Final project

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Introduction: Bees are a crucial role in the longevity of the ecosystem. Bees ensure continuous pollination of plants which in exchange help the atmosphere (Energy.org). In the state of Oregon, bees in urban areas effect the garden life by enriching insect wild life (Melathopoulos, 2020). Bees create environments for that allow for different insect pollinators to flourish (Melathopoulos, 2020). Bee season starts in spring and ends in early fall. With that being said, bees have a huge impact on the environment, in this study, examination of bees in 2018-2023 can help give better insight on which bees are the most popular in the 5 biggest cities in Oregon. Analysis on the top five bees and the top five associated flowers can allow us to visual the some of the bee populations in these cities over a six month span. Over these six months data of the minimum and maximum temperatures can help the observations of how the temperature affects the bee and flower species.

Question: What are the top 5 most abundant bee species and most visited flower species in the top 5 biggest cities in Oregon (April-September)? Does the Min or Max temperature for each month in each city affect the number of bee species or flower species observed?

Top 5 cities in Oregon 1 - Portland 2 - Eugene 3 - Salem 4 - Medford 5 - Bend

```
#shapefiles of the boundries of the five major cities

portland <- read_sf("/Users/averyharff/Downloads/portland/City_Boundaries.shp")
portland_vect <- vect(portland)

eugene <- read_sf("/Users/averyharff/Downloads/Eugene_Zoning___Hub_-8431398599973602668/Eugene_Zoning.sh
eugene_vect <- vect(eugene)

salem <- read_sf("/Users/averyharff/Downloads/CityLimits/CityLimits.shp")
salem_vect <- vect(salem)

medford <- read_sf("/Users/averyharff/Downloads/medfordCity_Limits (1)/City_Limits.shp")
medford_vect <- vect(medford)

bend <- read_sf("/Users/averyharff/Downloads/bend/Zoning.shp")
bend_vect <- vect(bend)
```

Dataframe of city, year, month, bee and plant

```
OBA <- read_excel("~/Downloads/OBA_2018-2023_Ponisio.xlsx")
OBA$Year <- OBA$`Year 1`
```

```
## data cleaning, removing all the spaces commas and periods not needed
OBA$`Abbreviated Location` <- trimws(OBA$`Abbreviated Location`)
OBA$`Abbreviated Location` <- sub(" .*", "", OBA$`Abbreviated Location`)
OBA$`Abbreviated Location` <- sub(",$","", OBA$`Abbreviated Location`)
```

```r
#loading in the Min and Max temperatures in Oregon in years 2018 and 2019
minTemp18 <- rast("/Users/averyharff/Desktop/18TEMPMINPRISM_tmin_stable_4kmM3_2018_all_bil/PRISM_tmin_s

maxtemp18 <- rast("/Users/averyharff/Desktop/18MaxPPRISM_tmax_stable_4kmM3_2018_all_bil/PRISM_tmax_stabl

mintemp19 <- rast("/Users/averyharff/Desktop/19MINPRISM_tmin_stable_4kmM3_2019_all_bil/PRISM_tmin_stable

maxtemp19 <- rast("/Users/averyharff/Desktop/MAXTEMP19PRISM_tmax_stable_4kmM3_2019_all_bil/PRISM_tmax_s
```

```r
#function will load in rasterfile and city shape file name, then crop raster to the city shape file, re
cropped_tempCity <- function(rasterfilename_min, rasterfilename_max,  cityfilename){
                    out_min <- terra::extract(x = rasterfilename_min, y = cityfilename,
                                fun = mean)
                     out_max <- terra::extract(x = rasterfilename_max, y = cityfilename,
                                fun = mean)
                    return(c(min=out_min[,2], max=out_max[,2]))
}

#loading in data for min and max temperatures of each city.
eugene18 <- cropped_tempCity(minTemp18, maxtemp18, eugene_vect)

eugene19 <- cropped_tempCity(mintemp19, maxtemp19, eugene_vect)

portland18 <- cropped_tempCity(minTemp18, maxtemp18, portland_vect)

portland19 <- cropped_tempCity(mintemp19, maxtemp19, portland_vect)

salem18 <- cropped_tempCity(minTemp18, maxtemp18, salem_vect)

salem19 <- cropped_tempCity(mintemp19, maxtemp19, salem_vect)

bend18 <- cropped_tempCity(minTemp18, maxtemp18, bend_vect)

bend19 <- cropped_tempCity(mintemp19, maxtemp19, bend_vect)

medford18 <- cropped_tempCity(minTemp18, maxtemp18, medford_vect)

medford19 <- cropped_tempCity(mintemp19, maxtemp19, medford_vect)
```

creating a function to made the numerical lists a dataframe and adding columns with MinTemp, MaxTemp and City. Merging them all together into one dataframe.

```r
#merge shape files for each city to one df have a column called year. create column for all files. crea
#changing portlands CRS to match the rest of the cities

portland <- st_transform(portland, crs = st_crs(eugene))

# creating a function to made the numerical lists a dataframe and adding columns with MinTemp, MaxTemp
convert_to_dataframe <- function(x) {

  combined_vector <- unlist(x)
  minTemp <- min(combined_vector)
  maxTemp <- max(combined_vector)
```

```
  df <- data.frame(minTemp, maxTemp)
  colnames(df) <- c("MinTemp", "MaxTemp")

  return(df)
}

#Df of min and max temp of the city
Bend18DF <- convert_to_dataframe(bend18)
Bend19DF <- convert_to_dataframe(bend19)
eugene18DF <- convert_to_dataframe(eugene18)
eugene19DF <- convert_to_dataframe(eugene19)
salem18DF <- convert_to_dataframe(salem18)
salem19DF <- convert_to_dataframe(salem19)
medford18DF <- convert_to_dataframe(medford18)
medford19DF <- convert_to_dataframe(medford19)
portland18DF <- convert_to_dataframe(portland18)
portland19DF <- convert_to_dataframe(portland19)

#merge all together
merged <- merge(Bend18DF, Bend19DF, by = c('MinTemp', 'MaxTemp'))

cityDF <- rbind(Bend18DF, Bend19DF, eugene18DF, eugene19DF, salem18DF, salem19DF, medford18DF, medford19

City <- c("Bend", "Bend", "Eugene", "Eugene", "Salem", "Salem", "Medford", "Medford", "Portland", "Portl
Year <- c("2018", "2019", "2018", "2019", "2018", "2019", "2018", "2019", "2018", "2019")


cityDF <- cbind(City, Year, cityDF)
cityDF$city_year <- paste(cityDF$City, cityDF$Year, sep = "_")
#made table with city max and min temps
```

Created a big table from 2018-2023 OBA data containing year, month, city, Species, and Assoicated Plants. Created a list of the years and cities and filtered them into the table. Once the big table was made I merged toghethr the temperature table and the OBA18&19 table by city year and added the min and max temperatures to the table.

```
# big table
years <- c("2018", "2019")
cities <- c("Eugene", "Portland", "Salem", "Medford", "Bend")
OBA18_19 <- OBA %>%
  filter(Year %in% years) %>%
  filter(`Abbreviated Location` %in% cities) #%in% telling filter to only use what is in the list
OBA18_19$city_year <- paste(OBA18_19$`Abbreviated Location`, OBA18_19$`Year 1`, sep = "_")


OBA18_19 <- OBA18_19[c("Dec. Long.", "Dec. Lat.", "MonthJul", "Associated plant", "Species" ,"city_year

complete_data<- merge(OBA18_19, cityDF, by = "city_year")

bee_plant_count <- OBA18_19 %>%  count(Species, `Associated plant`)
```

From the OBA18_19 data I made a table of just the bees and associated plants. Loaded them as a dataframe so R can count the amount of time the Bee landed on a certain plant. Then I sorted the table and put the

bees in increasing order and made R sort through the top 5 Bees assoicated with its preferred plant, with the number of times the bee was spotted on the plant.

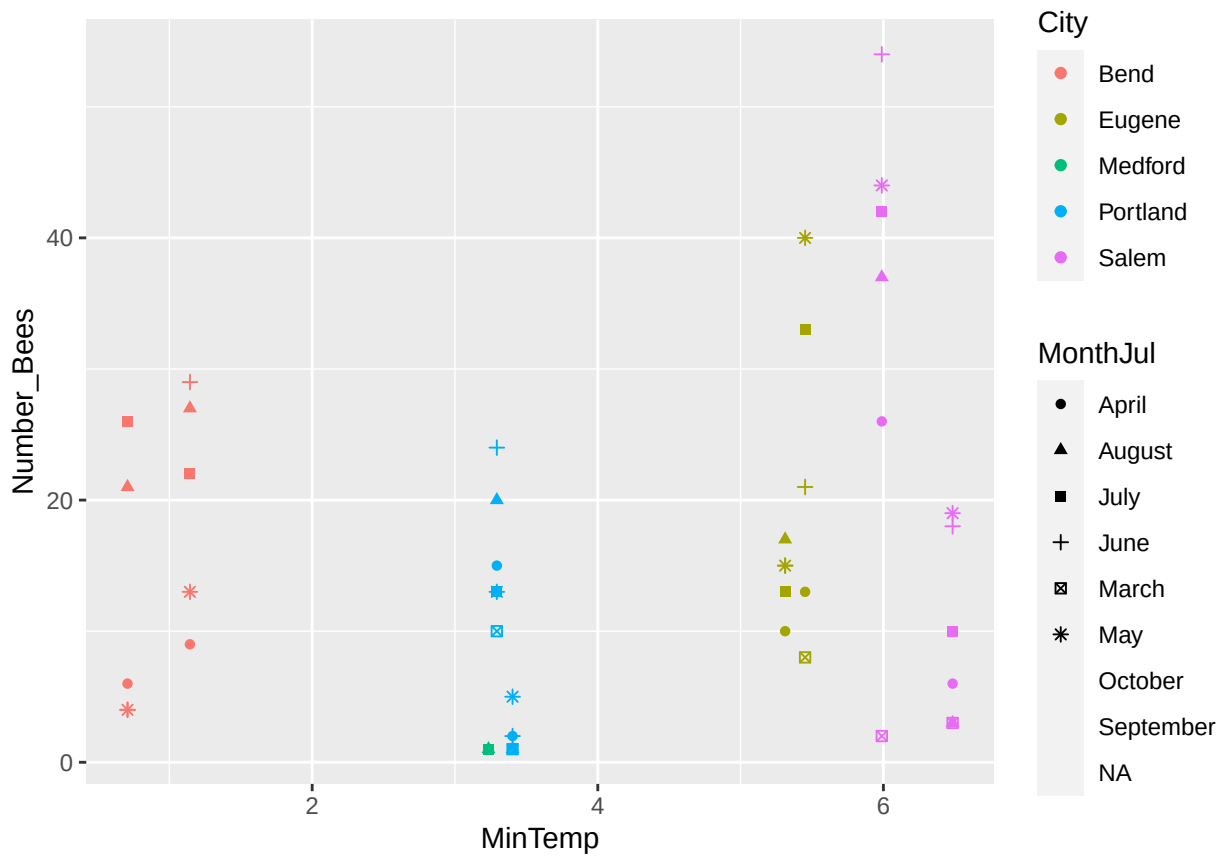
```
#making rowsum for bees and plants
landing_count <- table(OBA18_19$Species, OBA18_19$`Associated plant`)

landing_table <- as.data.frame.matrix(landing_count)

#Able to sort the top 5 bees
sortedTable <- landing_table[order(rowSums(landing_count), decreasing = TRUE) [1:5],order(colSums(landi

sortedTable
```

```
##              Ericameria nauseosa Phacelia hastata Solidago canadensis
## vosnesenskii                   1                1                   7
## tripartitus                    0                0                   4
## acantha                        0                1                   2
## vandykei                       0               11                   0
## huntii                         7                1                   0
##              Rhus aromatica Spiraea sp.
## vosnesenskii              0          14
## tripartitus              13           0
## acantha                   0           0
## vandykei                  0           0
## huntii                    0           2
```

took all my data and made a scatter plot of the Min and Max temperatures on the X axis and the number of Bees on the Y axis. The plot is organized as different colors indicating cities and the shapes indicating the months (April- September).

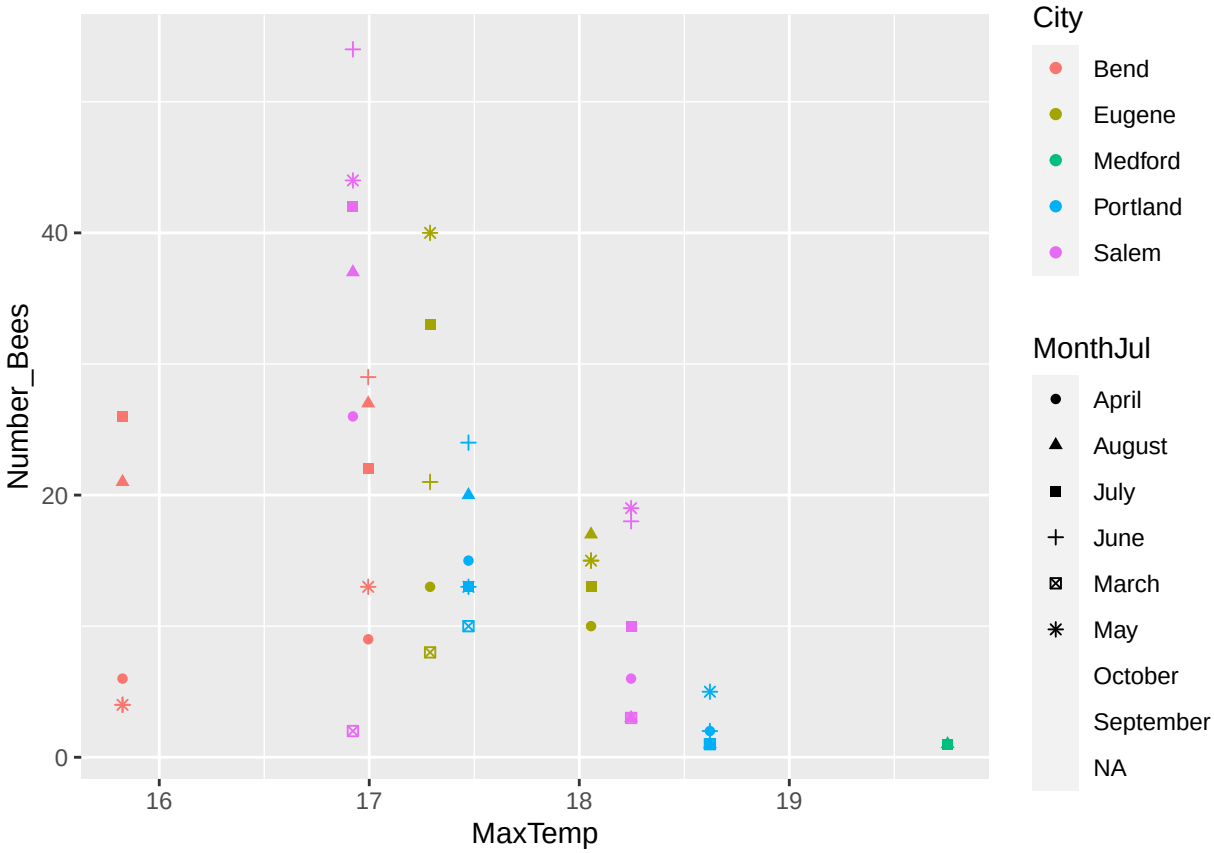
```
#plotting all the finalized data Minimum temp
complete_data %>%
  group_by(City, MonthJul, MinTemp, MaxTemp) %>%
  summarize(Number_Bees = n_distinct(Species)) %>%
  ggplot() +
  geom_point(aes(x = MinTemp, y = Number_Bees, colour = City, shape = MonthJul))
```

```
## `summarise()` has grouped output by 'City', 'MonthJul', 'MinTemp'. You can
## override using the `.groups` argument.
```




```
# Max temp
complete_data %>%
  group_by(City, MonthJul, MinTemp, MaxTemp) %>%
  summarize(Number_Bees = n_distinct(Species)) %>%
  ggplot() +
  geom_point(aes(x = MaxTemp, y = Number_Bees, colour = City, shape = MonthJul))
```

```
## `summarise()` has grouped output by 'City', 'MonthJul', 'MinTemp'. You can
## override using the `.groups` argument.
```



Resources: "National Pollinator Week: The Climate Threat to Bees." Energy.Gov, www.energy.gov/energysaver/articles/natio pollinator-week-climate-threat-bees#:~:text=Bees%20play%20a%20crucial%20role,and%20releasing%20oxygen%20to%20it. Accessed 8 Mar. 2024.

Melathopoulos, Andony., et al. "Enhancing Urban and Suburban Landscapes to Protect Pollinators." OSU Extension Service, Oregon State University Extension Service, 26 Jan. 2024, extension.oregonstate.edu/catalog/pub/em-9289-enhancing-urban-suburban-landscapes-protect-pollinators.