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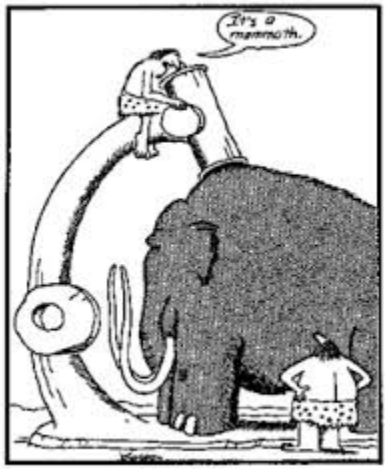
Finding the Bad Stuff

(Challenges in Citizen Monitoring)



Early microscope

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Chief, DOW Lake Monitoring and Assessment Section
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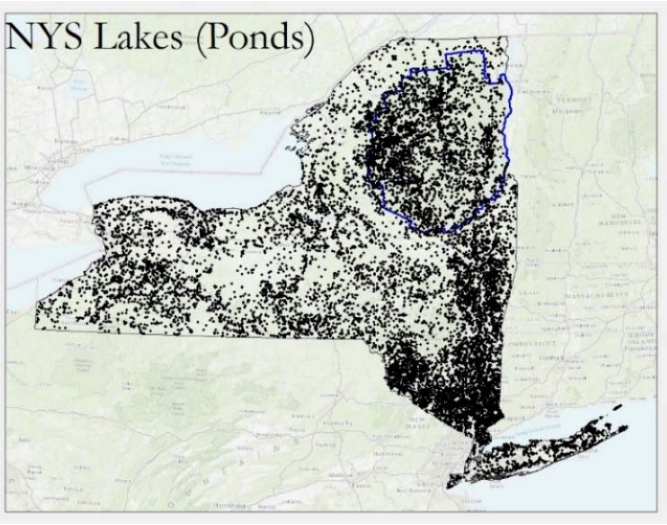
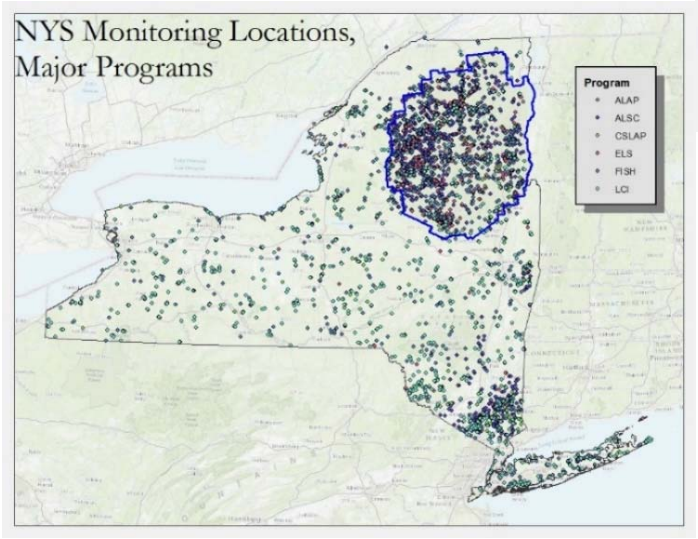
518-402-8286

Many many many NYS lakes, ponds and reservoirs

(7,500-16,000+, more or less)





Long history of monitoring (professionals and citizen scientists)

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What these monitoring efforts have in common…or what is typical monitoring?

Open water sampling

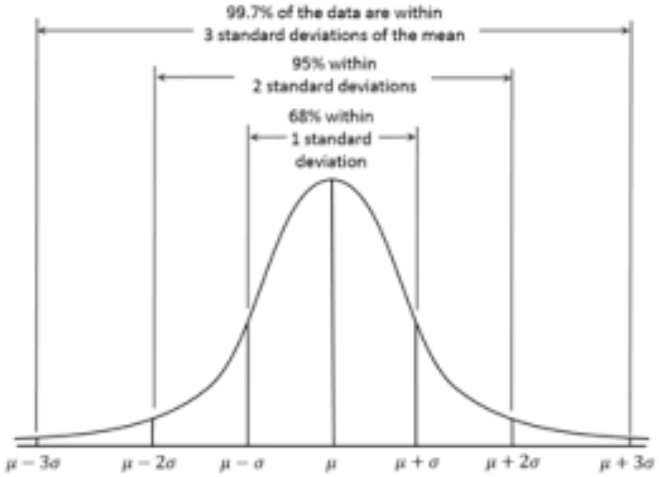
Assumes relative consistency or predictable changes in time (t) and space (x, y, z)

Seeking information about **representative** conditions to

- Characterize for overall waterbody **assessment**
- Identify problems – general water quality or specific issue

Measuring stuff

..through chemical signals



…that are normally distributed

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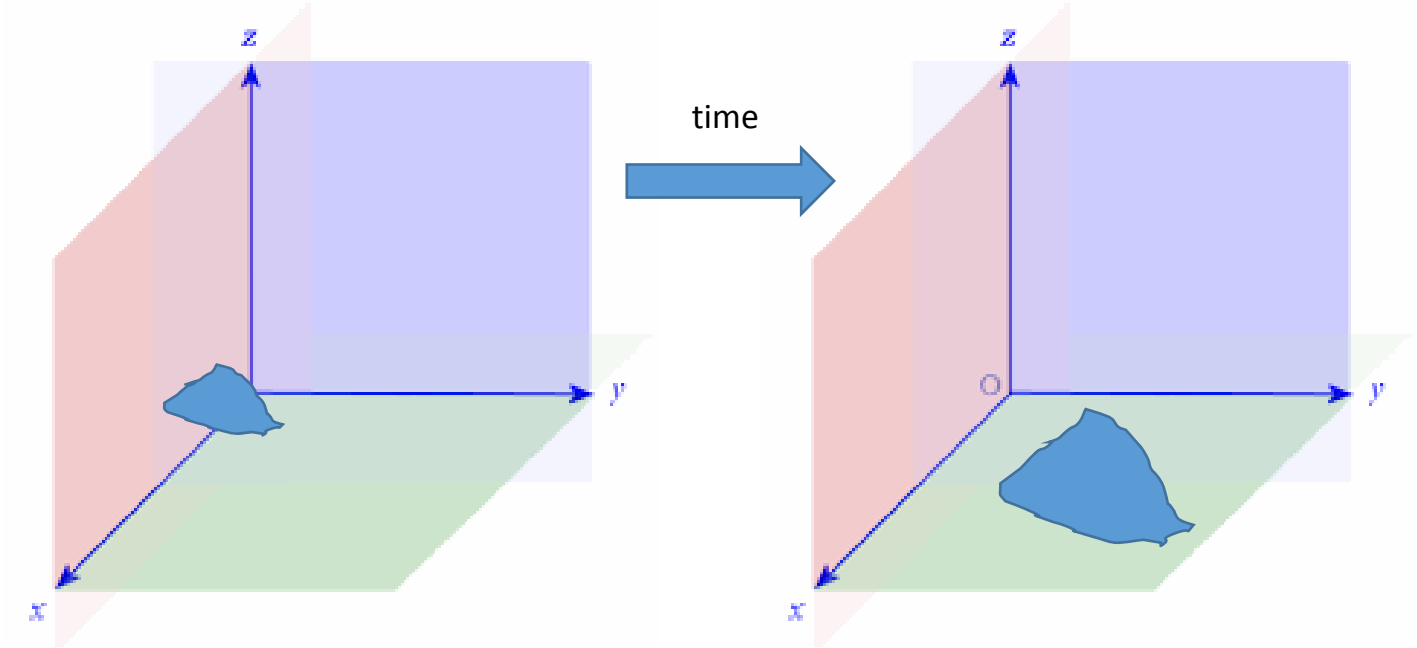
Disorienting to Reorienting



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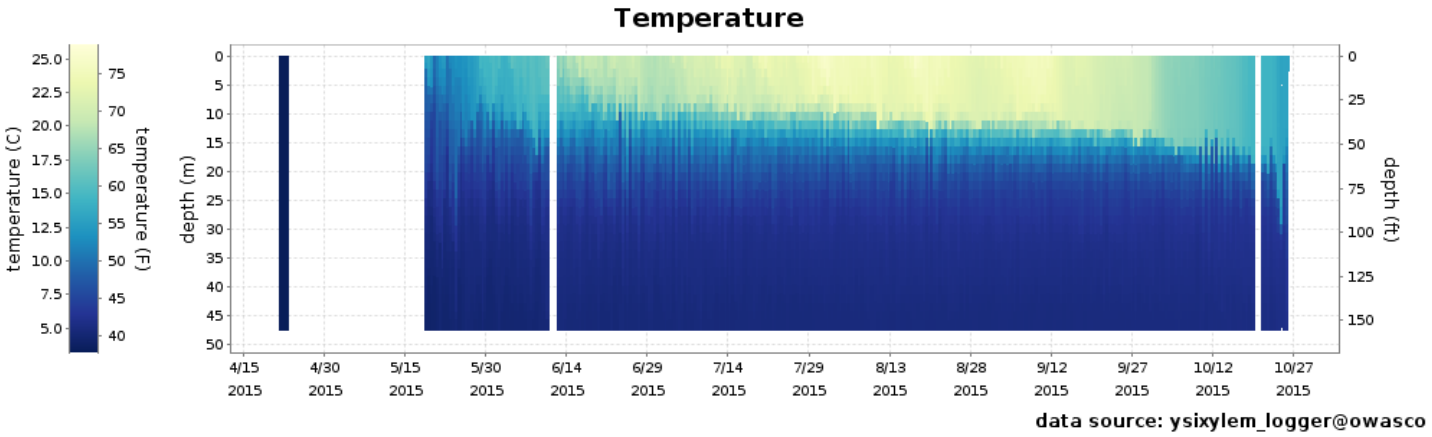
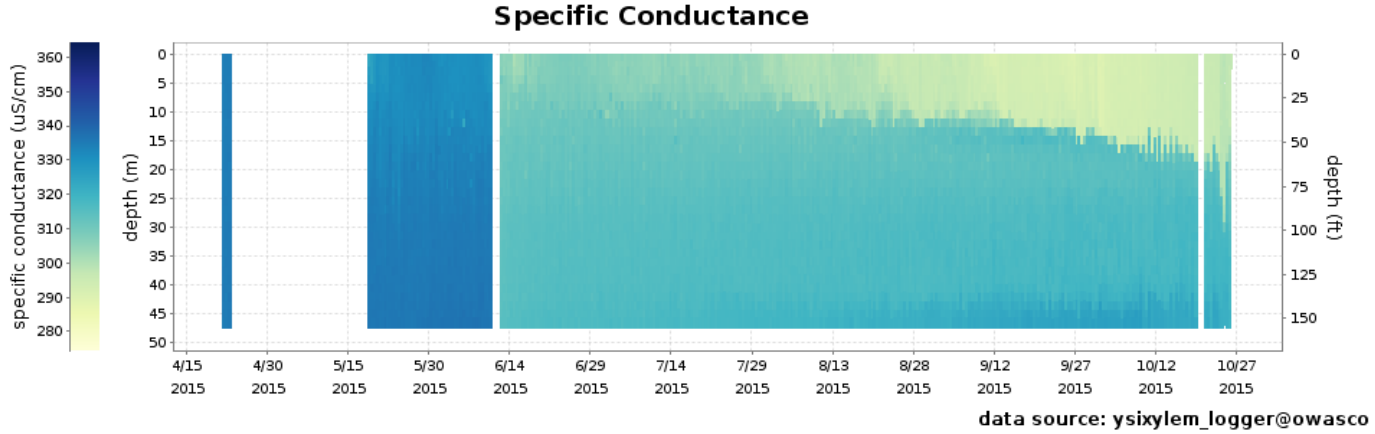
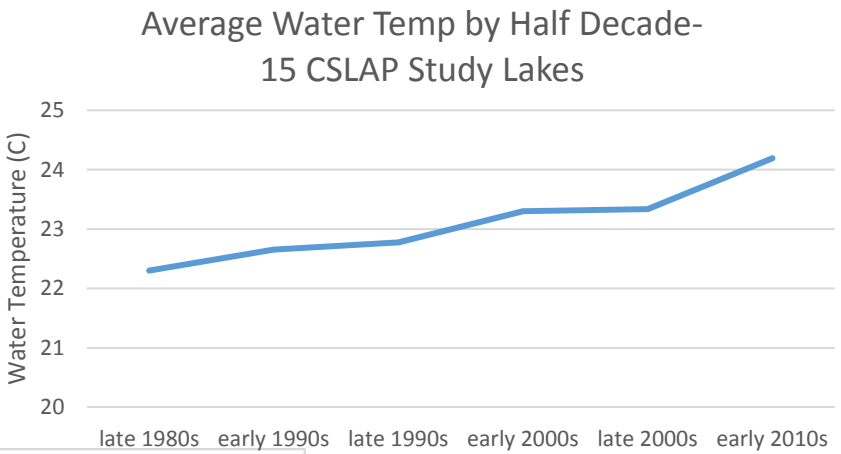
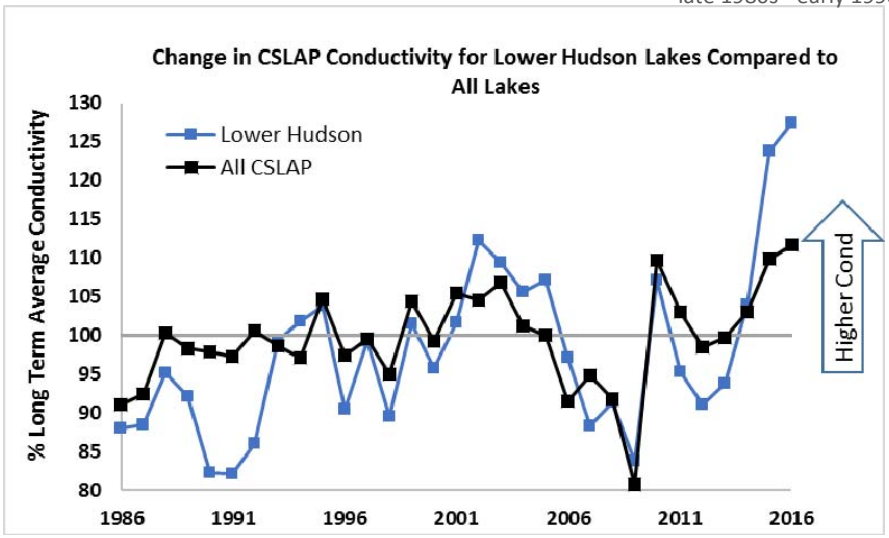


Physical and chemical indicators are often fairly stable in space and time



Routinely collected data can lead to….





(whether collected from professionals or citizen scientists)

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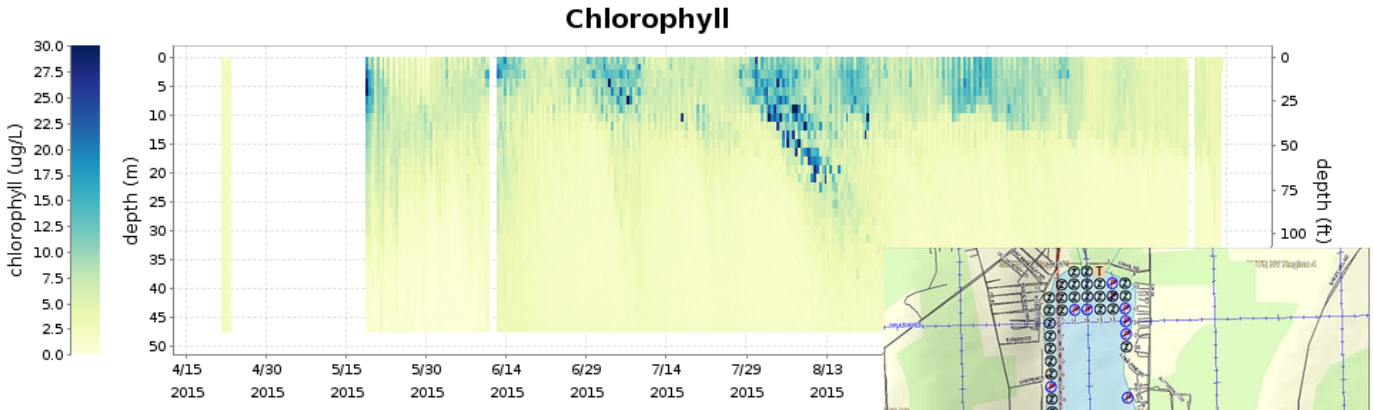
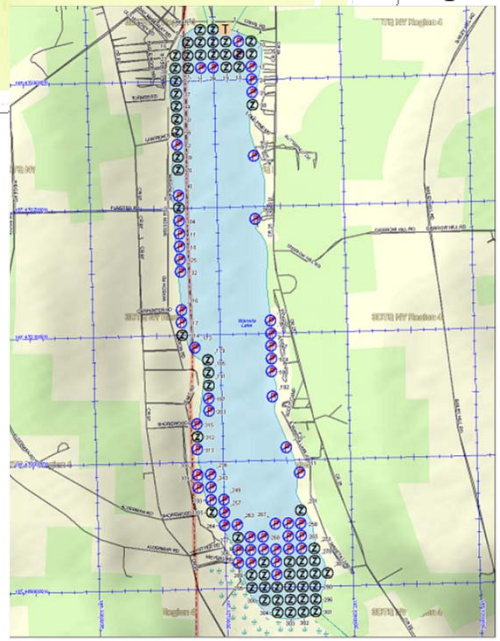
Some indicators more heterogeneous in time (t) and space (z)



…or in xy space



These differences may be important if sampling objective is presence / absence (“finding stuff”) rather than characterization

Agency/professional vs. citizen science

Professional monitors:

- Highly trained
- Expensive equipment (specialized, continuous,…)
- More legal authority
- Less familiar with local conditions
- “Pop in” sampling (limited x, y, and z; very limited t)

Citizen scientists:

- Some limits on training
- Some limits on equipment
- Less legal authority
- More familiar with local conditions
- “Constant” surveying (limited z, y, unlimited x and t)

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The power of volunteers

Committed and passionate environmental stewards

Donate time and money and effort

Live at lake- responsive to immediate and short-term changes (can adjust to variations in t)

Familiar with what is “normal” at their lake

- Can detect changes in lake condition (x and y)
- Can identify when unusual event occurs

Environmental data used to manage lake (most lake management in NYS is local and not regulatory)

Expands data collection throughout the state – beyond Agency survey sites= greater understanding of regional patterns and issues

Of all the issues plaguing all (some) of the lakes in all (part) the state….

Harmful algae blooms

Invasive Species

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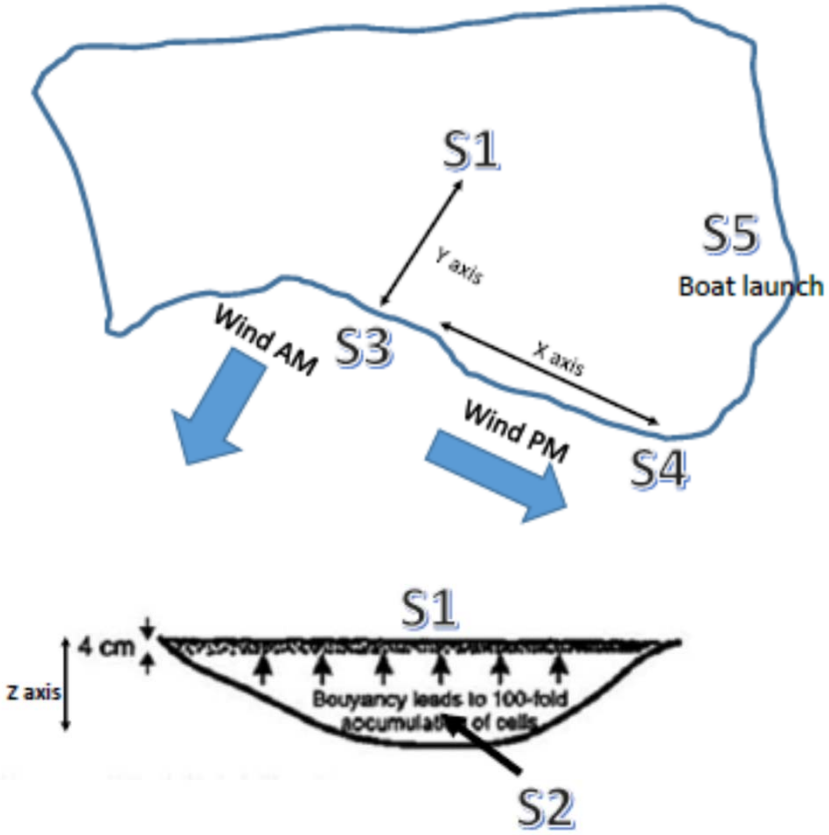
HAB sampling challenges



Imagine a lake with five possible bloom sampling locations

S1 = mid lake (open water): representative?

(S2 = near the bottom in the middle)

S3 = shoreline not used

S4 = SE corner, some use

S5 = boat launch, heavy use

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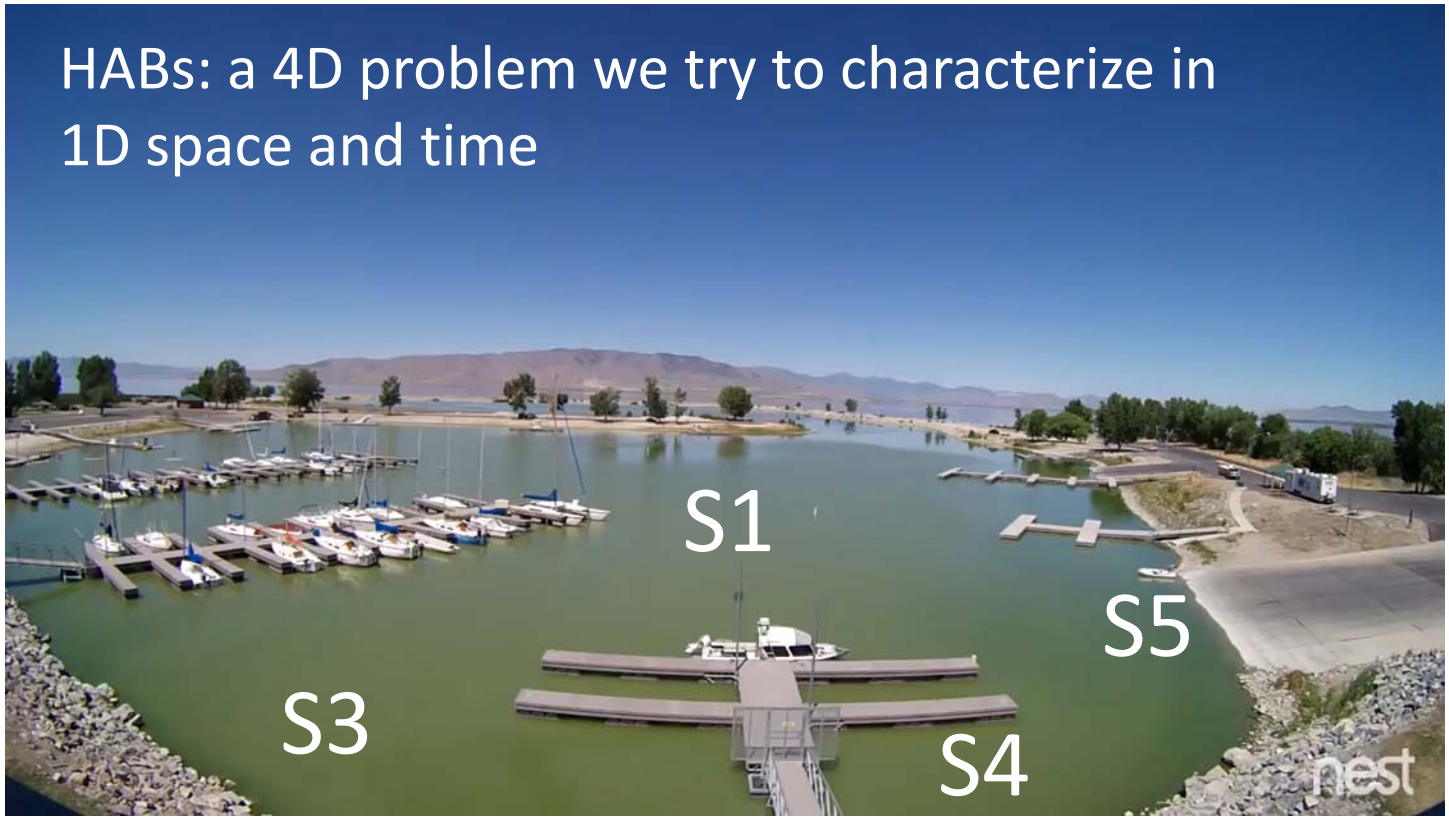
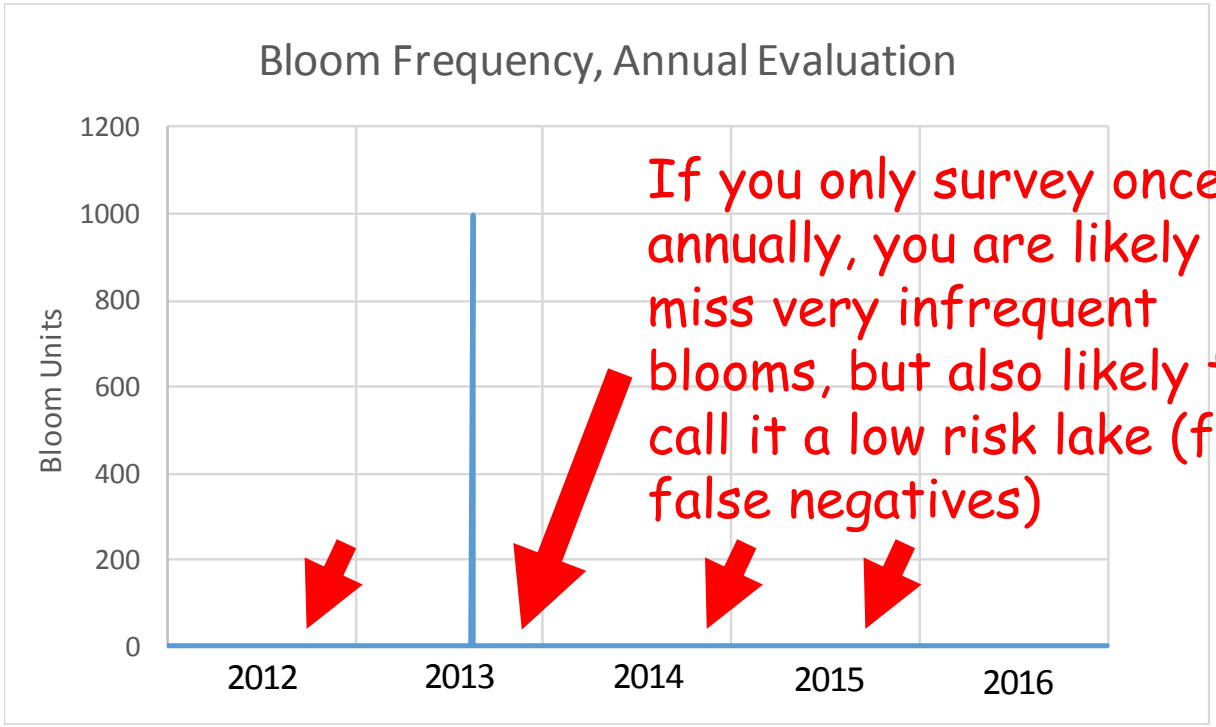
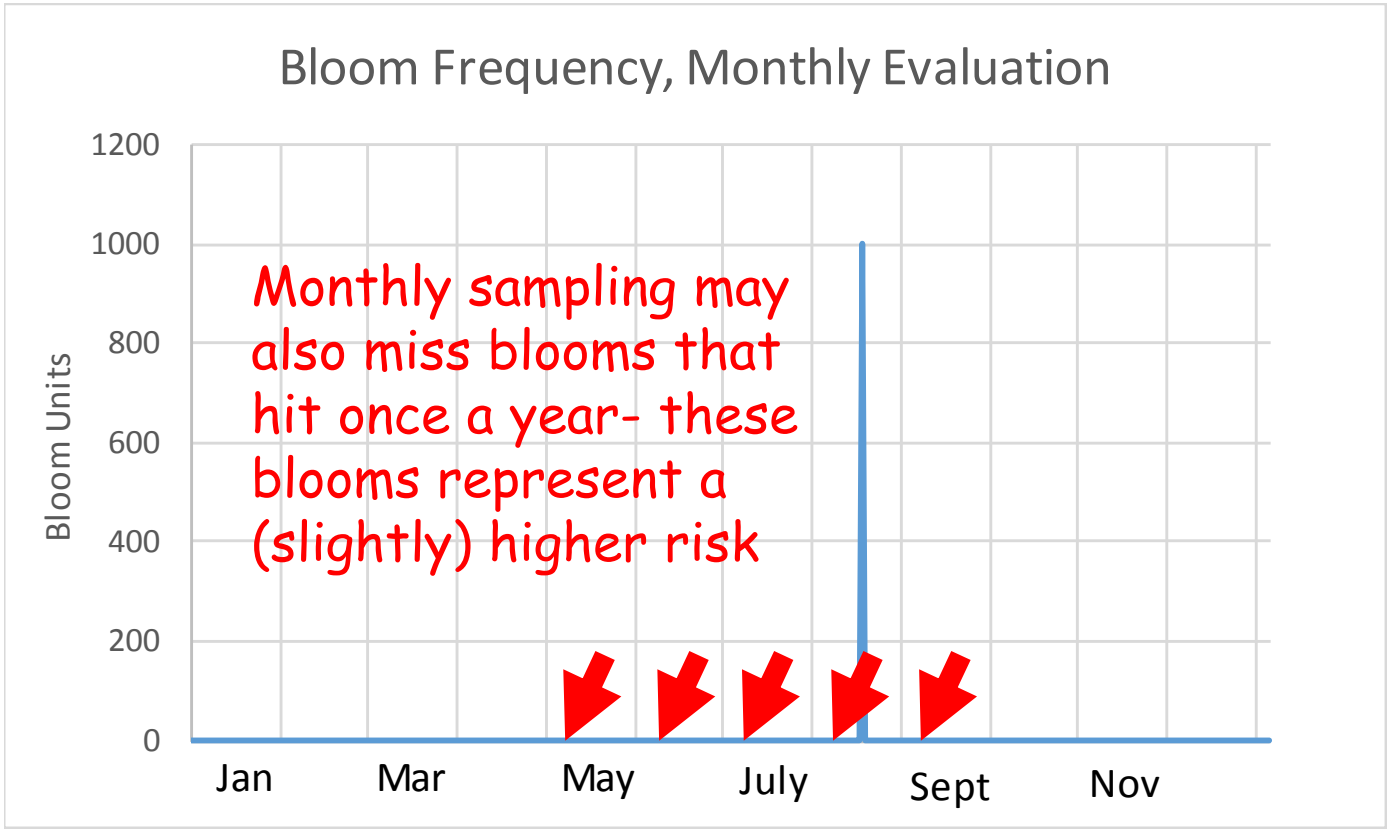
HABs: a 4D problem we try to characterize in 1D space and time



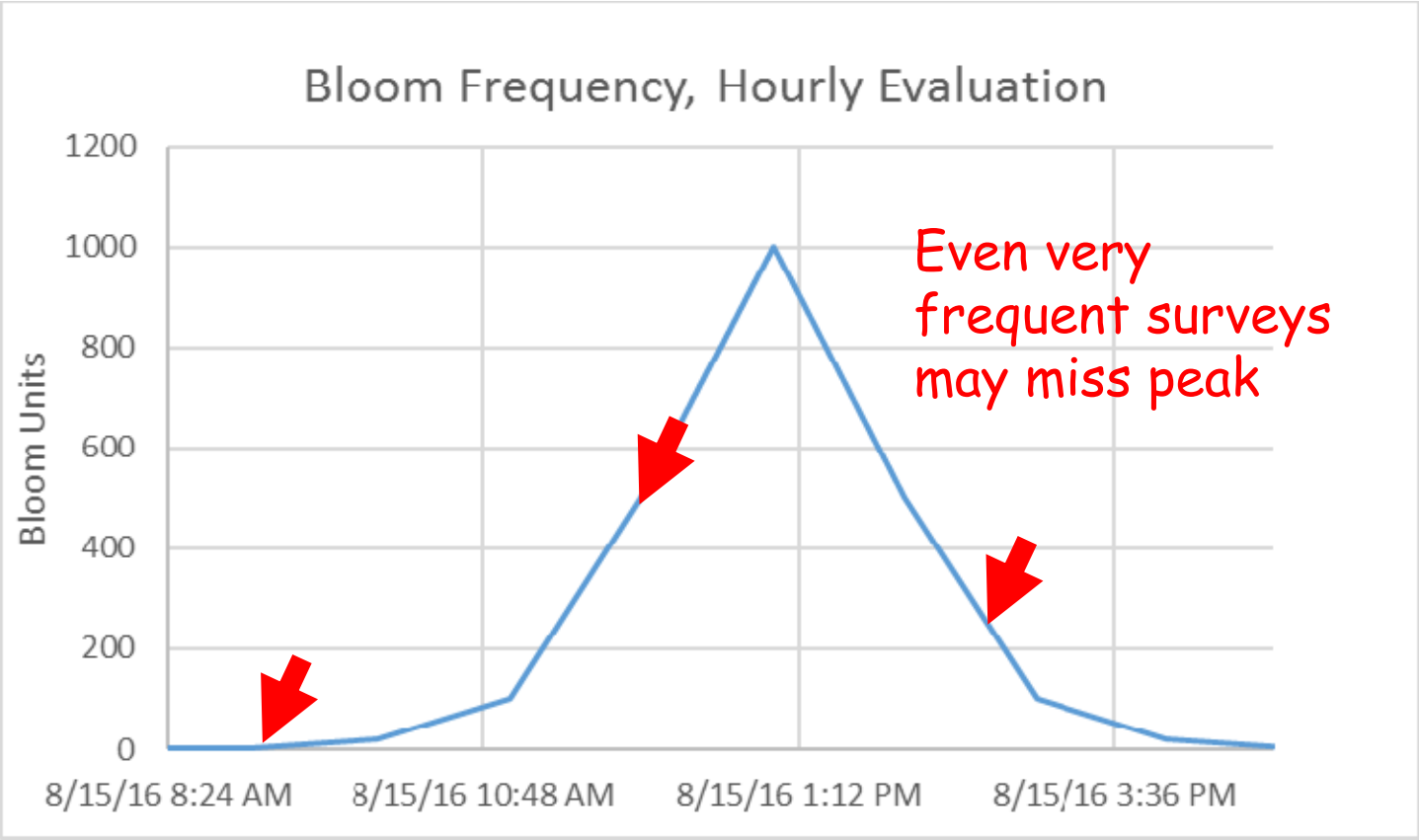

nest

Time Factor

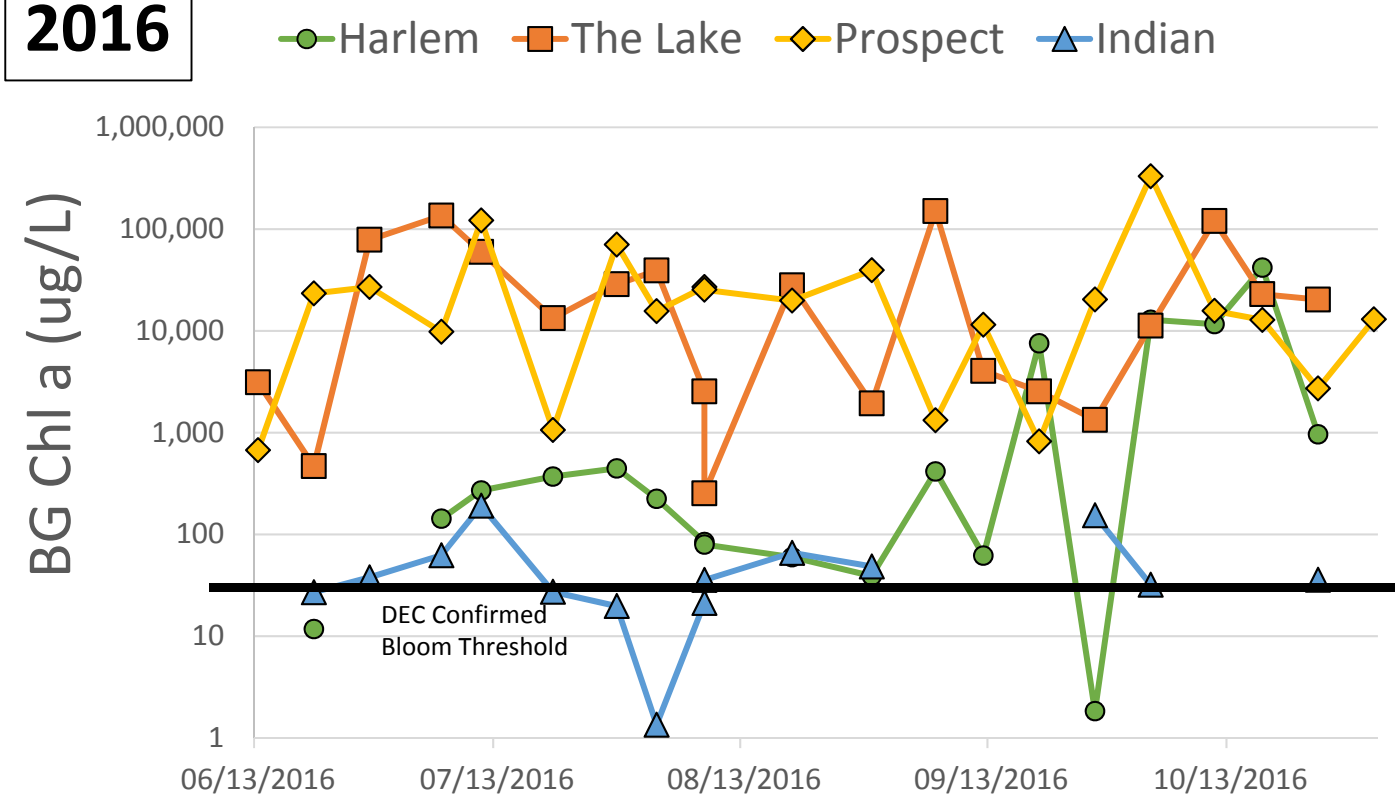

Bloom Frequency, Annual Evaluation
Bloom Units
1200
1000
800
600
400
200
0
2012
2013
2014
2015
2016
If you only survey once or annually, you are likely to miss very infrequent blooms, but also likely to call it a low risk lake (few false negatives)


Bloom Frequency, Monthly Evaluation
Bloom Units
1200
1000
800
600
400
200
0
Jan
Mar
May
July
Sept
Nov
Monthly sampling may also miss blooms that hit once a year- these blooms represent a (slightly) higher risk

Single blooms may be more like this….



2016



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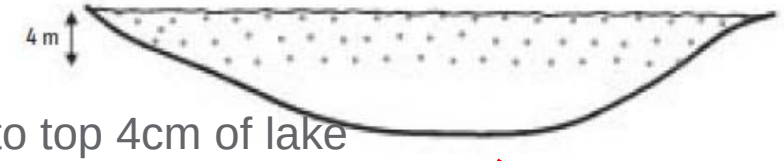
Up and Down: Z factor



Buoyancy:

- Concentrate from top 4m to top 4cm of lake
- Migrate top to bottom of photic zone (and back)

Types:

- Floating
- Suspended
- Benthic

Sampling:

- Picking wrong depth/sampling types misses layer
- Huge implications for PWS and beaches

Timing:

- May be at different depth at time of sample
- Differences in toxins (lingering Z)

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Example of Z

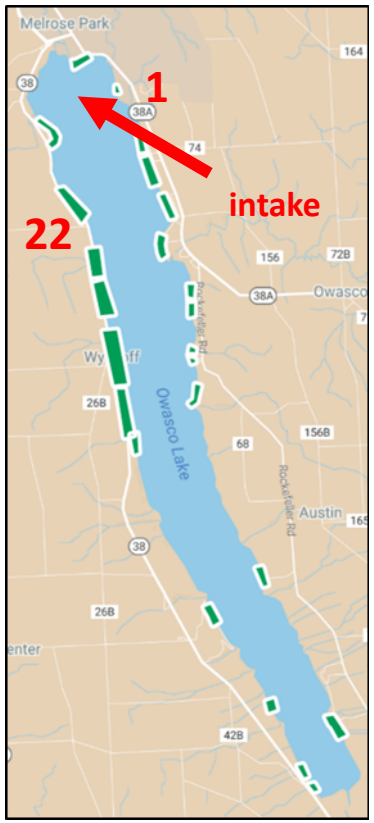
Owasco Lake Drinking Water

- 30+ feet deep intake
- Bloom first observed at plant on 9/22
- (Low level) toxins first detected at plant 9/25

Blooms documented in this time and area

- Only widespread bloom 9/19 reported NE side (zone 1)
- Only widespread bloom on 10/3 reported NW side (zone 22)

None reported in open water at that time



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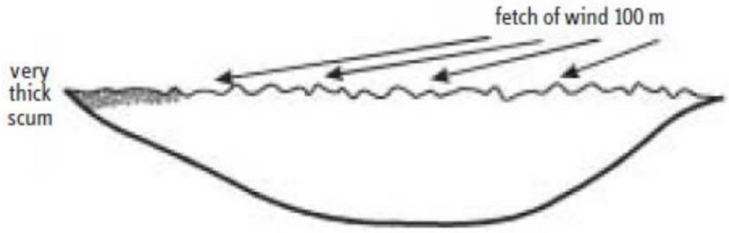
Y Factor



Wind movement

- Push / concentrate blooms from center to shore
- Blooms pushed into isolated coves may not escape
- WHO: can concentrate 10-1000x
- How much vertical movement (Z) near shoreline?

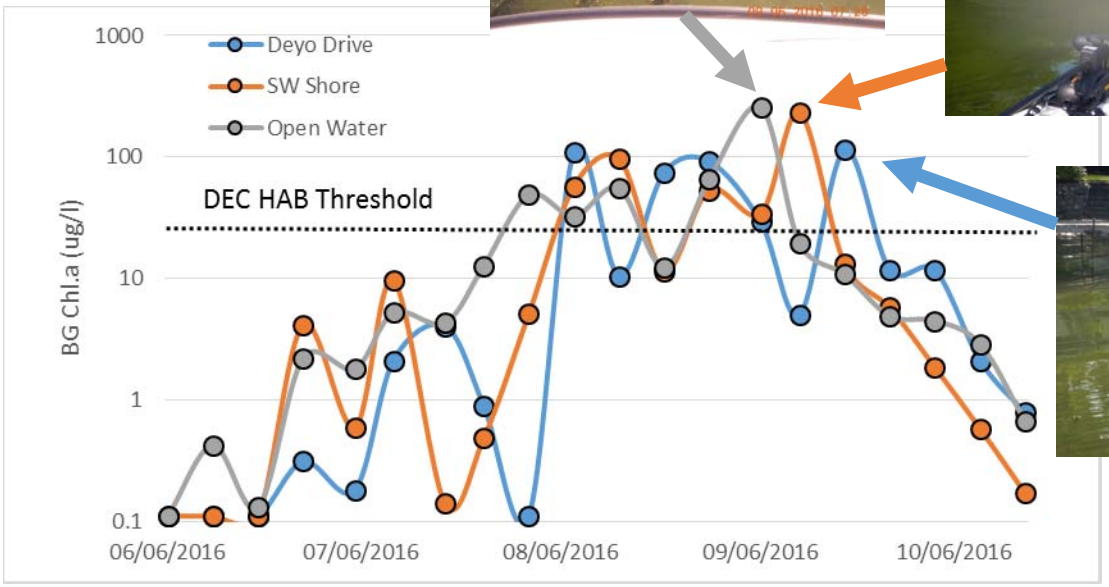
Blooms vs toxins

- Are they most concentrated at shore?
- Are they synchronized (bloom and toxin peak)?

Timing

- Exposure issues after visual evidence gone
- Surveying and sampling issues (shoreline vs. boat, access,…)

Lessons in Y: Honeoye Lake



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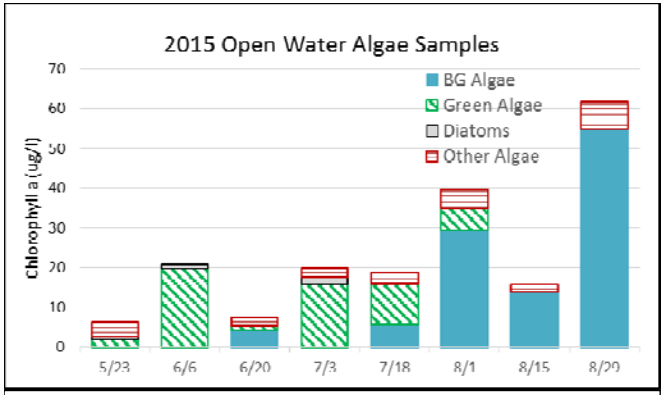
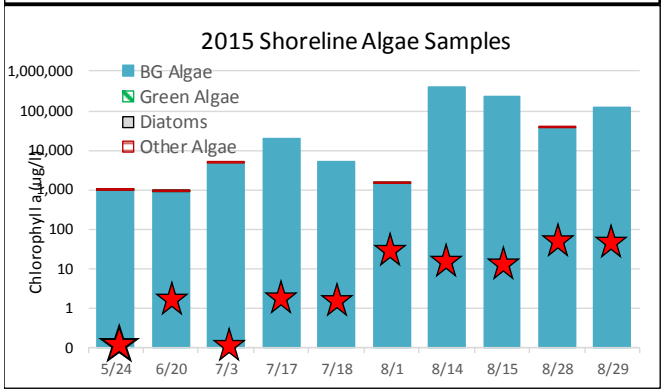
Deans Pond





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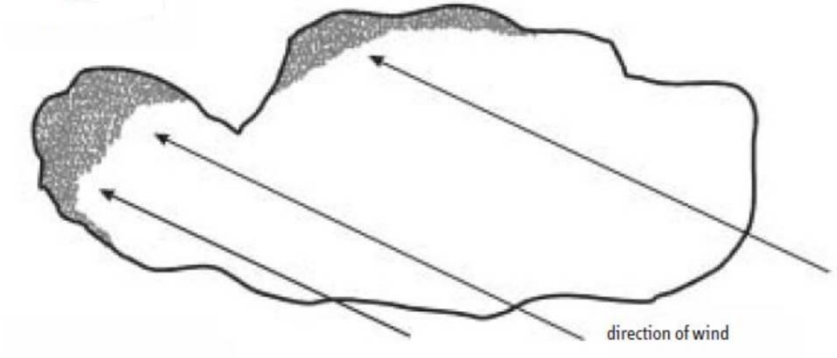
X Factor

Wind movement

- How much do blooms move laterally along the shore? (when does Y movement become X movement?)
- Can multiple shorelines hold trapped blooms?
- How heterogenous are blooms in X space?

Timing

- How long does it take for bloom to move along X?
- When are beaches at risk from lateral X movement?



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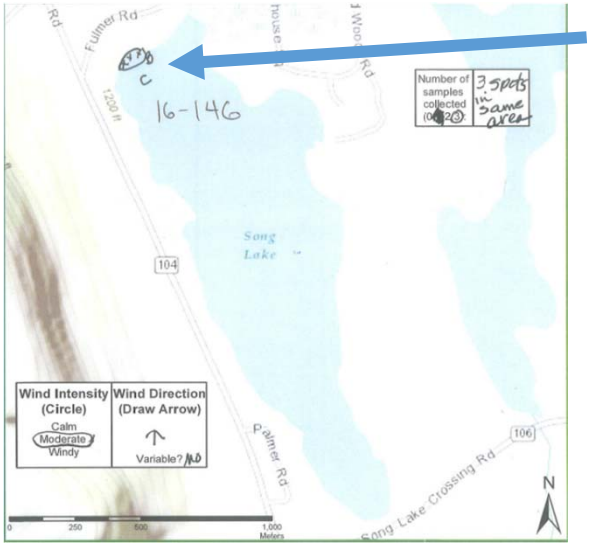

Song Lake bloom reports usually limited to north end of lake:

"Pea soup" bloom, usually wind driven

…except when wind pushes them to the south shore: "green dots"

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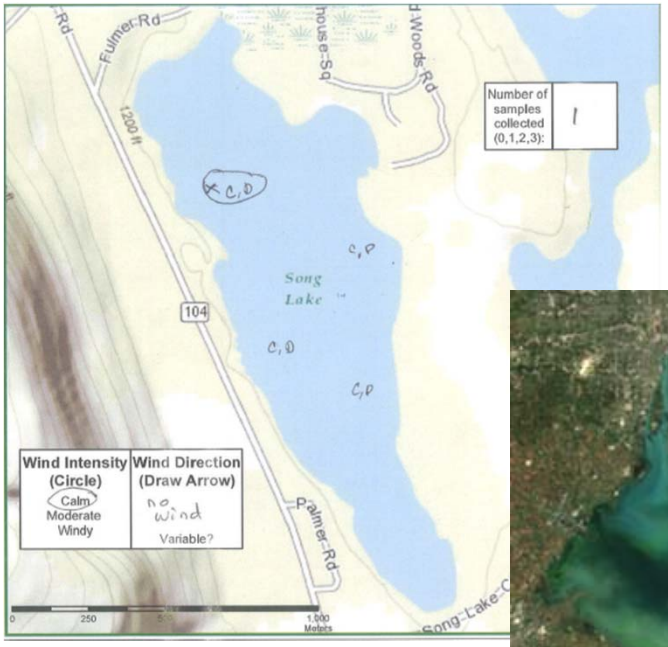
And then sometimes the entire lake is green



- Widespread / lakewide bloom
- Green dots and streaks
- No wind

Sampling and reporting in a 4D world

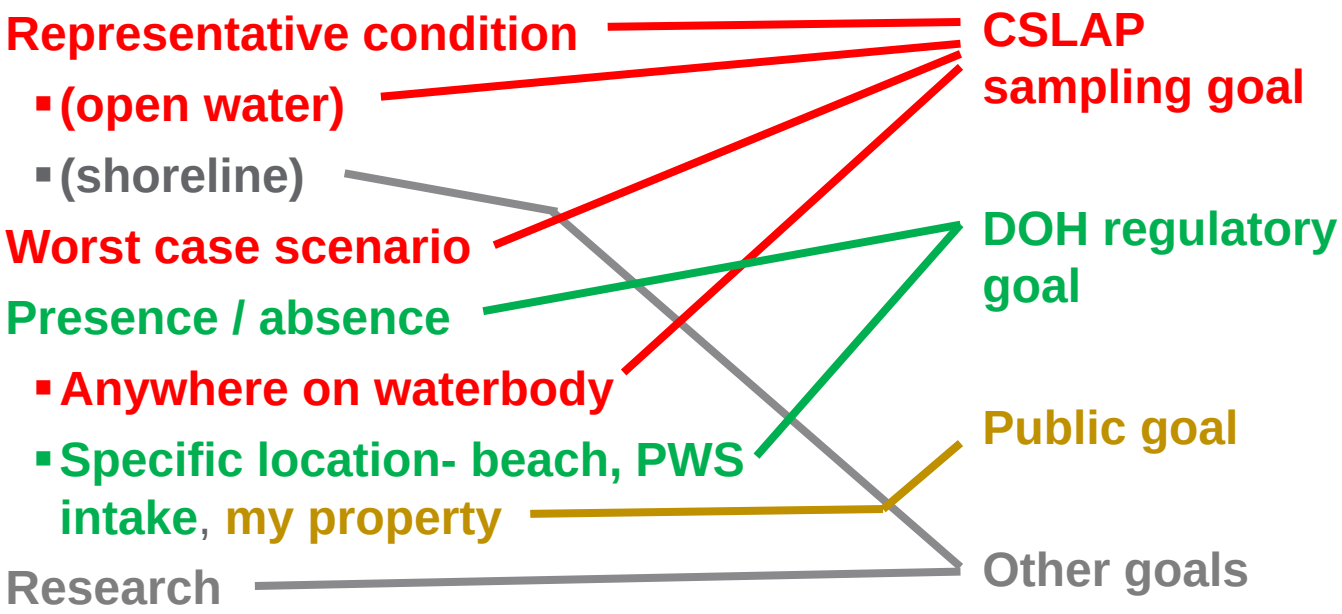
Sampling usually represents a single X, Y, Z and T

How important are variations in X, Y, Z space and T time?

What is the consequence of missing blooms in XYZT?

- Missed in X (impacts for multiple shorefront users)
- Missed in Y (variations in intensity)
- Missed in Z (invisible or impacting deep water intakes)
- Missed in T (do toxins end when blooms end?)

Goals of HABs sampling / surveillance (WHY)?



DEC HABS PROGRAM GOAL = ALL OF THIS

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How to optimize Z, Y, X and T

Z: integrated sampling through photic zone? (at multiple X,Y) water intake sampling? (NOT DONE THRU CSLAP)

Y: surveys along perpendicular transects? Assume max bloom at shore? Use of remote sensing, buoys and drones? (CSLAP OPEN WATER/SHORE SAMPLING)

X: inspect entire shoreline? Leeward shore only? Drones? (EXTENSIVE USE OF SHORELINE SURVEILLANCE ZONES/TEAMS)

T: survey at specific times (AM)? Before weekend exposure? (NOT DONE THRU CSLAP)

Challenges in XYZ:

Finding a needle in a haystack?

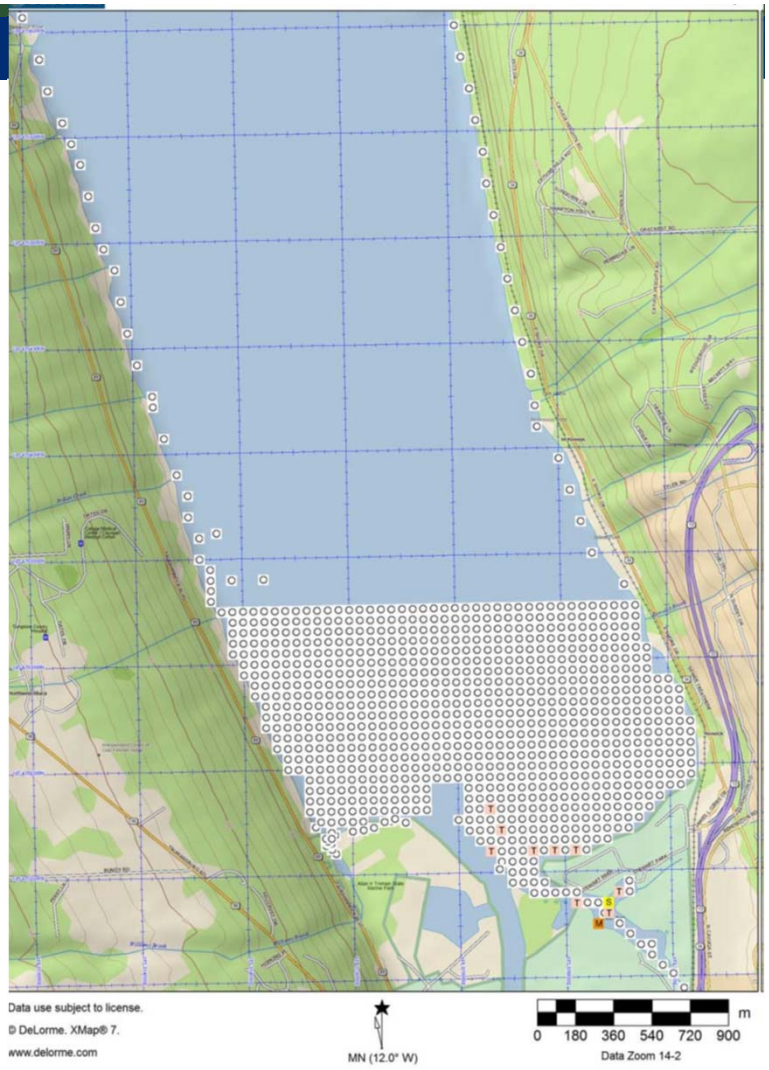
2013 Cayuga Lake survey

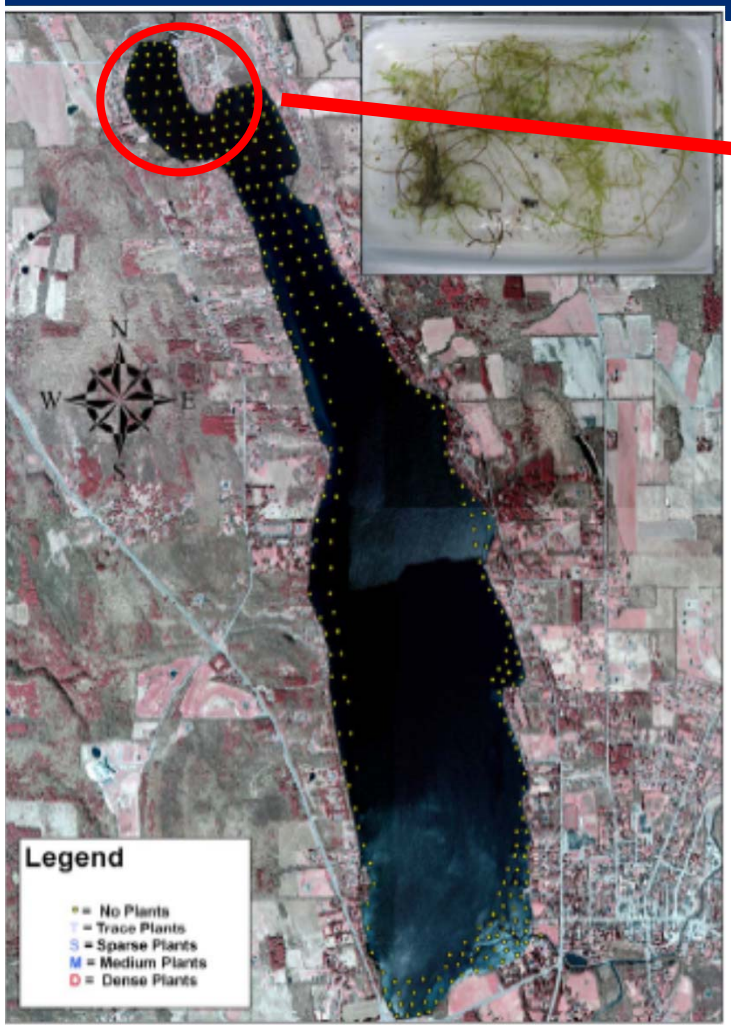
Hunting for hydrilla in the lake

50m x 50m grid

1942 rake tosses (2 per site)

Hydrilla found in <1% of sites





FINDING THE GOOD STUFF

Callitriche hermaphroditica
(autumnal starwort)

Found in 1 site of 304 in 2008, 2009

Not found 2010-2016

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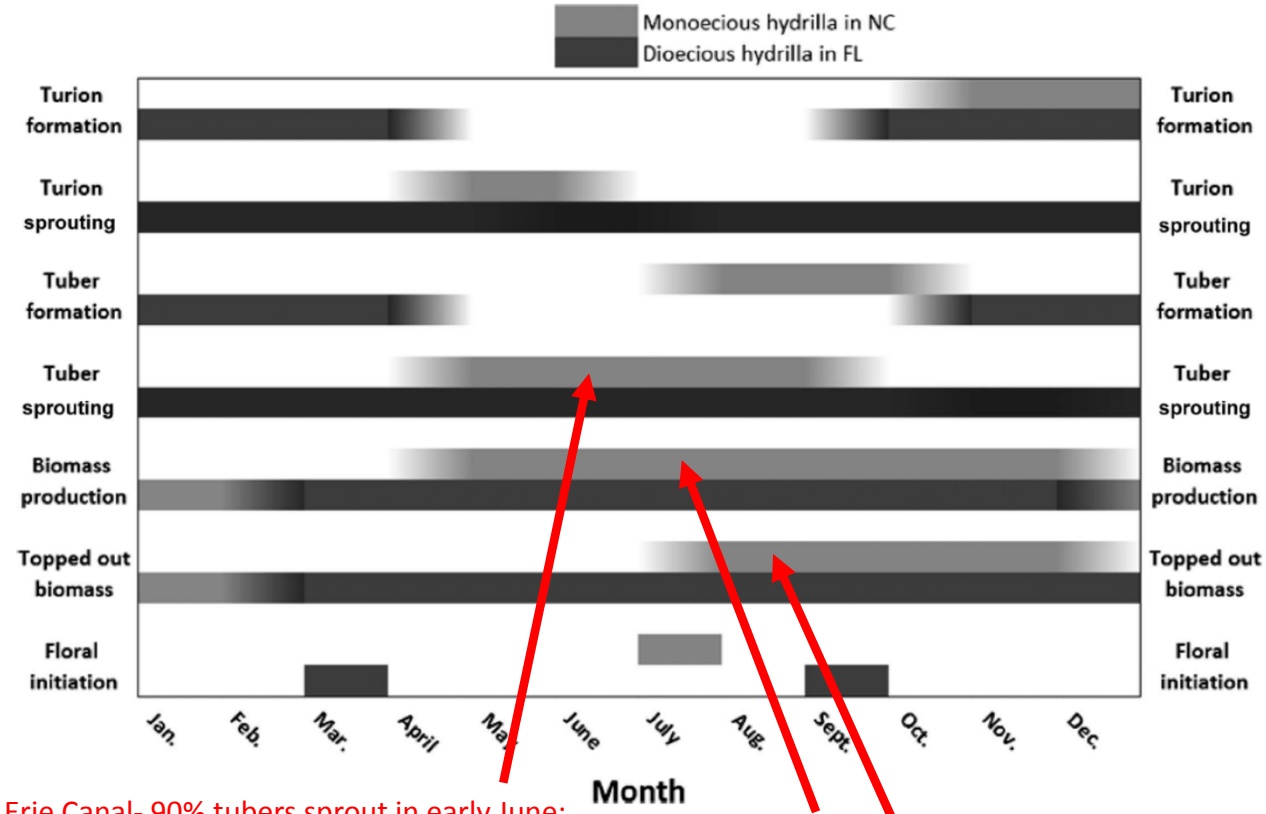
True-Meadows et al, 2016



Erie Canal- 90% tubers sprout in early June; start of herbicide treatment window

…but plants don't emerge until late June to early July

…and may not be visible until late summer

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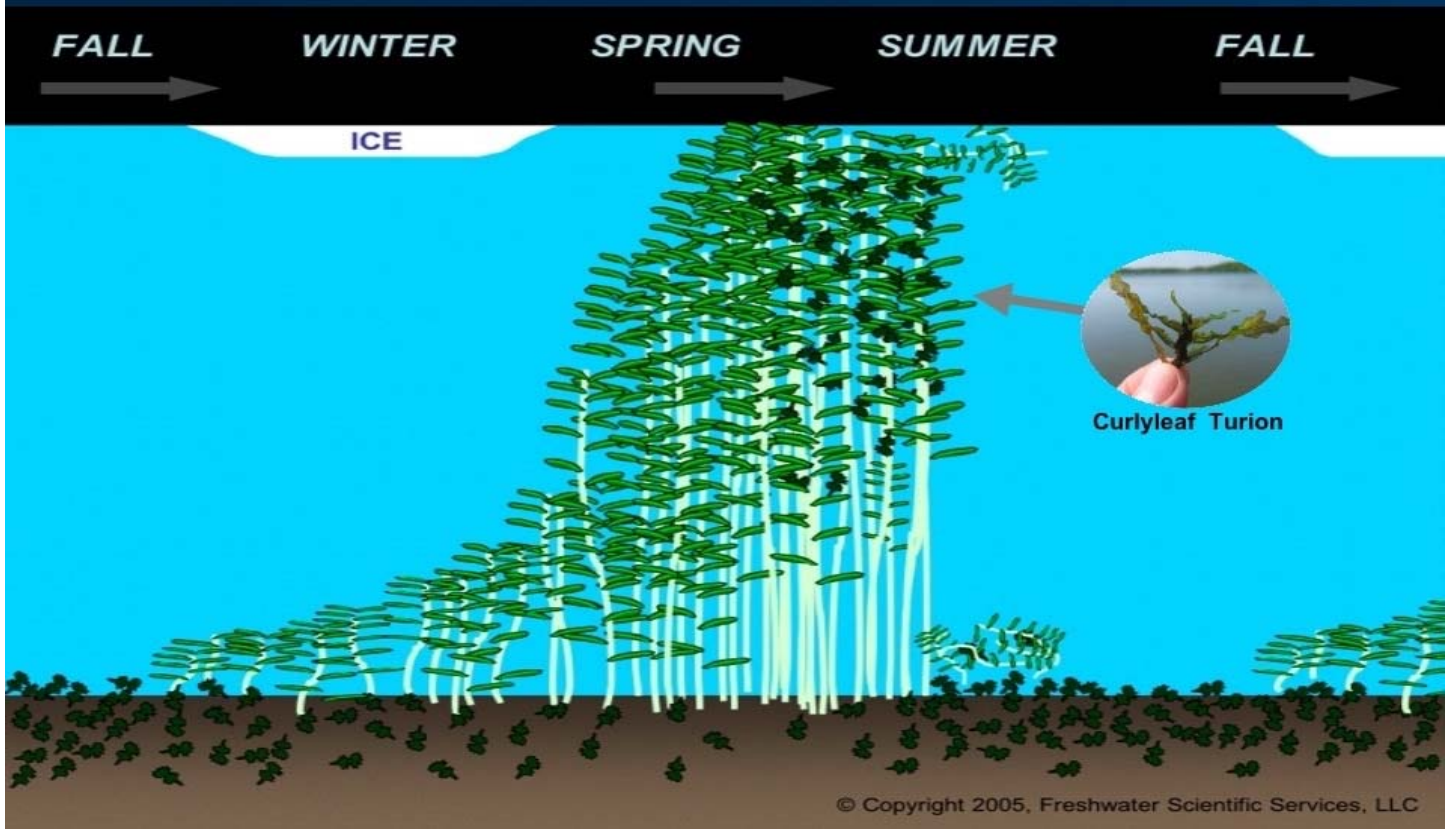
Curlyleaf Life-Cycle in MN

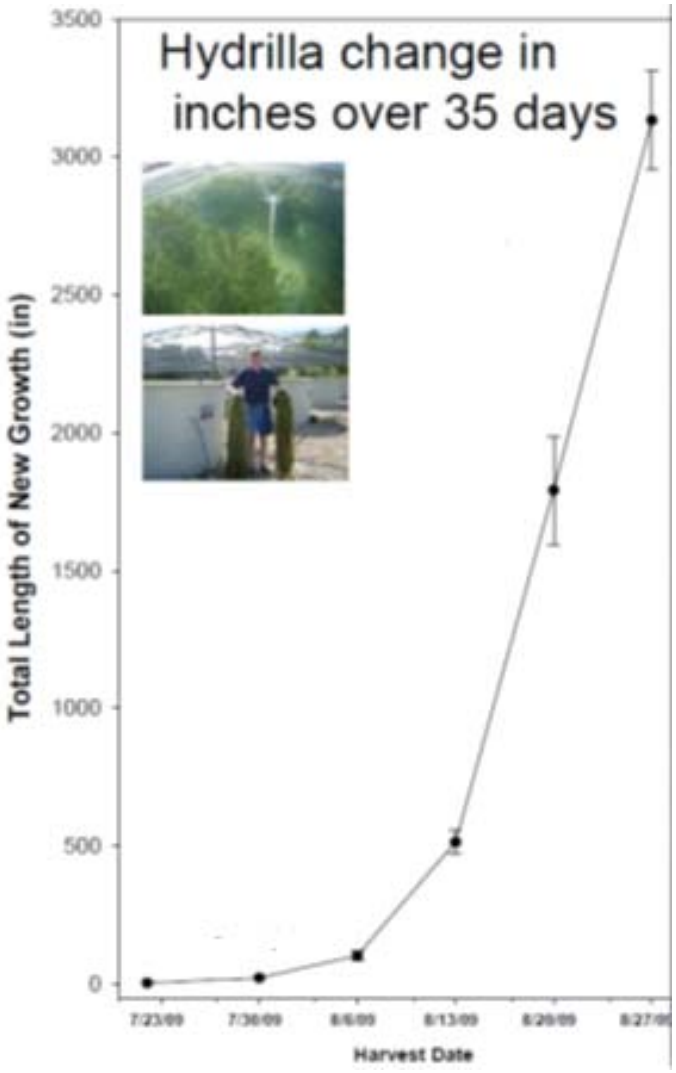


Challenges in T

When you look might determine what you find

Plant growth cycle may be out of sync with surveying timeline

Implications of missing (too early) can be significant



Why do we care?

Costs for AIS management

Cayuga hydrilla (74+ acres) = $300-500k annually

Erie Canal hydrilla (15 miles) = $500k annually

Ecological impacts

Loss of eelgrass /SAV in Hudson River

Avian Vascular Myelinopathy (AVM)

Significant oxygen swings

Recreational and economic impacts

Clogging boat propellers

Elimination of swimming and bathing areas

Loss in property values

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The hammer

PIRTRAM = point-intercept, rake toss, relative abundance method

USACE standardized technology

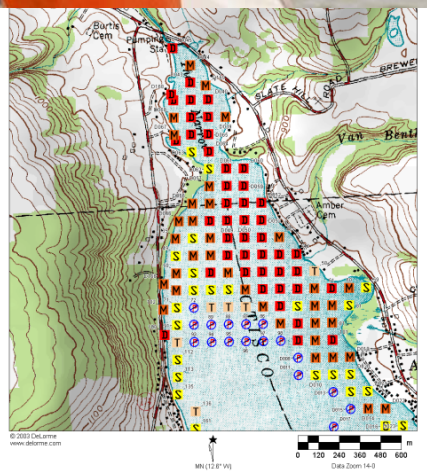
- Tethered two sided rakes
- Uniformly distributed grad sampling points
- Cornell-derived relative abundance scale

Advantages:

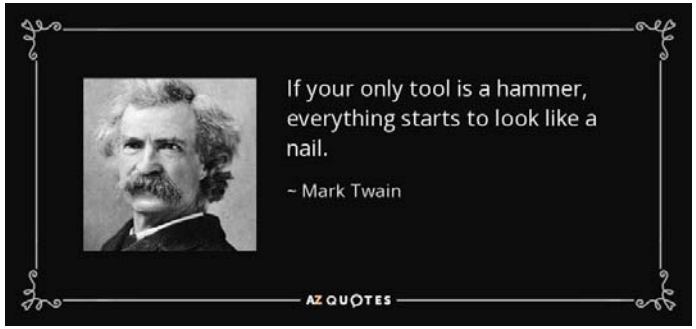
- Relatively easy to monitor many sites
- Lake to lake comparisons
- Collect/ID submergent plants from surface

Disadvantages:

- Some plants missed by rake
- Does not hit every nail



The nails



Find (some/all) taxa in waterbody
- Plant lists
- FQI

Find evidence of initial infestation of specific AIS
- Early detection
- Rapid response

Evaluate frequency distribution of specific or all taxa

Estimate biomass or abundance
- Modified FQI
- Evaluate plant control measures

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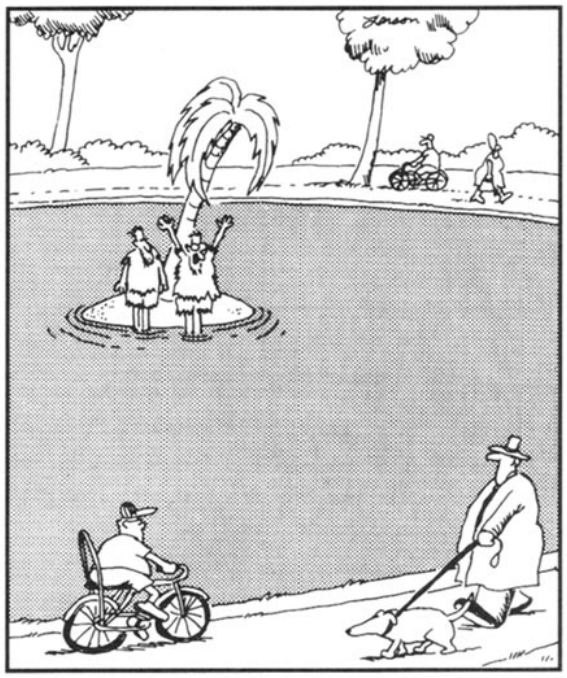
How to best find AIS?



"Yes! Yes! This is it, Sidney! The guy with the dog! ... I think he sees us!"

NYSFOLA shoreline AIS surveys?

Focus on areas where AIS likely to be found or wash up

Might help to narrow focus and identify where to look (more carefully)

Go to Jan Andersen's talk for more information

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How to resolve AIS XYZT issues

SUNY Albany/DEC (NEAPMS / U Hartford?) Study of alternative methods

- shoreline visual survey
- boatover survey
- diver assisted line intercept survey
- remote sensing methods
- hydroacoustic surveys
- eDNA methods (future)

Study design

- lakes with limited evidence of AIS w/ extensive PIRTRAM data
- lakes with no evidence of AIS
- lakes with multiple access points near other AIS sites

In the meantime….

Optimize Z: focus look on the surface where plants are visible and could spread more easily

Optimize Y: look on the shoreline- fragments more likely to land there

Optimize X: focus on the areas where plants are likely to land or grow- boat launches, inlets, outlets,..

Optimize T: look at the times when plants are likely to be visible (but not too late to prevent their spread)

At the end of the day…..

Lake issues increasingly dominated by stressors that defy traditional monitoring strategies

Complexities in XYZT require alternative surveillance methods

Citizen scientists play an indispensable role in this surveillance

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