DwitiBagadia_A03_DataExploration

Dwiti Bagadia

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OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics on Data Exploration.

Directions

1. Rename this file `<FirstLast>_A03_DataExploration.Rmd` (replacing `<FirstLast>` with your first and last name).
2. Change "Student Name" on line 3 (above) with your name.
3. Work through the steps, **creating code and output** that fulfill each instruction.
4. Assign a useful **name to each code chunk** and include ample **comments** with your code.
5. Be sure to **answer the questions** in this assignment document.
6. When you have completed the assignment, **Knit** the text and code into a single PDF file.
7. After Knitting, submit the completed exercise (PDF file) to the dropbox in Sakai.

TIP: If your code extends past the page when knit, tidy your code by manually inserting line breaks.

TIP: If your code fails to knit, check that no `install.packages()` or `View()` commands exist in your code.

Set up your R session

1. Check your working directory, load necessary packages (tidyverse, lubridate), and upload two datasets: the ECOTOX neonicotinoid dataset (ECOTOX_Neonicotinoids_Insects_raw.csv) and the Niwot Ridge NEON dataset for litter and woody debris (NEON_NIWO_Litter_massdata_2018-08_raw.csv). Name these datasets "Neonics" and "Litter", respectively. Be sure to include the subcommand to read strings in as factors.

```
#load packages and set working directory
library(tidyverse)
library(lubridate)
getwd()
```

```
## [1] "/Users/d/Desktop/UNC/Spring:23/DUKE 872 L1 - Environmental Data Analysis/EDA-Spring23/Assignmen
```

```
setwd('/Users/d/Desktop/UNC/Spring:23/DUKE 872 L1 - Environmental Data Analysis/EDA-Spring23/Data/Raw')

#upload datasets
Neonics <- read.csv("ECOTOX_Neonicotinoids_Insects_raw.csv", stringsAsFactors = TRUE)
Litter <- read.csv("NEON_NIWO_Litter_massdata_2018-08_raw.csv", stringsAsFactors = TRUE)
```

Learn about your system

2. The neonicotinoid dataset was collected from the Environmental Protection Agency's ECOTOX Knowledgebase, a database for ecotoxicology research. Neonicotinoids are a class of insecticides used widely in agriculture. The dataset that has been pulled includes all studies published on insects. Why might we be interested in the ecotoxicology of neonicotinoids on insects? Feel free to do a brief internet search if you feel you need more background information.

   Answer: Since the 1990s, neonicotinoids have become one of the most commonly used insecticides in the U.S. and the world. They are now widely used in the agricultural sector as they possess a low mammalian toxicity and are effective for controlling stubborn pests in the soil. As neonicotinoids have proved to lead to loss of pollinators, they can give us a better understanding on the mechanisms behind the various diseases caused to the pollinators.

3. The Niwot Ridge litter and woody debris dataset was collected from the National Ecological Observatory Network, which collectively includes 81 aquatic and terrestrial sites across 20 ecoclimatic domains. 32 of these sites sample forest litter and woody debris, and we will focus on the Niwot Ridge long-term ecological research (LTER) station in Colorado. Why might we be interested in studying litter and woody debris that falls to the ground in forests? Feel free to do a brief internet search if you feel you need more background information.

   Answer: Litter and the woody debris may act as a tinder that encourages the spreading of forest fires and in some cases also the start of the forest fire; in addition to their negative impacts they even act as a habitat for insects. Thus understanding about the quantity of the habitat for insects and influence on carbon budgets is important for integrating the ecotoxicity data.

4. How is litter and woody debris sampled as part of the NEON network? Read the NEON_Litterfall_UserGuide.pdf document to learn more. List three pieces of salient information about the sampling methods here:

   Answer: 1. Litter and fine woody debris are collected from elevated and ground traps. 2. The mass data is collected to an accuracy of 0.01 grams, for each group. 3. The randomness of trap placements is based on the type of vegetation.

Obtain basic summaries of your data (Neonics)

5. What are the dimensions of the dataset?

```
#obtaining dimensions of NEONICS dataset
dim(Neonics)
```

```
## [1] 4623   30
```

   Answer: 4623(R). 30(C)

6. Using the `summary` function on the "Effect" column, determine the most common effects that are studied. Why might these effects specifically be of interest?

```
#Summarizing the effects column
summary(Neonics$Effect)
```

```
##     Accumulation        Avoidance         Behavior     Biochemistry
##               12              102              360               11
##          Cell(s)      Development        Enzyme(s) Feeding behavior
##                9              136               62              255
##         Genetics           Growth        Histology       Hormone(s)
##               82               38                5                1
##    Immunological     Intoxication       Morphology        Mortality
##               16               12               22             1493
##       Physiology       Population     Reproduction
##                7             1803              197
```

Answer: The most common effects of Neonics(Population and Mortality) help us understand about how common mortality is a result of neonicotinoids. It helps us by indicating the non-selective nature of the insecticide and the serious effect it has on the pollinators.

7. Using the `summary` function, determine the six most commonly studied species in the dataset (common name). What do these species have in common, and why might they be of interest over other insects? Feel free to do a brief internet search for more information if needed.[TIP: The `sort()` command can sort the output of the summary command...]

```
#creating a sorted summary of if the Species with common name
sort(summary(Neonics$Species.Common.Name), decreasing = TRUE, na.last = TRUE)
```

```
##                          (Other)                       Honey Bee
##                              670                             667
##                   Parasitic Wasp            Buff Tailed Bumblebee
##                              285                             183
##               Carniolan Honey Bee                      Bumble Bee
##                              152                             140
##                  Italian Honeybee                  Japanese Beetle
##                              113                              94
##                Asian Lady Beetle                  Euonymus Scale
##                               76                              75
##                         Wireworm               European Dark Bee
##                               69                              66
##                Minute Pirate Bug             Asian Citrus Psyllid
##                               62                              60
##                    Parastic Wasp           Colorado Potato Beetle
##                               58                              57
##                  Parasitoid Wasp             Erythrina Gall Wasp
##                               51                              49
##                     Beetle Order       Snout Beetle Family, Weevil
##                               47                              47
##          Sevenspotted Lady Beetle                  True Bug Order
##                               46                              45
##             Buff-tailed Bumblebee                    Aphid Family
##                               39                              38
##                   Cabbage Looper             Sweetpotato Whitefly
##                               38                              37
##                    Braconid Wasp                    Cotton Aphid
##                               33                              33
##                   Predatory Mite           Ladybird Beetle Family
##                               33                              30
```

```
##                      Parasitoid                     Scarab Beetle
##                              30                               29
##                   Spring Tiphia                      Thrip Order
##                              29                               29
##             Ground Beetle Family                Rove Beetle Family
##                              27                               27
##                   Tobacco Aphid                      Chalcid Wasp
##                              27                               25
##            Convergent Lady Beetle                    Stingless Bee
##                              25                               25
##                Spider/Mite Class                Tobacco Flea Beetle
##                              24                               24
##                Citrus Leafminer                    Ladybird Beetle
##                              23                               23
##                       Mason Bee                         Mosquito
##                              22                               22
##                  Argentine Ant                           Beetle
##                              21                               21
##        Flatheaded Appletree Borer               Horned Oak Gall Wasp
##                              20                               20
##               Leaf Beetle Family                  Potato Leafhopper
##                              20                               20
##        Tooth-necked Fungus Beetle                      Codling Moth
##                              20                               19
##         Black-spotted Lady Beetle                      Calico Scale
##                              18                               18
##              Fairyfly Parasitoid                       Lady Beetle
##                              18                               18
##            Minute Parasitic Wasps                         Mirid Bug
##                              18                               18
##                Mulberry Pyralid                          Silkworm
##                              18                               18
##                   Vedalia Beetle              Araneoid Spider Order
##                              18                               17
##                       Bee Order                    Egg Parasitoid
##                              17                               17
##                    Insect Class           Moth And Butterfly Order
##                              17                               17
##      Oystershell Scale Parasitoid Hemlock Woolly Adelgid Lady Beetle
##                              17                               16
##             Hemlock Wooly Adelgid                             Mite
##                              16                               16
##                     Onion Thrip              Western Flower Thrips
##                              16                               15
##                    Corn Earworm                 Green Peach Aphid
##                              14                               14
##                       House Fly                         Ox Beetle
##                              14                               14
##               Red Scale Parasite                Spined Soldier Bug
##                              14                               14
##             Armoured Scale Family                  Diamondback Moth
##                              13                               13
##                   Eulophid Wasp                  Monarch Butterfly
##                              13                               13
```

```
##                     Predatory Bug               Yellow Fever Mosquito
##                                13                                  13
##               Braconid Parasitoid                     Common Thrip
##                                12                                  12
##      Eastern Subterranean Termite                           Jassid
##                                12                                  12
##                        Mite Order                        Pea Aphid
##                                12                                  12
##                  Pond Wolf Spider          Spotless Ladybird Beetle
##                                12                                  11
##             Glasshouse Potato Wasp                        Lacewing
##                                10                                  10
##           Southern House Mosquito           Two Spotted Lady Beetle
##                                10                                  10
##                        Ant Family                     Apple Maggot
##                                 9                                   9
```

Answer: The most commonly studied insects were - Honey Bee (667) and Parasitic Wasp (285). The honey bees being one of the most common insects which benfit from pollinators is the one that is studied the most. As Neonicotinoids are extremely dangerous to pollinators and benefitting insects, this data is important to study.

8. Concentrations are always a numeric value. What is the class of `Conc.1..Author.` column in the dataset, and why is it not numeric?

```
#class function to check the data type
class("Conc.1..Author")
```

```
## [1] "character"
```

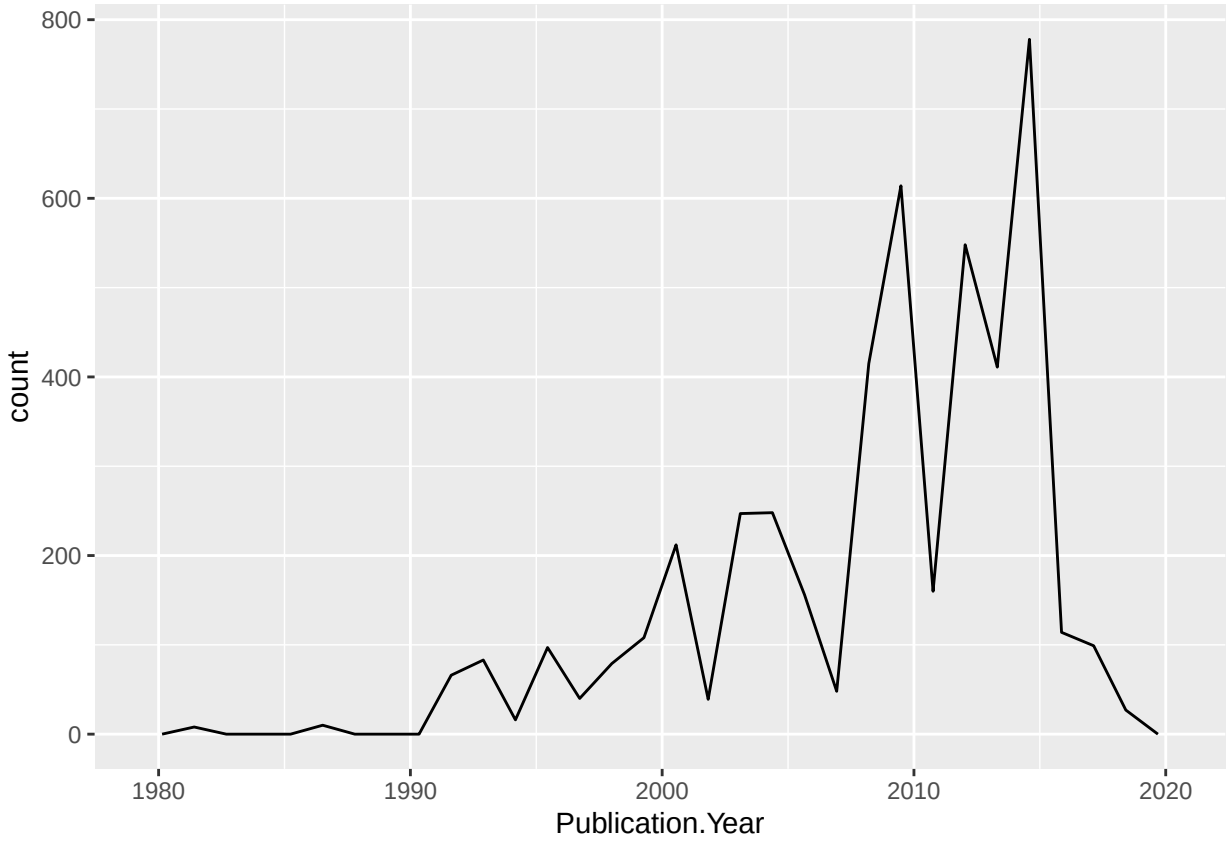
Answer: The Conc.1..Author is a character class, as the column has some data with both numbers and '<' signs. When some data in the column are charaters, the class of the vector wukk convert to character instead of numeric.

Explore your data graphically (Neonics)

9. Using `geom_freqpoly`, generate a plot of the number of studies conducted by publication year.

```
#creating a plot of number of studies done by publication year
ggplot(Neonics) + geom_freqpoly(aes(x = Publication.Year))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



10. Reproduce the same graph but now add a color aesthetic so that different Test.Location are displayed as different colors.

```
#set of commands to plot the graph with colors
is.na(Neonics$Test.Location)
```

```
##    [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [13] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [25] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [37] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [49] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [61] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [73] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [85] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [97] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [109] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [121] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [133] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [145] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [157] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [169] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [181] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [193] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [205] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [217] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
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```

```
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## [2809] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
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## [4621] FALSE FALSE FALSE
```
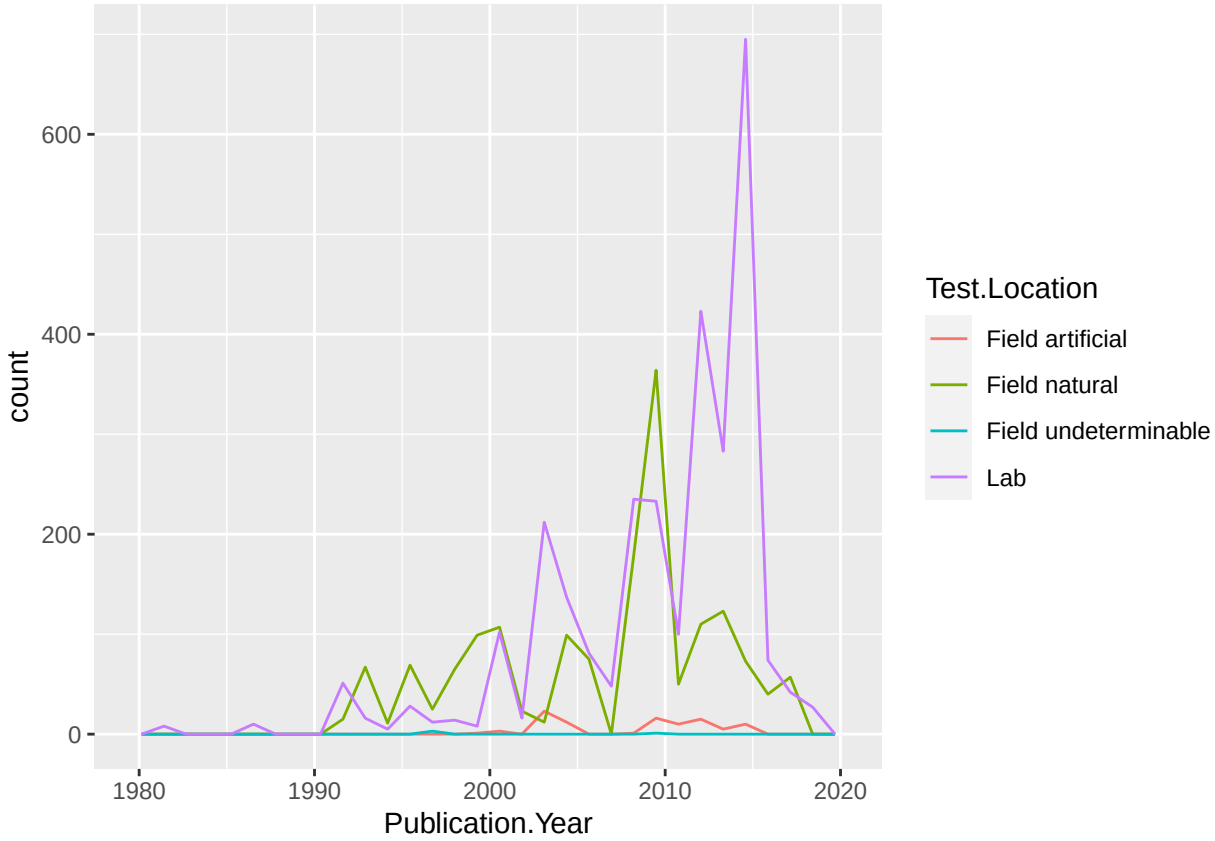

```
NeonicsComplete <- na.omit(Neonics$Test.Location)
ggplot(Neonics) +
  geom_freqpoly(aes(x = Publication.Year, color = Test.Location))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



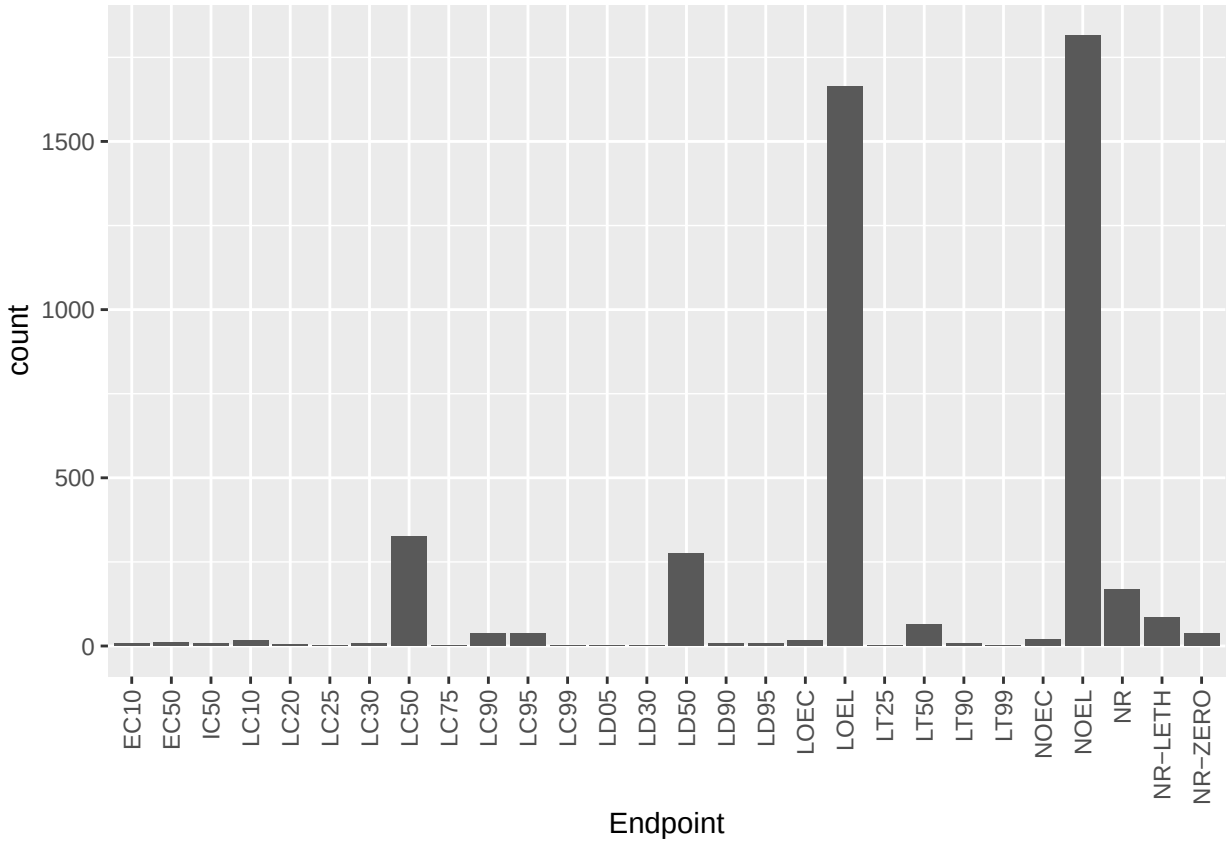
Interpret this graph. What are the most common test locations, and do they differ over time?

> Answer: Lab is the most test location more than once, first in 2000-2005 and then again in 2010-2020. While in time span of 1990-2000 and 2005-2010 the natural field was more common test location.

11. Create a bar graph of Endpoint counts. What are the two most common end points, and how are they defined? Consult the ECOTOX_CodeAppendix for more information.

[**TIP**: Add `theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))` to the end of your plot command to rotate and align the X-axis labels...]

```
#plotting endpoint counts
ggplot(Neonics) +
  geom_bar(aes(x = Endpoint)) +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust = 1))
```



Answer: LOEL and NOEL are the most common end points. LOEL is the lowest observable effect level - having the lowest dose of insecticides producing effects that were significantly different from responses of controls. NOEL is the no observable effect level - gavubg the highest dose producing effects that were not significantly different from the responses of controls according to the statistical tests reported by the author.

Explore your data (Litter)

12. Determine the class of collectDate. Is it a date? If not, change to a date and confirm the new class of the variable. Using the `unique` function, determine which dates litter was sampled in August 2018.

```
#data class check
class(Litter$collectDate)
```

```
## [1] "factor"
```

```
#output is factor#converting to date
Litter$collectDate <- as.Date(Litter$collectDate, format("%y/%m/%d"))
#checking class
class(Litter$collectDate)
```

```
## [1] "Date"
```

```
#summary and check
summary(Litter$collectDate <- as.Date(Litter$collectDate, format = "%y%m%d"))
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##      NA      NA      NA   "NaN"      NA      NA   "188"
```

```
unique(Litter$collectDate)
```

```
## [1] NA
```

```
#i cannot figure out what went wrong here.
```

13. Using the `unique` function, determine how many plots were sampled at Niwot Ridge. How is the information obtained from `unique` different from that obtained from `summary`?

```
#unique for Niwot Ridge
unique(Litter$siteID)
```

```
## [1] NIWO
## Levels: NIWO
```

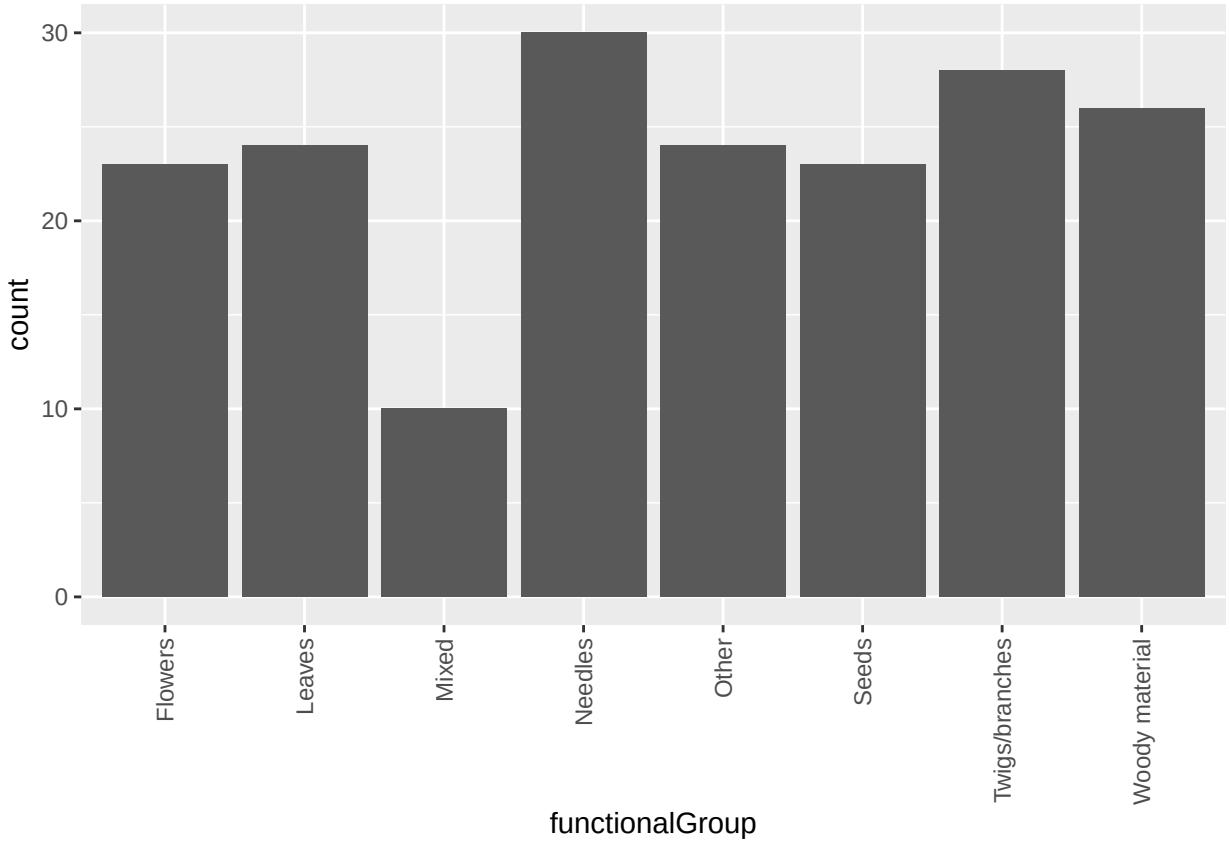
```
summary(Litter$siteID)
```

```
## NIWO
##  188
```

Answer: 188 plots were sampled at Niwot Ridge, unique command eliminated all the duplicate values, so the outcome was only 1 value - NIWO. where the summary command calculates the number of each value hence, giving us the number of the total plots (188) sampled at Niwot Ridge

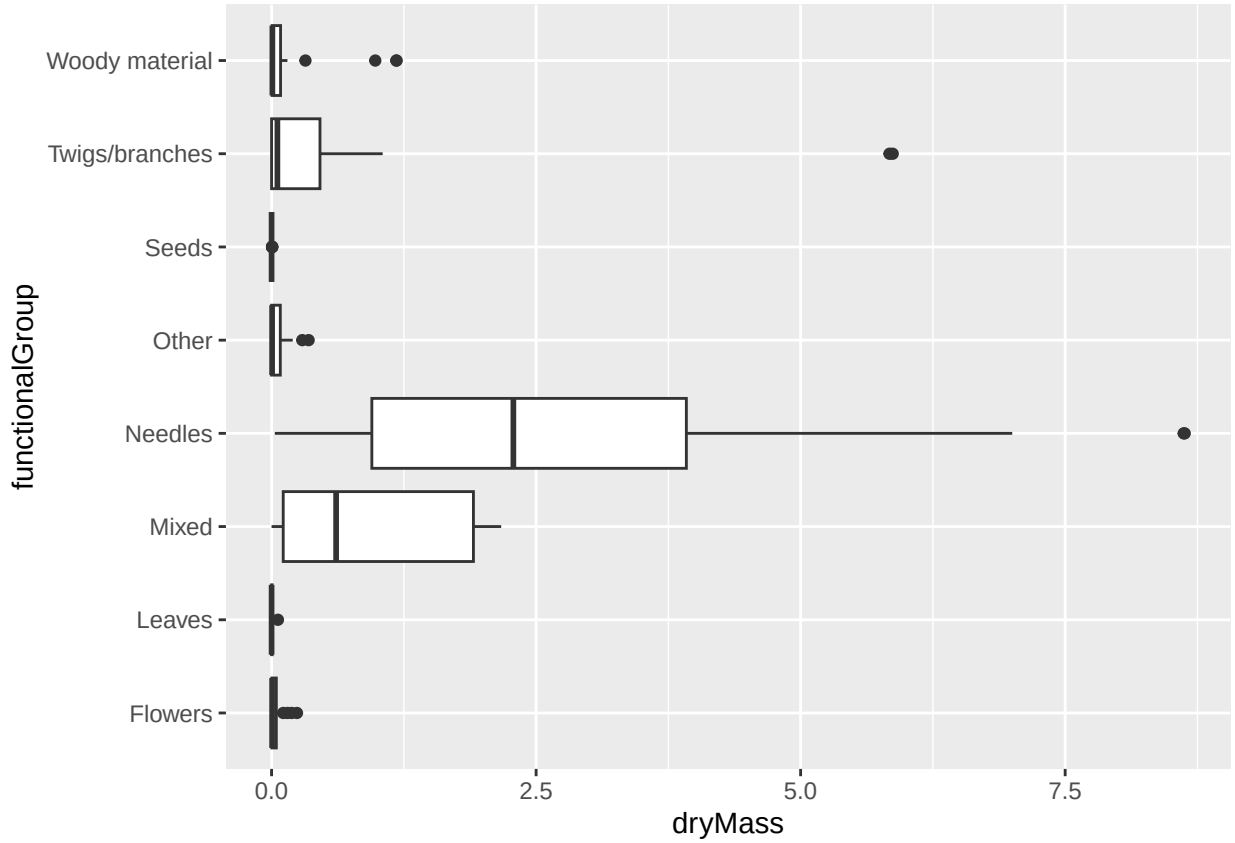
14. Create a bar graph of functionalGroup counts. This shows you what type of litter is collected at the Niwot Ridge sites. Notice that litter types are fairly equally distributed across the Niwot Ridge sites.

```
ggplot(Litter) + geom_bar(aes(x=functionalGroup)) +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust = 1))
```

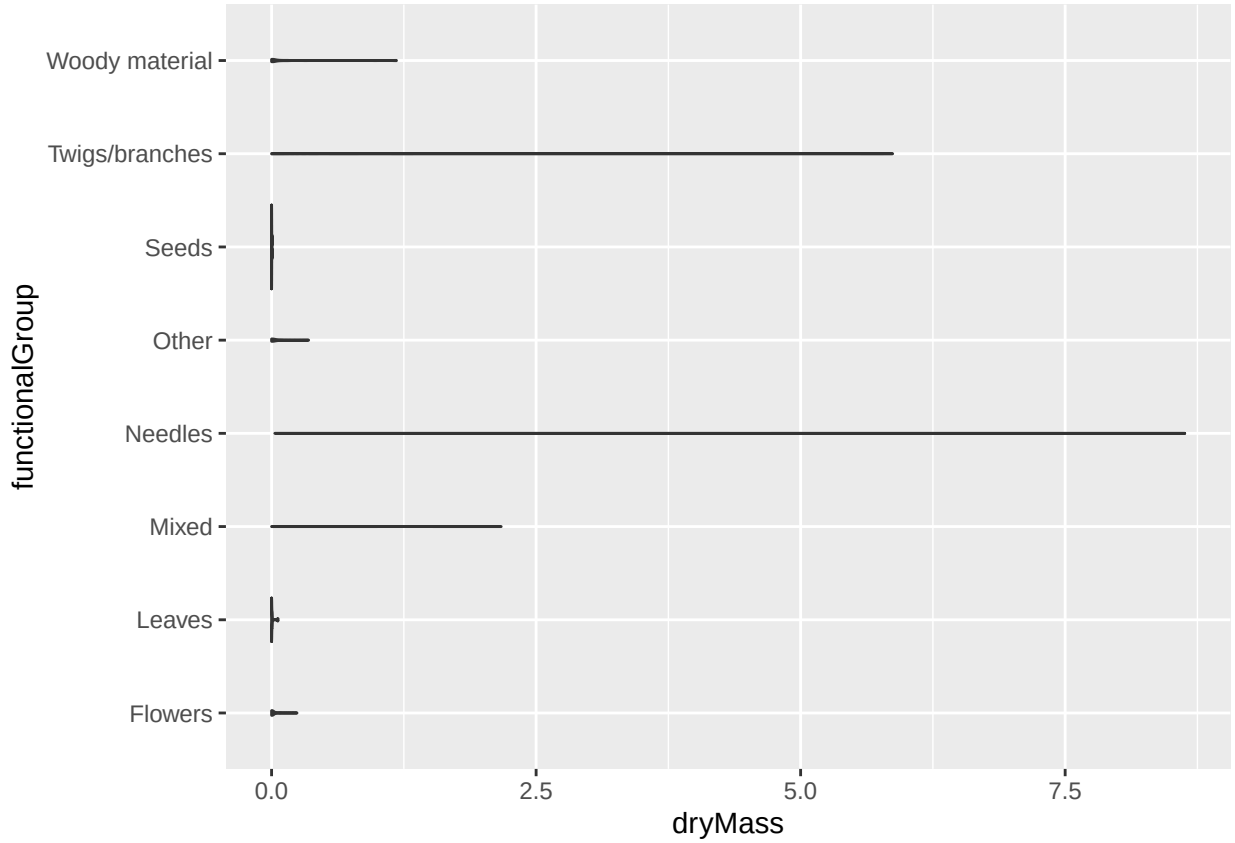


15. Using `geom_boxplot` and `geom_violin`, create a boxplot and a violin plot of dryMass by functionalGroup.

```
#box plot
ggplot(Litter) + geom_boxplot(aes(x=functionalGroup, y=dryMass)) + coord_flip()
```




```
#violin plot
ggplot(Litter) + geom_violin(aes(x=functionalGroup, y=dryMass)) + coord_flip()
```



Why is the boxplot a more effective visualization option than the violin plot in this case?

> Answer: In this case, Ieach functional group more aesthetically and captures the viewers attention to each group. The box plot shows only the summarized data, where as the violin plot shows all the data.

What type(s) of litter tend to have the highest biomass at these sites?

> Answer: Needless