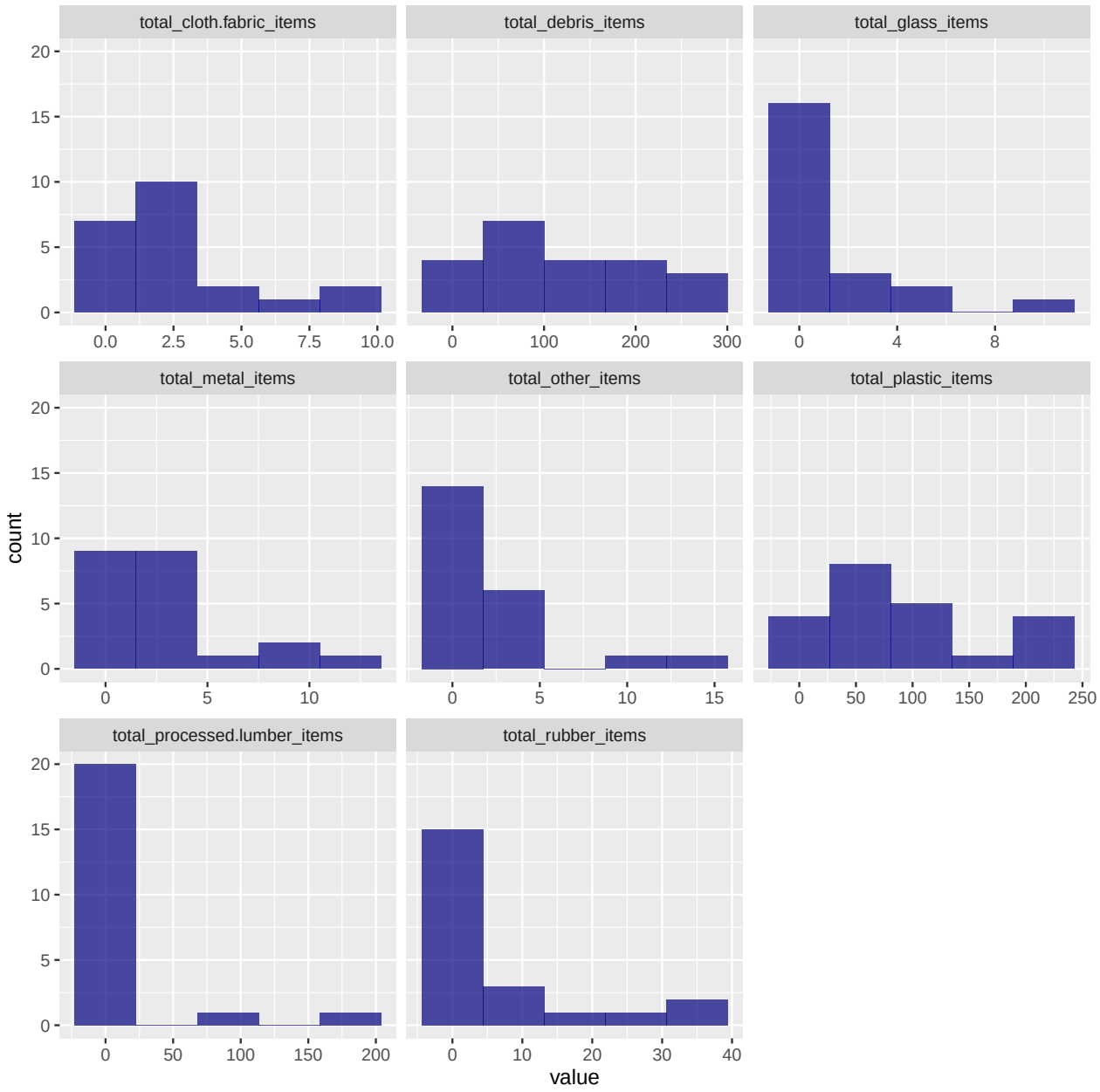
Debris Univariate Analysis - No Backbarrier

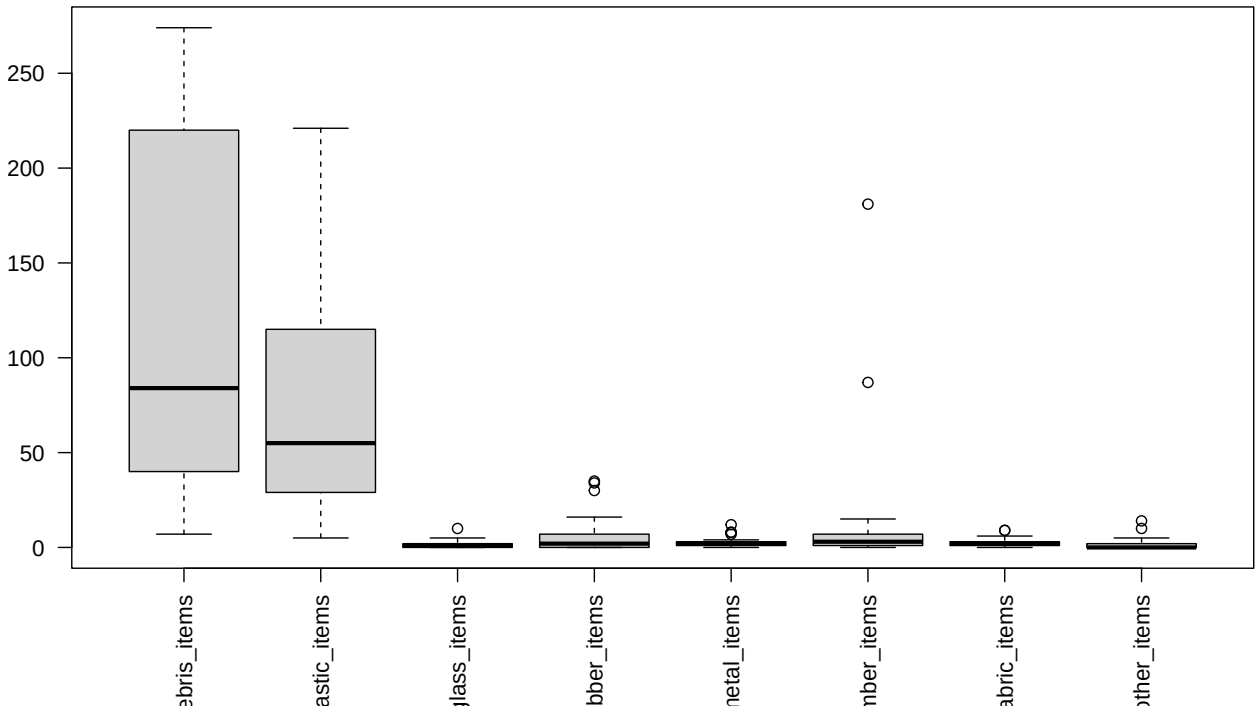
```
debris_df = read.csv("data/debris_data_no_backbarrier.csv")

totals_cols <- c(
  "total_debris_items",
  "total_plastic_items",
  "total_glass_items",
  "total_rubber_items",
  "total_metal_items",
  "total_processed.lumber_items",
  "total_cloth.fabric_items",
  "total_other_items"

)

numeric_columns <- c(
  "total_debris_items",
  "total_plastic_items",
  "total_glass_items",
  "total_rubber_items",
  "total_metal_items",
  "total_processed.lumber_items",
  "total_cloth.fabric_items",
  "total_other_items",
  "plastic.fragments.film",
  "plastic.fragments.foamed",
  "plastic.fragments.hard",
  "plastic.bags",
  "plastic.beverage.bottles",
  "plastic.bottle.or.container.caps",
  "plastic.cups",
  "plastic.food.wrappers",
  "plastic.other.jugs.or.containers",
  "plastic.straws",
  "plastic.utensils",
  "plastic.6.pack.rings",
  "plastic.cigar.tips",
  "plastic.cigarettes",
  "plastic.disposable.cigarette.lighters",
  "plastic.buoys.and.floats",
  "plastic.fishing.lures.and.line",
  "plastic.rope.and.nets",
  "plastic.balloons",
  "plastic.personal.care.products",
  "plastic.shotgun.shells.wads",
  "plastic.other", "metal.fragments",
  "metal.aerosol.cans",
```

```
  "metal.aluminum.tin.cans",
  "metal.other",
  "glass.fragments",
  "glass.beverage.bottles",
  "glass.jars",
  "glass.other",
  "rubber.fragments",
  "rubber.balloons",
  "rubber.flip.flops",
  "rubber.gloves",
  "rubber.tires",
  "rubber.other",
  "processed.lumber.building.material",
  "processed.lumber.paper.and.cardboard",
  "processed.lumber.bags",
  "processed.lumber.other",
  "cloth.fabric.fragments",
  "cloth.fabric.clothing.and.shoes",
  "cloth.fabric.face.masks",
  "cloth.fabric.gloves",
  "cloth.fabric.rope.and.nets",
  "cloth.fabric.towels.rags",
  "cloth.fabric.other",
  "other.other",
  "plastic.other.fireworks",
  "metal.other.construction.material",
  "rubber.other.lobster.claw.rubber.bands",
  "processed.lumber.paper.and.cardboard.fireworks",
  "other.other.asphalt",
  "other.other.brick",
  "other.other.wax")

debris_df <- debris_df[, sapply(debris_df, class) != "logical"]
debris_df$year <- substr(debris_df$survey_date, 1, 4)

write.csv(debris_df, "cleaned_debris_no_backbarrier.csv")
```

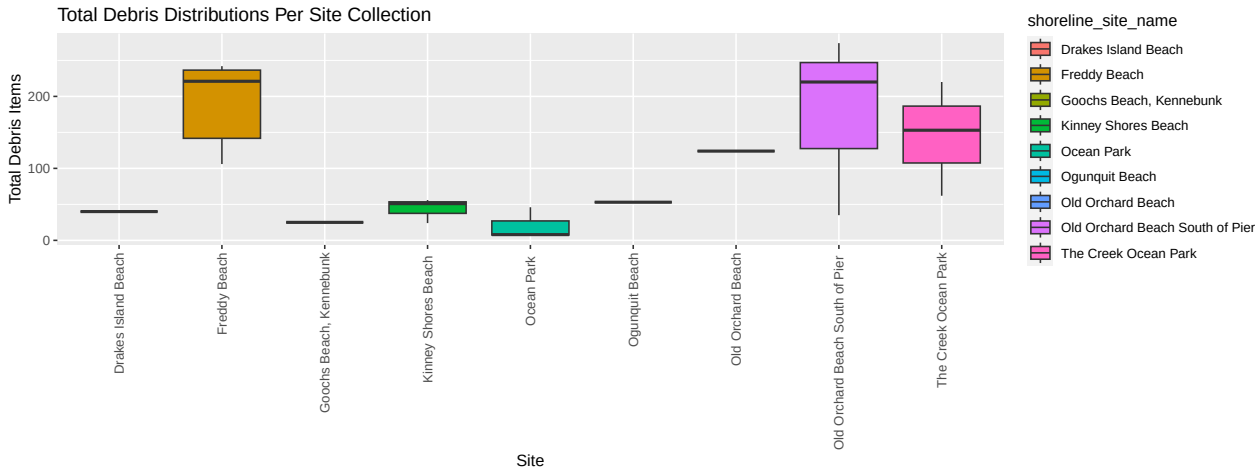
```
#hist(debris_df[test_cols])
#install.packages("tidyverse")
#install.packages("GGally")

# For ALL DATA
library(tidyr)
library(ggplot2)
ggplot(gather(debris_df[totals_cols]), aes(value)) +
    geom_histogram(bins = 5, fill="navyblue", alpha=.7) +
    facet_wrap(~key, scales = 'free_x')
```



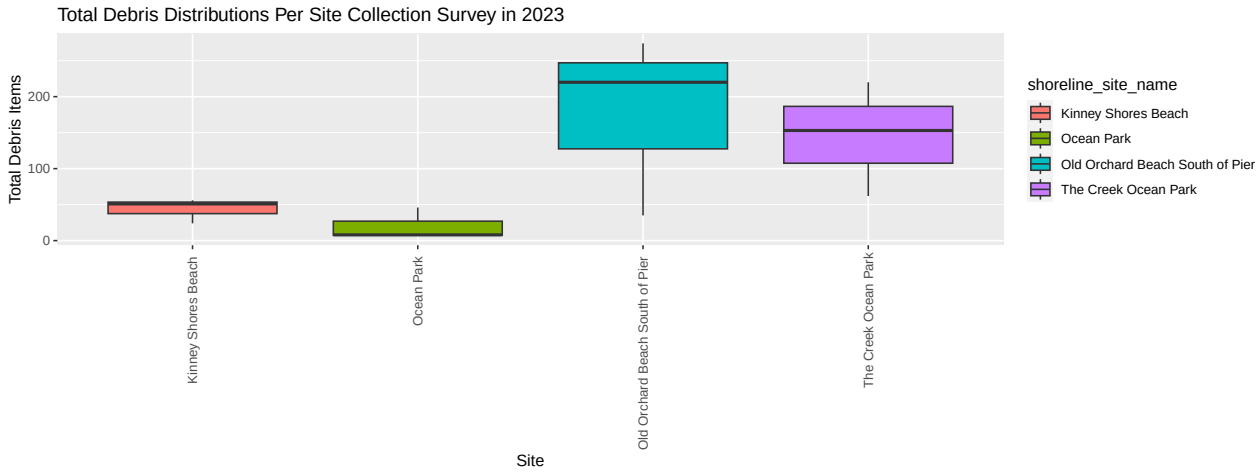

```
# FOR ALL DATA
boxplot(debris_df[totals_cols], las=2)
```



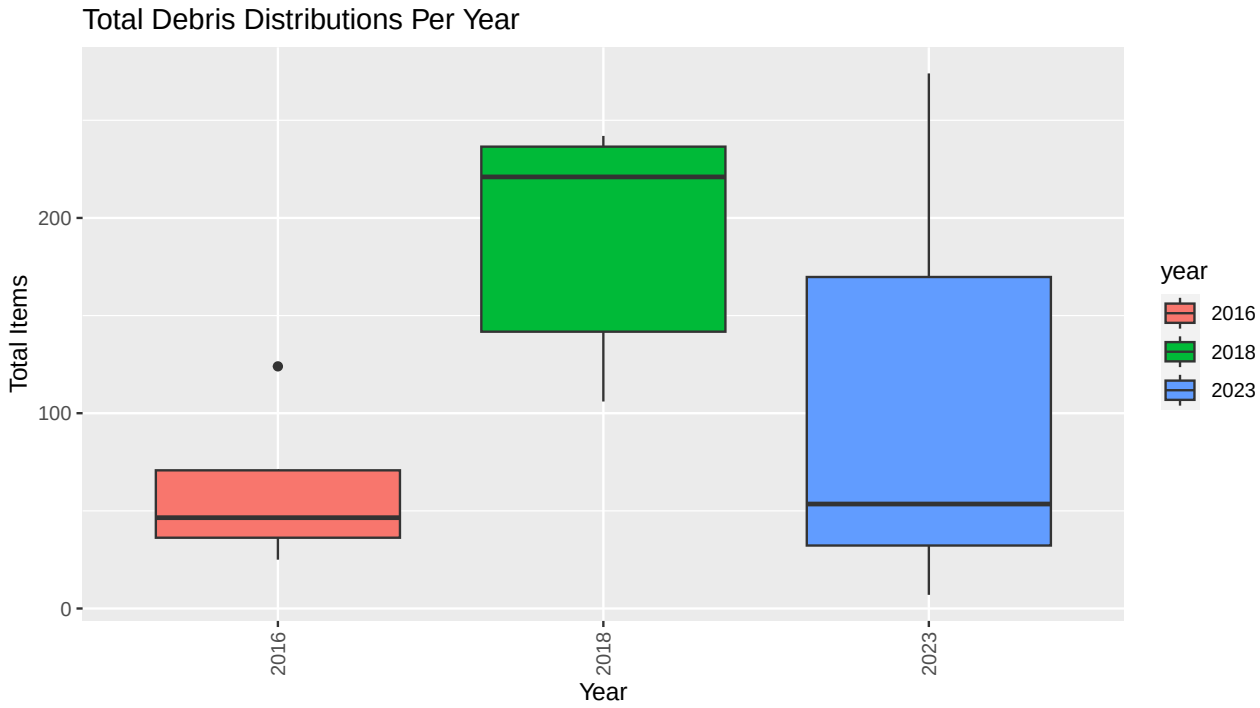

```
# boxplot of debris totals per site
ggplot(debris_df, aes(x=shoreline_site_name, y=total_debris_items, fill=shoreline_site_name)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Debris Distributions Per Site Collection") +
  ylab("Total Debris Items") +
  xlab("Site")
```



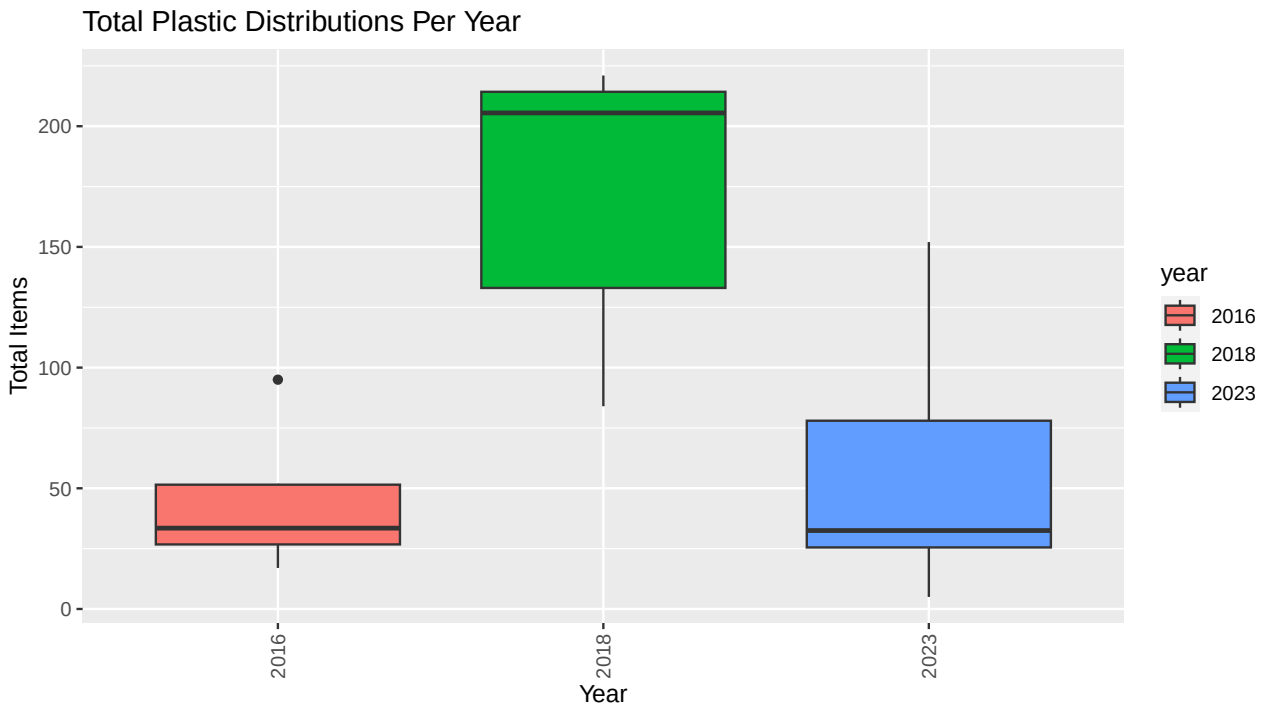

```
# boxplot of debris totals per site
ggplot(subset(debris_df, year == "2023"), aes(x=shoreline_site_name, y=total_debris_items, fill=shoreli
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Debris Distributions Per Site Collection Survey in 2023") +
  ylab("Total Debris Items") +
  xlab("Site")
```



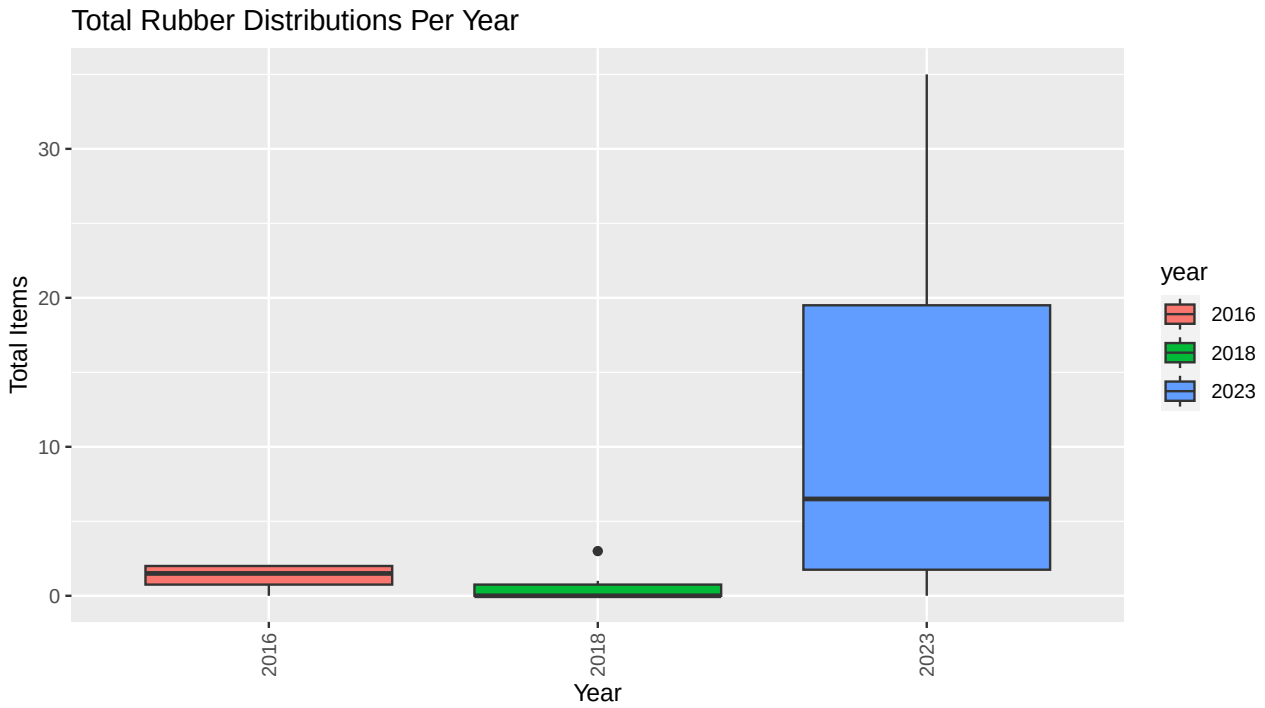

```
# boxplot of debris totals per year


ggplot(debris_df, aes(x=year, y=total_debris_items, fill=year)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Debris Distributions Per Year") +
  ylab("Total Items") +
  xlab("Year")
```




```
ggplot(debris_df, aes(x=year, y=total_plastic_items, fill=year)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Plastic Distributions Per Year") +
  ylab("Total Items") +
  xlab("Year")
```

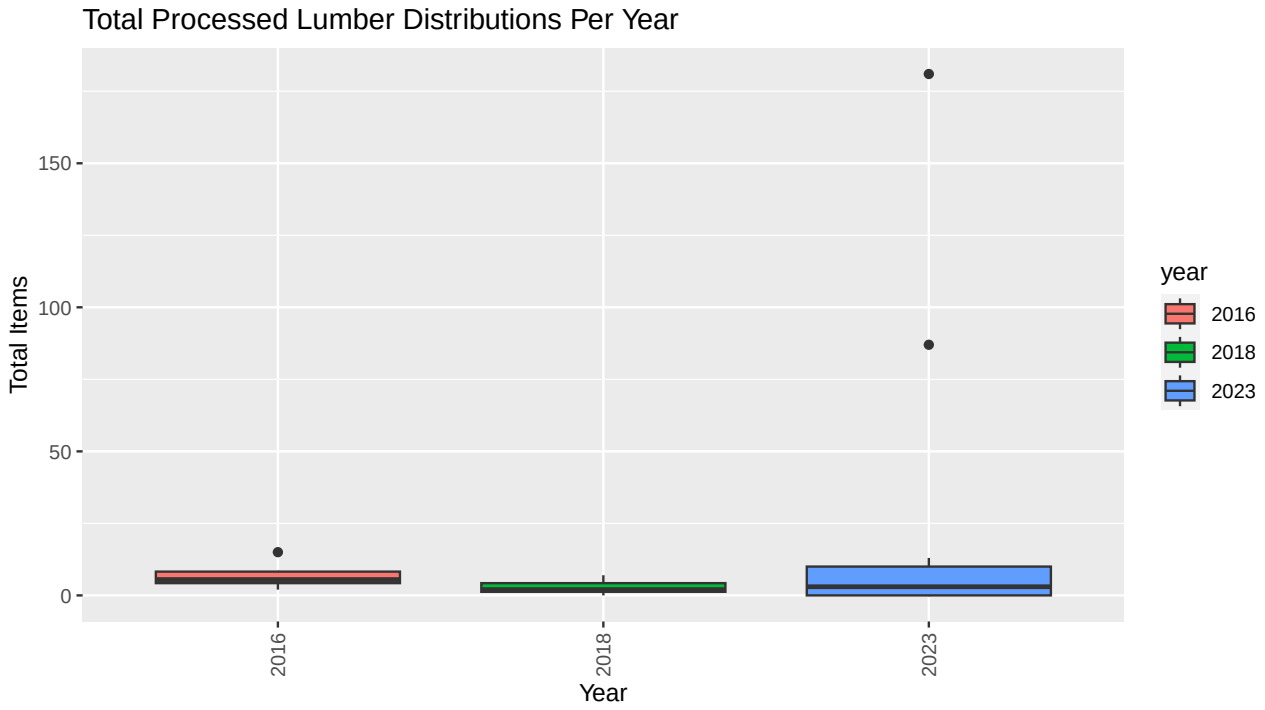



```
ggplot(debris_df, aes(x=year, y=total_rubber_items, fill=year)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Rubber Distributions Per Year") +
  ylab("Total Items") +
  xlab("Year")
```

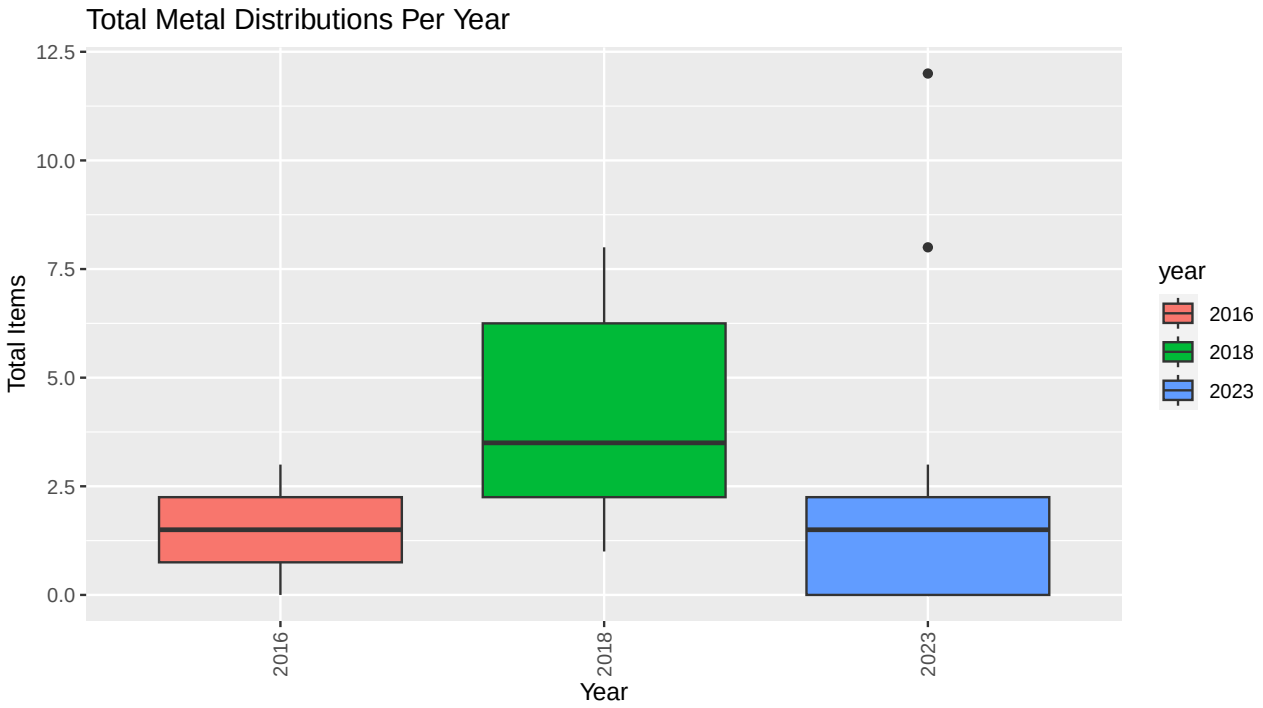



```
ggplot(debris_df, aes(x=year, y=total_processed.lumber_items, fill=year)) +
  geom_boxplot() +
```

```
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Processed Lumber Distributions Per Year") +
  ylab("Total Items") +
  xlab("Year")
```




```
ggplot(debris_df, aes(x=year, y=total_metal_items, fill=year)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
  ggtitle("Total Metal Distributions Per Year") +
  ylab("Total Items") +
  xlab("Year")
```




```
t.test(debris_df[debris_df$year == "2018"]$total_debris_items, debris_df[debris_df$year == "2023"]$total
```

```
##
##  One Sample t-test
##
## data:  debris_df[debris_df$year == "2018"]$total_debris_items
## t = 5.9658, df = 21, p-value = 6.388e-06
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##   75.35606 156.00758
## sample estimates:
## mean of x
##  115.6818
```

```
# boxplot of debris totals per site vs freddy beach
library("dplyr")
```

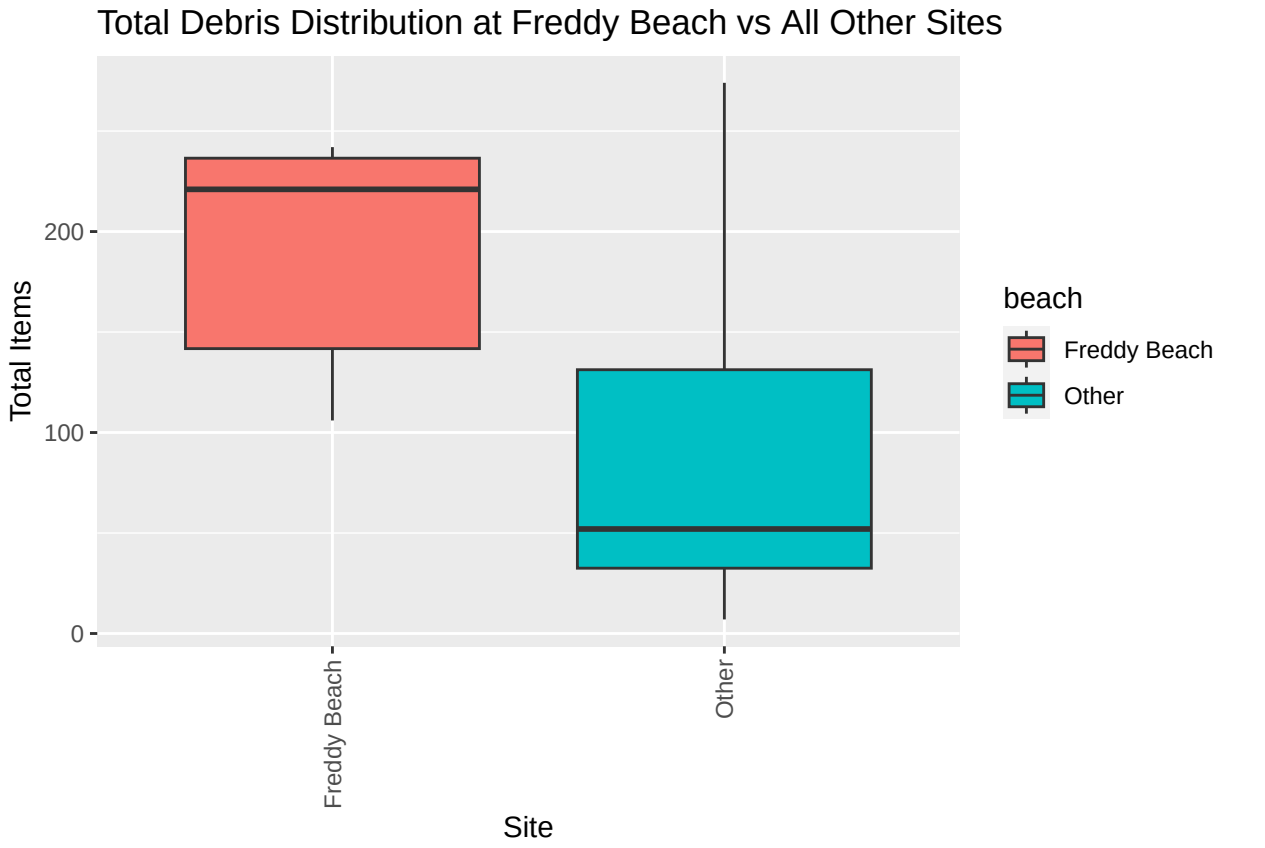
```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
freddy_vs_all_df <- debris_df
freddy_vs_all_df <- freddy_vs_all_df %>%
  mutate(beach = if_else(shoreline_site_name == "Freddy Beach", "Freddy Beach", "Other"))
ggplot(freddy_vs_all_df, aes(x=beach, y=total_debris_items, fill=beach)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 90)) +
```

```
  ggtitle("Total Debris Distribution at Freddy Beach vs All Other Sites") +
  ylab("Total Items") +
  xlab("Site")
```




```
# means of the two groups vs each other.
print(mean(freddy_vs_all_df[freddy_vs_all_df$beach == "Freddy Beach"]$total_debris_items))
```

```
## [1] 115.6818
```

```
not_freddy <- subset(freddy_vs_all_df, subset=beach != "Freddy Beach")
print(mean(not_freddy$total_debris_items))
```

```
## [1] 87.375
```

```
# On Average, there is 11% more debris at Freddy Beach than all other sites.
(116 - 87)/(116 + 87)
```

```
## [1] 0.1428571
```

```
# T test of Freddy beach total debris vs every other location.
# We have a p-value of 1e-6, and a confidence interval of 86 to 162 with the mean sitting at 124 debris

t.test(debris_df[debris_df$shoreline_site_name == "Freddy Beach"]$total_debris_items, debris_df[debris_
```

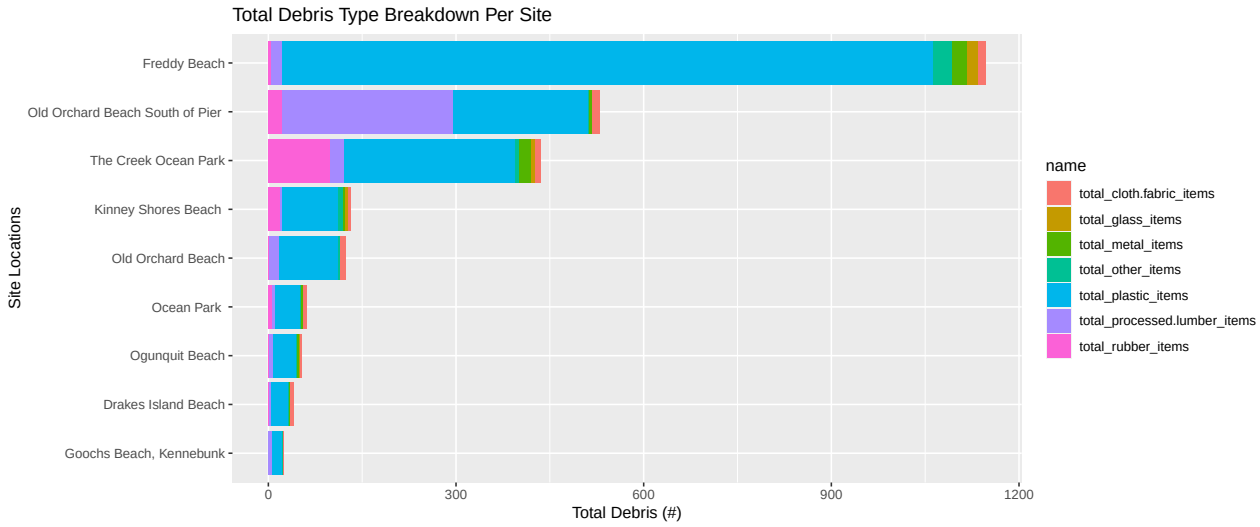
```
##
##  One Sample t-test
##
## data:  debris_df[debris_df$shoreline_site_name == "Freddy Beach"]$total_debris_items
## t = 5.9658, df = 21, p-value = 6.388e-06
## alternative hypothesis: true mean is not equal to 0
```

```
## 95 percent confidence interval:
##   75.35606 156.00758
## sample estimates:
## mean of x
##  115.6818
```

```
anovatest <- aov(total_debris_items ~ year, data=debris_df)
summary(anovatest)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## year         2  50860   25430   3.933 0.0372 *
## Residuals   19 122856    6466
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
trimmed_data <- subset(debris_df, select=c(
  'total_plastic_items',
  'shoreline_site_id',
  'shoreline_site_name',
  'total_glass_items',
  'total_rubber_items',
  'total_metal_items',
  'total_processed.lumber_items',
  'total_cloth.fabric_items',
  'total_other_items'))

total_columns <- c('total_plastic_items',
                   'total_glass_items',
                   'total_rubber_items',
                   'total_metal_items',
                   'total_processed.lumber_items',
                   'total_cloth.fabric_items',
                   'total_other_items')
sum_df <- trimmed_data %>% group_by(shoreline_site_name) %>% summarise_at(total_columns, sum)
sum_df <- sum_df[order(sum_df$total_plastic_items),]
sum_df$shoreline_site_name <- factor(sum_df$shoreline_site_name, levels=rev(c(
  'Freddy Beach', 'Old Orchard Beach South of Pier ', 'The Creek Ocean Park',
  'Kinney Shores Beach ', 'Old Orchard Beach',  'Ocean Park ', 'Ogunquit Beach', 'Drakes Island Beach',

sum_df |> pivot_longer(-shoreline_site_name) |> ggplot(aes(x=shoreline_site_name, y=value, fill=name)) +
  geom_bar(position="stack", stat="identity") + coord_flip() +
  ggtitle("Total Debris Type Breakdown Per Site") +
  xlab("Site Locations") +
  ylab("Total Debris (#)")
```


Total Debris Type Breakdown Per Site
Site Locations
Freddy Beach
Old Orchard Beach South of Pier
The Creek Ocean Park
Kinney Shores Beach
Old Orchard Beach
Ocean Park
Ogunquit Beach
Drakes Island Beach
Goochs Beach, Kennebunk
0
300
600
900
1200
Total Debris (#)
name
total_cloth.fabric_items
total_glass_items
total_metal_items
total_other_items
total_plastic_items
total_processed.lumber_items
total_rubber_items