Using ggplot2

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Part 1: Build a basic plot

- Open RStudio
- Make sure you are in the EVR628 project
- Create a new script, and save it to scripts as `week2_ggplot.R`
- Add a basic descriptive header
- Load packages

```
library(EVR628tools)
```

```
v v v You sucessfully loaded the EVR628tools package v v v
```

```
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.2     v tibble    3.3.0
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.1.0
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to beco
```

- Load data

```
data(data_lionfish)
```

- Inspect data

```
glimpse(data_lionfish)
```

```
Rows: 109
Columns: 9
$ id              <chr> "001-Po-16/05/10", "002-Po-29/05/10", "003-Pd-29/05/10~
$ site            <chr> "Paraiso", "Paraiso", "Pared", "Canones", "Canones", "~
$ lat             <dbl> 20.48361, 20.48361, 20.50167, 20.47694, 20.47694, 20.5~
$ lon             <dbl> -87.22611, -87.22611, -87.21167, -87.23278, -87.23278,~
```

```
$ total_length_mm <dbl> 213, 124, 166, 203, 212, 210, 132, 122, 224, 117, 211,~
$ total_weight_gr <dbl> 112.70, 27.60, 52.30, 123.10, 129.00, 138.75, 50.29, 1~
$ size_class      <chr> "large", "medium", "medium", "large", "large", "large"~
$ depth_m         <dbl> 38.1, 27.9, 18.5, 15.5, 15.0, 22.7, 13.4, 18.5, 18.2, ~
$ temperature_C   <dbl> 28, 28, 28, 28, 28, 29, 29, 29, 29, 29, 28, 28, 28, 28~
```

The `ggplot` function

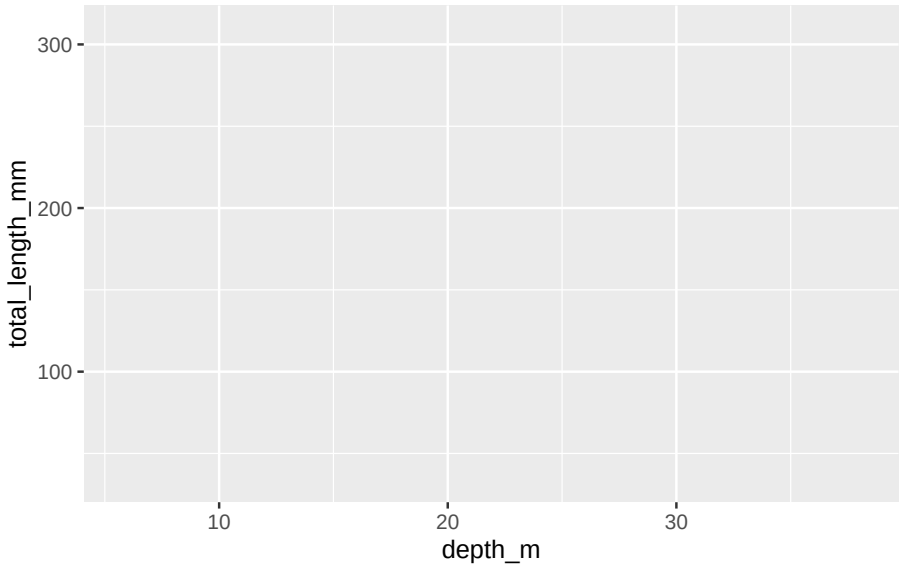
- Show documentation: point out data and mapping
- Specify data

```
ggplot(data = data_lionfish)
```


The `aes` function

- Show documentation
- Explain a function inside a function
- Then specify mapping
  - Emphasis on use of commas and named arguments without quotations
- Multiple lines and parentheses

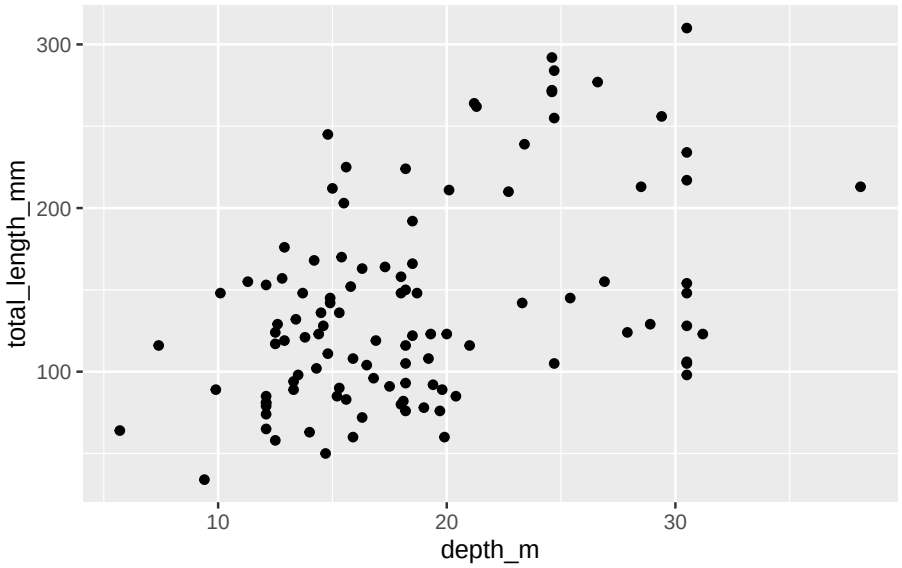
```
ggplot(data = data_lionfish,
       mapping = aes(x = depth_m, y = total_length_mm))
```



The `geom_point` function

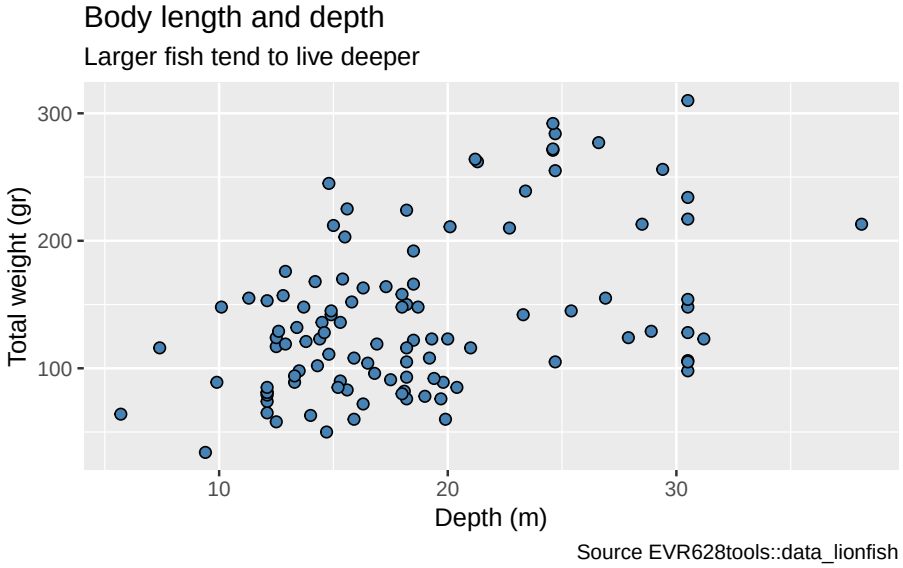
- Emphasiz on `+` for layering
- Run with simple points
- Show documentation and scroll down to the **Aesthetics** section
- Show how to change colors / sizes etc...
- Emphasize difference between using variables and constant values (inside vs outisde aes)

```
ggplot(data = data_lionfish,
       mapping = aes(x = depth_m, y = total_length_mm)) +
  geom_point()
```



`labs` function

```
ggplot(data = data_lionfish,
       mapping = aes(x = depth_m,
                     y = total_length_mm)) +
  geom_point(shape = 21,
             fill = "steelblue",
             size = 2) +
  labs(x = "Depth (m)",
       y = "Total weight (gr)",
       title = "Body length and depth",
       subtitle = "Larger fish tend to live deeper",
       caption = "Source EVR628tools::data_lionfish")
```

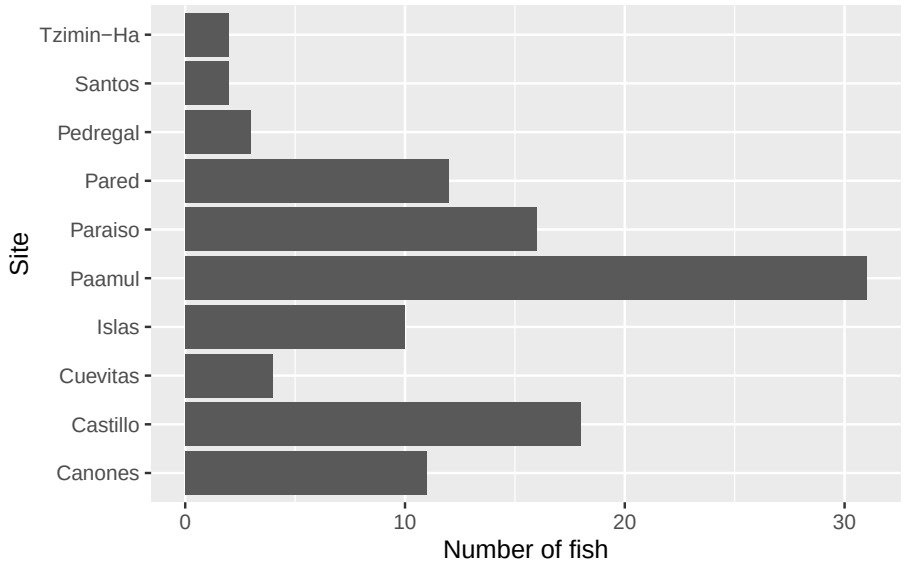


Part 2: Visualizing distributions

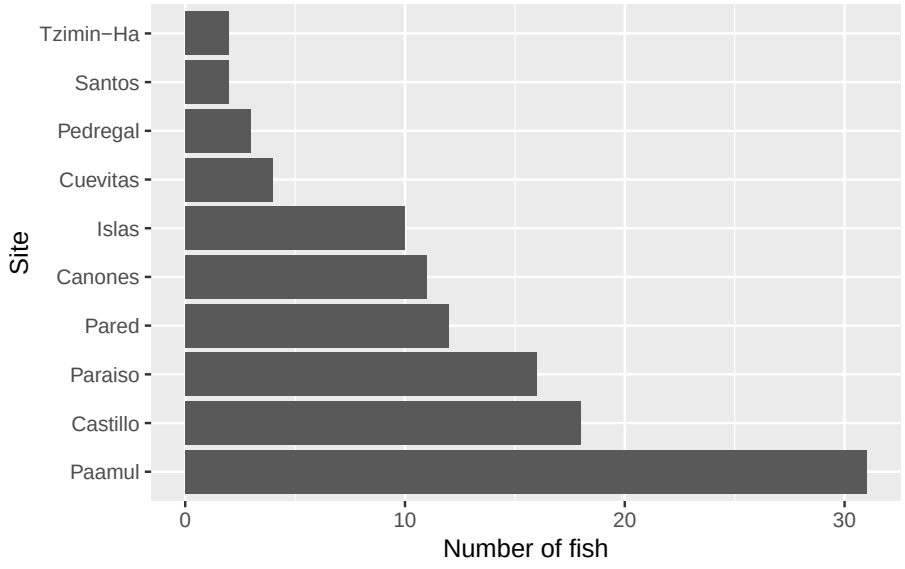
Distribution of a cateogrical variable

- Categorical variable with `geom_bar()`
  - basic with site
  - with `fct_infreq` and site

```
# Basic bar plot with site
ggplot(data = data_lionfish, aes(x = site)) +
  geom_bar() +
  coord_flip() +
  labs(x = "Site", y = "Number of fish")
```



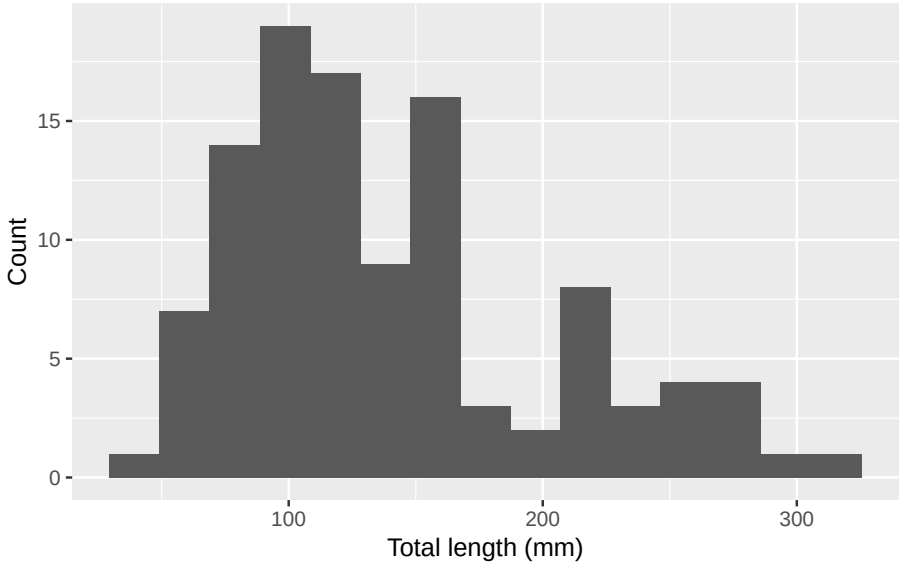

```
# Bar plot with sites ordered by frequency
ggplot(data = data_lionfish, aes(x = fct_infreq(site))) +
  geom_bar() +
  coord_flip() +
  labs(x = "Site", y = "Number of fish")
```



Distribution of a numeric variable

- Numerical variable with `geom_histogram()`
  - Distribution of lengths
  - Show bins vs bin width
  - $k = 1 + 3.322 \times log_{10}(N)$

```
# Histogram of lengths
ggplot(data = data_lionfish, aes(x = total_length_mm)) +
  geom_histogram(bins = 15) +
  labs(x = "Total length (mm)", y = "Count")
```

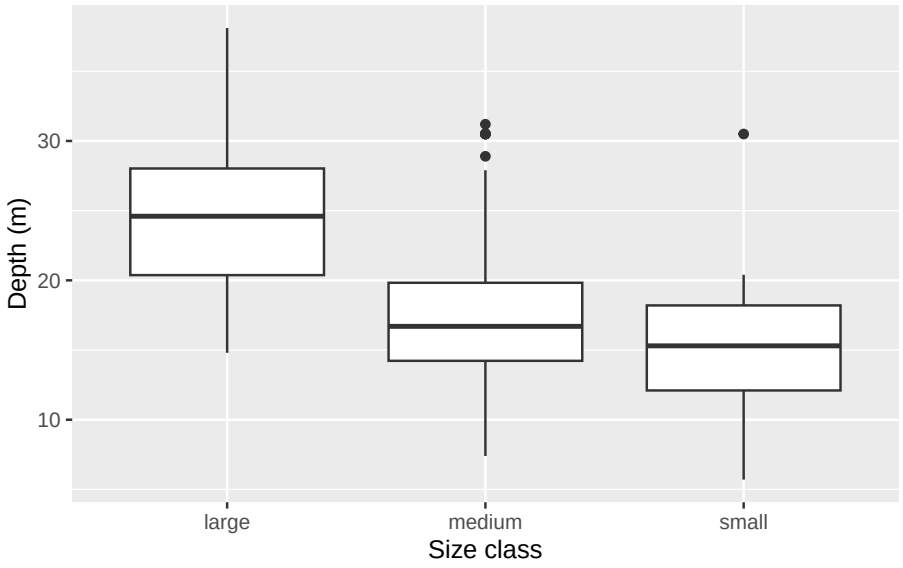


Part 3: Visualizing relationships

A numerical and a categorical variable

- depth by size class

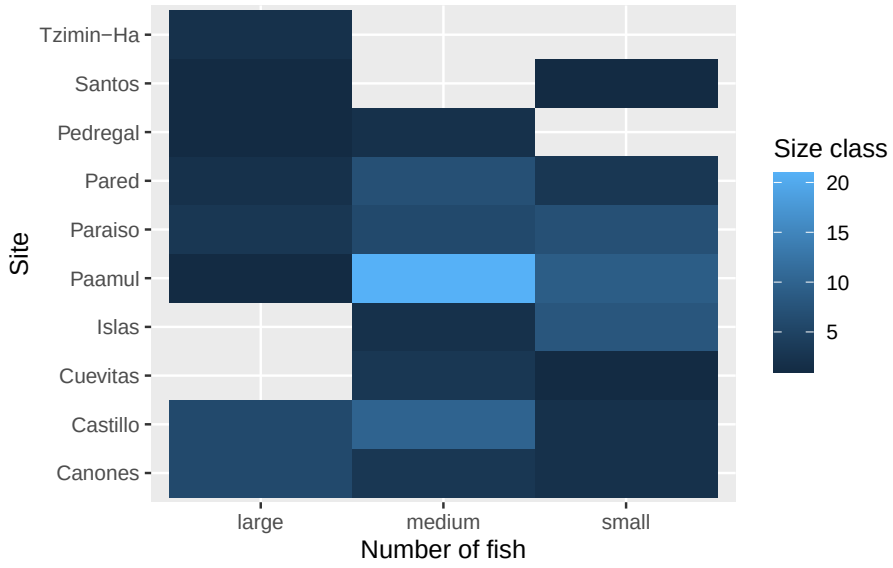
```
# Numerical vs categorical: depth by size class
ggplot(data = data_lionfish, aes(x = size_class, y = depth_m)) +
  geom_boxplot() +
  labs(x = "Size class", y = "Depth (m)")
```



Two categorical variables

- N by size class and site

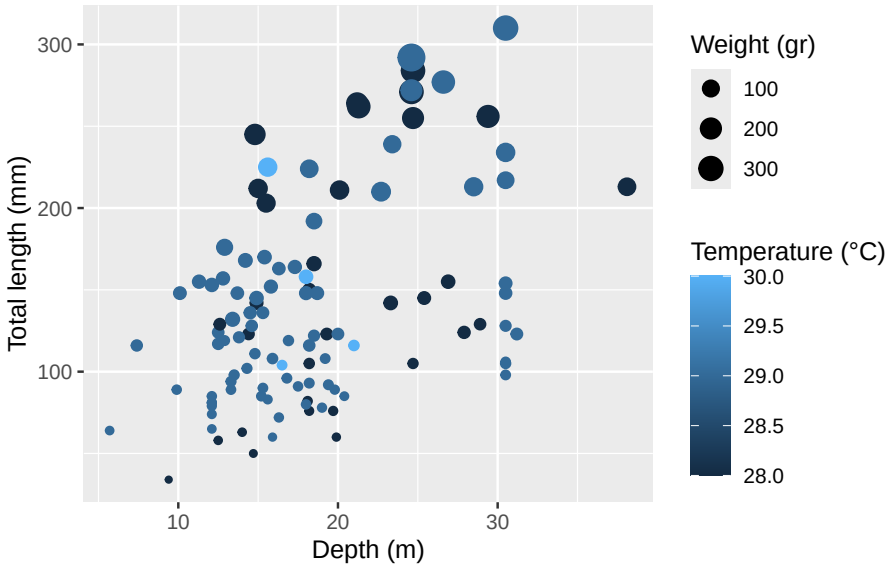
```
# Two categorical variables: N by size class and site
ggplot(data = data_lionfish, aes(x = site, y = size_class)) +
  geom_bin2d() +
  coord_flip() +
  labs(x = "Site", y = "Number of fish", fill = "Size class")
```



Three or more

- length vs depth with size for weight and color for temperature

```
# Three or more variables: length vs depth with size for weight
ggplot(data = data_lionfish,
       aes(x = depth_m, y = total_length_mm,
           size = total_weight_gr,
           color = temperature_C)) +
  geom_point() +
  scale_size_continuous(range = c(1, 5)) +
  labs(x = "Depth (m)", y = "Total length (mm)",
       size = "Weight (gr)", color = "Temperature (°C)")
```

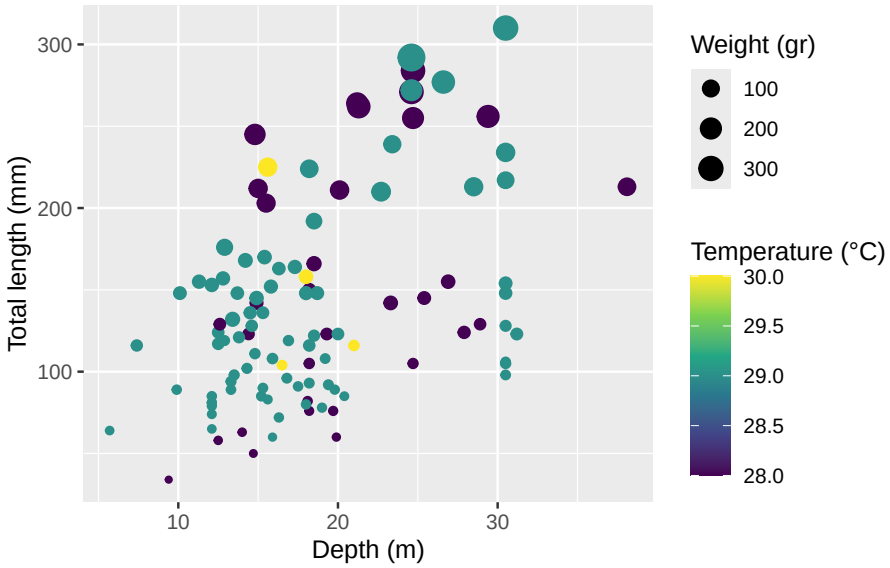


Part 4: Modifying colors

`scale_*_viridis_*`

- The easiest way is to use `scale_*_viridis_*`
  - Check documentation
  - An example

```
p <- ggplot(data = data_lionfish,
       aes(x = depth_m, y = total_length_mm,
           size = total_weight_gr,
           color = temperature_C)) +
  geom_point() +
  scale_size_continuous(range = c(1, 5)) +
  labs(x = "Depth (m)", y = "Total length (mm)",
       size = "Weight (gr)", color = "Temperature (°C)") +
  scale_color_viridis_c()

p
```

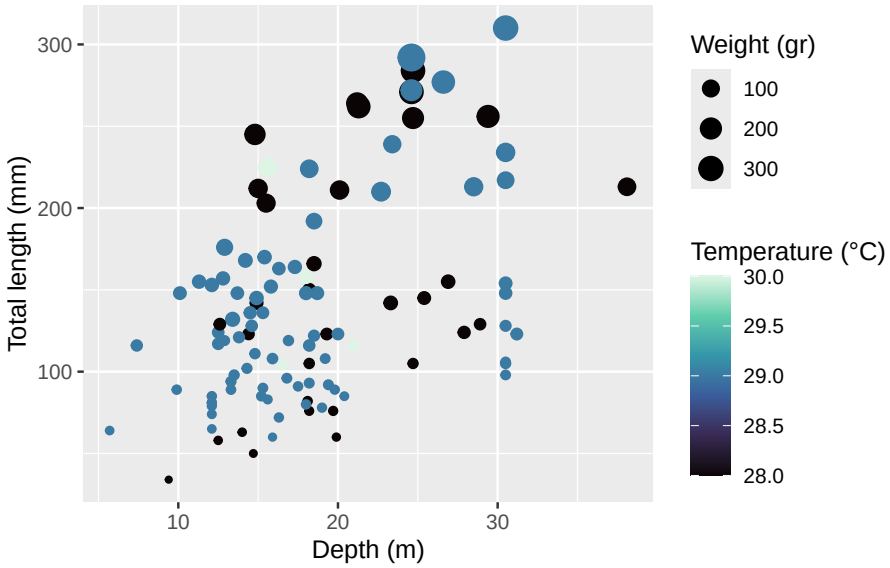


viridis options

- Show errors for wrong type of scale
- Change to `mako`

```
p +
  scale_color_viridis_c(option = "mako")
```

```
Scale for colour is already present.
Adding another scale for colour, which will replace the existing scale.
```

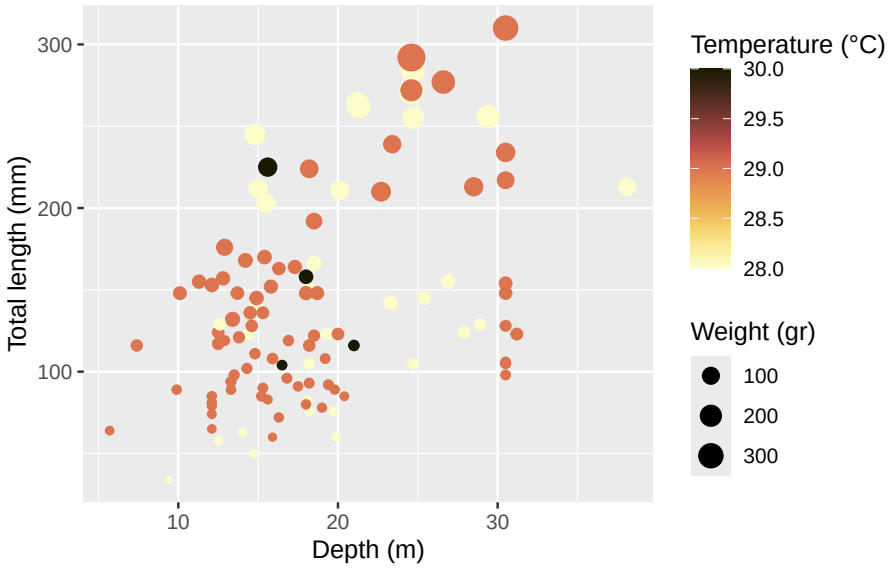


scale_color_gradientn

- `scale_color_gradientn` for continuous and custom palette
  - Check documentation
  - An example

```
p +
  scale_color_gradientn(colours = palette_IPCC(var = "temp", type = "seq"))
```

```
Scale for colour is already present.
Adding another scale for colour, which will replace the existing scale.
```

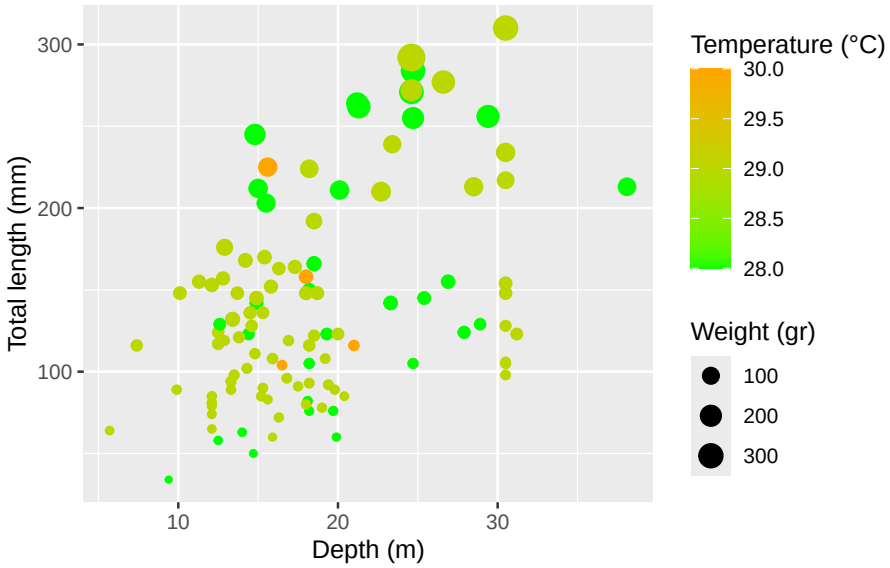


scale_color_gradient2

- `scale_color_gradient` vs `scale_color_gradient2` for continuous / divergent with ends
  - Check documentation
  - An example

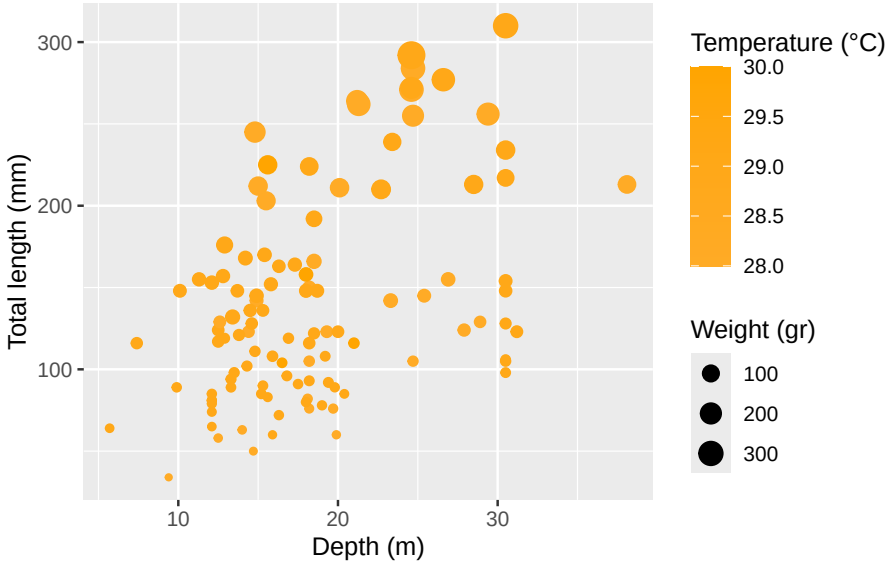
```
# Green to orange
p +
  scale_color_gradient(low = "green",
                       high = "orange")
```

```
Scale for colour is already present.
Adding another scale for colour, which will replace the existing scale.
```



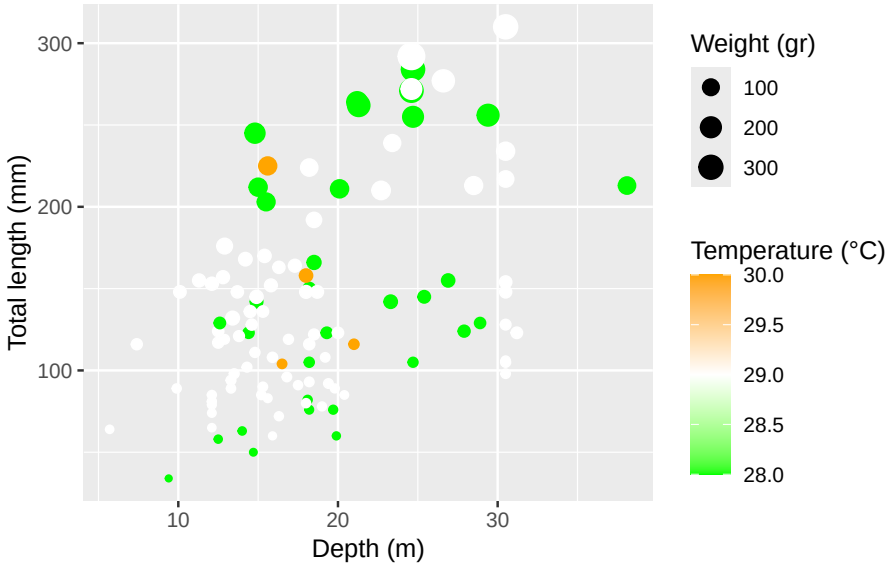

```
# Going through white
p +
  scale_color_gradient2(low = "green",
                        mid = "white",
                        high = "orange")
```

```
Scale for colour is already present.
Adding another scale for colour, which will replace the existing scale.
```



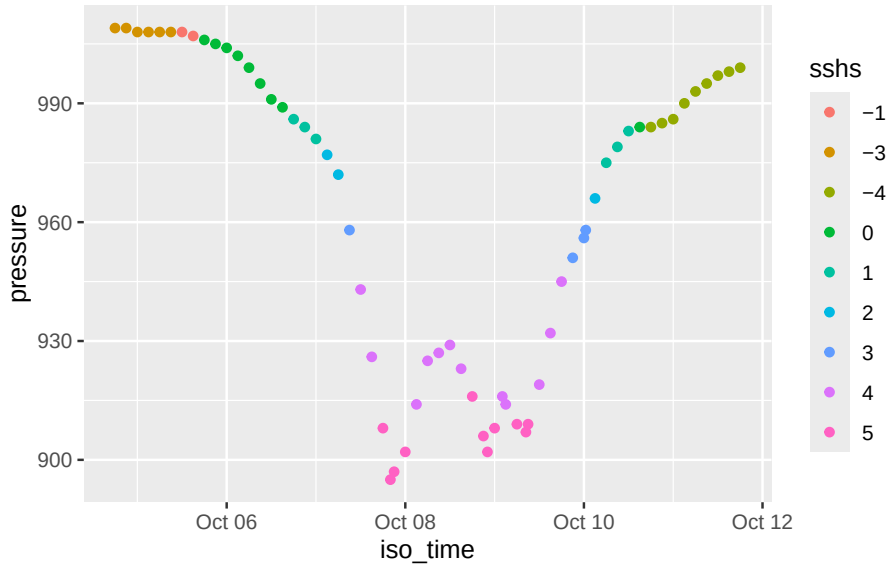
```
# Set white at 0
p +
  scale_color_gradient2(low = "green",
                        mid = "white",
                        high = "orange",
                        midpoint = 29)
```

```
Scale for colour is already present.
Adding another scale for colour, which will replace the existing scale.
```

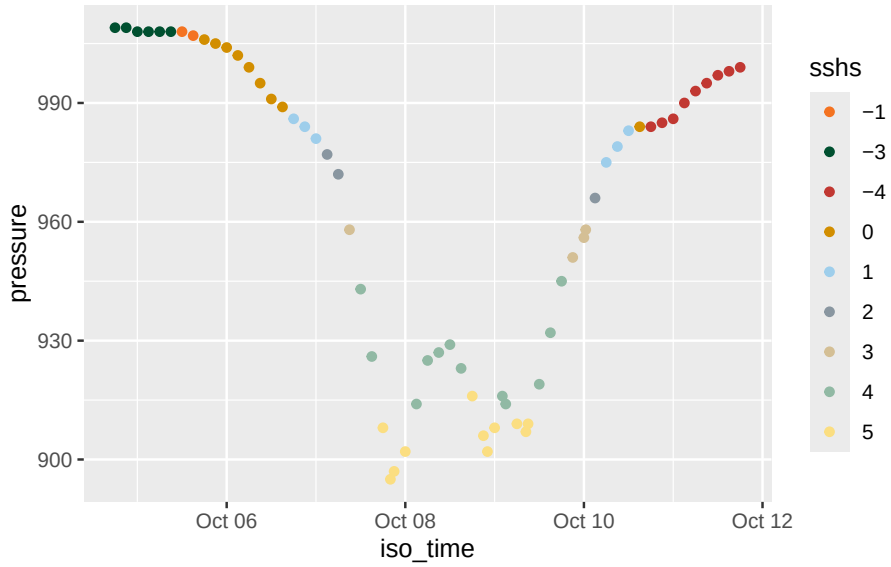


- `scale_color_manual` for discrete
  - Check documentation
  - An example

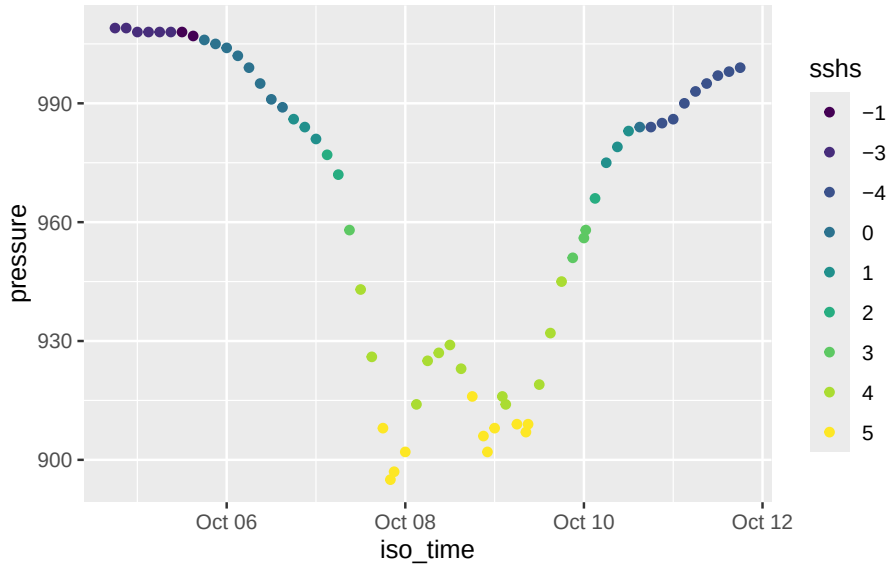
```
p <- ggplot(data = data_milton,
            aes(x = iso_time, y = pressure, color = sshs)) +
  geom_point()

p
```




```
p +
  scale_color_manual(values = palette_UM(n = 10))
```

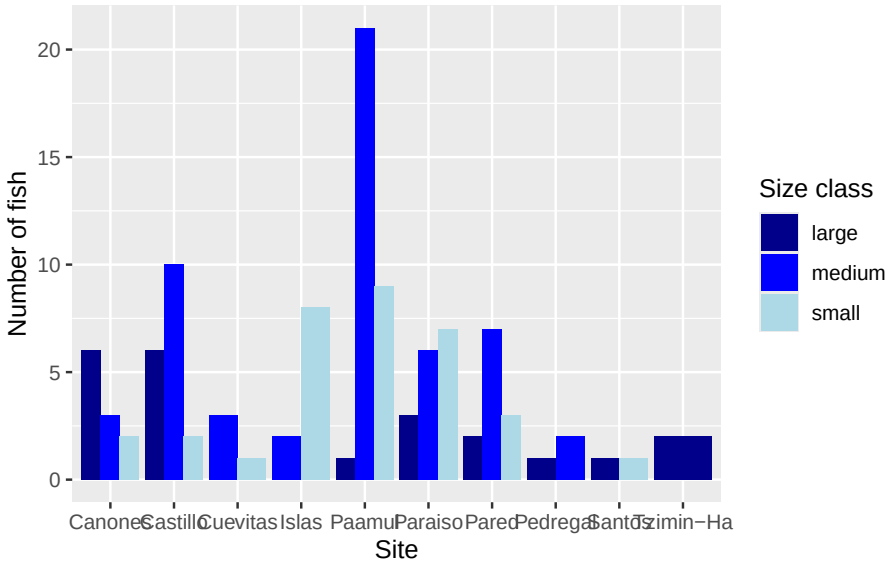



```
p +
  scale_color_viridis_d()
```



- `scale_*_manual`

```
# Example with manual color scale for discrete variables
ggplot(data = data_lionfish, aes(x = site, fill = size_class)) +
  geom_bar(position = "dodge") +
  scale_fill_manual(values = c("small" = "lightblue",
                               "medium" = "blue",
                               "large" = "darkblue")) +
  labs(x = "Site", y = "Number of fish", fill = "Size class")
```



Helpful resources

- ggplot cheatsheet

Part 5: Extra material if time allows

Saving plots

- Repeat the entire process, one line at a time, showing how to save to an object
- Then show how to save plot with ggsave
- Show documentation of ggsave
- Emphasize creating plot objects

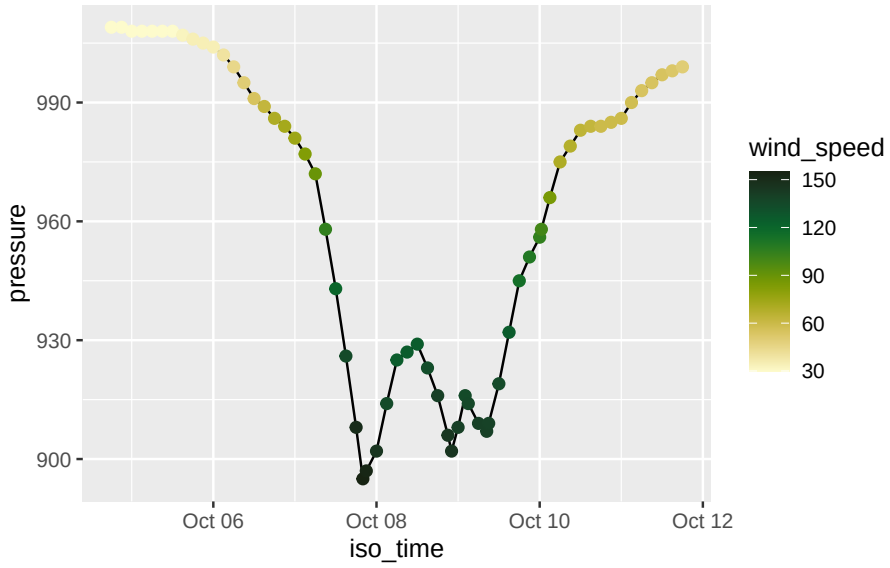
```
# Save plot to object
p <- ggplot(data = data_lionfish,
            mapping = aes(x = depth_m, y = total_length_mm)) +
  geom_point(shape = 21, fill = "steelblue", size = 2) +
  labs(x = "Depth (m)",
       y = "Total length (mm)",
       title = "Body length and depth")
```

```
# Save plot to file
ggsave("lionfish_depth_length.png", p, width = 8, height = 6, dpi = 300)
```

Layering

- Show `data_milton` documentation again
- Build plot below
- Show use of `color` vs `fill` inside main `aes()` (affecting line and points) vs `aes()` inside `geom_point()` (affecting only the poitns)

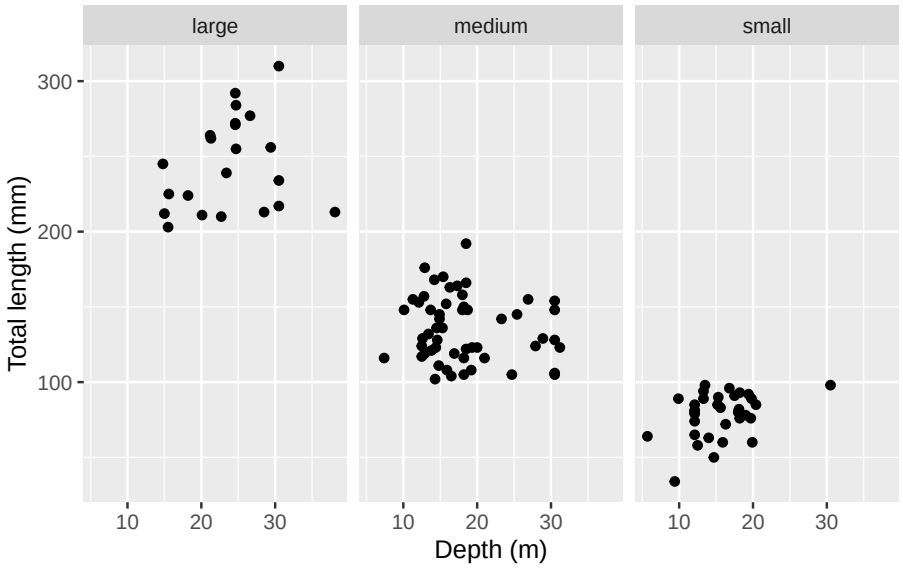
```
p <- ggplot(data = data_milton,
            mapping = aes(x = iso_time,
                          y = pressure,
            )) +
  geom_line() +
  geom_point(aes(color = wind_speed),
             size = 2)

p +
  scale_color_gradientn(colours = palette_IPCC(var = "wind", type = "seq"))
```



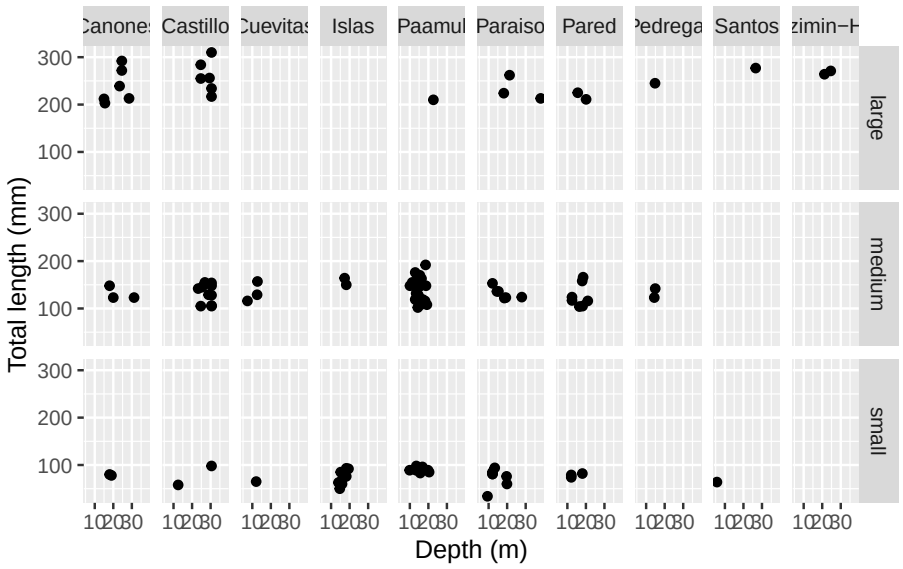
Facetting

- Show documentation for `facet_wrap` and `facet_grid`
- Show how each of these work

```
# Facet wrap example
ggplot(data = data_lionfish, aes(x = depth_m, y = total_length_mm)) +
  geom_point() +
  facet_wrap(~size_class, ncol = 3) +
  labs(x = "Depth (m)", y = "Total length (mm)")
```




```
# Facet grid example
ggplot(data = data_lionfish, aes(x = depth_m, y = total_length_mm)) +
  geom_point() +
  facet_grid(size_class ~ site) +
  labs(x = "Depth (m)", y = "Total length (mm)")
```




```
# Facet wrap with different scales
ggplot(data = data_lionfish, aes(x = depth_m, y = total_length_mm)) +
```

```
  geom_point() +
  facet_wrap(~size_class, ncol = 3, scales = "free_y") +
  labs(x = "Depth (m)", y = "Total length (mm)")
```