Final Project: Mapping Animal Migration Patterns

Jacob Bissonette, Sean Horton, Victoria Mirecki, Samantha Mora

Table of Contents

Overview and Motivation

At first, we were unsure of what we wanted to create for our final project. We initially agreed that we wanted it to deal with animals in some regard. Between discussions amongst ourselves and a recollection of a previously shared visualization from our weekly reflections (the blue whale avoiding ships), we decided we wanted to make a visualization showing the migration patterns of different animals on a world map.

Once we had the topic for our visualization, we understood that there are many animals to choose from. To solve this we narrowed it down to look for animals that had their migrations patterns tracked in the past, with latitude and longitude coordinates to make it easy for mapping in D3. Migration patterns have been observed by people for many years, and we hope to design a visualization depicting some of those results. When narrowing down our options, we also looked to have aquatic, avian, and terrestrial animals to be able to compare the differences between them.

Related Works of Inspiration

After we agreed that our final project should involve animals, we drew inspiration from a visualization that was previously shared in a reflection session from a fellow student in the class. This visualization involved a map of the Gulf of Ancud near Chile, with a blue shape representing a blue whale and its path, whereas all the dark red to peach shapes are the paths of the boats that the whale is attempting to avoid in order to feed. The blue whale visualization gave us an original idea in how we could map the entire world and track the movements of several animals in a similar manner to the blue whale.

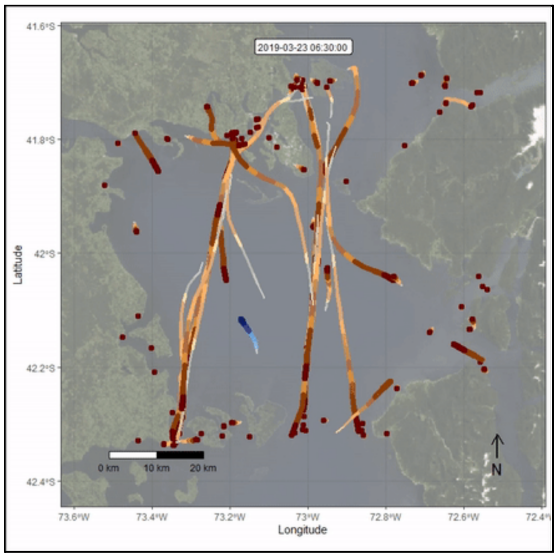

Figure 1. Blue Whale in High Boat Traffic

Once we had a general idea of what one way our data could look, we wanted to focus more on visualizations of migration patterns of animals to draw inspiration for our coding. One of our group members found a global map of migration patterns of several species of whales. This helped us realize that it would be more feasible to have a stagnant line for each animal's migration path so that the viewer can see where they start and end. Since we have a handful of animals for both water and land, there shouldn't be much overlap, making the paths easy to see and distinguish from each other.

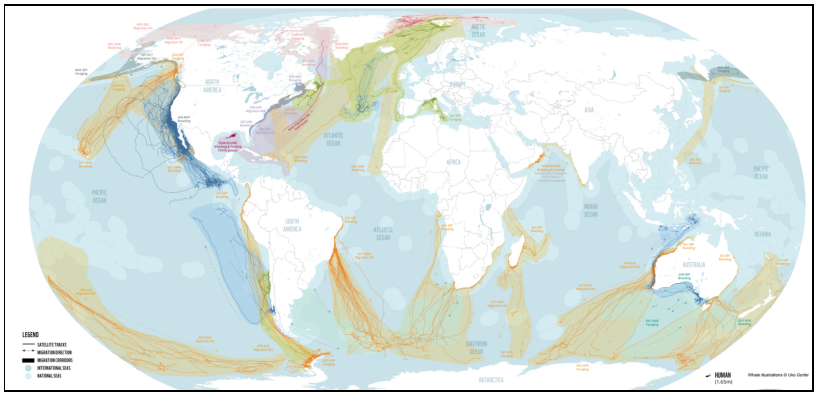

Figure 2. Whale Migration Patterns

Research Questions

From a general perspective, our team wanted to answer some questions relating to the migration patterns of different specials and also different animal types.

- Do animals of the same type cover greater distance when it is available to them?
    - For example, would a bird species in North America cover a greater area than a bird species located in Europe?
- How different are the patterns for animals of different types?
    - Do land animals seem to have more oriented/defined patterns than sea animals?
- Do some bird species circle back to the same places multiple times in a year?

Because of the size of files for some animals, it was difficult to scale them down and make them usable based on how they were ordered or unordered into a spreadsheet. Implementing the code to take into account a species' coordinates in a migration pattern offers a framework to observe the migration patterns of theoretically any desired species that already has a dataset containing the timestamp and respective coordinates of an animal's travels.

Data Collection and Cleaning

The primary source of data for this project came from Movebank and their online database of animal tracking data. We aimed to use species of different types (aquatic, land, air), and also varying across different continents to avoid clutter in the visualization. Once we explored Movebank's map of available animal data, we obtained around a dozen individual species and their tracking data, with the species being of differing types and regions.

One of the main issues with these datasets was the size of the files. GitHub only allows uploads of up to 25 MB, and some of these animals were more than double or triple the allowed file size. To resolve this, we first eliminated any columns with data that we didn't see as help or data that wouldn't be needed in our code. The end result of this step was five columns, containing the animal ID, a timestamp, the longitude, the latitude, and the species name.

Once our columns were set, we listed each animal and the new file sizes to see which ones were still too big, and we then scaled down by eliminating rows that were very close to each other in time.

Exploratory Data Analysis

Initial Visualizations

Because our data is heavily dependent on seeing the final visualization, there wasn't an effective or efficient way to visualize the original data with their CSV datasets. We had a strong idea on what we wanted our end product to be, being a mix of the visualizations seen in the *Related Works of Inspiration*. We also hoped to create a filter for the visualization to allow the user to view any animal(s) of their choosing.

Design Insights

Upon further research and given the timeframe of the project, it would be difficult to do a sort of dot and tail visualization, so we aimed to create a visualization mapping each animal's migration patterns with a respective solid line.

Design Evolution and Implementation

Initial Design Ideas

We originally wanted to create a map of the world with a path drawn for each animal's migration pattern. The idea would be that we would be able to choose which were being shown at a time and that we could see it change over time, or change in color to show the time that passed. We originally wanted to indicate each animal as a little animal figure that could move along the path to show the migration pattern. Below is a mock sketch of the map and the idea of the different animals moving along a path. The animals would also ideally be different colors to make the differences more apparent. With further investigating this idea, we decided to not implement animal figures because making them as polygons would not be feasible or easily mobile if possible. For feasibility, as mentioned in Design Insights, using a solid line to show the migration pattern would be the most feasible with our d3 capabilities and time restraints.

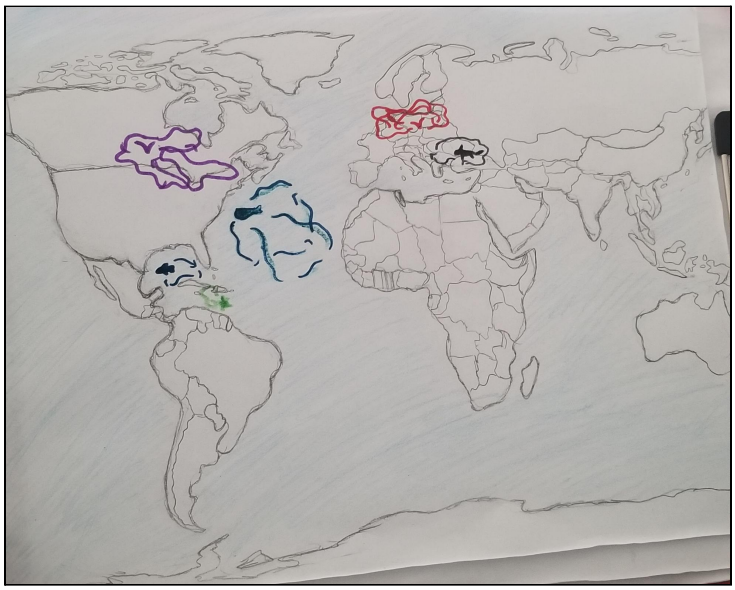

Figure 3. Initial Visualization Idea

Proposal and Scope Development

The scope of the project did not have to change drastically. It was hard to get the method of showing the animals moving across their paths, and the data took several edits/cleanups to make sure it was adequate, logical, and able to be used in the code. In all, we are very pleased with how our end result in being able to have a solid framework of displaying animal migration patterns with a zoom, filter, and hover option covering several visualization tasks.

Evaluation

Research Questions Revisited

Some of the animals that we chose appear to remain in close proximity when compared to the size of the whole map. One example being the roe deer, which is a deer species found across much of Western Europe. The tagged deer from this particular dataset of roe deer seem to travel only in parts of Italy as opposed to moving to neighboring countries.

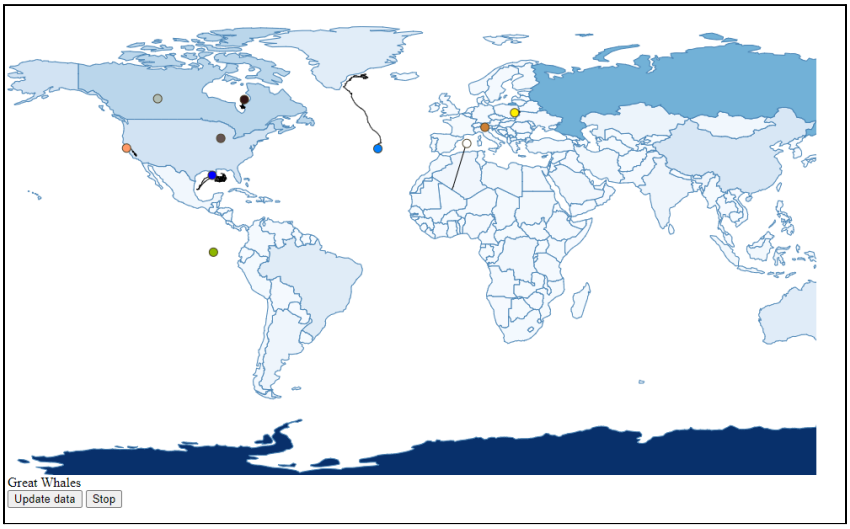

Figure 4. Final Project Visualization

As could be expected some sea animals travel much greater distances than some land animals, along with differing species of bird covering substantial distances. But, there are some sea animals that still stay in a certain area, like the whale shark remaining in the Gulf of Mexico while the great whale covers a good portion of the northern Atlantic Ocean.

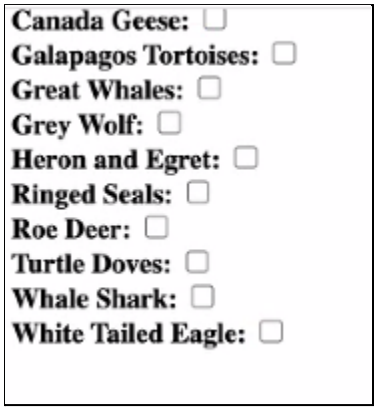

Figure 5. Datasets Toggleable in Final Design

Visualization Analysis and Improvements

- Successfully implemented a map depicting the migration patterns of different animals. Each colored dot represents a different animal.
    - Pressing “Plot” shows only the filtered animals’ paths
    - Pressing “Update data” shows all animals
    - Pressing “Stop” shows the starting and ending points of each path.
- Successfully implemented a checkbox filter that allows visualization of just one animal at a time as seen in Figure 5.
    - As opposed to only having different colored dots

Improvements:

- Time lapse of patterns
- Mouseover dot displays animal name in bottom corner
- Adding more animals for additional data
- Further analysis between the different animal paths (how far each animal moves between steps and overall)