Florida Manatee Mortalities

DSC 680

Project 2 Milestone 3

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Business Problem:

Manatees are essential members of the marine and freshwater ecosystems in Florida. They help maintain the balance and stop overgrowth of seagrasses, which could lead to die-offs of aquatic organisms (Castelblanco-Martínez 2011). Florida manatees are also considered to be a keystone species, that can help bring to light changes in the ecosystem early so that changes can be made to protect it (Florida Manatee Program). However, they are dying off rapidly, despite not having any natural predators, and are now considered to be a Threatened species according to the Endangered Species Act. Continued deaths of the Florida Manatees could lead to the collapse of aquatic ecosystems in Florida.

Background/History:

The Florida Manatee is a threatened species, despite not having any natural predators. Their mortalities are primarily caused by human activity, both directly and indirectly (Bassett 2020). Boating accidents, flood gates, fishing gear, poaching, and other human activities lead to many manatee deaths each year. Additionally, cold stress, malnutrition, and natural catastrophes, which all have worsened due to human activity, also lead to many mortalities each year. Current boating regulations prohibit hunting, harassing, capturing, or killing manatees. Furthermore, special manatee zones are in place in high-traffic waterways, requiring boats to slow down and be more vigilant (Rulemaking Activities).

Data Explanation:

This data was collected by the Florida Wildlife Commission (FWC) and their partners. It is stored on their website for public viewing. This dataset looks at manatee deaths from 1974 to 2021. It breaks down manatee mortalities by county and year. Deaths are split by category: watercraft, flood gate/canal lock, other human related, perinatal, cold stress, natural, undetermined, or not necropsied. Since manatees don't have natural predators, most of their mortalities are caused by human, and therefore, determining the most common causes can help focus protection efforts to reduce deaths. This dataset breaks down the mortalities into the following categories: Watercraft, Flood gate/Canal lock, Perinatal, Cold Stress, Other Human, Natural, Undetermined, Not necropsied.

Methods:

The first step in this project was downloading the datasets from the FWC website, compiling the separate year files into one summary file, and then removing null values. After that, exploratory data analysis could be performed using Python. The mortality data by category across the years was graphed to look for any potential trends. Additionally, a correlation matrix was created using the Pearson method. That information was used to guide the next steps. Linear regression models were deployed to assess any correlation between categories. Plots were created to visual the changes in mortalities over time.

Analysis:

As you can see in Graph 1, total manatee mortalities are increasing over time. In Graph 2, you can see that many of the categories (such as flood gate and canal lock, other human, natural, cold stress, and not necropsied) have little to no change over time, while other categories (such

as perinatal and watercraft) increase greatly over time. Table 1 shows the correlation matrix, where Perinatal deaths and Watercraft related deaths are found to be strongly, positively correlated with the year. Graphs 3 and 4 help to better visualize this correlation. Linear regression models for both watercraft-related and perinatal mortalities result in a slope of 2.4 and 2.2 deaths per year respectively (Image 1). Furthermore, both models are fairly accurate, as seen by r-squared values in Image 1. Additionally, linear regression of total mortalities results in a slope of 14.7 deaths per year (Image 1).

Conclusions:

Manatee mortalities have continued to increase at a rate of 15 more deaths per year over the last 40 years, despite increases in regulations for human activity in manatee habitats. While some mortalities do not have a clear cause of death, many can be directly attributed to human actions, many of which would likely be preventable. Some types of mortalities, such as cold stress, have remained fairly consistent over time, with a few peaks, likely related to extreme weather events that would have led to greater numbers of mortalities, however, perinatal deaths and watercraft-related deaths have been steadily increasing over time.

Assumptions:

For this project, we are assuming the FWC dataset is accurate. While it doesn't validate the data collectors, it is published by a government group, and therefore is likely to be accurate. With linear regression we are assuming that the variables have a linear relationship, are independent from each other, and are normally distributed.

Limitations:

With endangered and threatened species, the data shared with the public is often limited to help protect the species. Furthermore, biological datasets like this that are part of long-term studies often are not the most thorough and lack information and organization because they were started so many years ago, when so many current technologies were not available.

Challenges:

One challenge was accessing proper data for this project. Many biological datasets, and particularly ones related to endangered and threatened species, are hidden from the public to prevent illegal action against these species. Since this is a threatened species, only summary data, rather than the original datasets, are available. Another challenge is that this sort of biological data is poorly organized online and takes a lot of effort on the front end to compile it into a working dataset.

Future Uses/Additional Applications:

The results of this study will help direct future legislation regarding boating, fishing, and other human activities around waterways frequented by manatees.

Recommendations:

Due to the large increase in mortalities per year, and the clear correlation between perinatal deaths and watercraft related deaths and overall increase in mortalities, I recommend focusing

efforts on decreasing mortalities in those two categories. To do this, I would first focus watercrafts and educating all boaters and visitors on regulations and proper boating procedures. Next, I would increase monitoring of breeding areas in the spring and summer, which are prime breeding times for manatees.

Implementation Plan:

To better educate boaters, educational materials should be created and distributed at all watercraft launch sites and in all watercraft-related courses. While FWC does have many excellent educational materials on their website, putting these up at each launch site, in addition to having park rangers available to answer questions and share this information upon entry to different parks would help increase awareness in boaters. Next, I would recommend staffing regular breeding grounds with volunteers or paid park rangers during breeding season (spring and summer). Not only would this help increase safe practices in boaters, but it would also allow the FWC to gain more information on breeding behaviors if they were interested in studying that further.

Ethical Considerations:

Working with endangered and threatened species leads to many ethical considerations, as sharing their locations and other pertinent information about them can lead to increases in poaching or harassment. While this study is only narrowing in as far as the county level in Florida, it is important to be mindful that this data pertains to actual threatened species and the goal is to protect them. Furthermore, any conclusions or proposals for future action must be carefully considered as the meager resources for projects like these must be used wisely.

References:

Bassett, B. L., Hostetler, J. A., Leone, E., Shea, C. P., Barbeau, B. D., Lonati, G. L., Panike, A. L., Honaker, A., & Ward-Geiger, L. I. (2020). Quantifying sublethal Florida Manatee-watercraft interactions by examining scars on Manatee Carcasses. *Endangered Species Research*, *43*, 395–408. https://doi.org/10.3354/esr01075

Boating regulations. Florida Fish And Wildlife Conservation Commission. (n.d.). Retrieved April 14, 2022, from https://myfwc.com/boating/regulations/

Castelblanco-Martínez, D. N., Barba, E., Schmitter-Soto, J. J., Hernández-Arana, H. A., & Morales-Vela, B. (2011). The trophic role of the endangered Caribbean Manatee trichechus manatus in an estuary with low abundance of seagrass. *Estuaries and Coasts*, *35*(1), 60–77. https://doi.org/10.1007/s12237-011-9420-8

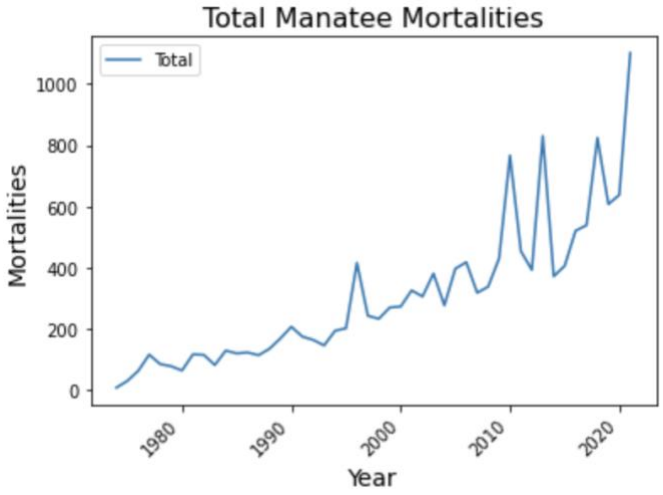
Descriptions of manatee death categories. Florida Fish And Wildlife Conservation Commission. (n.d.). Retrieved April 14, 2022, from https://myfwc.com/research/manatee/rescue-mortality-response/statistics/mortality/categories/

Florida Manatee Program. Florida Fish And Wildlife Conservation Commission. (n.d.). Retrieved April 14, 2022, from https://myfwc.com/wildlifehabitats/wildlife/manatee/

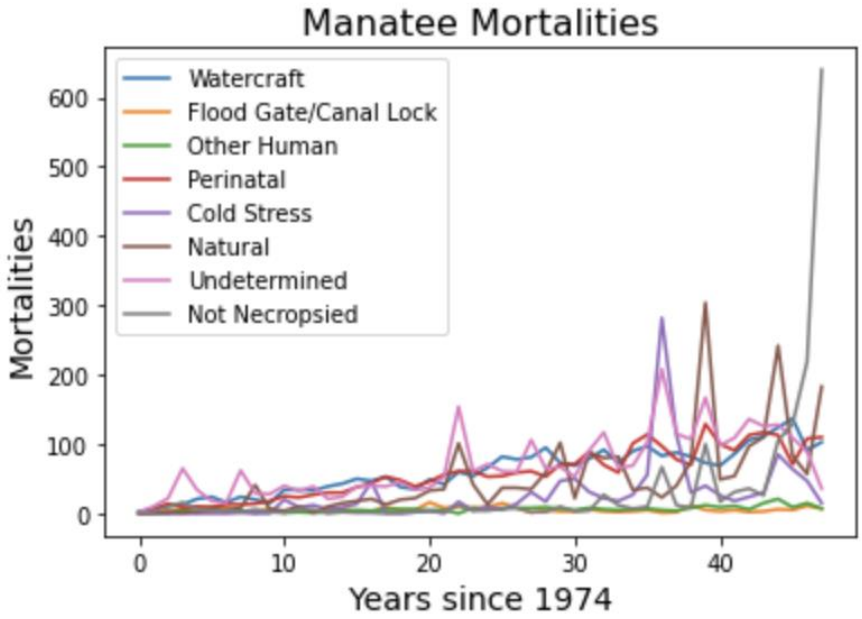
Rulemaking activities. Florida Fish And Wildlife Conservation Commission. (n.d.). Retrieved April 14, 2022, from https://myfwc.com/wildlifehabitats/wildlife/manatee/rulemaking/

Yearly mortality summaries. Florida Fish And Wildlife Conservation Commission. (n.d.). Retrieved April 14, 2022, from https://myfwc.com/research/manatee/rescue-mortality-response/statistics/mortality/yearly/

Appendix:



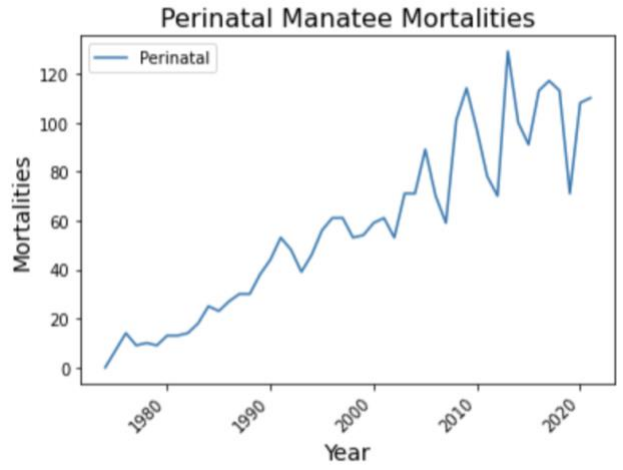
Graph 1: Total Manatee Mortalities by Year from 1974 to 2021.



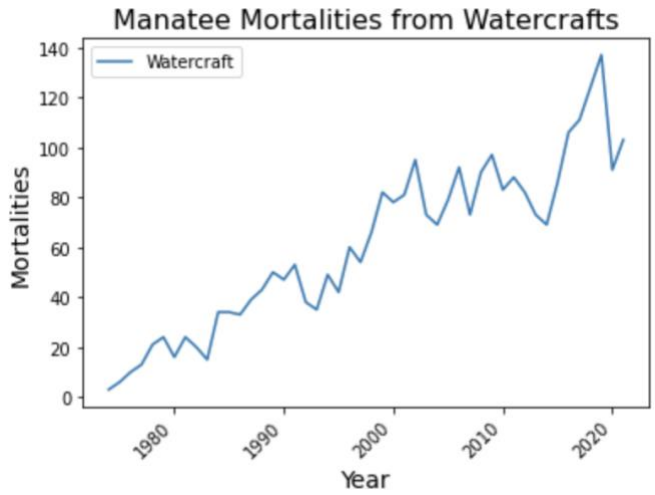
Graph 2: Manatee Mortalities by Category since 1974.

	Year	Watercraft	Flood Gate/Canal Lock	Other Human	Perinatal	Cold Stress	Natural	Undetermined	Not Necropsied	Total
Year	1.000000	0.940268	0.040610	0.703163	0.943592	0.460159	0.655773	0.727903	0.448139	0.868552
Watercraft	0.940268	1.000000	0.041948	0.687721	0.866256	0.446361	0.601421	0.698802	0.372136	0.811331
Flood Gate/Canal Lock	0.040610	0.041948	1.000000	0.177085	0.001726	-0.261120	0.039006	-0.090633	0.101552	0.009692
Other Human	0.703163	0.687721	0.177085	1.000000	0.689295	0.217815	0.621828	0.479589	0.275517	0.628085
Perinatal	0.943592	0.866256	0.001726	0.689295	1.000000	0.466077	0.701346	0.757772	0.405065	0.866474
Cold Stress	0.460159	0.446361	-0.261120	0.217815	0.466077	1.000000	0.193675	0.671397	0.126702	0.552985
Natural	0.655773	0.601421	0.039006	0.621828	0.701346	0.193675	1.000000	0.570387	0.492189	0.809036
Undetermined	0.727903	0.698802	-0.090633	0.479589	0.757772	0.671397	0.570387	1.000000	0.099075	0.725603
Not Necropsied	0.448139	0.372136	0.101552	0.275517	0.405065	0.126702	0.492189	0.099075	1.000000	0.704624
Total	0.868552	0.811331	0.009692	0.628085	0.866474	0.552985	0.809036	0.725603	0.704624	1.000000

Table 1: Correlation Matrix – Pearson Correlation



Graph 3: Perinatal Manatee Mortalities by Year



Graph 4: Watercraft-Related Manatee Mortalities

```
from scipy.stats import linregress
x = [df.Year]
y = [df.Perinatal]
slope, intercept, r_value, p_value, std_err = linregress(x, y)
print(slope)
print(r_value)
```

```
2.4083803734259663
0.9435918906454158
```

```
from scipy.stats import linregress
x = [df.Year]
y = [df.Watercraft]
slope, intercept, r_value, p_value, std_err = linregress(x, y)
print(slope)
print(r_value)
```

```
2.2365935735996527
0.9402676732080311
```

```
from scipy.stats import linregress
x = [df.Year]
y = [df.Total]
slope, intercept, r_value, p_value, std_err = linregress(x, y)
print(slope)
print(r_value)
```

```
14.667716022579244
0.8685522058213331
```

Image 1: Linear Regression outputs of slope and r-squared values for Perinatal Deaths, Watercraft-Related Deaths, and Total Deaths.