

Algal Bloom Turns Ocean Red

Sam Weybright¹, Parks Kelly¹

First Flight High School
100 Veterans Drive
Kill Devil Hills, NC 27949

In October of 2014 a large algal bloom formed off the coast of North Carolina near the Pea Island National Park, turning the waters red. In response to this unusual and potentially toxic bloom, students from the Phytofinders team of First Flight High School (FFHS) in Kill Devil Hills, NC, travelled south to collect water samples. Their goal was to examine and identify the genera or species of the organism(s) populating the spreading bloom. The analysis, reported in this paper, revealed that the bloom and resulting discoloration of the coastal waters were due to *Mesodinium rubrum*. This ciliate is well known for turning the waters red during mass blooms, but it has no other known harmful effects. While the observations and analysis of the Phytofinders had established that the bloom was unlikely to contain harmful constituents, the release of Barnacle, a protected loggerhead sea turtle that had completed a rehabilitation program at the North Carolina Aquarium, was delayed as a precaution.

I. INTRODUCTION

On October 27, 2014, a large algal bloom formed off the coast of North Carolina near the Pea Island National Park, turning the waters red. Resembling the annual red tide off of Northwest Florida, the bloom quickly drew local and regional attention. In response, a local high school club, the Phytofinders, traveled south to investigate the unusual bloom. Their goal was to collect water samples to identify the species and cause of the bloom. Although the Outer Banks rarely sees harmful algal blooms of any kind, numerous local

restaurants and organizations were on high alert. Reminiscent of the red tide bloom in October of 1987, The Aquarium, thinking the bloom was similar to those off of Florida's coast, delayed the release of the turtle, so as not to cause any harm to the recently rehabilitated turtle. After the Phytofinders collected and studied the water, it was agreed upon that the algal bloom was not the same as the one off the coast of Florida and was not harmful to organisms such as the loggerhead turtle. From this bloom, the Phytofinders confirmed that upwellings along the Outer Banks, combined with the right weather conditions, have the capability to produce massive blooms of plankton. This bloom proposed a vital question to the phytofinders; why this bloom happened, in such a quick and unexpected manner.



Figure 1: Mesodinium Rubrum bloom off coast of North Carolina

II. MATERIALS AND METHODS

After receiving word of the maroon waters stretching from Pea Island Nation Park through Buxton, NC, the Phytofinders traveled south towards the Bodie Island lighthouse. Trekking through the surf zone on the beach adjacent to the lighthouse, students collected samples of the water

using 20 µm plankton nets and tow lines. The students threw the net out into the surf and retrieved it with a zigzag motion. The group then collected whole samples of water by filling a five gallon bucket with water from the surf and preparing samples from the bucket. The ocean appeared a muddy brown from a combination of silt and the abundant plankton. It was evident that an algal bloom had occurred, but the Phytofinders were still eager to study the samples. After collecting the samples, the students met back up at the school and studied them. Using compound light microscopes and a digital microscope, the students searched the water samples for a suspect organism. While identifying various species of plankton under the microscopes, the students found the plankton too numerous to count. After making their conclusion, the students sent the findings to NOAA.

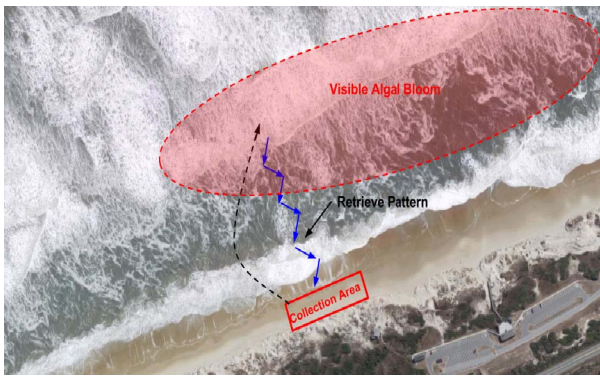


Figure 2: Collection process on 10/28/14

III. RESULTS

The Phytofinders originally concluded that the discoloration in the water was caused from a bloom in cyanobacteria, only to find later that *Mesodinium Rubrum* (*M. Rubrum*), a harmless ciliate, caused the massive bloom. After even further investigation, the group found that several factors contributed to this unusual bloom along the Pea Island National Seashore. Due to the proximity to the continental shelf, the Outer Banks of North Carolina often experiences a phenomenon known as upwelling. This normally happens when the winds blow from the southwest, driving the warm, Gulf Stream waters offshore and allowing the colder, nutrient-rich, deep ocean water up to the

surface. With steady southwest winds days prior to the bloom, the water temperature drop significantly from 20°C to 16°C at Jennette’s Pier and from 20°C to 14.5°C at the Field Research Facility in Duck, NC, confirming our suspicion of an upwelling event. Fueled by nutrient-rich water and plentiful sunshine, the autotrophic and heterotrophic (the autotrophic property was not discovered until 2006)

Jennette's Date	Water Temp. (°C)	Air Temp. (°C)	Salinity (ppt)	Weather	Wind	Wind Speed (mph)	Tide	Secchi Disk (cm)
10/21/2014	20	22	34	Sunny	SW	10 to 15	In-coming	59.9
10/28/2014	20	23	32	Sunny	S	10 to 15	Low	31
11/3/2014	16	13	30	Sunny	W	5 to 10	High	10

Figure 3: Data from weeks prior and during the algal bloom

protozoan flourished, causing the red waters. Although, *Mesodinium rubrum* can cause the ocean to appear a deep red, this species is not similar to the one commonly found off the coast of northwest Florida. *M. rubrum* can be found in coastal regions throughout the world, but has no harmful effects on sea life, even in large, bloom quantities. The species commonly associated with the Florida red tide, *Karenia brevis* (*K. brevis*), is known to produce a powerful neurotoxin called brevetoxin, while *M. Rubrum* produces no toxins. A similar species called *Pseudo nitzschia* does inhabit the waters of North Carolina. This organism is capable of producing domoic acid, which may contaminate shellfish and fish in a similar way as the brevetoxins. However, *Pseudo nitzschia* does not discolor the water as *K. brevis* and *M. Rubrum* do.



Figure 4: Mesodinium Rubrum

IV. DISCUSSION

The Phytofinders have been actively analyzing the oceans of the Outer Banks since 2005. Throughout the years, the Phytofinders have identified several algal blooms, including a toxic pseudo-nitzschia bloom in 2006. The *M. rubrum* bloom of 2014 was unique from the other algal blooms in many ways. This bloom was found exclusively south of our normal sampling sites, meaning the group had to travel more than usual to retrieve samples. Secondly, the bloom was not located near any accessible pier or dock, meaning the phytofinders had to wade through the chilly, October waters to collect samples. During the collection process, the Phytofinders found that water conditions were not ideal. With choppy seas and a strong current, the net continuously drifted north. The group was still able to collect viable samples despite the poor conditions. Due to the rough seas, some of the samples contained damaged organisms. Many individual cells within the sample were mangled by the strong waves. Upon first analysis of the samples, the Phytofinders

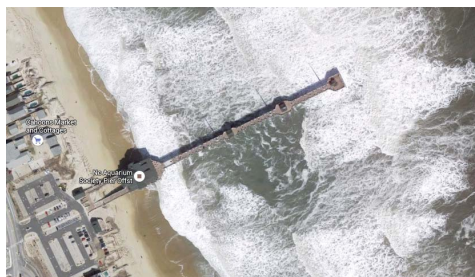


Figure 5: Jennette's Pier located at 35.910 N, 75.596 W

misidentified the *M. Rubrum* as a type of cyanobacteria.

The Phytofinders attributed the initial misidentification of *M. rubrum* to the rough seas which marred the appearance of many individual organisms contained within the samples. Still concerned about the potential bloom of an unknown cyanobacterium, the group prepared and shipped several samples to NOAA for further analysis. After receiving data from NOAA, the Phytofinders were relieved to find that the bloom was caused from non-toxic phytoplankton and

would cause no harm to the surrounding environment. The North Carolina Aquarium was one of the first organizations to actively respond to this event by delaying the release of a loggerhead sea turtle, named Barnacle, until November 4th. In conjunction with the unusually cold waters, the bloom forced Barnacle to be taken by boat to be released 32 miles offshore into the warmer waters of the Gulf Stream.



Figure 6: "Life in a Drop of Water" Plankton exhibit featured at Jennette's Pier

The Phytofinders are a locally known high school organization. The only one of its kind, the Phytofinders promotes the scientific and ecological study and upkeep of the environment in the surrounding area. The Phytofinders are a leading group in promoting ecological awareness. One sampling site, Jennette's Pier, houses an exhibit featuring the Phytofinders. This exhibit serves the purpose of educating the passing public about plankton by giving various statistics about each common species found in coastal North Carolina. The Phytofinders have become an integral part of ecological conservation along the fragile island chain of the Outer Banks. The regular observation of plankton by the Phytofinders provides vital information to NOAA, as well as many other local and regional organizations concerned with our waters. The Phytofinders play an instrumental role in the monitoring of the ocean

off the Outer Banks because most groups lack sufficient man-power and funds it takes to perform such tedious, but important tasks. The data provided by the Phytofinders benefits the community

This past year (2015) has also seen other blooms of species previously unknown to congregate on the Outer Banks. *Porpita Porpita* (*P. Porpita*) is often referred to as the blue button jellyfish have been a common sight on Outer Banks beaches this year. This jellyfish-like, creature is actually a colony of smaller hydroids that work together to obtain food. *P. porpita* is found in tropical and subtropical oceans, but usually only comes close to shore when blown by strong winds or storms. The spike in *P. porpita* sightings this year is believed to be caused by stronger than normal Gulfstream current, which had brought above-average water temperatures to the Outer Banks. The unusual currents and strong upwellings, could lead us to believe that the balance of the local and global climates has been disrupted.

ACKNOWLEDGMENT

Phytofinders thanks Katie Neller and Todd Morrison for all the time and effort they put forth for our group and environment. Also, for all the incredible help they provided for us while writing this paper. Phytofinders also thanks Jennette's Pier in Nags Head, North Carolina, and the Field Research Facility in Duck, North Carolina, for allowing us to use their beautiful facilities to collect our data.

REFERENCES

- [1] Wagner, Michelle. "Ocean Algal Bloom Generates Interest, but Not Concern -- Yet." The Outer Banks Voice.
- [2] The Outer Banks Voice, 28 Oct. 2014. Web. 28 Aug. 2015.
- [3] Hathaway, Terri Kirby. "FFHS Phytofinders to the Rescue." NC Seagrant. NC Seagrant, 11 Nov. 2014. Web. 28 Aug. 2015.
- [4] "North Carolina Aquariums » NC Aquarium Helps Sea Turtle Head for Home." North Carolina Aquariums NC Aquarium Helps Sea Turtle Head for Home Comments. N.p., n.d. Web. 28 Aug. 2015.
- [5] "Jellyfishlike Creature Invasion Leaves Outer Banks Beachgoers Mystified." Accuweather.com. Accuweather, 28 Aug. 2015. Web. 28 Aug. 2015.
- [6] "ClimateWatch." Blue Button. ClimateWatch, 2012. Web. 28 Aug. 2015.
- [7] "Harmful Algal Blooms." Harmful Algal Blooms. NOAA, 11 Aug. 2014. Web. 28 Aug. 2015.