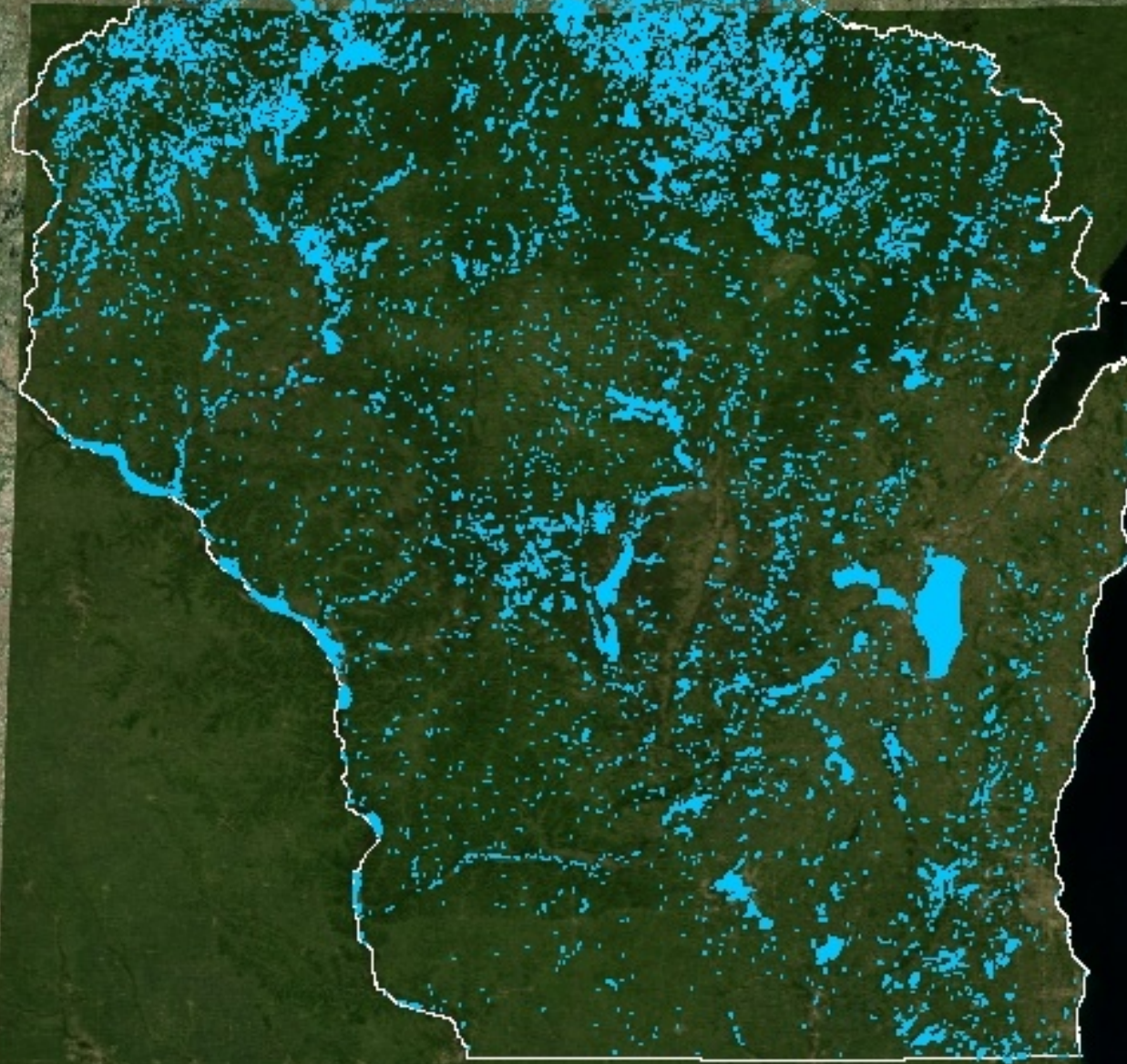


A woman with short brown hair and glasses, wearing a bright pink polo shirt, is leaning over the side of a white boat. She is smiling and holding a white rope that has a yellow float attached to it. The rope is being lowered into the dark blue water. The boat's interior is visible in the foreground, showing a blue seat and a black frame. The background is a vast expanse of water with gentle ripples.

How the DNR Uses Citizen Lake Monitoring Network Data

Katie Hein

14,300 lakes > 2.5 acres



In 1986, 126 volunteers began monitoring Secchi depth on 111 lakes



Slide from
Carolyn Betz

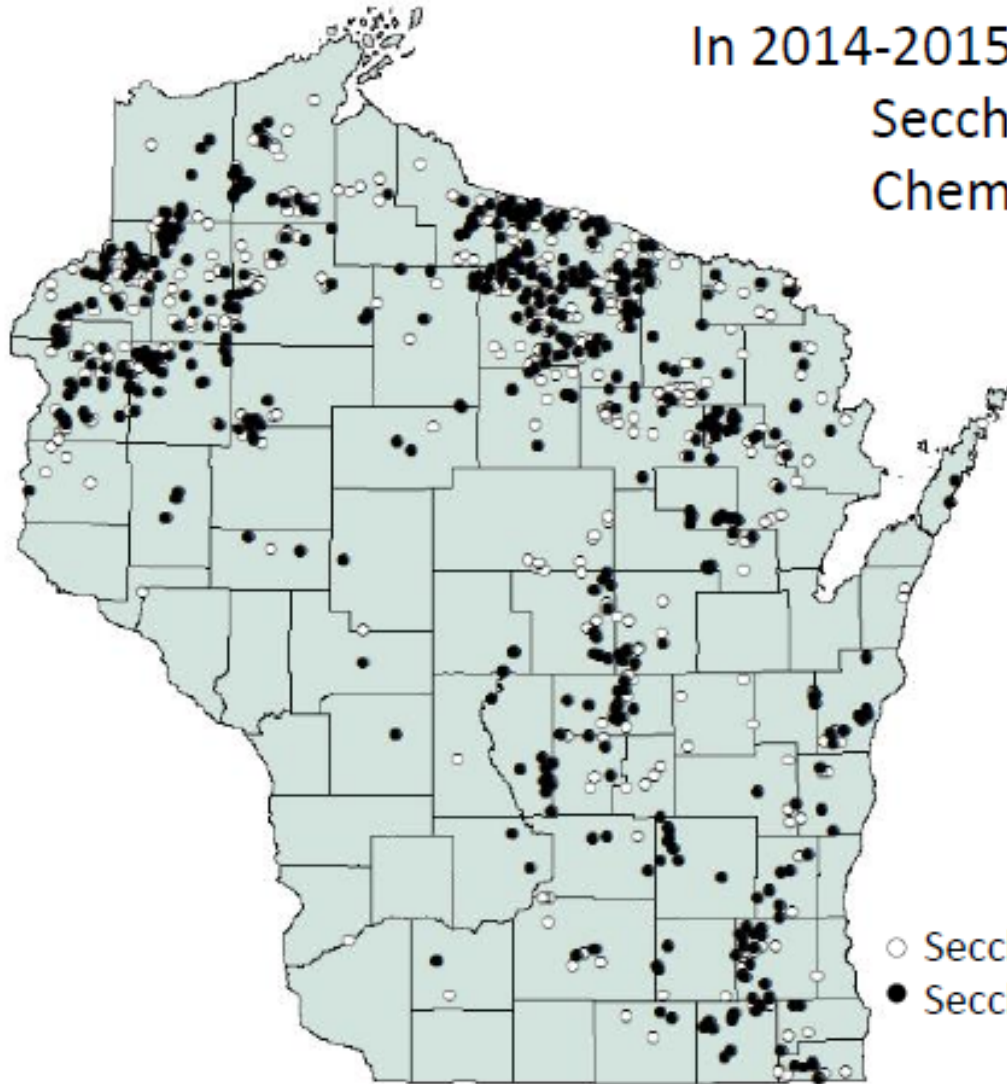
Now volunteers monitor much more!

- Phosphorus
- Chlorophyll *a*
- Temperature
- Dissolved Oxygen
- Aquatic Invasive Species
- Lake levels



And volunteers monitor MORE lakes!

In 2014-2015, citizens monitored:
Secchi depth on 1006 lakes
Chemistry on 542 lakes



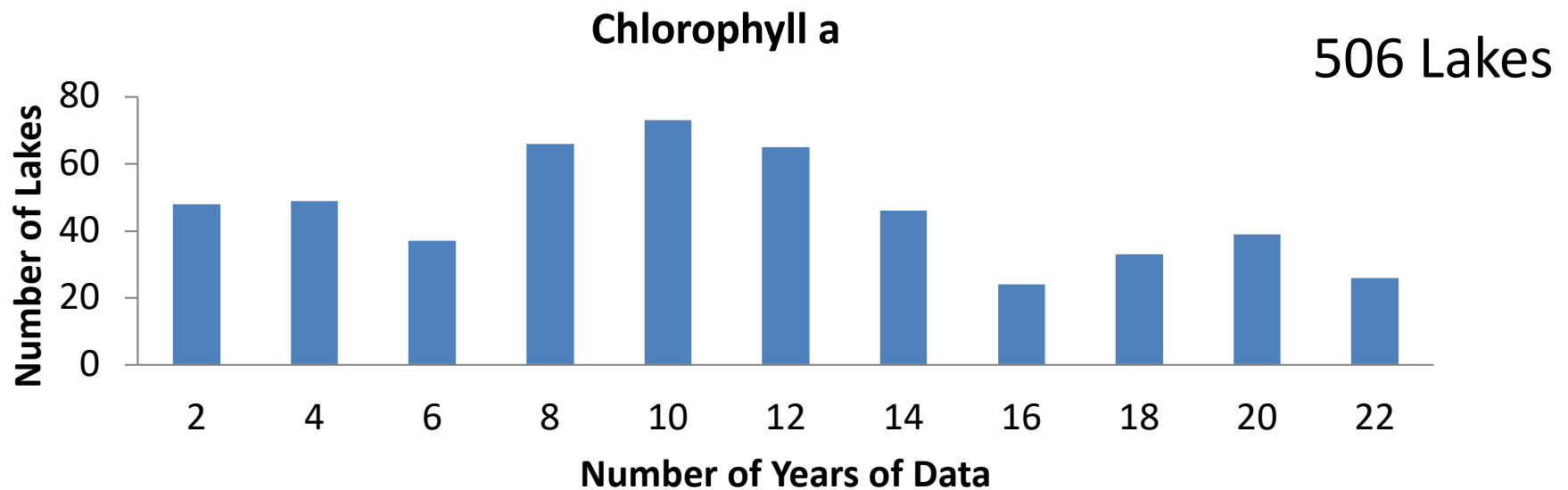
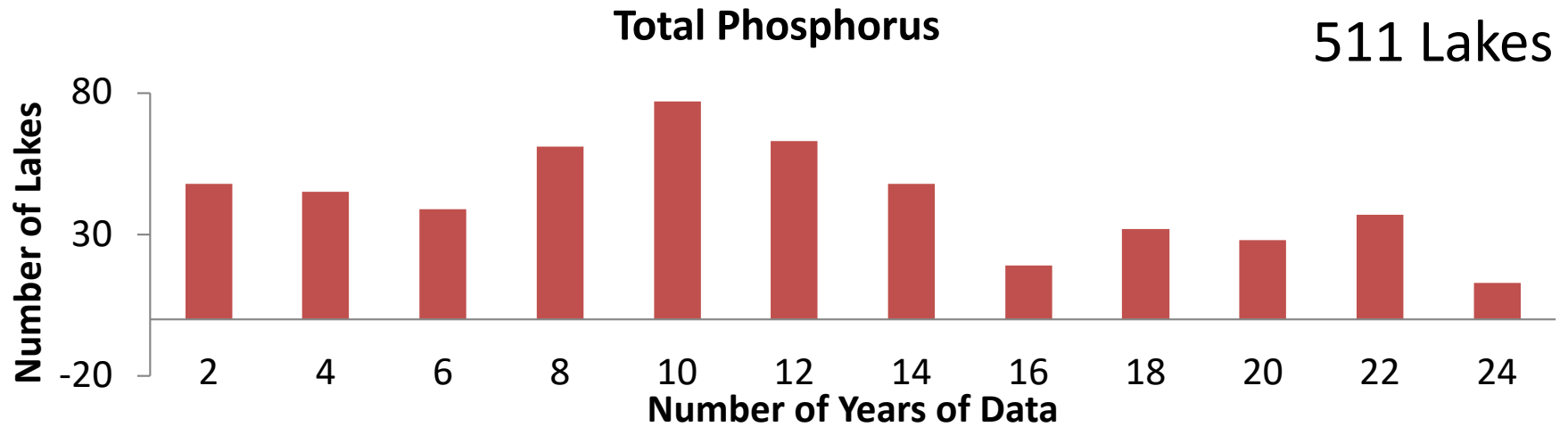
Bimonthly:
Secchi depth



Spring and 3 X's in summer:
Total Phosphorus
Chlorophyll *a*

- Secchi only
- Secchi, Chl-*a*, TP

Length of Chemistry Record



A background image of a calm lake with a misty atmosphere. The water is still, reflecting the sky and the trees on the right. The trees are dark and dense, framing the right side of the image. The sky is overcast and grey.

Volunteer Data Provides Answers:

- Clean Water Act
 - How healthy are Wisconsin lakes?
- Policy
 - What standards will provide good water quality?
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 - How can we better manage our lakes?
- Research
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Clean Water Act Goals

Restore Impaired Waters



Protect High Quality Waters



Compliance

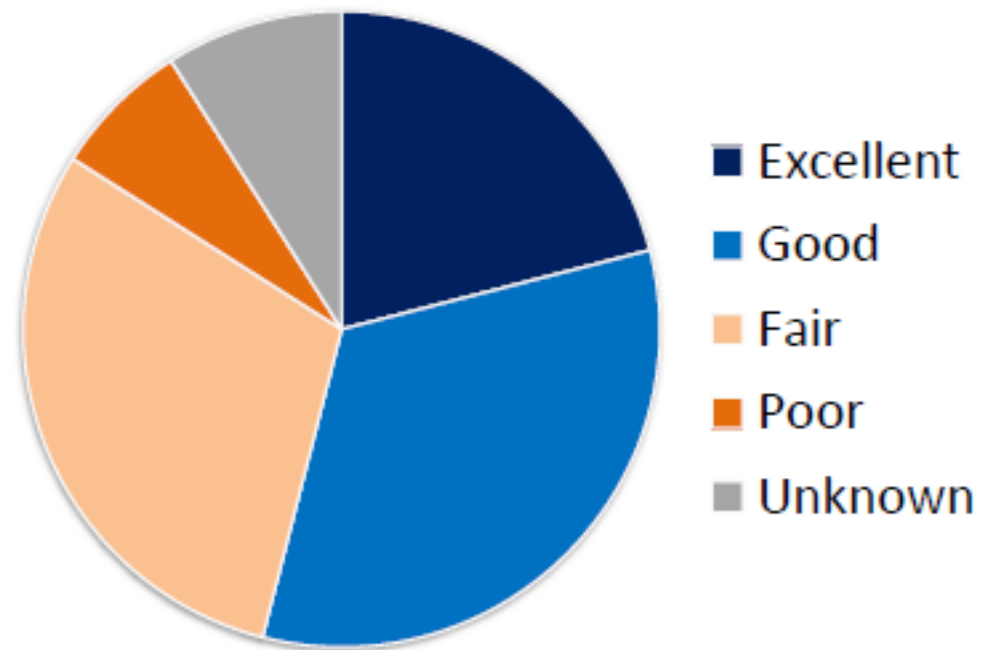


Maintain Ways We Use Water

How Healthy are Wisconsin Lakes?

Water Quality Report to Congress

Water Quality According to Lake Trophic Status

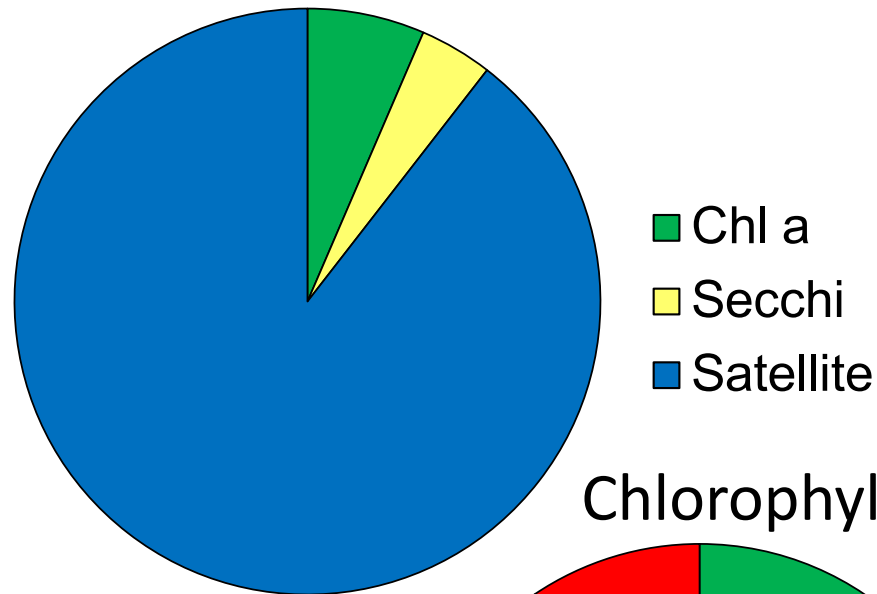


4506 lakes assessed with data through 2014

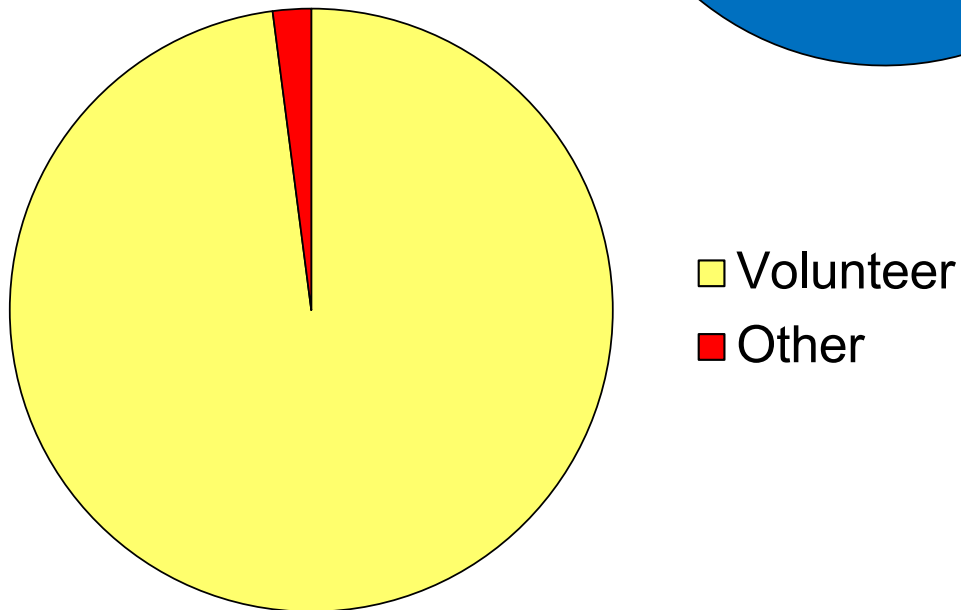
Volunteers Collect Majority of Data

Water Quality Report to Congress

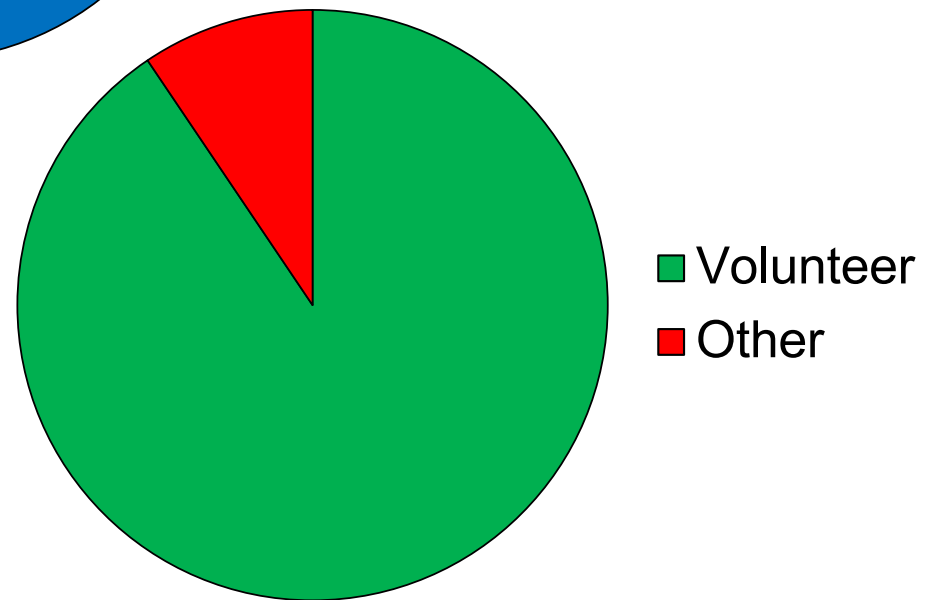
Assessed 6054 lakes in 2014!



Secchi Depth



Chlorophyll a



Satellite Secchi Depth

Goal:

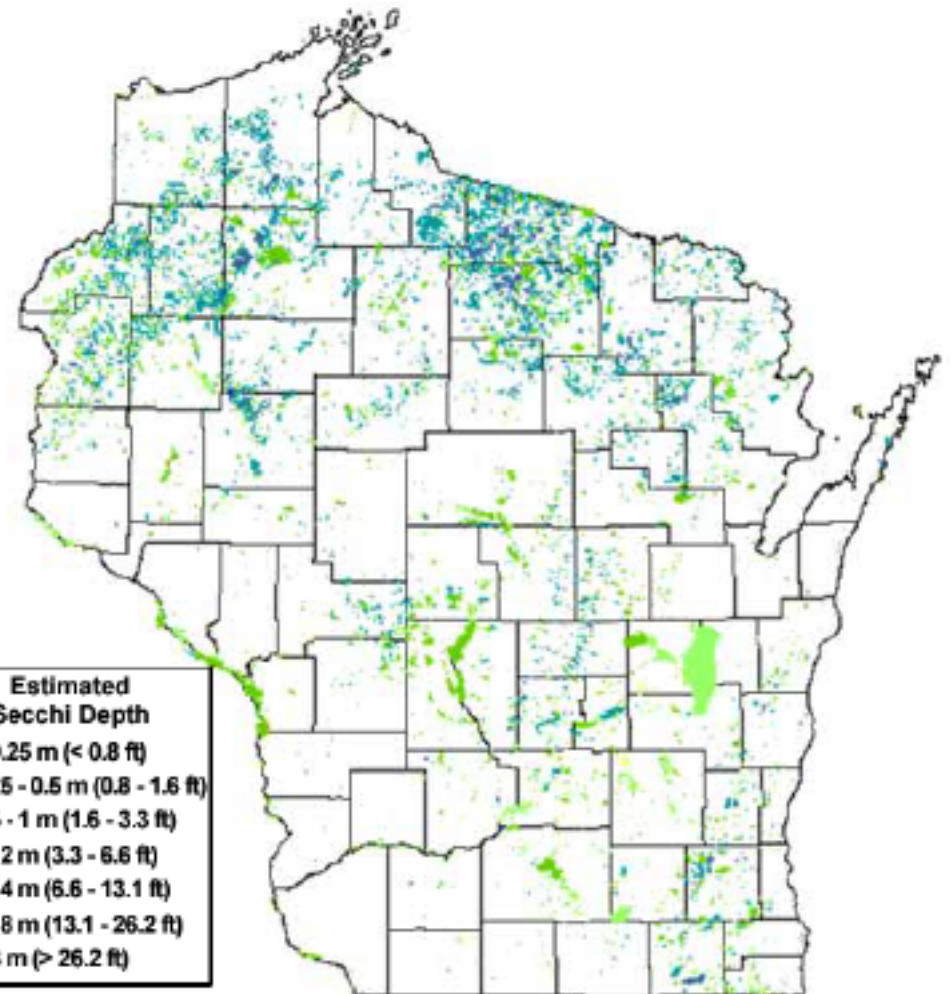
Use satellite data to assess lake water quality

Citizen Role:

Calibrate the models by taking Secchi depth on the same day as the satellite passes overhead



Trophic State Index	Estimated Secchi Depth
> 80	< 0.25 m (< 0.8 ft)
70 to 80	0.25 - 0.5 m (0.8 - 1.6 ft)
60 to 70	0.5 - 1 m (1.6 - 3.3 ft)
50 to 60	1 - 2 m (3.3 - 6.6 ft)
40 to 50	2 - 4 m (6.6 - 13.1 ft)
30 to 40	4 - 8 m (13.1 - 26.2 ft)
< 30	> 8 m (> 26.2 ft)



Refining Satellite Tools

Is water clarity low because the lake is green with algae or is the lake naturally stained?



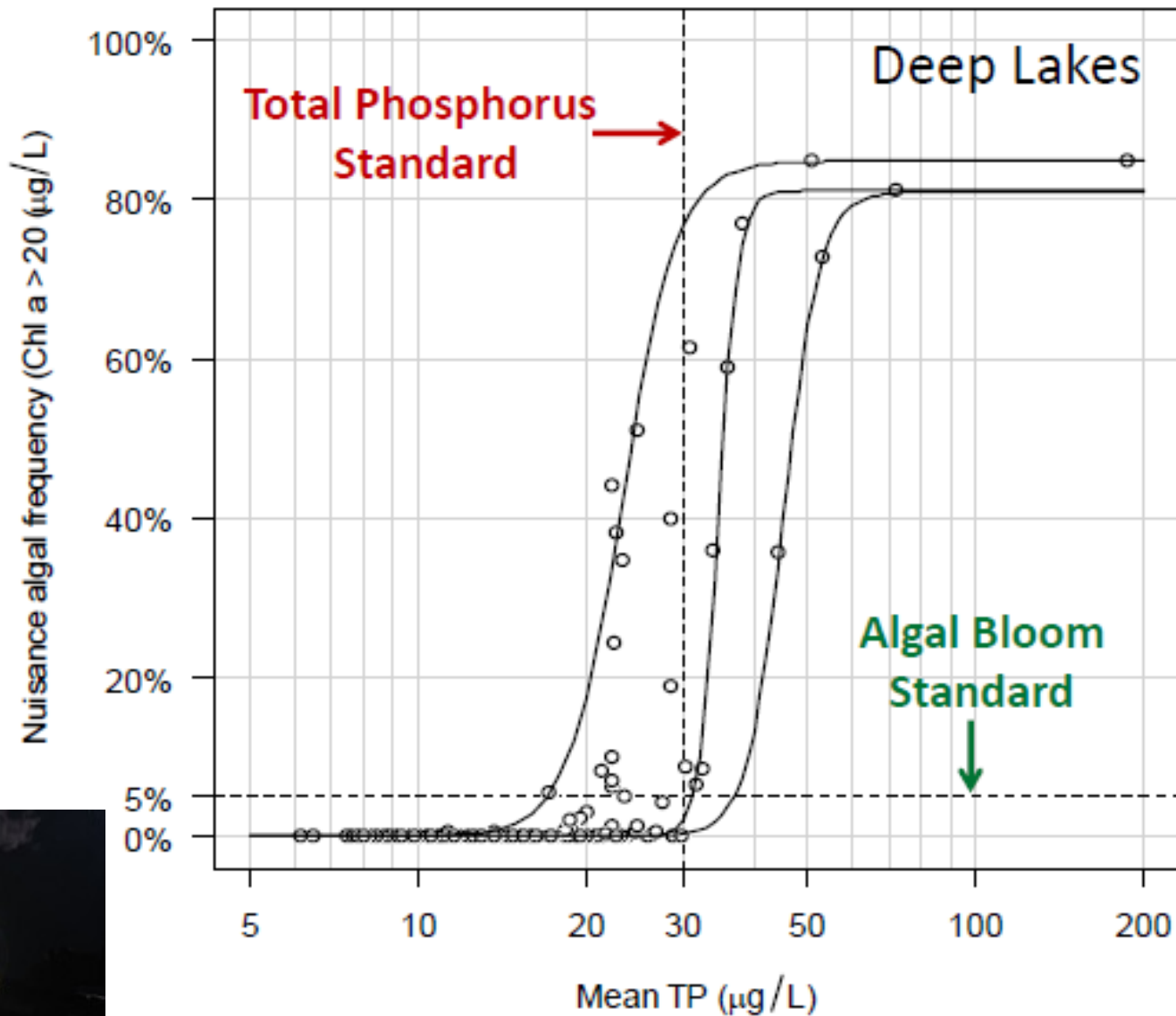
Daniela Gurlin & Steve Greb



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Lake Nutrient Standards

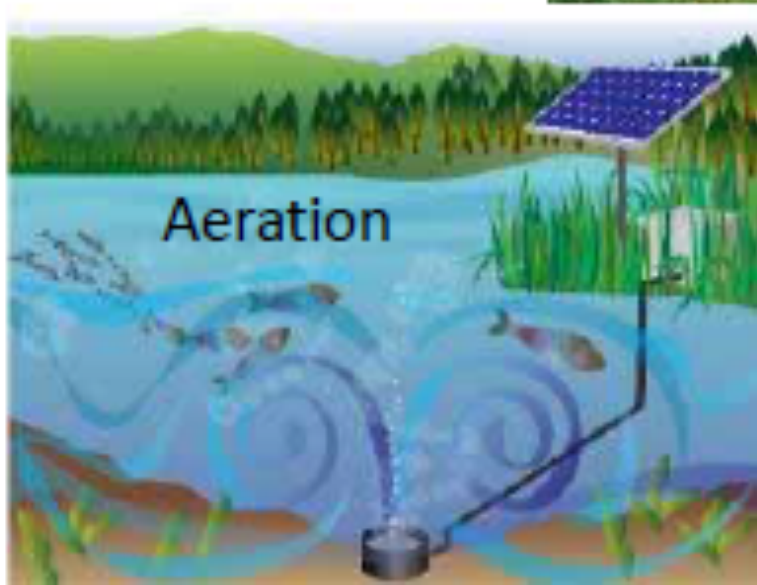


A background image of a calm lake with a misty atmosphere. The water is still, reflecting the sky and the surrounding trees. On the right side, there are dense evergreen trees. The overall tone is soft and somewhat somber due to the mist.

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Data to Diagnose Symptoms and to Track Success of Management Actions



Emerging Issues

Divisive mine plan draws challengers to usually uncontested Iron County Board races



FEBRUARY 09, 2014 6:45 AM • BY [STEVEN VERBURG](#) | [WISCONSIN STATE JOURNAL](#)

A divisive proposal for a huge open pit mine in the Penokee Hills of northern Wisconsin has helped spur a surprising number of challengers to run against Iron County Board members in upcoming elections.

Frac sand mines credited for rising, dropping property values



MARCH 30, 2014 6:00 AM • [ALISON DIRR](#) | [WISCONSIN CENTER FOR INVESTIGATIVE JOURNALISM](#)

TUNNEL CITY— Perry Schmitt describes himself as pro-mining but blames the frac sand mine



High-capacity wells possibly lowering some lake levels



JULY 22, 2013 5:30 AM • BY [MARK PITSCH](#) | [WISCONSIN STATE JOURNAL](#)

PLAINFIELD — Long Lake has lost its shoreline. Dock after dock dead-ends in the weeds. It looks more like an unmowed lawn with a pond in the middle than a place where families used to water ski and fish.

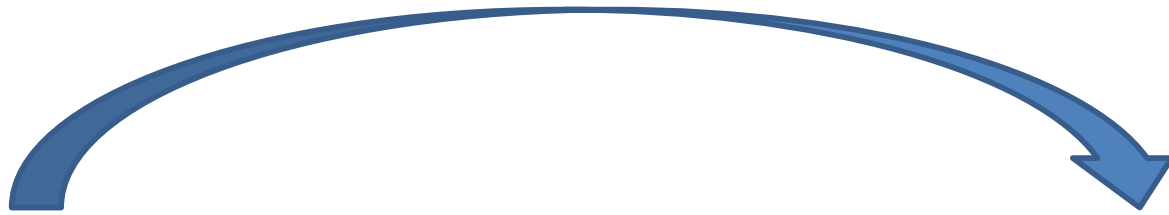
Once up to 12 feet deep, the lake is now closer to three, having bounced back slightly since 2006 when the lake dried up completely.



Volunteer Data Provides Answers:

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Is lake water quality getting better, worse, or staying the same?



Research

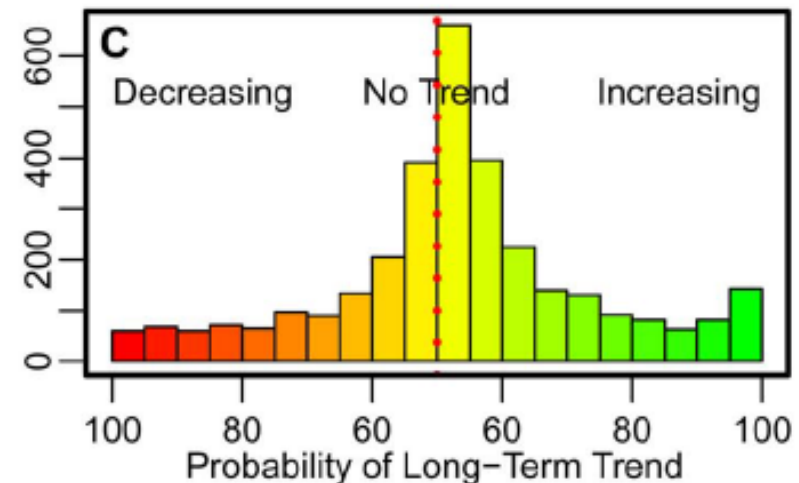
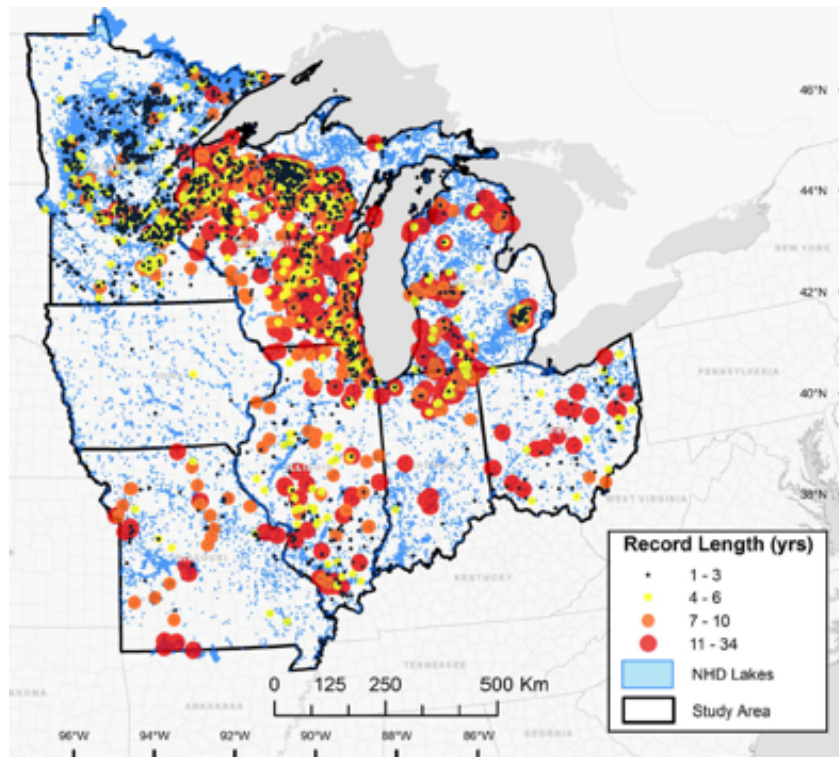


PLOS ONE

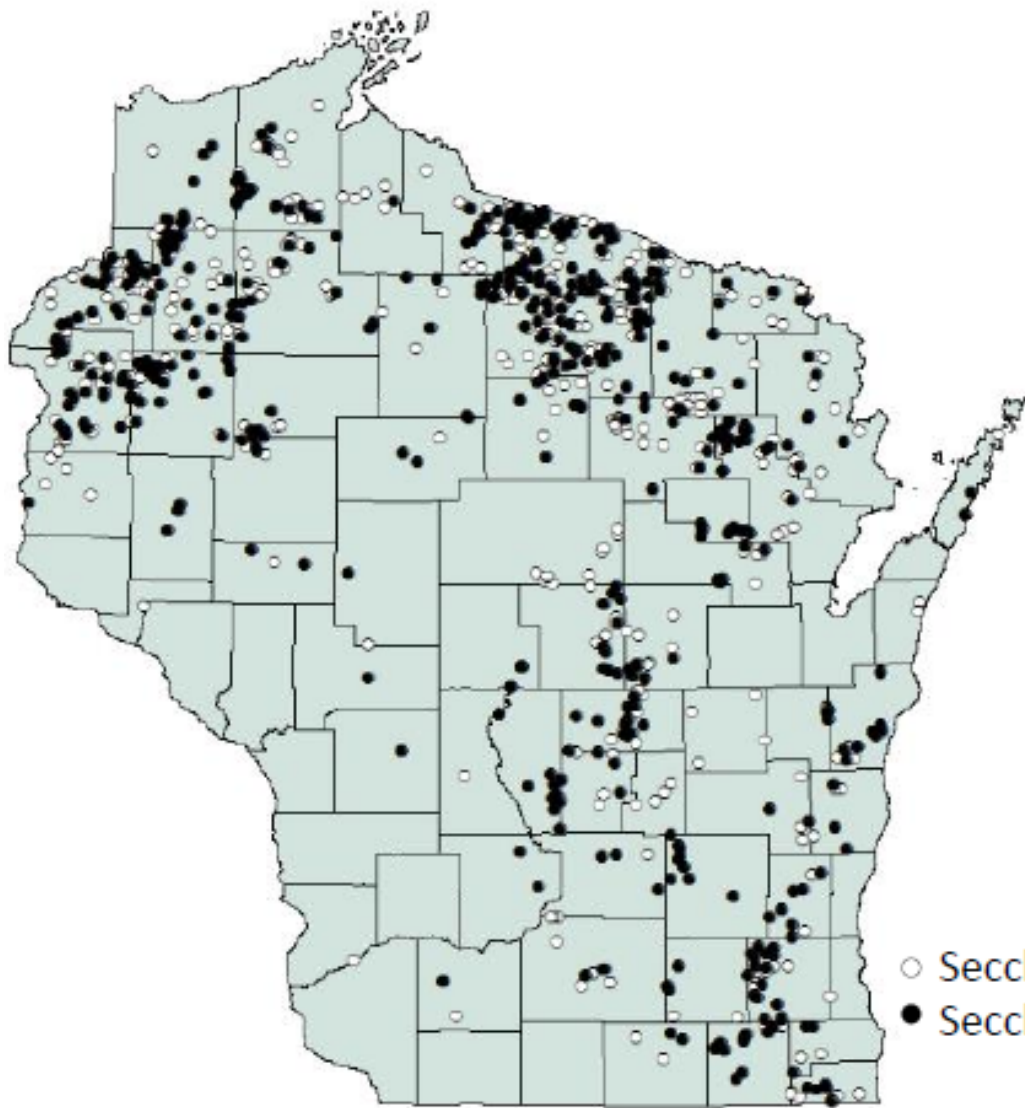
OPEN ACCESS Freely available online

Long-Term Citizen-Collected Data Reveal Geographical Patterns and Temporal Trends in Lake Water Clarity

Noah R. Lottig^{1*}, Tyler Wagner², Emily Norton Henry^{3,4}, Kendra Spence Cheruvilil^{3,5}, Katherine E. Webster⁶, John A. Downing⁷, Craig A. Stow⁸



Trends Over Time in CLMN & other lakes

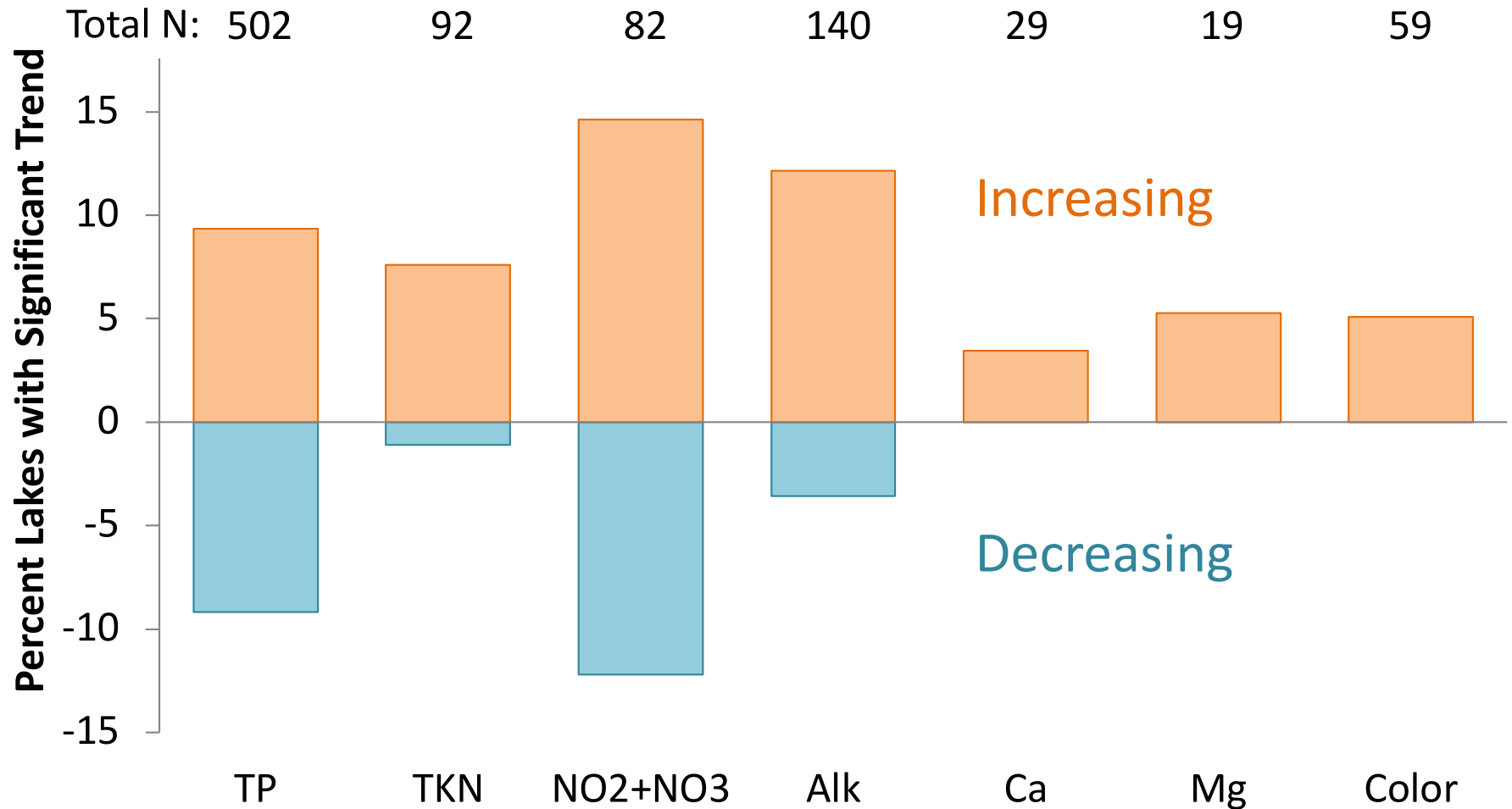


WDNR Data Download:

- 218,300 records
- 1501 lakes
- Data from 1968 - 2015
- Up to 34 years of data on a single lake

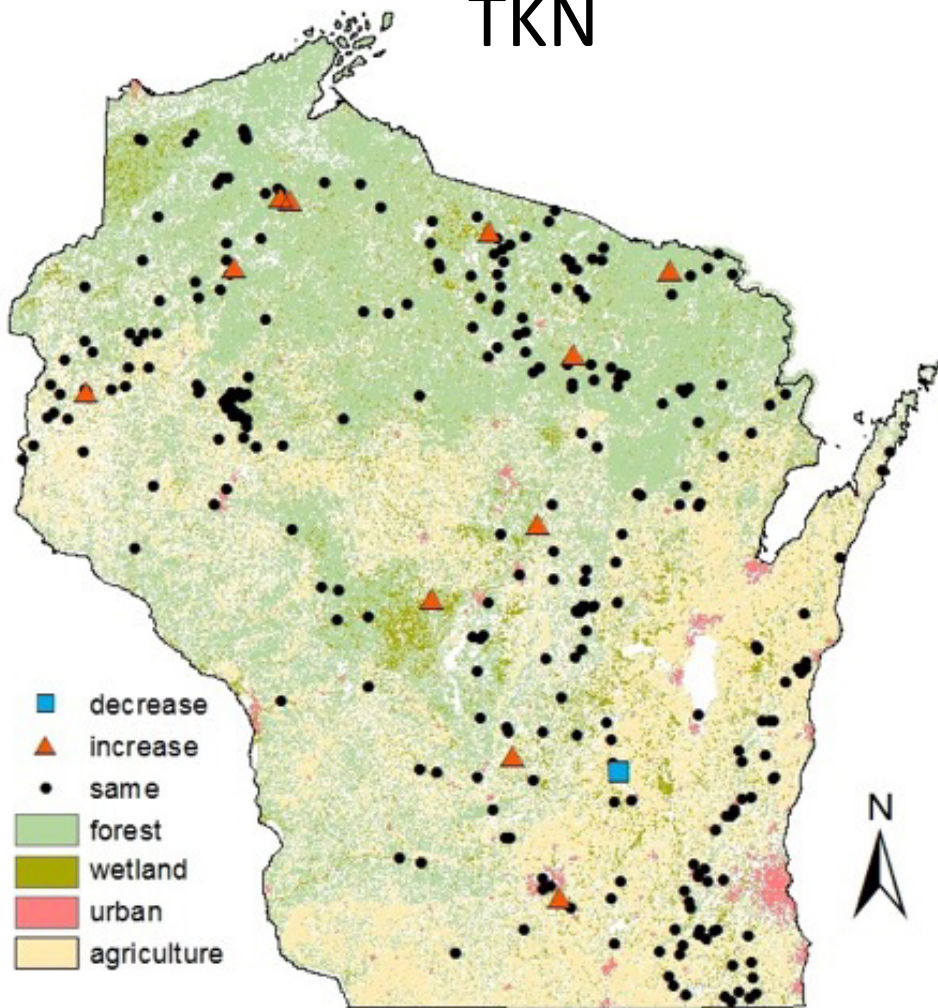
○ Secchi only
● Secchi, Chl- α , TP

3%-27% of lakes had a significant trend

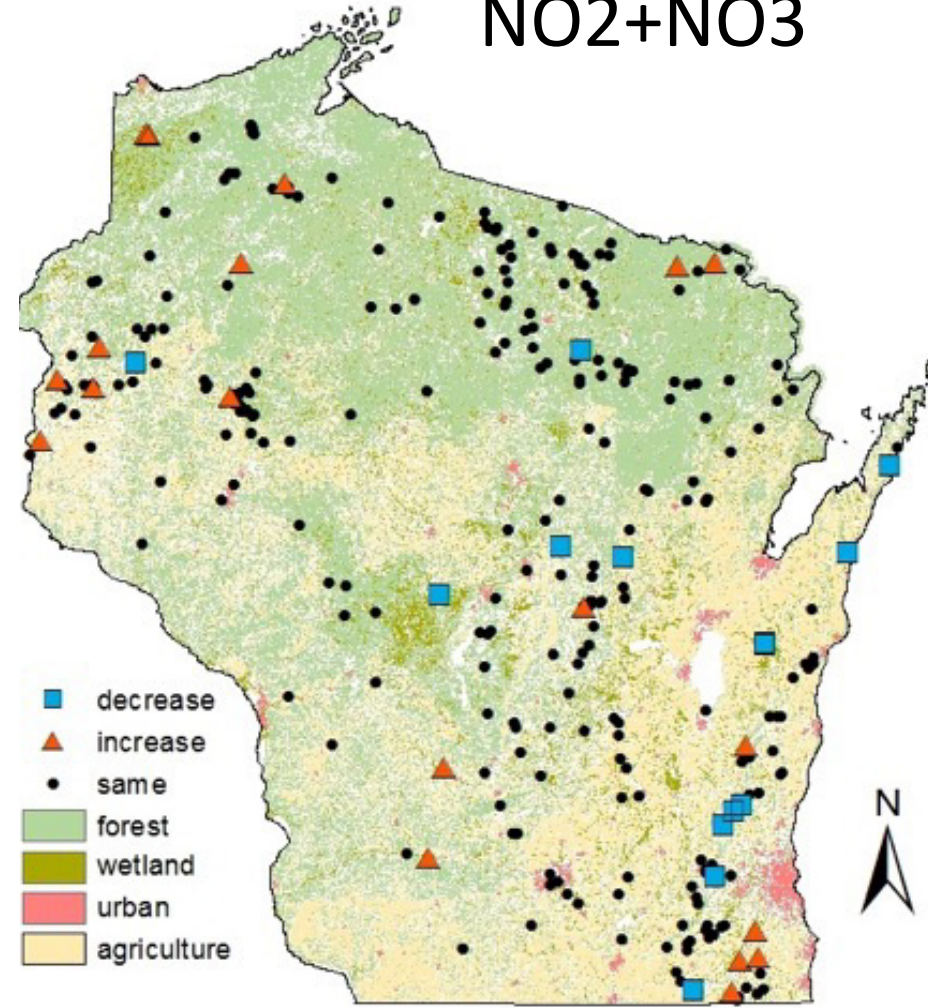


No Spatial Pattern in Temporal Trends

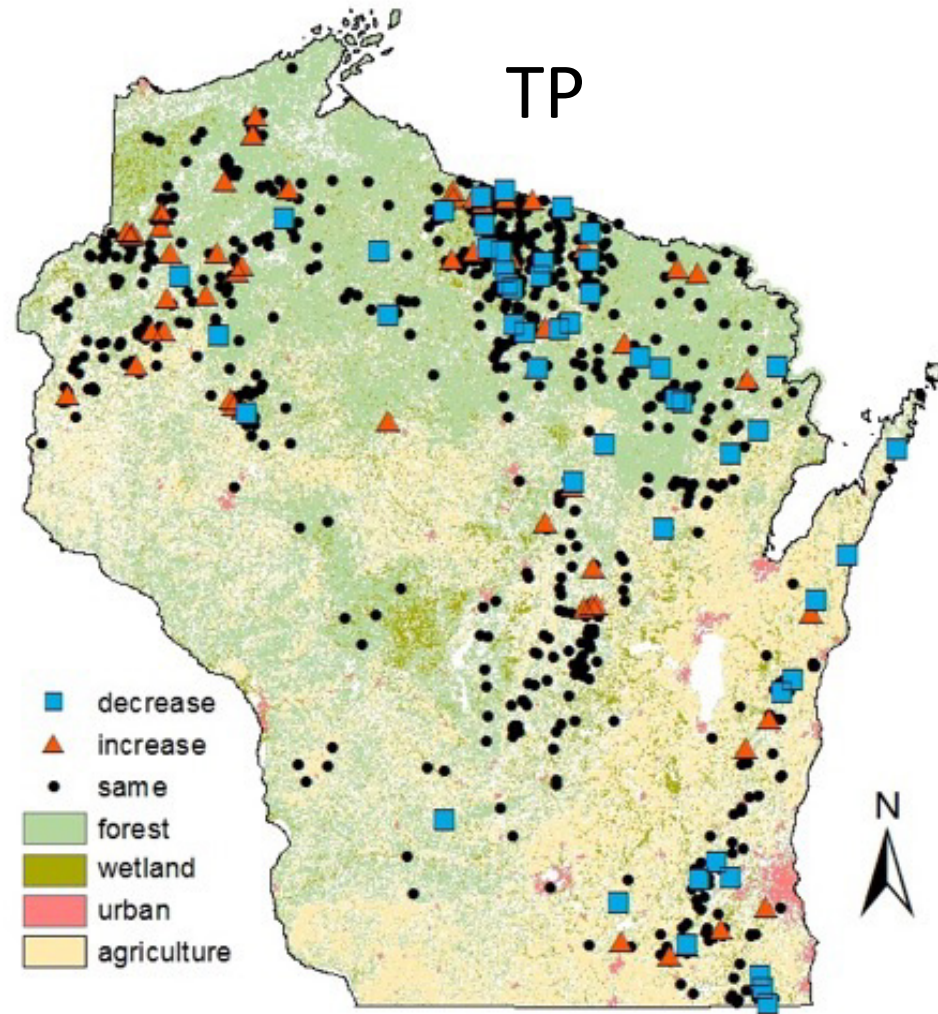
TKN



NO₂+NO₃



No Spatial Pattern in Temporal Trends



Reasons for Phosphorus Decline

Urbanization of Agricultural Land



Septic to Municipal Sewage



Algal to Plant-Dominated Lake



Best Management Practices



Reasons for Increasing Phosphorus

Agriculture



Lake Shore Development



Plant to Algal-Dominated Lake



Climate and Water Levels



Summary of Trends

- Most lakes have not changed over time spans of 3 – 43 years, but a small percent of lakes have increasing or decreasing trends
- Lack of spatial pattern suggests local watershed processes are important drivers

A background image of a calm lake with a misty atmosphere. The water reflects the sky and the surrounding trees. On the right side, there are dark, dense evergreen trees. The overall tone is soft and somewhat somber due to the mist.

Volunteer Data Provides Answers:

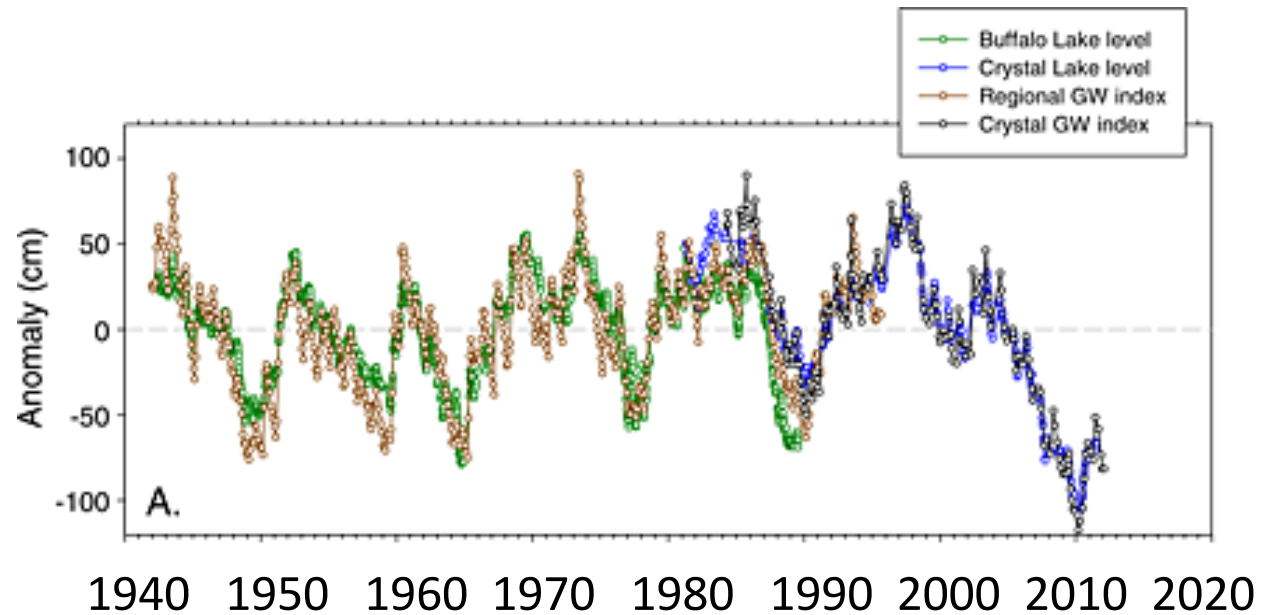
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How do changing water levels impact water clarity in WI?

Peter Lisi

UW Madison

13 year cycle in northeast Wisconsin lakes and aquifers



Watras et al. 2014 Geophysical Research Letters

Conventional wisdom:



Drought should result in a clearer water column.

- Reduced phosphorus loads
- Reduced shoreline erosion
- Ultraviolet bleaching



Wet years should result in a turbid lake

- Increased nutrient loads
- Increased sediments
- Increased shoreline erosion

Conventional wisdom: **opposite response can also be true.**



Drought can increase severity of harmful algal blooms.

- Warmer surface temps
- Internal mixing, P recycling
- Concentration of key nutrients

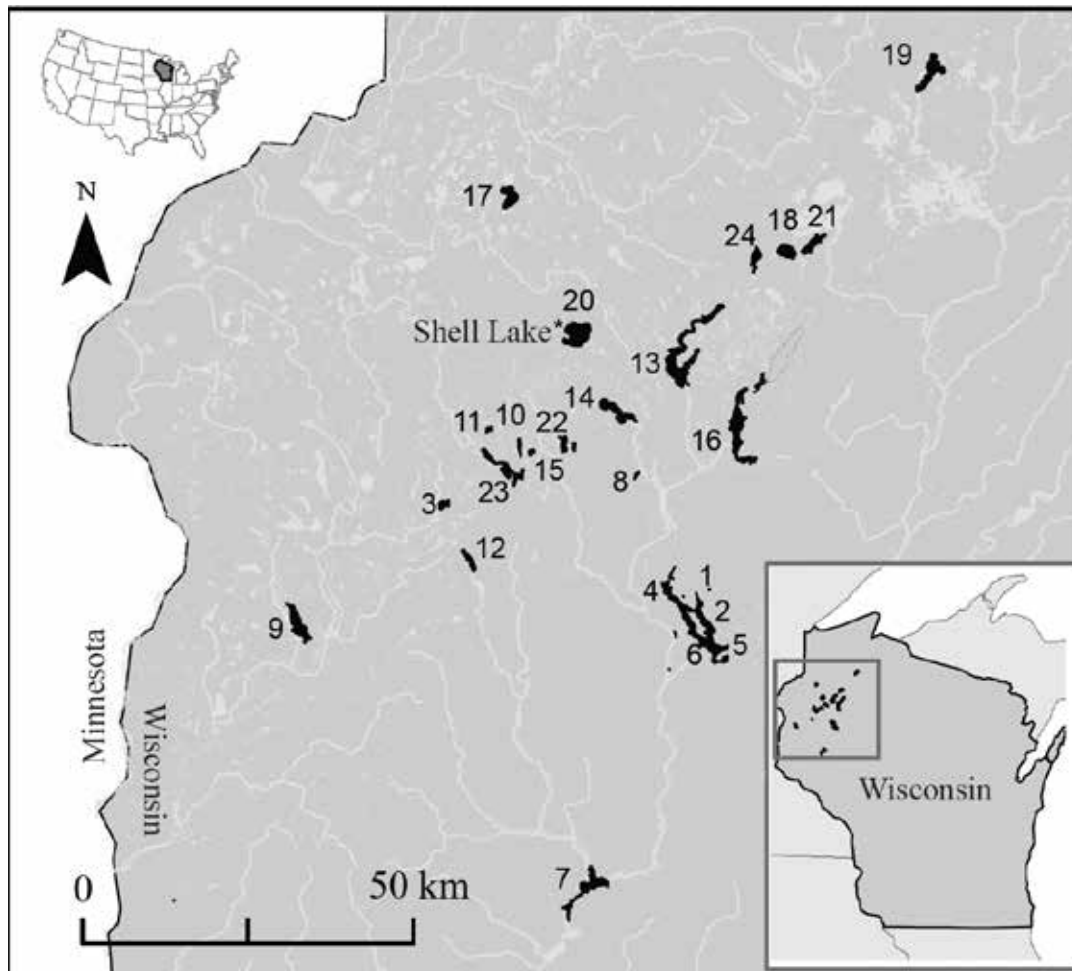


While higher lake levels result can in clearer lake!

- Reduced water temperatures
- Deeper lake, increased stratification
- Flushing of nutrients

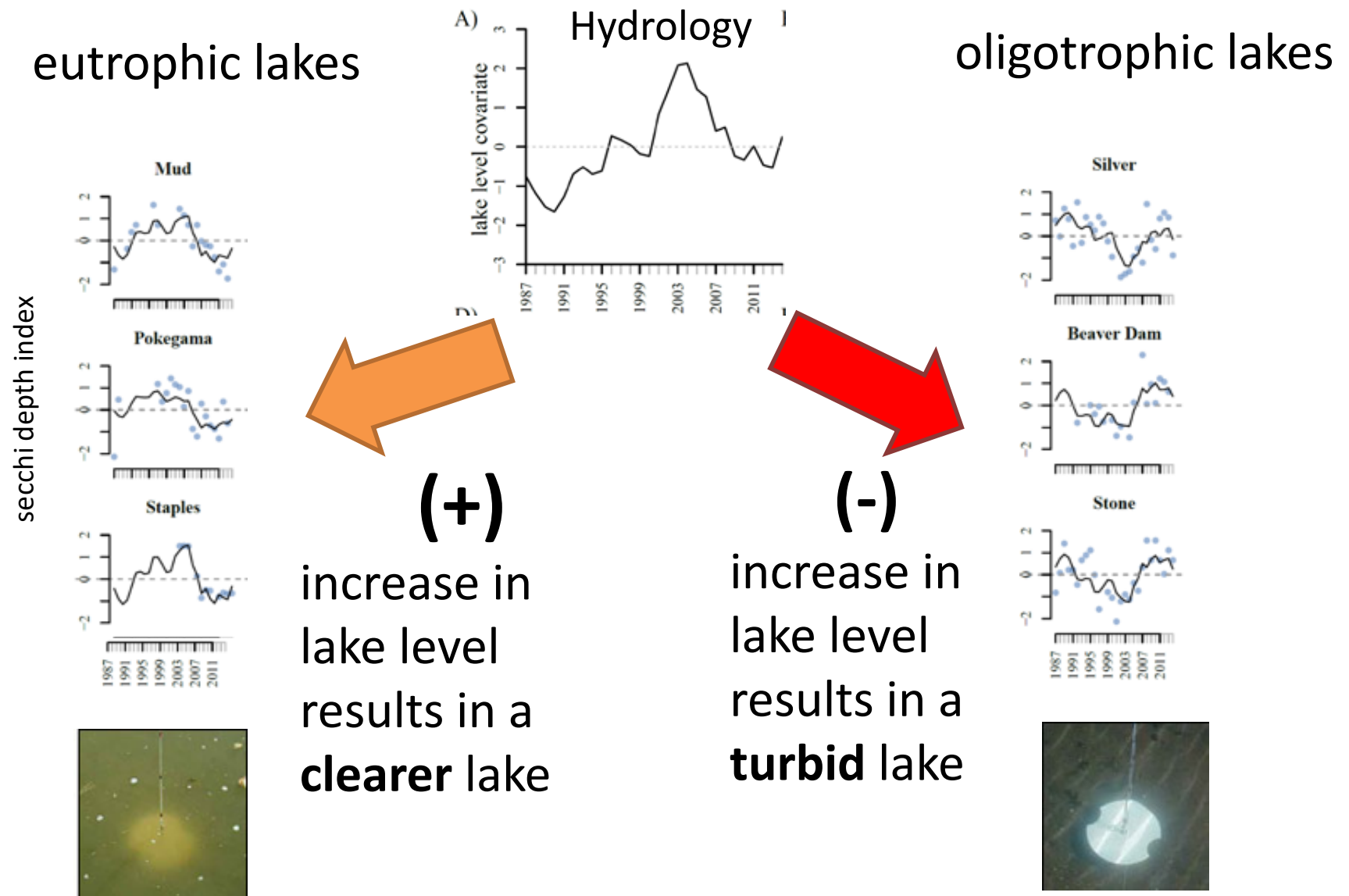
see L.M. Mosley 2015 earth science reviews

Case study in northwest Wisconsin. Citizen scientist Secchi depth time series



Award winning citizen scientists

Results: divergent response of water clarity to hydrology



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Lake Suitability for Aquatic Invasive Species

The Invasive Species Interactive Mapping System



--Zoom to a County--



<http://www.aissmartprevention.wisc.edu/mappingtool.php>



[Back to the Smart Prevention HomePage](#)

Legend: (Turn on and off layers with checkbox)

Select a Species:

Lake Suitability for Rainbow Smelt

Methods

Suitable

Not Suitable

Data Not Available

2009 Rainbow Smelt Records

Lakes

Base Map:

Bing Base Map

Bing Aerial Map

This site was made possible by:



[Vander Zanden Lab](#)
[University of Wisconsin-Madison](#)
[Center for Limnology](#)
[WI Sea Grant](#)



IRA AND MEVA REILLY BALDWIN
WISCONSIN IDEA ENDOWMENT



Sea Grant
University of Wisconsin

Rainbow Smelt



Jake Vander Zanden

Changes in water clarity after zebra mussel invasion

Marianne Geisler – Master's Student at University of Manitoba



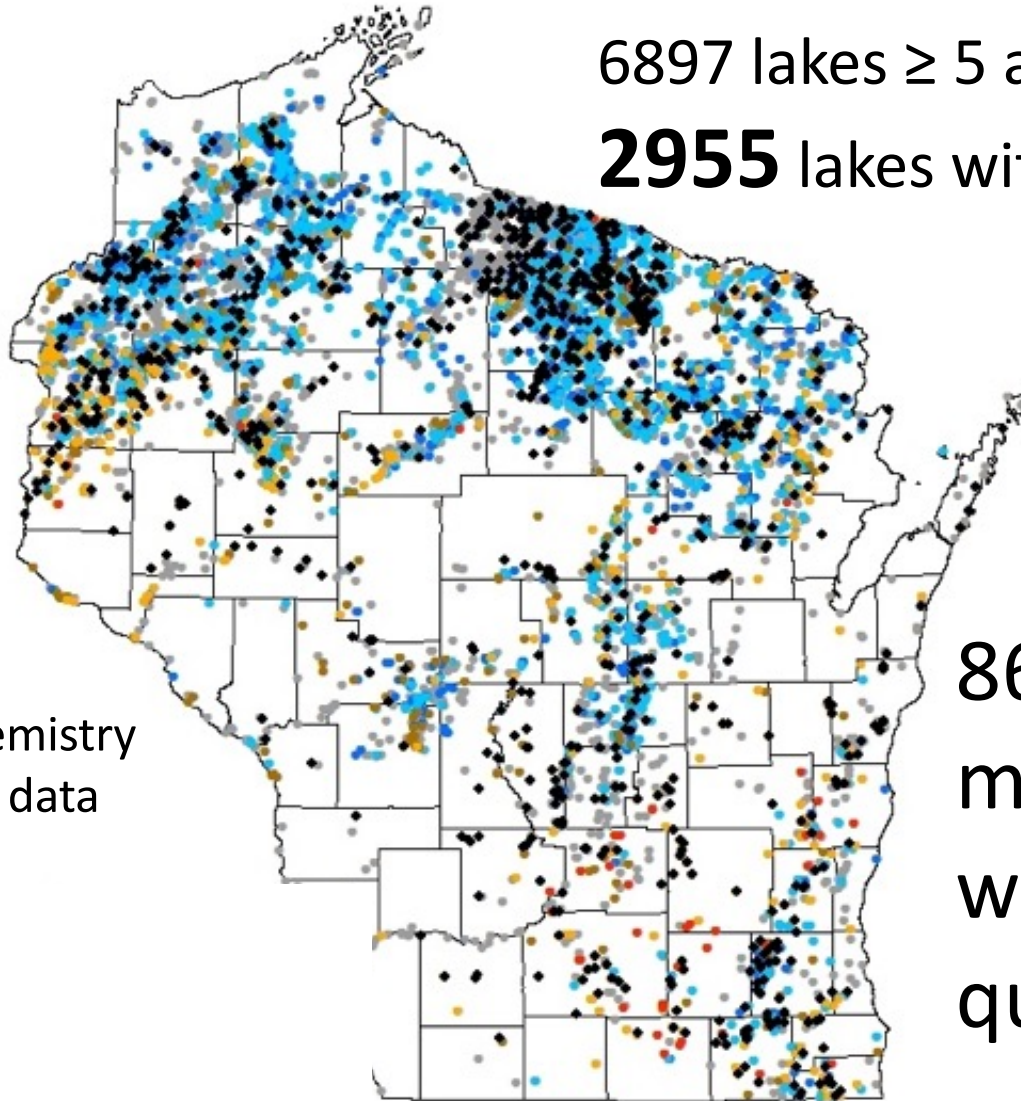
**Where is
volunteer
monitoring
going next?**



We still need data on MORE lakes!

6897 lakes \geq 5 acres area

2955 lakes without satellite/chemistry



- IR 2014 chemistry
- Insufficient data
- Satellite:
 - Excellent
 - Good
 - Fair
 - Poor

86 lakes on fisheries
monitoring rotation
without ANY water
quality information


Monitor More Parameters

- Chemistry: chloride, sulfate, dissolved reactive phosphorus, nitrogen, hypolimnetic iron and sulfide, metals
- Biological indicators
- Shoreland habitat
- Blue-green algae
- E. coli



Lessons Learned from Citizen Lake Data

- Health of Wisconsin lakes
- Standards for lake health
- Prescribing and tracking success of management
- Lakes vary over time. Some are getting better, others are getting worse.
- Eutrophic lakes are more clear in wet years.
Oligotrophic lakes are less clear in wet years.
- Lake characteristics determine risk of invasions

A photograph of a sunset over a large body of water. In the foreground, a person is silhouetted standing on a wooden dock. To the left, a boat with a canopy is also silhouetted. The sky is a mix of deep blue and orange, with the sun low on the horizon. The water reflects the colors of the sky.

Citizen Data Advances Lake Policy, Management, and Science!