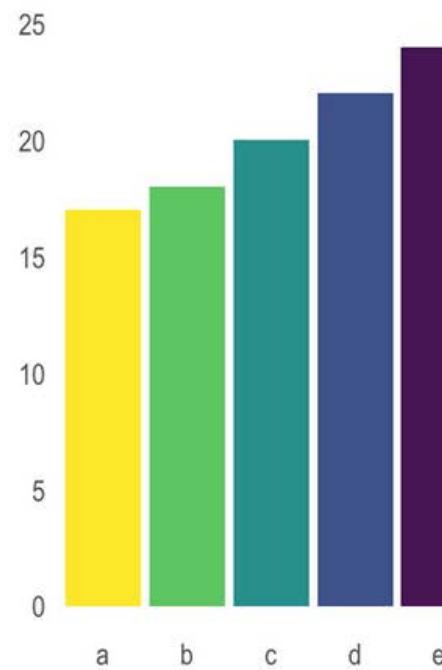
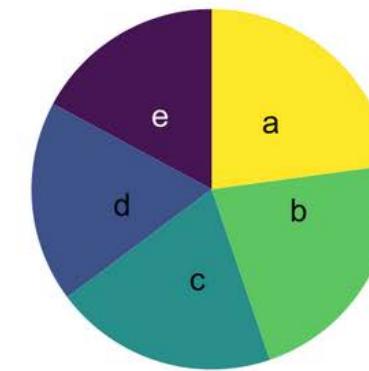
# 2

## Without misleading the audience!

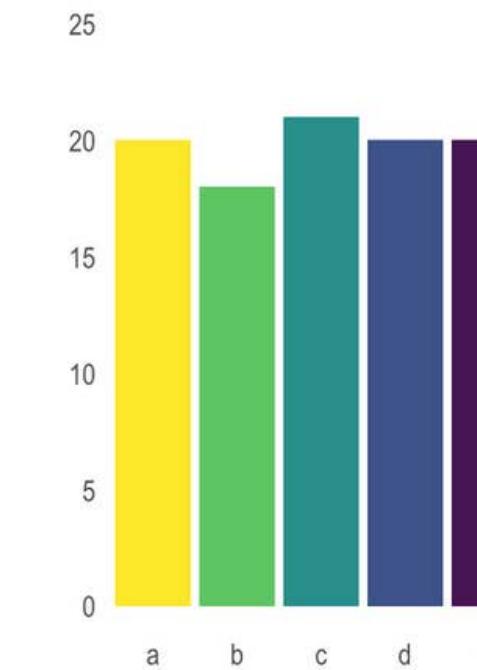
- Missing labels
- Data is left out
- Y-axis not starting at zero, log-transformed
- Misleading types of charts (ex: pie charts)



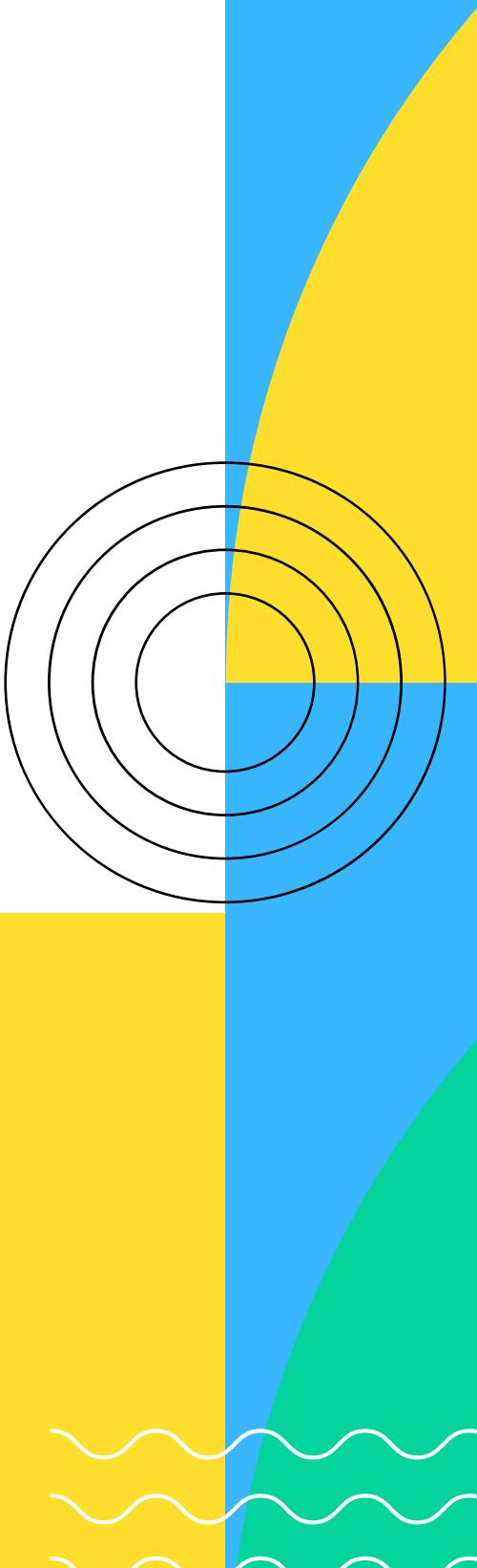
ggpubr::ggpie



ggplot2::geom\_bar



source: data-to-viz.com Y Holtz and C Healy





## Without misleading the audience!

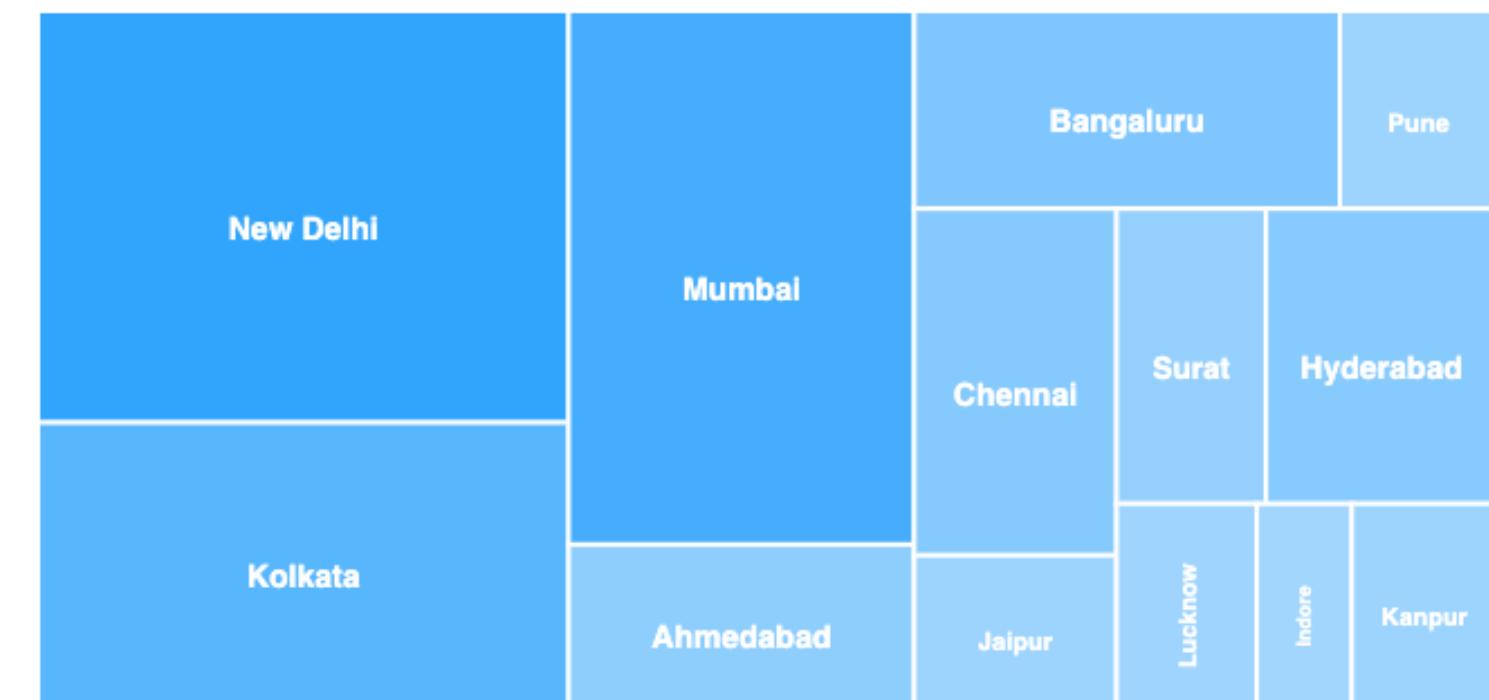
Alternatives to pie charts:

- barplot
- lollipop
- tree



source: sthda.com

ggpubr::ggdotchart

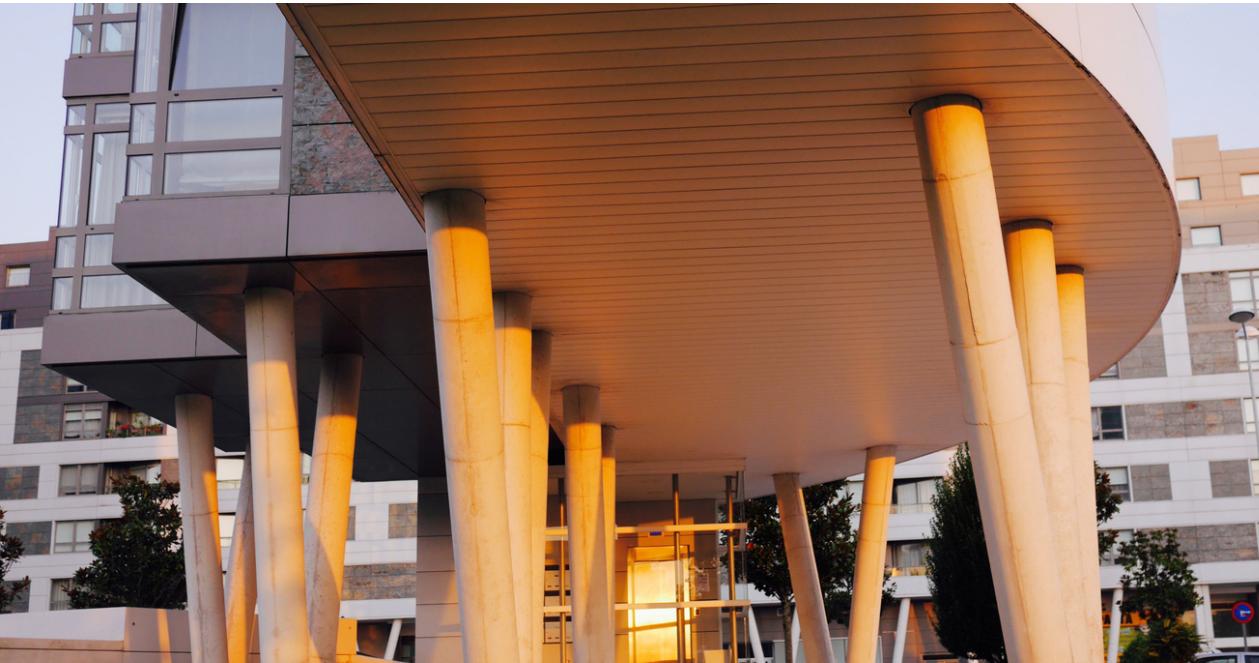


source: ApexCharts.com

treemapify::geom\_treemap

# 3

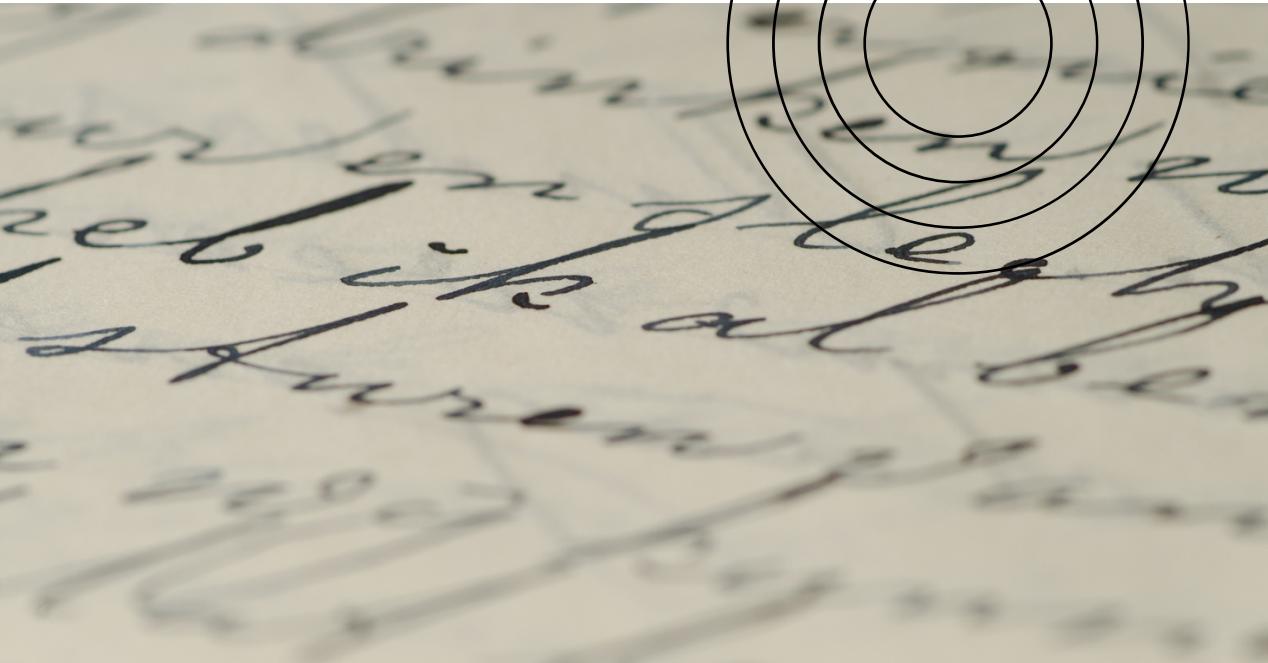
## Apply basic design techniques



STRUCTURE



COLOR THEORY



FONTS

# Structure



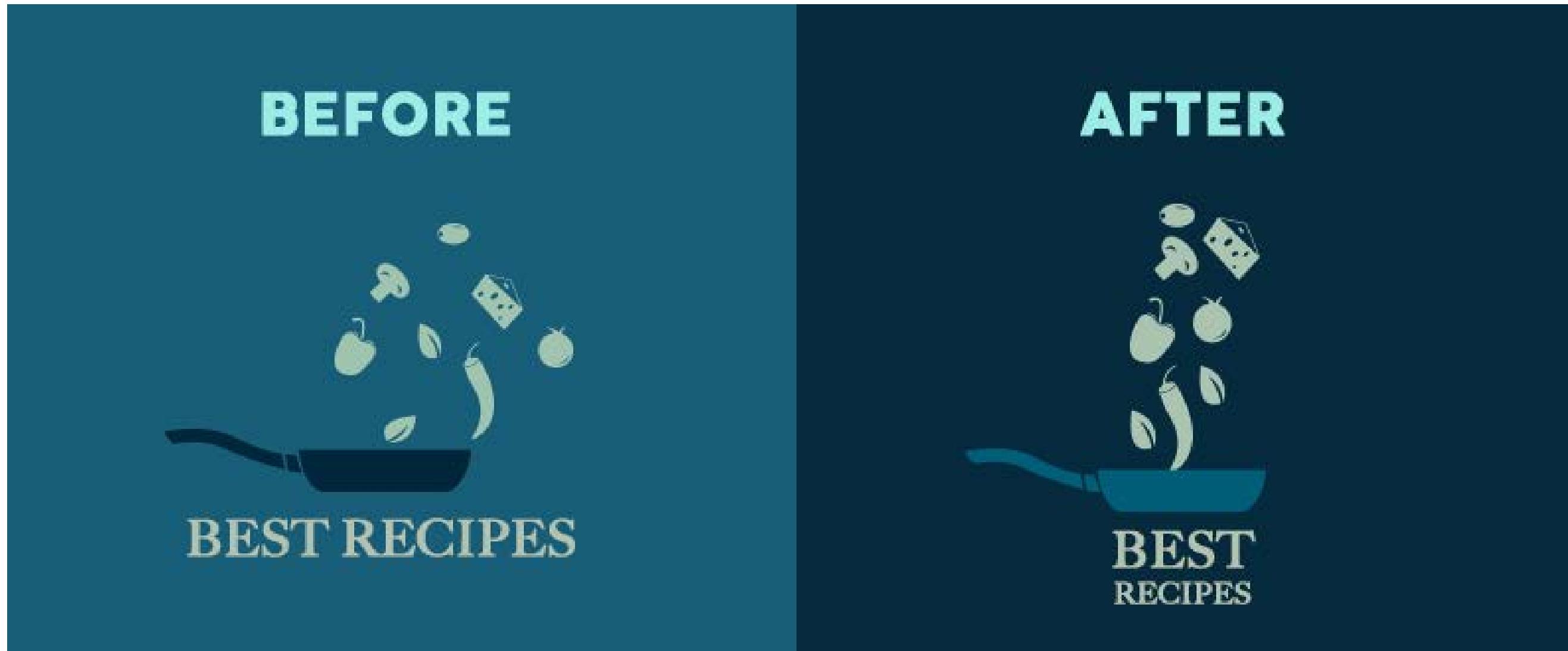
WATCH FOR ALIGNMENTS!



# Structure



WATCH FOR ALIGNMENTS!



<http://kingkom.net/12-criteres-hierarchie-visuelle/>

# Structure



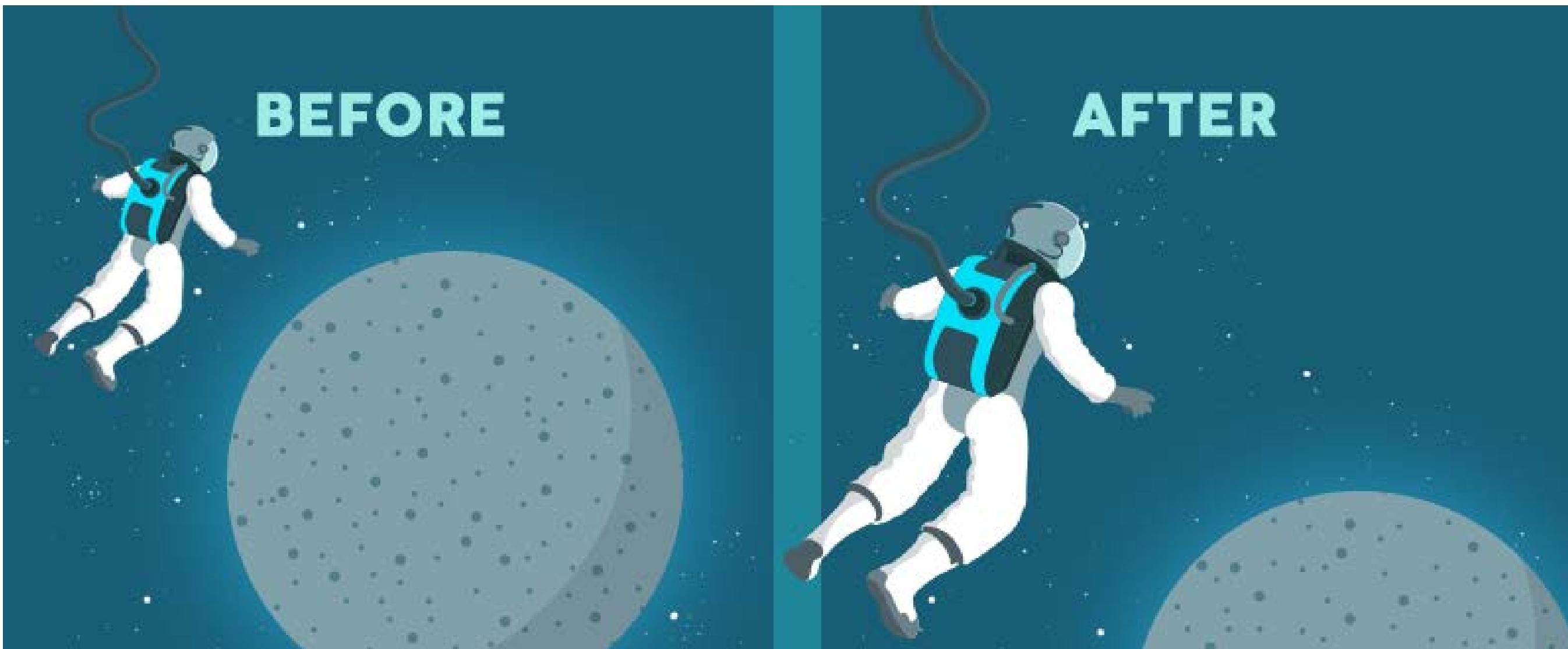
EMBRACE THE EMPTY SPACE



# Structure



EMBRACE THE EMPTY SPACE

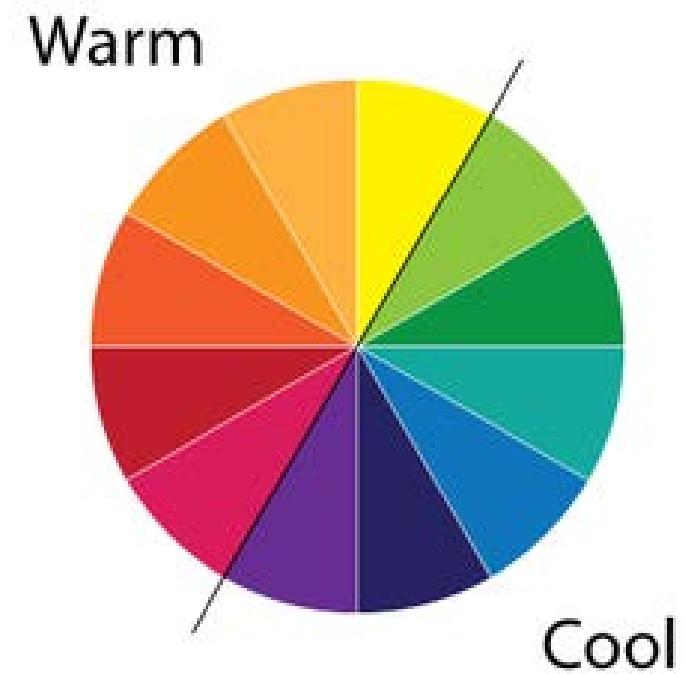


<http://kingkom.net/12-criteres-hierarchie-visuelle/>

# Colors



PLAY WITH PALETTES

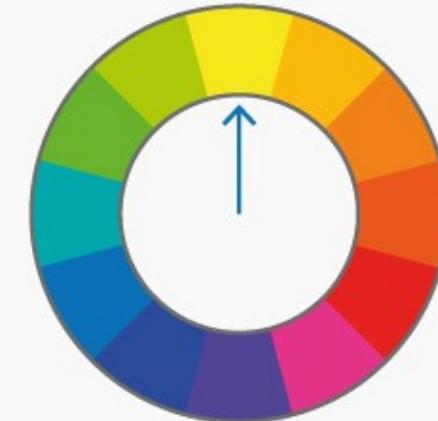


source: wawaloamart.weebly.com

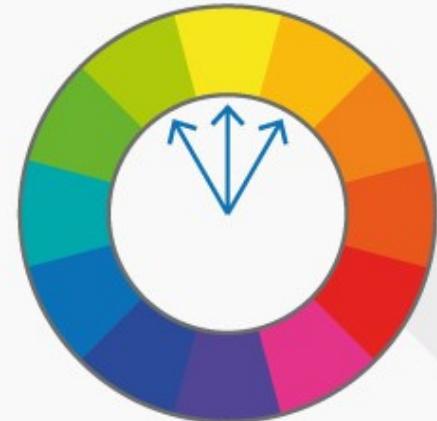
4- Communication & outreach

## Color Schemes

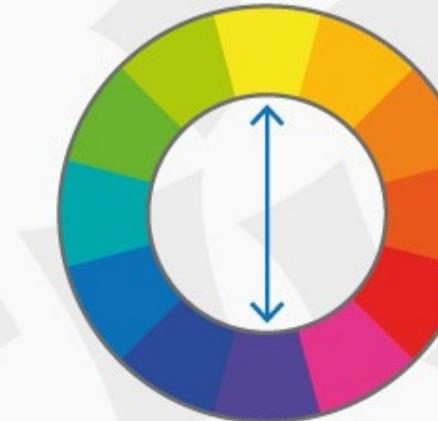
Monochromatic



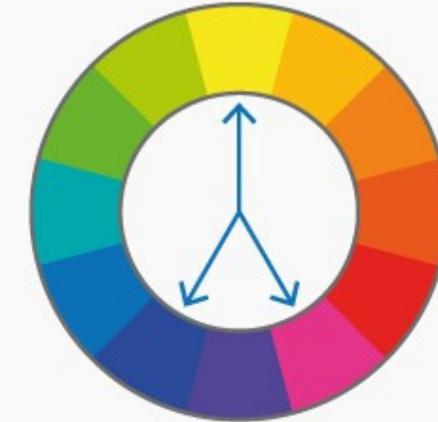
Analogous



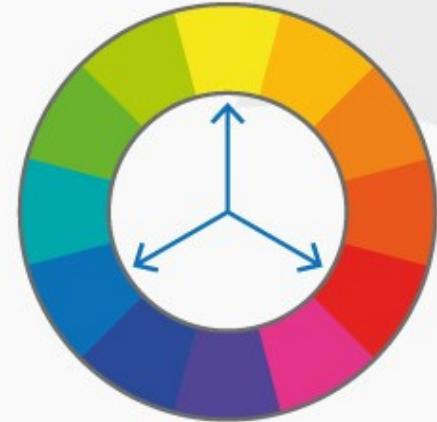
Complementary



Split-Complementary



Triad



Tetradic



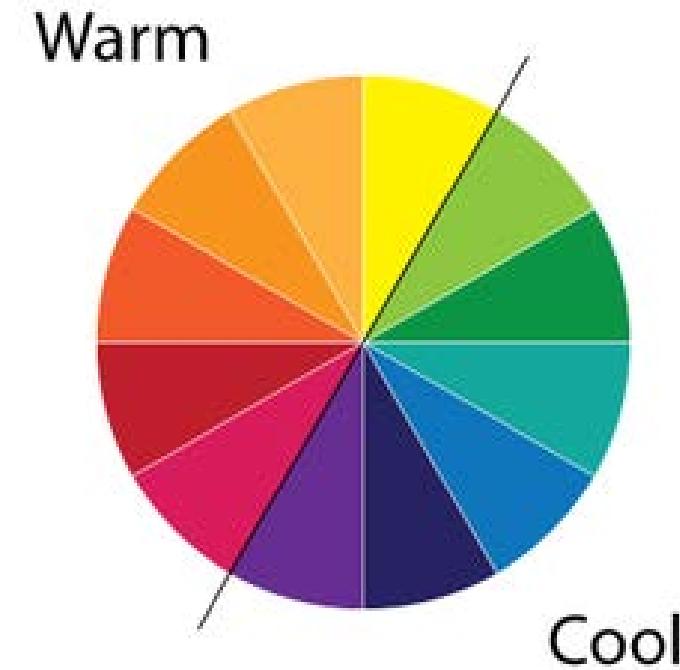
INTERACTION DESIGN  
FOUNDATION

INTERACTION-DESIGN.ORG

# Colors

CREATIVITY AND PARCIMONY

- The hero color
- Warm vs cool colors
- Color psychology



source: wawaloamart.weebly.com

## COLOR EMOTION GUIDE



source: huffpost

# Fonts



FONT FOR PURPOSE

# Serif

Classic style, designed for reading



# Sans serif

Designed to look clean on digital screen



# Display

More personality, but to be used in small doses!



More fonts? <https://www.dafont.com/fr/>

# Fonts



## COMBINING FONTS

- Contrasting fonts are complementary
- Tall with small, Bold with thin etc.

# CONTRASTING FONTS

Complementarity

# Contrasting fonts

COMPLEMENTARITY

CONTRASTING FONTS ARE

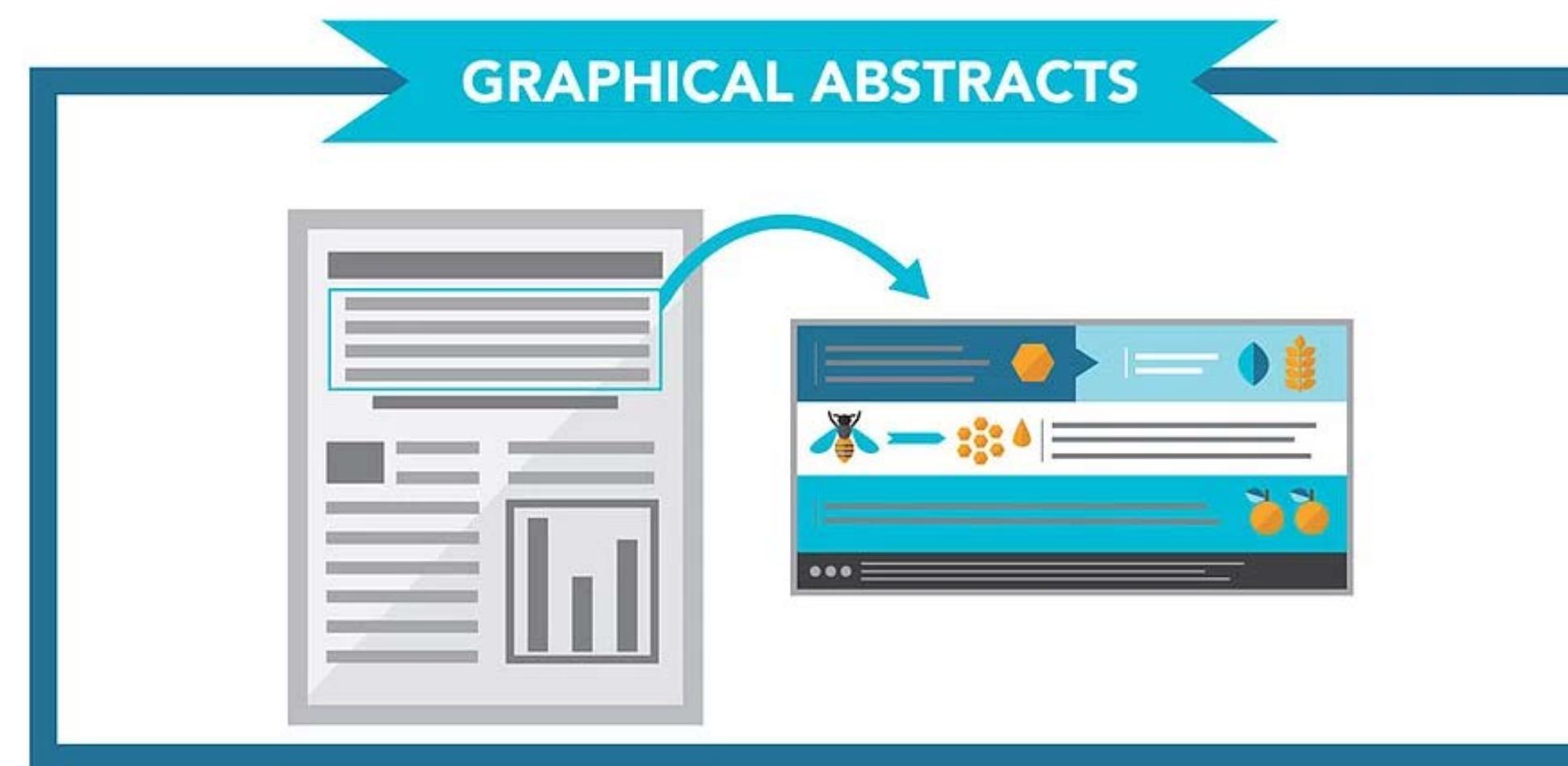
# Complementary



# Graphical abstracts



# Graphical abstracts: why and how?



source: methodspace.com by Tullio Rossi

- Explaining and summarizing scientific information in a visual form
- Increases the reach of your research (e.g., Twitter Ibrahim et al. 2017 - Annals of Surgery)
- Sits somewhere on the experts-public audience spectrum

# Tips for a good graphical abstract



## STRUCTURE

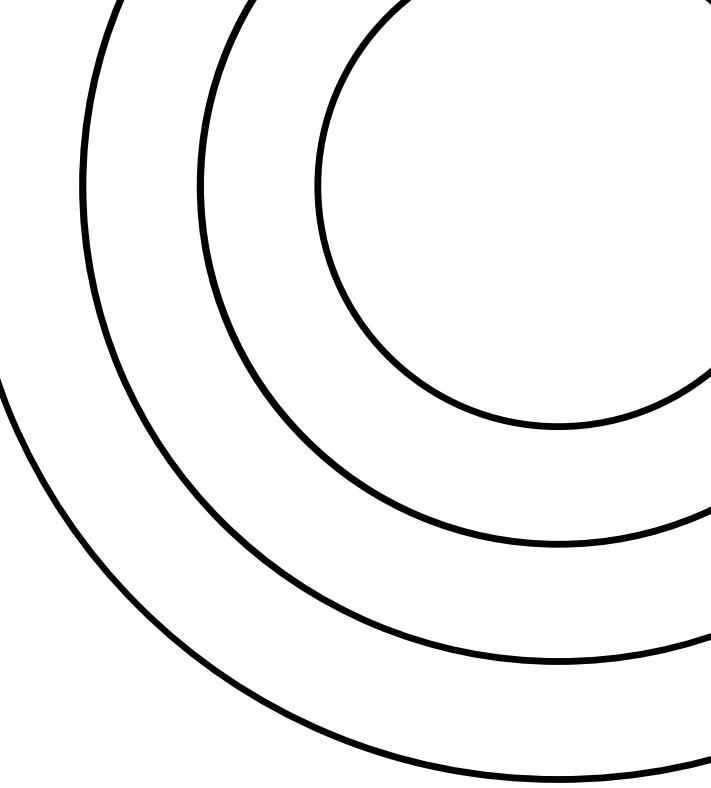
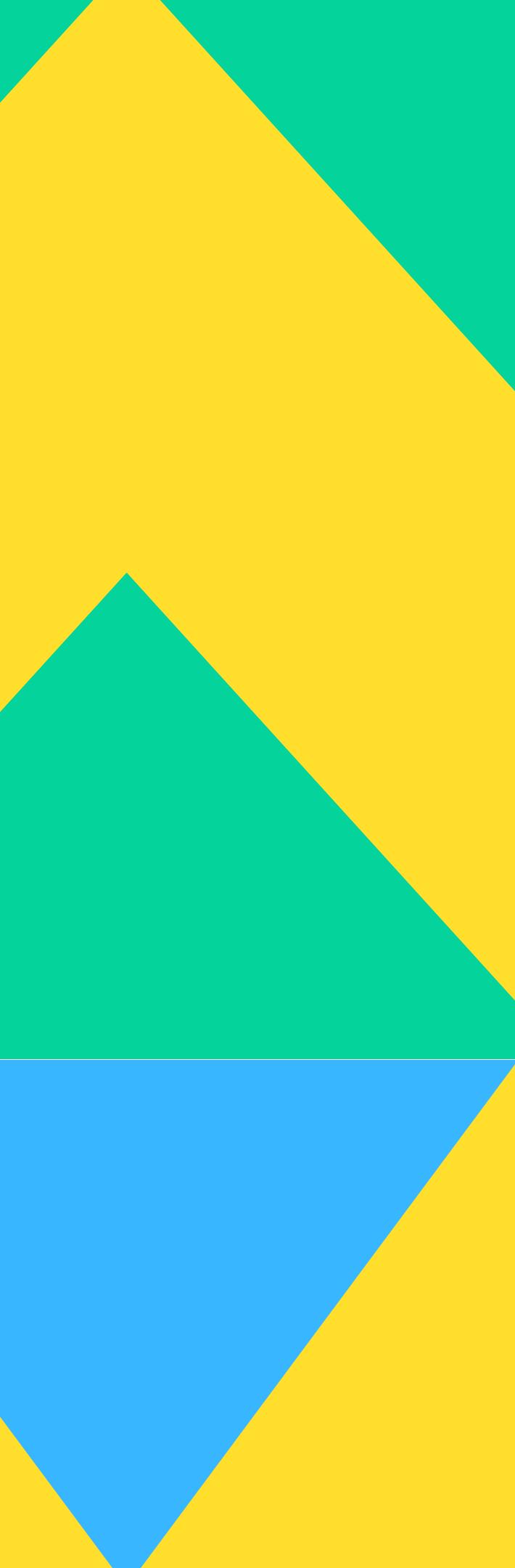
Context, question, outcome (methods are somewhat optional)

## VISUAL APPEALING AND ACCESSIBLE

- Avoid passive voice, jargon, p-values etc. It does not have to be as detailed as your abstract!
- Icons rather than complicated charts (even quantitative data)

## TRACEABILITY

- Logos
- Contact information
- Social media @
- Article reference



# **Learning from examples**

# MARINE MAMMAL CONSERVATION

# OVER THE HORIZON

## KEY THREATS

-  Fisheries
-  Climate change
-  Exploitation
-  Industrial development
-  Pollution

## CONSERVATION MECHANISMS

-  MPA Practical management
-  Monitoring and sampling
-  Policy and guidance

## RESEARCH AND MONITORING

-  Satellite and drone imagery
-  Biologging and telemetry
-  Molecular techniques
-  Societal engagement

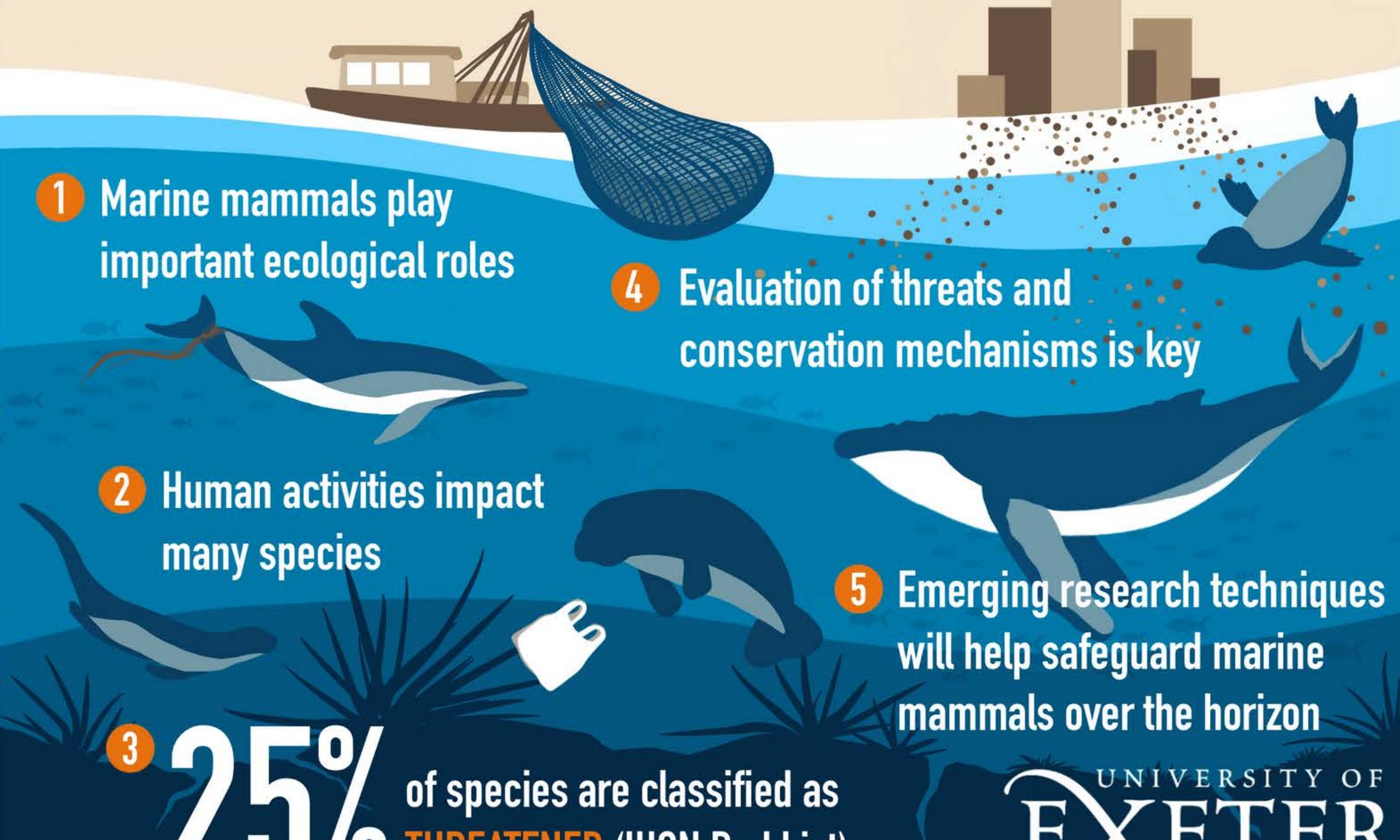
1 Marine mammals play important ecological roles

2 Human activities impact many species

3 **25%** of species are classified as **THREATENED** (IUCN Red List)

4 Evaluation of threats and conservation mechanisms is key

5 Emerging research techniques will help safeguard marine mammals over the horizon



UNIVERSITY OF  
**EXETER**

# Inshore rockfish

are slow-growing and late to mature, making them especially vulnerable to overfishing. Rockfish Conservation Areas with fishing restrictions are key to their recovery, but are met with poor compliance in the Strait of Georgia.

We studied the impact of a public outreach campaign to alert recreational fishers to the presence and purpose of Rockfish Conservation Areas. The campaign involved:

MATERIALS  
AT COMMUNITY EVENTS



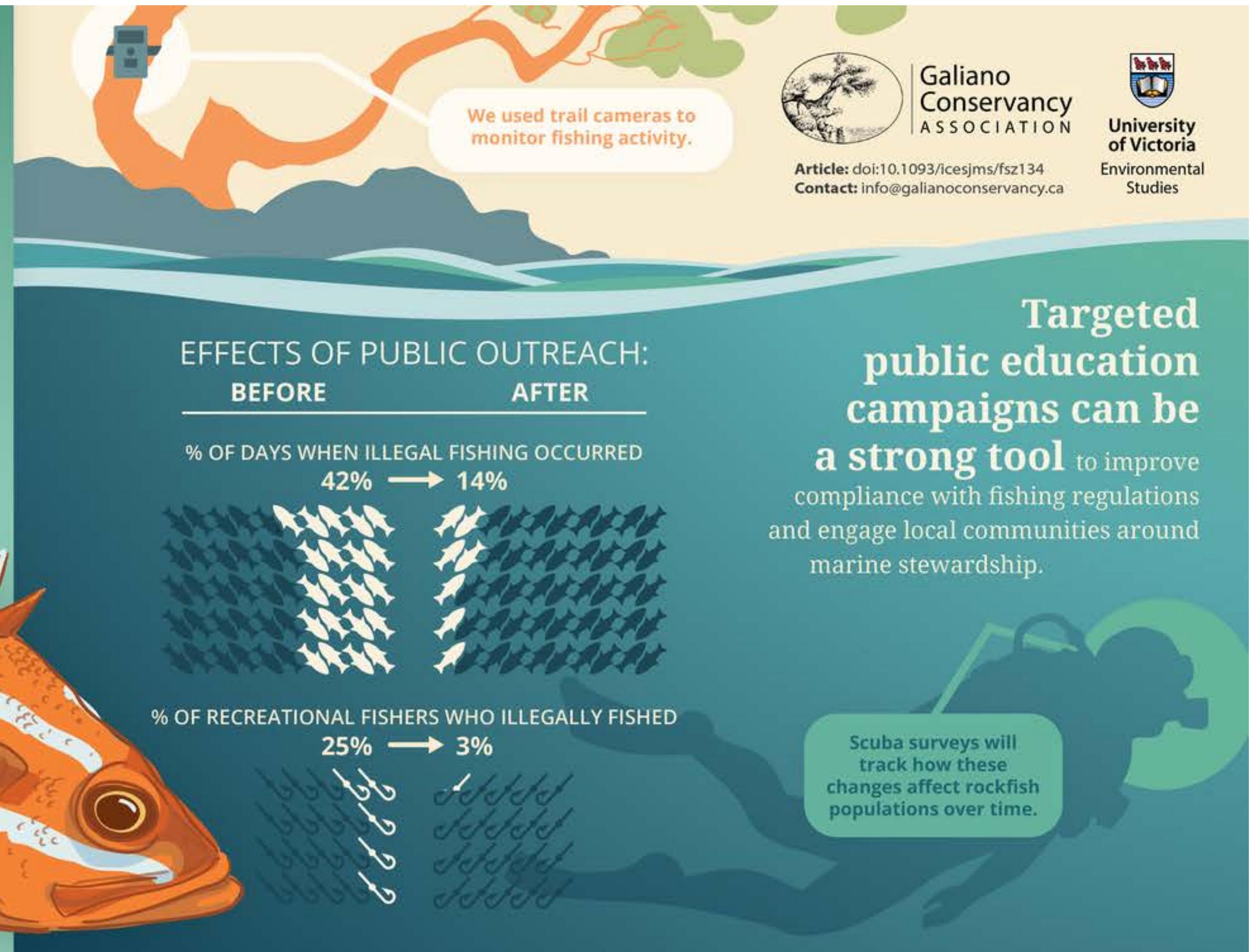
INTERVIEWS  
WITH RECREATIONAL FISHERS



METAL SIGNS  
WITH MAPS OF NEARBY AREAS



Infographic by Kate at Fuse Consulting Ltd.



Galiano  
Conservancy  
ASSOCIATION



Article: doi:10.1093/icesjms/fsz134  
Contact: info@galianoconservancy.ca



University  
of Victoria  
Environmental  
Studies

## Targeted

## public education campaigns can be a strong tool

to improve  
compliance with fishing regulations  
and engage local communities around  
marine stewardship.

# HOW CHEETAHS RESPOND TO PREY PULSES

Carnivore populations depend on prey resources, but **how carnivores adapt to fluctuating resources in space and time is unclear.**

The annual wildebeest migration in the Maasai Mara (Kenya) provides an ideal opportunity to study how a sudden influx of prey affects the distribution and movement behaviour of carnivores.

We used spatially-explicit capture-recapture models to study the space-use of cheetahs both during and out of the migration season.

## DURING MIGRATION

PREY CONCENTRATED IN SOUTHERN WILDLIFE AREAS



## OUT OF MIGRATION

PREY SPLIT UP AND SHIFT TO OTHER AREAS



INFOGRAPHIC BY FUSE CONSULTING

Female cheetahs congregated seasonally in areas with lots of prey.



Male cheetahs exhibited larger movements during the migration, but local densities did not vary as strongly.



There was no clear relationship between overall cheetah density and the influx of prey.

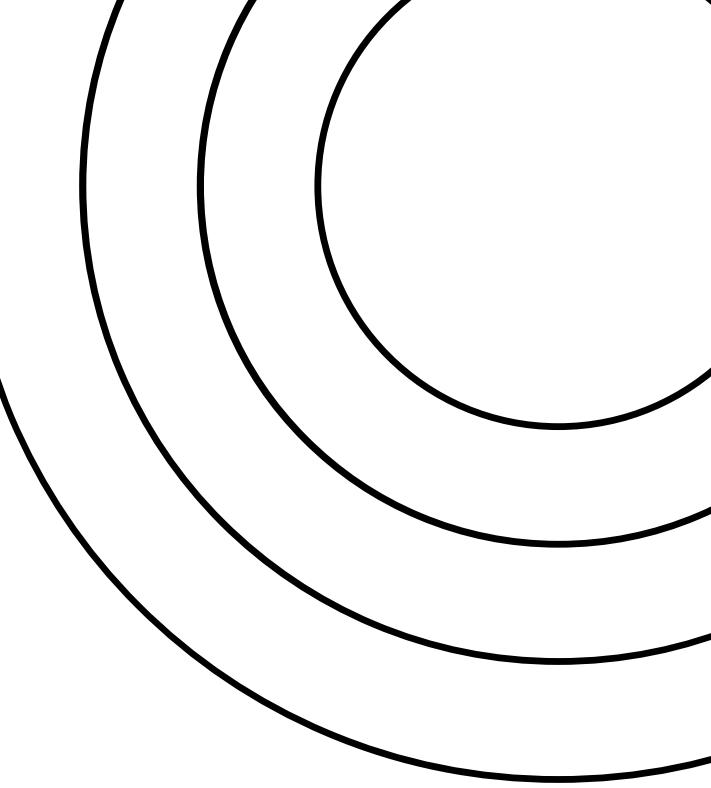
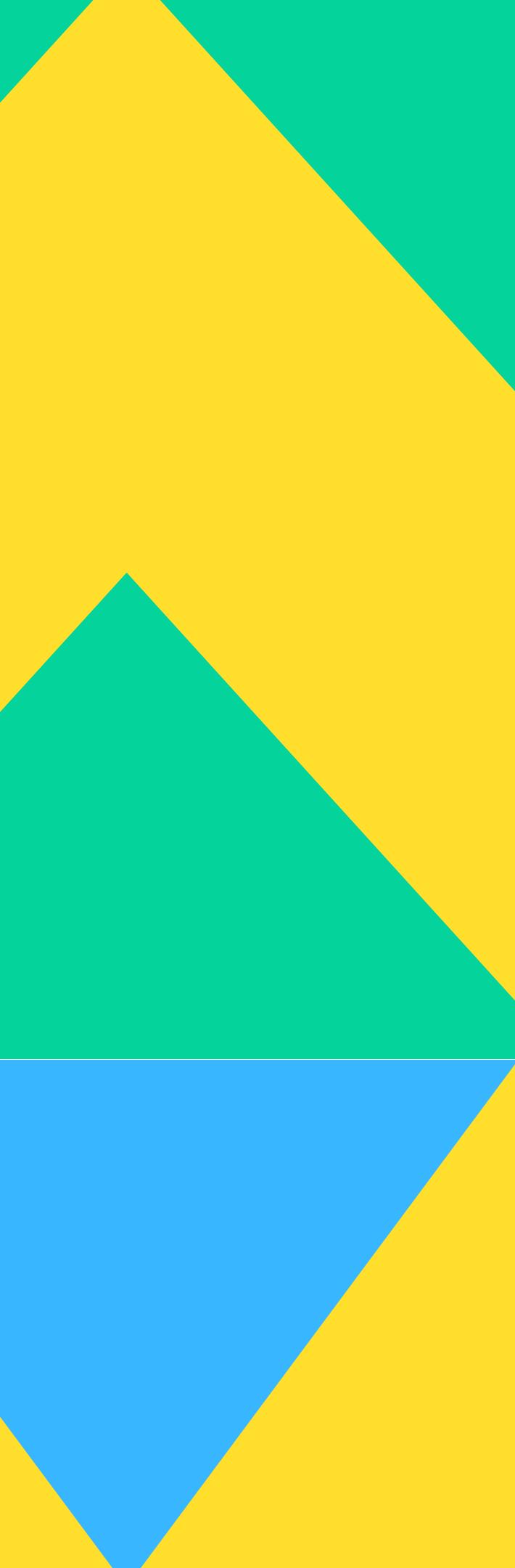
These findings show that female and male cheetahs respond to resource pulses differently. This may be because females must provide for their cubs and so prioritise access to prey, while males balance access to prey, with defending territories and finding females.



Carnivores are an important part of healthy ecosystems. Understanding their adaptability to fluctuating resources is key to their conservation, especially as human activities and climate change can alter existing resource pulses or create new ones.

BROEKHUIS ET AL. (2020) ECOGRAPHY.  
DOI: 10.1111/ecog.05154





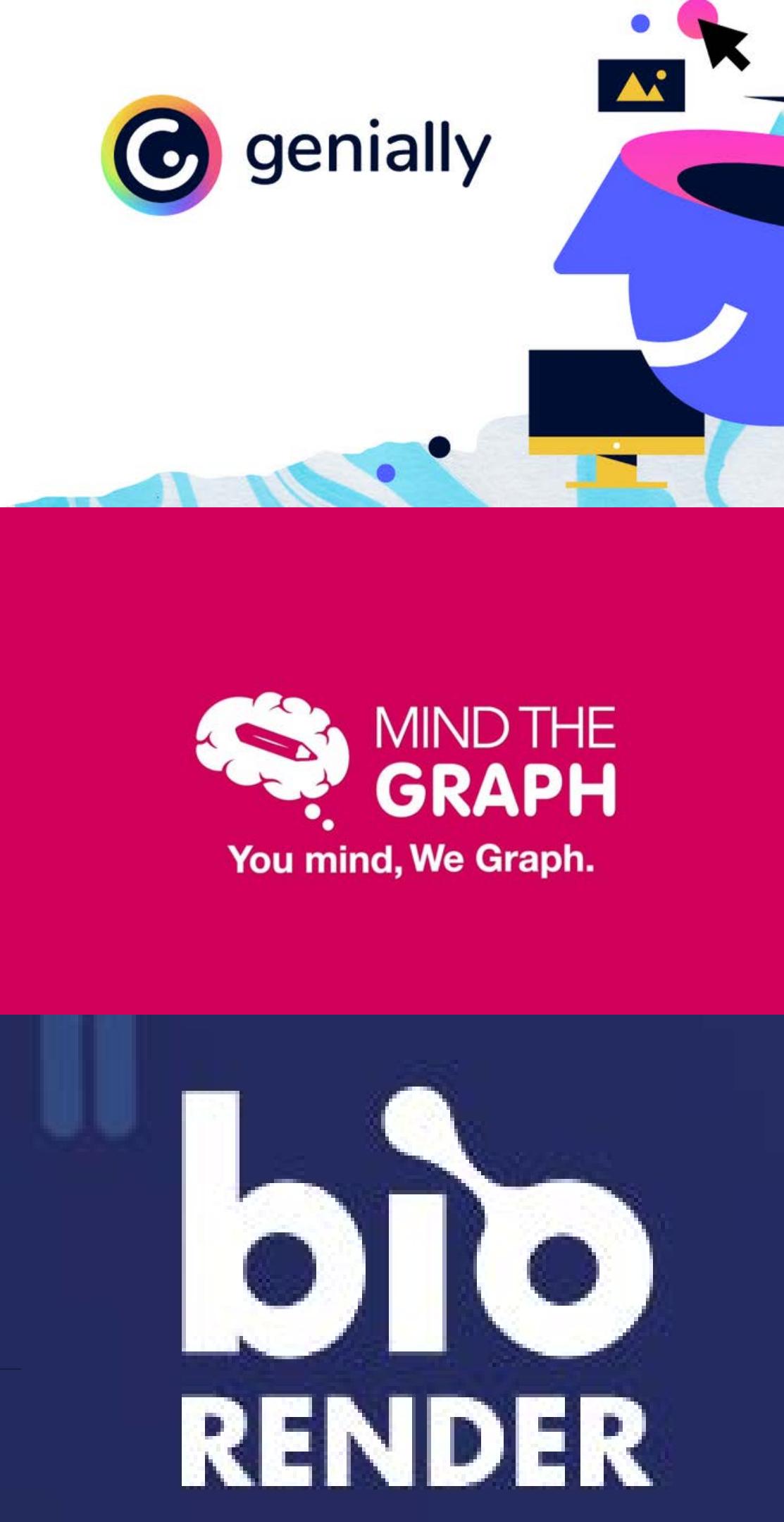
# Using Canva

[www.canva.com](http://www.canva.com)



# Some other cool tools

All available with a free beginner plan



GENIALLY

Presentations are communication tools that can be used as demonstrations, lectures, speeches, reports, and more.

MIND THE GRAPH

Scientific illustrations and graphics (great library in the fields of biology, health, chemistry... less so in ecology)

BIO RENDER

Scientific illustrations BUT need to pay for premium license to get publishing rights



**BE CREATIVE!**

# Online resources

## GENERAL ASPECTS

Choose a graph type: <https://www.adventurousgrace.com/presentations/2017/12/7/g-is-for-graphs>

## FIGURES FOR PUBLICATION

Publication-ready figures: <https://b.nanes.org/figures/>

Ten Simple rules for better figures: <https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833>

Creating effective scientific figures for publication, by Ashley Smith: <https://www.aje.com/dist/docs/Guide-Creating-Effective-Scientific-Figures-for-Publication.pdf>

## FIGURES FOR OUTREACH

Misleading plots: <https://www.data-to-viz.com/caveat/pie.html>

Introduction to sketchnoting by Mike Rhode: <https://www.youtube.com/watch?v=39Xq4tSQ31A>

## DATA VISUALIZATION IN R

ggplot2 extensions: <https://mode.com/blog/r-ggplot-extension-packages/>

Excellent workshop by Thomas Lin Pedersen: <https://www.youtube.com/watch?v=0m4yywqNPVY>

How to make a good map: <https://gisgeography.com/map-elements-how-to-guide-map-making/>

<https://mgimond.github.io/Spatial/good-map-making-tips.html>

## DATA VISUALIZATION IN R

Graphical abstract examples: <https://www.methodspace.com/graphical-abstract-examples/>

More examples: <https://www.fuseconsulting.ca/infographics>

Rules to a good graphical abstract: <https://mindthegraph.com/blog/create-effective-graphical-abstract/>