



February 20, 2018

*Phytoplankton Sampling Protocols Development*  
*Department of Environmental Quality*  
*Division of Water Resources*



# *Why do we need them?*

- Algal blooms occur in the Cape Fear River
  - Algae known to produce toxins
  - Large long river
- Monitoring/Assessing blooms requires multiple agencies
  - 2013 Seventy one miles of visible flecks and swirls
    - Coordinated response:
      - DWR (WSS, FRO, WiRO) Coalitions (MCFRBA & LCFRP), ACOE, PWS, WTP & DPH
  - 2015 Bloom reported after the Toledo water crisis
    - Coordinated response:
      - DWR (WSS, WiRO), PWS, DPH, WTPs, & Coalitions (MCFRBA & LCFRP)
- Cape Fear River Water Quality Model Development



# *Current protocols insufficient*

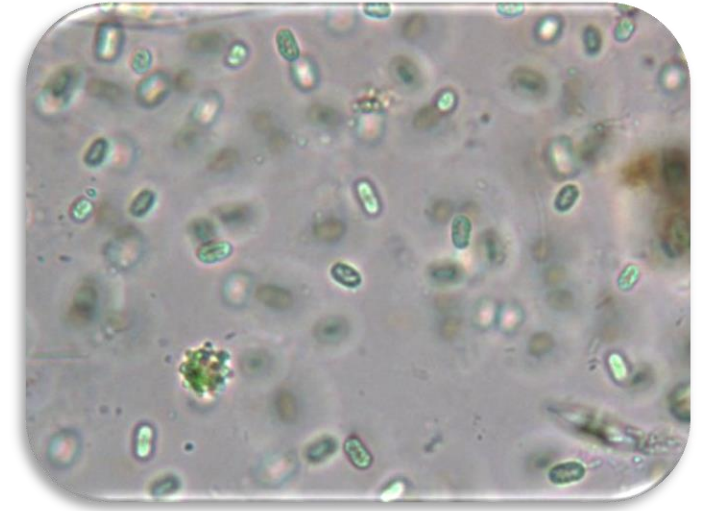
- Developed for routine monitoring
- Episodic protocols too general
  - Encompasses all algae, aquatic plants and related organisms
  - Random bottles (i.e. Water, Gatorade, gelato)
- Health concerns not major focus
- Needs to address
  - In-house Cyanotoxin analytical capabilities
  - Collection and handling important!
  - Quality Assurance
  - Results must be legally defensible





# *Algae Basics*

- Not plants!
- Diverse group of somewhat related organisms
- Algae forms: Phytoplankton, Filamentous & Periphyton
- Procedures concentrate on phytoplankton:
  - Algae in water column
  - Concentration varies
    - Spatial and temporal
    - Quantification/Densities
  - Blooms move!
    - Flowing water
    - Wind and waves



# *How difficult can it be?*

- Find a bloom
- Put it in a bottle
- Send it to a phycologist
  - How many phycologists do you know?
- Everything relies on:
  - Communication
  - Coordination
  - Contacts





# Challenges

- What do you sample?
  - Water column
    - Photic vs grab
  - Surface film
- Shipping and handling
- When to preservative
  - Quantification requires it
  - Toxin analysis? Maybe.
    - Recreational: no
    - Finished drinking water: yes

## IDENTIFYING ALGAL BLOOMS

Algae are responsive to physical and chemical conditions in the aquatic environment. Sometimes their rapid reproduction causes nuisance growths or blooms. Most blooms occur when favorable environmental conditions exist, such as an extended photoperiod during summer months, sufficient nutrients, and slow moving stagnant waters. Several indicators of excessive algal growth can be observed in the field and used to determine the steps necessary to effectively investigate a potential algal bloom. This document can be used as a field guide for identification of algal bloom activity and to distinguish between different types of algal blooms including those that would be categorized as potential harmful.

### VISUAL INDICATORS:

#### Title: Surface Scums

**Description:** Surface scums have the appearance of spilled paint forming a film across the water's surface. They can appear in a variety of colors including bright green, red, brown, or even blue. Surface scums are formed by algae that are able to swim or float to the surface where sunlight is readily available for photosynthesis. Common scum forming algal groups include cyanobacteria, euglenoids, and green algae.



#### Title: Algal Mats

**Description:** Algal mats are dense, macroscopic growths of algae that generally float on the surface or the water, but can also be found growing along the bottom. Algal mats form from an accumulation of filamentous algae. Algal groups such as green algae, cyanobacteria, and diatoms contain filamentous species capable of forming algal mats.



#### Title: Discolored Water

**Description:** Algae suspended throughout the water column can cause the water to appear green, brown, red, or even blue. At high densities, all algal groups have the ability to discolor the water. However, a variety of non-algal, environmental factors can also cause water discoloration including suspended minerals and organic matter.



#### Title: Fish Kills

**Description:** Fish kills can occur when algal bloom die off and microbial decomposition consumes the dissolved oxygen in the water. Because there are a variety of environmental factors that can trigger a fish kill event, it is important to identify additional indicators of algal bloom activity.

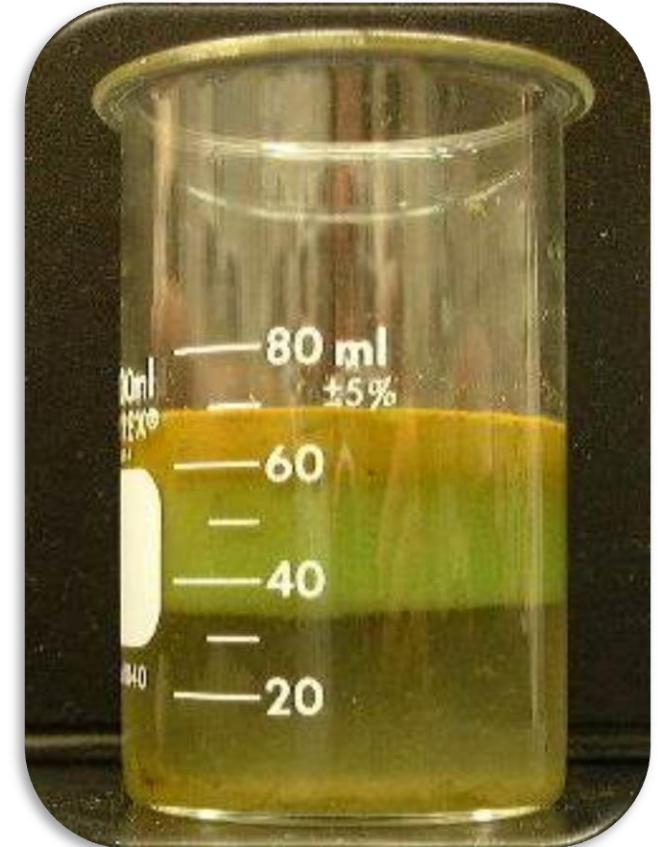


### DISSOLVED OXYGEN AND PH:

Elevated photosynthetic activity of high density algal blooms has an observable effect on the dissolved oxygen and pH of a waterbody. A healthy and productive algal bloom typically produces dissolved oxygen concentrations  $\geq 120\%$  saturation and a pH of  $\geq 8$ . If the bloom has died off and begun to decay, it is typical to observe dissolved oxygen concentrations  $\leq 30\%$  saturation.

# *What is the question?*

- Multiple protocols to select from
  - Photic vs grab
    - Quantification
  - Surface scoop
- Exposure risk assessment
  - Recreational
    - Shoreline, surface & water column
  - Aquatic life
    - Water column
  - Drinking water
    - Source (raw) and finished
- Division of Public Health: Health Risk Evaluations (HREs)
  - HREs based on:
    - Cell counts
    - Toxin levels (ug/L or ppb)
- May (often) require more than one sample



# Supplies, Equipment & Documents

- Sample collection form
- Physical parameters: meters
  - Dissolved oxygen & pH
- Chemical parameters: bottles and coolers
  - Chlorophyll-a & nutrients
- Phytoplankton:
  - Bottle selection important
    - Disposable
      - Iugol's solution stains
    - PTEG
      - Reusable
      - Wash
  - Glass amber

**SAMPLE COLLECTION AND FIELD EVALUATION FORM FOR ALGAE, AQUATIC PLANTS, AND RELATED ORGANISMS**

**SAMPLE INFORMATION**

Sampler Name(s):  Agency:

Date:  Time:  Station #:

Waterbody/Address:  Basin:  County:

Latitude:  Longitude:  HUC:

Sample Type: ☐ Filamentous Algae ☐ Periphyton ☐ Phytoplankton ☐ Aquatic Plant ☐ Unknown

Collection Method: ☐ Photic Zone ☐ Grab ☐ Scoop Attached: ☐ Map ☐ Photographs (PLEASE)

Other Samples Collected: ☐ Nutrients ☐ Chlorophyll-a ☐ Cyanotoxins: ☐ Other:

Algal Bloom Response? ☐ Yes ☐ No Fish Kill Response? ☐ Yes ☐ No

\*\*If yes, please fill out a NC DWR Fish Kill Field Investigation Form and submit with sample.

**ENVIRONMENTAL CONDITIONS**

Weather Conditions:

Water Clarity: ☐ Clear ☐ Turbid ☐ Tannic ☐ Green ☐ Other (Explain)

Characteristics: ☐ Filaments ☐ Balls ☐ Flecks ☐ Surface Film ☐ Other

Algal Color:  Algal Abundance:  % Coverage

Secchi Depth:  meters Bottom Depth:  meters

**CHEMICAL AND PHYSICAL SAMPLE DATA**

Depth (m)	Cond (µS)	Temp (°C)	DO (mg/L)	DO (%sat)	pH (SU)	Salinity (ppt)
0.15 (surface)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
1.0	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
2.0	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
3.0	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
4.0	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

**NOTES:**

°C = degrees Celsius Cond = conductivity m = meter ppt = parts per billion  
 %sat = percent saturation DO = dissolved oxygen µS = microsiemens SU = standard units

**SAMPLE INSTRUCTIONS**

Sample collection should follow Standard Operating Procedures for the Collection and Analysis of Aquatic Algae (2016) and the Standard Operating Procedures Manual: Physical and Chemical Monitoring (2013). Sample quantities, handling requirements, and preservation methods are below. All samples should be kept on ice or in a refrigerator for storage and shipping.

Sample Type	Preservation Method	Quantity if Preserved	Quantity if Unpreserved
Filamentous Algae	Wet paper towel, plastic bag	N/A	2-3 golf-ball sized clumps
Periphyton	500 mL jar, 4mL Lugol's	50 milliliters of scrapings	2 small (4-inch) rocks/wood
Phytoplankton	500 mL jar, 2mL Lugol's	500 mL	500 mL
Aquatic Plant	Wet paper towel, plastic bag	N/A	3-5 stems, leaves, flowers, fruits
Cyanotoxin	500 mL PETG bottle	N/A	500 mL

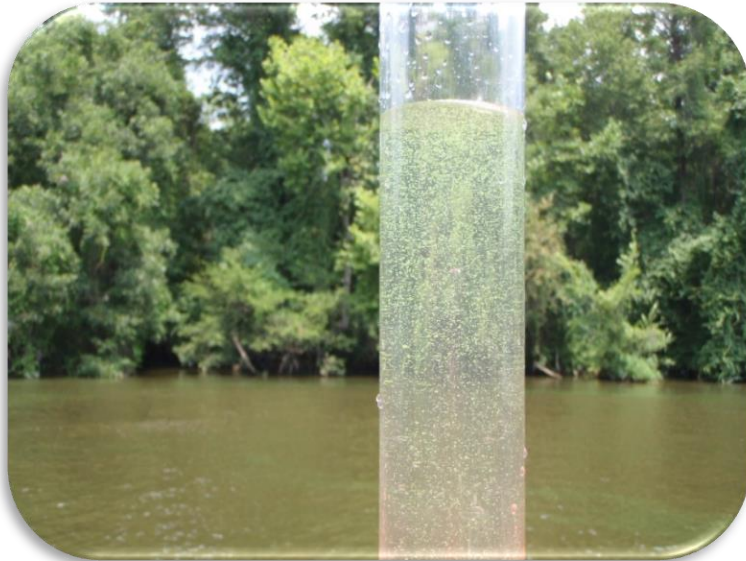
Send this form along with the sample and any supplemental information to the address included on the reverse. Copies of this and other sample collection forms can be obtained by calling (919) 743-8400 or visiting [www.deq.nc.gov](http://www.deq.nc.gov).





# *Conclusion*

- Phyto sampling protocols needed
  - Can be field tested
  - Multiple agencies/organizations can follow
  - Blooms can be better documented
  - Exposure risks be better evaluated
  - Data is comparable
  - Data is defensible



# *Contact Information: Ecosystems Branch*

- Brian Wrenn: Supervisor
  - [brian.wrenn@ncdenr.gov](mailto:brian.wrenn@ncdenr.gov)
  - (919) 743-8409
- Leigh Stevenson
  - [leigh.Stevenson@ncdenr.gov](mailto:leigh.Stevenson@ncdenr.gov)
  - (919) 743-8451
- Elizabeth Fensin
  - [elizabeth.Fensin@ncdenr.gov](mailto:elizabeth.Fensin@ncdenr.gov)
  - (919) 743-8421
- Mark Vander Borgh
  - [mark.vanderborgh@ncdenr.gov](mailto:mark.vanderborgh@ncdenr.gov)
  - (919) 743-8423

