



Department of
Environmental
Conservation

HABs in NY and Canandaigua Lake

What we know (and don't know)

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NYSDEC Division of Water

A recent history of NY HABs

Lake Ontario 2010



Lake Erie 2009



Lake Champlain 2008



Lake algae may be killing animals, birds

Authorities: Don't fish or touch the water. Water samples to be tested.

By Delen Goldberg
Staff writer

A dog climbed out of Lake Neatahwanta in Fulton after a short swim Tuesday night, broke into convulsions and began vomiting.

Within minutes, the Labrador

While the toxin is unlikely to be fatal to humans, officials said high levels of the poison can cause liver and nervous system damage.

"Until we find out for sure what is going on, it's better that people stay away," said Evan Walsh, associate public health sanitarian for the county Health Department.

Authorities posted signs Thursday on parts of the lake's eastern shore warning people to



The Post-Standard

Two DEC biologists wearing





**Sodus Bay
(Lake Ontario)
2010**

A photograph showing a body of water with a thick, green, foamy layer of algae or cyanobacteria. In the background, a wooden dock and two pickup trucks (one teal, one silver) are visible on the shore. Two people are standing near the trucks.




**Song Lake
(Central NY)
2009**

A photograph of a lake with a large, dense, green mass of algae or cyanobacteria floating on the surface. The water is a milky green color.



**Hedges Lake
(Eastern Adks)
2010**

A photograph of a lake with a large, dense, green mass of algae or cyanobacteria floating on the surface. The water is a milky green color. A wooden dock is visible in the foreground.



**Cuba Lake
(Western NY)
2010**

A photograph of a lake with a large, dense, green mass of algae or cyanobacteria floating on the surface. The water is a milky green color. A wooden dock is visible in the foreground.



**Mill Pond
(Long Island)
2008**

A photograph of a pond with a large, dense, green mass of algae or cyanobacteria floating on the surface. The water is a milky green color. A wooden dock is visible in the foreground.

2013.... New York is a HABsy state...



10

New York had 50 laboratory confirmed toxic algae warnings, an indication of how a strong monitoring system can reveal the true depth of the problem.



best management practices on their farms that protect water quality.

1 For the first time, **Kentucky** officials found toxic algae this summer at four lakes which collectively serve more than 5 million people a year. Visitors to the lakes have complained of nausea and stomach problems.

2 Toxic algae has become a regular occurrence in **Lake Erie**, due primarily to agricultural runoff. Thick mats of algae have closed beaches, derailed fishing, and diminished outdoor recreation opportunities.

system can reveal the true depth of this problem.

11 In southeast **Florida**, a massive toxic algae outbreak covered St. Lucie River and Indian River Lagoon with fluorescent green slime. The summer prompting warnings from health officials to not touch the water. Scores of dolphins, manatees, birds and fish have died, and thousands of residents have protested, calling for a statewide emergency management plan to stop the toxic slime.

12 A new USGS-funded project in **Alabama** is tracking toxic algae in 350-400 freshwater sites around the south western U.S. Most states in the region do not currently monitor HABs.

Toxic Algae: Coming Soon to A Lake Near You? :: 3



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And now? 2014 HAB “Season”

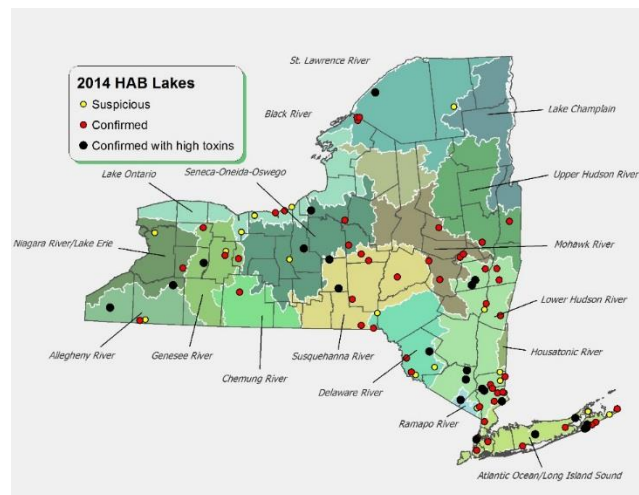
Season = June thru October

93 waterbodies reported blooms

- 74 “confirmed” (out of 195 sampled waterbodies)
- 19 “suspicious”

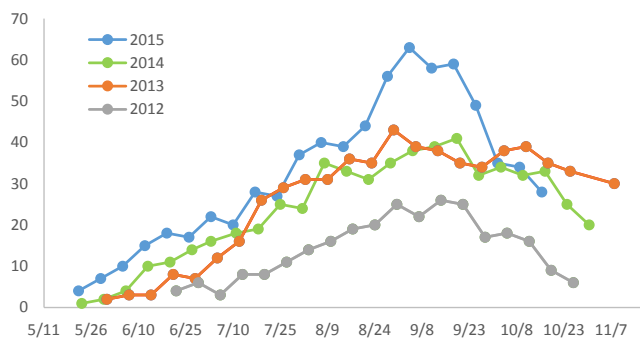
75 lakes identified through DEC or other baseline monitoring programs

18 lakes identified by public reporting outside of baseline monitoring programs

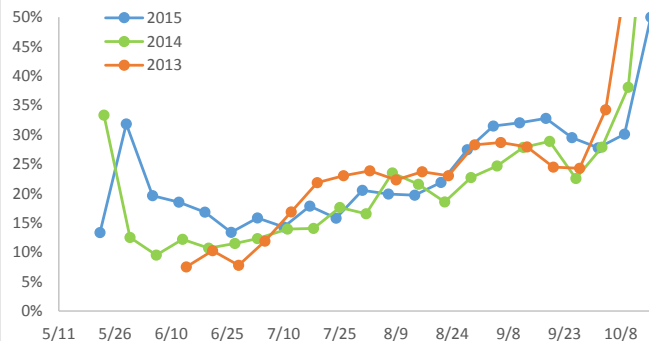


Sidebar: Is it getting worse? 4 looks

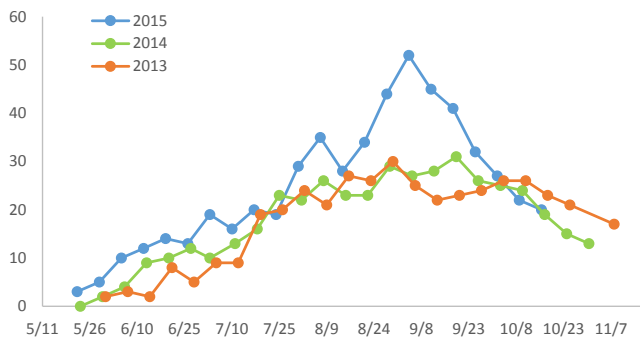
Statewide # Lakes Reported BGA Blooms (by week)



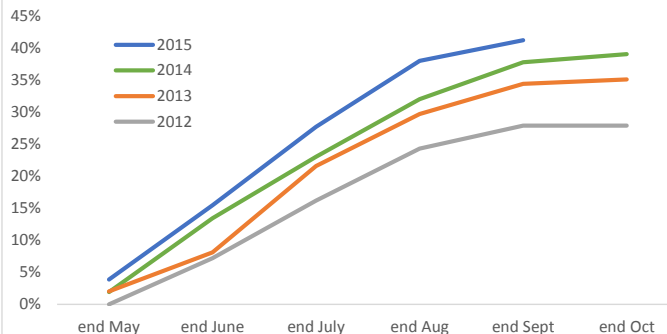
Statewide % Sampled Lakes w/BGA Blooms



Statewide # Lakes Confirmed BGA Blooms



Cumulative % Routine Sampled NYS Lakes Reporting HABs



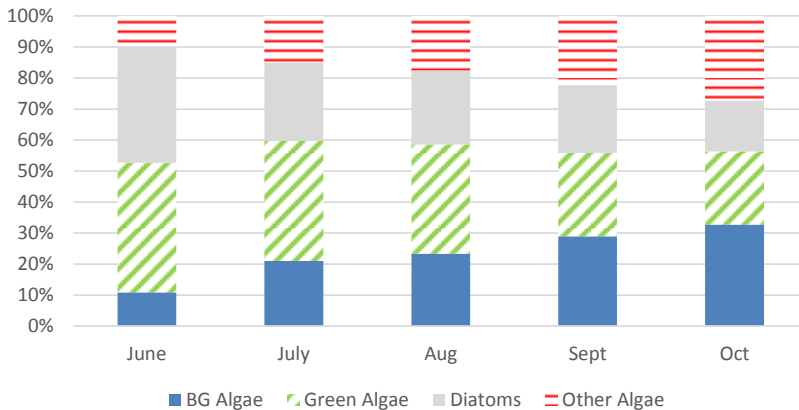
Change from year to year- things getting better?

Less Algae and Fewer blooms in 2014?

Year	Open N	AvgTChl Open	%TChl>50 Open	AvgBG Open	%BG>30 Open	AvgMC Open	%MC>4 Open
2014	902	7.8	2%	3.7	3%	0.2	0%
2013	905	16.9	3%	7.4	5%	0.5	2%
2012	650	15.1	2%	9.4	2%	0.5	2%

Year	Shore N	AvgTChl Shore	%TChl>50 Shore	AvgBG Shore	%BG>30 Shore	AvgMC Shore	%MC>4 Shore
2014	460	5492	45%	5370	44%	35	13%
2013	473	3471	43%	3166	43%	144	29%
2012	79	3482	72%	3378	59%	96	35%

2014 Open Water Algae Types, CSLAP Lakes



Open water:

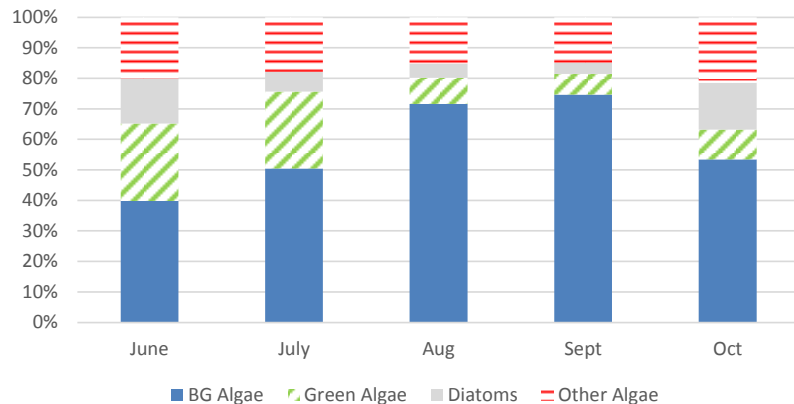
Early: Green algae
and diatoms

Late: Blue green algae
and other species

Shoreline blooms:

Increasing BGA levels
into late summer with
decreasing green
algae and diatoms

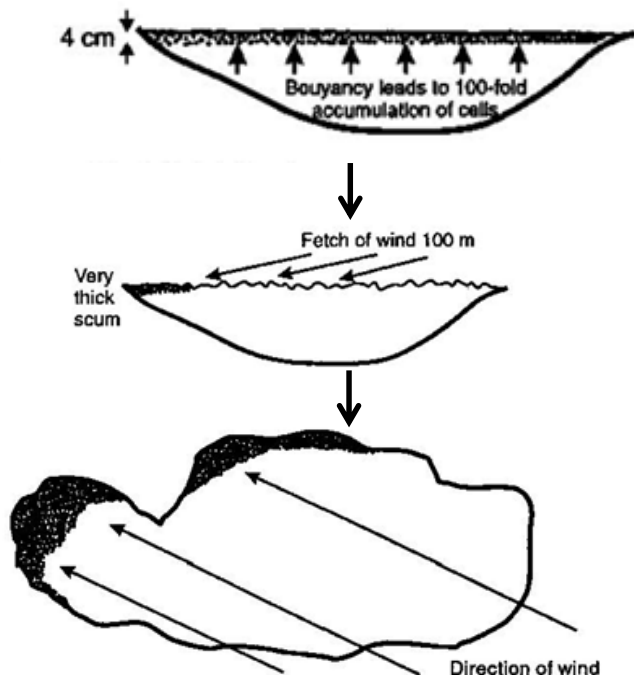
2014 Shoreline Bloom Algae Types, CSLAP Lakes



Where (in the state) (and why) in a table

Region	# 13-14 All Sampled Lakes	# 13-14 HAB Lakes	2014 avg TP HABs Lakes	2014 avg TP non - HABs Lakes	# Lakes w/ High Toxins
Western and Finger Lakes	37	24	46 ug/l	18 ug/l	7
Downstate and Long Island	95	66	45 ug/l	21 ug/l	27
Central	113	51	44 ug/l	16 ug/l	15
Adirondacks (region)	86	10	24 ug/l	9 ug/l	2

Be careful of wind concentrated scums



2011-14 CSLAP

Open water samples

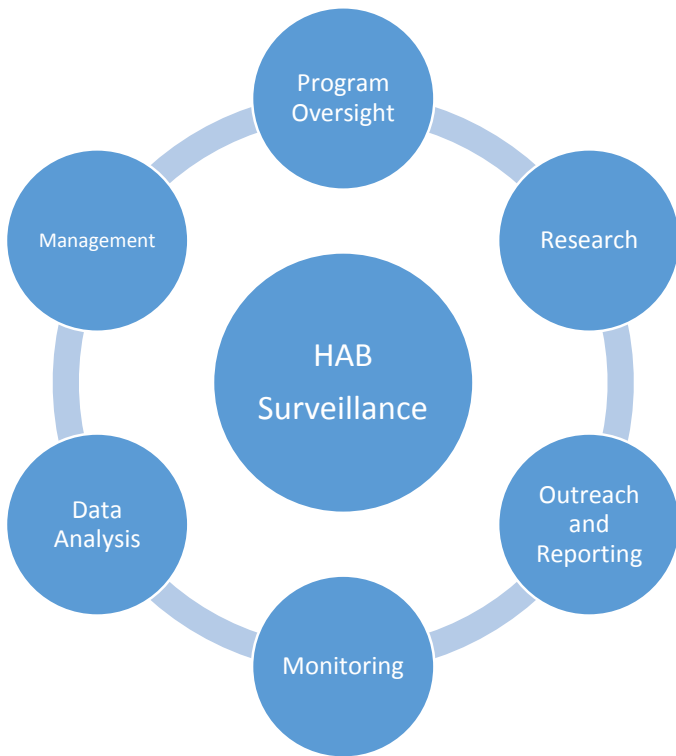
- 2460 samples
- 3% BGA blooms
- <1% high toxins

"Bloom" Samples

- 1010 samples
- 65% BGA blooms
- >23% high toxins

What (is NY doing)?

Elements of the NY HABs Program



Who: The 3 Ps of surveillance and monitoring

Programs

- Citizens Statewide Lake Assessment Program (CSLAP)
- Lake Classification and Inventory Survey (LCI)



Partnerships

- **NY Federation of Lake Associations**
- Agencies: **DEC**, NYS/County DOH, NYS/NYC Parks
- Academic: **SUNY ESF**, Stony Brook University
- Big Lakes: Honeoye Lake, Seneca Lake,
- Canandaigua Lake Watershed Council



Public



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A word about the SUNY ESF-DEC-FOLA partnership



DEC secured multiple EPA supplemental grants to support CSLAP and public HAB analysis thru ESF

Work is largely subsidized by other SUNY ESF grants

Very large number of samples (>2000 annually) analyzed by ESF- MANY (MANY) more than paid for thru grants

Analysis includes pigment (fluoroprobe chlorophyll a), microscopics, toxins

Relies heavily on expertise of Greg Boyer lab and grad students

Canandaigua Lake Watershed Council plugged into this partnership



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Breakdown of NYS Surveillance and Monitoring

Category	Visual-Public	Visual-Professional	Sampling-Microscopic	Sampling-Pigment	Sampling-Toxins
Description	Digital images or comparison to image gallery	Beach manager visual evidence of BGA bloom	Microscopic scan of dominant taxa	Unextracted or extracted chl.a, phycocyanin	Lab PPIA/ELISA or field ELISA
Implication	DEC Web Notification-Suspicious	DOH/OPRHP Beach Closure	DEC Web Notification-Confirmed w/ evidence bloom	DEC Web Notification-Confirmed	DEC Web Notification-Confirmed / High Toxins
Decision Trigger	DEC review	DOH/OPRHP review	BGA / toxin producer ID	BG chl.a > 25-30; or PC > 50 & tChl > 30	MC-LR > 20 ug/l (> 10 ug/l open water)
Timing	Immediate (same day DEC review if needed)	Immediate	1-2d (transit-immediate analysis/report)	1-2d (transit-immediate analysis/report)	2-10d (transit + extraction)
Accuracy	Low to mod	Mod to high?	High	Mod to high	Mod to high
Cost	None	None	Low to mod	Mod	Mod to high
Expertise / Availability	None required	"Regulated" sites only	Few labs	Some labs	Few labs

We have all this data... now what?

“Suspicious”

- Credible evidence indicates likelihood of both BGA and bloom conditions from visual, field report, other
- Not (yet) verified by laboratory analysis

“Confirmed”

- BGA bloom confirmed by blue green chlorophyll a levels > 25-30 ug/l (interpretation of WHO guidance)
- Dominance by BGA (fluoroprobe, microscopics)
- Toxins above WHO “moderate risk” threshold (2-4 ug/l microcystin-LR)

Now what...continued

“Confirmed with high toxins”

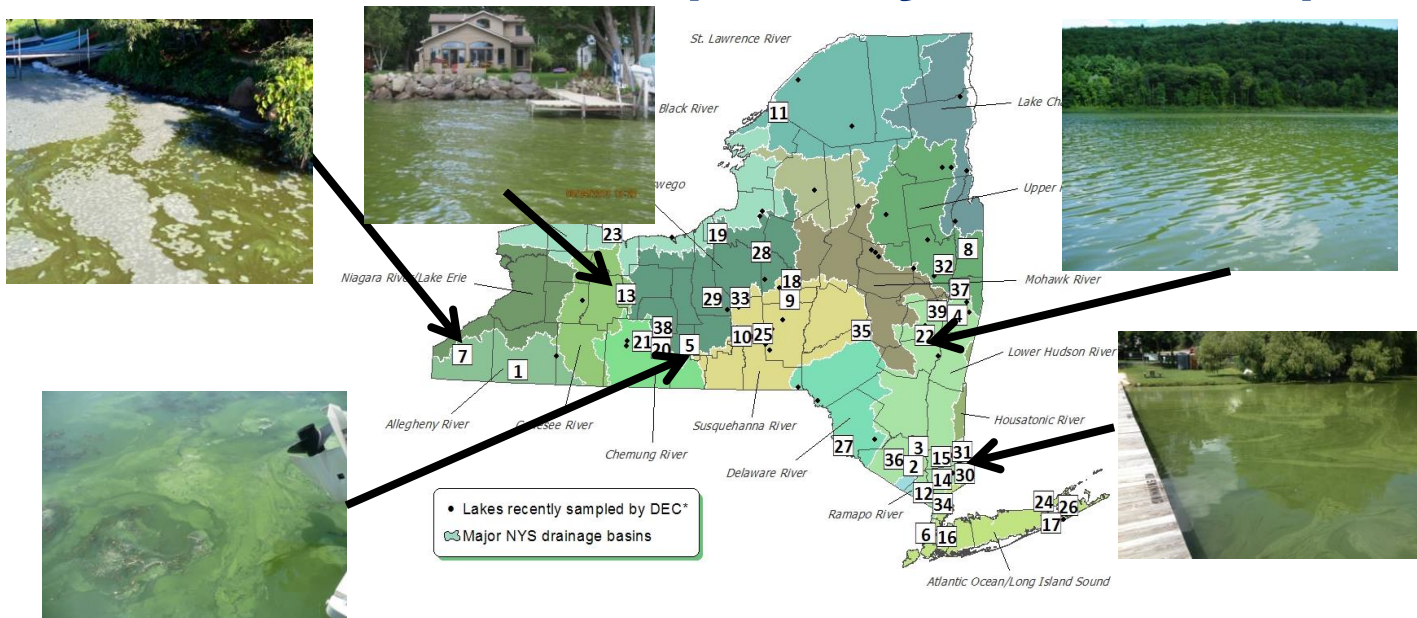
- BGA bloom with microcystis-LR > WHO “high risk” threshold (20 ug/l shoreline, 10 ug/l open water)

For ALL categories, public advised to

- Avoid exposure to / keep kids and pets away from surface scums or heavily discolored water
- Seek immediate medical assistance for symptoms consistent with BGA exposure
- Report any symptoms to local/state Health Department
- Report additional and on-going blooms to DEC through visual images, web page forms



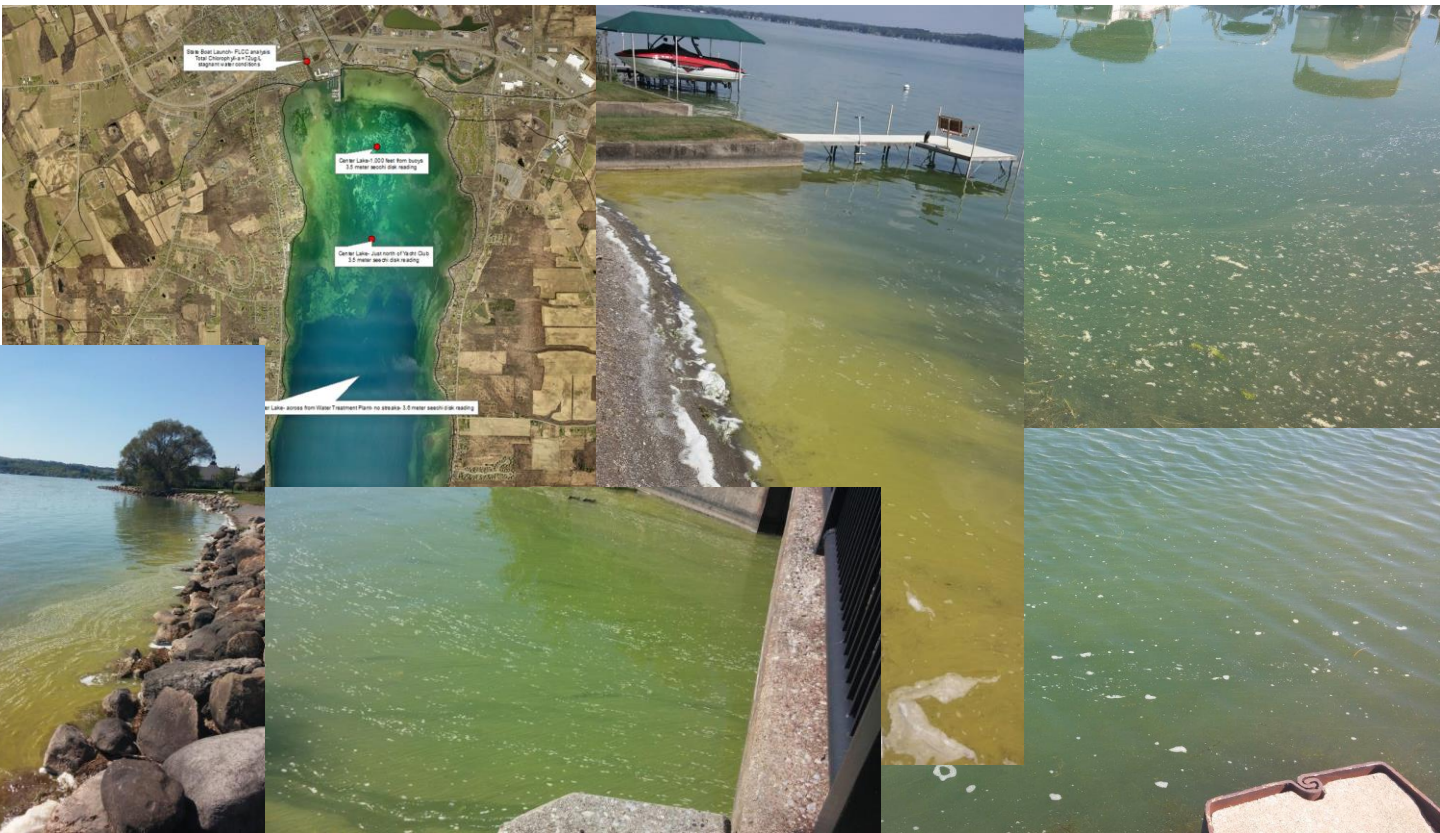
Web notification (Friday outreach)



Waterbodies with Blue-Green Algae Notices

Map Number	Waterbody Name	County	Status	Extent of bloom	Status Date	Type of Sample	Change in Status
1	Allegheny Reservoir+	Cattaraugus	Confirmed	Large localized	10/7/2013	Lab sample	Updated listing
2	Beaver Dam Lake	Orange	Confirmed	Small localized	10/7/2013	Lab sample	Updated listing
3	Browns Pond	Orange	Suspicious	Widespread	10/3/2013	Visual	No change
4	Burden Lake	Rensselaer	Confirmed	Small localized	9/29/2013	Lab sample	No change

Canandaigua Lake HABs in 2015



Canandaigua Lake Monitoring Framework

Who:

Canandaigua Lake Watershed Council
Finger Lakes Community College (FLCC)
SUNY ESF
DEC Division of Water in Albany
Others (DOH, public,...)

What:

Visual evidence of blooms (CLWC)
Collecting samples from the most intense part of apparent blooms
Analysis for total chlorophyll (FLCC), microscopics (FLCC
and ESF), total and BG chl.a and toxins (ESF)

When/How Often:

Once evidence of blooms was observed
In advance of events (triathlon, holiday weekend,...)



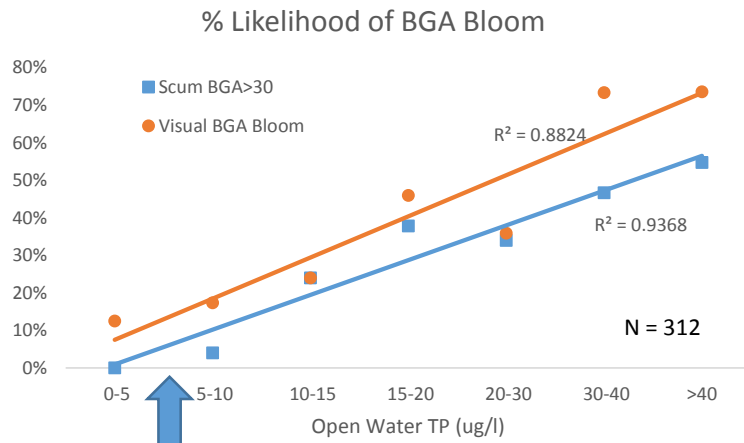
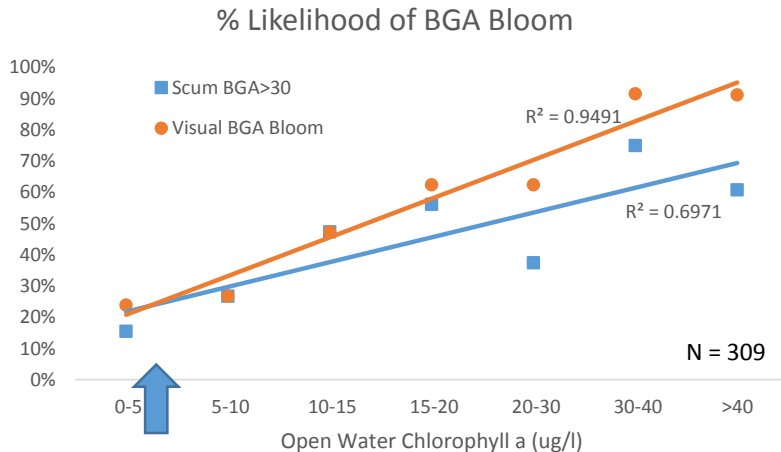
Chronology of BGA blooms Canandaigua Lake

< Aug 28:	no evidence/reports of blooms
Aug 31:	bloom first reported in Sucker Brook
Sept 1 am:	no blooms observed during lake surveillance
Sept 1 pm:	blooms reported in north end of lake
Sept 1 pm:	high toxins first measured Club Center
Sept 3:	high algae levels Cottage City Shore
Sept 1-8:	blooms observed, beaches closed
Sept 8:	high toxins measured Butler Road beach
Sept 10:	low BGA found triathlon sites
Sept 15:	visible evidence of blooms multiple locations
Sept 18:	high algae levels Hope Point
Sept 24:	high BGA isolated area south of Meredith Point
Sept 30:	no evidence/reports of BGA blooms



Why?

Canandaigua Lake has much lower open water TP and algae levels than most lakes with BGA blooms



What (other) factors are contributing to blooms?

What about other Finger Lakes?

Lake	Avg TP*	Avg Chl.a*	BGA Blooms?
Canandaigua	6	1	2015 north end
Canadice	8	3	No reports recent years
Cayuga	10	4	Cladophora /one BGA site? 2015; little BGA < 2015
Conesus	22	8	Periodic reports 2014-2015, some reports < 2015
Hemlock	10	3	No reports recent years
Honeoye	24	8	Persistent reports 2008-2015; fewer reports 2015
Keuka	8	3	No reports recent years (some Cladophora 2015)
Otisco	13	5	No reports recent years
Owasco	12	4	Persistent blooms 2014-2015, some reports < 2014
Seneca	10	2	BGA blooms late summer 2015, some reports <2015
Skaneateles	4	1	No reports recent years

* DEC Finger Lakes study 1996-1999



When did blooms hit in Finger Lakes?

Lake	First Bloom Report	Last Bloom Report	Duration of Blooms+	Peak BGA Levels	Peak Toxin Levels
Canandaigua	9/1/15	9/24/15*	23 days	192 ug/l	49 ug/l
Conesus	7/22/15	10/9/15	6 days	-	-
Honeoye	7/27/15	10/8/15	20 days	1377 ug/l	8 ug/l
Owasco	9/2/15	10/4/15	32 days	4516 ug/l	792 ug/l
Seneca	8/17/15	10/7/15	14 days	10406 ug/l	<1 ug/l

+ estimated based on visual reports and/or lab data

* bloom ended for year

Blooms hit Owasco Lake around same time; peak blooms in Seneca and Honeoye Lake were also around same time



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So why?



Weather- near term (local storms)

Weather- long term (climate change)

Localized sources of nutrients

Different (higher TP, higher SRP,...) in 2015?

Nitrogen (N:P ratio)

Other nutrients or water quality factors

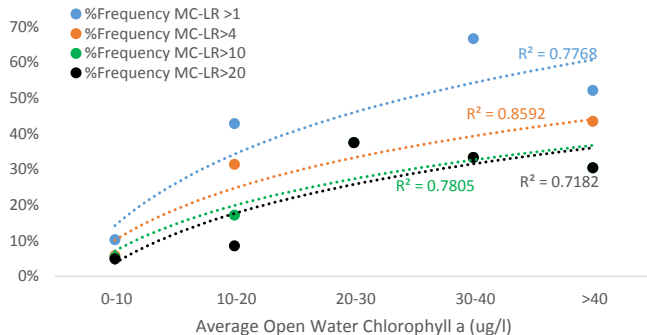
Food web- macrophytes, zoops, zebras, quaggas

Fetch length (wind concentration)

???

(Why are blooms in Canandaigua unexpected?)

% Frequency Max Shoreline MC Levels v. Chl.a

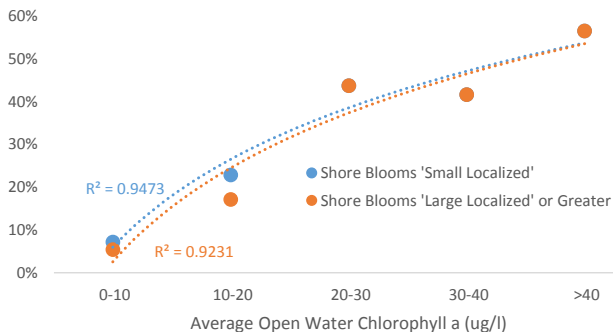


Few oligotrophic lakes with low P and low chl a (open water) experience blooms

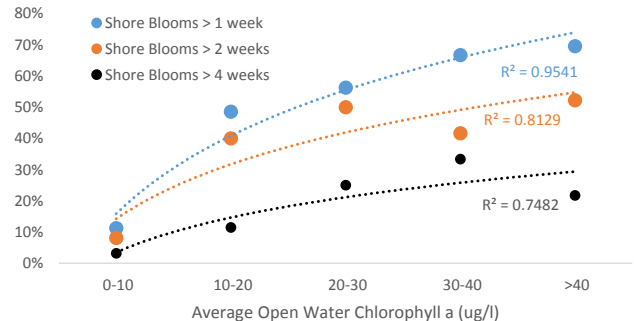
In some lakes, cyanobacteria can extract the little available P and N

Sediment P via vertical migration
Nearshore P from storms/septics
“Bleed” from macrophytes

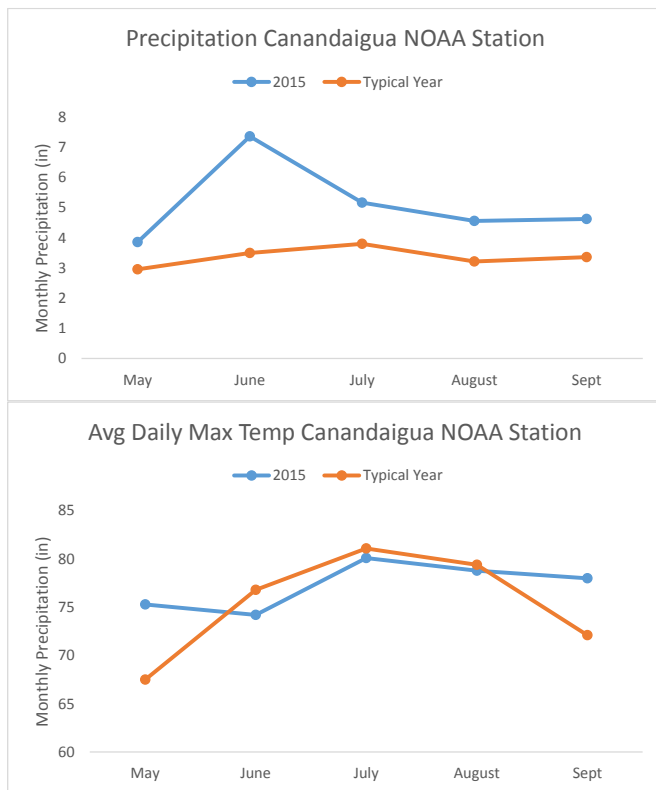
% Frequency Shore Blooms Maximum Extent



% Frequency Shore Blooms Duration



Can we blame the weather?



Precipitation at the Canandaigua NOAA station was much higher than normal in June

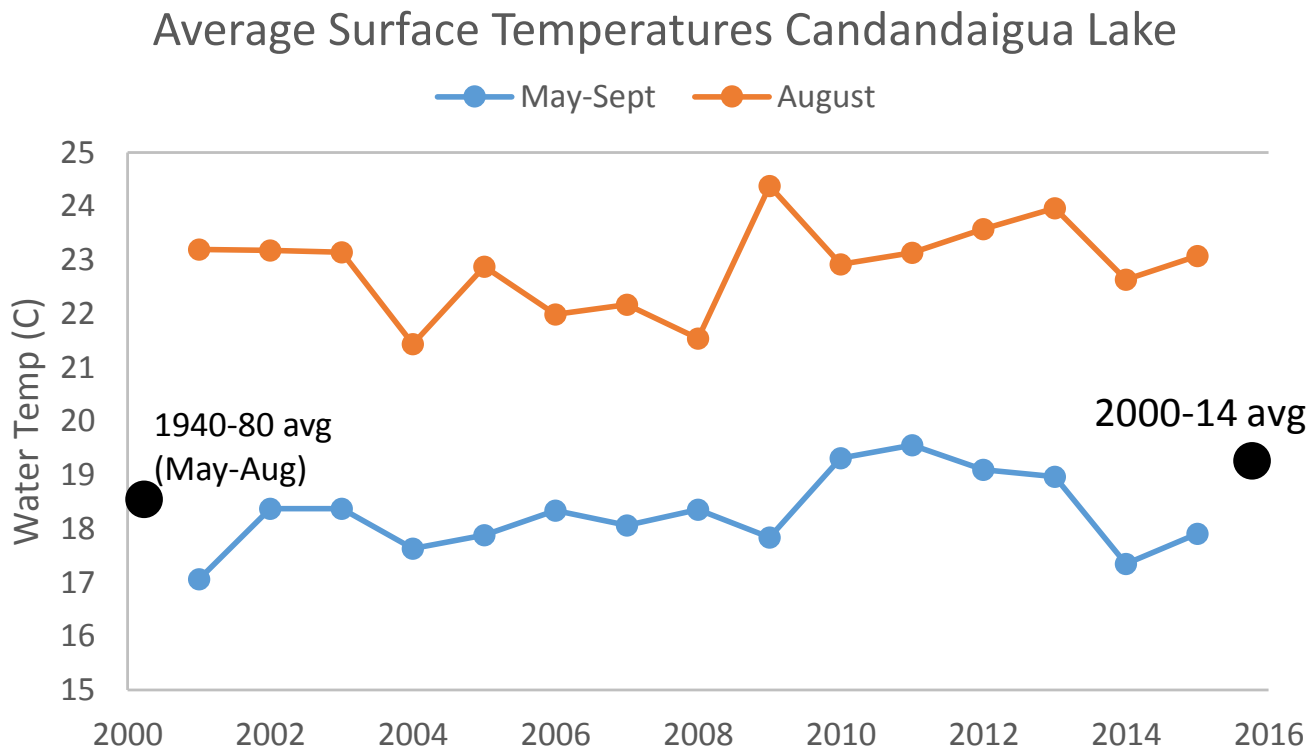
Average daily maximum temperatures higher in May and September

Little to no rain August 21 thru September 13

Peak bloom conditions hit after very wet conditions for several months leading to bloom prior to very hot and dry September

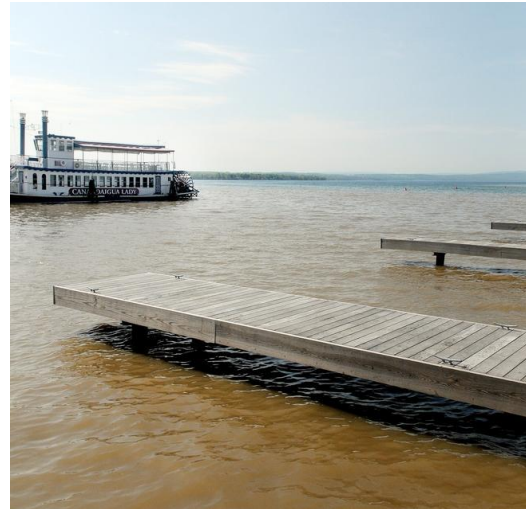


Was there an obvious effect on the lake?



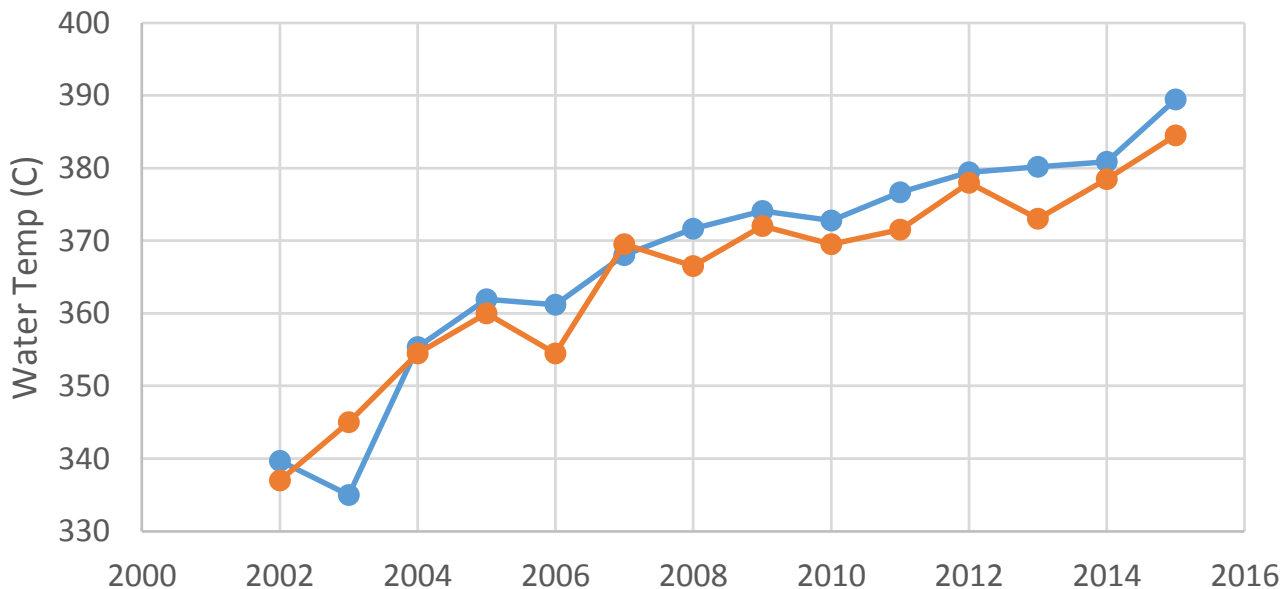
[illegible]

Large plumes apparent

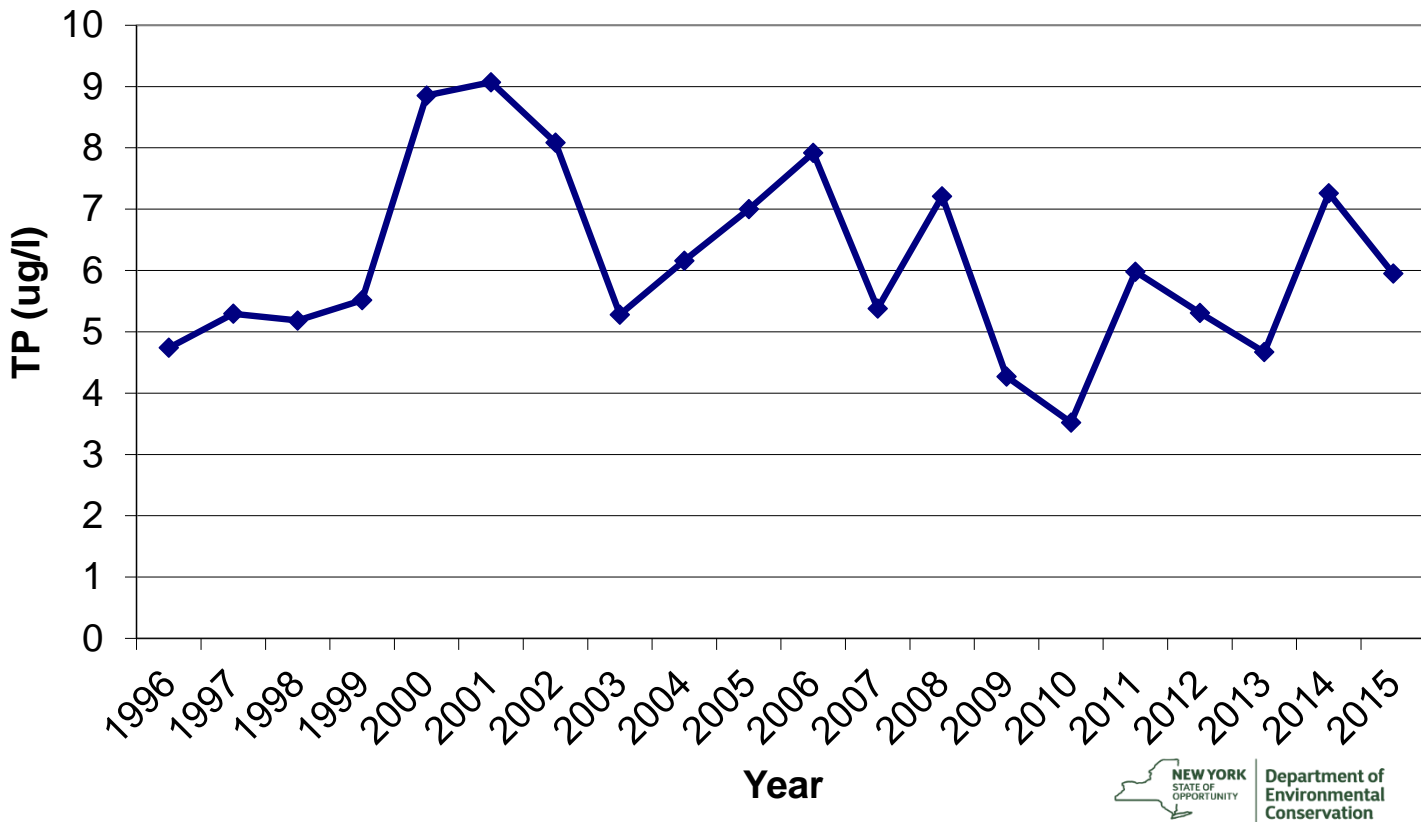


Average Conductivity Candandaigua Lake

—●— May-Sept —●— August

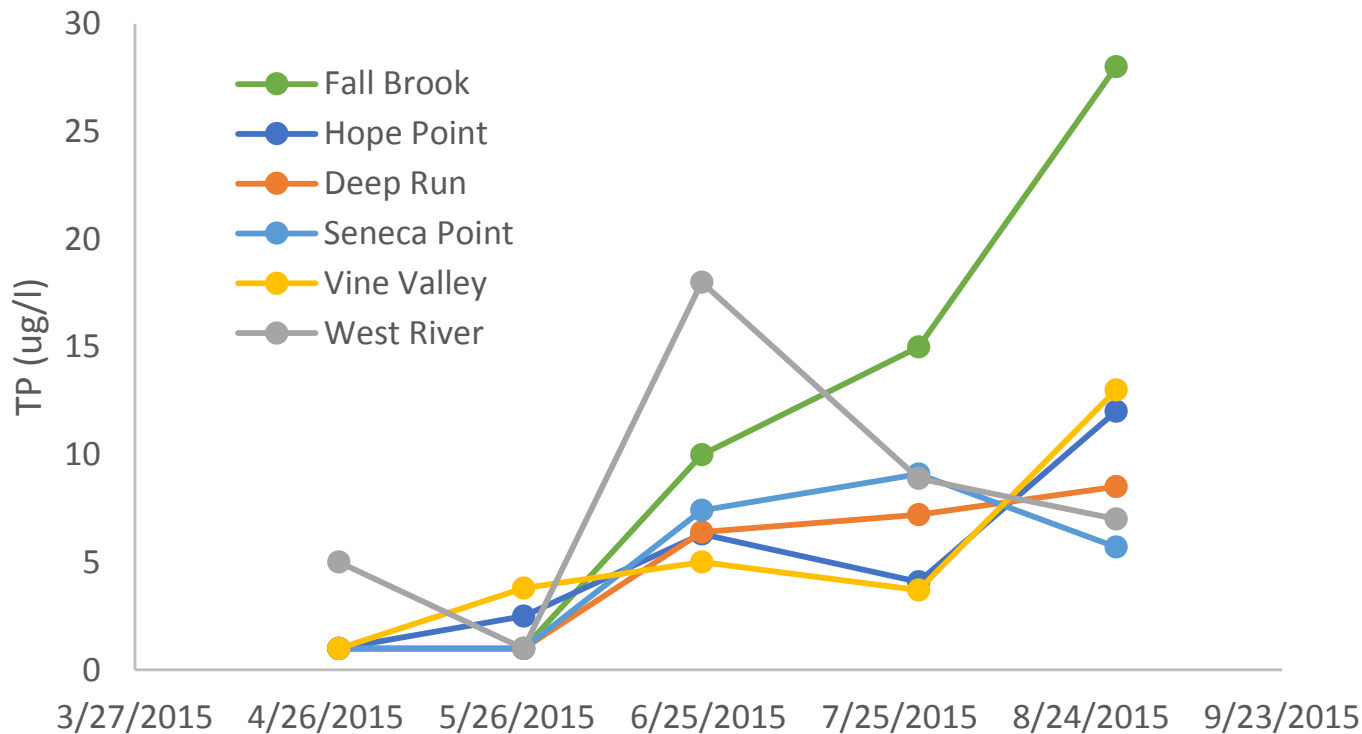


Canandaigua Lake- TP 1996-15



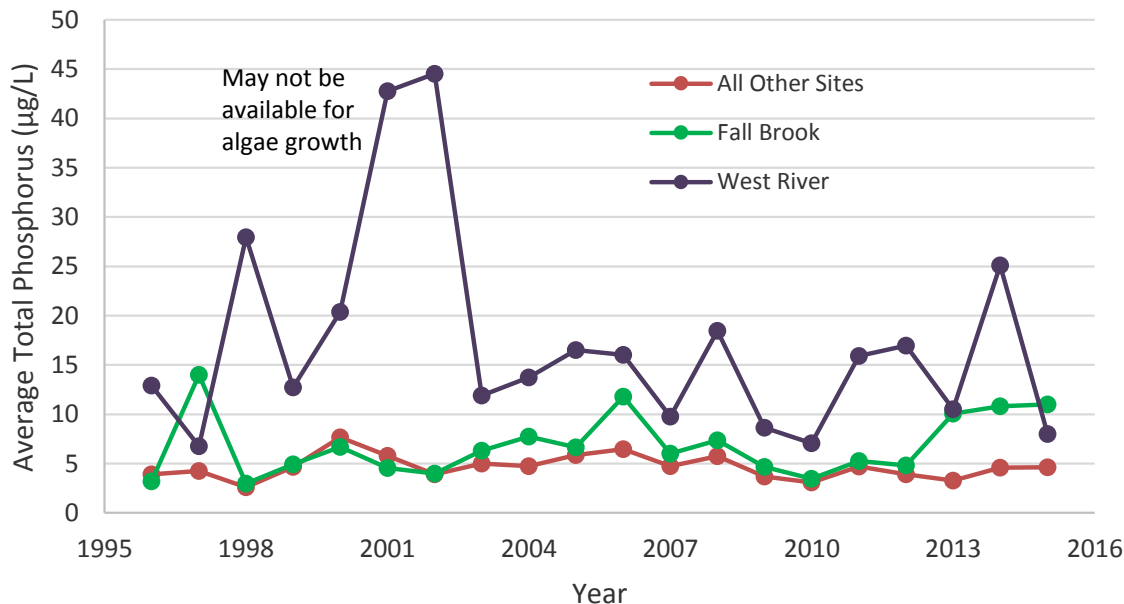
Canandaigua Lake 2015: North to South

Surface TP Canandaigua Lake

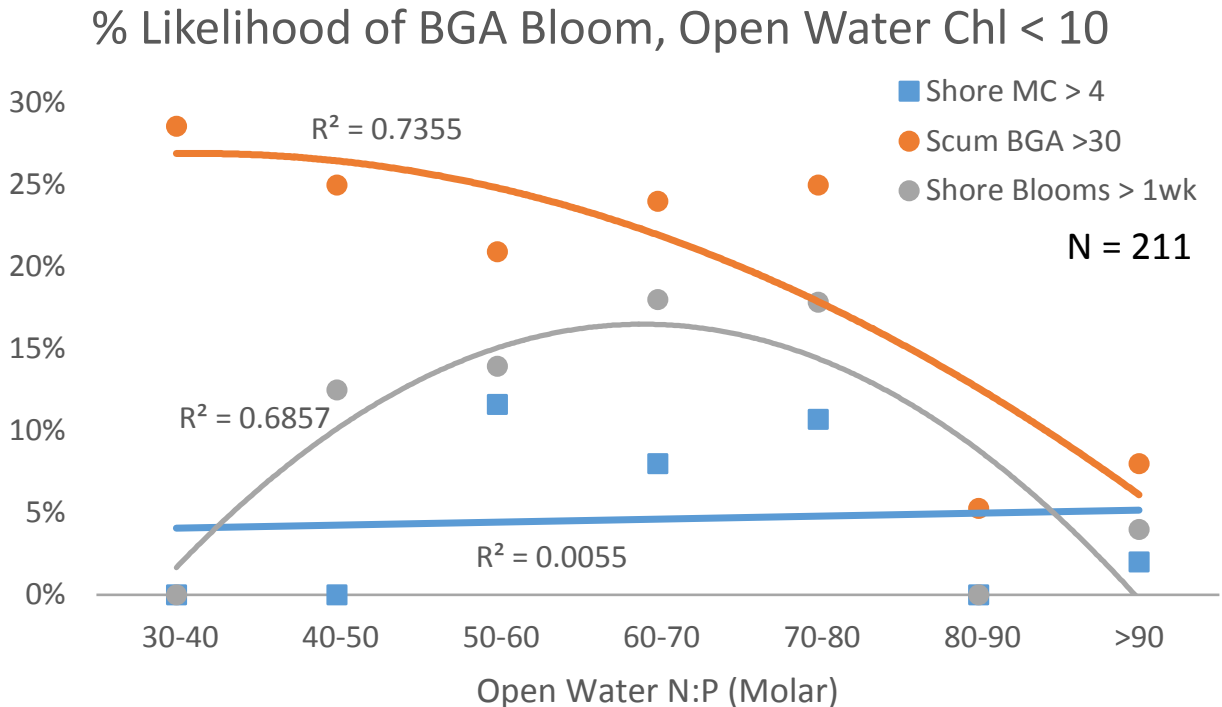


Fall Brook and West River sites 1996-2015

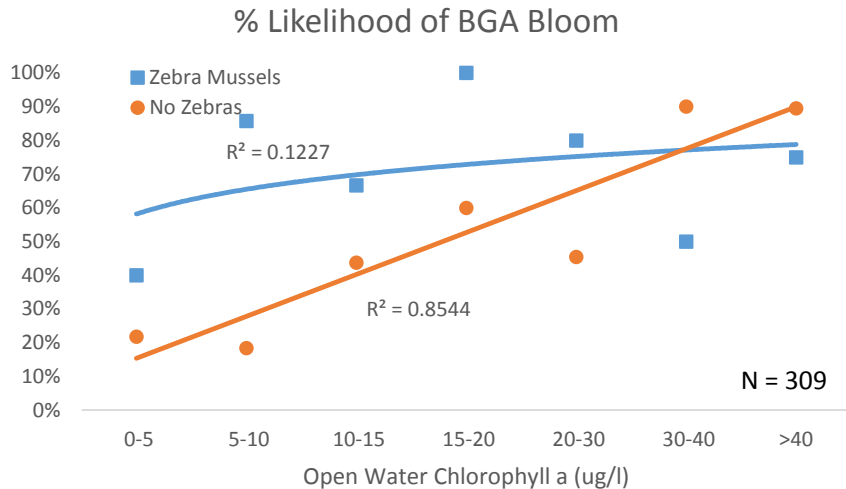
Annual Average Total Phosphorus by Site



In low algae lakes, N:P ratio may affect bloom production



Zebra mussels and other biological changes



Quagga mussels now significantly outnumber zebras (shifted from 3000 zebras/m² early 2000s to 6000 quagga/m² in 2011)

Both mussels strip out beneficial algae and leave cyanos

Food web interactions can cause ↑ in zebras and alter relationship between algae and nutrients

Macrophytes and BGA

Most weeds (vascular plants) extract nutrients from sediment
...but Starry Stonewort and other macroalgae draw from water

2015: north end of lake = substantial increase in vascular plants, replacing macroalgae → more nutrients for BGA

2015: south end of lake = substantial increase in starry stonewort (where P load is usually highest) → fewer nutrients for BGA

Stratification and mixing

Relationship between nutrients, algae and blooms less clear during greater and more frequent mixing

Nutrient buildup in deep waters dissipates in fall and winter during most years

Greater ice cover last few years may have led to nutrient mixing in spring after ice out (not dissipated during fall and winter)

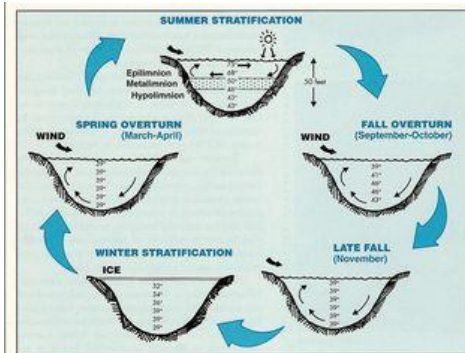
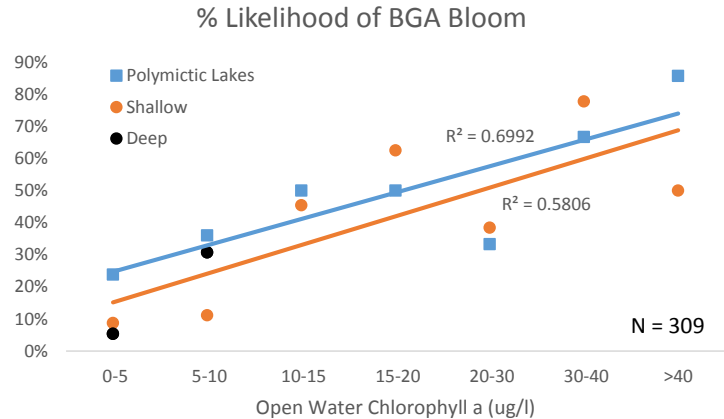


Figure 2. Seasonal Stratification of lakes (taken from Shaw et al. 2000 "Understanding Lake Data")

What does it all mean?



Data indicates Canandaigua Lake may be highly susceptible to small changes in phosphorus and nitrogen

Some factors and nutrient sources can't be controlled

Watershed management of nutrients (as per watershed plan) will be needed to decrease likelihood of future blooms

What has been done to date?

2014 Canandaigua Lake Watershed Management Plan

Many years of FLCC water quality monitoring

Ontario/Yates Co SWCD watershed management actions over last 70 years:

- Agricultural/farm BMPs thru NYSDEC WQIP (> \$3M)

- Municipal water quality BMPs/erosion and sediment controls

- Watershed Inspection Program

- Educational workshops re WQ/lake friendly living

- Water chestnut control in watershed

Many other local initiatives



What should be done next?

Continuing surveillance, monitoring, and reporting

Canandaigua Lake Watershed Council, FLCC, SUNY ESF,
DEC and others should continue to work together to
document and study blooms and WQ in the lake

Data should continue to be evaluated

Precautionary messaging- stay away from any heavily discolored
water and surface scums

Work toward controlling nutrients thru watershed management plan

Individuals can help by managing properties- septics, buffers, etc.

Identify and line up funding sources to help support this work

