NOAA Phytoplankton Monitoring Network- A Citizen Scientist Program

Promoting a better understanding of Harmful Algal Blooms by way of volunteer monitoring.

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Marine Biotoxins Program

NOAA Marine Biotoxins Program

http://www.chbr.noaa.gov/pmn/

PHYTOPLANKTON MONITORING NETWORK

NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

Science Serving Coastal Communities

To educate the public on harmful algal blooms (HABs) while expanding the knowledge of phytoplankton that exist in coastal waters through research based monitoring.

- **PMN started in 2001 as part of Marine Biotoxins Program in Charleston, SC**
- **Over 100 active sites in 12 coastal states**

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To educate the public on harmful algal blooms (HABs) while expanding the knowledge of phytoplankton that exist in coastal waters through research based monitoring.

Train citizen scientists to:

- *Collect samples on weekly or bi-weekly basis*
- *Identify potential harmful algal species*

NOAA scientists can then:

- *analyze water samples for HAB toxins*
- *Together can identify temporal and geographic HAB trends*

Monitoring Benefits

- **Allows for an 'early warning system'**
  - e.g. Can close shellfish beds and help prevent people getting sick

- Monitor and maintain an extended survey area along coastal waters throughout the year
- Create a comprehensive list of harmful algal species inhabiting coastal marine waters (establish baseline)
- Identify general trends where HABs are more likely to occur
- Promote an increased awareness and education to the public on HABs
- Create a working relationship between volunteers and researchers

MARINE BIOTOXINS PROGRAM SERVICES

Phytoplankton Monitoring Network

Network that monitors distribution of harmful algae and species composition throughout the coastal US. Observations and samples by PMN monitors assist the research that is being done by the Marine Biotoxins program.

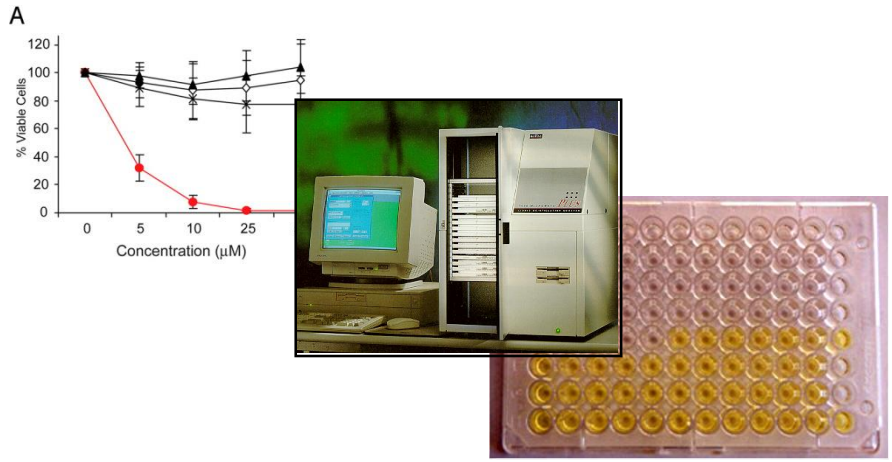
Analytical Response Team

Provides rapid and accurate identification and quantification of marine algal toxins in suspected harmful algal blooms, marine animal mortality events and human poisonings.

Identification and analytical capability provides support for management agencies that can then make timely and informed decisions impacting stakeholders involved in coastal wildlife, human health and commerce.

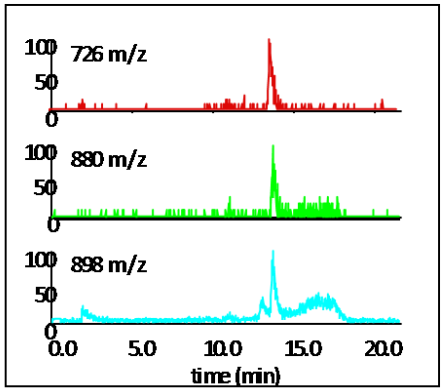
Two-tiered approach to analysis

Rapid screen by toxin class-specific assays



- ELISA
- Receptor Binding Assay
- Protein Phosphatase Inhibition Assay
- Neuroblastoma 2A Assay
- General Cytotoxicity Assay
- Surface Plasmon Resonance
- Radioimmunoassay

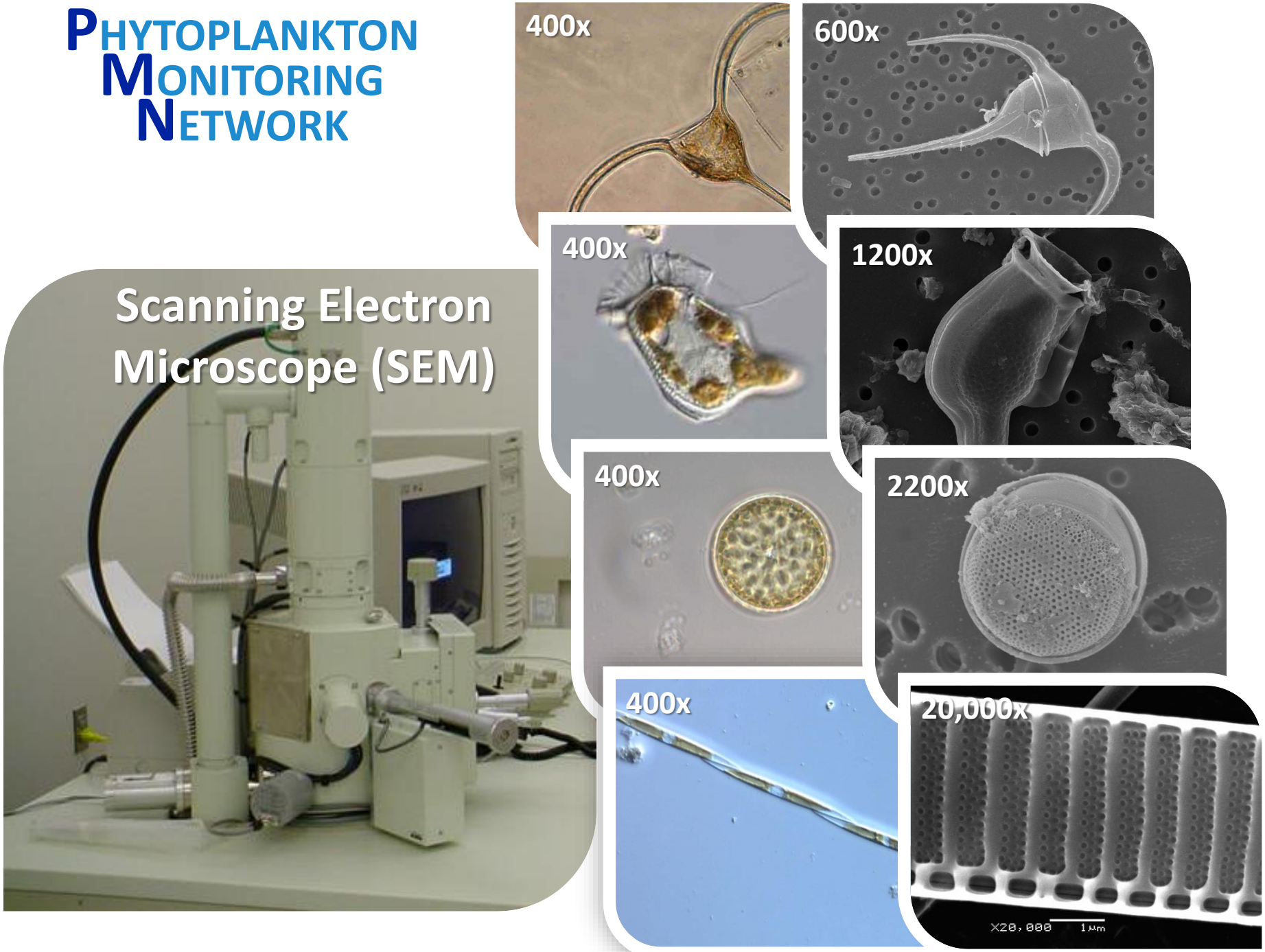
Confirmation of toxin by analytical methods



Liquid chromatography-tandem mass spectrometry (LC-MS/MS)

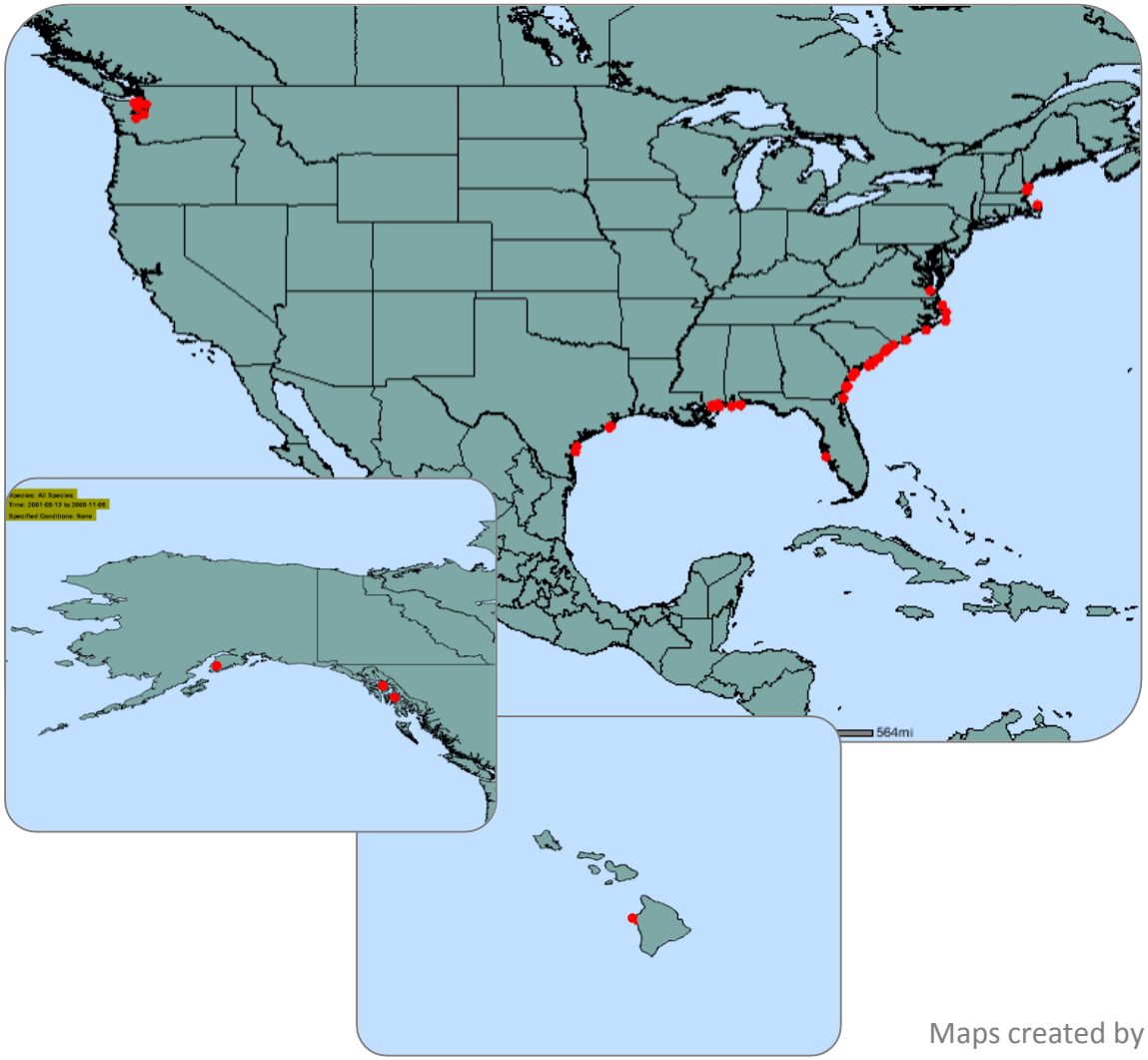
- Brevetoxins (PbTx)
- Saxitoxins (STX)
- Ciguatoxins (CTX)
- Domoic Acid (DA)
- Microcystins
- Okadaic Acid (OA)
- Azaspiracids (AZA)

PHYTOPLANKTON MONITORING NETWORK



Phytoplankton Monitoring Network

Bloom Events from 2001 – 2014



Volunteer Reported Blooms > 200

Non-harmful species > 150

Potentially toxic species = 37

Confirmed toxic events = 12

- 9 Domoic Acid
  - Texas = 3
  - Mississippi = 2
  - North Carolina = 2
  - Alaska=2
- 1 Okadaic Acid
  - Texas
- 2 Saxitoxin
  - Alaska

Maps created by NOAA Coastal Data Development Center (NCDDC)

2015 PMN and EPA

- **Entered into a partnership to create a freshwater citizen science program to monitor CyanoHABs**
  - ***FY15 included a pilot program in EPA Region 5 and Region 8***
- **Used previously established PMN methods with modifications for freshwater habitats.**

Why the PMN?

Problem: Very few government or private institutions have the capacity or capability to monitor thousands of lakes (and reservoirs), from the Great Lakes to small residential lakes annually impacted by HABs.

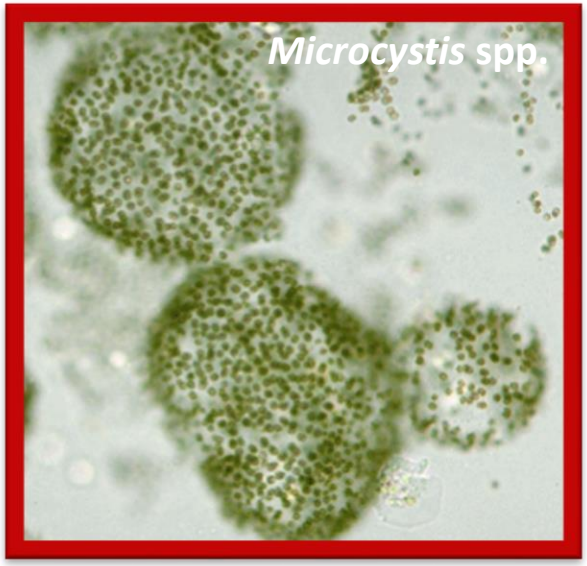
Solution: ***Engage local citizens*** in environmental monitoring of potentially harmful cyanobacteria to aid NOAA & EPA scientists and others in their research.

Toxins and Cyanobacteria

Genus	Toxins produced
Anabaena	Anatoxins, Microcystins, Saxitoxins
Anabaenopsis	Microcystins
Aphanizomenon	Saxitoxins, Cylindrospermopsins
Cylindrospermopsis	Cylindrospermopsins, Saxitoxins
Hapalosiphon	Microcystins
Lyngbya	Aplysiatoxins, Lyngbyatoxin a
Microcystis	Microcystins
Nodularia	Nodularin
Nostoc	Microcystins
Phormidium (Oscillatoria)	Anatoxin
Planktothrix (Oscillatoria)	Anatoxins, Aplysiatoxins, Microcystins, Saxitoxins
Schizothrix	Aplysiatoxins
Trichodesmium	yet to be identified
Umezakia	Cylindrospermopsin

Table credit: Cyanosite http://www-cyanosite.bio.purdue.edu/

5 Target Freshwater Cyanobacteria

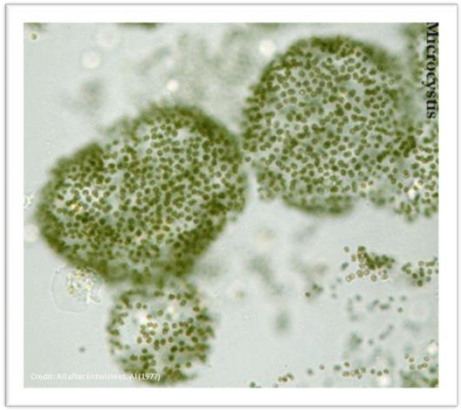


Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring, and management, World Health Organization, 1999

Cyanobacterial Harmful Algal Blooms (cyanoHABs)

SOME species are potentially harmful, and can produce toxins that can impact drinking and recreational waters.

Can affect wildlife, pets and humans



Freshwater Phytoplankton Monitoring Network (PMN)

Promoting a better understanding of Cyano Harmful Algal Blooms by way of volunteer monitoring.

Volunteering

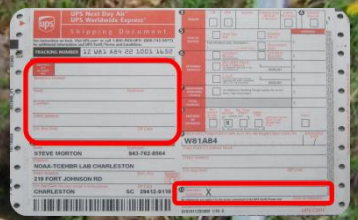
Phytoplankton Monitoring Network

Volunteer Requirements:

1) ***Collect sample*** at least once every two weeks during the sampling season (Ice Out – Ice In)
2) ***Analyze sample*** identifying target algae
3) ***Take*** digital pictures to send into the PMN
4) ***Input*** data into the PMN database
5) ***Send*** sample to PMN when water is visibly green with target species

Volunteer Equipment

Volunteers are loaned all sampling equipment



- Thermometer
- 5 gridded slides
- Cover slips
- 1L & 125 mL bottles
- 30 mL of Lugol's solution for sample preservation
- Pre-paid overnight shipping label and shipping envelopes

*Identification sheets for target species

Volunteer Equipment

SWIFT M10 T digital microscope

- **Provided to Pilot Program participants**
- **Volunteers take digital pictures of suspected target species and send to PMN**
- **Allows for rapid confirmation of tentative ID**
- **Build virtual archive of organisms observed**
- **WiFi capable- Great for public demonstrations**

DATA ENTRY

- **Data entered online for each sample**
  - Whether target spp. found or not
- **No counting of cells**

No= zip, zilch, zero

Yes= 0-65% slide coverage

Elevated = >65% with discoloration

Phytoplankton Monitoring Network
Promoting a better understanding of Harmful Algal Blooms by way of Volunteer Monitoring

HAB SCREENING DATA SHEET

Freshwater Cyanobacteria

FIELD DATA
♦ REQUIRED

Name:

Sampling Site:

Sample Date:

Sample Time:

Water Temp (°C):

TARGET SPECIES SCREENING LIST

	No	Yes	Elevated
Aphanizomenon spp.	○	○	◇
Anabaena spp.	○	○	◇
Cylindrospermopsis spp.	○	○	◇
Microcystis spp.	○	○	◇
Oscillatoria spp.	○	○	◇

If water is visibly discolored and a target species is identified, please send pictures to pmn@noaa.gov and contact staff to confirm sample shipment for toxin analysis.

◊ OPTIONAL

Weather: Sunny | Partly Cloudy | Mostly Cloudy | Cloudy | Rain

Wind direction: N | NE | E | SE | S | SW | W | NW

Wind speed (mph): 0-5 | 5-10 | 10-15 | 15-20 | 20-25 | 25+

Tides: High | Low | Incoming | Outgoing

Air Temp (°C):

pH:

Dissolved Oxygen (ppm):

Barometric pressure (mmHg):

	None	YES	Elevated
Centric Diatoms	○	○	◇
Pennate Diatoms	○	○	◇
Dinoflagellates	○	○	◇
Cyanobacteria	○	○	◇
Ciliates	○	○	○
Other Zooplankton	○	○	○

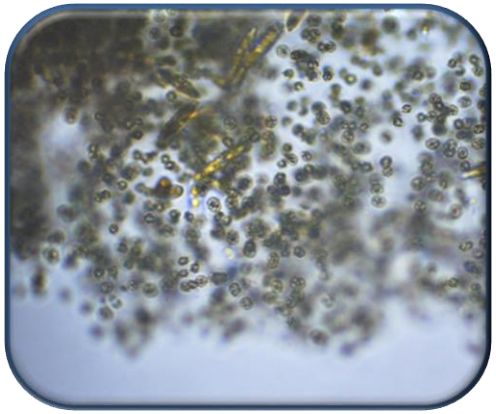
SHIPPING INFORMATION

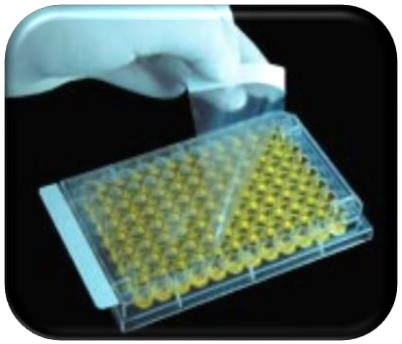
○ - No samples needed

◇ - **Contact PMN staff to confirm shipment of samples for testing.**
-preserve 125 mL bottle with Lugol's
-do NOT add Lugol's to 1 liter bottle.
-use overnight shipping label to ship both bottles

NOAA PMN, 219 Fort Johnson Rd, Charleston, SC 29412 | 843-762-8857

When a bloom is reported



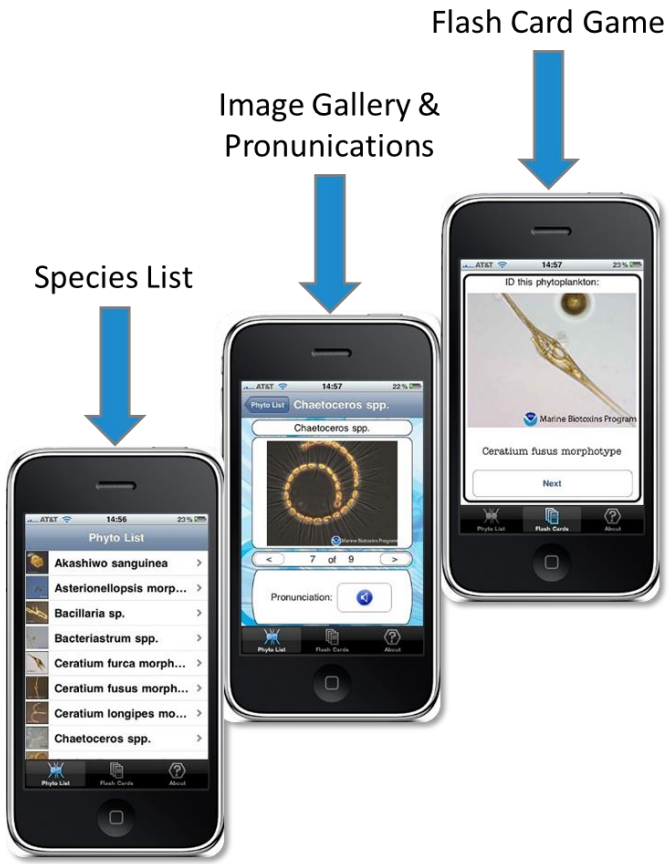


Managers
Stakeholders

Tools for cyanoHAB training & identification

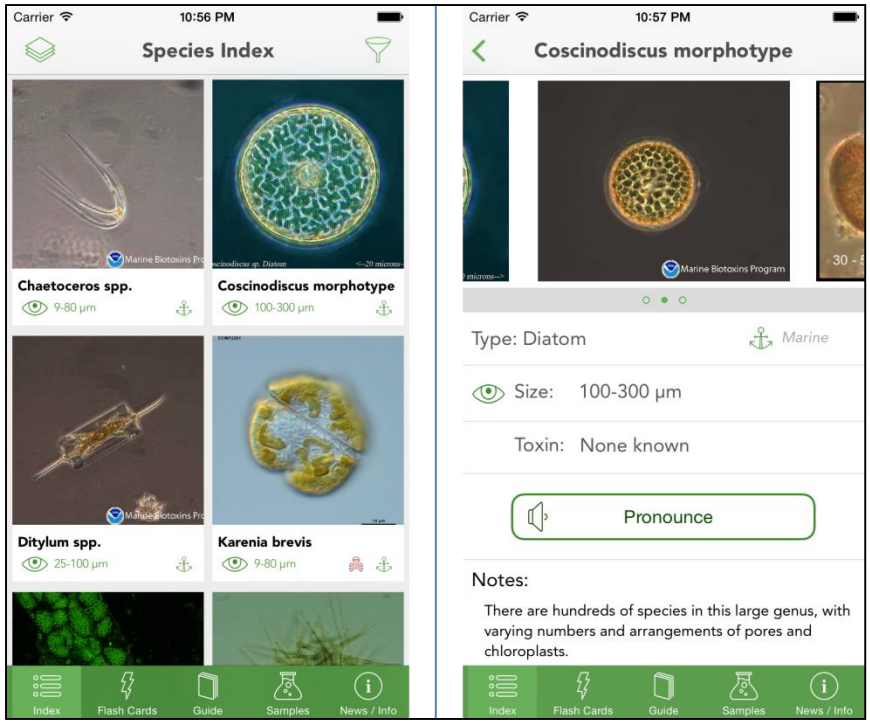
PHYTO app

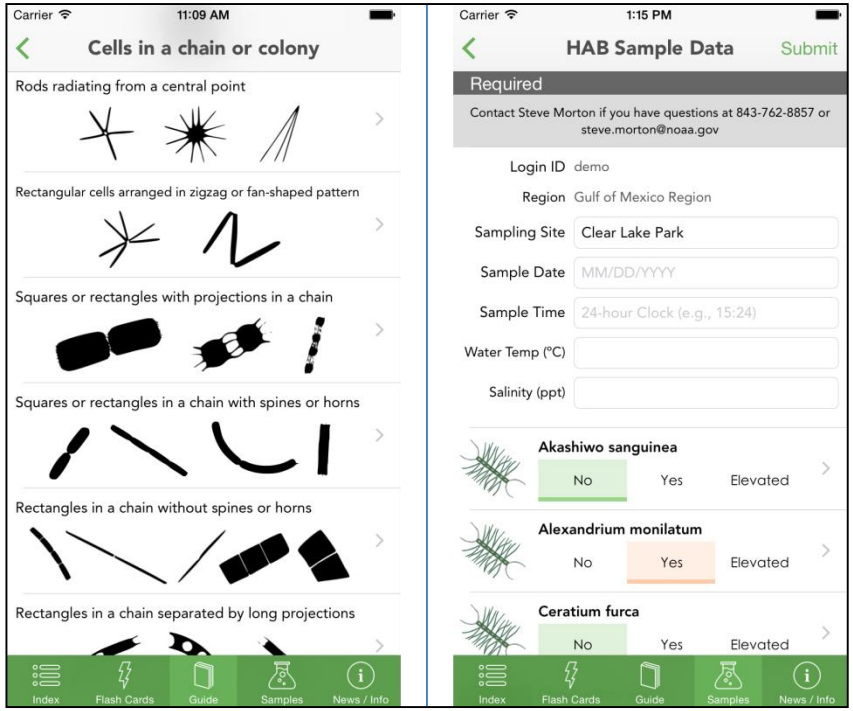
- Developed by PMN volunteer Shawn Gano to assist with and improve volunteer's identification skills of marine algae
- Being updated with more species and will include freshwater target species as well



http://youtu.be/ItzxoB06De0

Phyto version 2- *coming soon!*





https://www.youtube.com/watch?v=ItzxoB06De0&feature=youtu.be

Tools for cyanoHAB training & identification

WebEx training sessions

- Done remotely to make training more convenient when on-site is not possible
- Allows NOAA scientists to observe real samples online with volunteers

Freshwater Phytoplankton Monitoring Network

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2015 Pilot Project Sampling Season

FY 2015

training done in June 2015

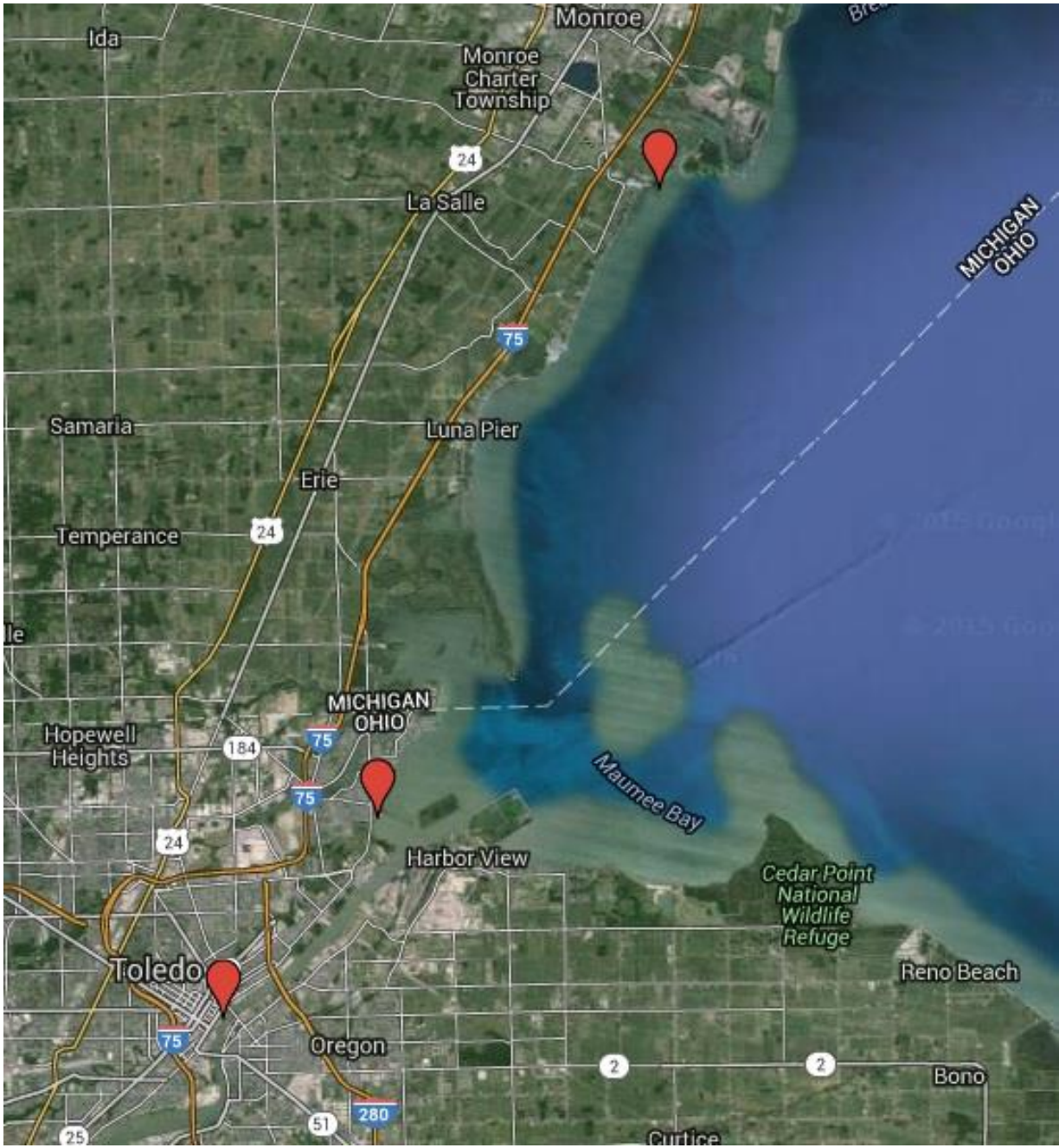
<u>Region 5:</u>

Ohio (2 sites)

Michigan (1 site)

<u>Partners include</u>:

- Imagination Station
- Knabusch Math & Science Center



FY 2015

trainings in August 2015

<u>Region 8:</u>

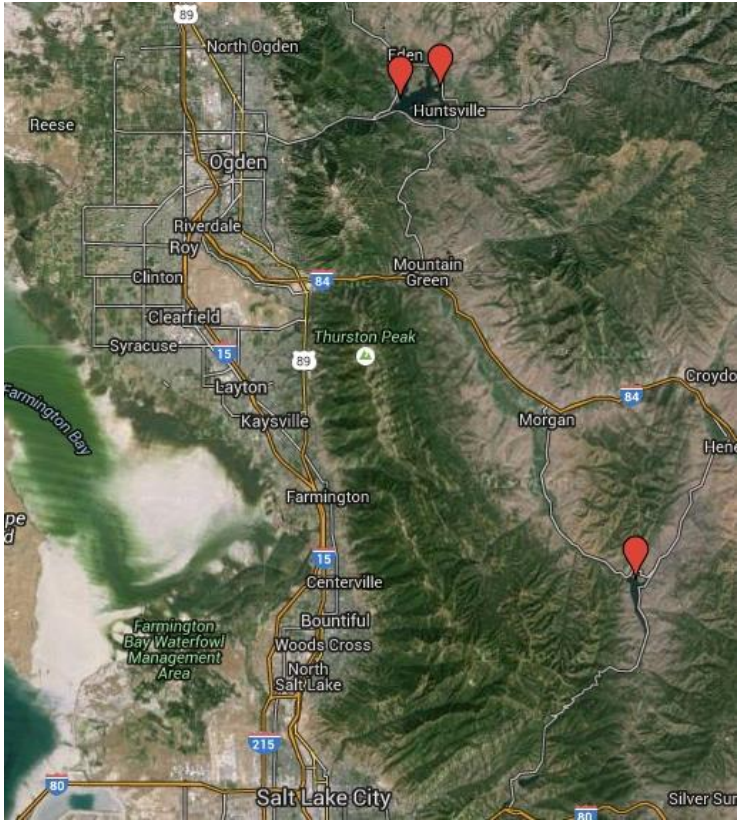
Colorado

Montana (1 site)

Utah (4 sites)

<u>Partners include</u>:

- Weber-Morgan Health Dept.
- UT DEQ-DWQ
- TriCounty Health Dept.
- EPA



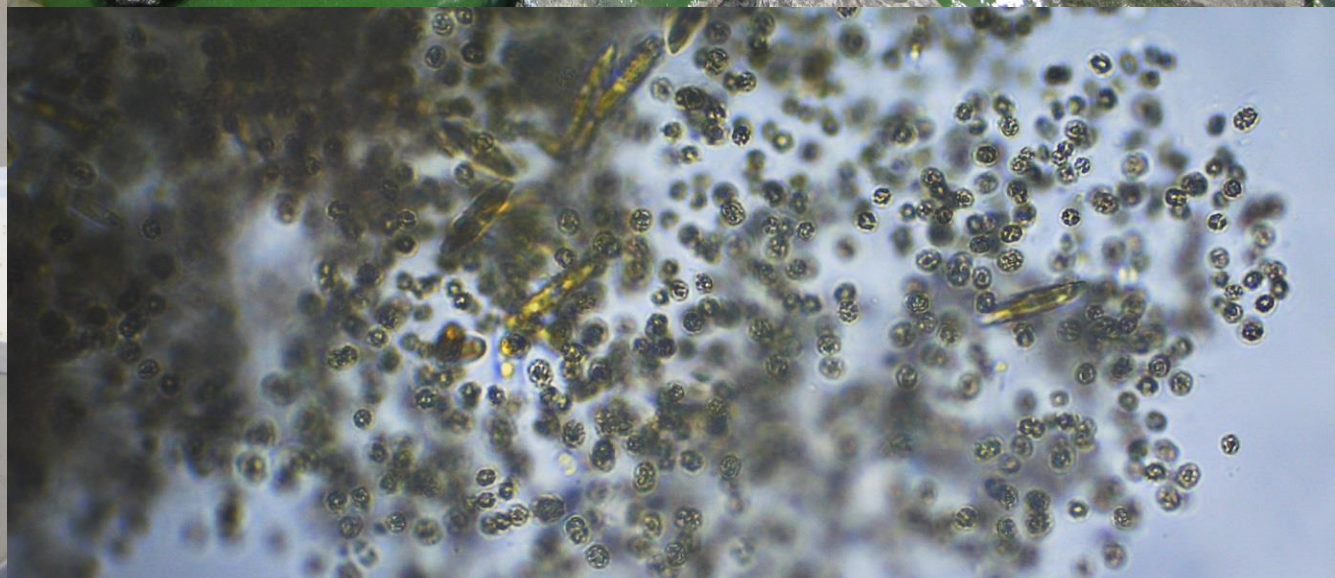
Data Summary for 2015

ID	UT01	UT02			MI01	OH01
Site name (total # samples)	**Utah Lake** (7)	**East Canyon** (7)	**Middle Inlet** (6)	**Boat Dock** (7)	**Bolles Harbor** (9)	**Imagination Station** (4)
Anabaena	3	2	1	1	---	---
Aphanizomenon	---	---	---	---	---	---
Cylindrospermopsis	---	---	---	---		---
Microcystis	2	---	---	---	7*	---
Oscillatoria	4	---	---	---	---	---

* 3 were elevated

July 22nd -August 19th

Persistent *Microcystis* bloom in western Lake Erie



Photos by Tom Green

Experimental Lake Erie Harmful Algal Bloom Bulletin

National Centers for Coastal Ocean Science and Great Lakes Environmental Research Laboratory

31 July, 2015, Bulletin 06

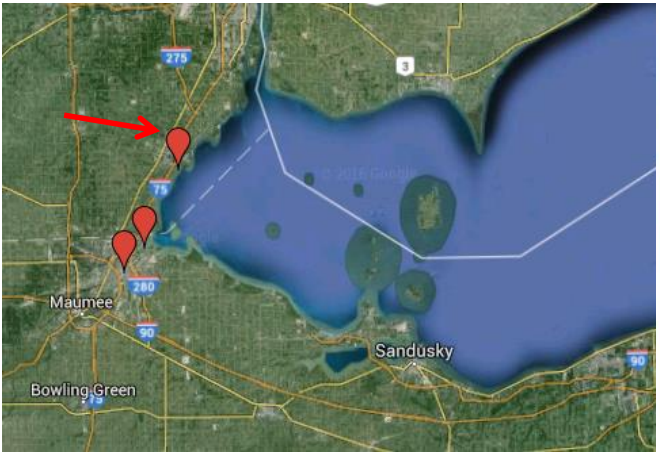
The Microcystis cyanobacteria bloom continues in the western basin. The bloom extends from near Michigan across the western basin south of West Sister Island, then east through the islands. Mixing has reduced the surface concentration in the last day. Along the Canada coast east of Pelee Point, mixing has lowered the surface concentration to the point of non-detection. In that area, the bloom may reappear when calm weather returns. Microcystin is present, with toxin levels especially high in scums or areas of obvious bloom.

Over the weekend, >15 knots winds are expected, favoring continued mixing and lower surface concentrations of the bloom. Scum formation should be rare over the weekend while these winds persist.

Westerly winds over the next few days will favor eastward transport of the bloom away from the Michigan and Ohio coasts. The persistent bloom in Sandusky Bay is present. No other blooms are evident in the central basin and eastern basins.

Please check Ohio EPA's site on harmful algal blooms for safety information. http://epa.ohio.gov/habalgae.aspx
Keep your pets and yourself out of the water in areas where scum is forming.

- Stumpf, Dupuy



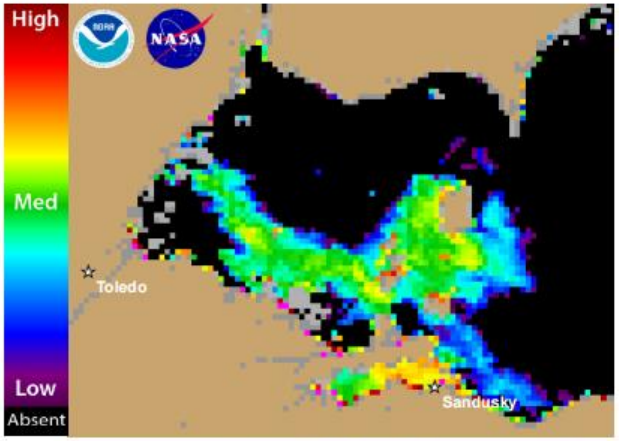


Figure 1. Cyanobacterial Index from NASA's MODIS- Aqua data collected 30 July, 2015 at 13:05 EST. Grey indicates clouds or missing data. Black represents no cyanobacteria detected. Colored pixels indicate the presence of cyanobacteria. Cooler colors (blue and purple) indicate low concentrations and warmer colors (red, orange, and yellow) indicate high concentrations. The estimated threshold for cyanobacteria detection is 20,000 cells/mL.

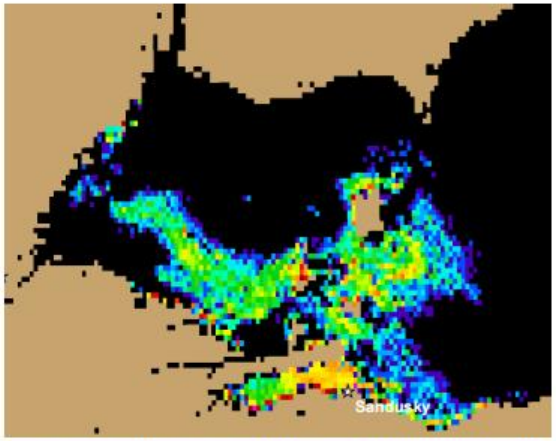


Figure 2. Nowcast position of bloom for 31 July, 2015 using GLCFS modeled currents to move the bloom from the 30 July, 2015 image.

2016 Pilot Project Sampling Season

Adding Microcystin ELISA analysis

- Samples must be visibly discolored with identified target spp.

New sites being added in Region 8

- Trained Colorado Parks & Wildlife staff along with Colorado River Watch volunteers
- Trained SD DENR watershed coordinator
- Trained ND Walsh Co. watershed coordinator-Homme Dam
- Turtle Mountain Tribe (North Dakota)

Looking to expand in Region 5

- New trainee in Buffalo, NY
- Add Lake St Clair site(s) and Lake St Mary

Gauging R10 interest?

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Summary

- **Volunteer Phytoplankton Monitoring Networks are a proven key asset in the detection of harmful algal blooms.**
- **Data generated by volunteer citizen scientists is very useful in many aspects of HAB research and management decisions.**
    - **Can be an important early indicator of potential cyanoHAB events in recreational and drinking water areas**

Funding partners

NOS/NCCOS/CCEHBR

EPA- Office of Water

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