EVSC 3201 Materials

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Contents

Introduction

In light of the extenuating circumstances regarding COVID-19, I've decided to experiment with a new format for teaching the Fundamental of Ecology Lab. For the rest of the semester, I'll add instructions, notes, and videos to tabs on this site. The goal of these materials is to supplement the lab manual by providing some interactivity that we're missing out on by not meeting face-to-face. Assignments due each week will be added to the bottom of each page.

Chapter 1

Forest Lab Data Analysis: Results

See below for results from the forest lab field study. When answering the questions on page 27 of your lab manual, make sure your interpretations align with what's shown here.

1.1 Processing and analytical code

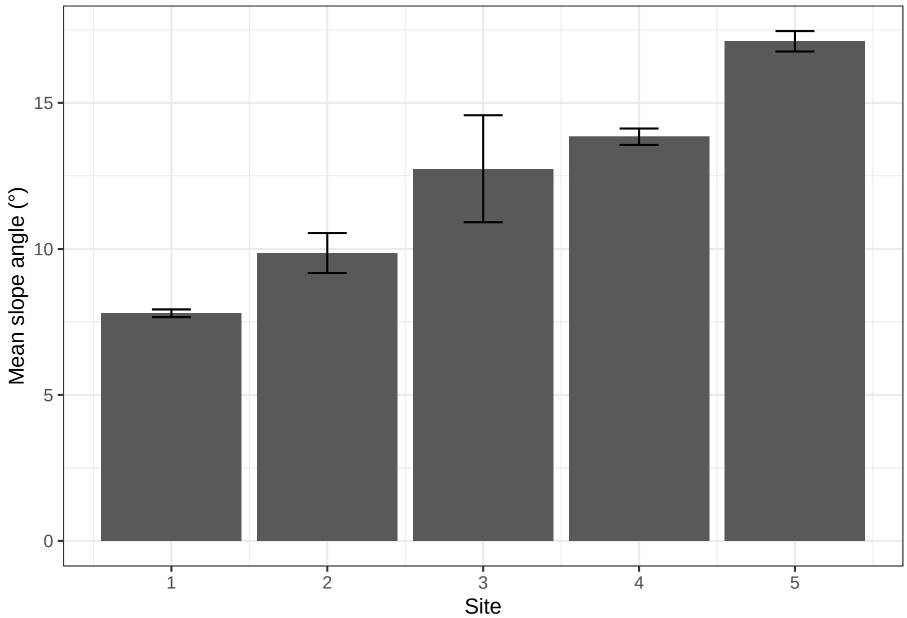
Important: This code must be evaluated prior to running any other code in this document. Note that I used `read_excel` to read in data directly from where it is located on my computer. To reproduce these analyses you will need to alter those lines to match where the data is located on your own computer.

```
# read in libraries
library(readxl)
library(tidyverse)


#read in data - change these lines to reflect where the data are stored on your computer
env = read_excel("/users/seanhardison/desktop/ecology lab/environmental_data.xlsx")
forest = read_excel("/users/seanhardison/desktop/ecology lab/forest_lab.xlsx")

#summarise data
summary_env = env %>%

  #create new column for slope angle
  mutate(slope_angle = atan(Rise/Run) * 180/pi) %>%

  #Tell R to group by Site for finding mean and standard deviation
```

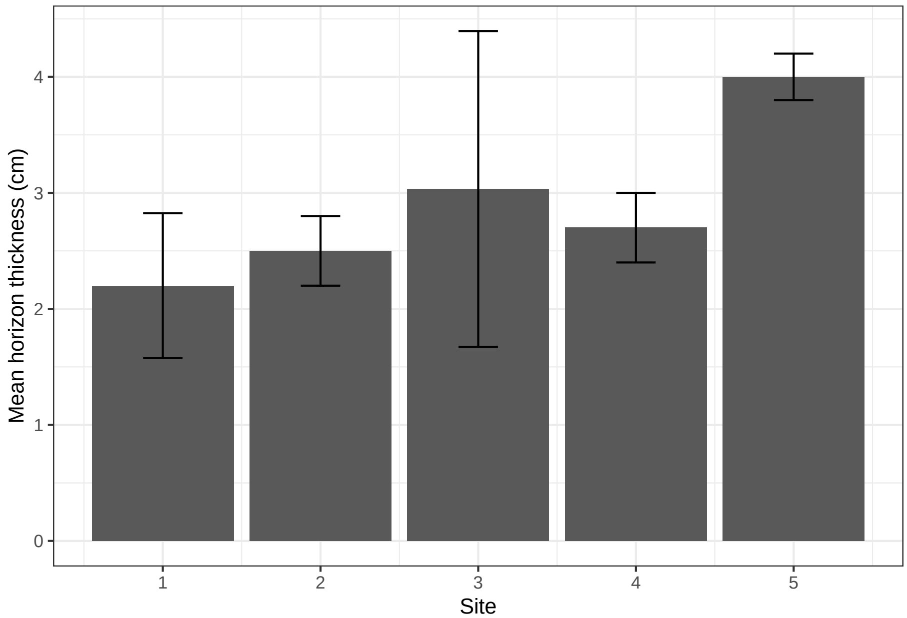
```
  group_by(Site) %>%

  #Find the mean and standard deviation by site
  summarise(mean_slope_angle = mean(slope_angle, na.rm = T),
            sd_slope_angle = sd(slope_angle, na.rm = T),

            mean_thickness = mean(`Horizon Thickness`),
            sd_thickness = sd(`Horizon Thickness`),

            mean_moisture = mean(`Soil Moisture`),
            sd_moisture = sd(`Soil Moisture`),

            mean_temperature = mean(`Soil Temperature`),
            sd_temperature = sd(`Soil Temperature`))
```

1.2 Environmental data: barplots (Q1)

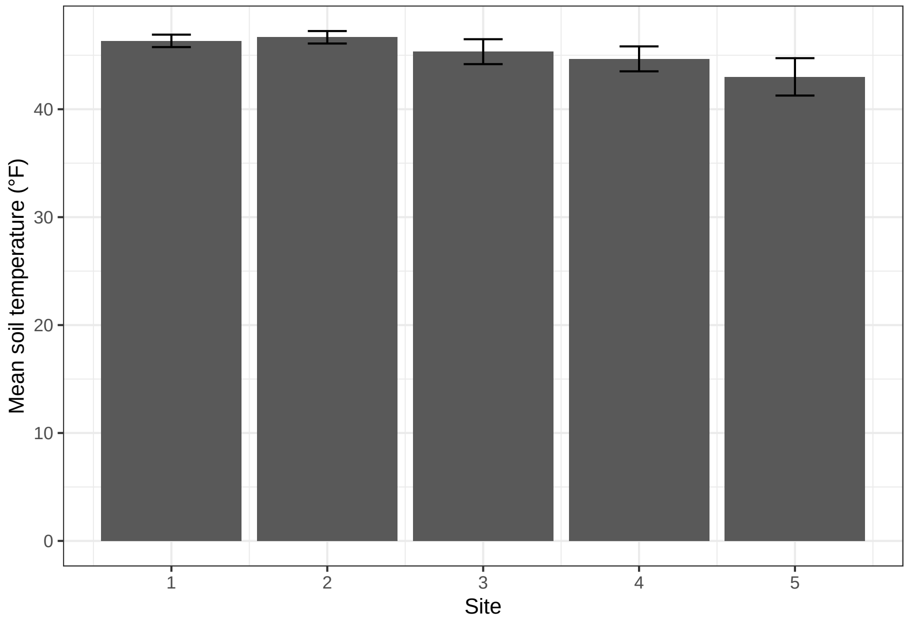
```
ggplot(summary_env) +
  geom_bar(aes(x = Site, y = mean_slope_angle), stat = "identity") +
  geom_errorbar(aes(x = Site, ymin = mean_slope_angle - sd_slope_angle,
                    ymax = mean_slope_angle + sd_slope_angle),
                width = 0.25) +
  ylab("Mean slope angle (°)") +
  theme_bw()
```



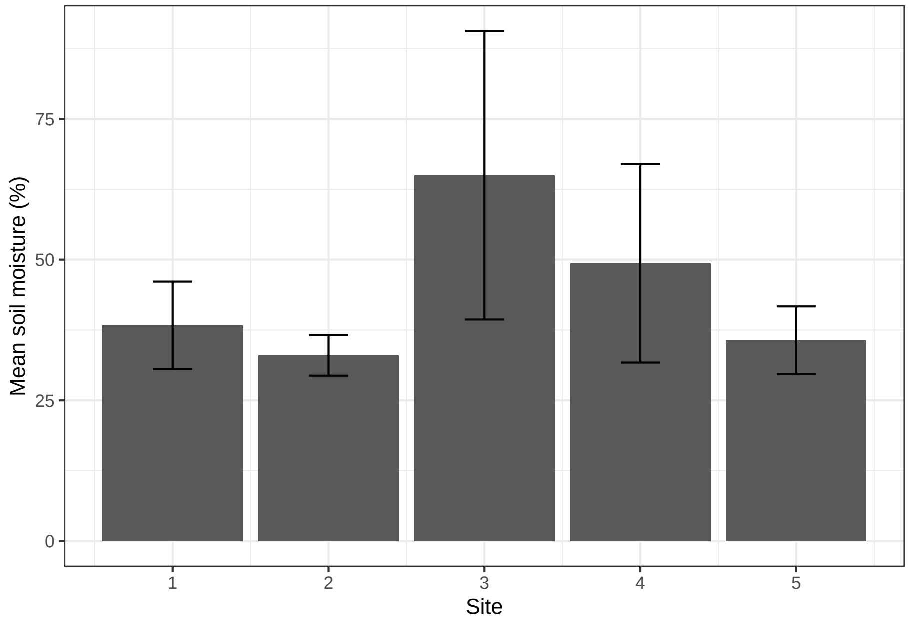

```
ggplot(summary_env) +
  geom_bar(aes(x = Site, y = mean_thickness), stat = "identity") +
  geom_errorbar(aes(x = Site, ymin = mean_thickness - sd_thickness,
                    ymax = mean_thickness + sd_thickness),
                width = 0.25) +
  ylab("Mean horizon thickness (cm)") +
  theme_bw()
```




```
ggplot(summary_env) +
  geom_bar(aes(x = Site, y = mean_temperature), stat = "identity") +
  geom_errorbar(aes(x = Site, ymin = mean_temperature - sd_temperature,
                    ymax = mean_temperature + sd_temperature),
                width = 0.25) +
  ylab("Mean soil temperature (°F)") +
  theme_bw()
```



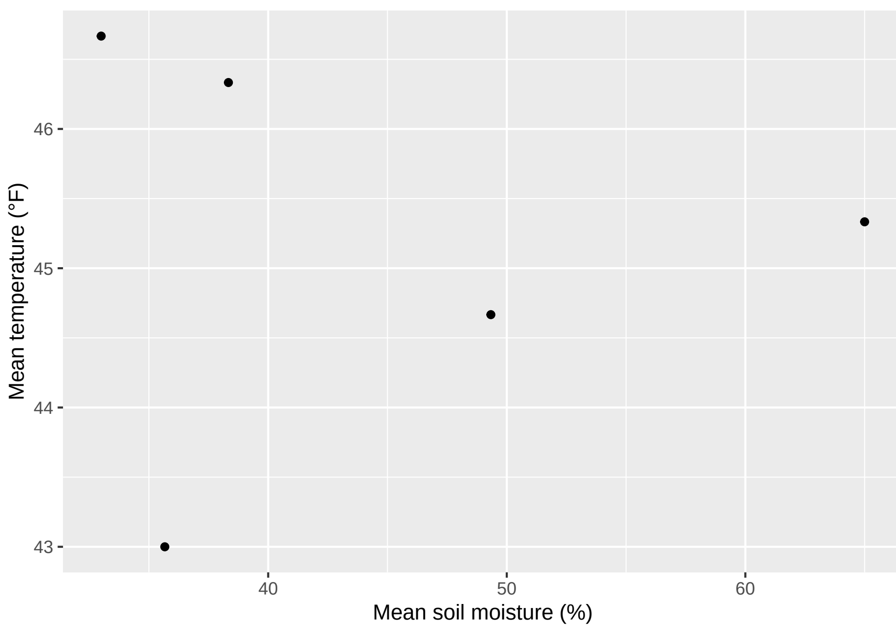

```
ggplot(summary_env) +
  geom_bar(aes(x = Site, y = mean_moisture), stat = "identity") +
  geom_errorbar(aes(x = Site, ymin = mean_moisture - sd_moisture,
                    ymax = mean_moisture + sd_moisture),
                width = 0.25) +
  ylab("Mean soil moisture (%)") +
  theme_bw()
```



1.3 Environmental data: linear models and scatter plots (Q2)

Lines of best fit are shown on plots when significant relationships (P < 0.05) are identified using linear models.

```
ggplot(summary_env) +
  geom_point(aes(x = mean_moisture, y = mean_temperature)) +
  ylab("Mean temperature (°F)") +
  xlab("Mean soil moisture (%)")
```

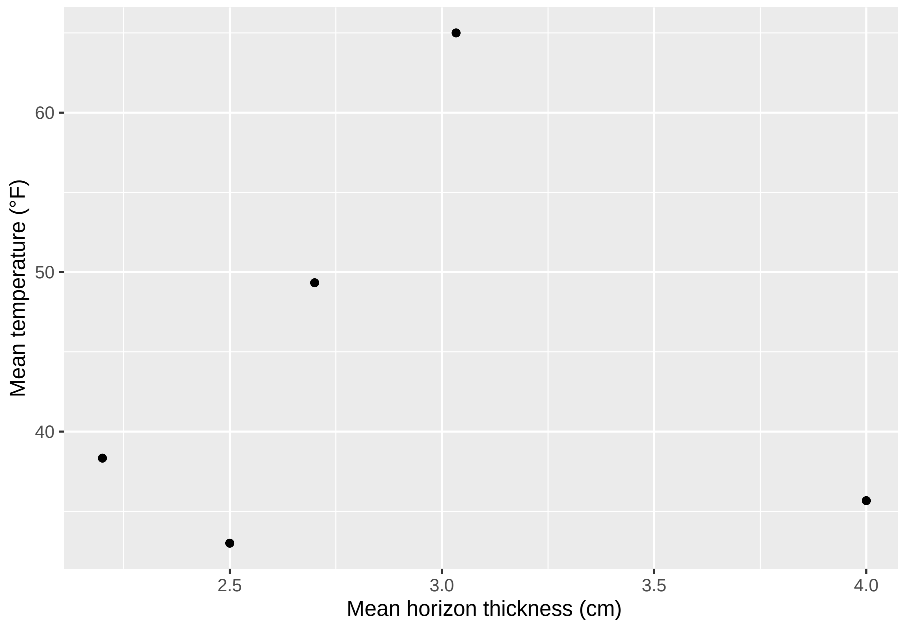



```r
temp_moisture_mod = lm(mean_temperature ~ mean_moisture, data = summary_env)
summary(temp_moisture_mod)
```

```
##
## Call:
## lm(formula = mean_temperature ~ mean_moisture, data = summary_env)
##
## Residuals:
##       1       2       3       4       5
##  1.0967  1.3972  0.2612 -0.5021 -2.2531
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   45.473075   2.940404  15.465 0.000587 ***
## mean_moisture -0.006169   0.064197  -0.096 0.929507
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.688 on 3 degrees of freedom
## Multiple R-squared:  0.003068,   Adjusted R-squared:  -0.3292
## F-statistic: 0.009234 on 1 and 3 DF,  p-value: 0.9295
```

soil moisture ~ horizon thickness

```
ggplot(summary_env) +
  geom_point(aes(x = mean_thickness, y = mean_moisture)) +
  ylab("Mean temperature (°F)") +
  xlab("Mean horizon thickness (cm)")
```

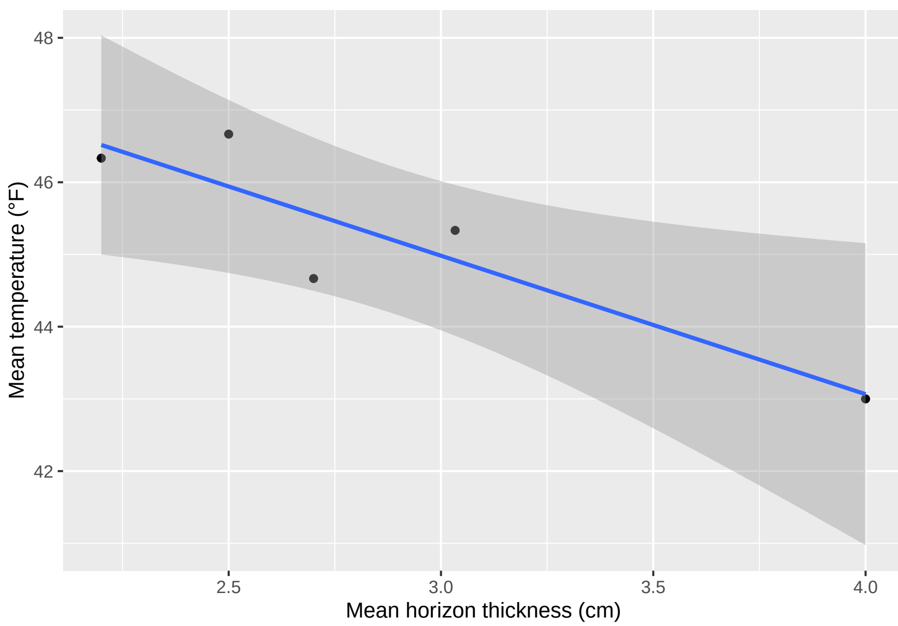



```
moist_hor_thickness_mod = lm(mean_moisture ~ mean_thickness, data = summary_env)
summary(moist_hor_thickness_mod)
```

```
##
## Call:
## lm(formula = mean_moisture ~ mean_thickness, data = summary_env)
##
## Residuals:
##       1       2       3       4       5
##  -5.593 -11.075  20.661   5.159  -9.152
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     42.8344    32.3667   1.323    0.278
## mean_thickness   0.4962    10.9631   0.045    0.967
##
## Residual standard error: 15.18 on 3 degrees of freedom
## Multiple R-squared:  0.0006823,  Adjusted R-squared:  -0.3324
## F-statistic: 0.002048 on 1 and 3 DF,  p-value: 0.9667
```

soil temperature ~ horizon thickness

```
ggplot(summary_env) +
  geom_point(aes(x = mean_thickness, y = mean_temperature)) +
  ylab("Mean temperature (°F)") +
  xlab("Mean horizon thickness (cm)") +
  geom_smooth(aes(x = mean_thickness, y = mean_temperature), method = "lm")
```



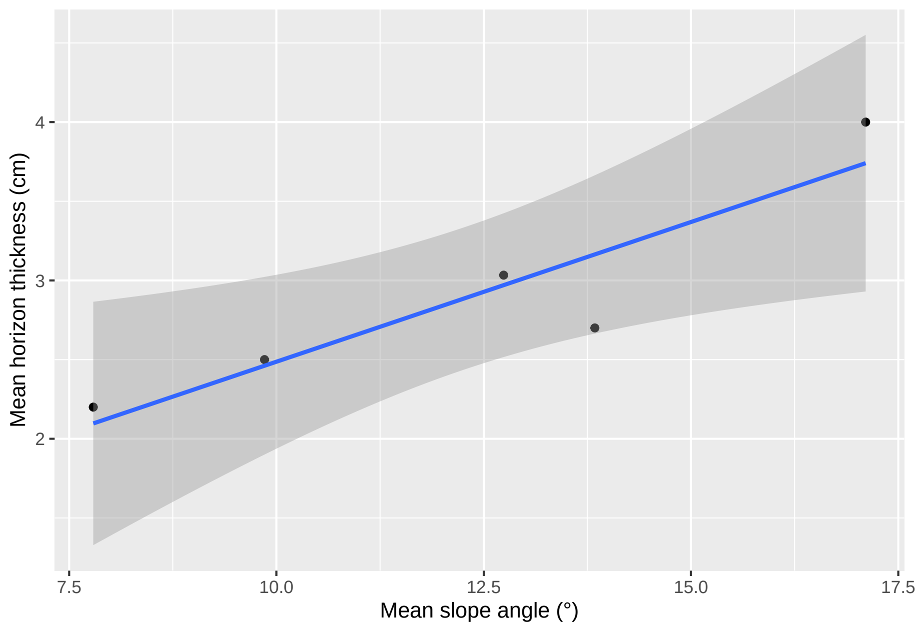

```
temp_thick_mod = lm(mean_temperature ~ mean_thickness, data = summary_env)
summary(temp_thick_mod)
```

```
##
## Call:
## lm(formula = mean_temperature ~ mean_thickness, data = summary_env)
##
## Residuals:
##        1        2        3        4        5
## -0.18332  0.72525  0.41456 -0.89126 -0.06523
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     50.7351     1.5229  33.316 5.94e-05 ***
## mean_thickness  -1.9175     0.5158  -3.717   0.0339 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 0.7142 on 3 degrees of freedom
## Multiple R-squared:  0.8216, Adjusted R-squared:  0.7622
## F-statistic: 13.82 on 1 and 3 DF,  p-value: 0.03387
```

horizon thickness ~ slope angle

```
ggplot(summary_env) +
  geom_point(aes(x = mean_slope_angle, y = mean_thickness)) +
  ylab("Mean horizon thickness (cm)") +
  xlab("Mean slope angle (°)") +
  geom_smooth(aes(x = mean_slope_angle, y = mean_thickness), method = "lm")
```



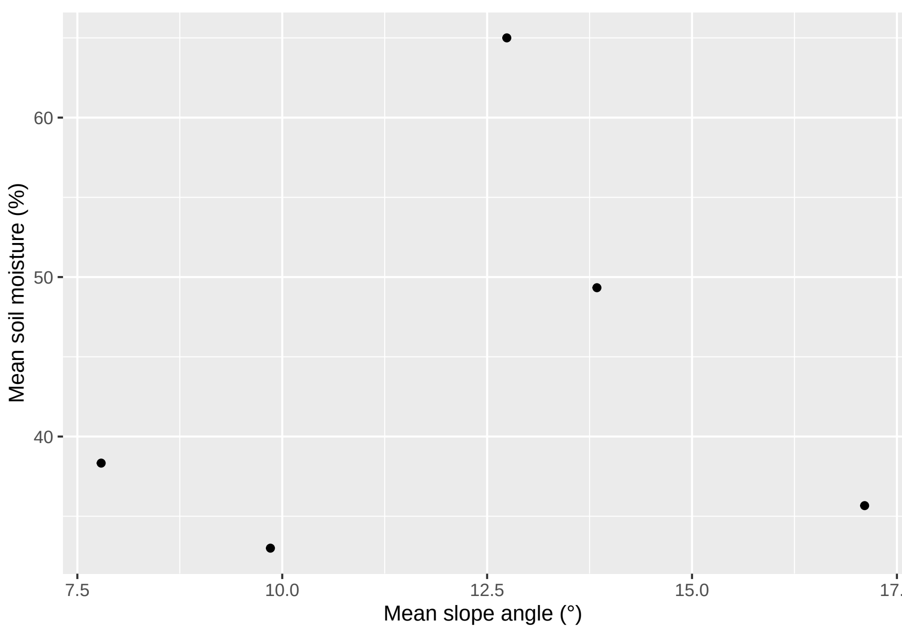

```
thickness_slope_mod = lm(mean_thickness ~ mean_slope_angle, data = summary_env)
summary(thickness_slope_mod)
```

```
##
## Call:
## lm(formula = mean_thickness ~ mean_slope_angle, data = summary_env)
##
## Residuals:
##        1        2        3        4        5
##  0.10310  0.03869  0.06312 -0.46425  0.25934
##
## Coefficients:
```

```
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        0.72216    0.55535    1.30   0.2844
## mean_slope_angle   0.17646    0.04379    4.03   0.0275 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3156 on 3 degrees of freedom
## Multiple R-squared:  0.8441, Adjusted R-squared:  0.7921
## F-statistic: 16.24 on 1 and 3 DF,  p-value: 0.02747
```

soil moisture ~ slope angle

```
ggplot(summary_env) +
  geom_point(aes(x = mean_slope_angle, y = mean_moisture)) +
  ylab("Mean soil moisture (%)") +
  xlab("Mean slope angle (°)")
```




```
moist_slope_mod = lm(mean_moisture ~ mean_slope_angle, data = summary_env)
summary(moist_slope_mod)
```

```
##
## Call:
## lm(formula = mean_moisture ~ mean_slope_angle, data = summary_env)
##
## Residuals:
```

```
##       1       2       3       4       5
##  -3.360  -9.881  20.461   4.162 -11.383
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)        37.213     26.381   1.411    0.253
## mean_slope_angle    0.575      2.080   0.276    0.800
##
## Residual standard error: 14.99 on 3 degrees of freedom
## Multiple R-squared:  0.02484,    Adjusted R-squared:  -0.3002
## F-statistic: 0.07642 on 1 and 3 DF,  p-value: 0.8002
```

1.4 Table of model summaries (Q4)

Relationship (y ~ x)	slope	y-intercept	R^2	P value
soil temperature ~ soil moisture	-0.006	45.473	0.003	0.930
soil moisture ~ horizon thickness	0.496	42.834	0.001	0.967
soil temperature ~ horizon thickness	-1.917	50.735	0.822	0.034
horizon thickness ~ slope angle	0.176	0.722	0.844	0.027
soil moisture ~ slope angle	0.575	37.213	0.025	0.800

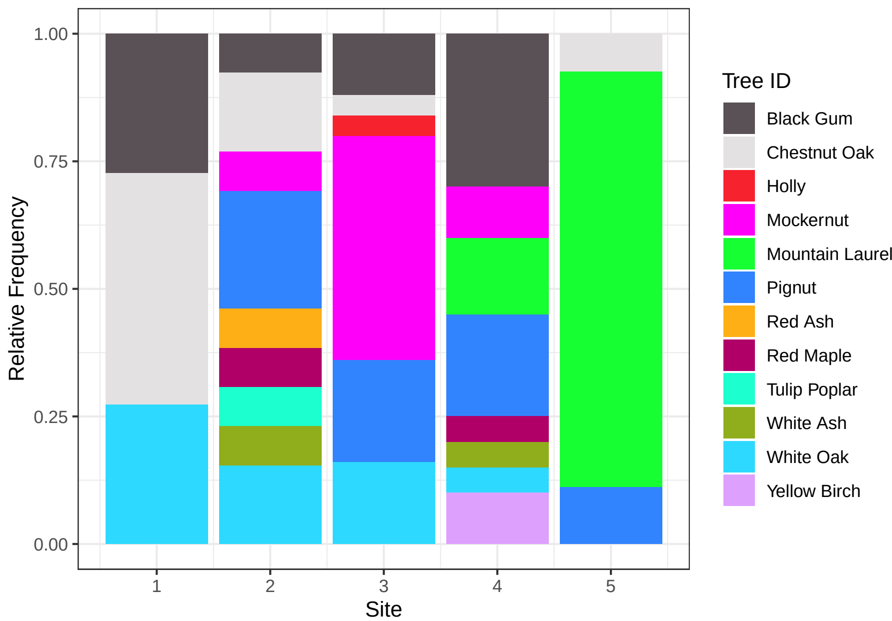
1.5 Tree community composition

In order to better visualize individual species, I added a line specifying a new color palette: `... + scale_fill_manual(values = as.vector(pals::polychrome(35)))`.

Species relative frequency

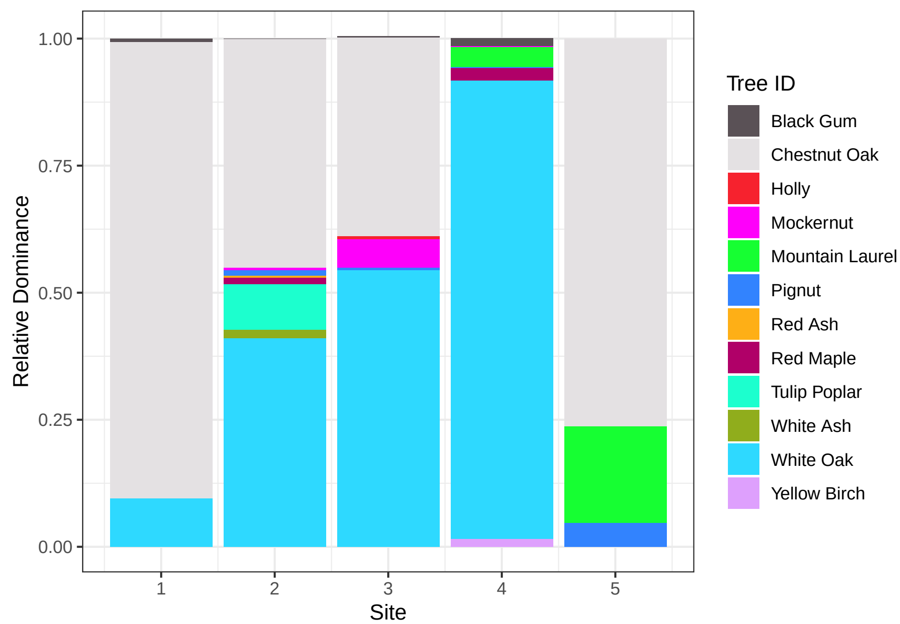
```r
# Data processing
rel_freq = forest %>%

  # Select columns we want to plot
  select(Site, `Relative Frequency`, `Tree ID`) %>%

  # Get distinct values of each row
  distinct()

# Plot the data
ggplot(data = rel_freq) +
  geom_bar(aes(x = Site, y = `Relative Frequency`,
               fill = `Tree ID`), stat = "identity") +
```

```
  #add color palette
  scale_fill_manual(values = as.vector(pals::polychrome(35)))+
  theme_bw()
```

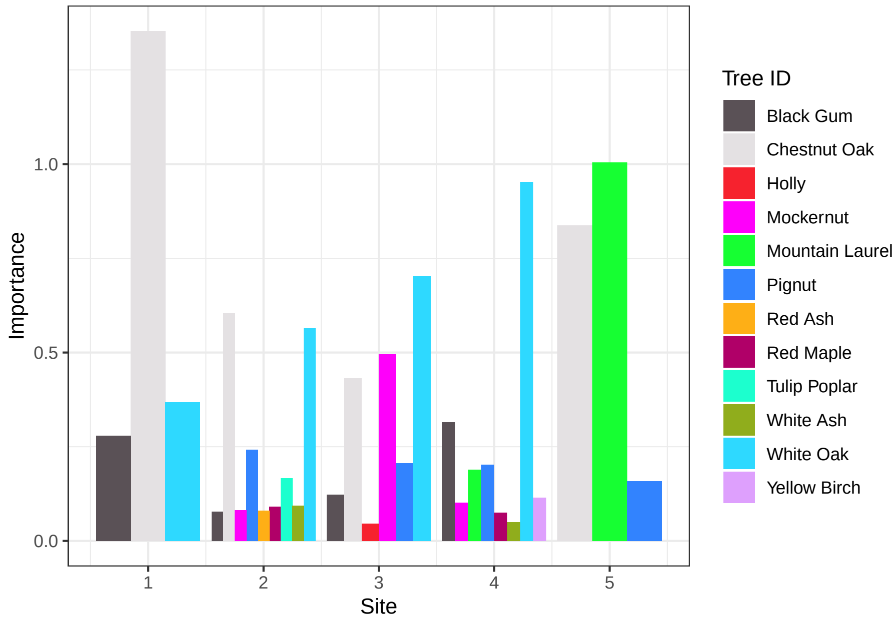


Species relative dominance

```
# Data processing
rel_dom = forest %>%

  # Select columns we want to plot
  select(Site, `Relative Dominance`, `Tree ID`) %>%

  # Get distinct values of each row
  distinct()

# Plot the data
ggplot(data = rel_dom) +
  geom_bar(aes(x = Site, y = `Relative Dominance`,
               fill = `Tree ID`), stat = "identity") +

  #add color palette
  scale_fill_manual(values = as.vector(pals::polychrome(35)))+
  theme_bw()
```




```
# Data processing
importance = forest %>%

  # Select columns we want to plot
  select(Site, Importance, `Tree ID`) %>%

  # Get distinct values of each row
  distinct()

# Plot the data
ggplot(data = importance) +
  geom_bar(aes(x = Site, y = Importance,
               fill = `Tree ID`),
           position = "dodge", stat = "identity") +

  #add color palette
  scale_fill_manual(values = as.vector(pals::polychrome(35))) +
  theme_bw()
```


Importance
0.0
0.5
1.0
1
2
3
4
5
Site
Tree ID
Black Gum
Chestnut Oak
Holly
Mockernut
Mountain Laurel
Pignut
Red Ash
Red Maple
Tulip Poplar
White Ash
White Oak
Yellow Birch

Chapter 2

Stream Lab (week of 3/27)

2.1 Supplemental videos

Stream stressors: impervious surfaces

Stream restoration in Baltimore County

Stream characteristics: pools and riffles