

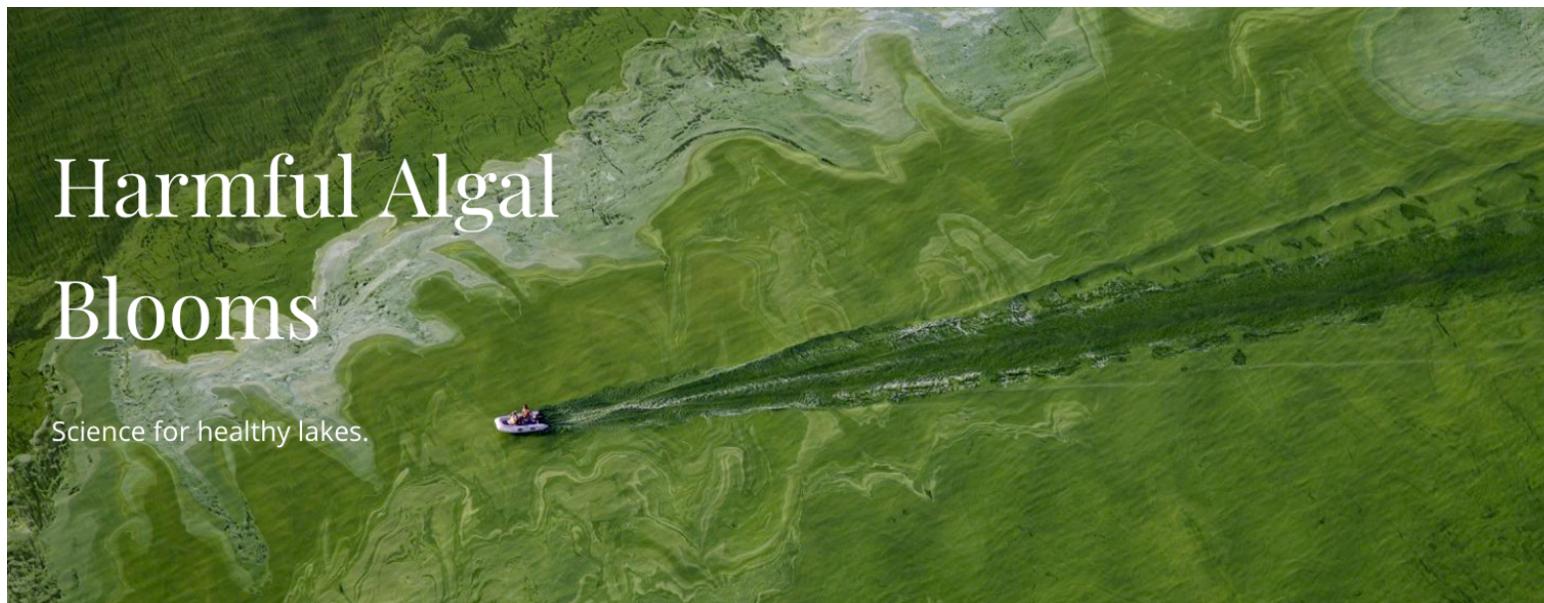
*NRI: FND: COLLAB: RAPID: Targeted
Sampling of an Unanticipated Harmful
Algal Bloom in Lake Anna, Virginia with
Aerial & Aquatic Robots*

David G. Schmale III, Virginia Tech (PI)
Stephen Jacquemin, Wright State University (Co-PI)
Judy Westrick, Wayne State University (Co-PI)



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What are harmful algal blooms (HABs)?



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What are harmful algal blooms (HABs)?

Toxic Algae Bloom Leaves 500,000 Without Drinking Water in Ohio

By Circle of Blue | Aug. 03, 2014 01:15PM EST

CLIMATE



PUBLIC HEALTH

Algae Toxins In Drinking Water Sickened People In 2 Outbreaks

November 9, 2017 · 4:16 PM ET

GRETA JOCHEM



A algae bloom in Lake Erie contaminated the water supply for Toledo, Ohio, in August 2014. About 400,000 people were without useable water.

The Washington Post/Getty Images



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What are harmful algal blooms (HABs)?



People aren't the only swimmers in Lake Anna—algae blooms are cause for concern



By SCOTT SHENK THE FREE LANCE-STAR Jul 30, 2019



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New tools and technology are needed to understand the transport and fate of HABs



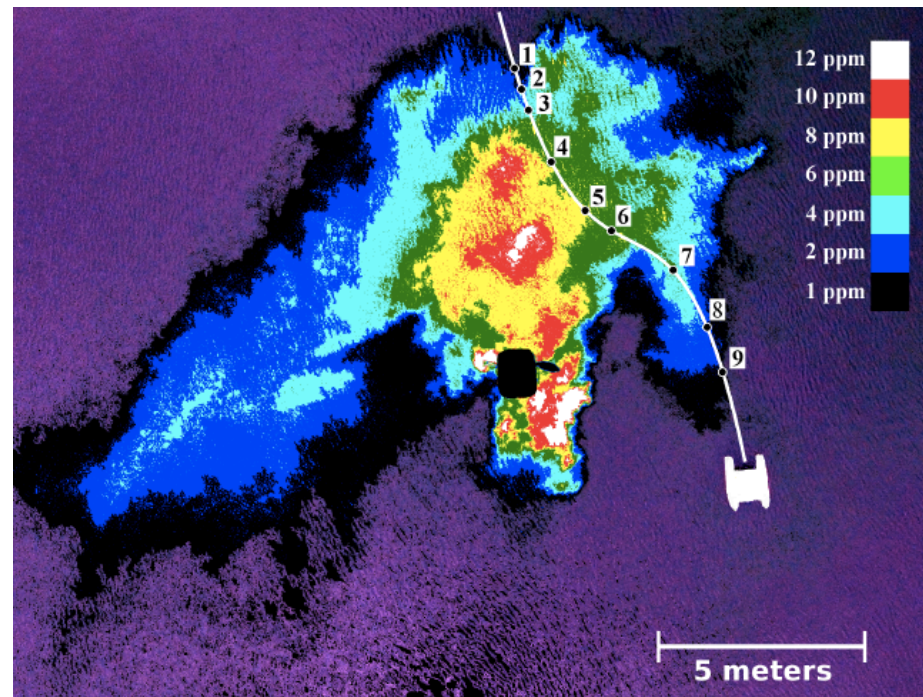
Powers, C.W., Hanlon, R., and Schmale, D.G. 2018. Tracking of a fluorescent dye in a freshwater lake with an unmanned surface vehicle and an unmanned aircraft system. *Remote Sensing*, 10(1), 81. doi:10.3390/rs10010081



Dr. Craig Powers
Ms. Regina Hanlon



New tools and technology are needed to understand the transport and fate of HABs

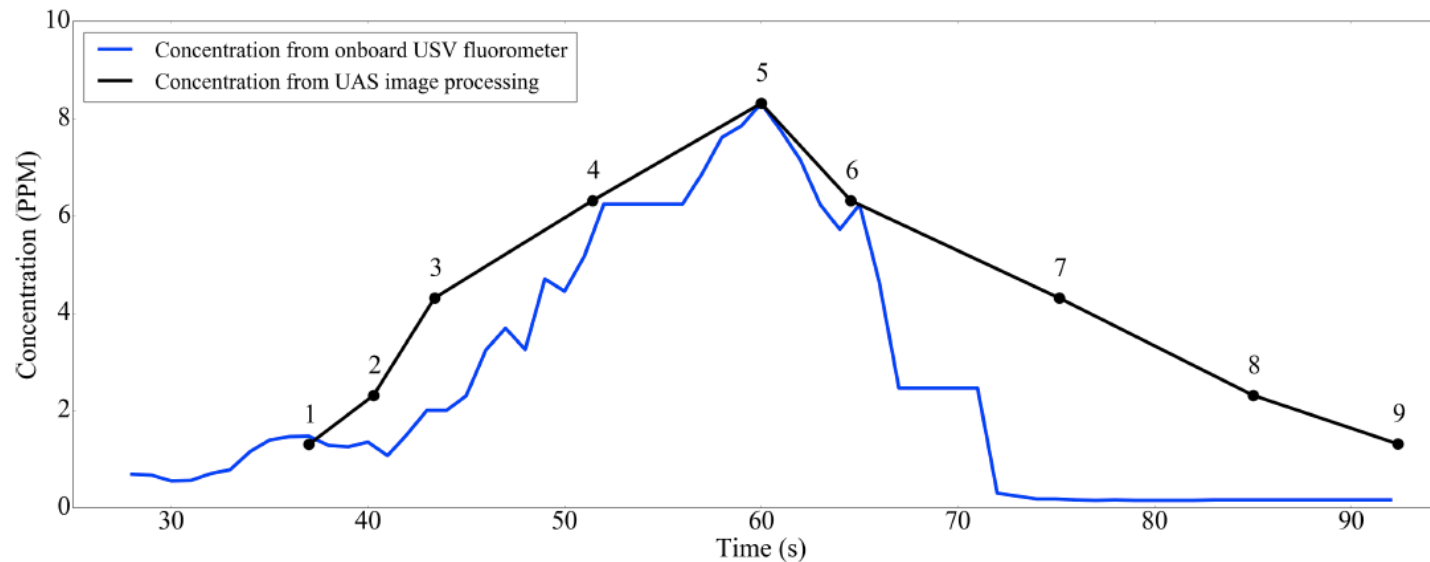


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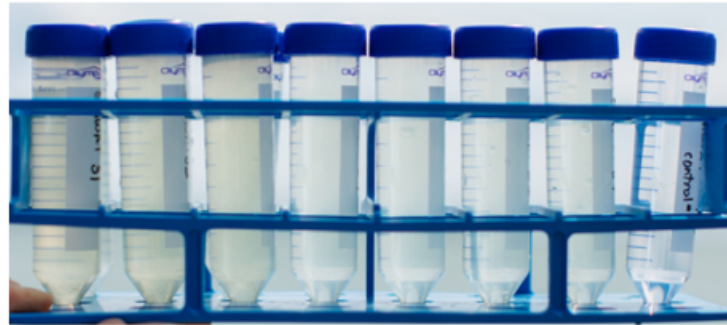
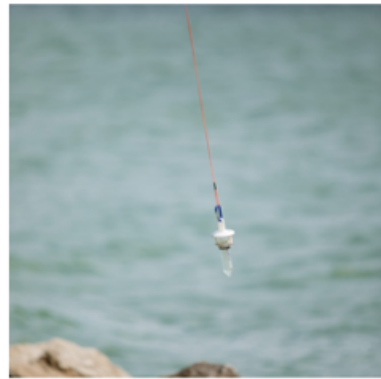
Mr. Bryan Bloomfield



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Sampling HABs with UAS



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Meteorological measurements with UAS



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The HAB at Lake Anna, Virginia

Subject **HAB at Lake Anna**

8/15/19, 3:00 AM

To Dr. David Schmale ★

Read an article where you were quoted. I'm a VT grad and owner of a place at Lake Anna where we're dealing with HABs. Purportedly, the Spotsylvania Sheriff's department has a report of a recent dog death at the lake, but it's not made the press yet. I've been asked by the LACA president to get more involved in dealing with this problem and am looking for resources. The DEQ tests help alert us, but we need to better understand what lakefront homeowners can do to mitigate this problem. Fertilizer runoff is obviously playing a significant role, and we can do things to address that, but what else can we do?

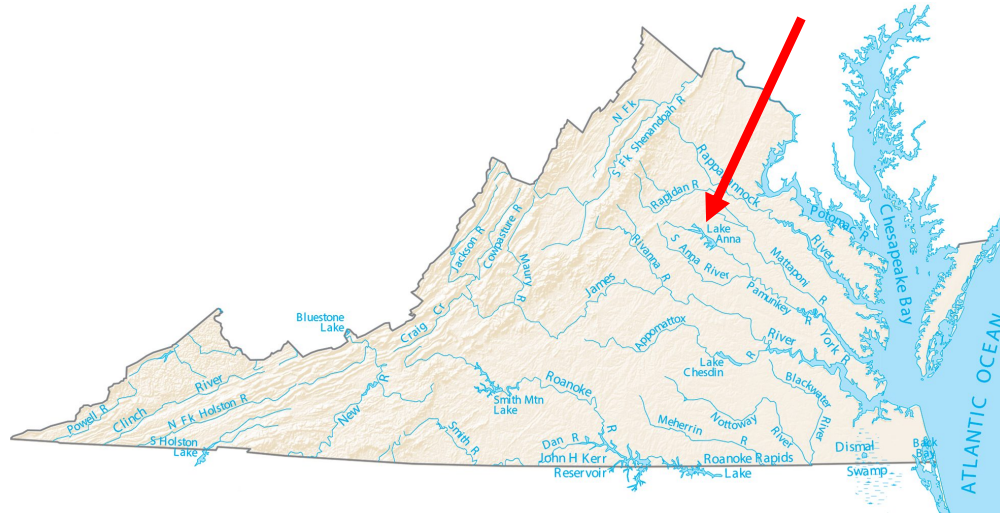
Lowell
VT Class of '83



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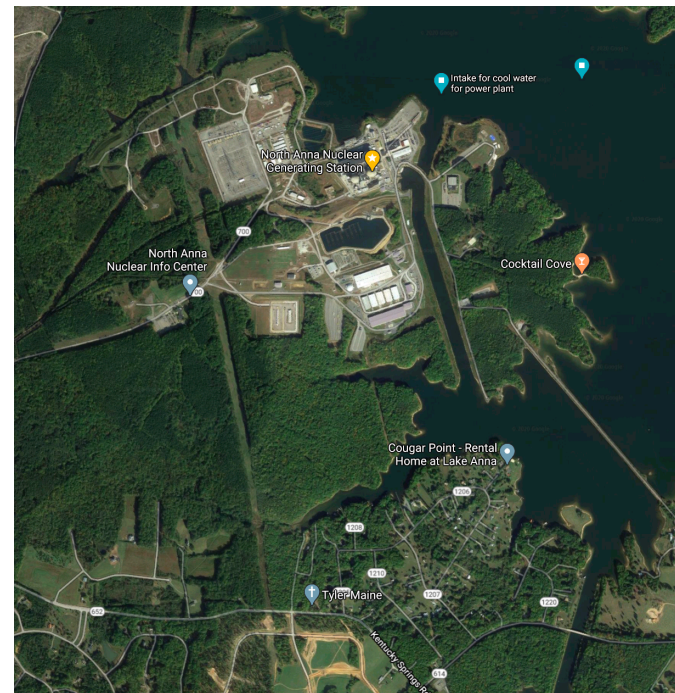
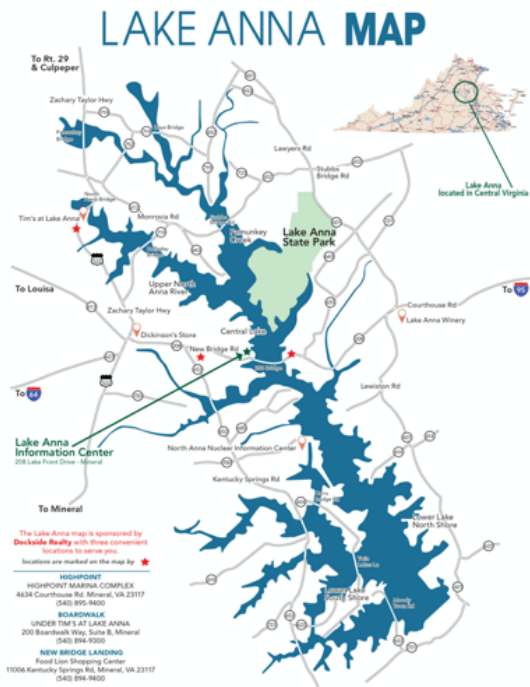
The HAB at Lake Anna, Virginia



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The HAB at Lake Anna, Virginia



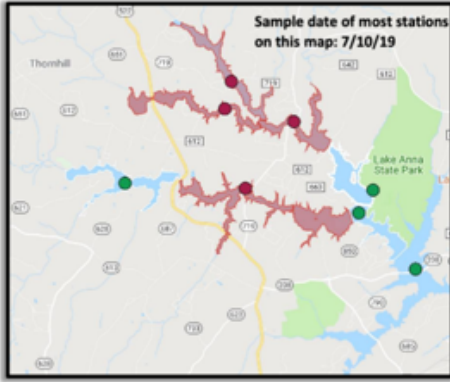
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The HAB at Lake Anna, Virginia

Lake Anna - Harmful Algae Bloom (HAB) Report
Issued Tuesday 7/16/19
Next Issue: Early August (weather dependent)

Sample date of most stations
on this map: 7/10/19



- Harmful algae (cyanobacteria) concentrations exceed safe levels.
- Harmful algae (cyanobacteria) concentrations below safe levels.
- ➔ Lake area under swimming advisory

Helpful Tip!

Visit www.SwimHealthyVa.com and click on the Harmful Algae Bloom Map to review sample results near you!

Expand the map using the symbol in the upper right hand map title bar, then click on the magnifying glass. You can search my location name or address!

View the news release in the VDH Newsroom: www.vdh.virginia.gov/news/2019-news-releases/

How do I protect myself, my family, and my pets from cyanobacteria blooms?

- Don't swim, water ski, or boat in areas where the water is discolored or where you see foam, scum, or mats of algae on the water's surface.
- Do not allow children or pets to play in or drink scummy water.
- If you do swim in water that might contain harmful cyanobacteria, rinse off with fresh water as soon as possible afterward.



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The HAB at Lake Anna, Virginia



COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
NORTHERN REGIONAL OFFICE
13901 Crown Court, Woodbridge, Virginia 22193
(703) 583-3800
www.deq.virginia.gov



COMMONWEALTH of VIRGINIA

Department of Health

PO BOX 2448
RICHMOND, VA 23218



Lake Anna Civic Association
P.O. Box 217
Lake Anna, Virginia 23117-0217
www.LakeAnnaVirginia.org



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The HAB at Lake Anna, Virginia



Objective 1: Use aerial and aquatic robots to target the HAB in Lake Anna, VA and collect samples at strategic locations.



Objective 2: Determine toxin concentrations and nutrient loads in samples collected by robots working alongside humans.



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The logo for Virginia Tech, consisting of a red diagonal line to the left of the letters "VT" in a stylized red font, with "VIRGINIA TECH." in a smaller red font below it.



The HAB at Lake Anna, Virginia



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The HAB at Lake Anna, Virginia



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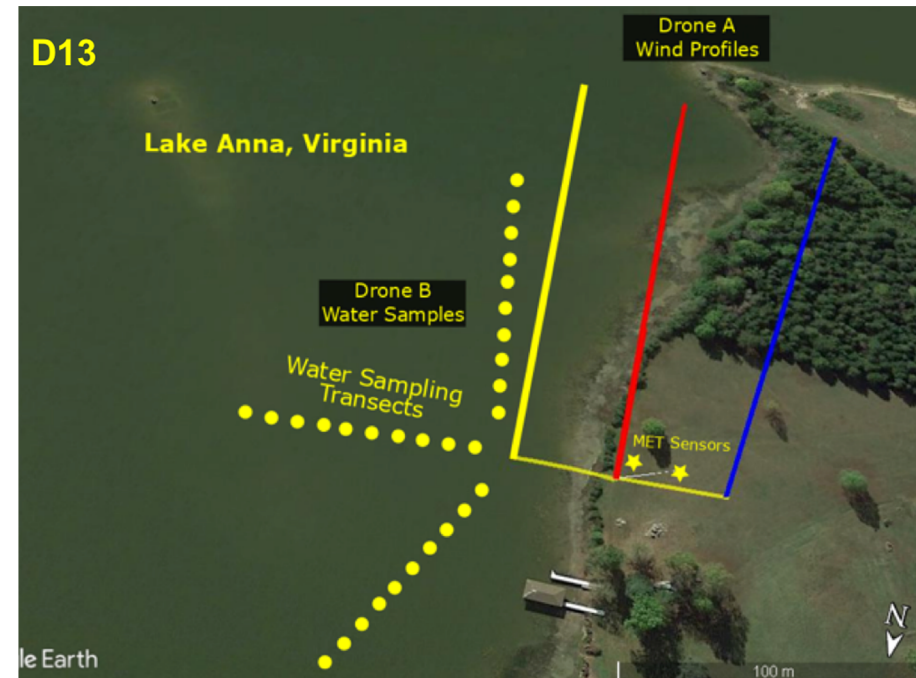
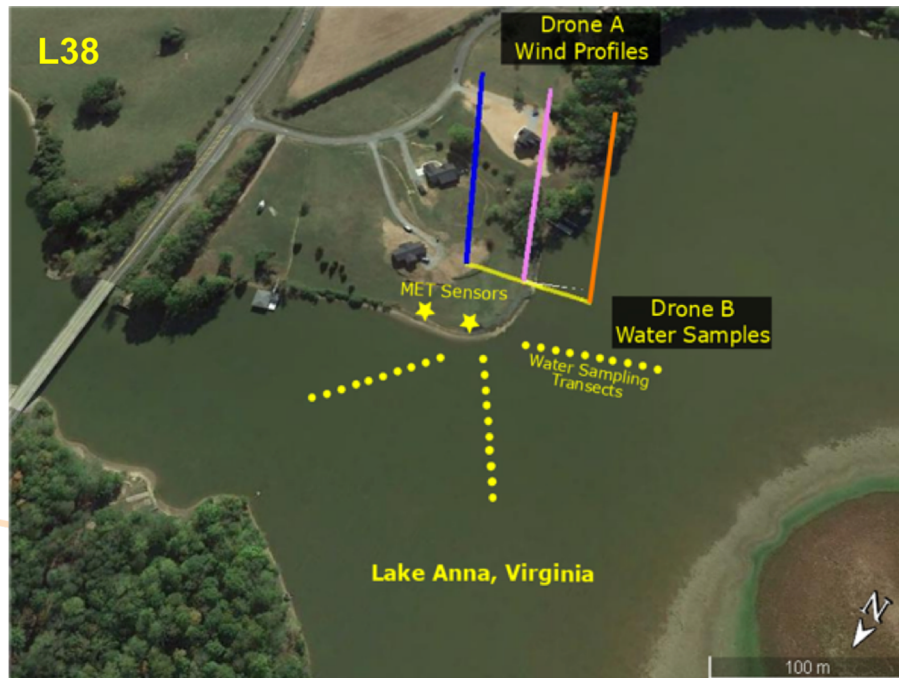
The HAB at Lake Anna, Virginia



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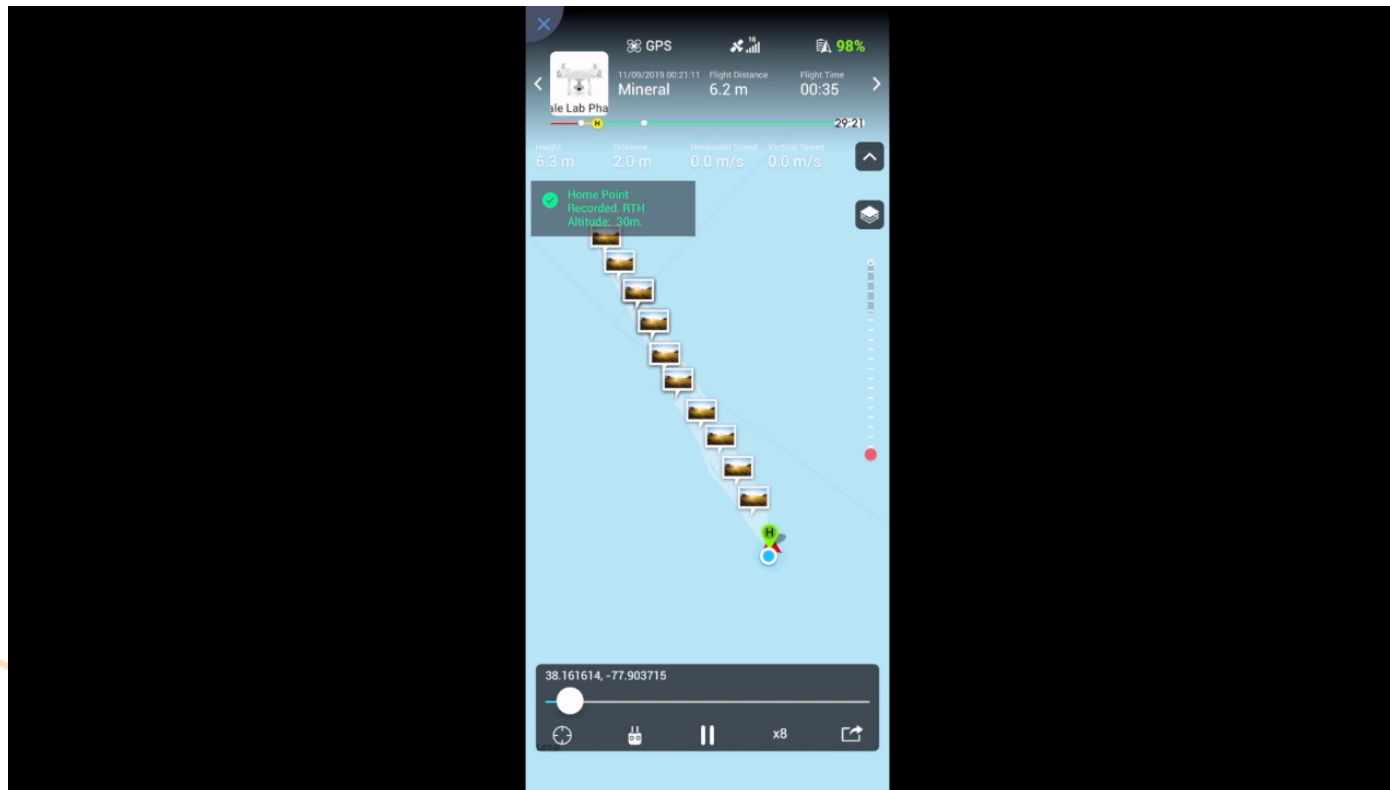
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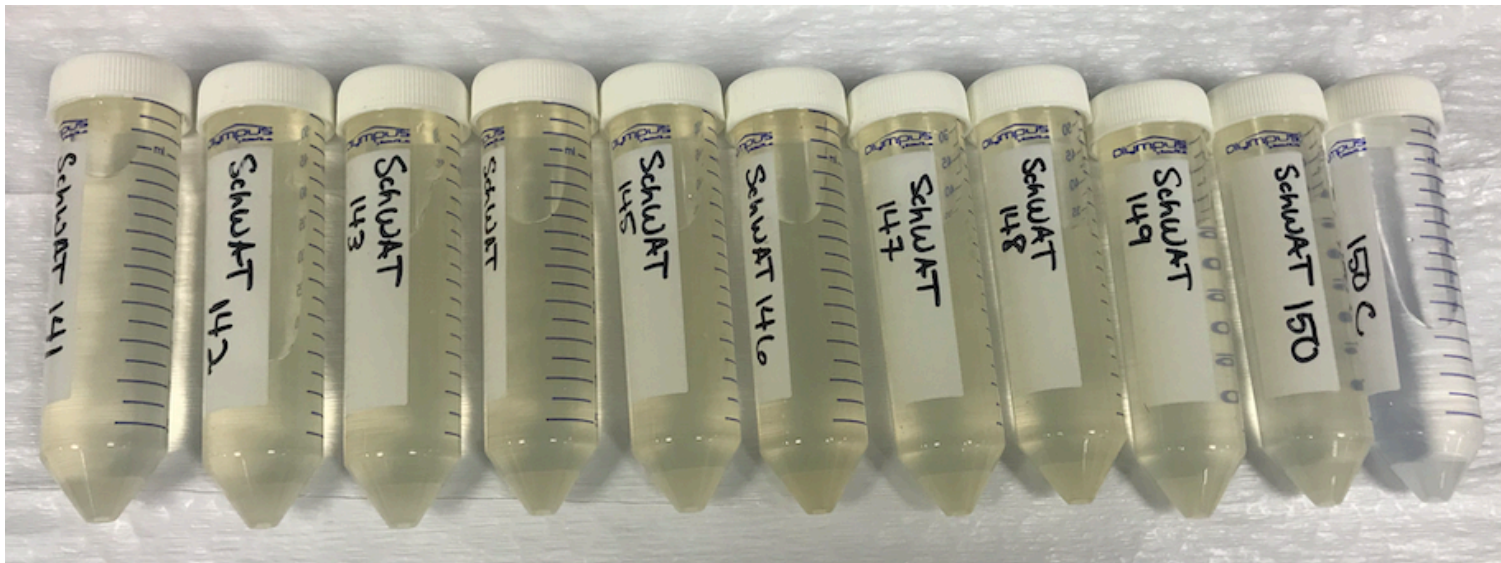
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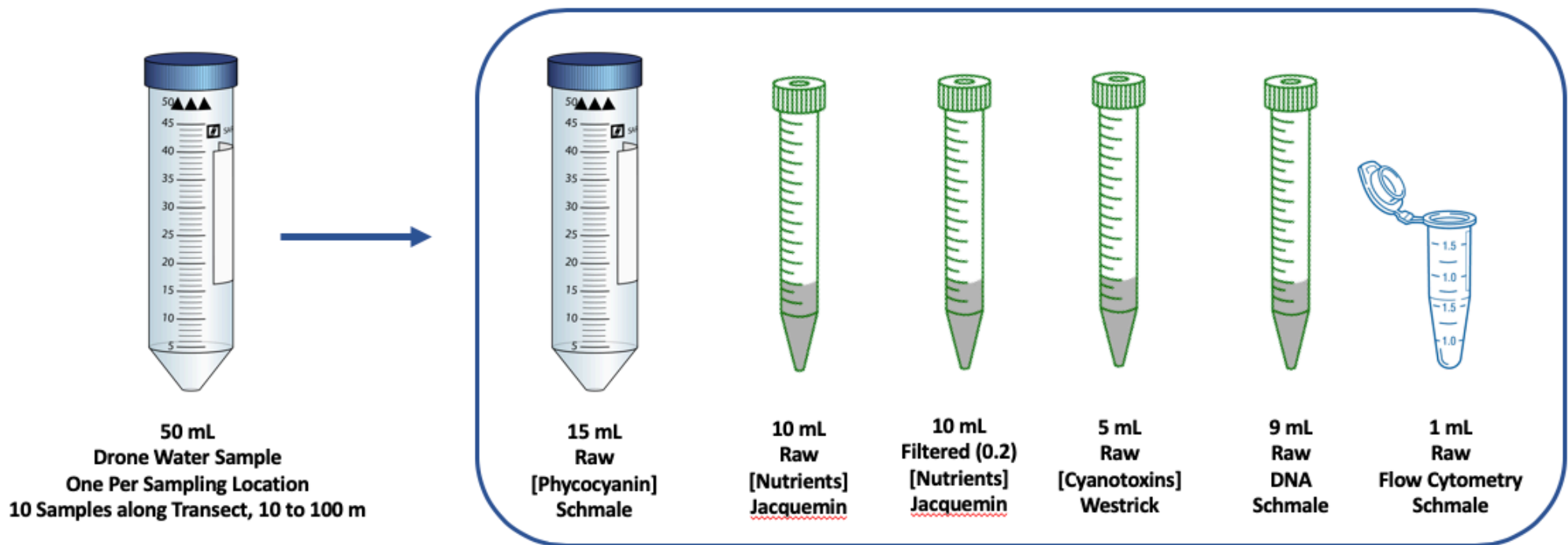
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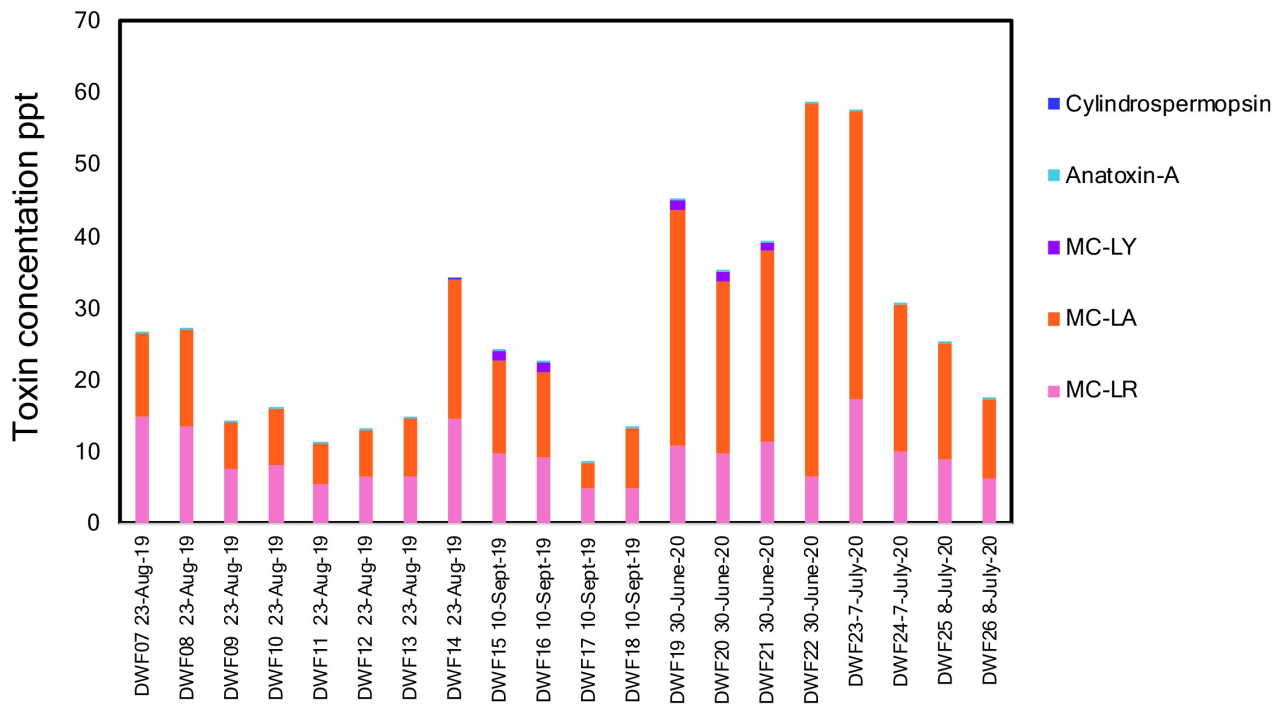
The HAB at Lake Anna, Virginia



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Cyanotoxins from drone transects at Lake Anna



Lake Anna Drone Water-Sampling Flight (DWF)




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Ongoing and future work

- Despite significant challenges associated with the COVID-19 pandemic, we were able to conduct three field campaigns at Lake Anna in 2020 (June, July, and October).
 - Resulting field-tested technology has provided decision-makers with co-robots to track the dispersal of HABs in the environment.
 - Information is critical for determining time-sensitive health advisories for the communities of people that live at the lake.
- 



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Ongoing and future work

Flying slime: Harmful algal blooms can become airborne



January 22, 2018

Contact: [Morgan Sherburne](mailto:Morgan.Sherburne@mich.edu)
morganis@mich.edu

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Jessica Axson prepares to collect a freshwater sample from Lake Erie at Maumee Bay State Park in Ohio. The cloudy green tint in the water is due in part to the high concentration of blue-green algae—84 parts per billion—that has caused large harmful algal blooms in the western basin of Lake Erie. Image credit: Nathaniel May



ACS Publications

www.acs.org




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The future?

- Maps and plots of ongoing analyses of the HAB at Lake Anna are provided through a citizen science online portal managed by LACA.
 - Analyses on aerosol sample collection and wind profiles are ongoing, but indicate a potential for the toxins in the lake to become aerosolized and transported inland.
- 



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Thank you for your attention!



Perspectives on Harmful Algal Blooms (HABs) and the Cyberbiosecurity of Freshwater Systems

David G. Schmale III^{1*}, Andrew P. Ault^{2,3}, Walid Saad⁴, Durrelle T. Scott⁵ and Judy A. Westrick⁶

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