

Jacob Aleixo
BIO II
TA: Theresa

Assignment 1: measuring species diversity

In this lab, we measured plankton species diversity at two Narragansett Bay sites, Fox Island and the GSO Dock, during both incoming and outgoing tides. Using Simpson's Diversity Index, we compared diversity values across sites and tides with recent class data and long-term data collected from 1999–2017. Our goal was to test null and alternate hypotheses about whether tide direction influences plankton diversity, and to examine seasonal and long-term trends in diversity at Fox Island.

A) Hypotheses

Experiment 1: compare the species diversity values at Fox Island on incoming tide to outgoing tide

H0: There is no difference in plankton species diversity between incoming and outgoing tides at Fox Island.

HA: Plankton species diversity is greater during the incoming tide at Fox Island.

Experiment 2: compare the species diversity at GSO on incoming tide to outgoing tide

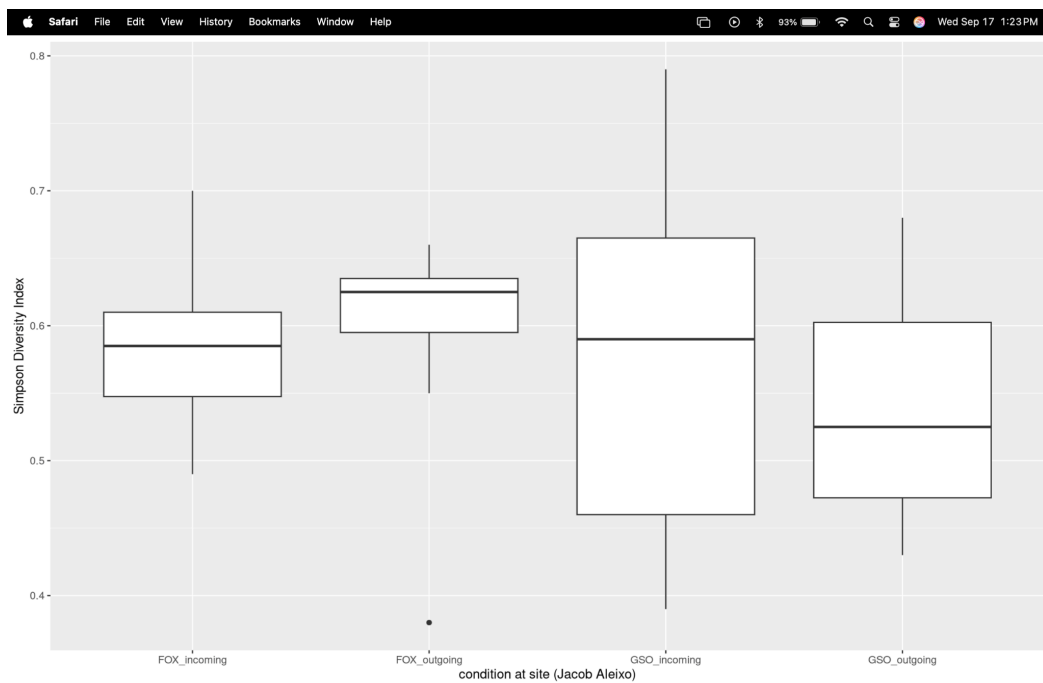
H0: There is no difference in plankton species diversity between incoming and outgoing tides at the GSO Dock.

HA: Plankton species diversity is greater during the incoming tide at the GSO Dock.

B) Class data analysis (counting 2025 plankton sample in lab)

Site	Tide	n	Min	Median	Max
Fox Island	Incoming	8	0.49	0.585	0.7
Fox Island	Outgoing	8	0.38	0.625	0.66
GSO Dock	Incoming	8	0.39	0.59	0.79
GSO Dock	Outgoing	8	0.43	0.525	0.68

[Summary lab]

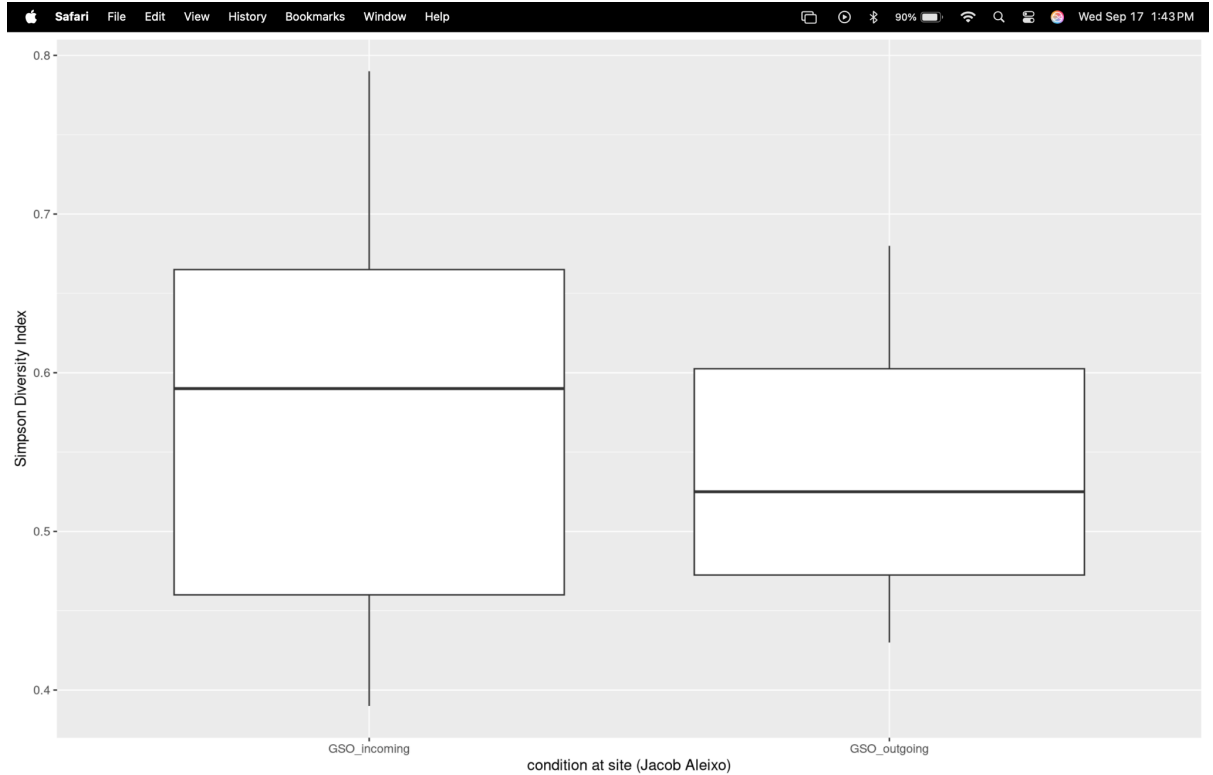


[figure 1 - Fox island]



Boxplot of Simpson's Diversity Index for plankton samples collected at Fox Island during incoming ($n = 8$) and outgoing ($n = 8$) tides. Higher values represent greater plankton diversity.

[Figure 2 - GSO]



Boxplot of Simpson's Diversity Index for plankton samples collected at the GSO Dock during incoming (n = 8) and outgoing (n = 8) tides. Higher values represent greater plankton diversity.

Result

Highest vs. lowest median

The medians were Fox incoming = 0.585, Fox outgoing = 0.625, GSO incoming = 0.590, and GSO outgoing = 0.525. The highest median was Fox outgoing (0.625), and the lowest was GSO outgoing (0.525).

Variation between sites

Ranges (max – min) were Fox incoming = 0.21, Fox outgoing = 0.28, GSO incoming = 0.40, and GSO outgoing = 0.25. GSO incoming had the greatest variation, while Fox incoming had the least.

Fox Island hypothesis

At Fox Island, the medians were close (0.585 vs. 0.625), showing little difference. Because of this, the null hypothesis was not rejected.

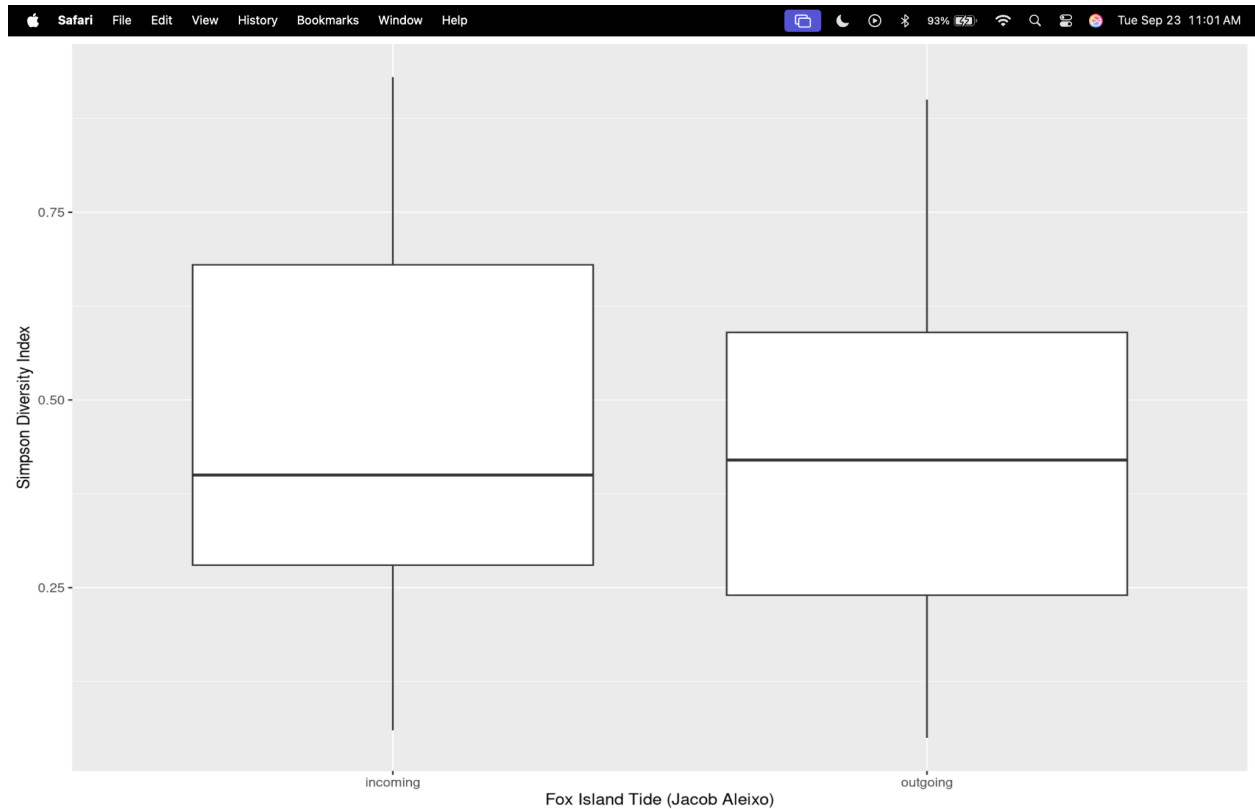
GSO Dock hypothesis

At the GSO Dock, incoming was slightly higher (0.590 vs. 0.525), but the ranges overlapped. Because of this, the null hypothesis was also not rejected.

Overall, Fox outgoing had the highest median diversity, GSO outgoing had the lowest, and GSO incoming showed the most variation. Both sites showed overlap in results, so the null hypotheses were not rejected.

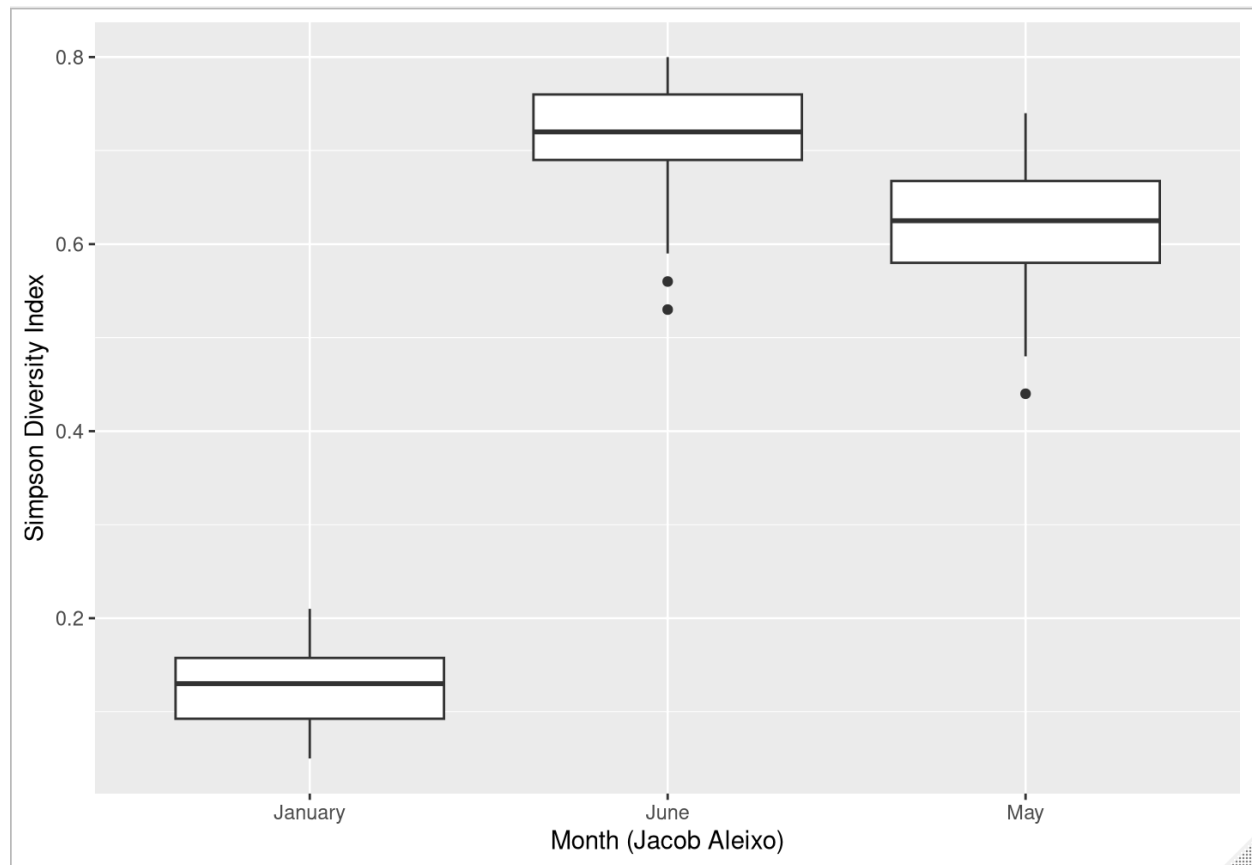
Part C) Long-term data from Fox Island site (plankton samples counted from 1999 – 2017)

Figure 3. Boxplot of Fox Island Long-term data by tide



Boxplot of long-term Simpson's Diversity Index values for Fox Island plankton samples (1999–2017), separated by incoming (n = 228) and outgoing (n = 228) tides. Median diversity values were 0.40 for incoming and 0.42 for outgoing tides, with ranges of 0.06–0.93 and 0.05–0.90, respectively. Higher values indicate greater plankton diversity.

Figure 4. Boxplot of Fox Island Long-term data for 3 months



Boxplot of long-term Simpson's Diversity Index values for Fox Island plankton samples during January ($n = 38$), May ($n = 38$), and June ($n = 38$) from 1999–2017. Median diversity values were 0.13 for January, 0.625 for May, and 0.72 for June, with ranges of 0.05–0.21, 0.44–0.74, and 0.53–0.80, respectively. Higher values indicate greater plankton diversity.

Results Part 2

After viewing the median values for incoming and outgoing tides, I found that outgoing had the higher median at 0.42 compared to 0.40 for incoming, meaning outgoing showed slightly greater diversity. For variation, incoming had the wider range with a minimum of 0.06 and maximum of 0.93, while outgoing ranged from 0.05 to 0.90. This shows incoming had the greater spread in diversity values. Looking at Figure 4, the medians for the three months were January = 0.13, May = 0.625, and June = 0.72, so June had the highest median diversity index. Finally, the ranges were January = 0.16, May = 0.30, and June = 0.27, showing that May had the greatest variation of the three months.

- Higher median tide: Outgoing (0.42 vs. 0.40)
- Greater variation tide: Incoming (0.06–0.93)
- Highest month median: June (0.72)
- Greatest month variation: May (0.30)

These results show outgoing tides had slightly higher diversity, while incoming tides had more variability. June had the highest diversity, while May showed the most variation.

Part D)

```
# Jacob Aleixo, TA: Theresa
# Assignment 1: Measuring Species Diversity
# BIO 104 Lab A1

# -----
# Load libraries
# -----
library(gsheet) # to pull class/long-term data directly from Google Sheets
library(ggplot2) # to make boxplots
library(dplyr)  # to filter and summarize data

# -----
# Load Class Data (Section B)
# -----
url_class <-
'https://docs.google.com/spreadsheets/d/1iirObM-FBJjKvAvLMBsc1Ms-196t9MAo3G6d
V0p1ks/edit?gid=604983628#gid=604983628'
diversitydata <- gsheets2tbl(url_class)

# Summary stats for Table 1
diversitydata %>%
  group_by(SiteType) %>%
  summarise(
    n = n(),
    min = min(Diversity, na.rm = TRUE),
    median = median(Diversity, na.rm = TRUE),
    max = max(Diversity, na.rm = TRUE)
  )

# Boxplot: Fox Island
FOXonly <- filter(diversitydata, SiteType %in% c("FOX_incoming", "FOX_outgoing"))
ggplot(FOXonly, aes(x=SiteType, y=Diversity)) +
  geom_boxplot() +
  scale_x_discrete(name="Fox Island Tide (Jacob Aleixo)") +
  scale_y_continuous(name="Simpson Diversity Index")

# Boxplot: GSO Dock
GSOonly <- filter(diversitydata, SiteType %in% c("GSO_incoming", "GSO_outgoing"))
ggplot(GSOonly, aes(x=SiteType, y=Diversity)) +
  geom_boxplot() +
  scale_x_discrete(name="GSO Dock Tide (Jacob Aleixo)") +
  scale_y_continuous(name="Simpson Diversity Index")
```

```

# -----
# Load Long-Term Data (Section C)
# -----
url_long <-
'https://docs.google.com/spreadsheets/d/1RdEzJqLi1vRcpR80nH__0n7nJJ8gPZxoxxuH
QqvtbWs/edit?gid=0#gid=0'
longtermdata <- gsheets2tbl(url_long)

# Boxplot: Fox Island long-term by tide
ggplot(longtermdata, aes(x=Tide, y=Diversity)) +
  geom_boxplot() +
  scale_x_discrete(name="Fox Island Tide (Jacob Aleixo)") +
  scale_y_continuous(name="Simpson Diversity Index")

# Boxplot: Long-term for 3 months (Jan, May, June)
months_subset <- filter(longtermdata, Month %in% c("January", "May", "June"))
ggplot(months_subset, aes(x=Month, y=Diversity)) +
  geom_boxplot() +
  scale_x_discrete(name="Month (Jacob Aleixo)") +
  scale_y_continuous(name="Simpson Diversity Index")

# Summary stats for 3 months
months_subset %>%
  group_by(Month) %>%
  summarise(
    n = n(),
    min = min(Diversity, na.rm = TRUE),
    median = median(Diversity, na.rm = TRUE),
    max = max(Diversity, na.rm = TRUE)
  )

```

Overall, the class data showed small differences in diversity between incoming and outgoing tides at both Fox Island and the GSO Dock, with overlapping ranges that led us to not reject the null hypotheses. Long-term data analysis suggested slight differences between tides at Fox Island, with outgoing tides having a slightly higher median and incoming tides showing more variation. When comparing months, June consistently showed higher diversity, while May showed more variation. These results highlight the natural variability in plankton diversity and the importance of long-term monitoring to detect broader patterns in Narragansett Bay ecosystems.