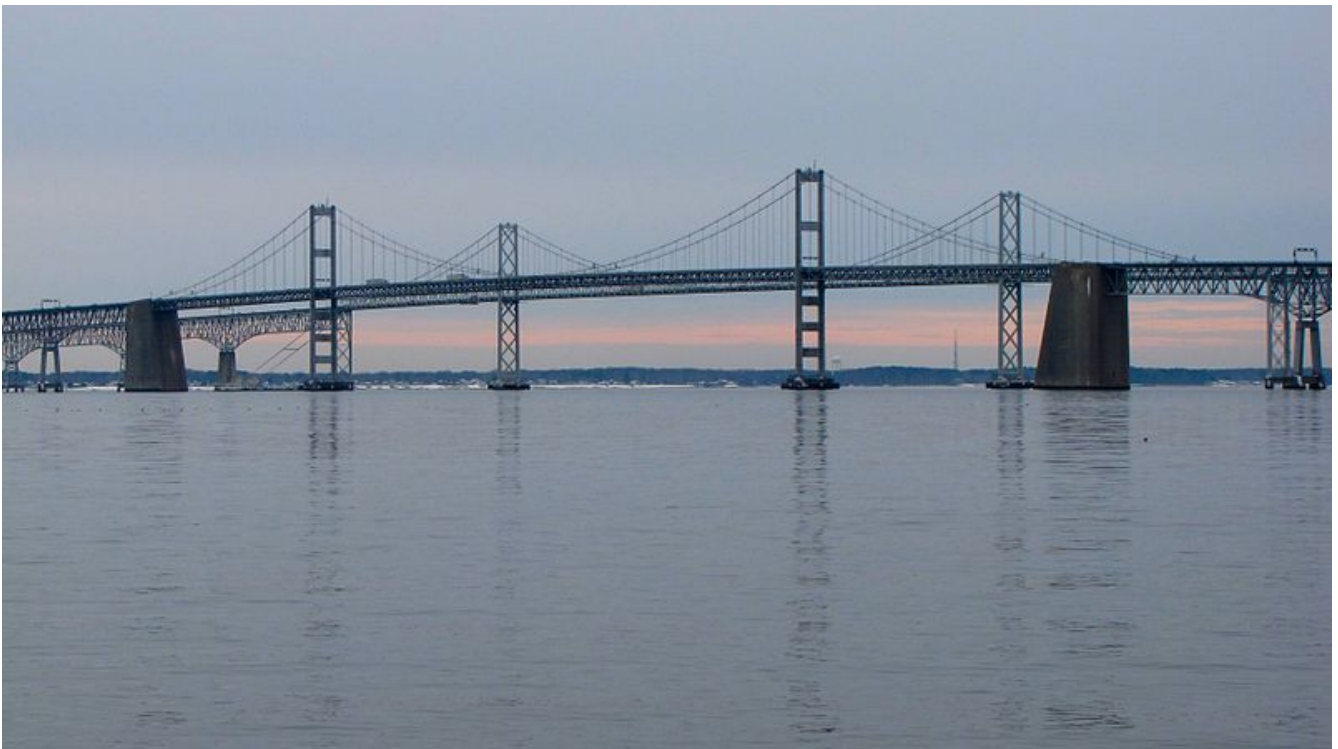


Chesapeake Bay Water Quality

Stacie Kuamoo
CS171 – Spring 2015



Credit: Ben Schumin

Overview and Motivation

I initially chose to do a project visualizing the decline of the oyster population in the Chesapeake Bay in recent years. I had a strong interest in this topic because I live on the Chesapeake Bay and am aware of the effects of the dramatic decline in oysters in recent years on the health of the bay as well as Maryland's economy. I intended to explore patterns in weather, oyster harvesting, water quality, pollution, and economic data in order to better understand the causes and results of the oyster population decline, as well as the success of efforts to restore the oyster population. My hope was to come up with a visualization to provide meaningful insight into this issue that could be leveraged to assist oyster restoration efforts.

Related Work

In the beginning stages of my research I found a number of articles and anecdotes about the importance of oysters in the Bay and in the region that inspired me. Oysters are especially important for filtering harmful nutrients and toxins out of the water in order to provide sufficient conditions for other species to survive in the Bay. One article included a time lapse video of how effectively oysters filter and clean the contaminants that plague modern society out of the water (<http://goo.gl/AgbLgT>). Having observed how poor the water quality of the Bay has become first hand, I was both fascinated and inspired by the potential, and did quite a bit more research on current oyster restoration efforts into which the Maryland government has invested millions of dollars in recent years.



<https://www.youtube.com/embed/VTuBbuUro4g?rel=0>

Questions

My initial questions for this project were:

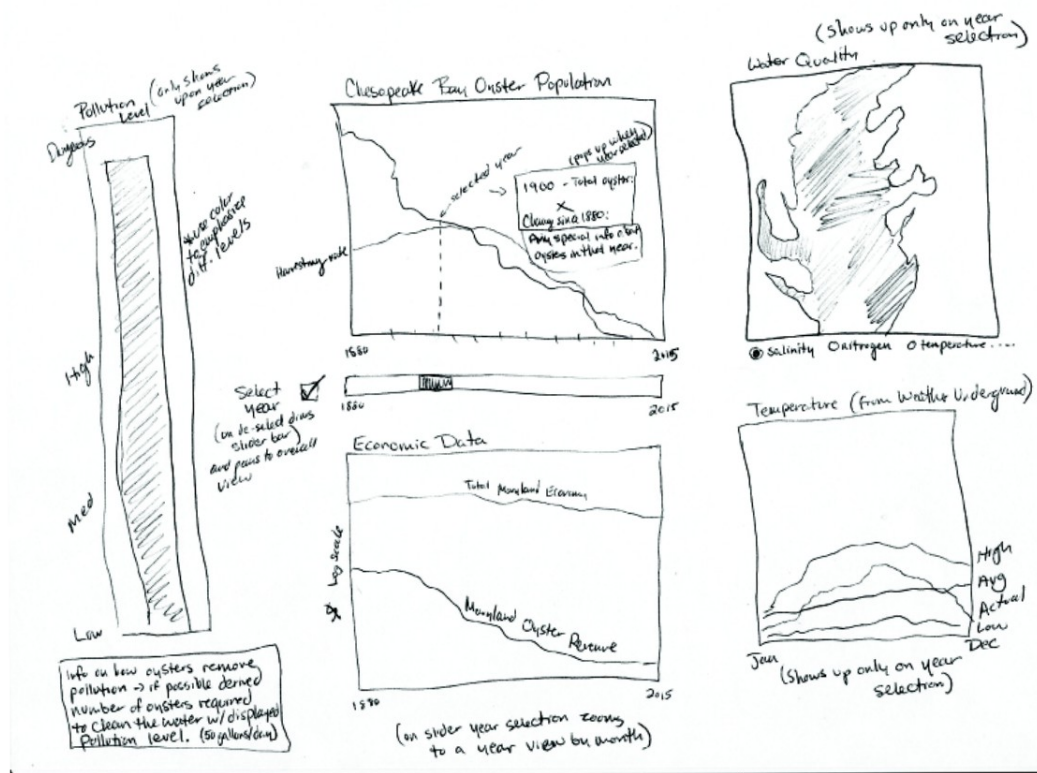
- How has the oyster population changed over time in the Chesapeake Bay?
- What are the primary causes of the decline in oyster population?
- What are the effects of the decline in oyster population on the water quality (oysters filter the water), and the local economies?
- How can efforts to reintroduce oysters be most successful? What other elements need to be considered?

Over the course of my work these changed slightly to the following:

- How has the water quality of the Chesapeake Bay changed over time (with a particular focus on nutrients and conditions that are potentially harmful to creatures living in the Bay)?
- Are there observable patterns in the selected measures based on time of year?
- Are there substantial differences in these measures based on geographic location in the Bay? How do the measures at each station compare to overall Bay averages?

Design

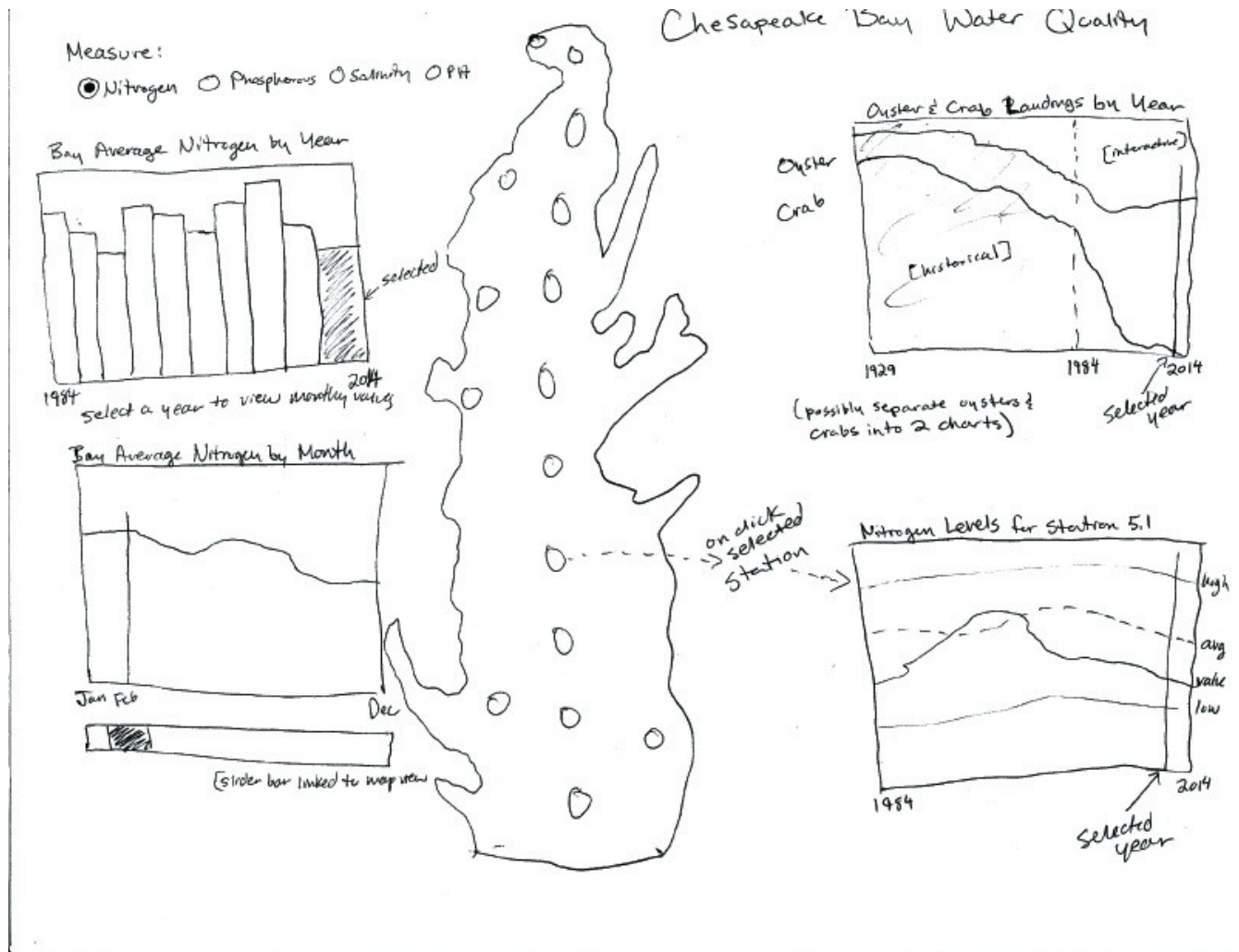
In my initial design I sought to explain through visualization the effect of water quality and pollution on the oyster population and vice versa, as well as the effect on the local economy:



I did decide to modify the topic slightly after some discussion. The most detailed data I had was for water quality from different stations, so instead of having a time series view centered around the oyster population as the focus for the majority of my visualization, I decided instead to move to a geographic layout with the water quality stations as the focus. I thought this would result in a more interesting visualization because the data was much richer.

My modified view centers around a plot of the water quality stations on a map of the Bay coastline. In this design the user can choose a measure (i.e. nitrogen, dissolved oxygen, water temperature, salinity, water clarity) and a bar chart updates with the average yearly values for all stations across the Bay. The user can then select one of the bars to choose a year to filter down for the data in a chart showing the monthly averages across all stations. The user can then interact via a slider bar representing all months in the selected year, to observe how the values change by month (the current month will be represented

by a line on the monthly averages chart, and the size of the circles representing each station on the map will change based on the relative values of the selected measure for that month. Since I did want to keep a focus of the project on the relationship between water quality and oyster populations, if the data supports it I plan to have a chart on the right that shows the oyster population by year, with a line representing the current selected year. Finally, the user will be able to click on any single station and view the full history of the selected measure across all years with available data.



Data

The data gathering phase was far more difficult and time consuming than I expected. The data I needed resided in many different places and forms. I found many charts representing some aspects of the data so I assumed it would be easy to find the source data as well but this was not the case. After thoroughly researching the topic and data for days I still had very little to work with. It got to the point where I thought about switching topics entirely to something with more readily available data. However I feared I would not learn as much from this project about overcoming real world challenges if I took the easy way out and based my topic off of readily available data instead of finding the data I needed to answer the question at hand, so I decided to press on.

After extensive research I was able to find the data I need, collecting it from a broad range of sources. There is an API for Chesapeake Bay water quality data but it is very slow and required pulling data in small batches. The data is also fairly dirty and required a lot of de-duplicating and cleaning. I scraped

the oyster and crab population data from HTML tables on web pages. I was also able to obtain water quality data by emailing the Department of Natural Resources and NOAA.

One of the hardest parts of the data to find was the shape file for the geographic visualization. While there was a significant amount of GIS data for the Chesapeake Bay, most of these shape files were created as part of studies and included extraneous information which prevented me from being able to use them. After much research I was able to get a hold of a shape file for the Chesapeake Bay coastline and figure out how to work with it via TopoJSON:



Chesapeake Bay coast shapefile implemented in D3/topoJSON