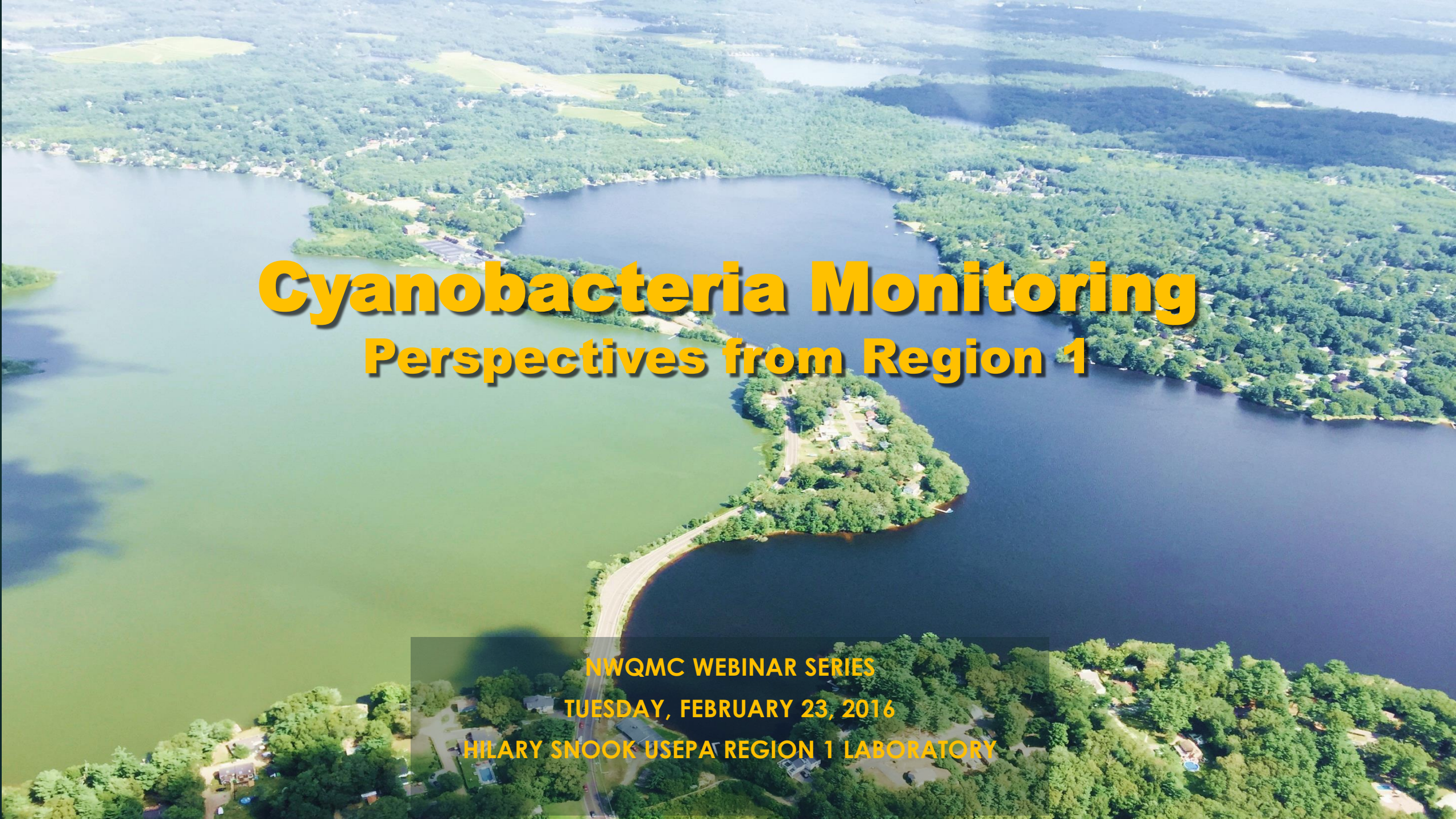


Cyanobacteria Monitoring

Perspectives from Region 1

NWQMC WEBINAR SERIES

TUESDAY, FEBRUARY 23, 2016

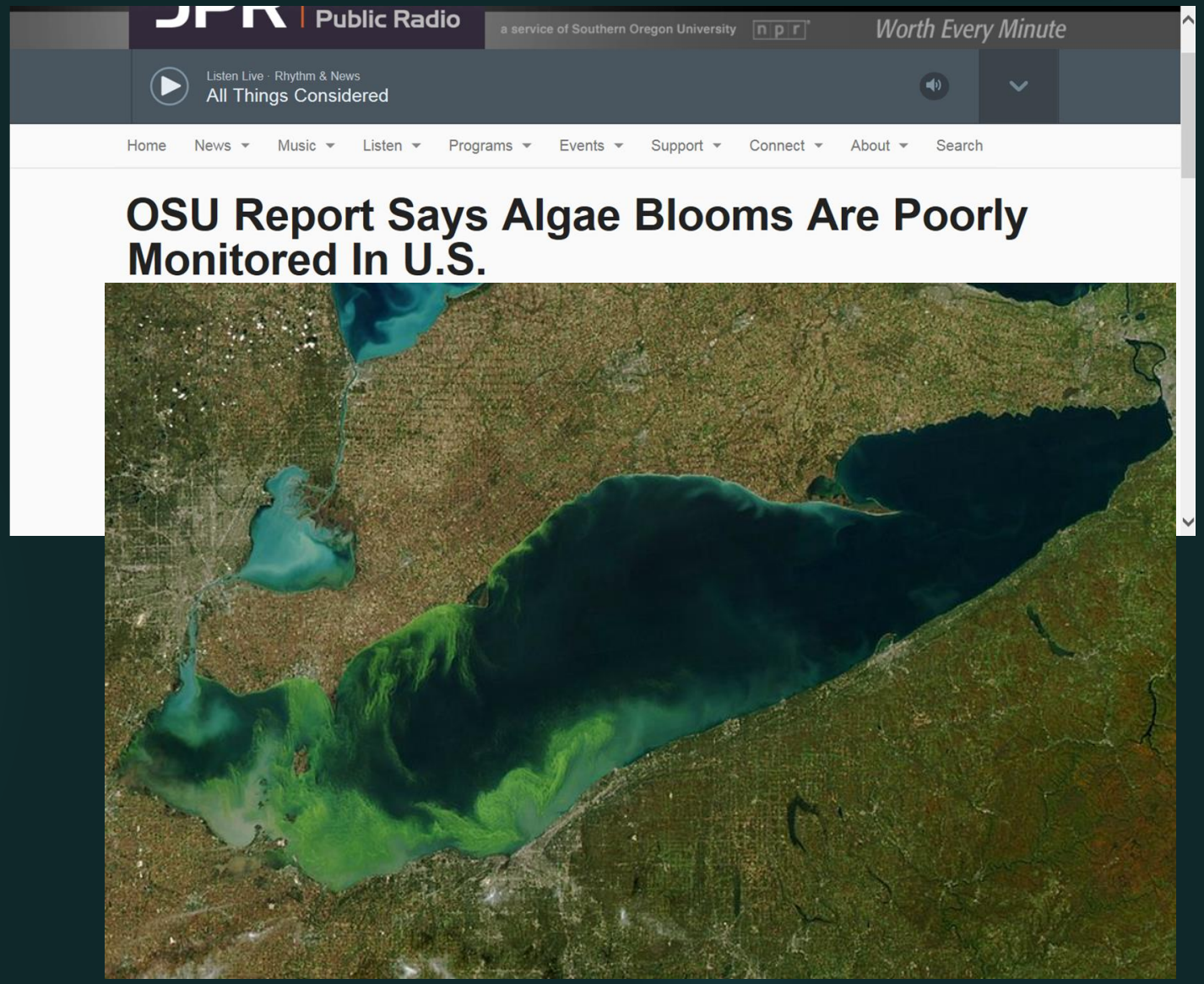
HILARY SNOOK USEPA REGION 1 LABORATORY

Today's Talk

- Basic approach
- Methods and tools employed
- Addressing data

Why the Need?

- A request from states
- No clear picture
- A moving target
- A need at multiple levels
  - Educational
  - Data need/modeling
  - Resource management tool
    - Risk/vulnerability



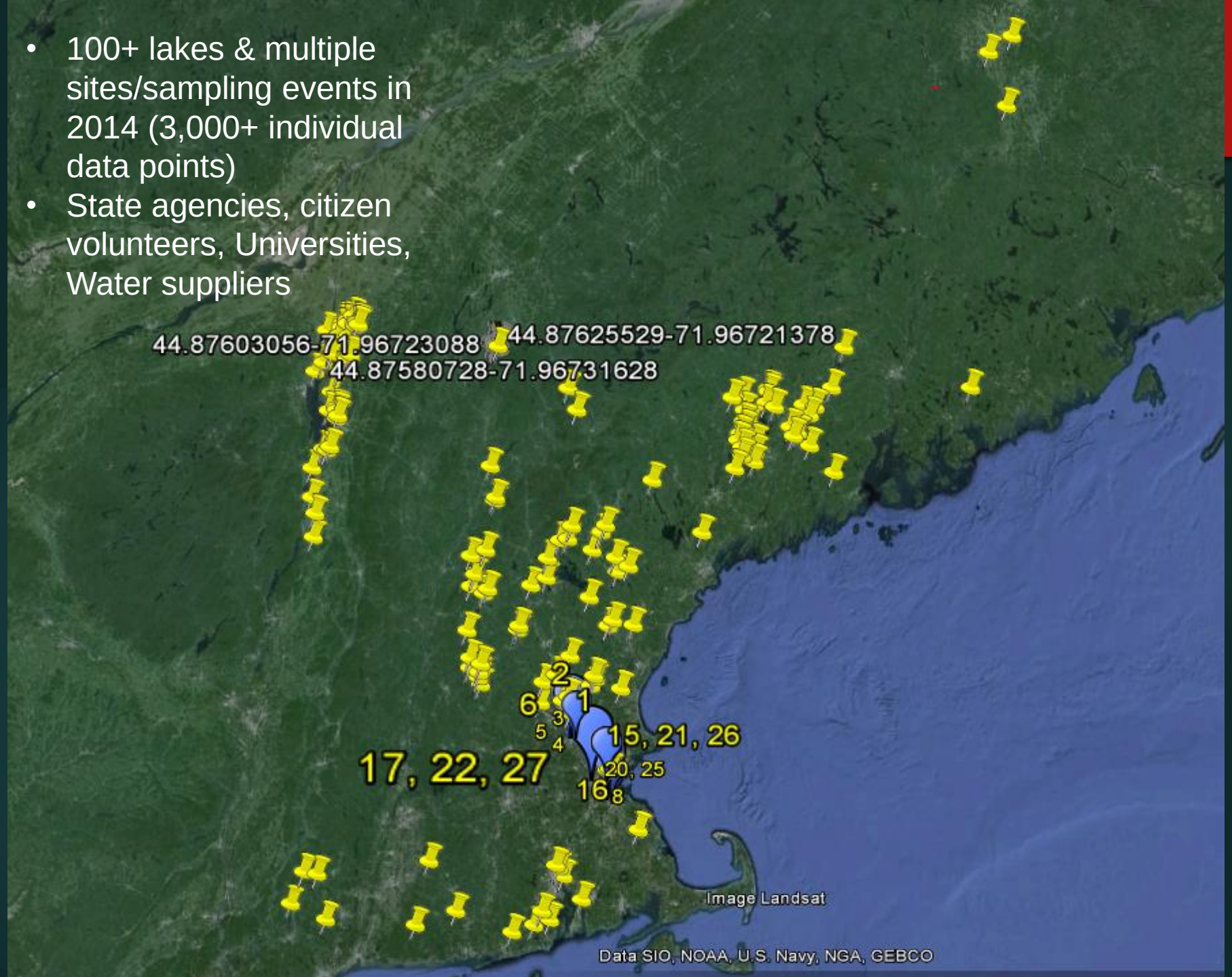
What Must it Encompass

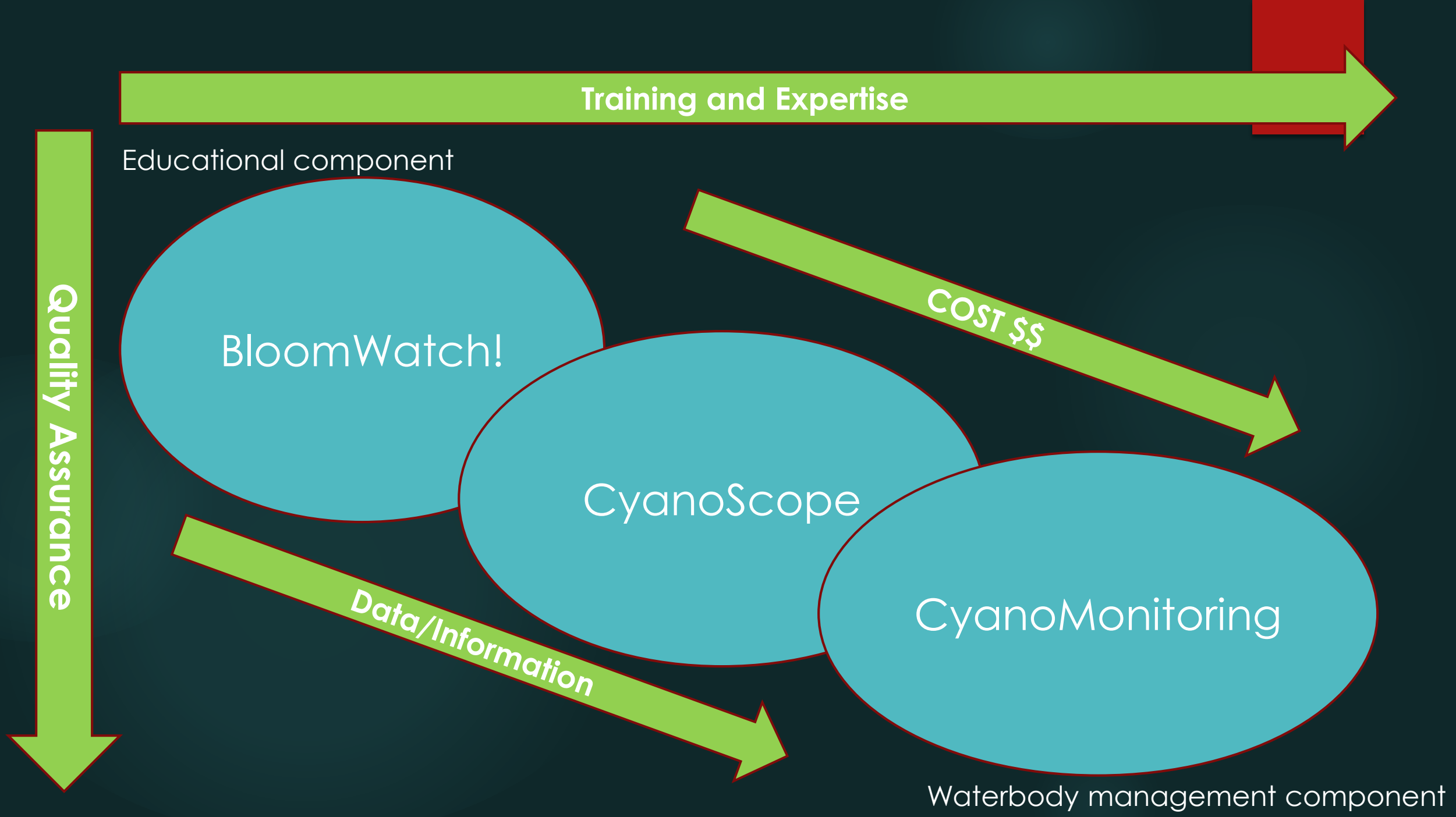
- Multi-tiered with ability for technical expansion
- Low budget but technically sound
- Easily implemented
- Regionally consistency (standardized methods)
- New information at multiple levels
  - Educational/Informative
  - Utility for resource management applications
- Address ambient waters (preemptive) and bloom conditions
- Commensurate QA

Workgroup Participants

- VTDEC
- Lake Champlain Basin Monitoring Program
- NHDES Volunteer Monitoring Network
- NHDES Beaches/Lakes Program
- NHDES Drinking Water Program
- University of New Hampshire CFB
- University of New Hampshire Extension Office
- Lebanon NH PWS
- Manchester NH PWS
- Merideth NH PWS
- Pennichuck Water Works NH
- Wakefield New Hampshire Lakes Collaborative
- Maine DEP Lakes Program
- Maine Dover-Foxcroft Water District
- MADEP Watershed & Drinking water Programs
- Umass Amherst Dept. of Civil Engineering
- Massachusetts Abbington Rockland Water District
- Massachusetts Charles River Watershed Association
- University of Rhode Island Watershed Watch Partnership
- New England Interstate Water Pollution Control Commission
- USEPA Atlantic Ecology Division
- CTDEEP Ambient Monitoring Program
- CT Federation of Lakes
- USEPA Mid-Continent Ecology Division
- USGS
- Lim-Tex, LLC
- Eastern Analytical, Inc.
- Penobscot Nation
- Individual Citizen Scientists
- White Pond Lake Association
- Candlewood Lake Authority
- Lake Attitash Association
- Esperanza Academy

- 100+ lakes & multiple sites/sampling events in 2014 (3,000+ individual data points)
- State agencies, citizen volunteers, Universities, Water suppliers



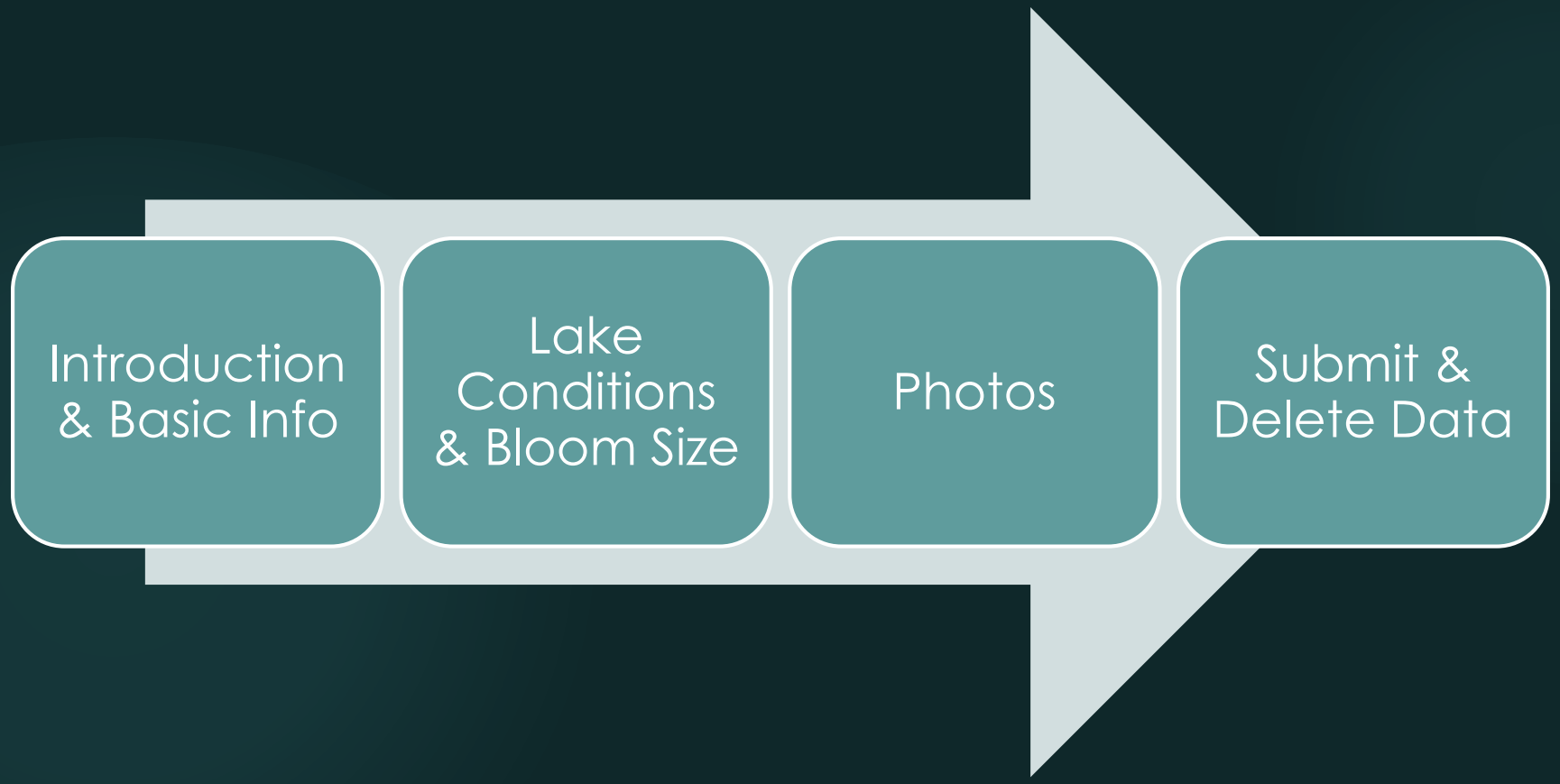

Training and Expertise
Educational component
Quality Assurance
BloomWatch!
COST $$
CyanoScope
Data/Information
CyanoMonitoring
Waterbody management component

BloomWatch!

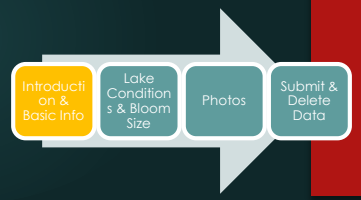
To determine the spatial and temporal patterns of bloom occurrence in the region

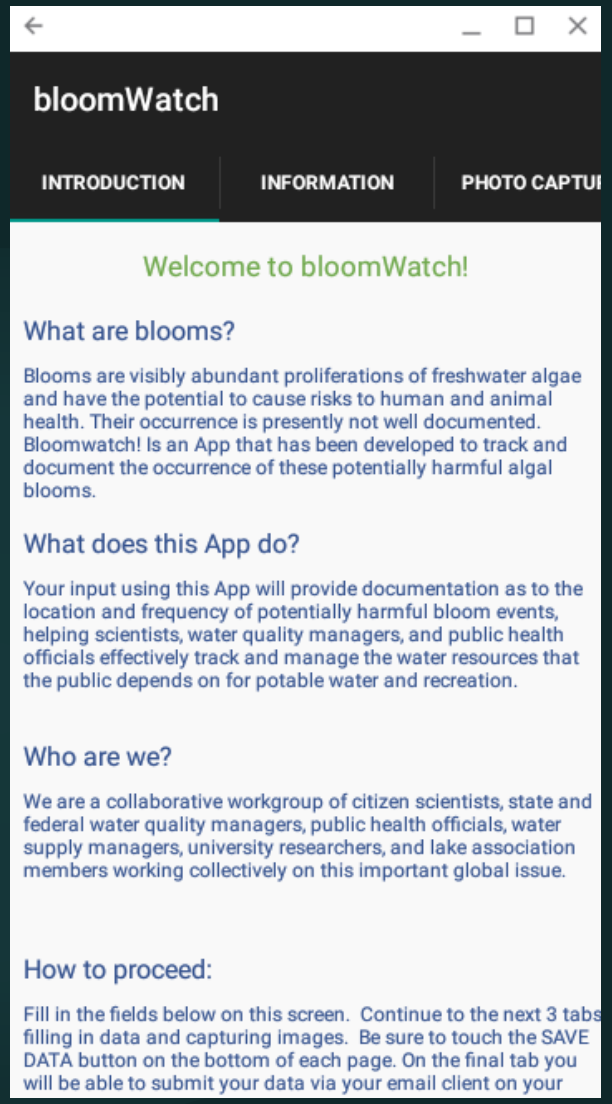
- Bare bones basic
- Educational
- Crowdsourced information
- Smart phone
- App- established methodology
- Data Visualization – public domain

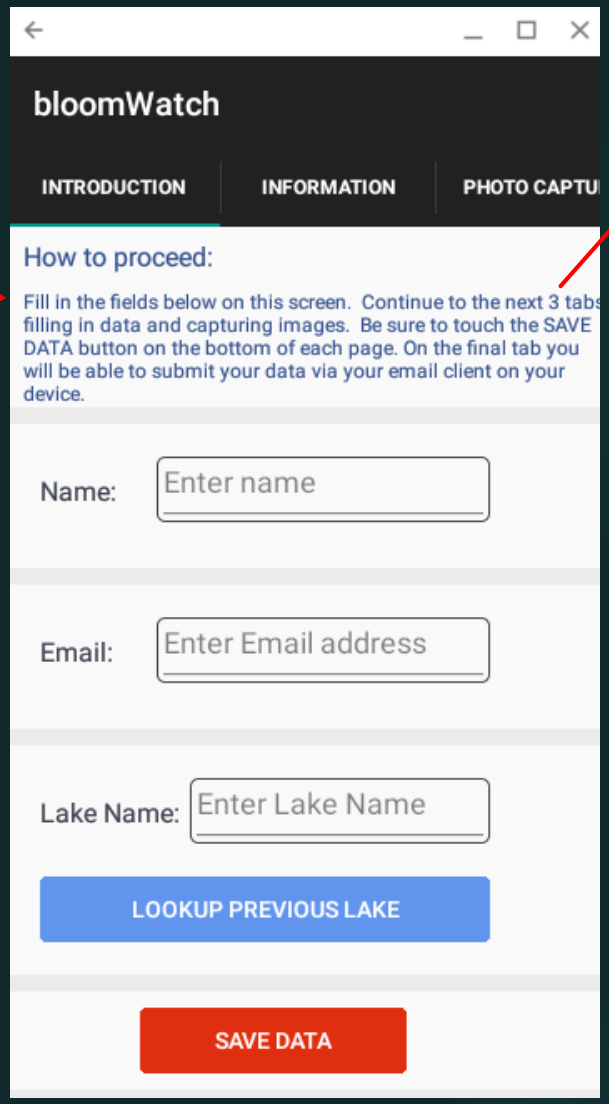
BloomWatch App



Introduction & Basic Info Screen

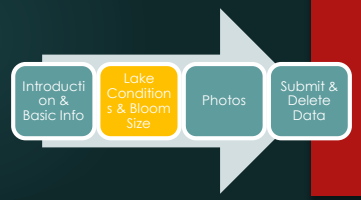


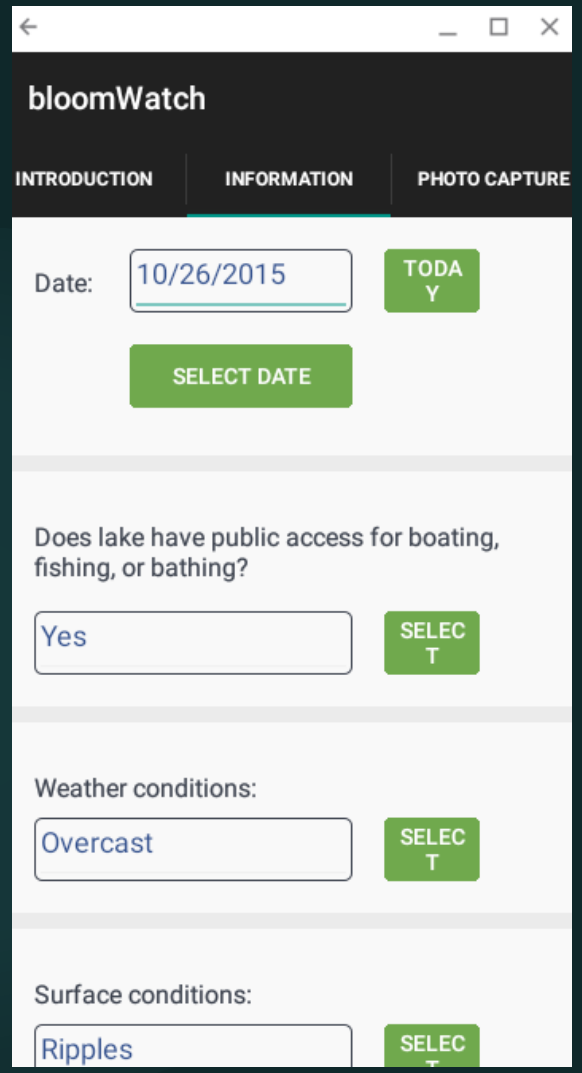


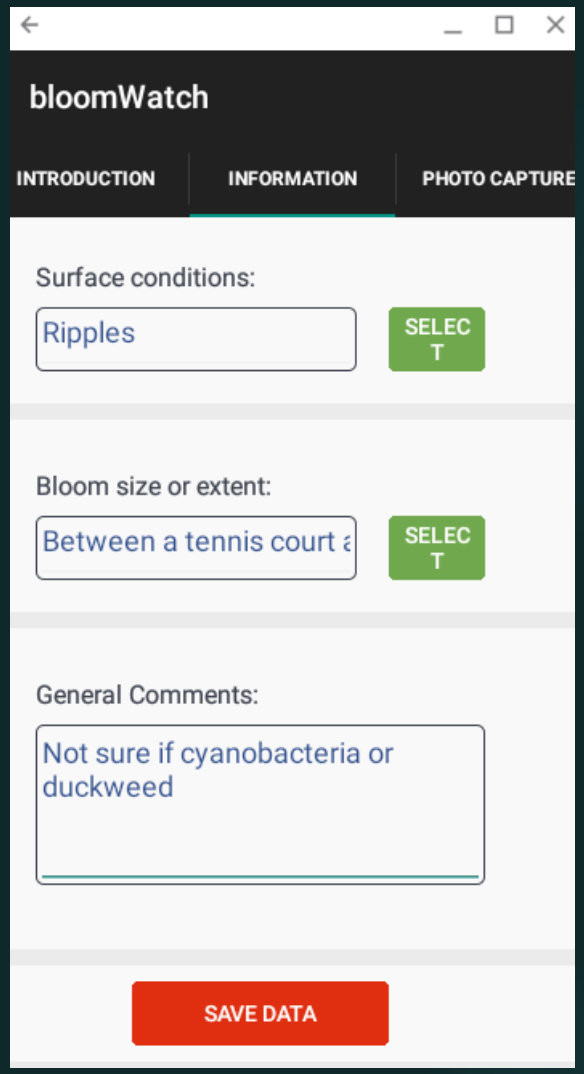


Video training clip to be installed

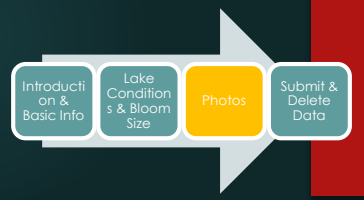
Lake Conditions & Bloom Size Screen

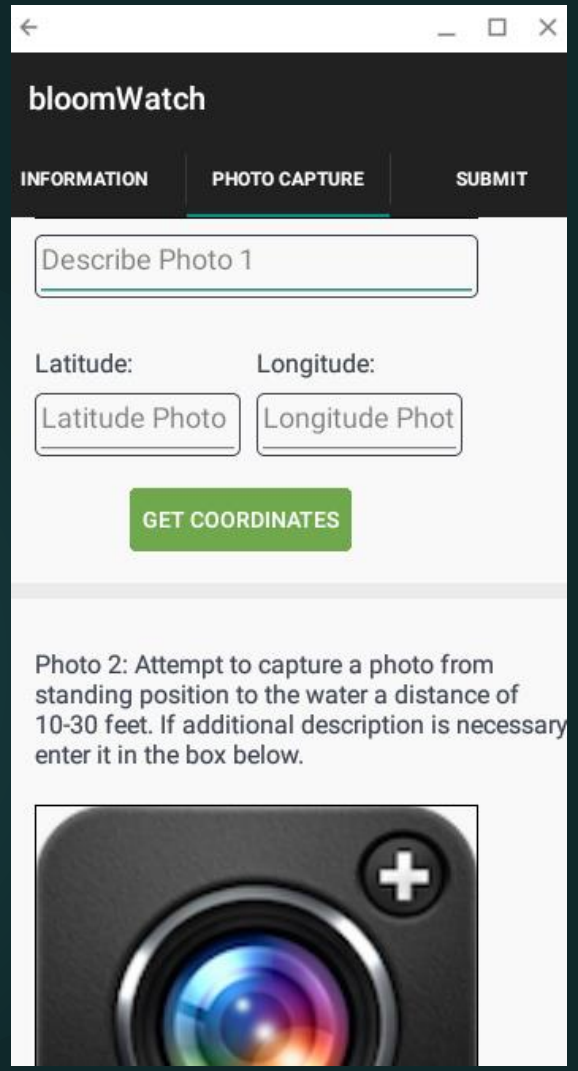


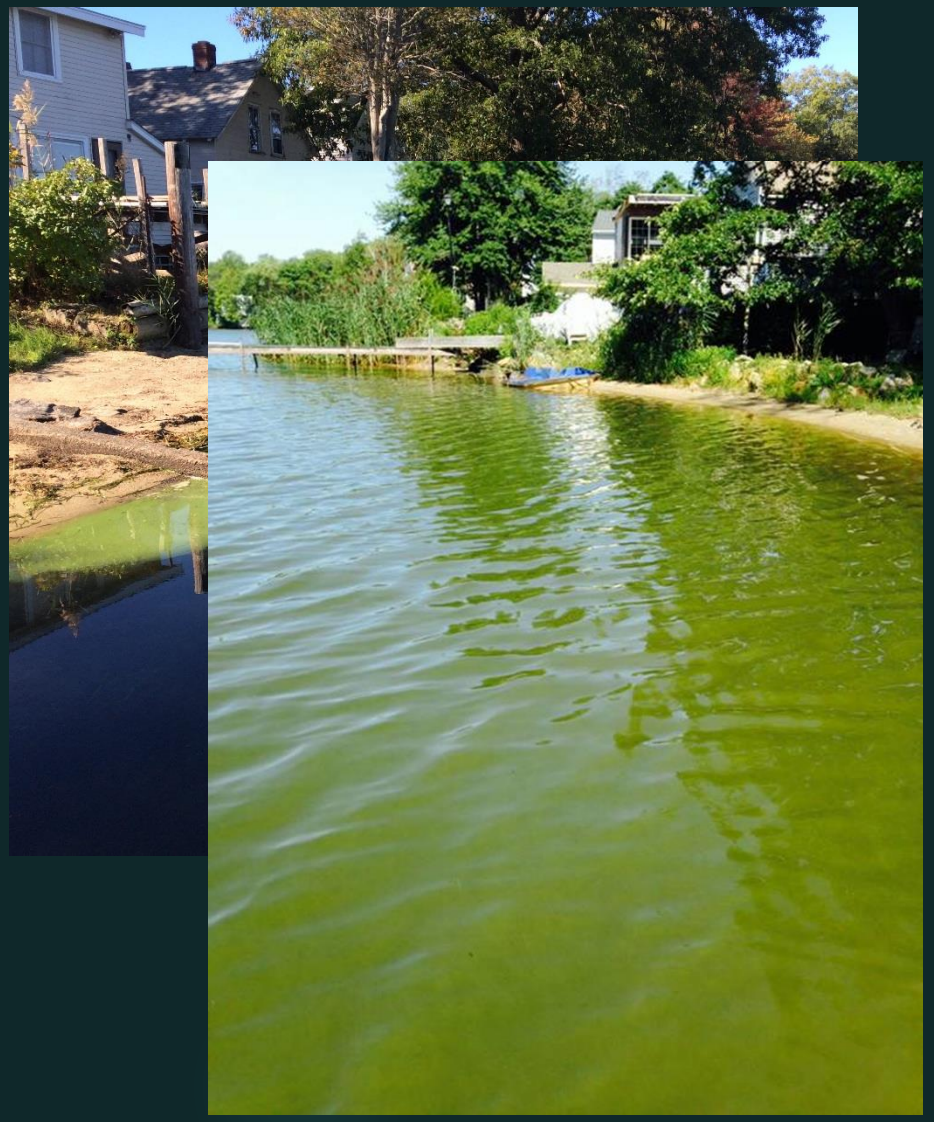




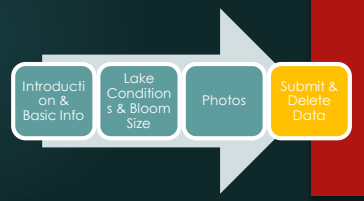
Photos Screen



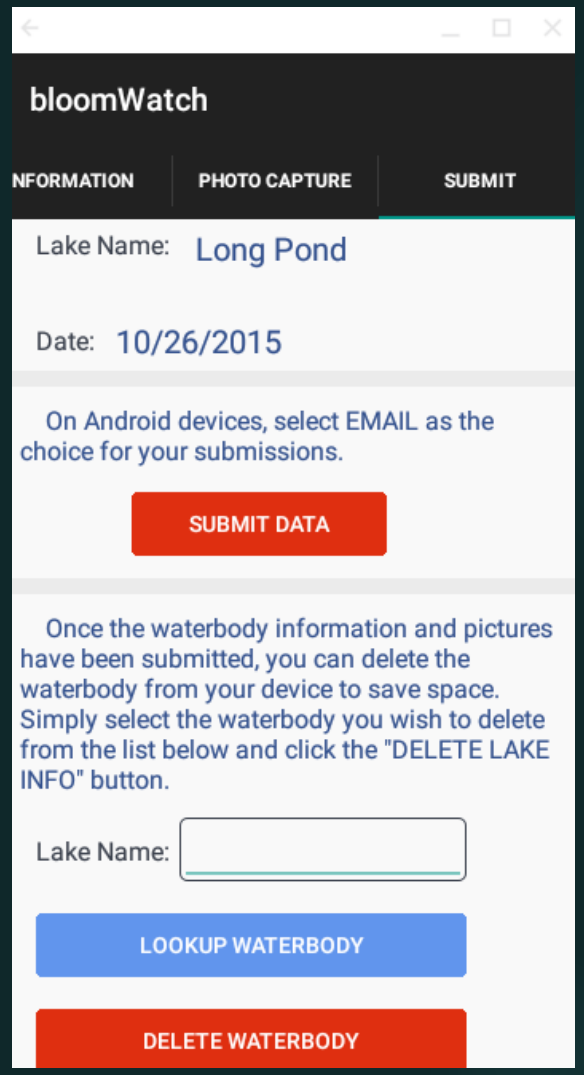




Submit & Delete Data Screen



- Shoreline/areal coverage of bloom
- Close proximity photo (5-10m out)
- Macro photo if possible
- Float test pic?
- Hope to add video training clip
  - 4 photo example and possible examples of look alikes (i.e. pollen)
- Should be available to all by June



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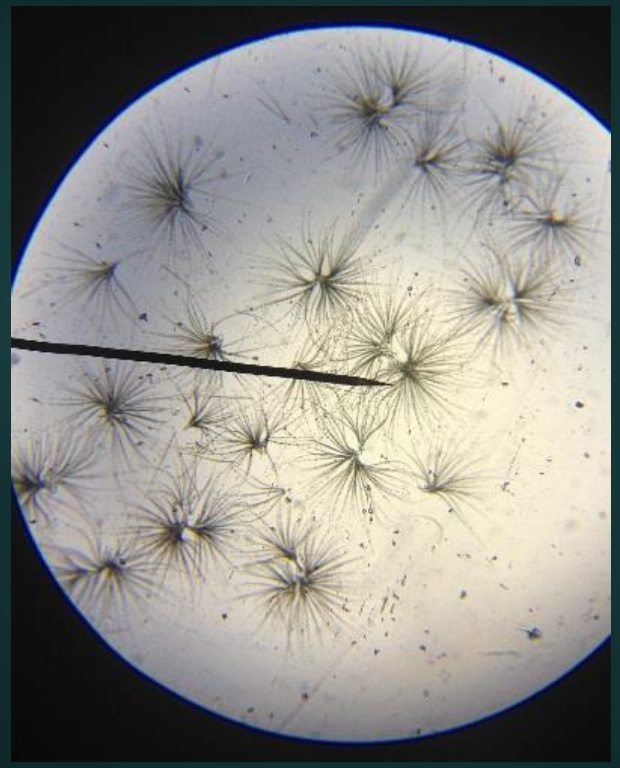
Legend

- Project Headquarters
- Observations
- Project Data

CyanoScope



Established to determine the occurrence and distribution of cyanobacteria genus/species across the region (mapping of potentially toxin producing waterbodies)

- ORD NHEERL Ideation Grant
- Citizen Science
- Low cost tools
- Sample collection/separation Protocol
- Non-temporally based
- Image capture protocol
- Image based database
- Public domain data

Sampling Design

On-Shore

- BOH/Beach Programs
- 1 meter IT sample or net tow
- CyanoScope Kit

In-Lake

- Lake associations, state WQ folks, BOH, beach programs
- 3 meter IT sample or net tow
- CyanoScope kit

Designed to complement currently existing programs

Cyanoscope Kit

Approximately $640 with digital optics

CORNING
Cover Glass
Thomas
100's

Image Capture Procedure

1. Make sure the "**locations**" function is turned on. If you google "Android Camera Turn Location On" or "iphone Turn Location On" you will find information on how to do this. Here are a couple of links.
    a. http://www.androidcentral.com/how-change-your-location-settings-android
    b. http://www.imore.com/how-to-turn-off-photo-geotagging-protect-privacy-iphone-ipad

2. Once the GPS is on the location information (GPS coordinates) will be stored with the photos. **NOTE:** *This will only work when you are outside.*

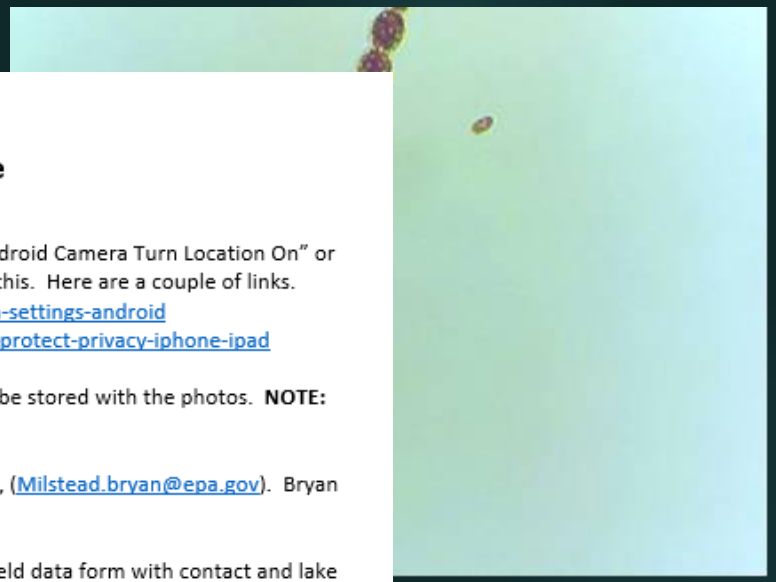
3. Test the camera by taking a picture outside and sending it to Bryan, (Milstead.bryan@epa.gov). Bryan will notify you on whether the GPS is working.

4. When you arrive at the lake/waterbody, fill in the top part of the field data form with contact and lake location information filled out. Then, take a photo of the field form. This needs to be your first image.

5. Now you can take photos of (***follow the steps for cyanobacteria images as outlined in Phytoplankton Sampling and Processing Procedure***). Other photos can also be submitted, including photos of the lake, surface scums or blooms, station locations, sampling efforts, etc.

6. When you get back to the lab, download the photos and send good sharp images to Bryan and to Dr. Haney (Jim.Haney@unh.edu).

7. Information on where the photos were taken can be put in the message. So that Bryan can find these photos easily, the subject line must contain the single word: "**cyanophotos**".



iNaturalist.org

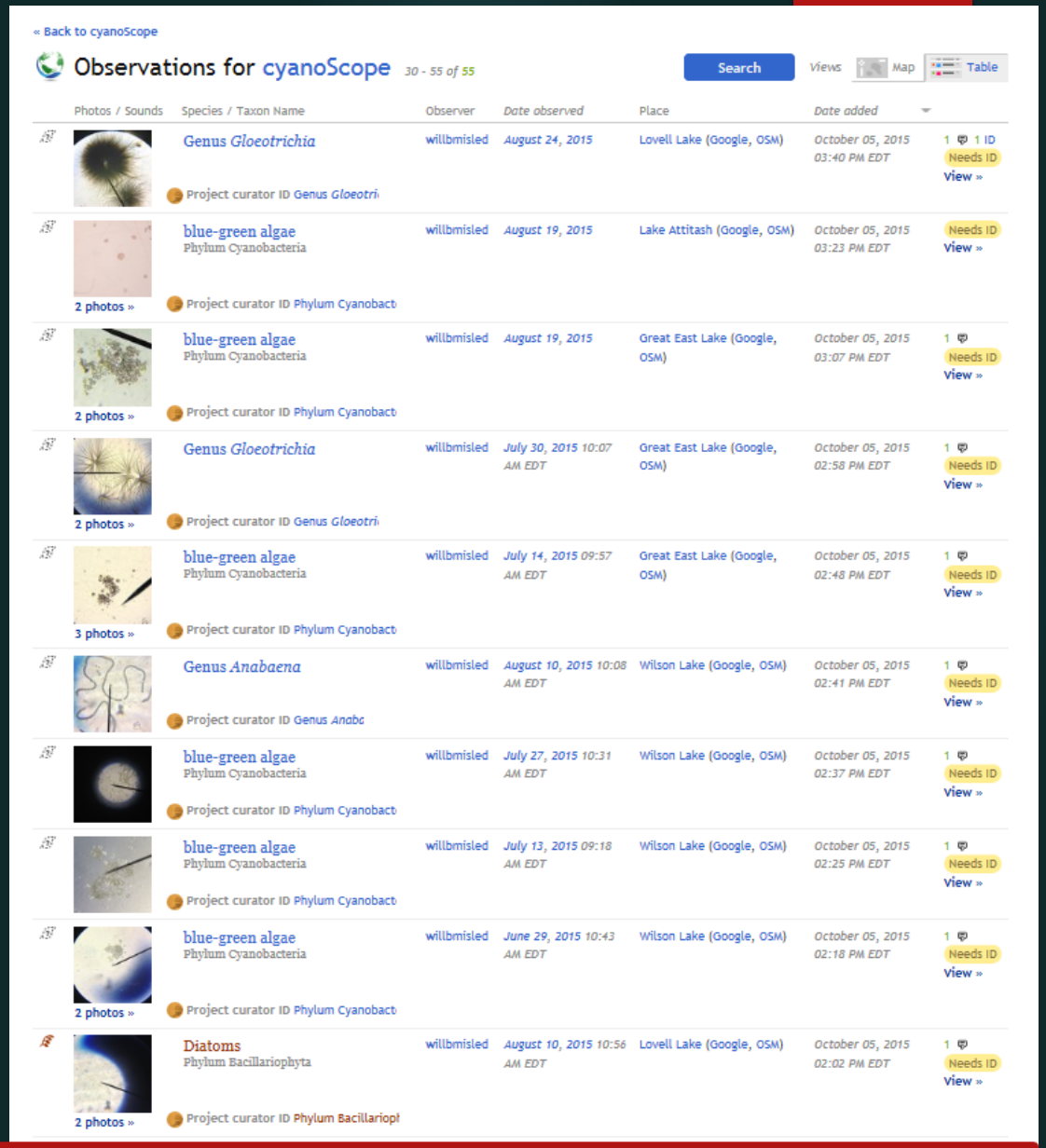
1 Record your observations

2 Share with fellow naturalists

3 Discuss your findings

Contribute to Science

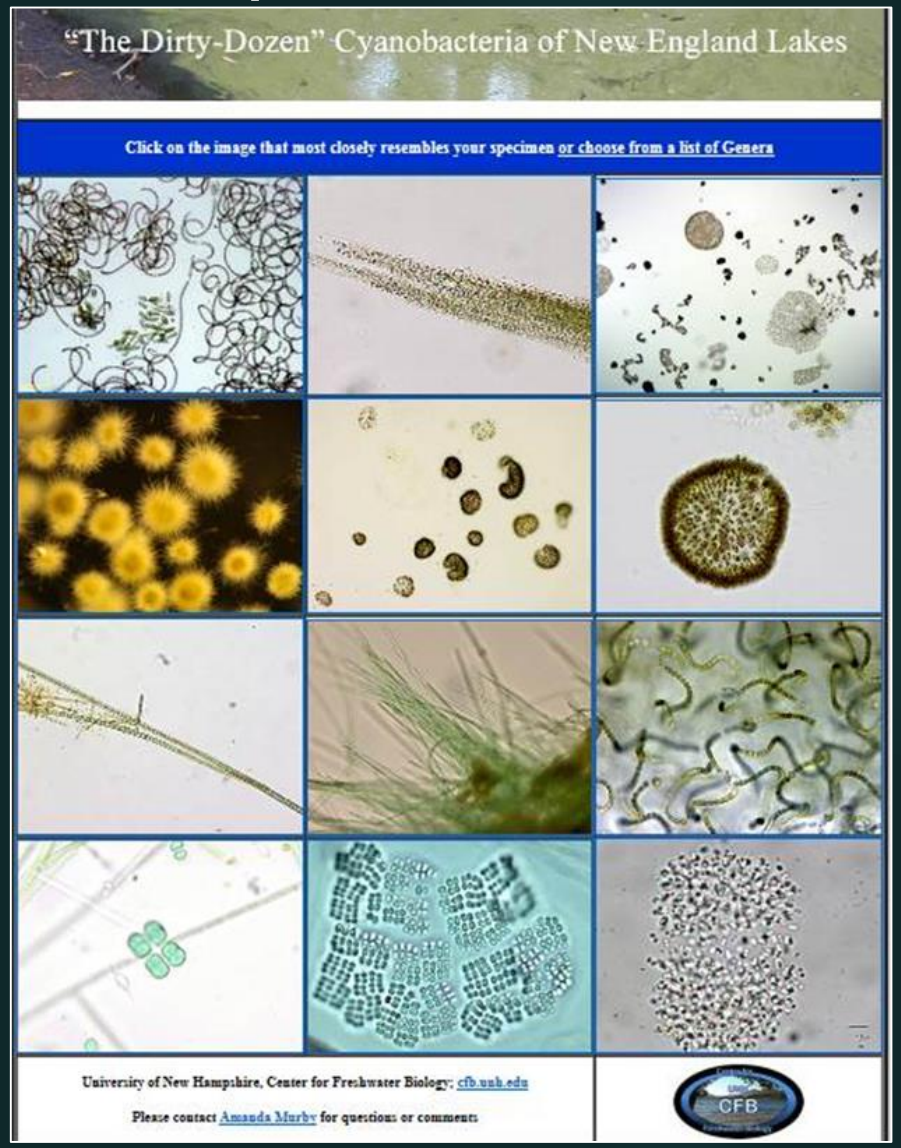
Every observation can contribute to biodiversity science, from the rarest butterfly to the most common backyard weed. We share your findings with scientific data repositories like the Global Biodiversity Information Facility to help scientists find and use your data. All you have to do is observe.



Wiggins, A. and He, Y. (2016). Community-based Data Validation Practices in Citizen Science, In *Proceedings of the 19th conference on Computer-supported Cooperative Work and Social Computing (CSCW)*, February 27-March 2, San Francisco, CA.

Bloom watch/CyanoScope component

- Low Budget, readily available tools
- Simplistic data collection and transfer
- Highly informative data
- Universally available

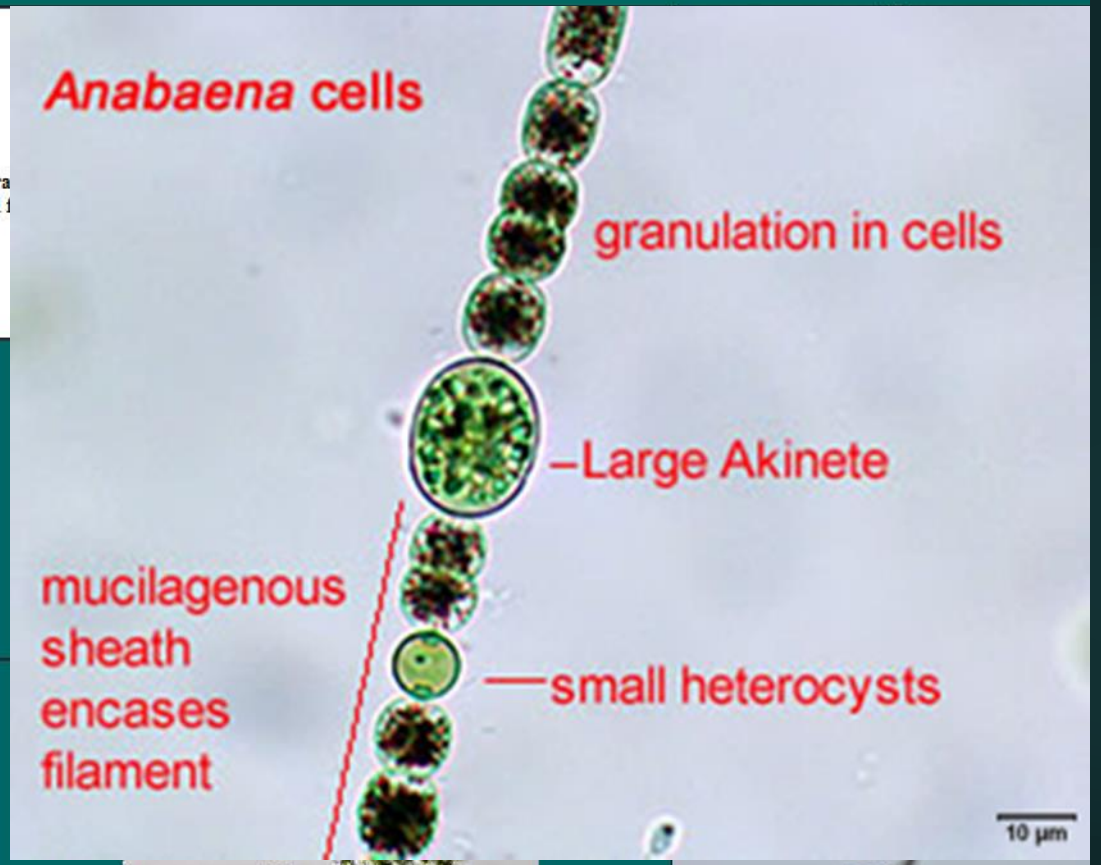


http://cfb.unh.edu/CyanoKey/indexCyanoQuickGuide.html

Anabaena / *Anabaenopsis*

General Description

- *Anabaena* cells are usually arranged in filaments or chains and can be stra
- Filaments also have specialized cells called heterocysts and akinetes, used f
- A mucilagenous sheath surrounds the cells of the filament



Home

How to get started!

1. **Join the cyanoScope project on iNaturalist.org** → Create an account and join the project at: www.iNaturalist.org/projects/cyanoscope.
2. **Purchase the collection and microscopy kit on www.cyanoScope.org** → The kit includes: Portable microscope and supplies, an adapter to connect a smartphone or PC to the microscope, plankton net, and a cyanobacteria concentrator.
3. **Get Training** → Check our website, www.cyanoscope.org, for training materials and information on upcoming sessions.

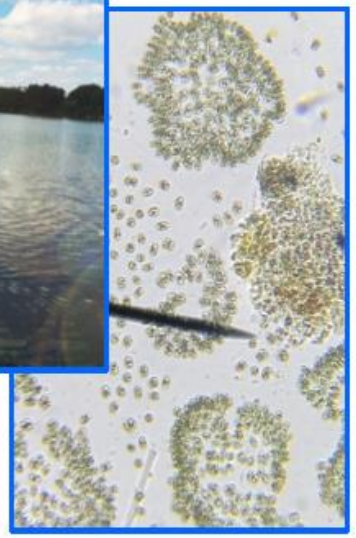
What is cyanoScope?

cyanoScope uses modern technologies and social media platforms to learn more about cyanobacteria.

By participating you will be helping scientists and water resource managers gain information on the occurrence and timing of cyanobacteria in lakes, ponds, and reservoirs.

Goals

- Public Outreach — Work with stakeholders to increase awareness of cyanobacteria.
- Crowdsourcing Identification — Use social media platforms to effectively and efficiently identify the cyanobacteria present in our waters.
- Scientific — Map the spatial distribution and seasonal occurrence of cyanobacteria in lakes, ponds, and reservoirs.



Participation Details

Collect

- Collect a water sample from your favorite lake or pond as you learned in training.
- Prepare your microscope slides.
- Now — hunt for cyanobacteria!

Report

- Upload your photos to the cyanoScope project on iNaturalist.
- Include basic information about where and when the sample was collected.

Interact

- Now the iNaturalist community can help identify the cyanobacteria.
- Get involved! Ask questions, submit your identifications, and learn about organisms that have been found near you.

CyanoMonitoring

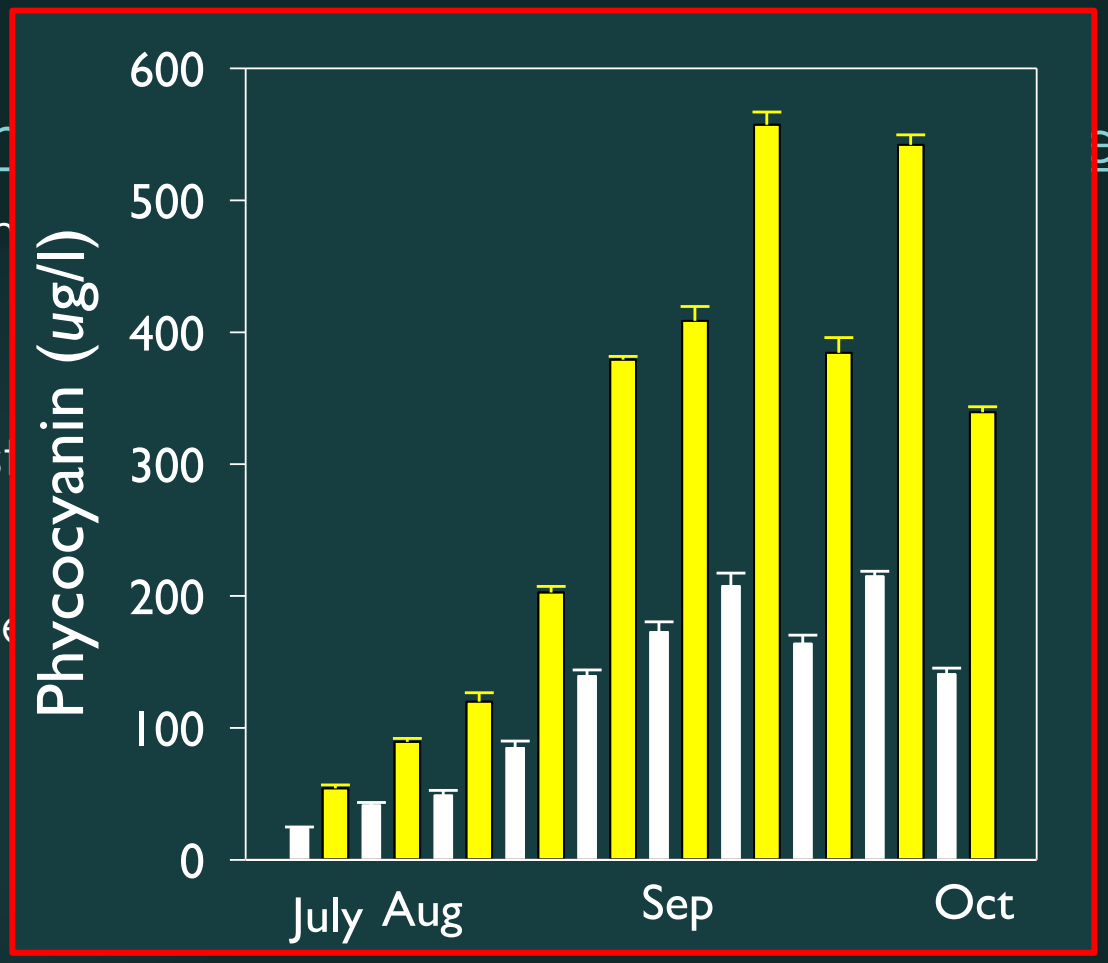
Tracking of cyanobacteria concentrations within regional waterbodies in combination with efforts to forecast bloom occurrences, determine risk, and assess waterbody/human health vulnerability to toxic cyanobacteria.

- Standardized methods
- App development
- Specialized low cost “Tool Kits”
- Centralized Data
- Data Visualization tools

Sampling Methodology

Cyanomonitorin ecasting

- On-lake and/or sh sampling
- Weekly sampling
- Integrated Tube st
- BFC separation
- PC/CHLa fluorome measurement
- Microscopy
- Sample freezing



Center for
UNH
Freshwater Biology
LIM-TEX

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UNH
Freshwater Biology
LIM-TEX
06/10/2015

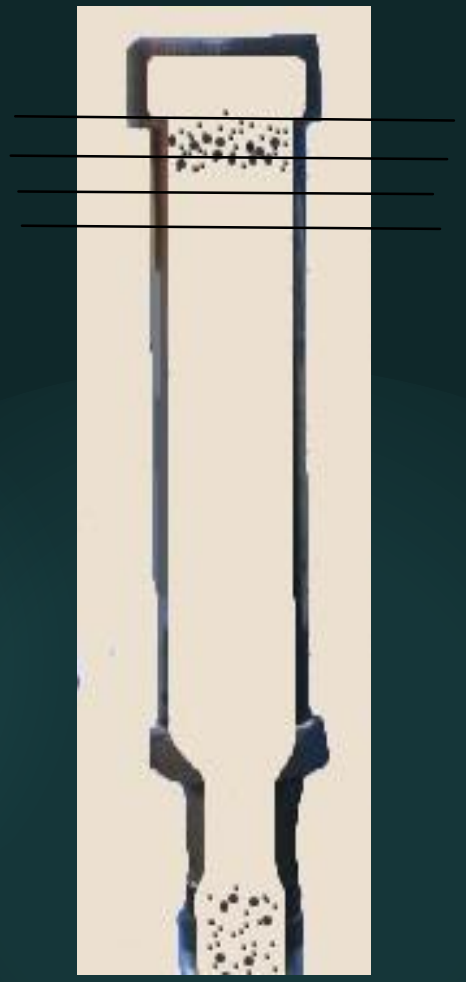
06/10/2015

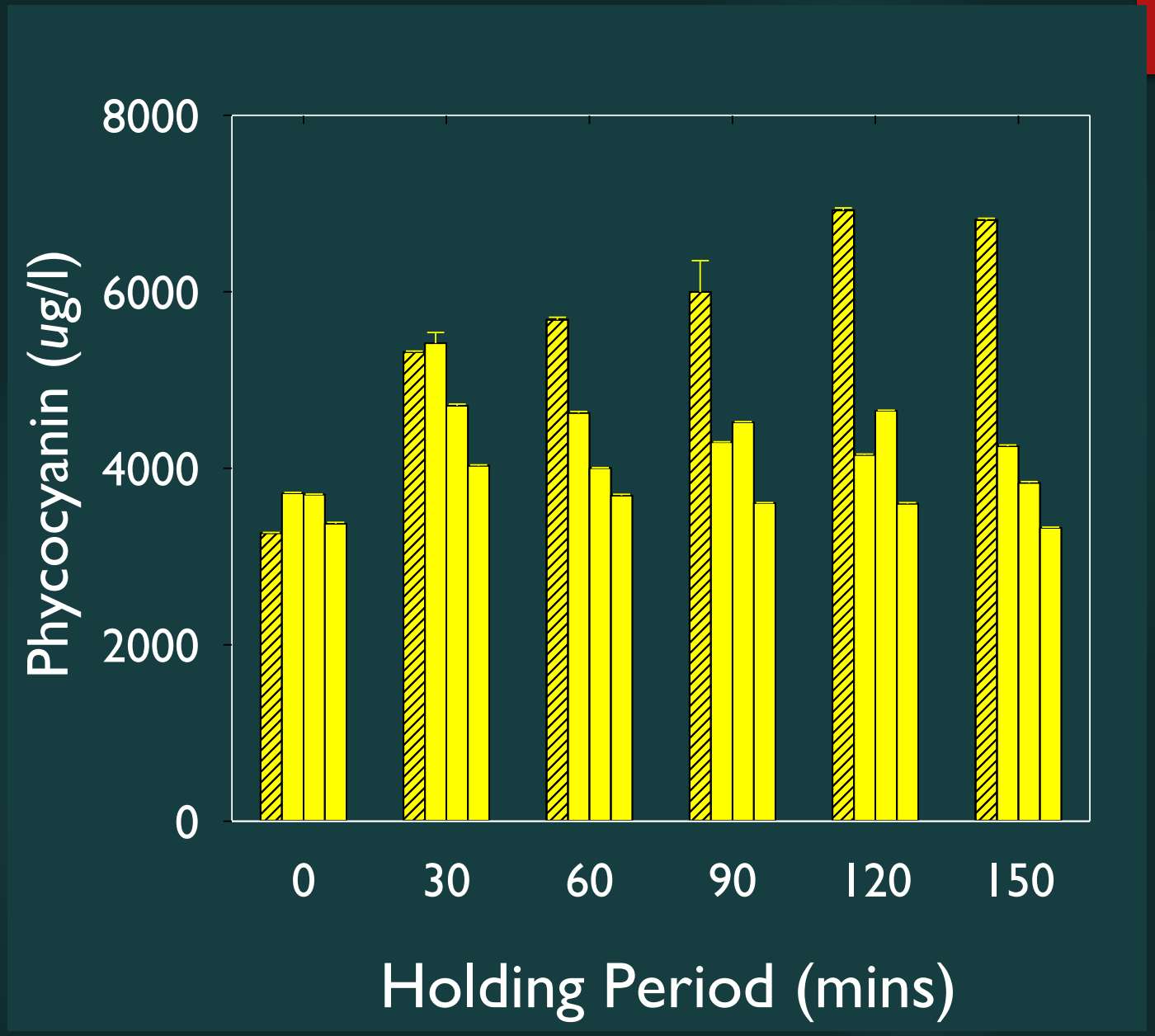
06/10/2015

06/10/2015

Leland

Process of Respiration/Buoyancy



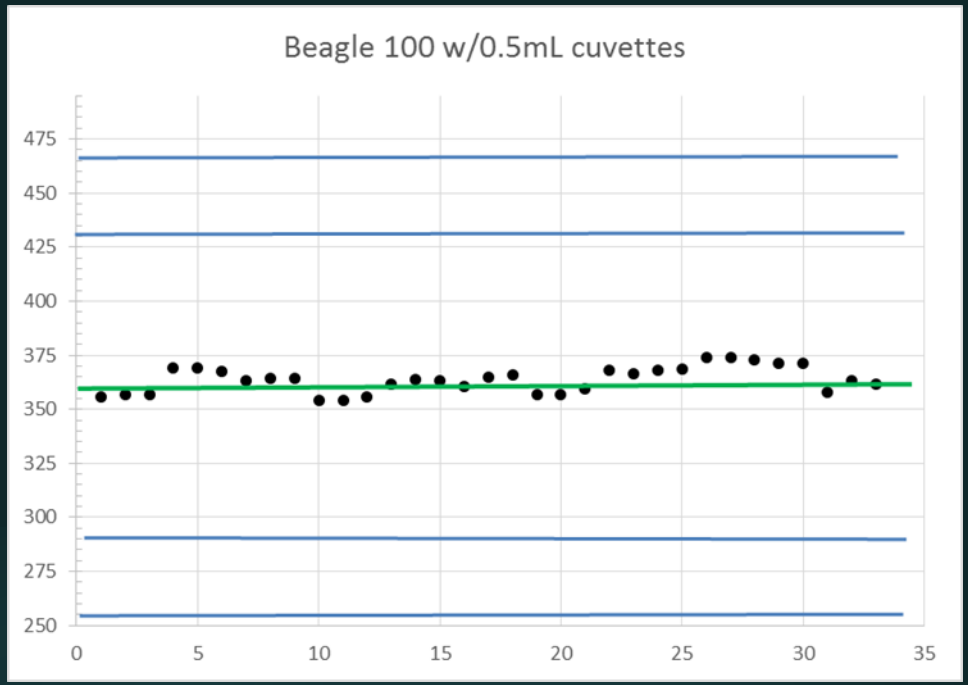


Patent Pending

Handheld 2-Channel Flourometer

- Chlorophyll a
  - .25 - 2,500 ppb
- Phycocyanin (improving MDL)
  - 10 - 100,000 ppb
- Other 2-chnl handhelds available
- $1,500 - $2,500
- Stnds approx. $200 each (2 month shelf)
- Rhodamine solid state standards (2 year shelf)

Meter Madness!



	Connecticut Federation of lakes			Manchester Water Works			Massachusetts DEP			EPA Atlantic Ecology Division		
	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Prim100L	367.88	366.56	367.88	368.38	373.75	373.75	372.83	371.06	371.06	357.9	363.24	361.46
Prim50L	175.21	173.9	175.21	169.78	169.78	169.78	172.63	172.63	172.63	172.92	172.92	171.14
Prim25L	78.82	80.14	78.82	80.2	78.4	80.2	74.8	76.6	74.8	78.4	78.4	78.4
Prim12.5	25.88	25.88	25.88	24.4	29.8	28	24.4	24.4	26.2	29.8	31.6	31.6
Prim6.25	15.29	13.97	15.29	15.4	13.6	15.4	11.8	10	10	13.6	13.6	15.4
Prim3.12	11.32	11.32	11.32	2.8	8.2	6.4	8.2	4.6	2.8	4.6	4.6	2.8
Prim1.56	23.23	21.91	21.91	15.4	15.4	15.4	37	35.2	37	11.8	10	11.8
Prim0.78	1	2.28	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Secondary Standard Log Sheet			
Instrument Serial #:			
Production Lot #:			
Set #:		Rhodamine volume: 0.5mL / 0.2mL	
		Phycocyanin	Chlorophyll
Concentration (ug/L)		0.0015 µ/L	0.15 µ/L
Channel		RFU 1 Hi	RFU 2 Hi
DATE	Temp. °C		

SAP-SOPs-QAPP

Phytoplankton Sampling and

Materials:

Plankton tow net, 50um pore size, 15cm opening, 50 cm
Plankton separation unit (approx. 60 ml total volume)
3 ounce spray bottle filled with deionized water
Transfer pipette
Plastic microscope slides
Plastic cover slips
Richter Optica F1 Elementary Microscope
Carson GoMicro Smart Phone Adapter
Smart Phone (Apple iPhone 5 or smaller)
Plastic gloves (to protect skin from toxin irritation)
Chest waders-if collecting samples by wading off the sho
Life Jacket

Phytoplankton Collection Protocol

Collecting Net Plankton Sample: A sample for cyanobact
tow using the Students Plankton net (50 micron mesh), l
hand over hand, at a rate of 0.5 m/s. (If sampling from sh
tow by throwing the net out a distance of approximately
and pulling the net to shore.) Gently rinse down the side
entire net plankton sample should fill the cod end (appro

Figure 1. Collection of net plankton sample using a vertical tow.

Figure 2. Further reduction of net plan sample volume.

FluoroQuik Field SOP

Calibration

The calibration of your instrument should have been completed in a laboratory settin
conditions with certified primary calibrators for chlorophyll and phycocyanin. Your
also have been programmed through the calibration steps to read out in *parts per b*
sure this step has been completed properly or your measurements will not be comp
Calibrations with primary calibrators should only need to be completed once prior t
the sampling season, or if you experience substantial drift during the course of you
Your secondary rhodamine dye calibrators should be read and values recorded immedi
calibration is complete; this will be your baseline for all future measurements. The se
should also be routinely measured prior to any field or laboratory analysis activi
calibrators provide a quick check to determine if your instrument is in working
instrument is experiencing any "drift" due to changes in internal components or other
this check process each time prior to the beginning of your sampling day and record
field notebook/log sheet so that any changes in instrument conditions can be tracked

Blanking the Fluorometer

1. Turn on your fluorometer.
2. Record date and ambient temperature in secondary standards log sheet (kee
fluorometer, and secondary standards together).
3. Fill a new unused cuvette with de-ionized water and insert the blank into the
appropriately orienting the cap and being careful not to leave residue/fingerp
cuvette.
4. Select "**Measure**" from main menu screen **[Measure/Calibrate/Info/Data]**.
5. Select "**1 Phycocyanin**" from the **[1 Phycocyanin/2 Chlorophyll/Next/Return**
6. Select "**Blank**" from the **[1 Phycocyanin/Blank/Measure/Return]** – *the screen*
"measuring" but you will not see a number. When the instrument is done "bla
return to the **[1 Phycocyanin/ Blank/Measure/Return]** *screen.*
7. Select "**Return**" – This will take you back to the **[1 Phycocyanin/2 Chlorophyll**
screen.
8. Select "**2 Chlorophyll**" from the **[1 Phycocyanin/2 Chlorophyll/Next/Return]**
9. Select "**Blank**" from the **[2 Chlorophyll/Blank/Measure/Return]** screen. The
"measuring" as before and again you will not see a number. When finished it
[2 Chlorophyll/ Blank/Measure/Return] screen.
10. Select "**Return**" to take you to the initial **[Measure/Calibrate/Info/Data]** scre
11. You have now completed "blanking" your instrument.

Image Capture Procedure

1. Make sure the "**locations**" function is turned on. If you google "An
"iphone Turn Location On" you will find information on how to do t
   a. http://www.androidcentral.com/how-change-your-location
   b. http://www.imore.com/how-to-turn-off-photo-geotagging-
2. Once the GPS is on the location information (GPS coordinates) will
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4. When you arrive at the lake/waterbody, fill in the top part of the fi
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6. When you get back to the lab, download the photos and send good
Haney (Jim.Haney@unh.edu).
7. Information on where the photos were taken can be put in the mes
photos easily, the subject line must contain the single word: "cyano

Cyanobacteria Monitoring & Bloom Watch Program
Final Rev
FINAL SAP DATE
Page 1 of 12

Sampling and Analysis Plan (SAP)
For the

CYANOBACTERIA & BLOOM WATCH MONITORING PROGRAM

By the

U.S. ENVIRONMENTAL PROTECTION AGENCY
ECOLOGY MONITORING TEAM
ECOSYSTEMS ASSESSMENT UNIT
OFFICE OF ENVIRONMENTAL MEASUREMENT & EVALUATION
NEW ENGLAND REGIONAL LABORATORY
11 TECHNOLOGY DRIVE
NORTH CHELMSFORD, MASSACHUSETTS 01863

Title and Approval Page:

_____ Date: _____
Hilary Snook, Ecology Monitoring Team Project Lead

_____ Date: _____
Diane Switzer, EMT Team Leader

_____ Date: _____
Dr. Jim Haney, University of New Hampshire

_____ Date: _____
Tracy Lizotte, Connecticut Dept. of Energy & Environmental Protection

_____ Date: _____
Linda Bacon, Maine Department of Environmental Protection

_____ Date: _____
Sonya Carlson, New Hampshire Department of Environmental Services

_____ Date: _____
Angela Shambaugh, Vermont Department of Environmental Conservation

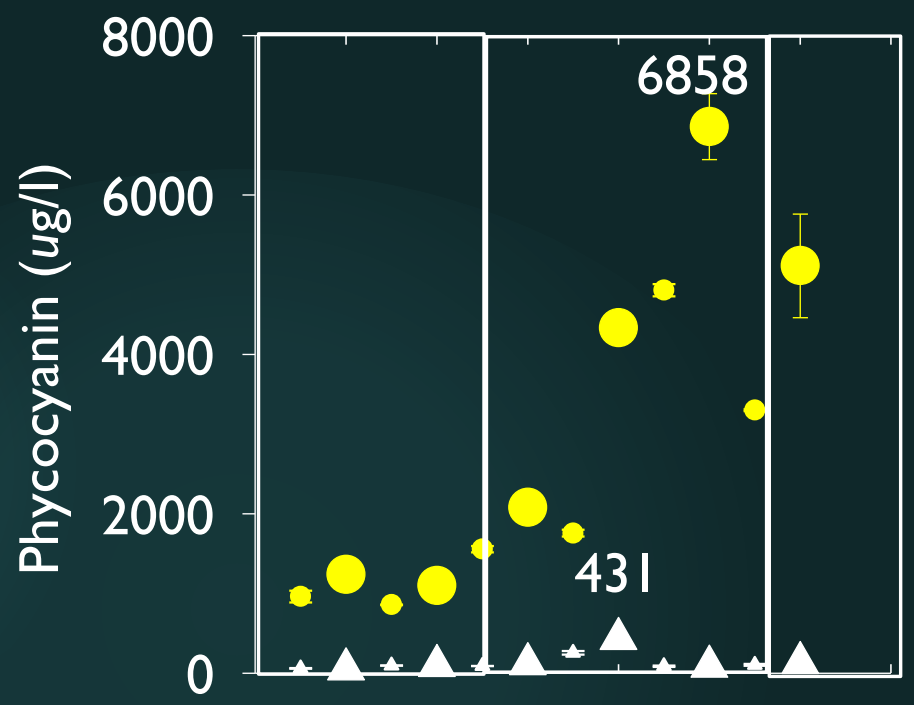
_____ Date: _____
Linda Green, University of Rhode Island

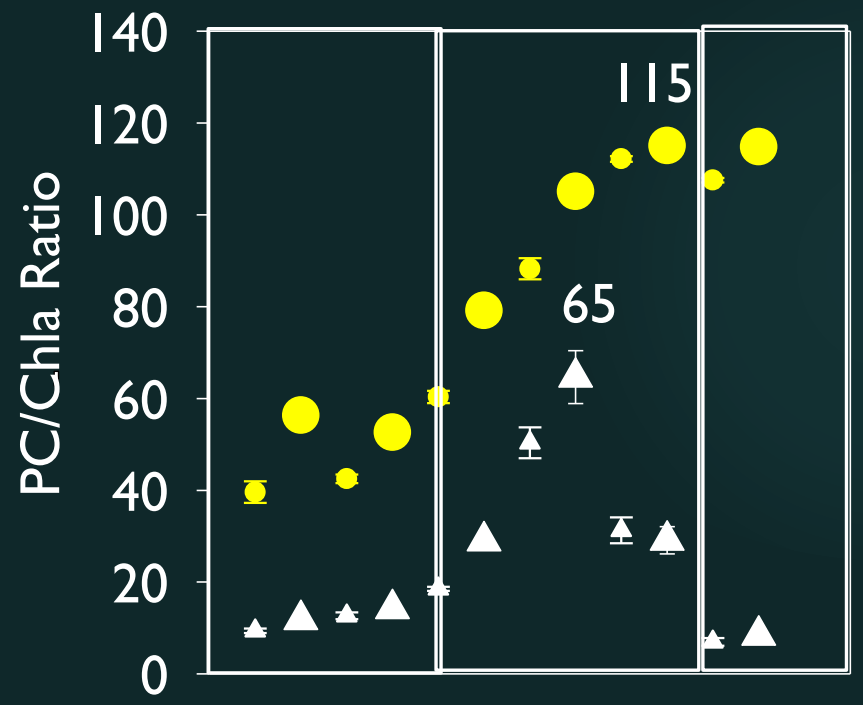
_____ Date: _____
Bryan Dore, Charles River Watershed Association

_____ Date: _____
Katrina Kipp, Manager, Ecosystems Assessment Unit

Comparison of Lake Attitash and Lake Cochichewick

PC/Chla Ratio can identify similarities and differences





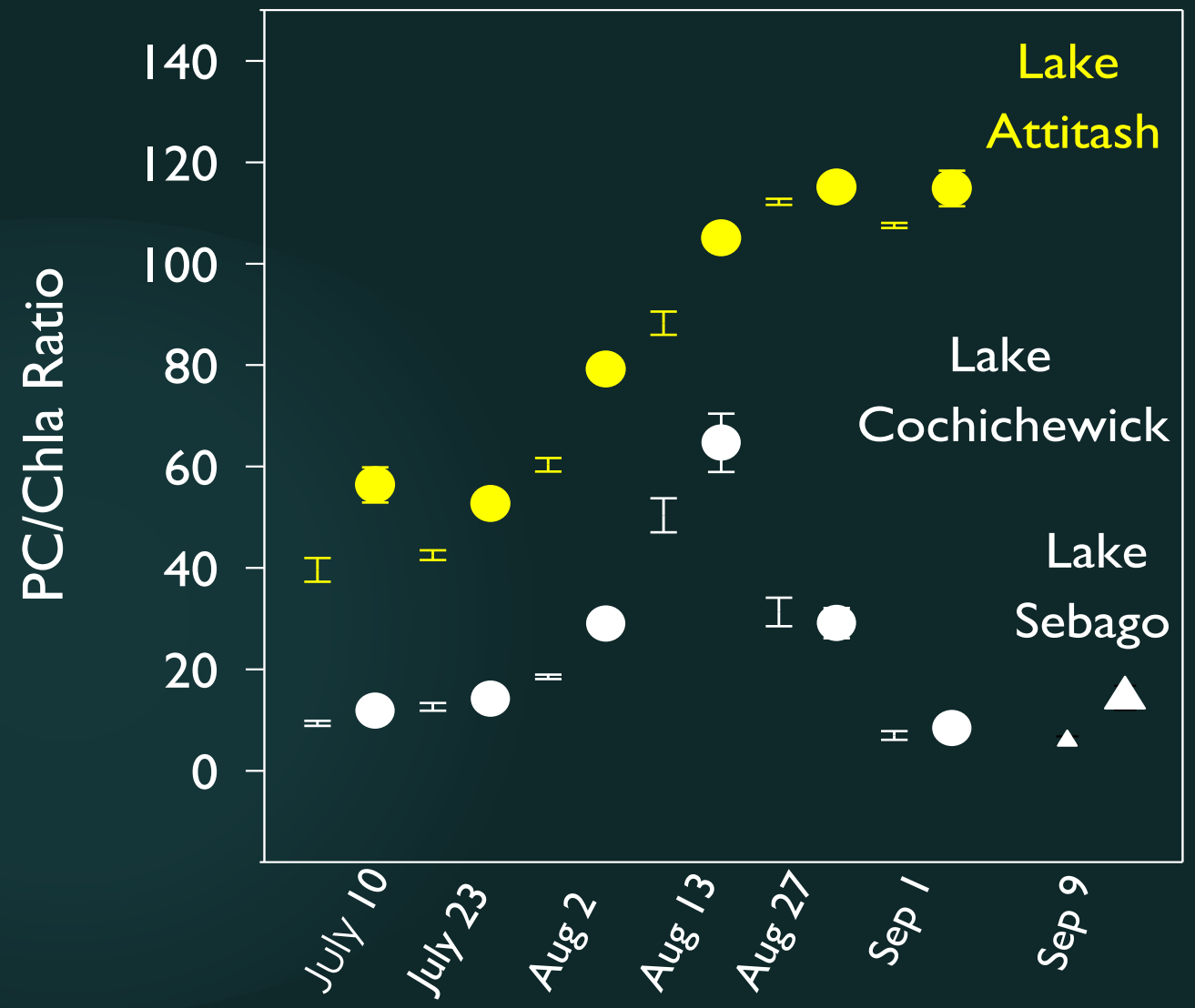
Lake Attitash

Lake Cochichewick

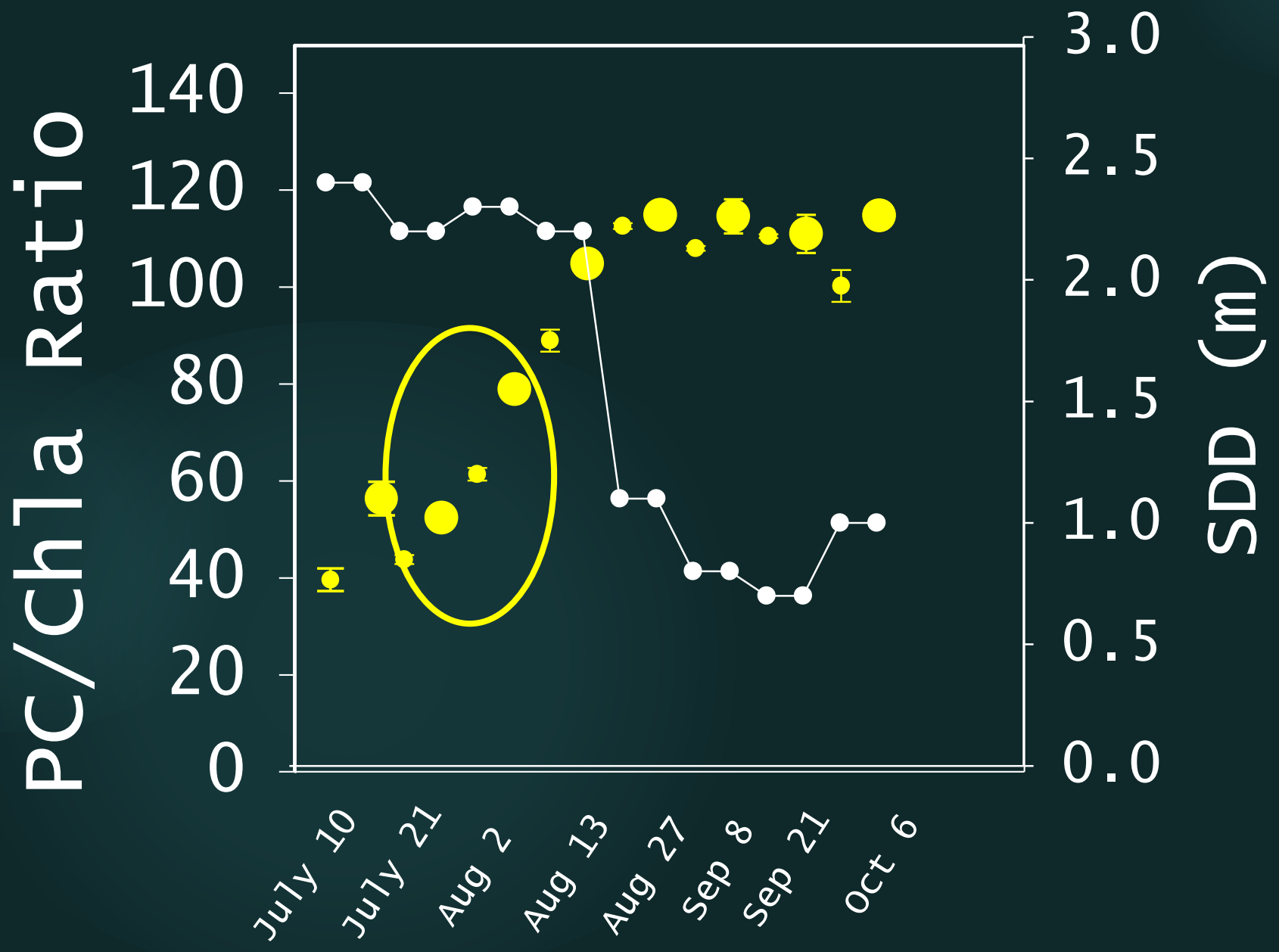
What happens across multiple study sites ??

Summer 2015

Lake Attitash, Lake Cochichewick and Lake Sebago

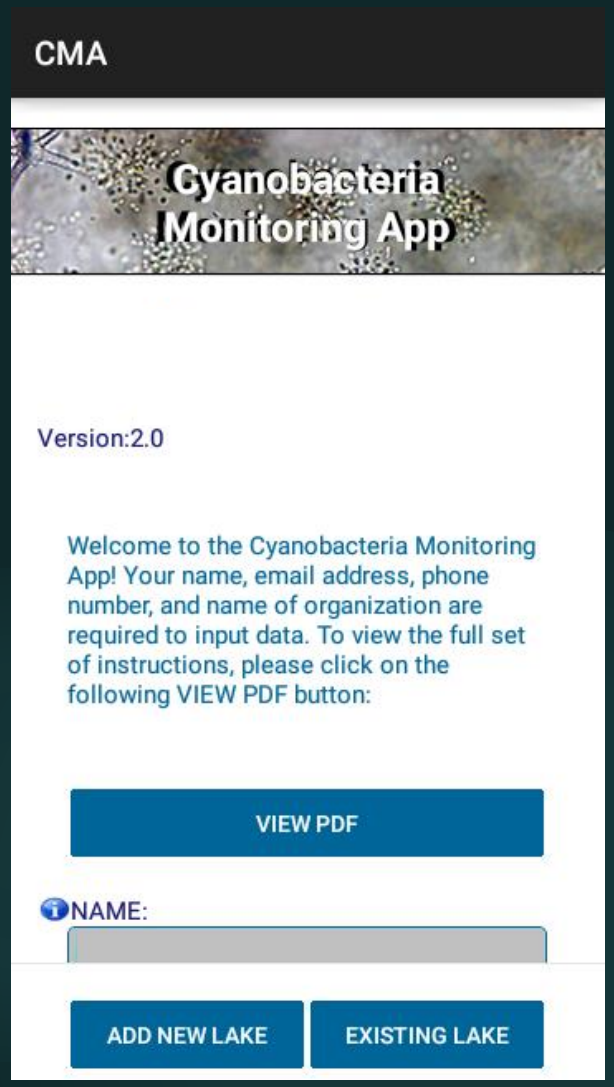


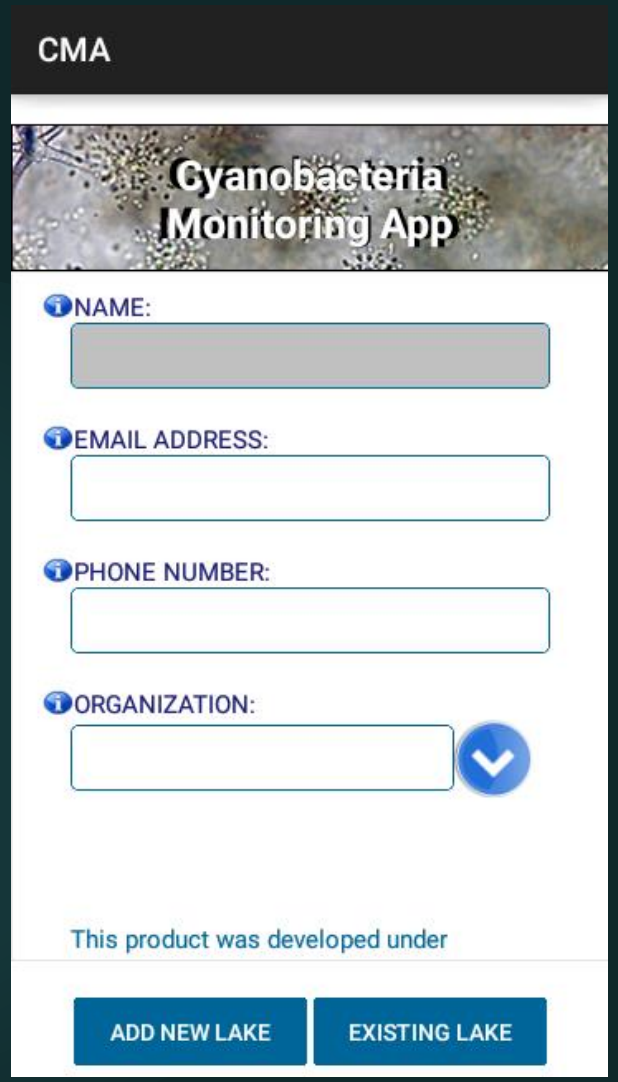
Leland



PC/Chla Ratio precedes Secchi Disk depth and is most sensitive parameter

Leland

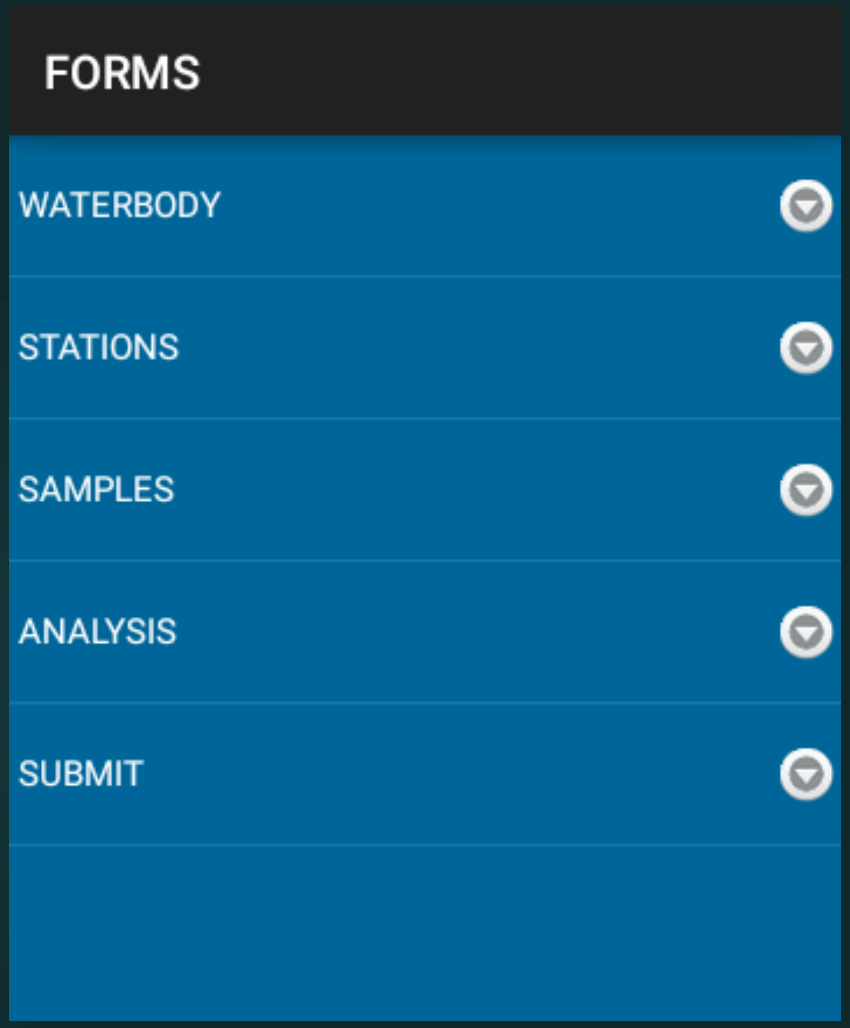

CMA
Cyanobacteria Monitoring App
Version:2.0
Welcome to the Cyanobacteria Monitoring App! Your name, email address, phone number, and name of organization are required to input data. To view the full set of instructions, please click on the following VIEW PDF button:
VIEW PDF
NAME:
ADD NEW LAKE
EXISTING LAKE


CMA
Cyanobacteria Monitoring App
NAME:
EMAIL ADDRESS:
PHONE NUMBER:
ORGANIZATION:
This product was developed under
ADD NEW LAKE
EXISTING LAKE

Thomas
100's

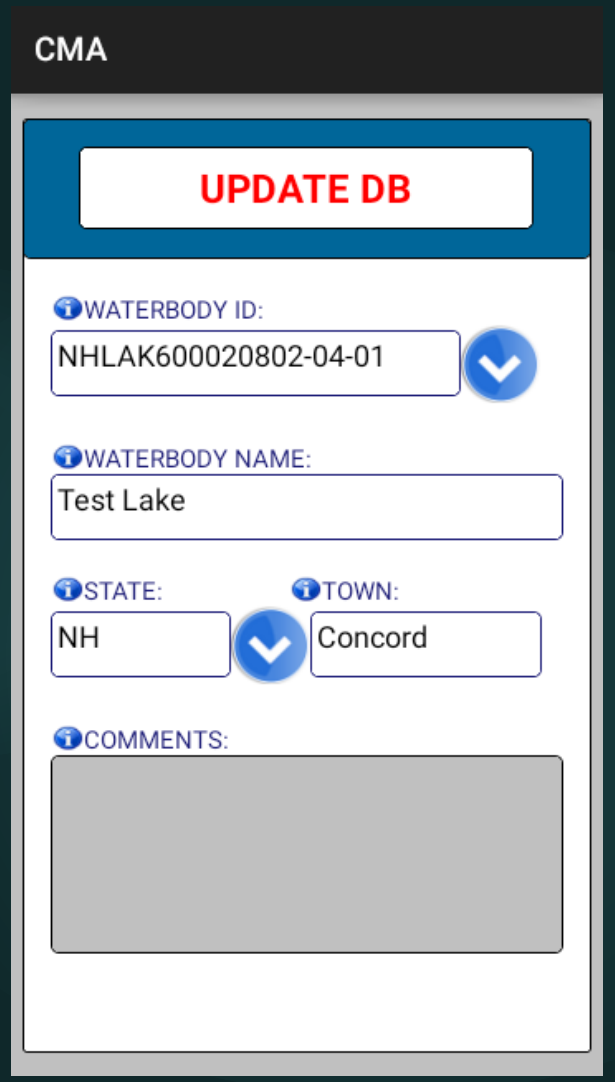
Cyanobacteria Monitoring App

Data Forms Overview Screen

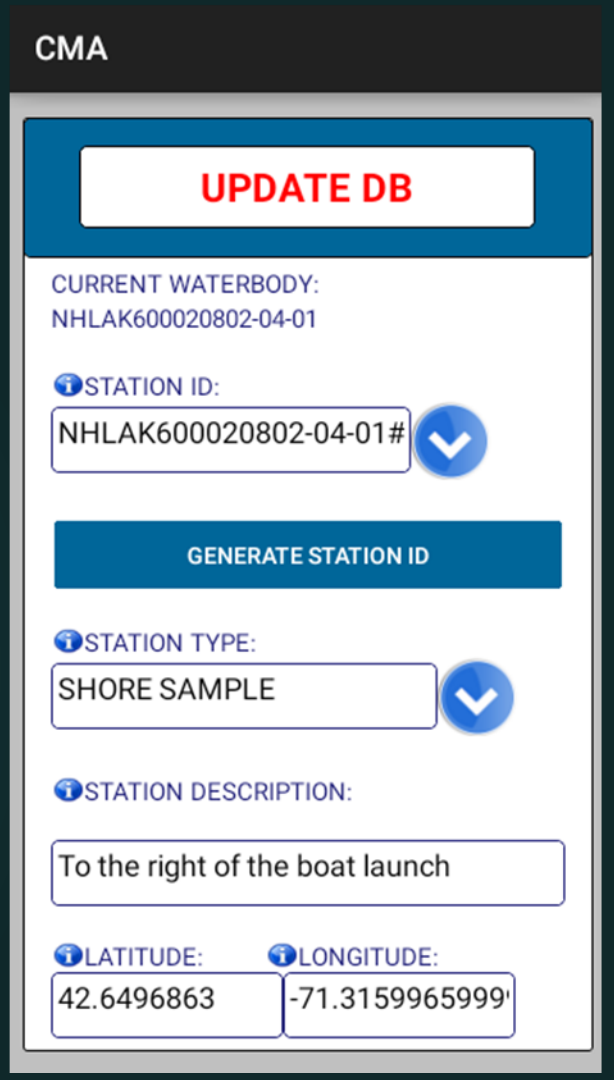


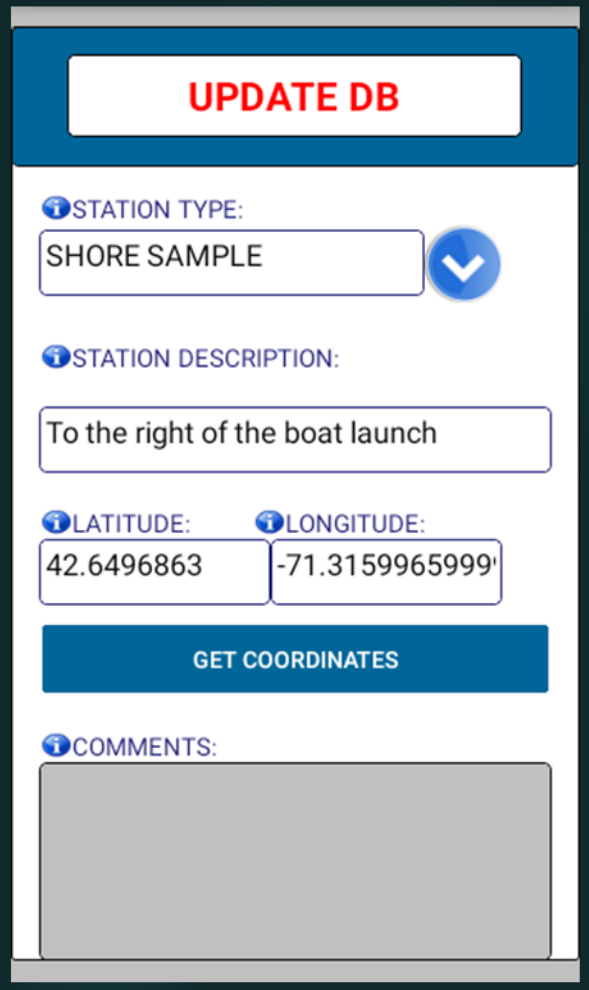
Cyanobacteria Monitoring App

Waterbody



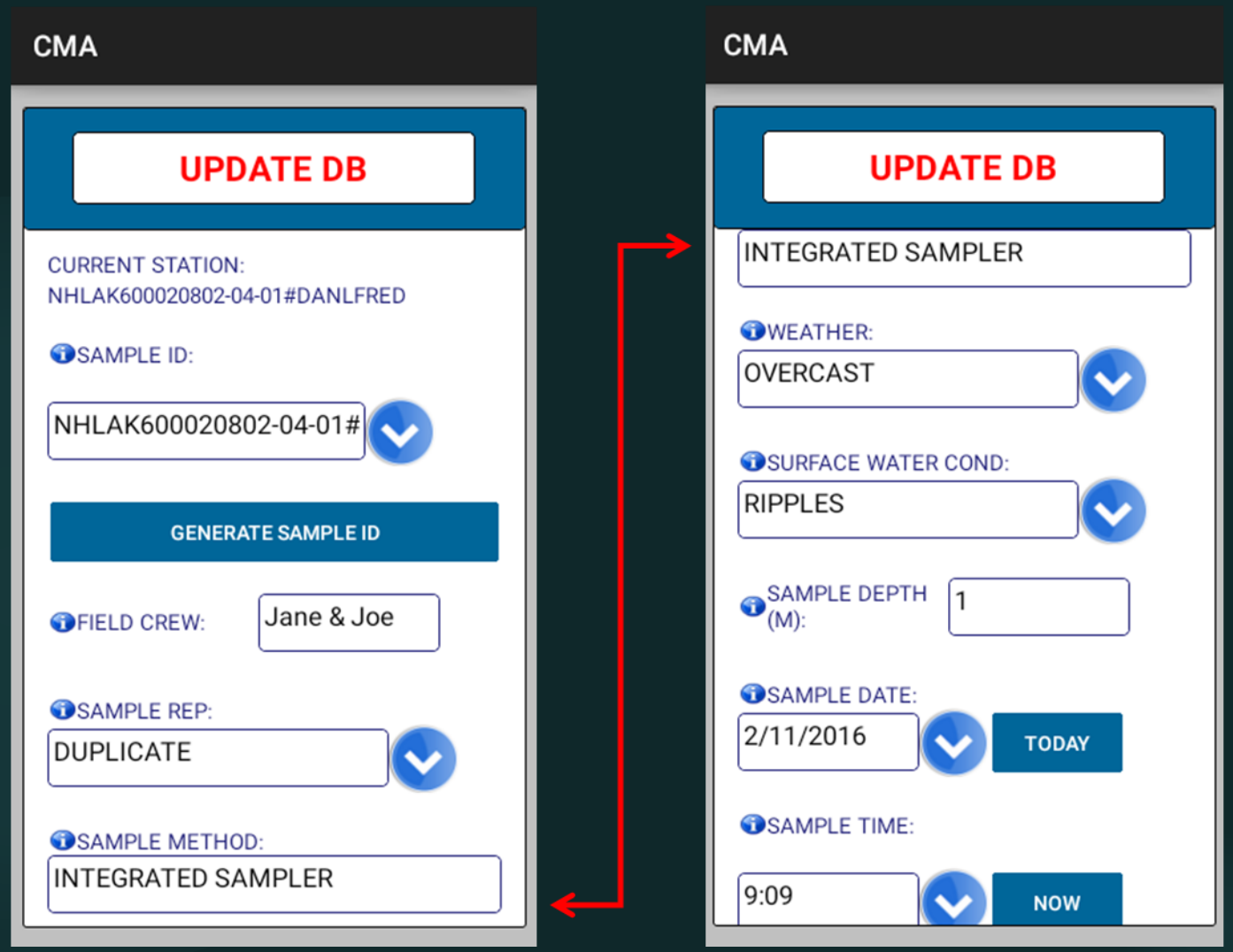
Station Screen





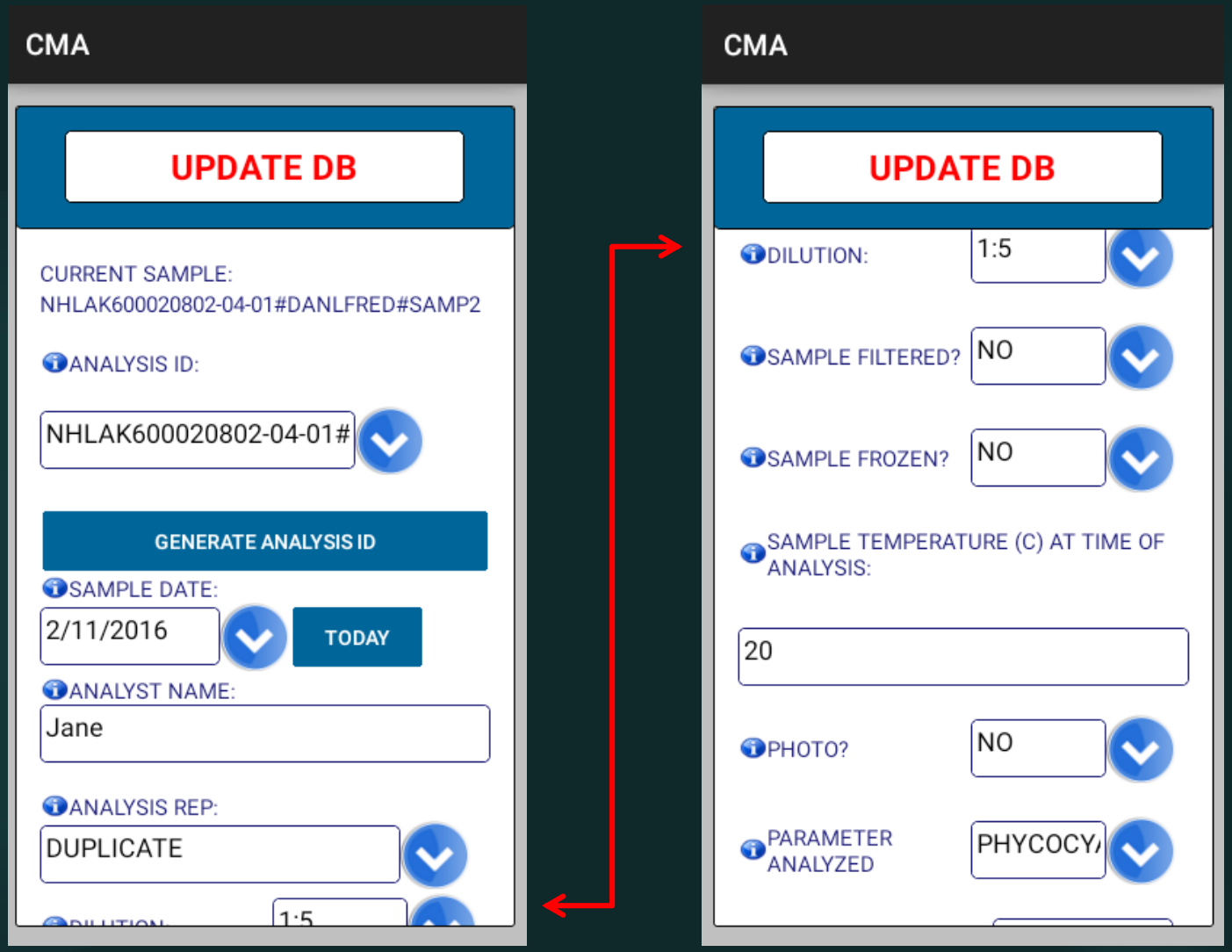
Cyanobacteria Monitoring App

Sample Screen

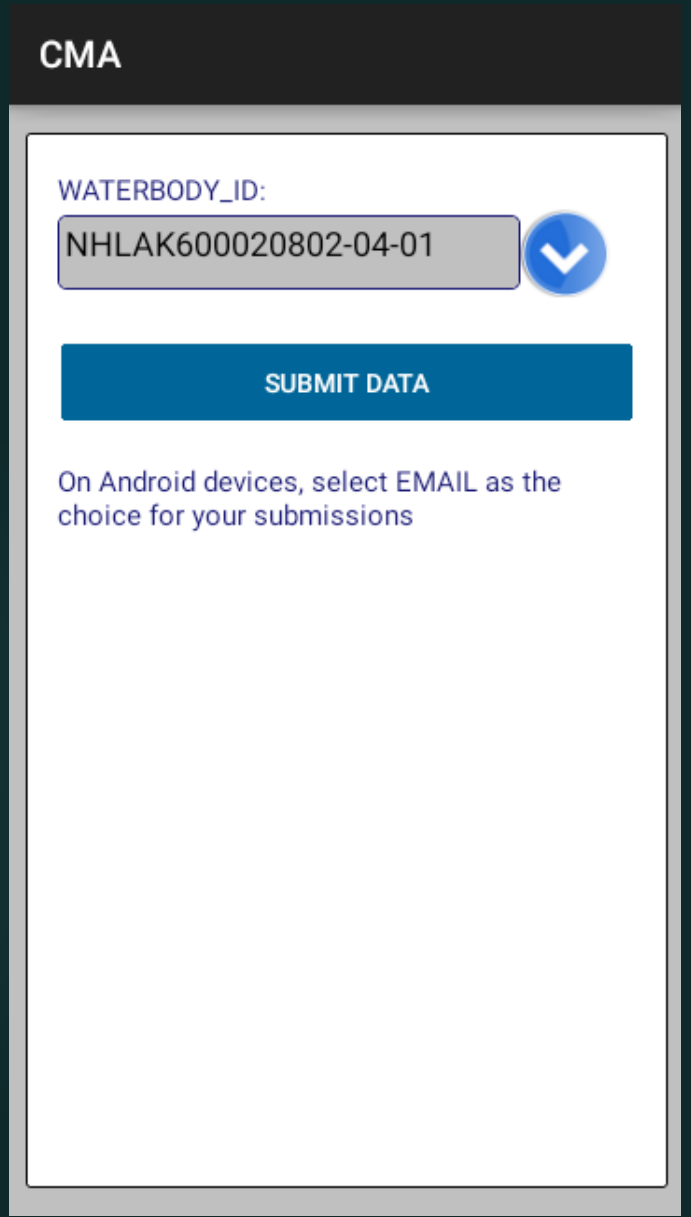


Cyanobacteria Monitoring App

Analysis Screen



Cyanobacteria Monitoring App



Summary & Next Steps

- BloomWatchers
  - Smartphone Apps (training provided on the app)
  - CitSci submission (WIP)
- CyanoScope
  - App/microscope image training
  - iNaturalist submission
- Monitoring folks
  - Training on methods/kits (video clip & Mobile lab)
  - Forecasting (WIP, Pilot)
- Outreach
  - Mobile lab training roadshow?

ELISA testing possibly this summer in relation to PC/Chla work

Forecasting pilot project slated for this summer

QUESTIONS?

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617-918-8670