

Seasonal Changes in Phytoplankton Biodiversity on the Outer Banks 2005 to 2013

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The First Flight High School PytoFinders analyze the data from phytoplankton samples collected between 2005 and 2013 to determine if significant seasonal variations in species composition exist. Sampling could not be carried out with sufficient regularity during the summers, so this study focuses mostly on samples collected during the fall, winter, and spring seasons. These observations contribute to a more complete understanding of community composition and biodiversity, and the variables that can influence changes through the seasons. The PhytoFinders have made various hypotheses as to why these variations exist.

For almost a decade the First Flight High School (FFHS) Phytoplankton Team, or PhytoFinders, has partnered with the Phytoplankton Monitoring Network (PMN), a division of NOAA's Marine Biotoxins Program, to monitor phytoplankton populations along the Atlantic coast of the Outer Banks of North Carolina and to search for harmful algal blooms. The target species that the PhytoFinders look for is *Pseudo nitzschia spp.*, a marine diatom which produces the neurotoxin domoic acid which causes amnesic shellfish poisoning and can be dangerous to marine life and humans.

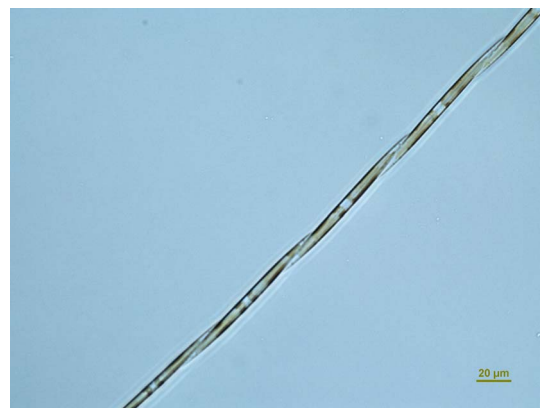
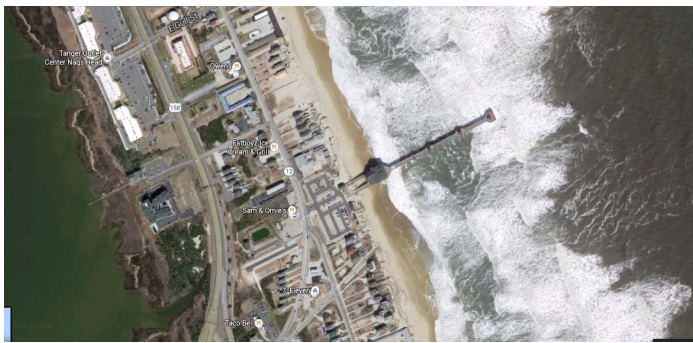


Image of toxic phytoplankton *Pseudo Nitzschia spp.* with scale.

The PhytoFinders team collects phytoplankton samples using a 20 μm net at the US Army Corps of Engineers Field Research Facility in Duck, NC, and at Jennette's Pier in Nags Head, NC. Members analyze phytoplankton samples with optical light microscopes, identifying diatoms and other biota to genus or species level, and record population counts. A methodology that includes replicate samples and multiple counts by several students, with experienced students teaching new members, is used to promote program continuity and accuracy.

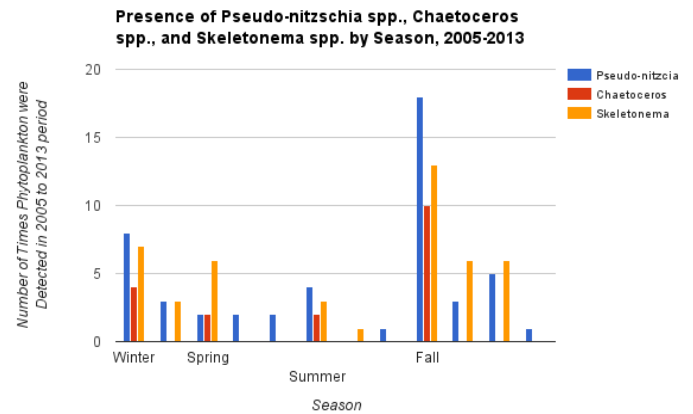


Google satellite image of the U.S. Army Corps of Engineers Field Research Facility in Duck, North Carolina.



Google satellite image of Jennette's Pier in Nags Head, North Carolina.

Data from the years 2005 to 2013 was analyzed focusing on three species of phytoplankton, *Pseudo nitzschia spp.*, *chaetoceros spp.*, and *skeletonema spp.* They were all found to follow seasonal patterns. In the spring and summer months there was little phytoplankton activity. In the fall the phytoplankton populations became more abundant, and then lessened through the winter months.



The above graph is an analysis of the data recorded by the PhytoFinders from 2005 to 2013 focusing on *Pseudo-nitzschia spp.*, *Chaetoceros spp.*, *Skeletonema spp.*

During the summer of 2015 PhytoFinders Jodi Awtrey and Nathan Butcher volunteered with the Education Department at Jennette's Pier in a collaborative citizen's science project teaching the public about phytoplankton and collecting phytoplankton data for the PMN as well. The PhytoFinders team does not usually collect samples over the summer and usually only collects during fall to spring, during the school year. Over the course of the summer the two PhytoFinders found that the concentration of phytoplankton populations dwindled too little to none. With recording instruments limited to only a thermometer and their senses, Awtrey and Butcher could not determine the characteristics of the water such as salinity and pH. The two have hypothesized that the lack of phytoplankton numbers was due to the lack of nutrients in that water and the relatively high salinity of the water. Butcher commented on their observations saying "I have an idea that the lack of rain and runoff water that the Outer Banks experienced this past summer has caused a lack of nutrients in the water; in conjunction with the higher salinity from the summer, a favorable environment for phytoplankton was not created. I

think that the phytoplankton prefer a balance between the two.”



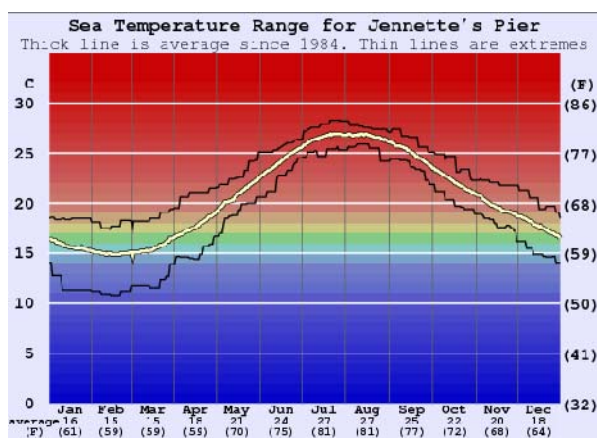
PhytoFinders Jodi Awtrey and Nathan Butcher demonstrating techniques for collecting phytoplankton samples off of Jennette’s Pier in Nags Head for their Collaborative Citizens Science Project.

The salinity of the ocean rises during the fall and is higher during those months than any other time of the year. This could be a contributing factor causing the higher levels of marine phytoplankton, which are adapted to live in environments of high salinity.

The air and water temperatures also affect the presence of phytoplankton. During the spring and summer, seasons associated with rising air and water temperatures, plankton levels are lower. However, during the fall and winter, seasons associated with falling temperatures, plankton levels are much higher. This observation could be attributed to colder water’s ability to carry more dissolved oxygen and more nutrients for phytoplankton.

The climatic changes going on across the world have also been thought to play a role in phytoplankton populations. As the years have progressed since the first recorded data collection in 2005, bloom levels of a variety of phytoplankton species have increased in the fall and winter months

on the Outer Banks. This is most likely due to the increase in water flow from the melting of the ice caps and other sources of freshwater running into the oceans. The increase in the water flowing through these currents allows more nutrients to be brought up, giving access for more phytoplankton species to grow. Yet, in other locations across the globe there have been records of a decrease in the population of phytoplankton and an earlier blooming season. Studies have shown that species have been blooming up to two months earlier than usual. These smaller size blooms at an off time play a large role in the entire ecosystem and are throwing balances off kilter.



The above graph shows the average sea temperature range at Jennette’s Pier in Nags Head, NC. As you can see in the fall months there is a gradual decline in the water temperature, bringing more nutrients to the water and in turn greater numbers of phytoplankton.

Parallels can be drawn from the presence of phytoplankton on the coast of North Carolina to the issue of “The Blob” in the North Pacific. Both of these occurrences are heavily influenced by the heating of water, and have caused an alarming increase in the toxic phytoplankton, *Pseudo Nitzschia spp.* The Blob is much larger than our phenomenon, and has become so serious that fisheries have been closed across the West

Coast. Our situation is different, however in that the heating associated with The Blob is mostly unexplained, and while we know the heating of our water is seasonal. We are hoping that the high tech research scientists conducting research on The Blob will push forward technologies that can be used in the case of red tides, which occasionally occur here.

References:

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"Phytoplankton Blooms and Climate Change." *Institute for Global Environmental Strategies*. Earth System Science Education Alliance, 17 June 2013. Web. 27 Aug. 2015.

Image of toxic phytoplankton Pseudo Nitzschia with scale. Digital image. Northwest Fisheries Science Center, 2013. Web. 27 Aug. 2015.

Sea Temperature Range for Jennette's Pier. Digital image. Surfforecast.com, n.d. Web. 27 Aug. 2015.