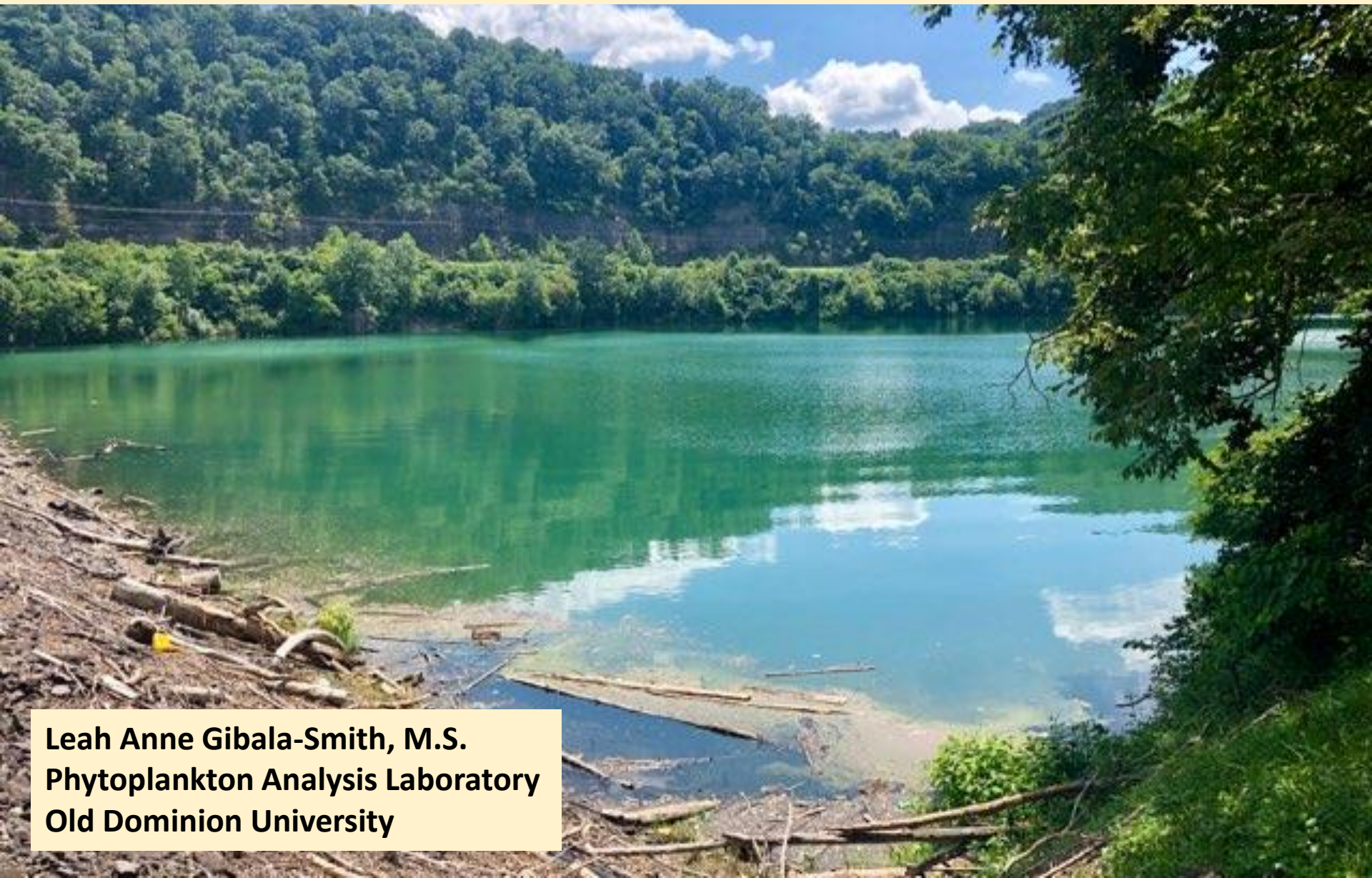


2020 ODU Freshwater Summary



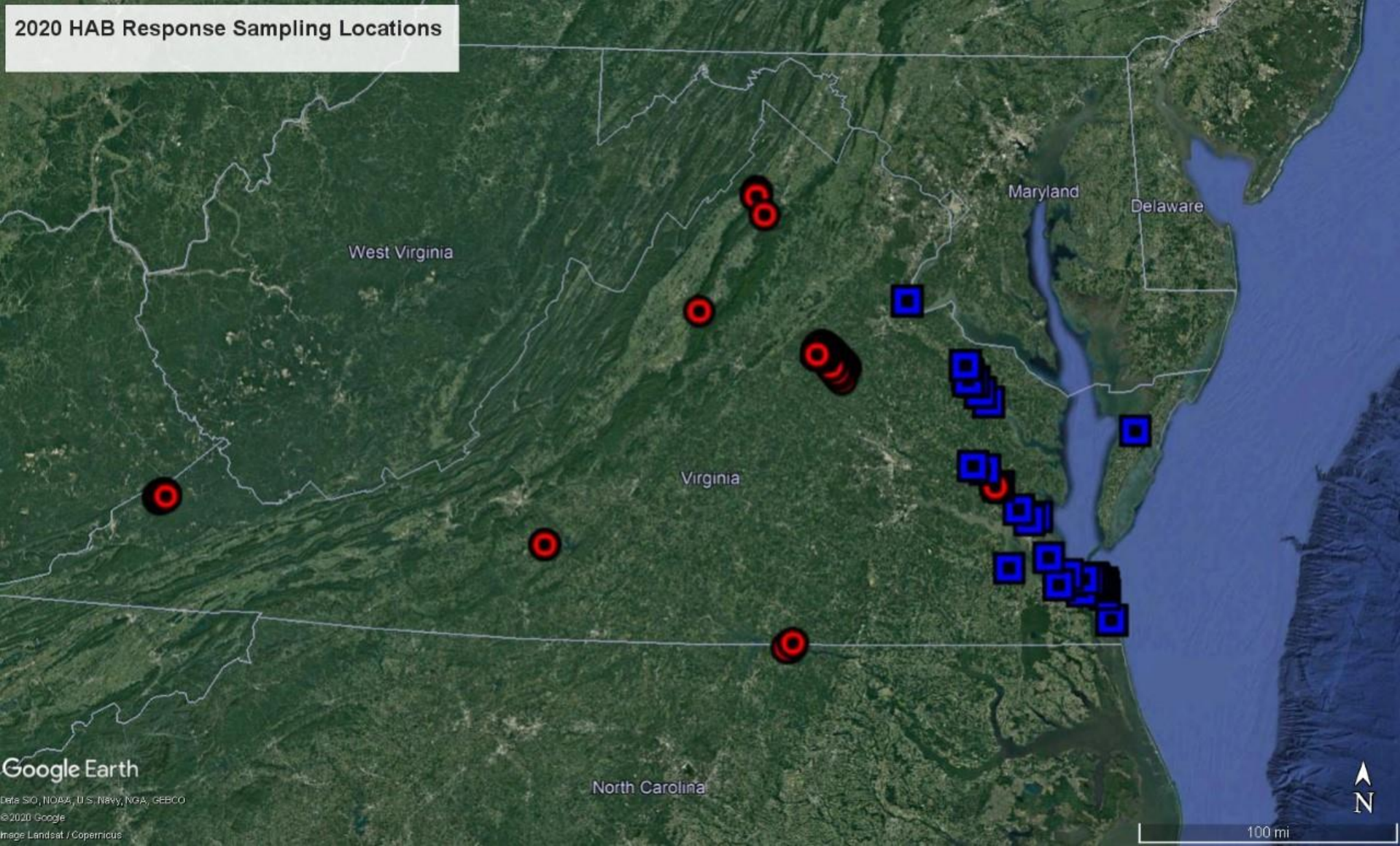
Leah Anne Gibala-Smith, M.S.
Phytoplankton Analysis Laboratory
Old Dominion University

2020 Freshwater Overview

- **593 samples under our VDH contract**
 - 402 were part of our shellfish monitoring efforts
 - 191 of these were associated with a rapid HAB response
 - 49 samples from tidal waters
 - 142 inland freshwater samples
- **Freshwater breakdown**
 - 142 samples received
 - 678 analyses conducted
 - 111 taxonomic enumerations
 - 141 microcystins by ELISA
 - 141 cylindrospermopsin by ELISA
 - 129 anatoxin-a by ELISA
 - 129 saxitoxin by ELISA
 - 27 mc/cylindro by MBIO



2020 Virginia Statewide Rapid Responses for HAB events



2020 Virginia Statewide Rapid Responses for HAB events

2020 HAB Response Sampling Locations



Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2020 Google
Image Landsat / Copernicus

North Carolina

100 mi



2020 Freshwater Overview

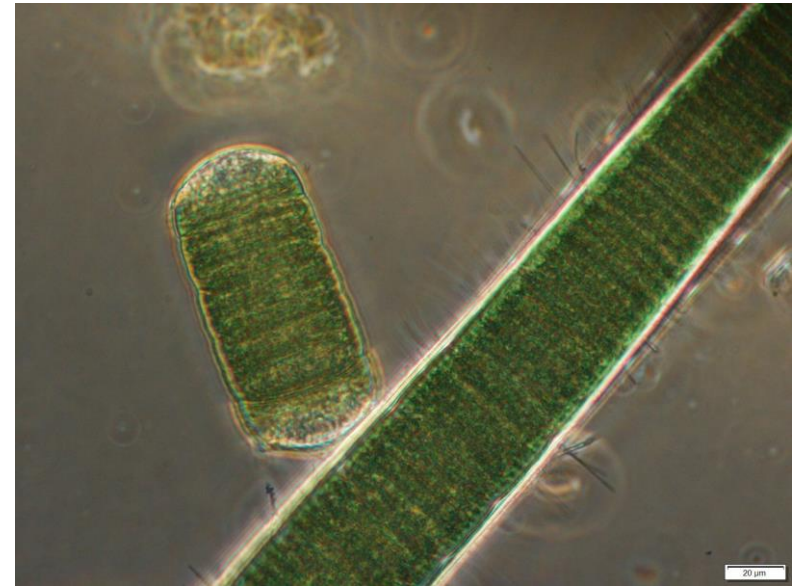
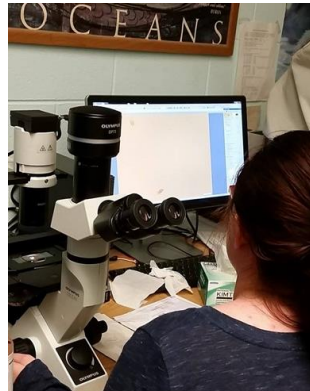
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Freshwater Bloom Analysis

Taxonomic enumeration

Scan is conducted to identify dominant species.



Toxin assays

Abraxis microcystins (ADDA) ELISA

8.0 ppb 0.15ppb - 5.0ppb (higher w/dilution)

Abraxis cylindrospermopsin ELISA

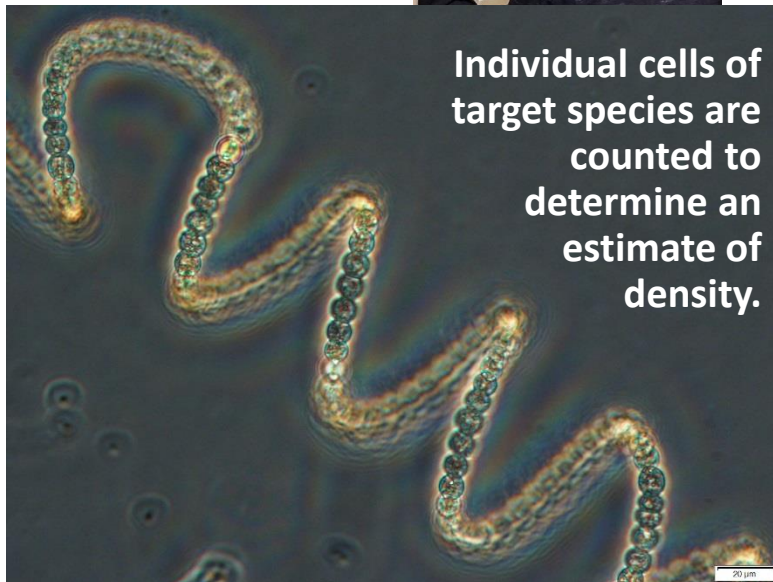
15.0 ppb 0.05ppb - 2.0ppb (higher w/dilution)

Abraxis anatoxin-a ELISA

0.15ppb - 5.0ppb (higher w/dilution)

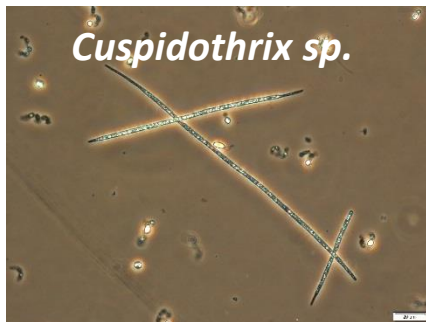
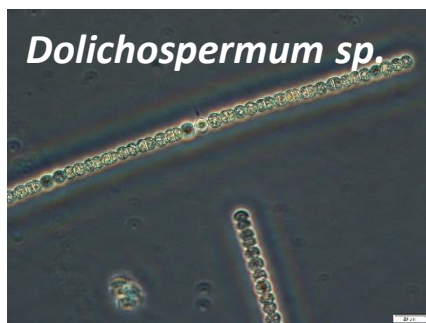
Abraxis saxitoxin ELISA

0.02ppb - 0.4ppb (higher w/dilution)



Individual cells of target species are counted to determine an estimate of density.

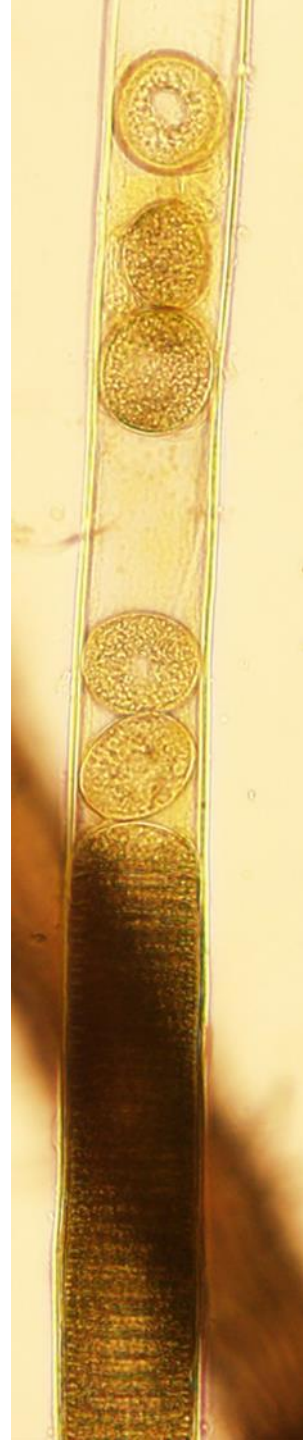
Cyanobacteria taxa groups



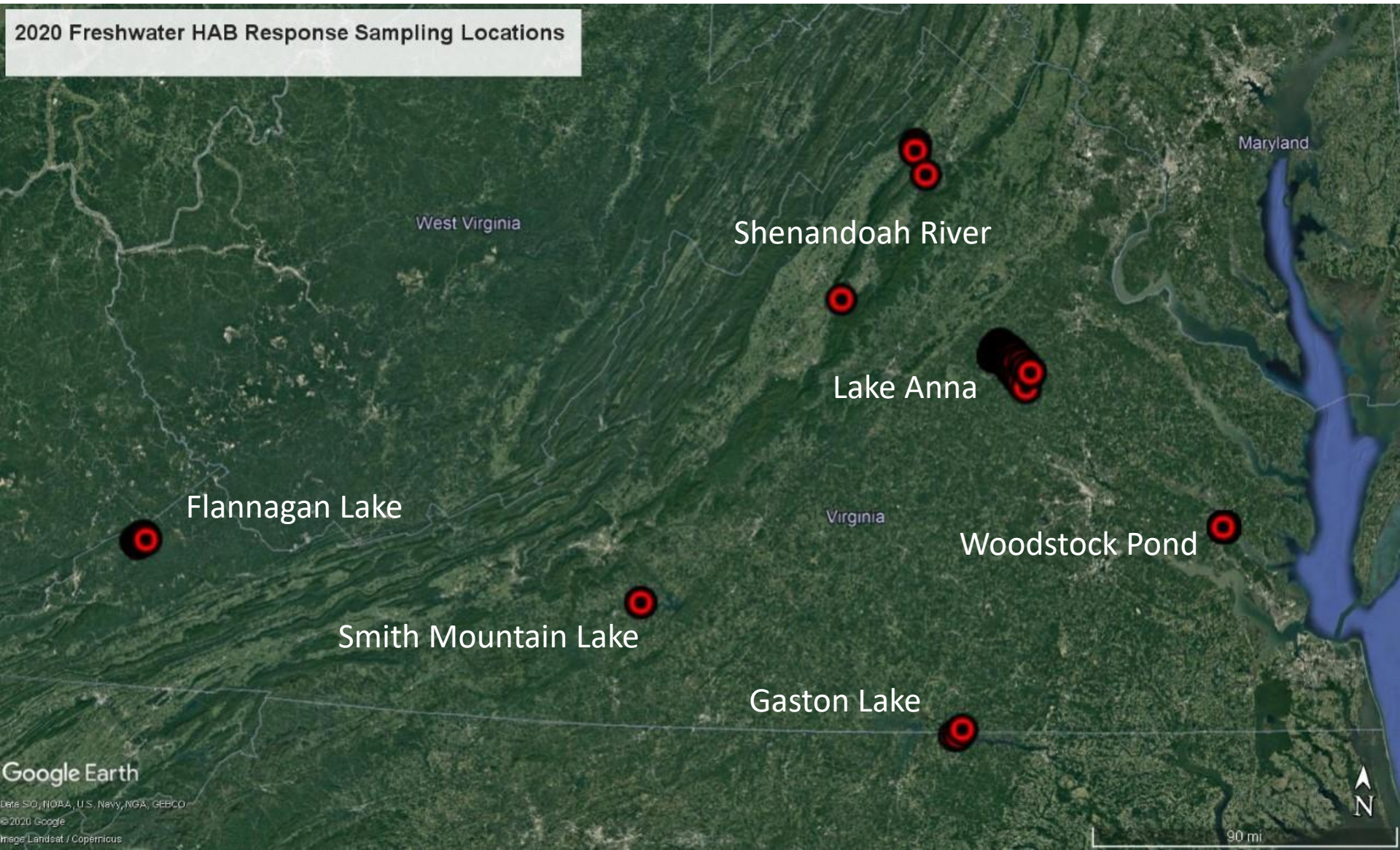
2020 Freshwater Blooms

Overview of maximum cell count of dominant PTOX for each Inland Freshwater HAB response with highest toxin concentration

Location	cells/mL	PTOX taxa	MC	CYL	ATX	STX
Aquilla Creek	5,000	Sphaerospermopsis spp.	bdl	bdl	bdl	bdl
Flannagan Lake	25,000	Nostocalean filament	0.2255	bdl	0.2035	bdl
Lake Anna	126,000	Raphidiopsis raciborskii	0.4315	bdl	bdl	bdl
Lake Anna QAQC	x	x	0.2025	bdl	bdl	bdl
Lake Gaston	260	Planktolyngbya limnetica	bdl	bdl	bdl	bdl
Shenandoah River	500	Planktothrix sp.	bdl	bdl	bdl	bdl
Smith Mountain Lake	0	no PTOX cyanobacteria	bdl	bdl	bdl	bdl
Woodstock Pond	1,427,000	Cuspidothrix issatschenkoi	0.4795	bdl	bdl	0.0265
Rappahannock River	39,000	Planktolyngbya spp.	0.176	0.284	bdl	0.0215

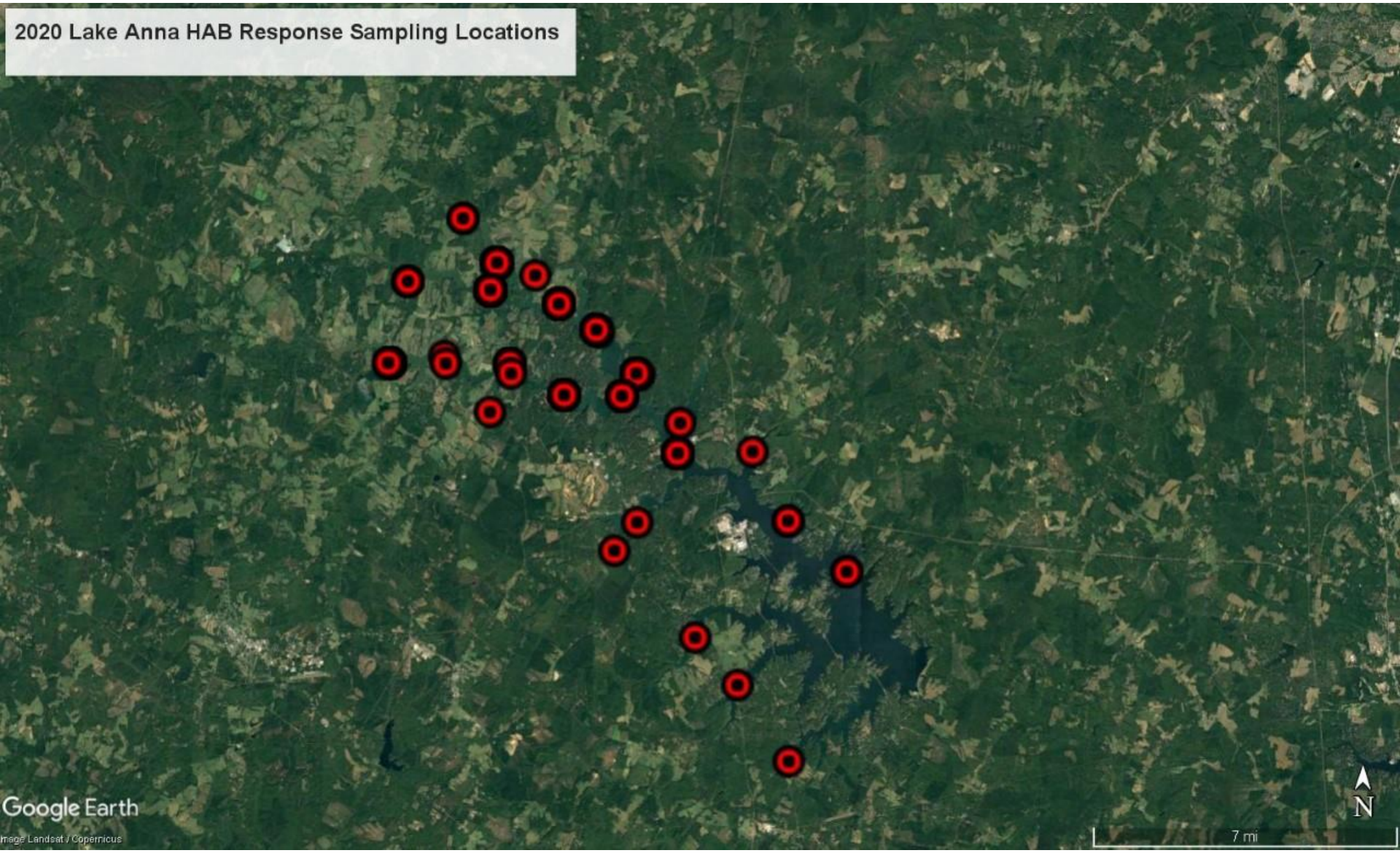


2020 Virginia Freshwater Bloom Locations

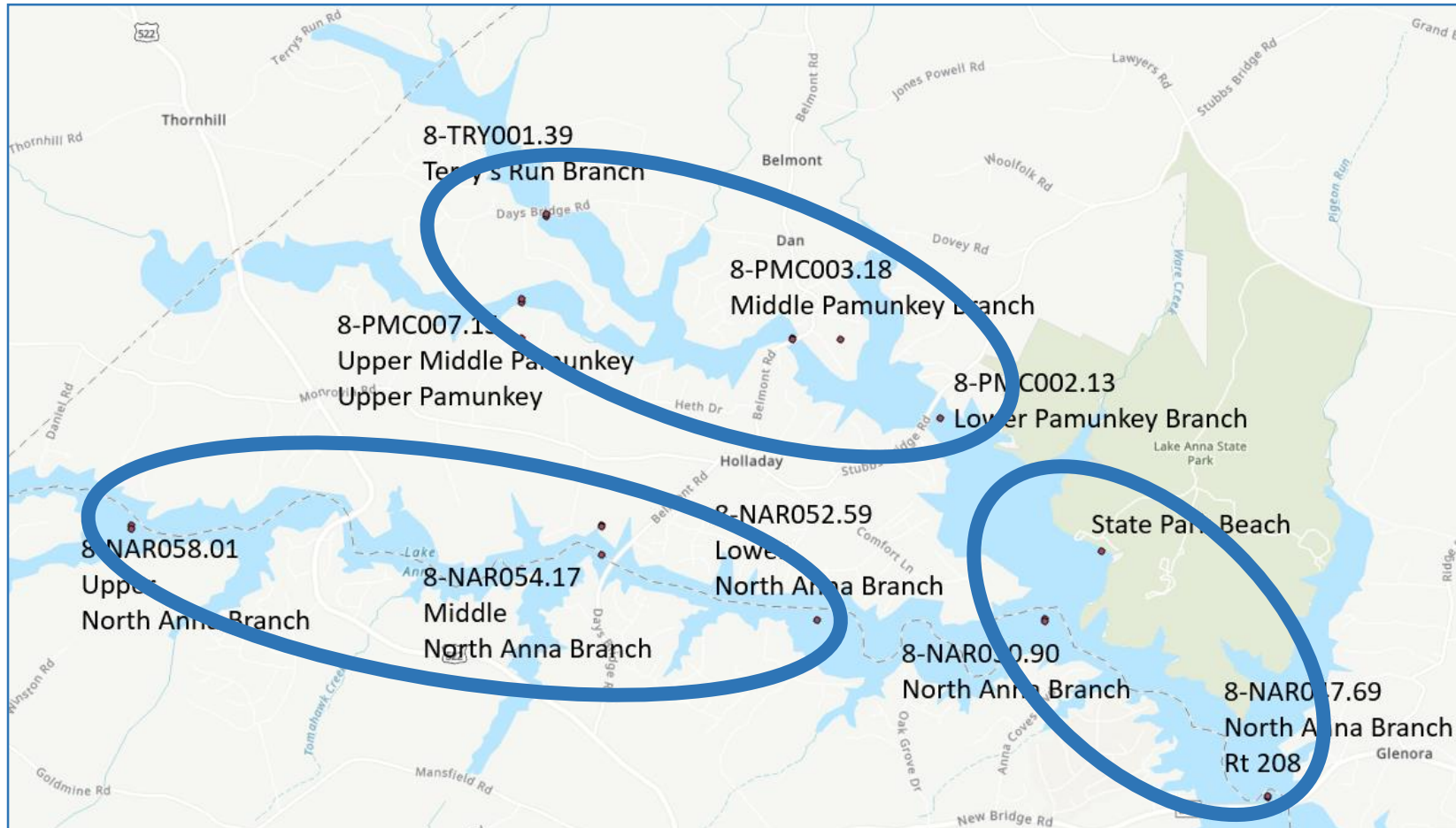
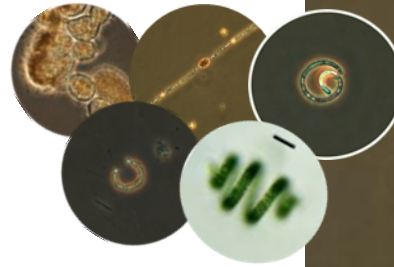


2020 Lake Anna

2020 Lake Anna HAB Response Sampling Locations



2020 Lake Anna



LOWER SECTION OF NORTH ANNA BRANCH

- North Anna Branch - Upper 8-NAR058.01
 - PTOX 1,000 – 185,000 cells/mL
- North Anna Branch - Lower 8-NAR052.59
 - PTOX 0 – 125,000 cell/mL
- North Anna Branch - MID (Rt. 719)8-NAR054.17
 - PTOX 9,000 – 125,000 cell/mL

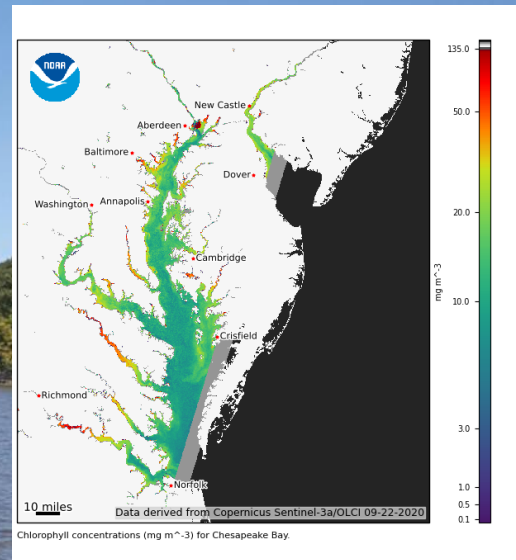
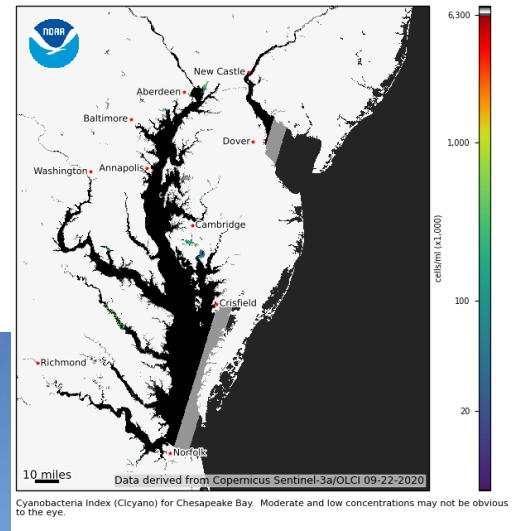
PAMUNKEY BRANCH

- Pamunkey Branch - MID (Rt. 719) 8-PMC0003.18
 - PTOX 1,000 – 47,000 cells/mL
- Pamunkey Branch - Upper 8-PMC007.15
 - PTOX 9,000 – 42,000 cell/mL
- Terry's Run Branch - MID (Rt. 719) 8-TRY001.39
 - PTOX 19,000 – 89,000 cell/mL

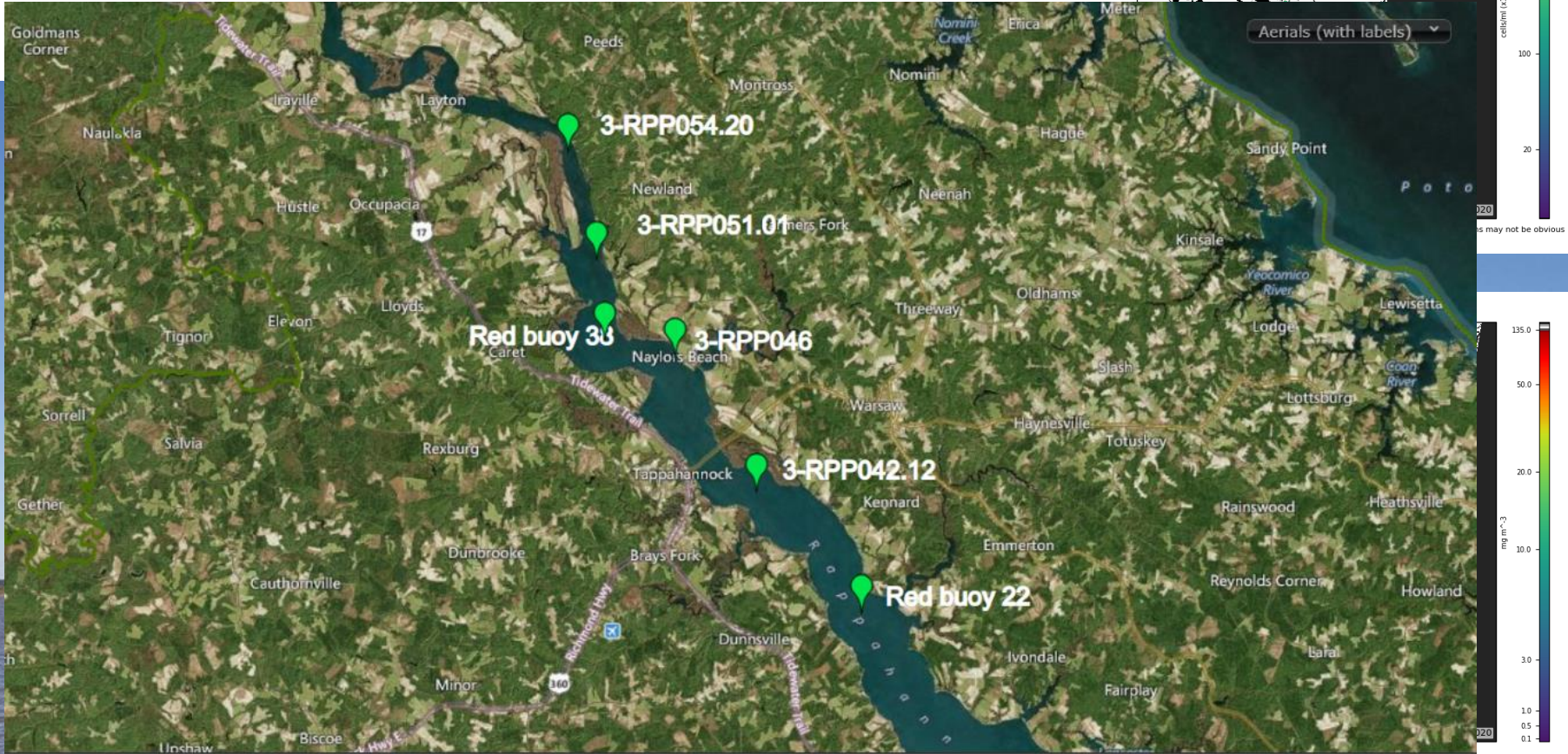
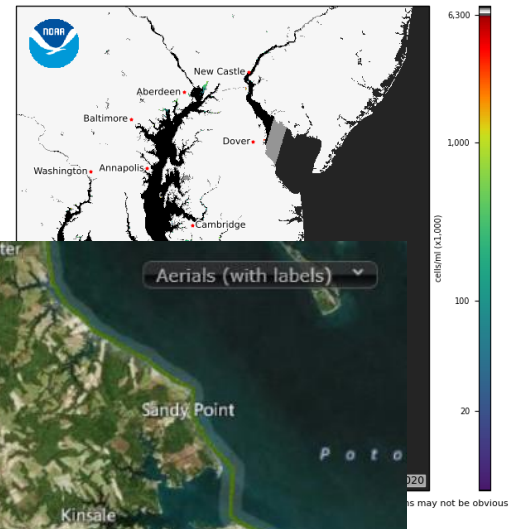
WESTERN SECTION OF NORTH ANNA BRANCH

- State Park Beach
 - PTOX 0 – 34,000 cells/mL
- North Anna Branch @ Split 8-NAR050.90
 - PTOX 1,000 – 78,000 cell/mL
- North Anna Branch @ RT 208 8-NAR047.69
 - PTOX 23,000 – 138,000 cell/mL

2020 Rappahannock River

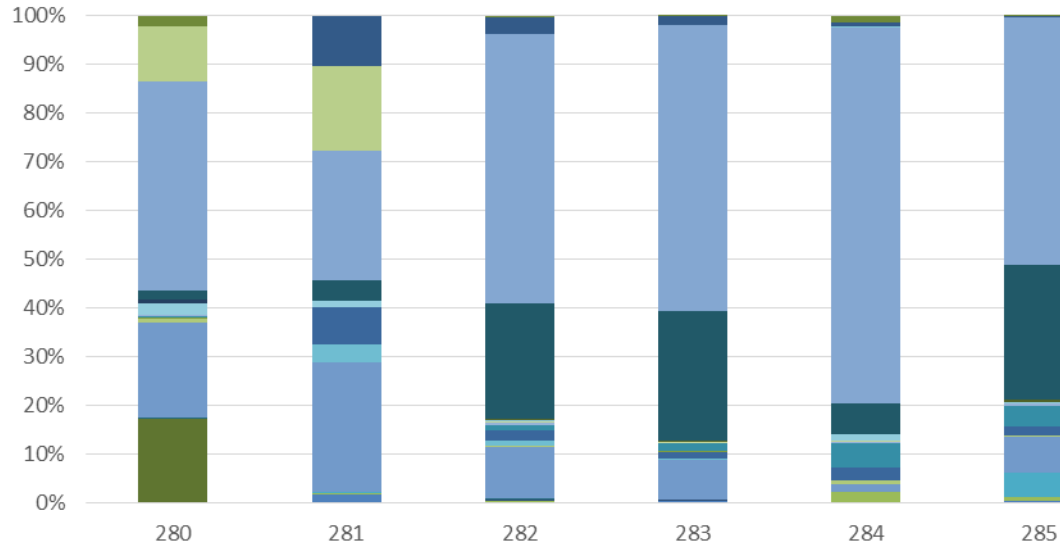


2020 Rappahannock River



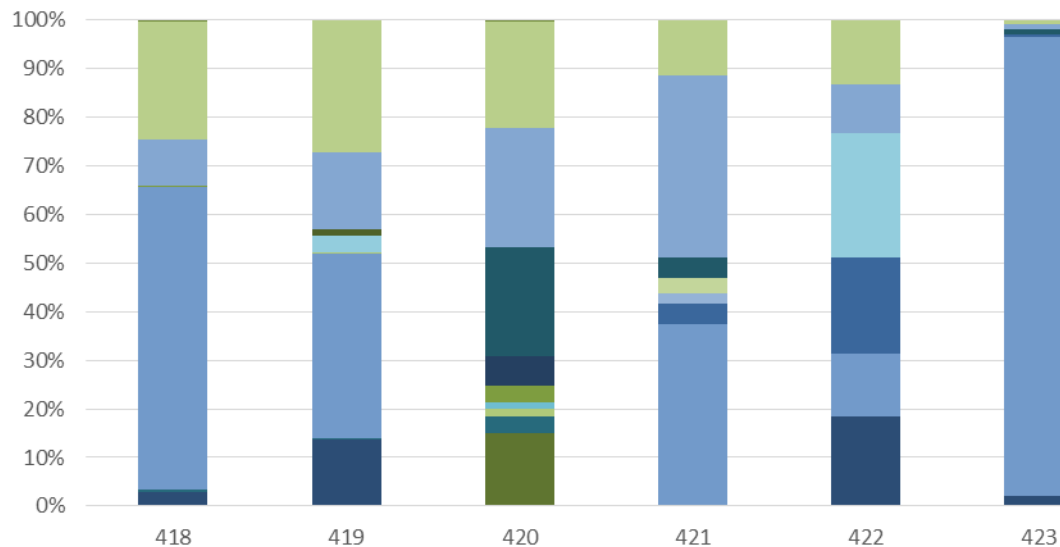
Rappahannock River 8/28/2020

- *Romeria* sp.
- *Raphidiopsis raciborskii*
- *Raphidiopsis curvata*
- *Pseudanabaena limnetica*
- *Planktolyngbya limnetica*
- *Planktolyngbya contorta*
- *Microcystis wesenbergii*
- *Merismopedia tenuissima*
- *Merismopedia*
- *Gloeocapsa*
- *Dolichospermum* sp.
- *Dolichospermum circinale*
- *Dactylococcopsis raphidioides*
- *Cuspidothrix issatschenkoi*
- *Chrysochloris ovalisporum*
- *Chroococcus*
- Blue green sphere b
- Blue green sphere
- *Aphanocapsa incerta*
- *Aphanocapsa*
- *Aphanizomenon gracile*
- *Anabaenopsis* sp.
- *Anabaena/Sphaerospermopsis*-like filament



Rappahannock River 10/08/2020

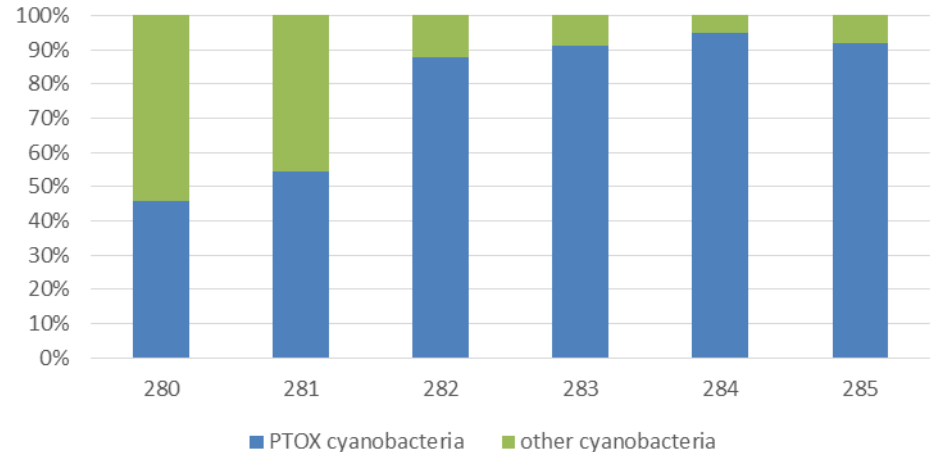
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- *Aphanocapsa*
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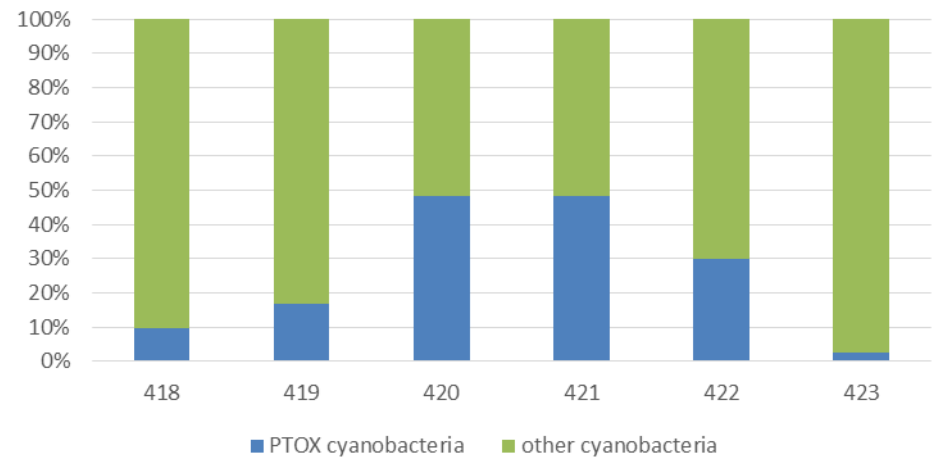
- PTOX cyanobacteria dominated the community in August – *Planktolyngbya* and *Raphidiopsis* were the major component, with *Pseudanabaena*, *Aphanocapsa* and “small unicellular blue greens” comprising the other category.

- End of bloom dominated by *Pseudanabaena* and “small unicellular blue greens” with lower densities of *Merismopedia*, *Romeria*, and *Aphanocapsa*. The PTOX component consisted primarily of *Cuspidothrix* and *Planktolyngbya*.

Rappahannock River 8/28/2020

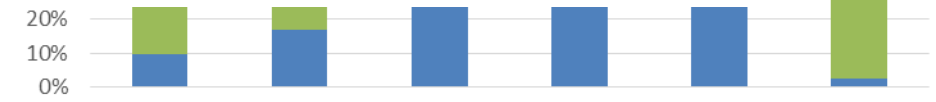
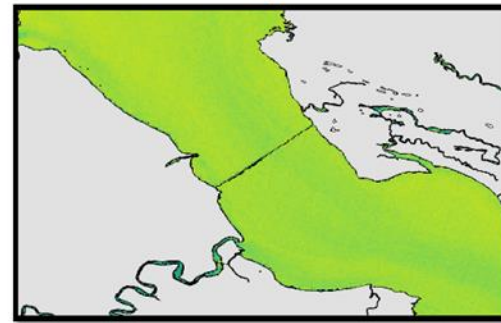
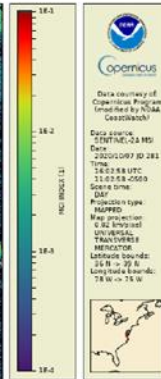
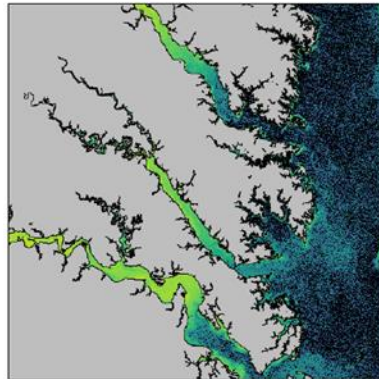
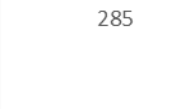
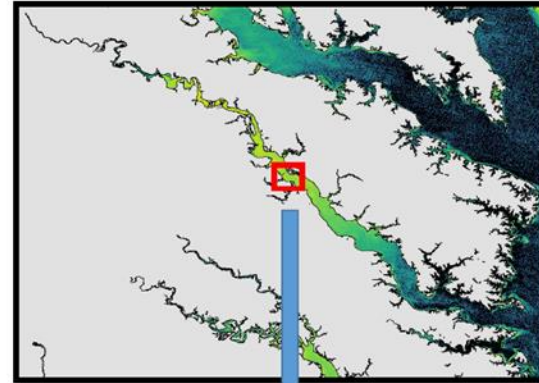
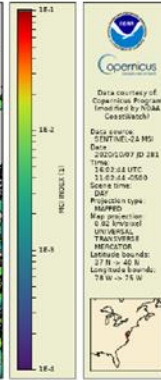
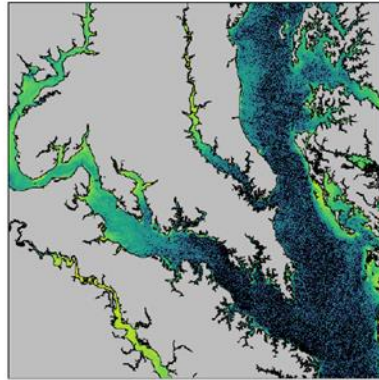
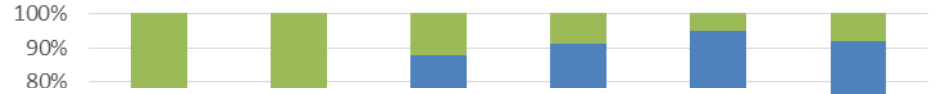


Rappahannock River 10/08/2020



Rappahannock River
 October 7, 2020
 Event date: 10/8/2020

Rappahannock River 8/28/2020



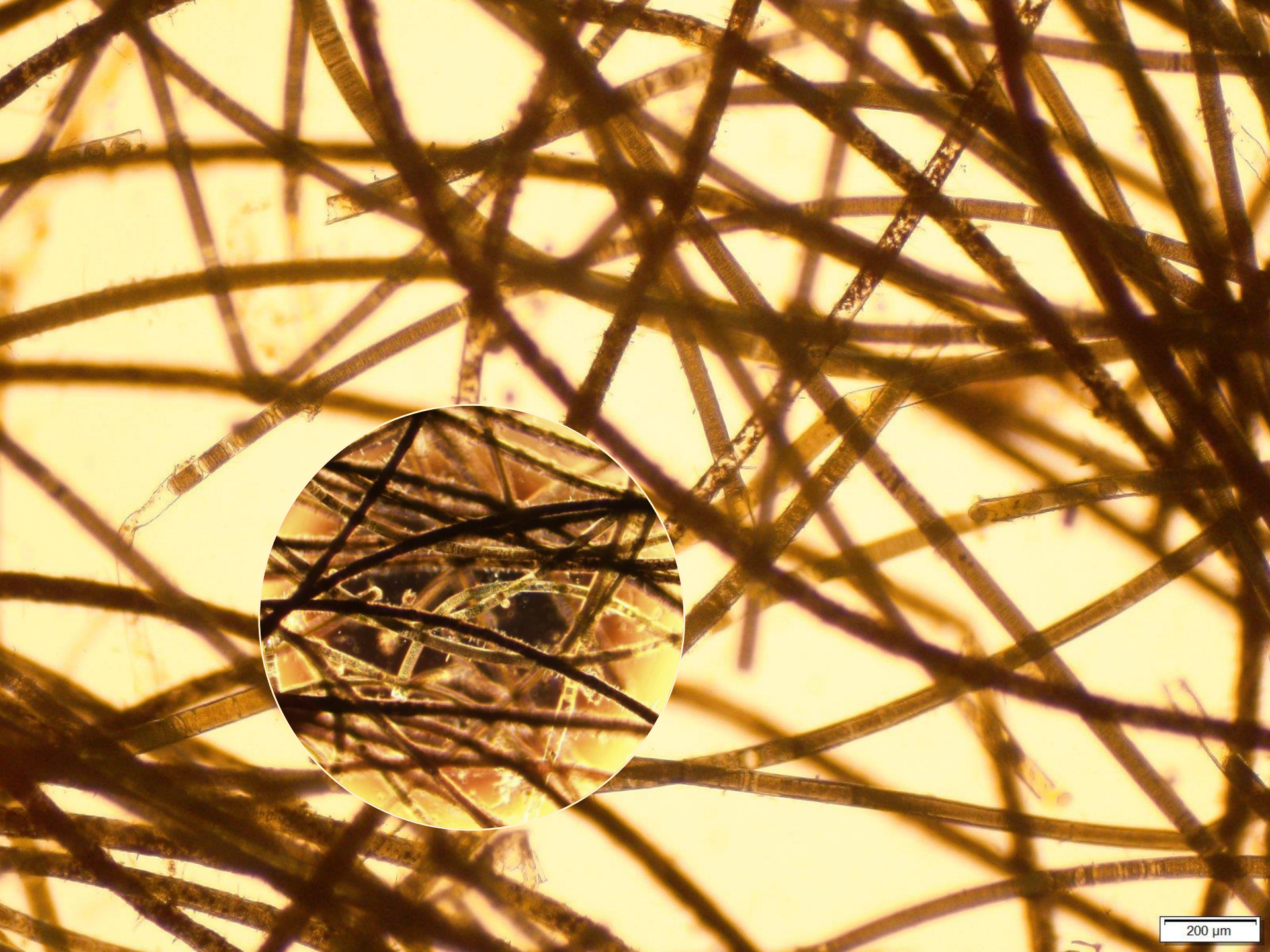
■ PTOX cyanobacteria ■ other cyanobacteria



2020 Lake Gaston & benthic mats



2020 Lake Gaston & benthic mats



200 μm

A light micrograph showing a filament of the diatom *Microseira wollei*. The filament consists of several cells. The cells at the top and bottom of the filament are elongated and contain a dense, green, granular material, likely chloroplasts. The middle cells are more rounded and also contain similar green granules. The cells are arranged in a linear fashion, with some overlapping. The background is a light, slightly textured surface.

Microseira wollei

20 μ m



Microseira wollei

This micrograph shows a dense population of *Microseira wollei* diatoms. The organisms appear as long, thin, dark brown to black filaments against a yellowish-brown background. The filaments are composed of individual diatom cells, some of which are clearly visible as small, rectangular or cylindrical structures. The background is filled with numerous smaller, individual diatom cells and fragments, indicating a high concentration of the organism. The overall appearance is that of a thick, fibrous mat or a dense suspension of diatoms.

200 µm

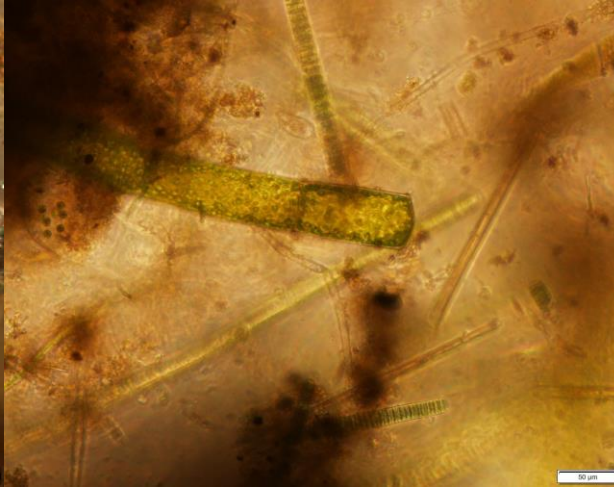
20 µm

Development of benthic protocol

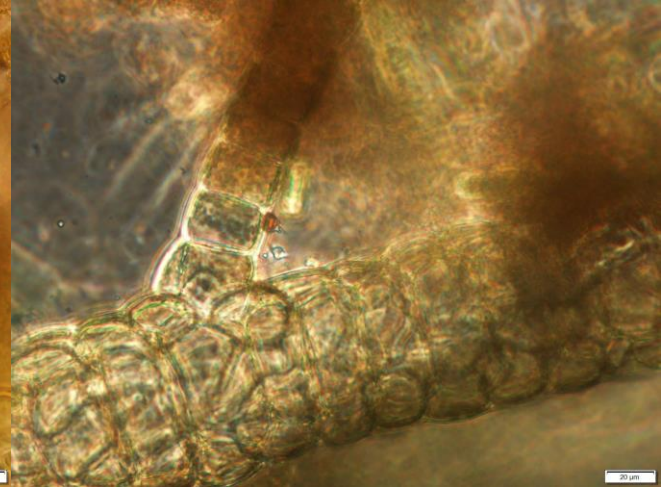
- Collection method – grabs
- Prep method for taxonomy – identify dominant taxa
 - No cell counts
- Prep method for toxins –
 - Remove excess water
 - Weigh 5g of sample
 - Add 5 mL appropriate dilutant specific to each test
 - Lyse using freeze/thaw method with addition of mortar pedestal and tissue homogenizer
 - Separate vegetative material of liquid using centrifuge
 - Run using standard ELISA method
 - Reporting toxin ppb/g wet weight



Pennate diatom



Filamentous green algae



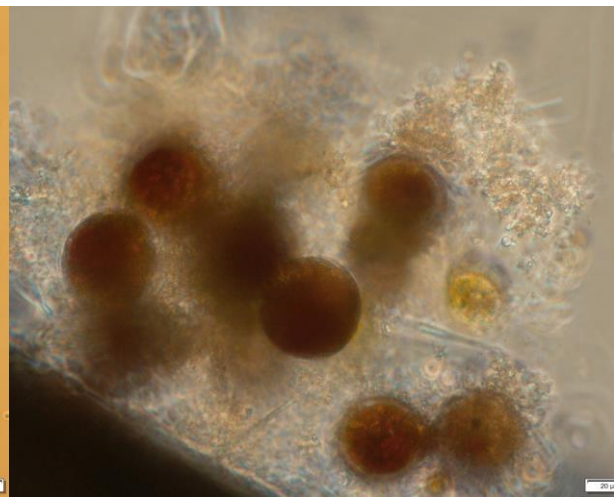
Filamentous green algae

Not all freshwater HAB events are caused by cyanobacteria!

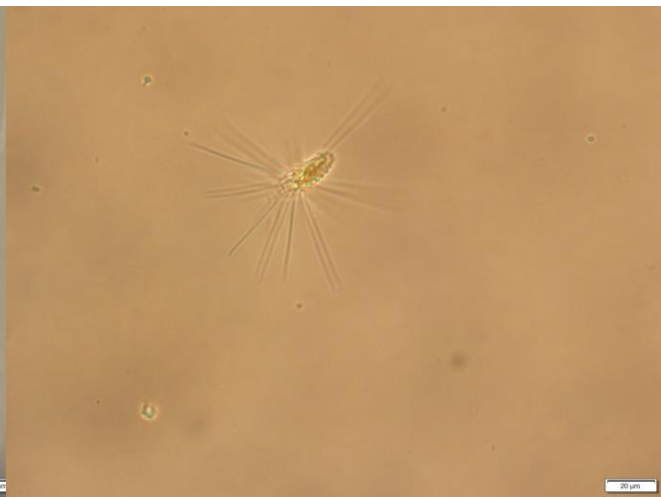
Euglena – motile stage



Euglena – palmella stage





Mallomonas



Smith Mountain Lake
August 26, 2020
Event date: 8/24/2020



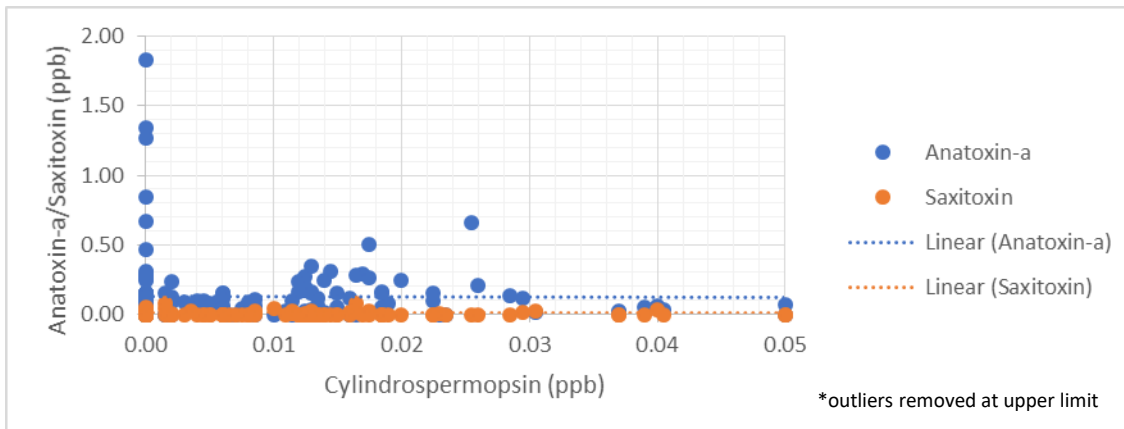
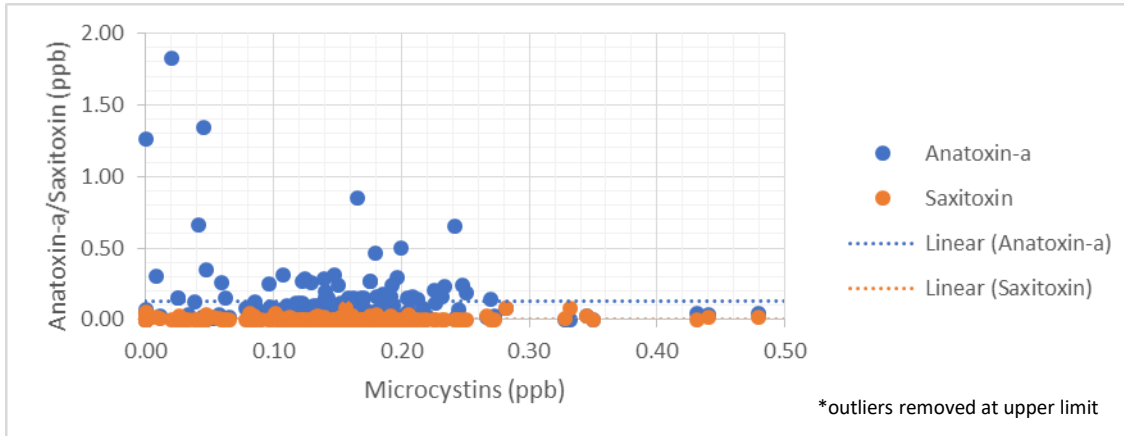



Data courtesy of:
Copernicus Program
(modified by NOAA
CoastWatch)

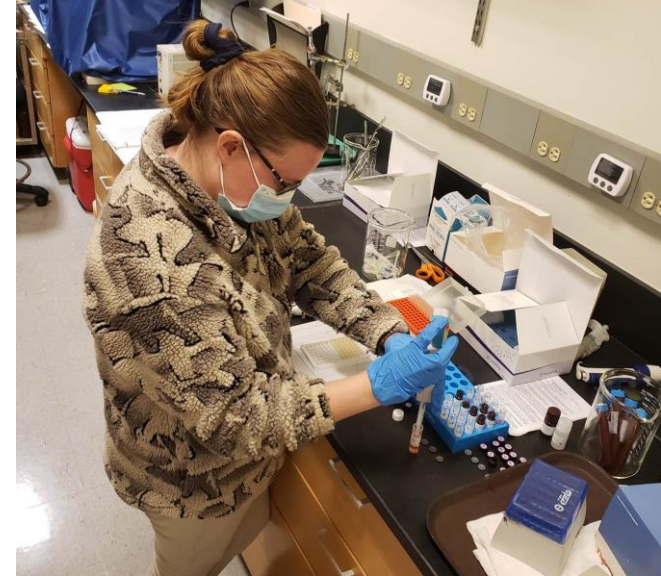
Data source:
SENTINEL-2B MSI
Date:
2020/08/26 JD 239
Time:
16:13:00 UTC
11:13:00 -0500
Scene time:
DAY
Projection type:
MAPPED
Map projection:
0.02 km/pixel
UNIVERSAL
TRANSVERSE
MERCATOR
Latitude bounds:
36 N -> 39 N
Longitude bounds:
81 W -> 78 W

!

2020 Neurotoxins

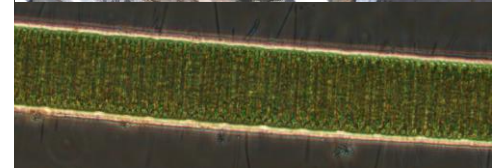
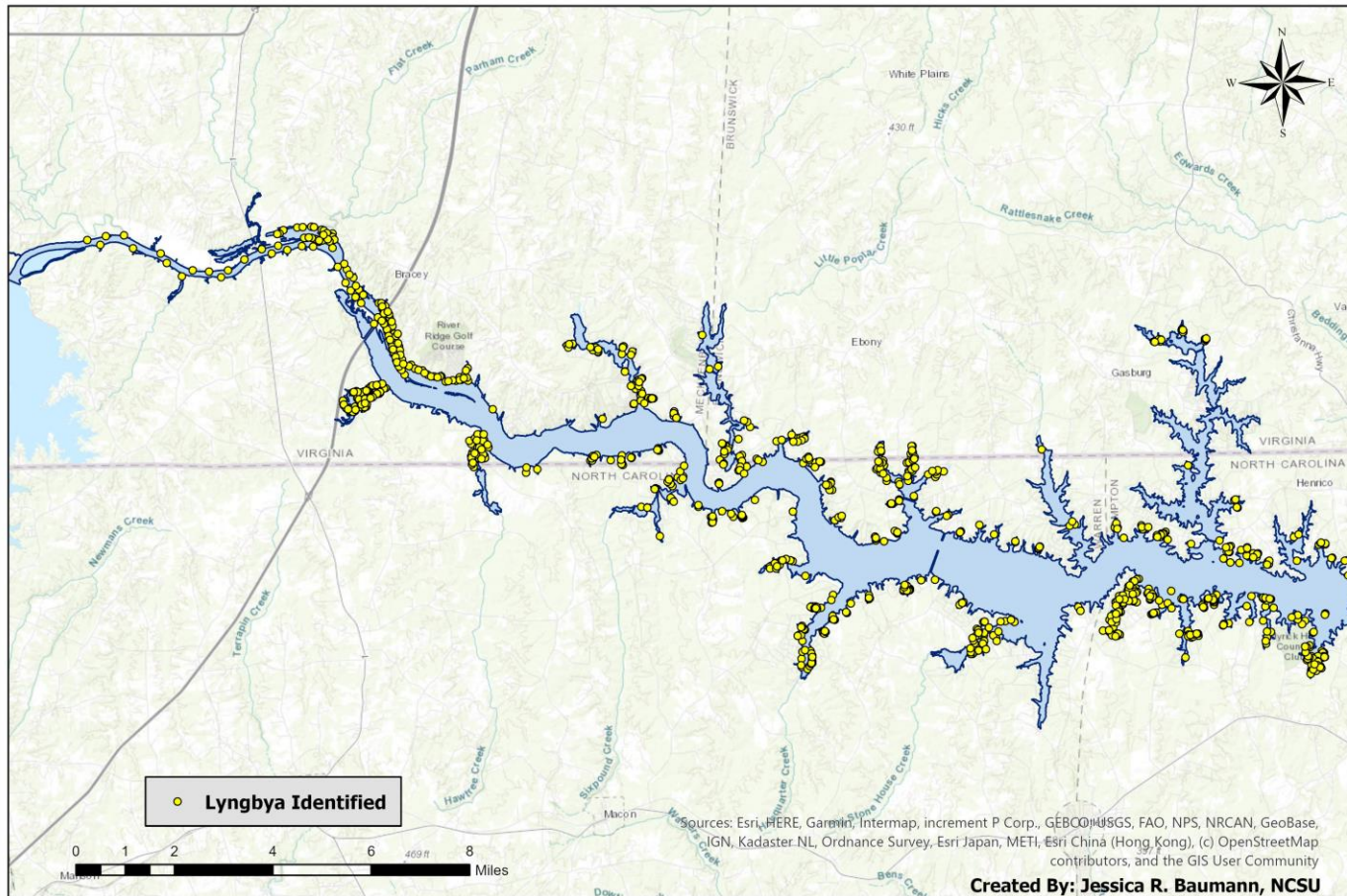


Little to no relationship between the presence, absence, or concentration of microcystins or cylindrospermopsin on the presence, absence, or concentration of neurotoxins.

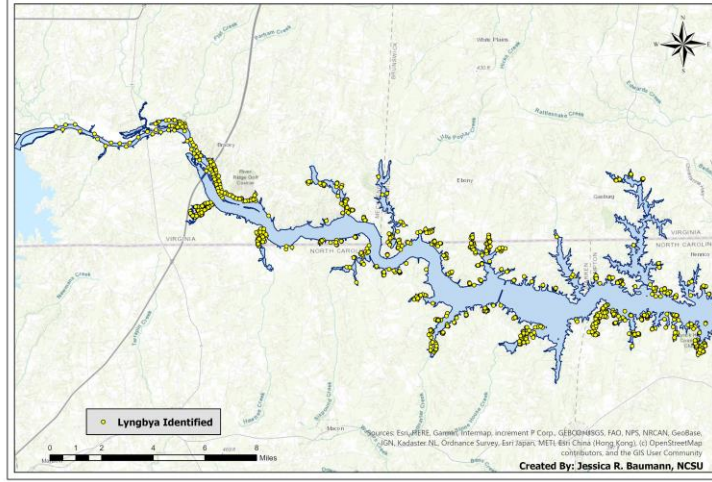


2021 Additional HAB projects

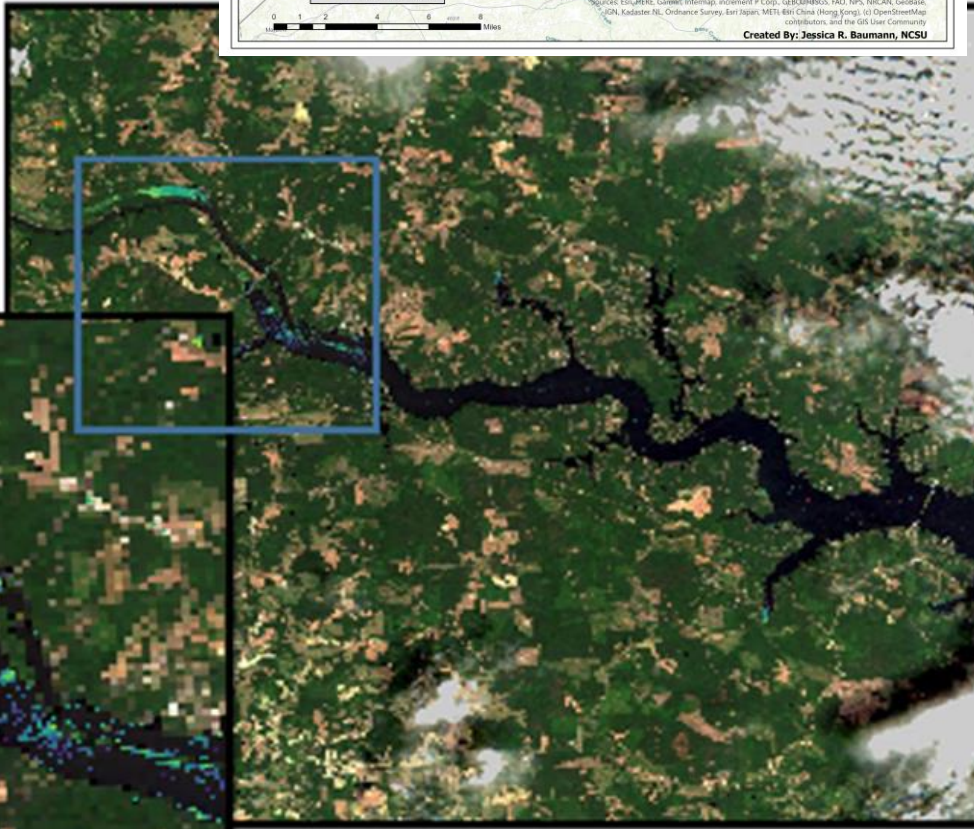
Lake Gaston Lyngbya Detections Volunteer Vegetation Survey - 2019



Lake Gaston Lyngbya Detections Volunteer Vegetation Survey - 2019



Lake Gaston
July 19, 2020
Event date: 7/20/20





 Data courtesy of:
 Copernicus Program
 (modified by NOAA
 CoastWatch)
 Data source:
 SENTINEL-2A MSI
 Date:
 2020/07/19 JD 201
 Time:
 16:03:15 UTC
 11:03:15 -0500
 Scene time:
 DAY
 Projection type:
 MAPPED
 Map projection:
 0.02 km/pixel
 UNIVERSAL
 TRANSVERSE
 MERCATOR
 Latitude bounds:
 35 N -> 38 N
 Longitude bounds:
 79 W -> 76 W



2021 Additional HAB projects

- Continued collaboration with Lake Gaston group
- *Microseira* culture from Lake Gaston to investigate molecular methods for assessing potential of cyanotoxin production
- Pilot study using SPATT collectors for the detection of cyanotoxins in water column associated with benthic HABs
- Continued collaboration with VIMS to determine relationship between cells counts and the presence of shellfish toxins in tidal waters
- Assessment of automated image instrumentation for the detection of rare/uncommon HAB species in monitoring programs, and well as informing us as to the with in bloom dynamics missed by infrequent sampling
- Expanded nutrient investigation on Lake Anna – year round full taxonomy on a subset of monitoring stations
- Outreach with LACA to help build capacity to monitor and respond to events
- Continue MBIO investigation and QA/QC with partners

lgibalas@odu.edu

Special thanks to:
Kathryn Mogatas (ODU)
Wick Harlan, Matt Carter, and Jeff Talbot (DEQ)
Eric Molleen (DCR)
Jamie Pritchard (VDH)

