Emily

Toxic cyanobacterial blooms and food web contamination in the Chowan River and western Albemarle Sound

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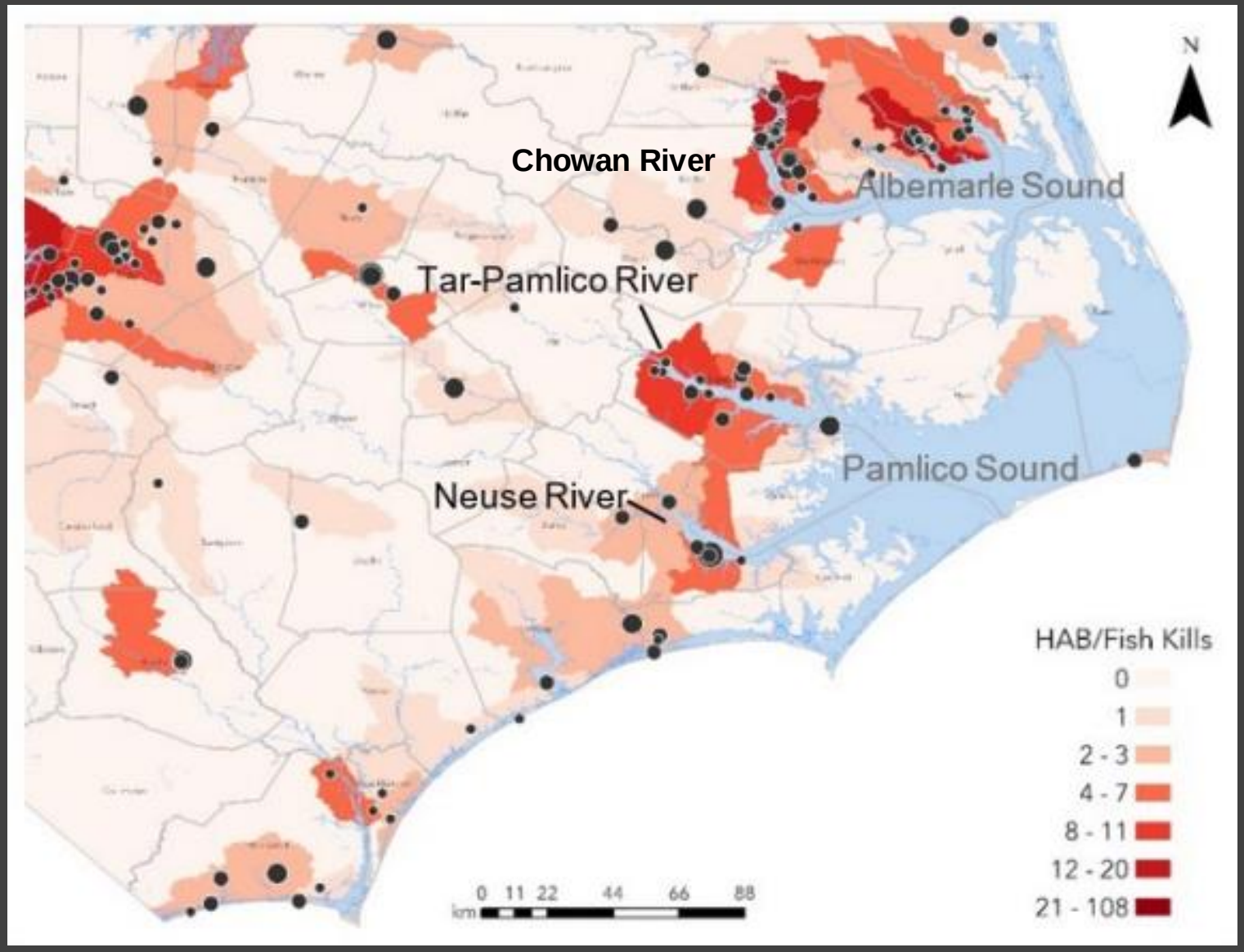
Marine, Earth and Atmospheric Sciences
North Carolina State University

Albemarle Algal Bloom Summit 2023

HAB and fish kills reported to the DEQ, 2020 - 2022






https://www.epa.gov/cyanohabs

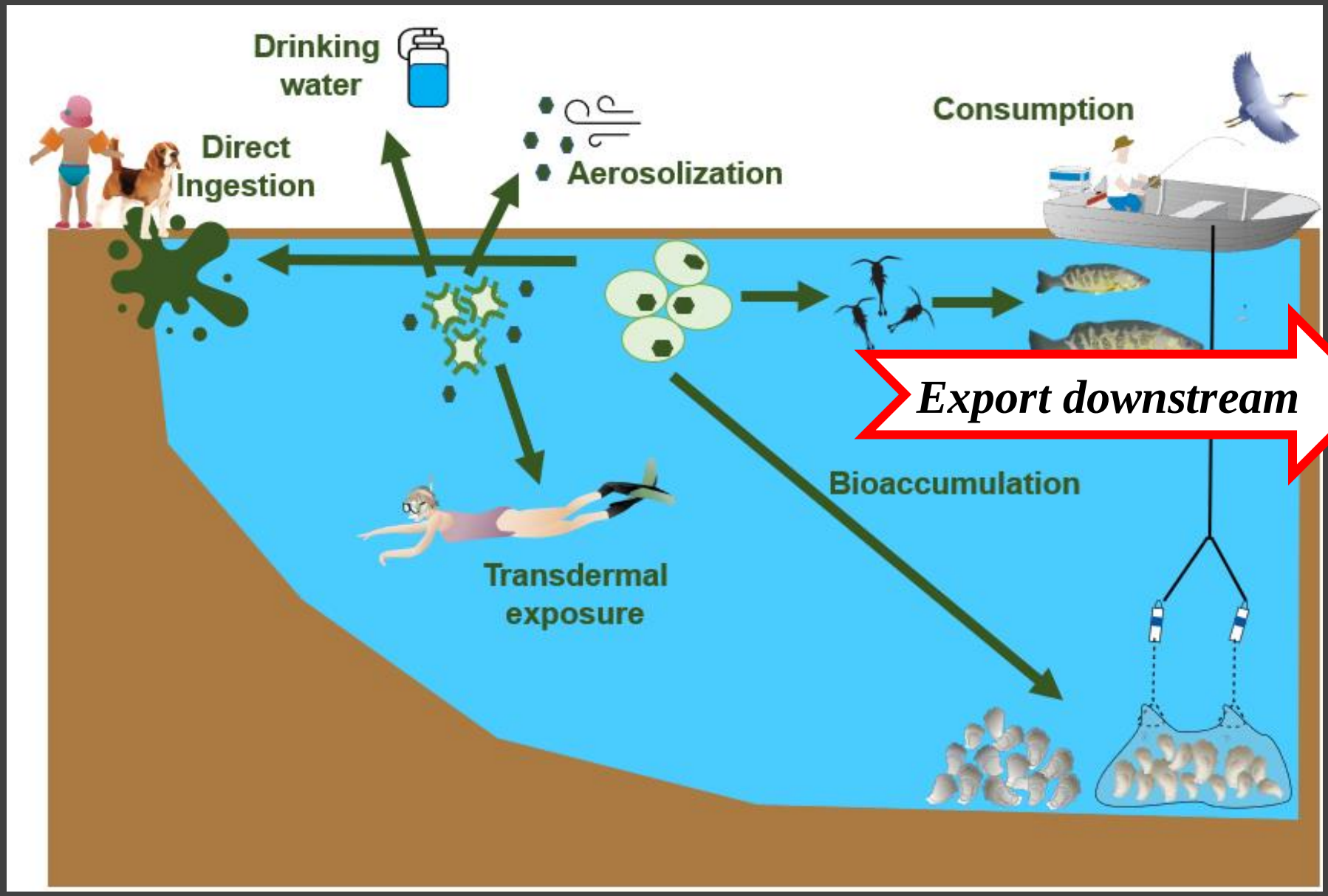
Issues:

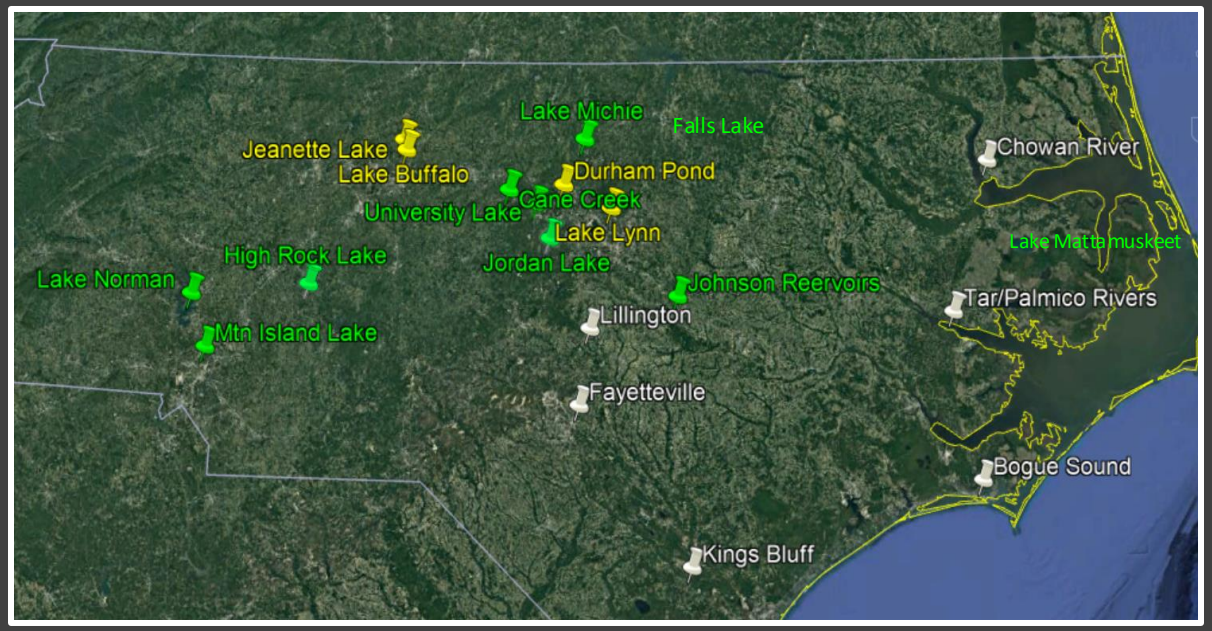
- Anoxia and fish kills
- Light reduction and loss of benthic communities
- Water quality (property values, tourism)
- Socioeconomic impacts (fisheries, drinking water,…)
- Animal deaths and human health risks …….

Role of toxins?

NC Department of Environmental Quality

Pathways of toxin exposure





Major Questions

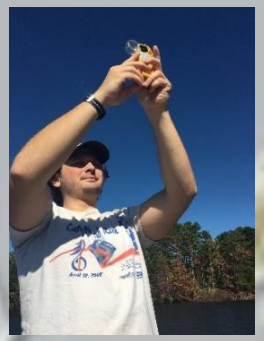
- Cyanotoxins present?
- How toxic are blooms?
- Fate of toxins?

Plankton Ecology Lab

Emily

Kaitlin

Maddy

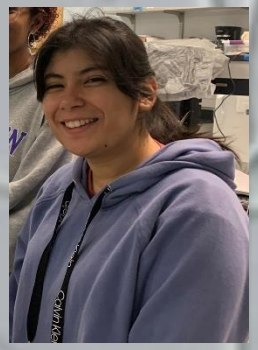


Marco

Emily

Dan

Baily

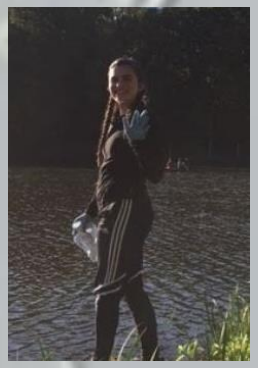


Angelina

Aidan

Miranda

Madison



Nolynn

Lucy

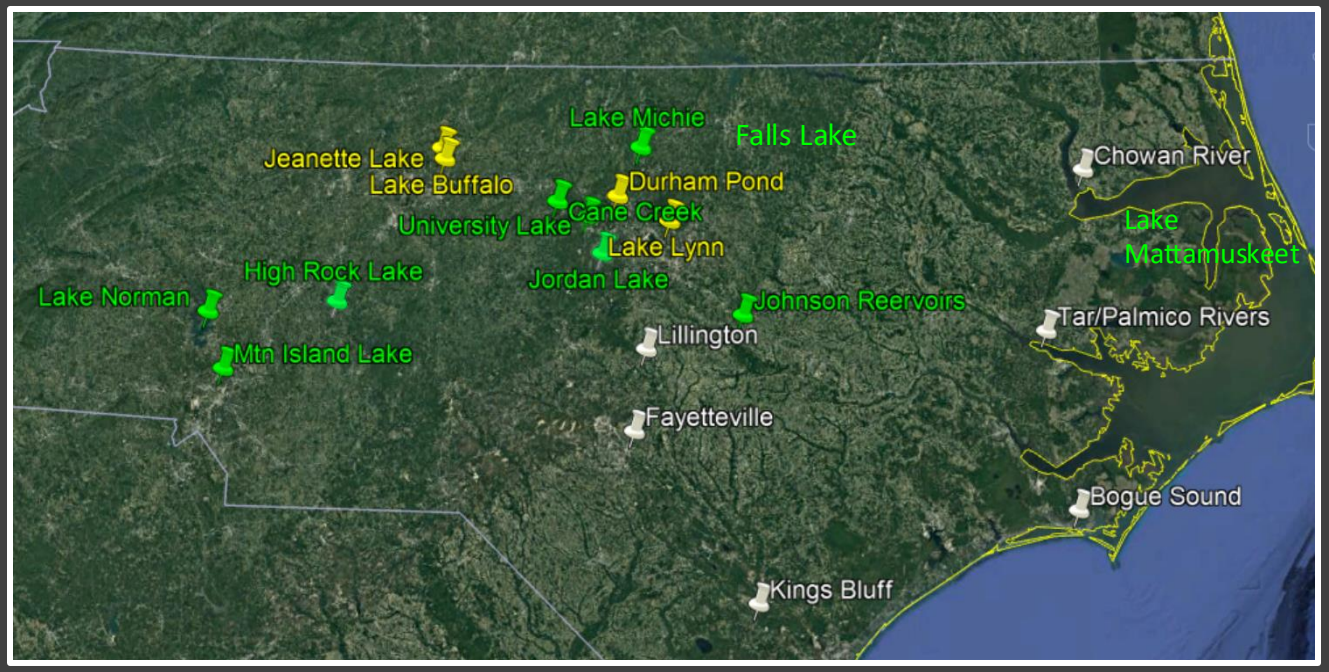
Barrett

Clara

Kirsten

Will

Dr. Ben-Horin team

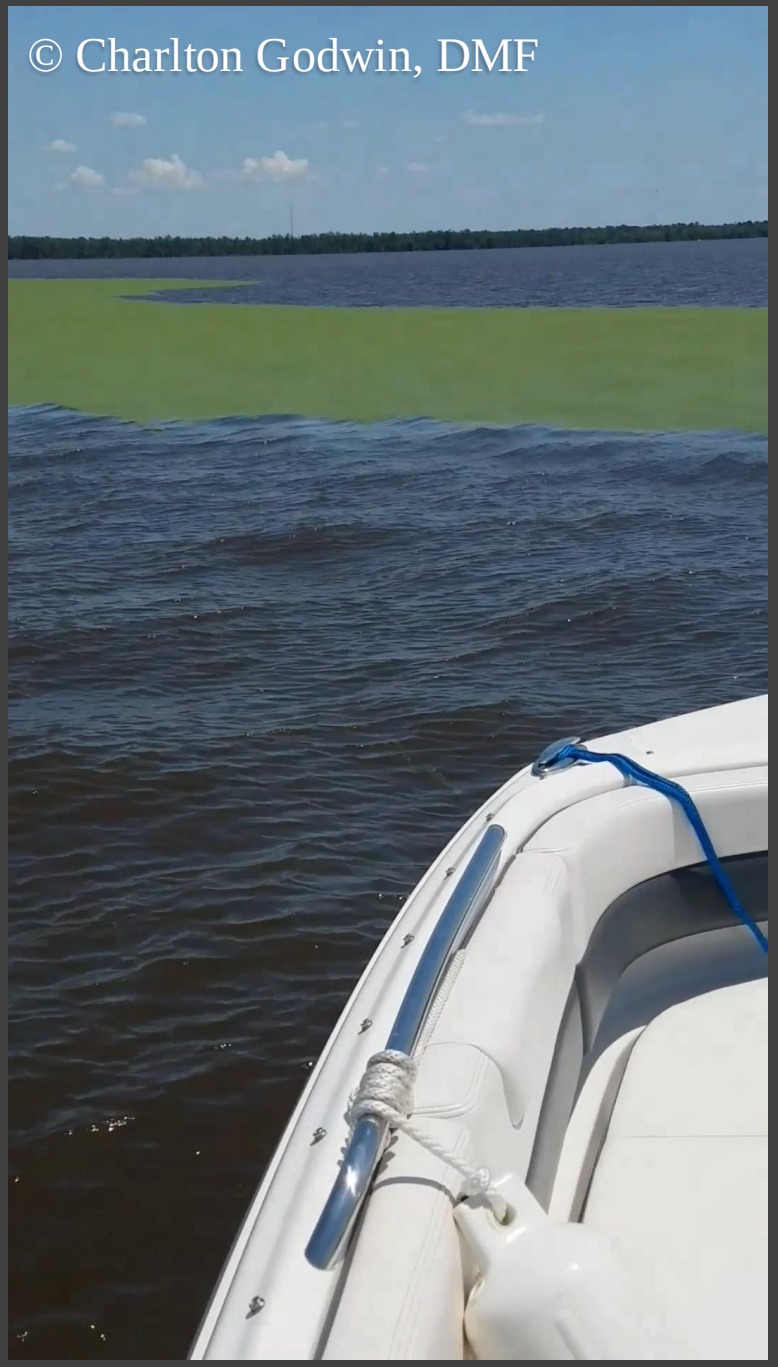


Some General Findings

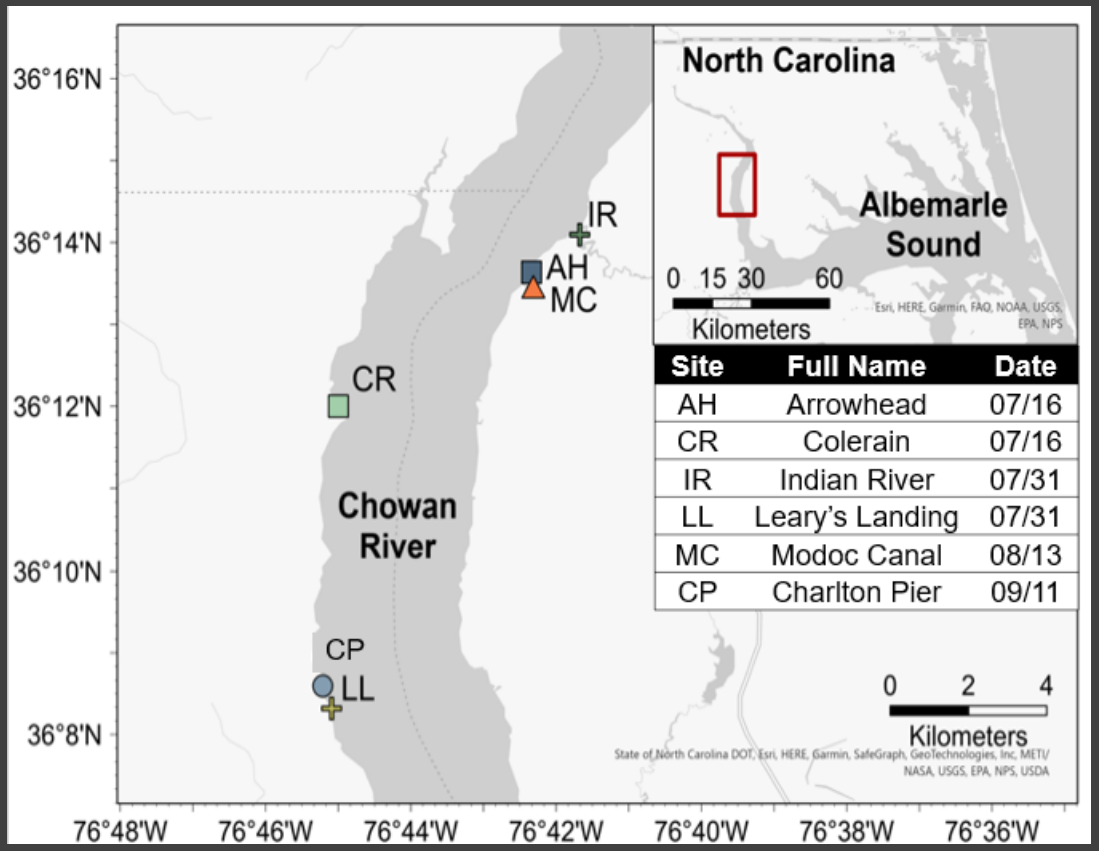
- Multiple cyanotoxins are detectible year-round in **low concentrations – Microcystin > Anatoxin > Cylindrospermopsin > BMAA > Saxitoxin**
- Toxins occur simultaneously ➔ chronic exposure to mixtures?
- Cyanotoxins and marine toxins merge in coastal zones

Challenges in HAB research

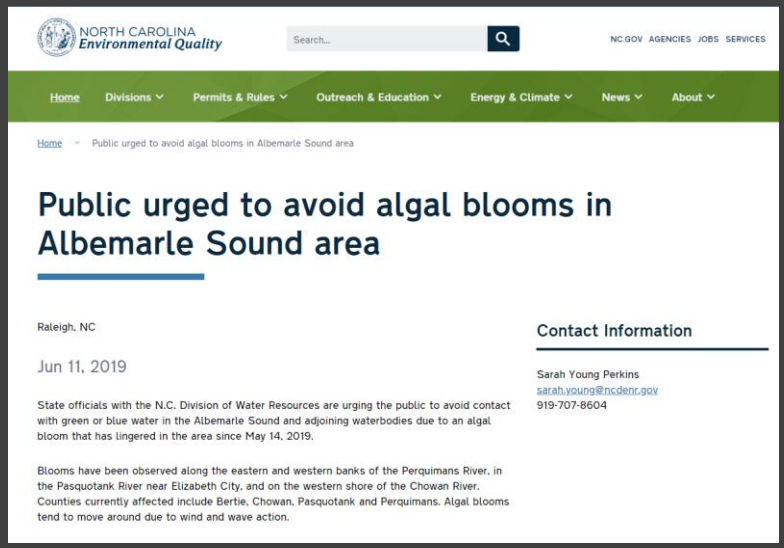
- Ephemeral events
- Patchy
- Not all species toxic
- Not all toxic species continually toxic
- More than one toxin per species
- Presence of multiple toxins?
- Exposure risks and guidelines?
- Fate of toxins?



2019 bloom season



Site	Full Name	Date
AH	Arrowhead	07/16
CR	Colerain	07/16
IR	Indian River	07/31
LL	Leary's Landing	07/31
MC	Modoc Canal	08/13
CP	Charlton Pier	09/11



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Public urged to avoid algal blooms in Albemarle Sound area

Raleigh, NC

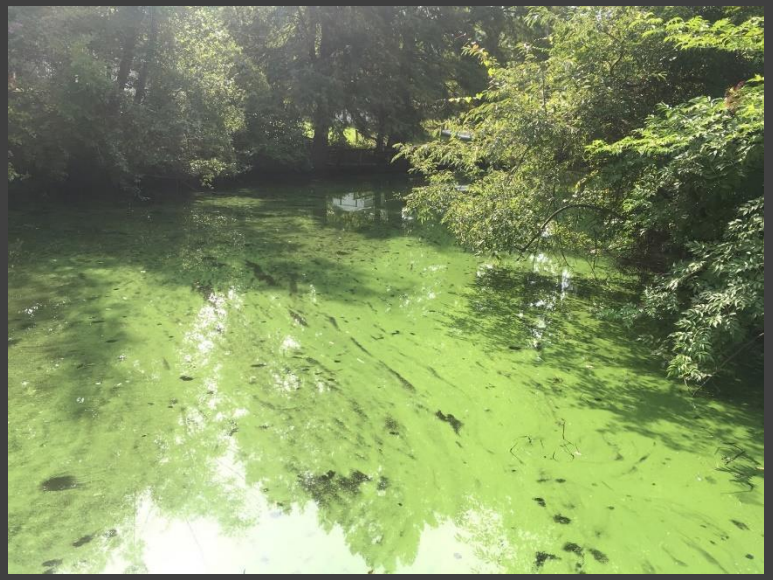
Jun 11, 2019

State officials with the N.C. Division of Water Resources are urging the public to avoid contact with green or blue water in the Albemarle Sound and adjoining waterbodies due to an algal bloom that has lingered in the area since May 14, 2019.

Blooms have been observed along the eastern and western banks of the Perquimans River, in the Pasquotank River near Elizabeth City, and on the western shore of the Chowan River. Counties currently affected include Bertie, Chowan, Pasquotank and Perquimans. Algal blooms tend to move around due to wind and wave action.

Contact Information

Sarah Young Perkins
sarah.young@ncdenr.gov
919-707-8604



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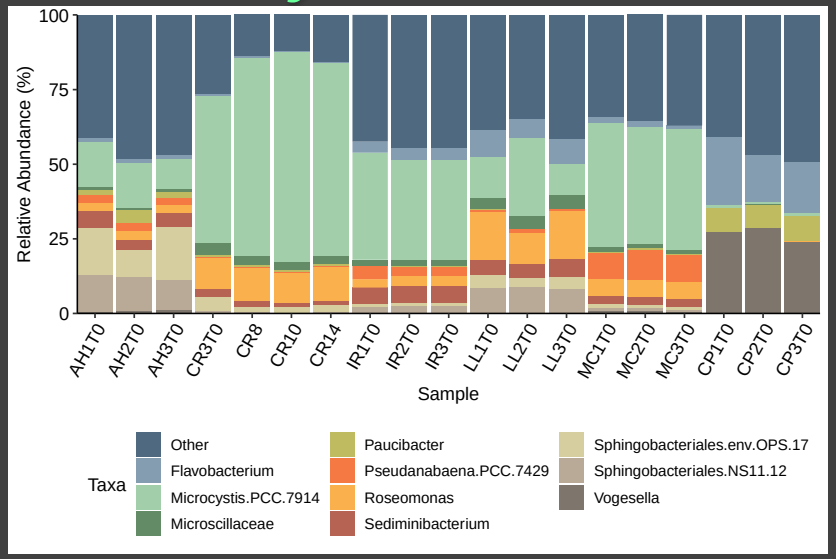
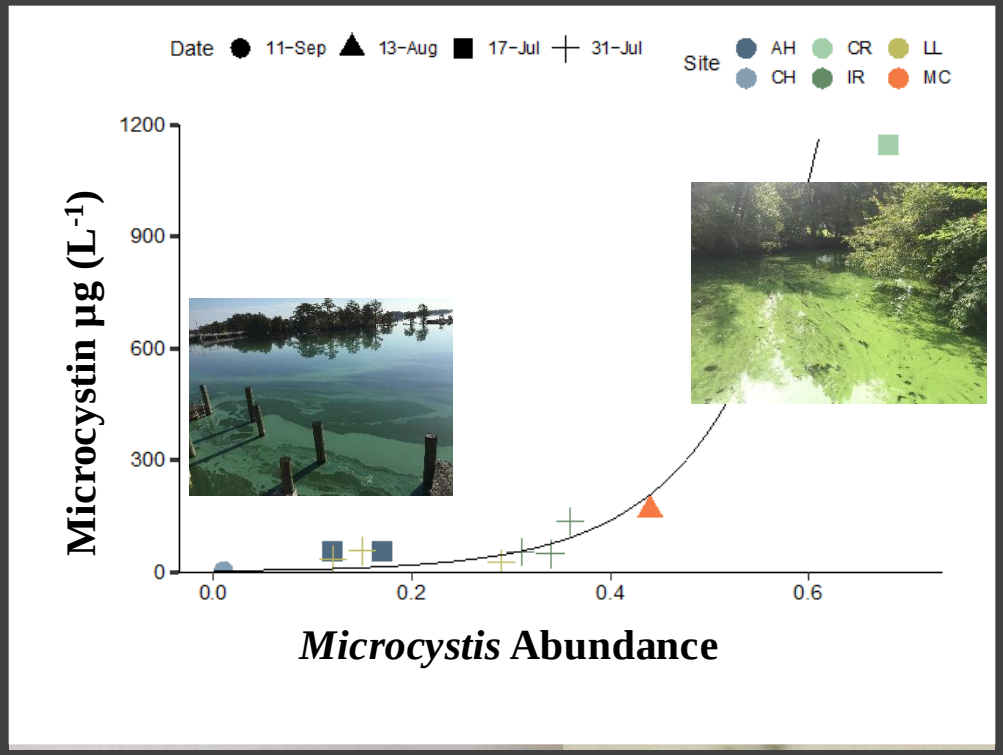
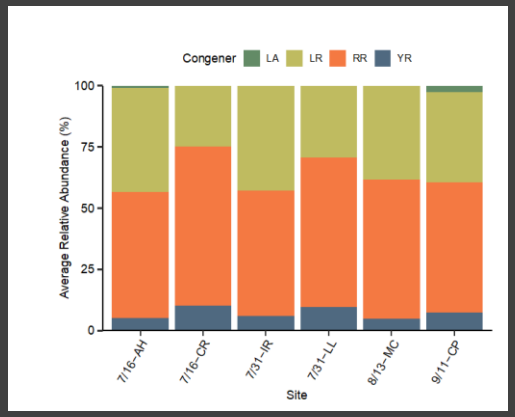
Record Levels of Microcystin during 2019 bloom season

- ***Microcystis*** dominated





Chlorophyll and toxin do not correlate



Different Types of Microcystins

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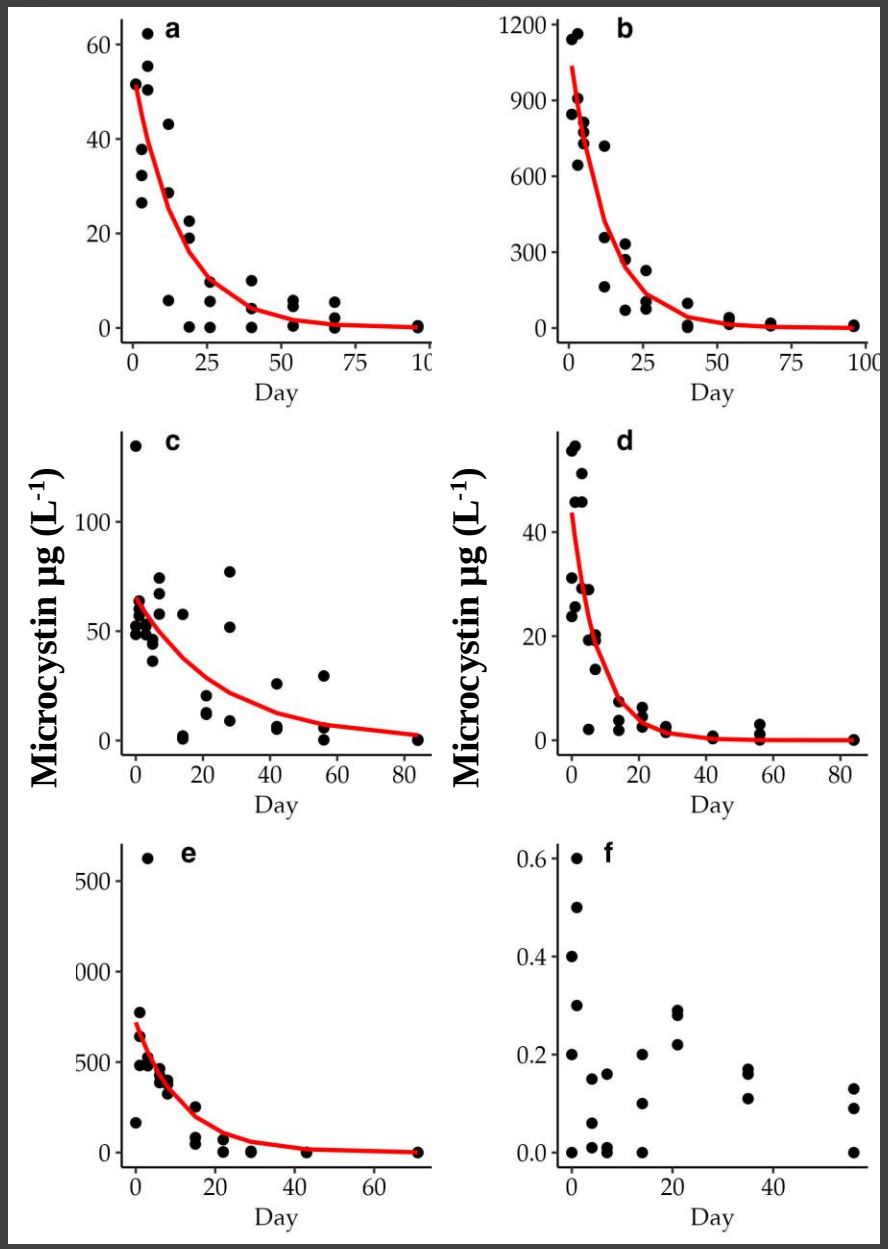
Degradation Experiments



- **particulate toxin** took on average **50 days** to fall below recreational guidance levels with 10 µg L^{-1} (range = 14 to 96 days)
- **dissolved toxins** still detected after 100 days above recommended threshold for drinking (1 µg L^{-1})

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Food Web Study in Western Albemarle

- **Fate of toxins?**

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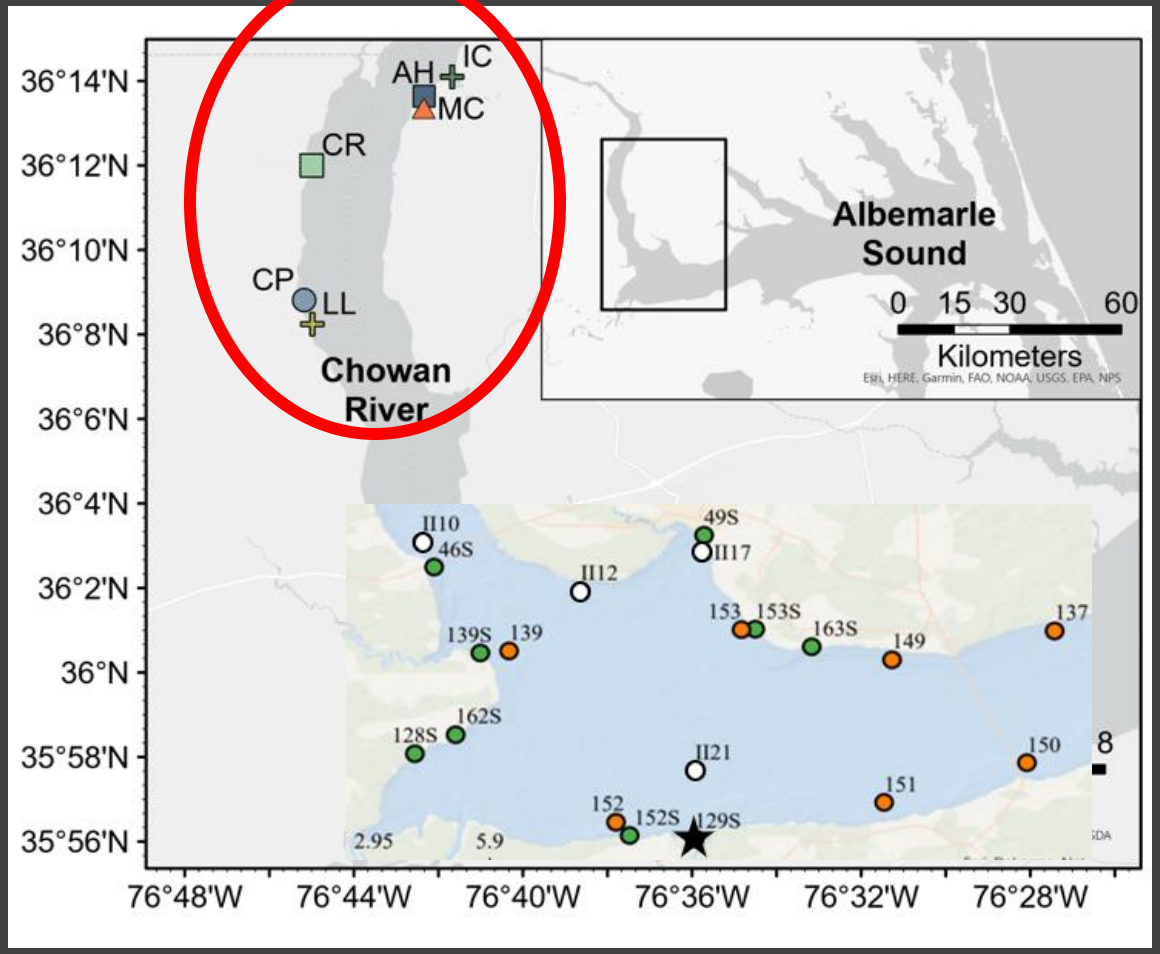
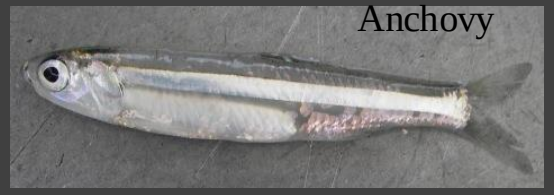
Community Collaborative Research Grant Program



- Gill Net
- Seining
- Trawling
- ★ Clam Bed/Seining/

Charlton Godwin

North Carolina Marine Fisheries



Species	n
Alosa	10
American Shad	3
Anchovy	6
Blue Catfish	26
Blue Crab	17
Bunker	4
Channel Catfish	2
Eastern Silvery Minnow	3
Gizzard Shad	17
Inland Silverside	10
Spot-tailed Shiner	3
White Catfish	43
White Perch	45
Yellow Perch	1
Rangia	44
Total # of samples	234

Sample Type	n
Muscle	96
Liver	42
Viscera	23
Gut	25
Whole Fish	45
Eggs	3

Images: Jacobs, R. P., & O'Donnell, E. B. (2009 A Pictorial Guide to Freshwater Fishes of Connecticut. Connecticut Department of Energy and Environmental Protection

Microcystin

Acute health effects in humans

Abdominal pain, headache, sore throat, vomiting and nausea, dry cough, diarrhea

Tolerable Daily Intake (TDI) – Adult Lifetime

0.04 µg per kg body weight^{-1} day^{-1}

No Observed Adverse Effect Level (NOAEL) - Adult -

40 µg per kg body weight^{-1} day^{-1}

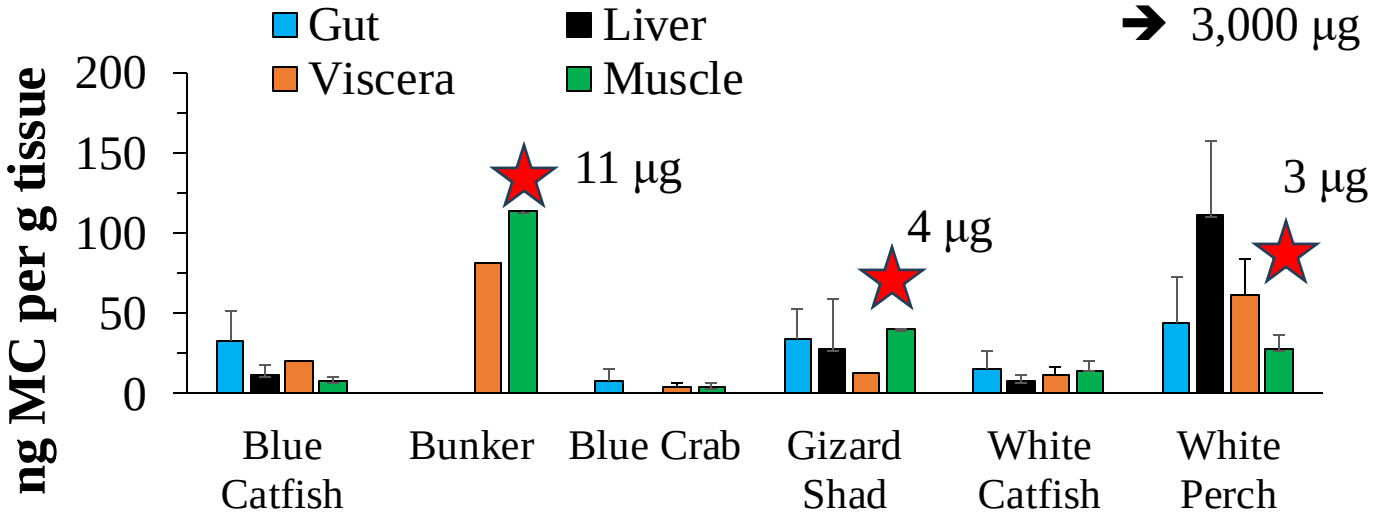
➔ Low biomass and *Microcystis*

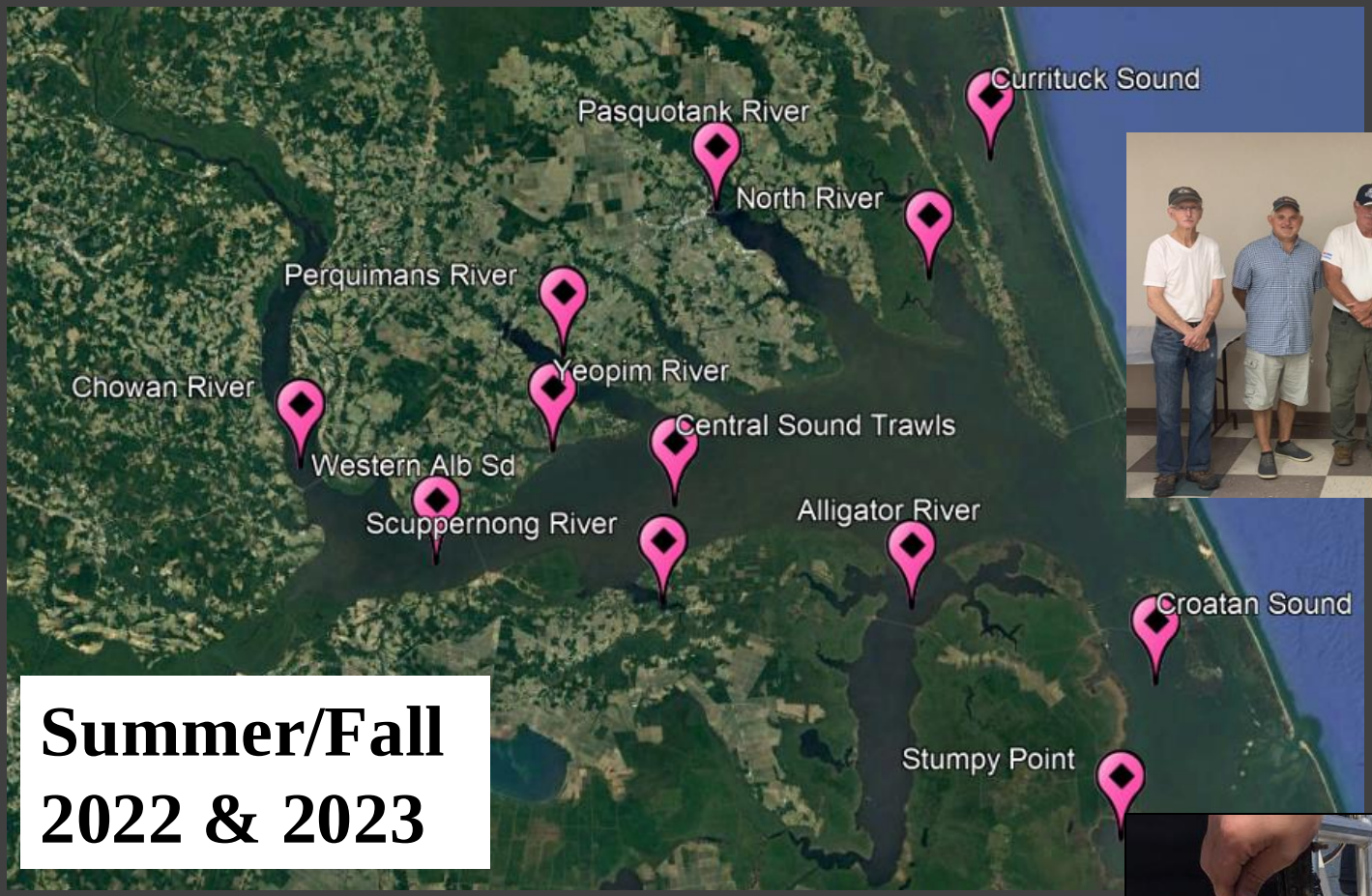
➔ Low to non-detectable levels of toxin

For a 70 kg /165 lb human

➔ 3 µg - TDI

➔ 3,000 µg - NOAEL





Summer/Fall 2022 & 2023

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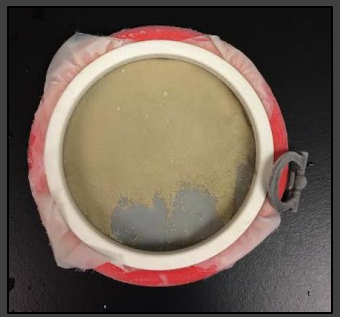

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Community Collaborative Research Grant Program

Thank you!