Long-Term Research on the Yahara Chain of Lakes

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University of Wisconsin – Madison
Birthplace of North American Limnology
WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Center for Limnology

Global leadership, local impact

Jake Vander Zanden, Director
Invasive Species

Emily Stanley
Nutrient Cycling

Hilary Dugan
Pollution Global Change

Paul Hanson
Water Quality Modeling

Grace Wilkinson
Algal Blooms

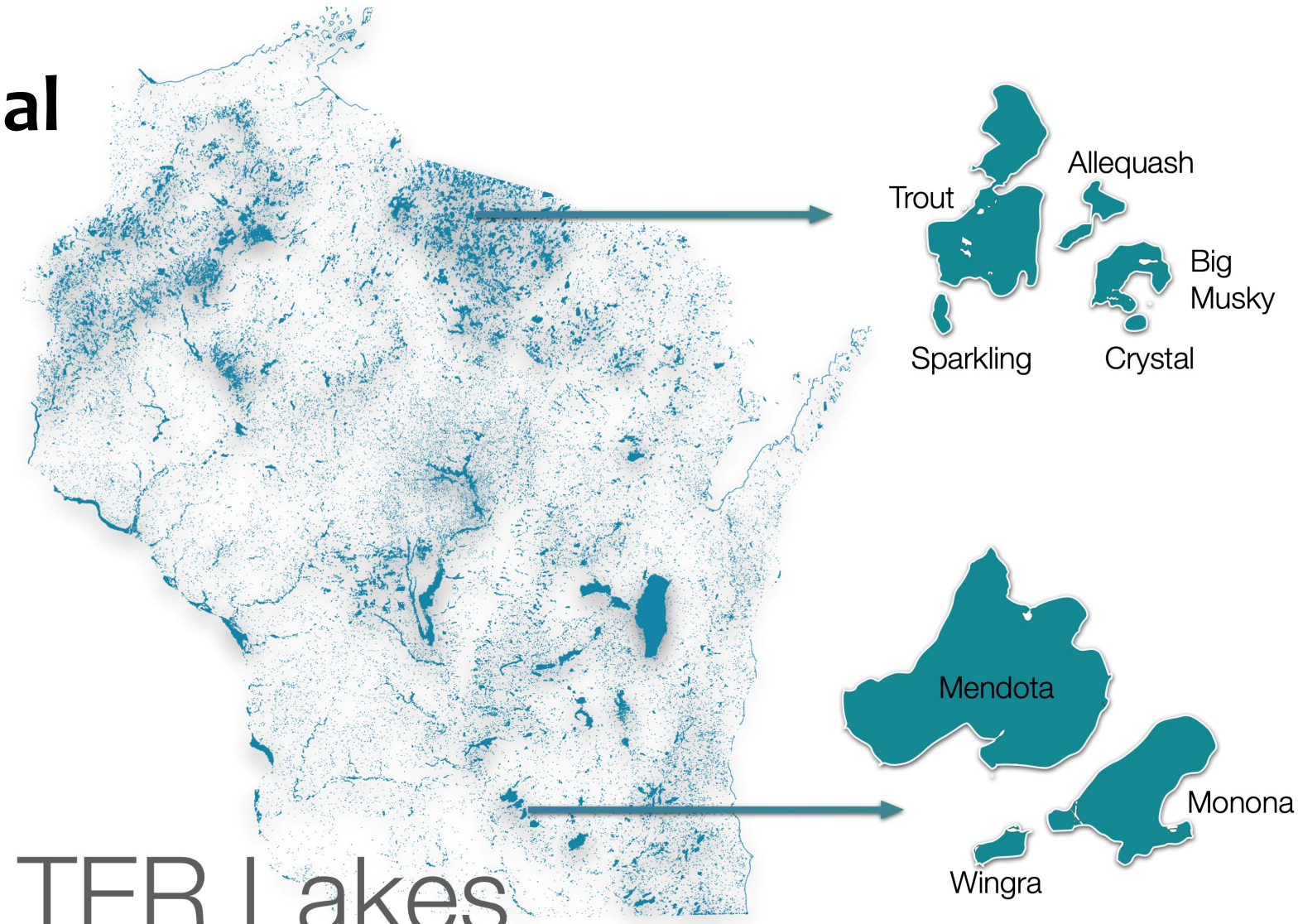
Zach Feiner
Fisheries

North Temperate Lakes

Long-Term Ecological Research Program

Continuously funded by the National Science Foundation for the past four decades

1. Advance understanding of long-term lake dynamics
2. Generate and share long-term datasets



NTL-LTER Lakes

lter.limnology.wisc.edu

"Some of us remember that there was less snow last winter, or fishing was better a couple of years ago. It is the unusual person who senses with any precision changes occurring over decades.

Because we are unable to sense slow changes directly… processes acting over decades are hidden in

'the invisible present'

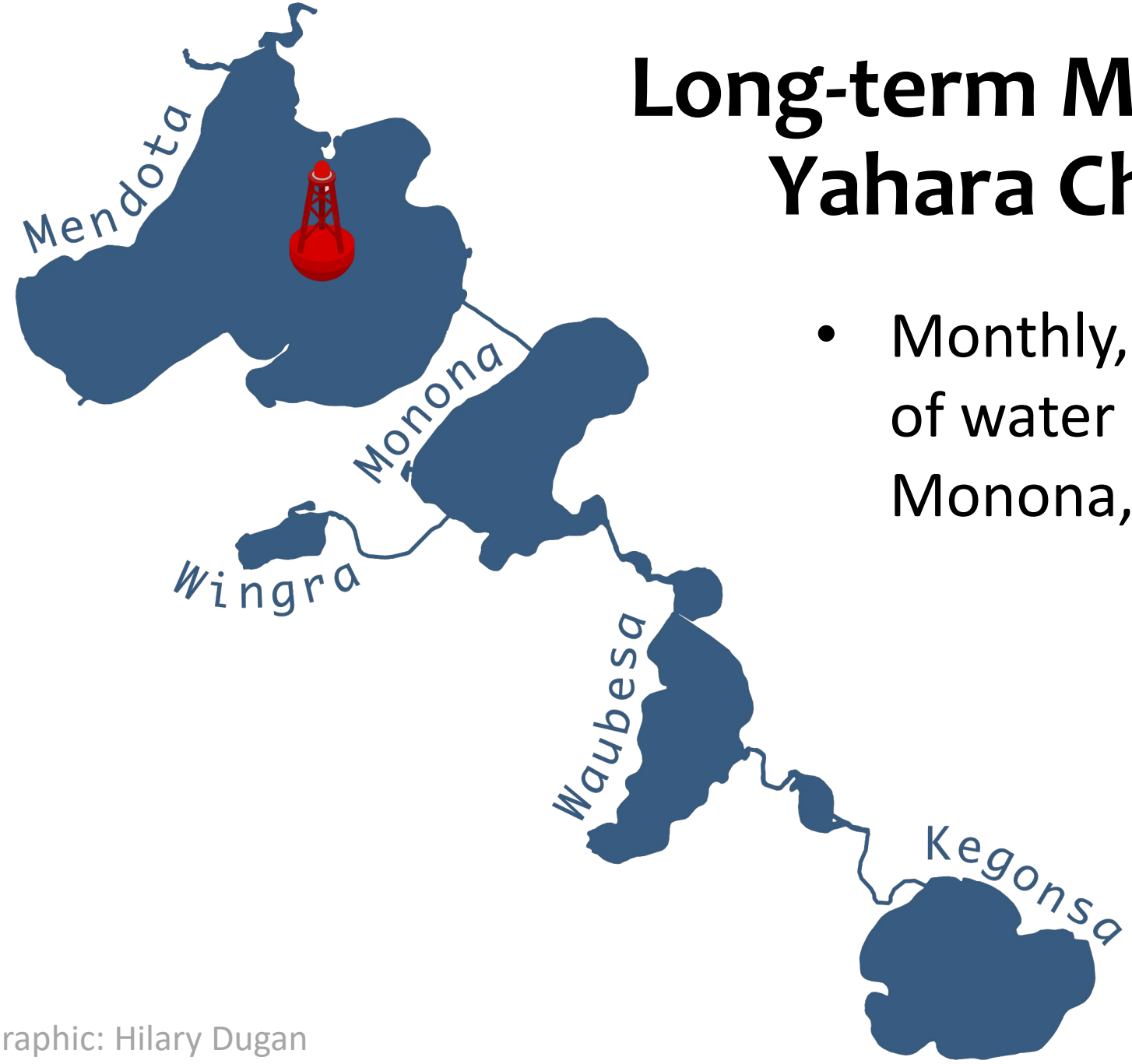
In the absence of long-term research, serious misjudgments can occur in our

attempts to manage

the environment."

- John Magnuson, Center for Limnology

Lake Monona, Madison, Wisconsin USA
Photo: Kirby Wright



Long-term Monitoring of the Yahara Chain of Lakes

- Monthly, year-round monitoring of water quality on Mendota, Monona, Wingra
  - Samples collected at multiple depths
  - Summer surface sampling on Waubesa and Kegonsa

Graphic: Hilary Dugan

Physical Variables

- Water clarity (Secchi depth)
- Dissolved oxygen
- Stratification

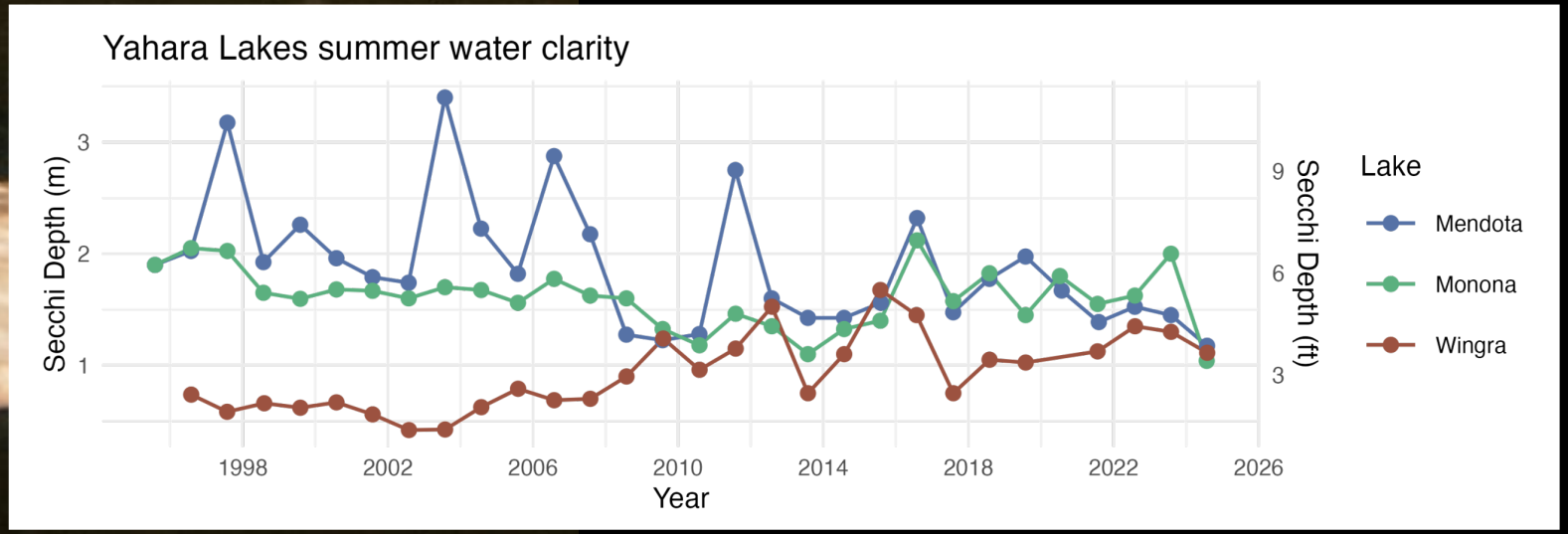
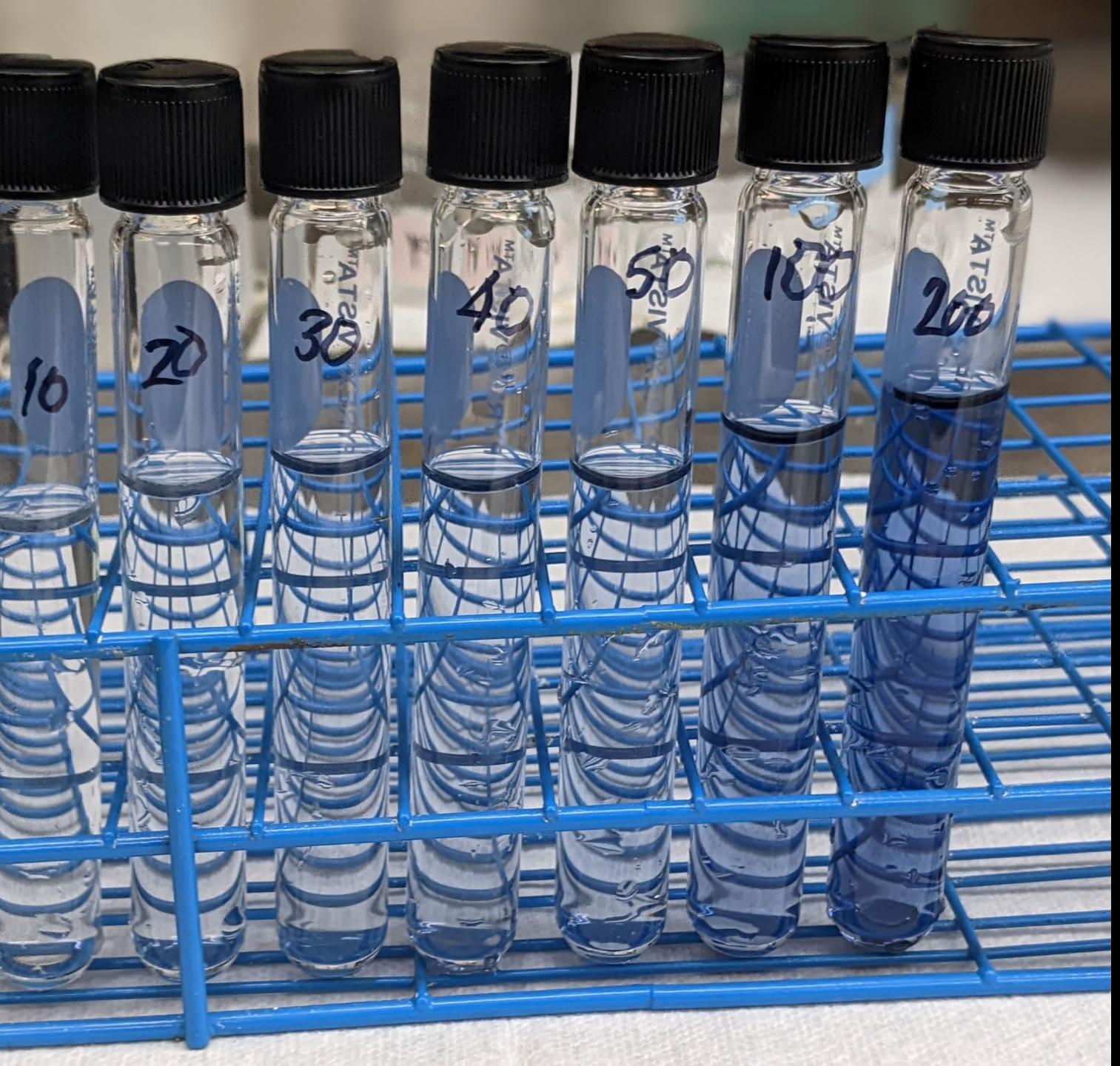


Photo: Hilary Dugan



Water Chemistry

- Nutrients (N + P)
- pH
- Carbon
- Chloride
- Cations (e.g., iron)

WI DNR

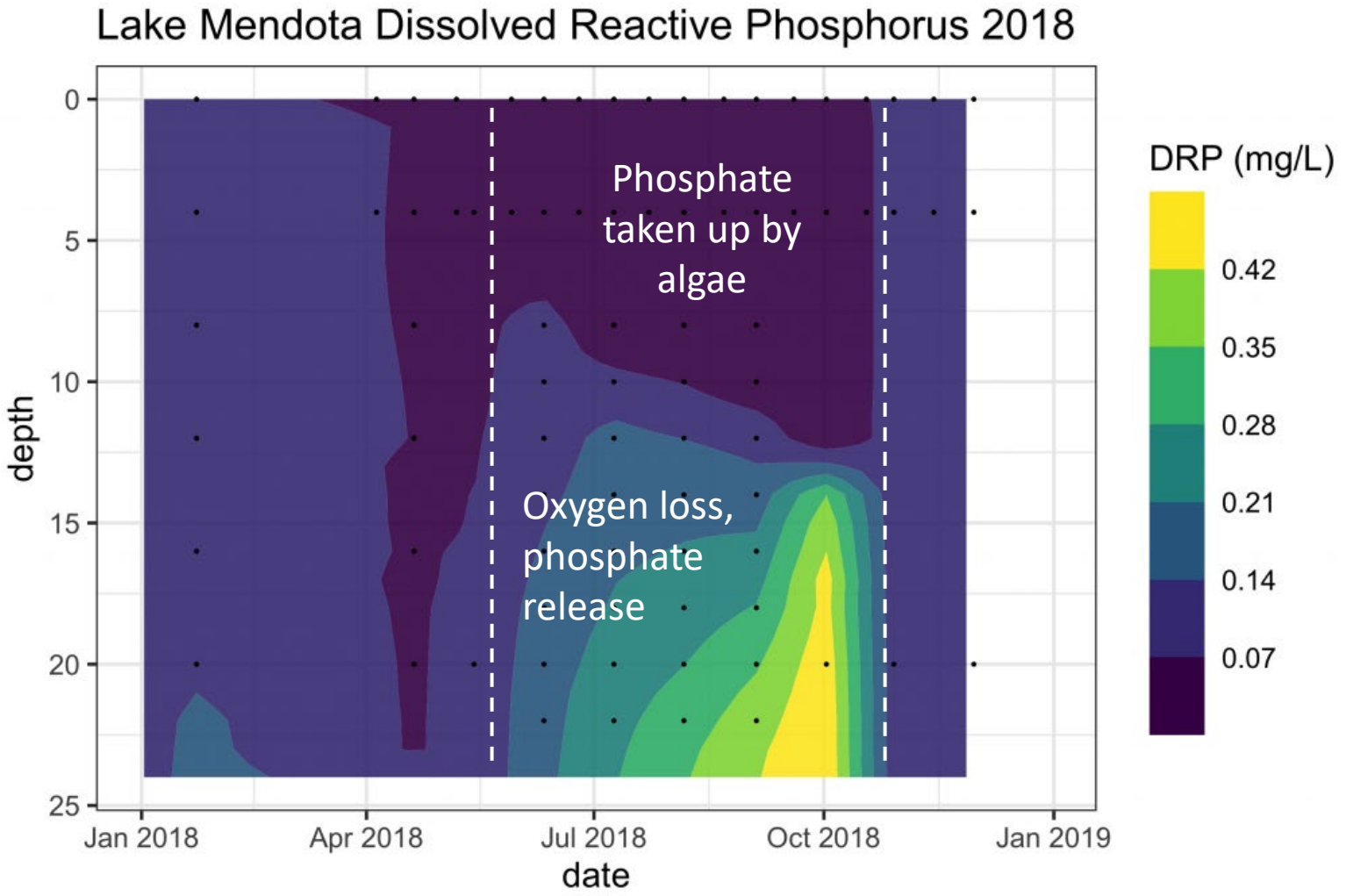
NTL LTER


Photo: Finn Ryan from Yahara Project

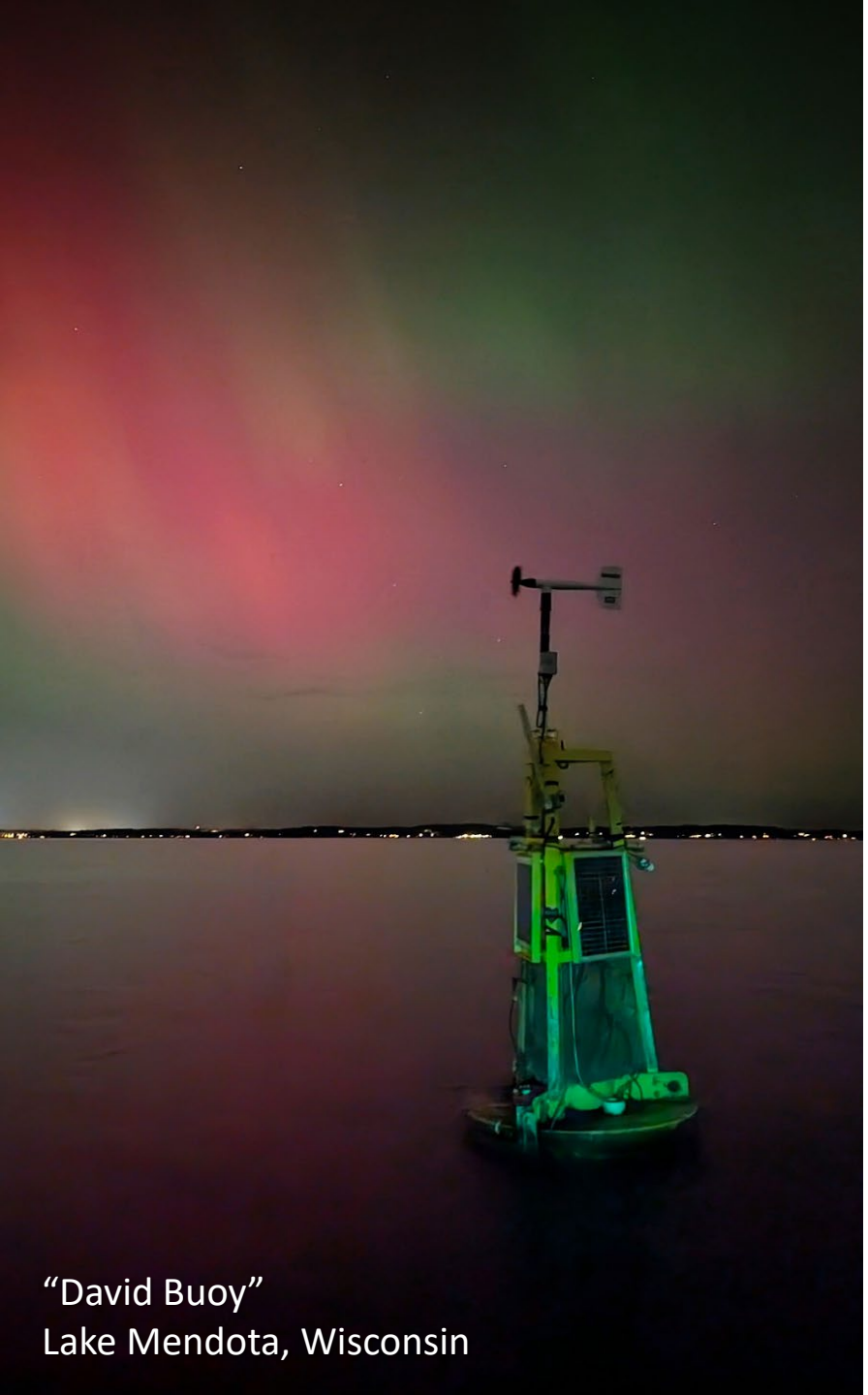
Biological Variables

- Chlorophyll (index of algae abundance)
- Zooplankton
- Fish Biodiversity Surveys
- Aquatic Plant Surveys

Comprehensive Monitoring to Understand Mechanisms Controlling Water Quality



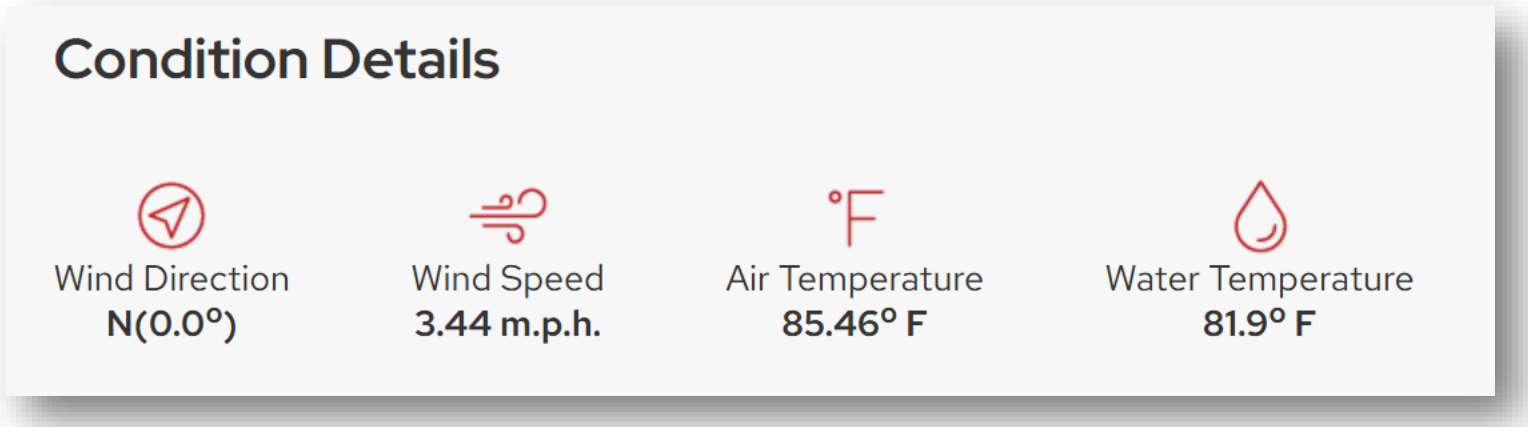
- **Mechanism:** stratification leads to oxygen loss in bottom waters, release of phosphate from sediment
- Changing weather patterns altering this mechanism – **how is water quality responding?**



"David Buoy"
Lake Mendota, Wisconsin

High Frequency Sensors

- Measurements every minute of:
  - Temperature
  - dissolved oxygen
  - pH
  - Chlorophyll
  - **Phycocyanin (index of cyanobacteria abundance)**



2024 STATE

Top Indirect-Impact Actions

1. **Continue to work together as Yahara CLEAN Compact members.** Maintain ongoing member meetings to collaborate on recommended actions, report progress, and coordinate around new initiatives. Ongoing collaboration should consider how actions might affect the watershed phosphorus mass balance, among other factors.

2. **Increase participation in producer-led watershed groups.** Expand farmer involvement in conservation planning and practice adoption through continued learning, information sharing, and distribution of cost-share incentives.

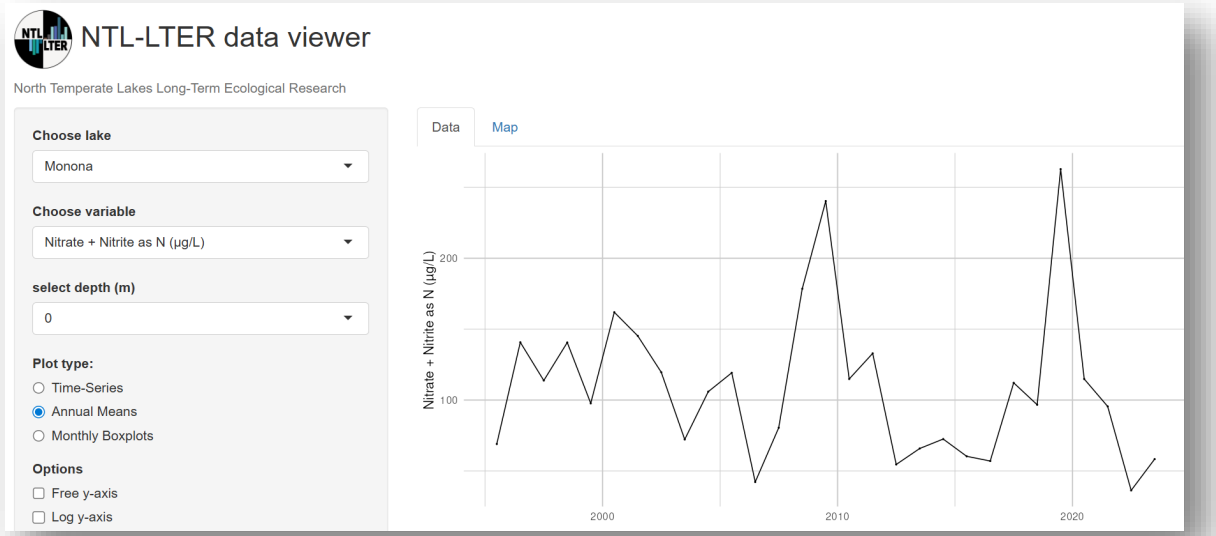
3. **Complete an inventory of shoreline and beach conditions.** Establish guidelines and criteria for the sustainable design, development, management, and restoration of shorelines and public beaches.

4. **Increase *E. coli* testing at public beaches.** Focus efforts on beaches shown to be most susceptible to problems. Assess *E. coli* bacteria sources at beaches with high closure rates so corrective measures can be taken.

5. **Continue to track and report progress.** Use and support the annual *State of the Lakes Report* as a means of outreaching to the community. Support continued maintenance and operation of stream-gaging stations that track changes in phosphorus loading.

Renew the Blue

Consistent, comprehensive, offshore water quality data for over 30 years



Dane County Water Quality Plan

Appendix B Update

Surface Water Quality Conditions

P-loading strongly linked to extreme precipitation, with a longer lag effect on cyanobacteria blooms

Carpenter et al. (2024)

Proceedings of the National Academy of Sciences

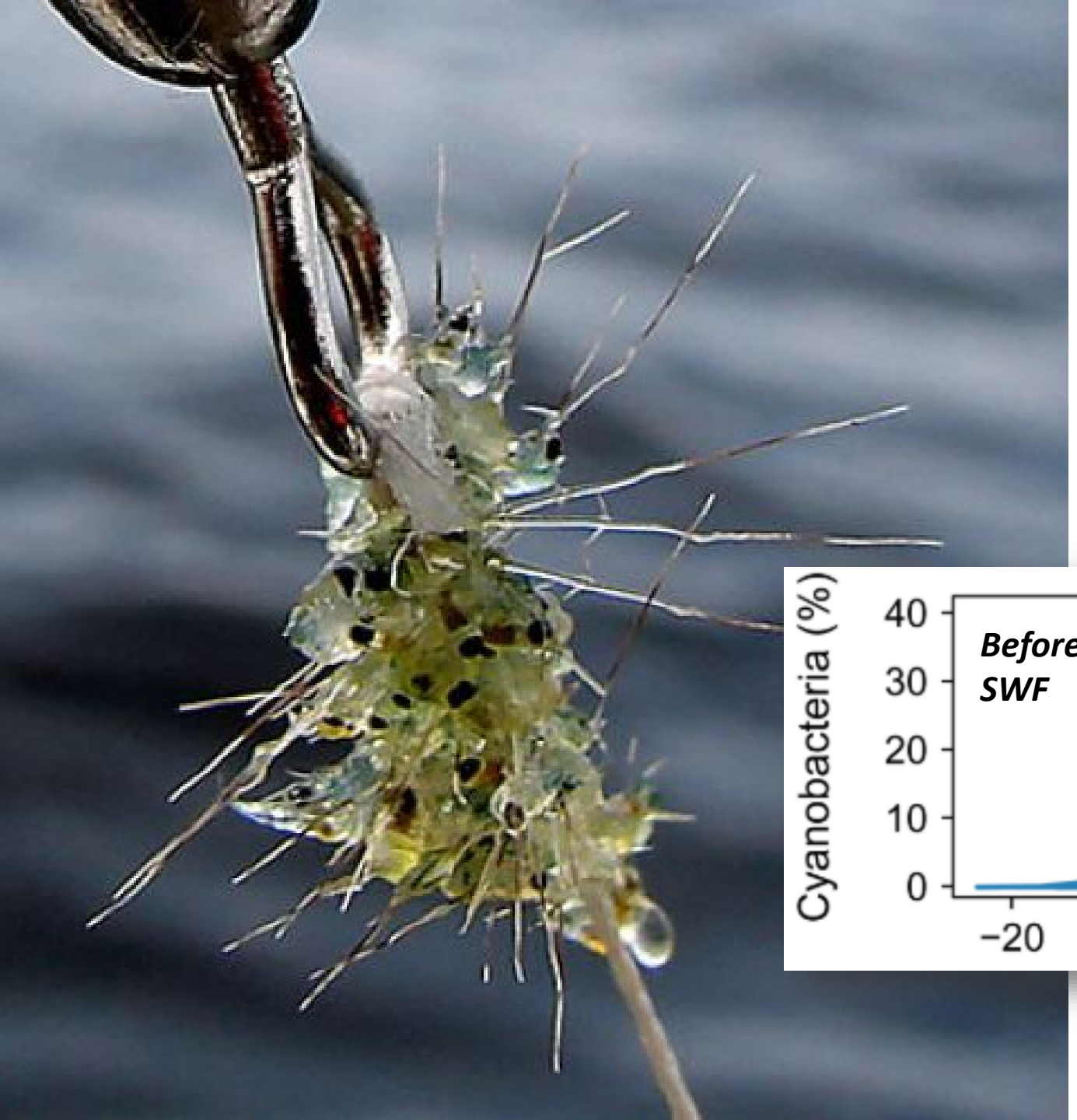
“Pathway to recovery” of Mendota water quality under varying P-reduction scenarios

Hanson et al. (2023)

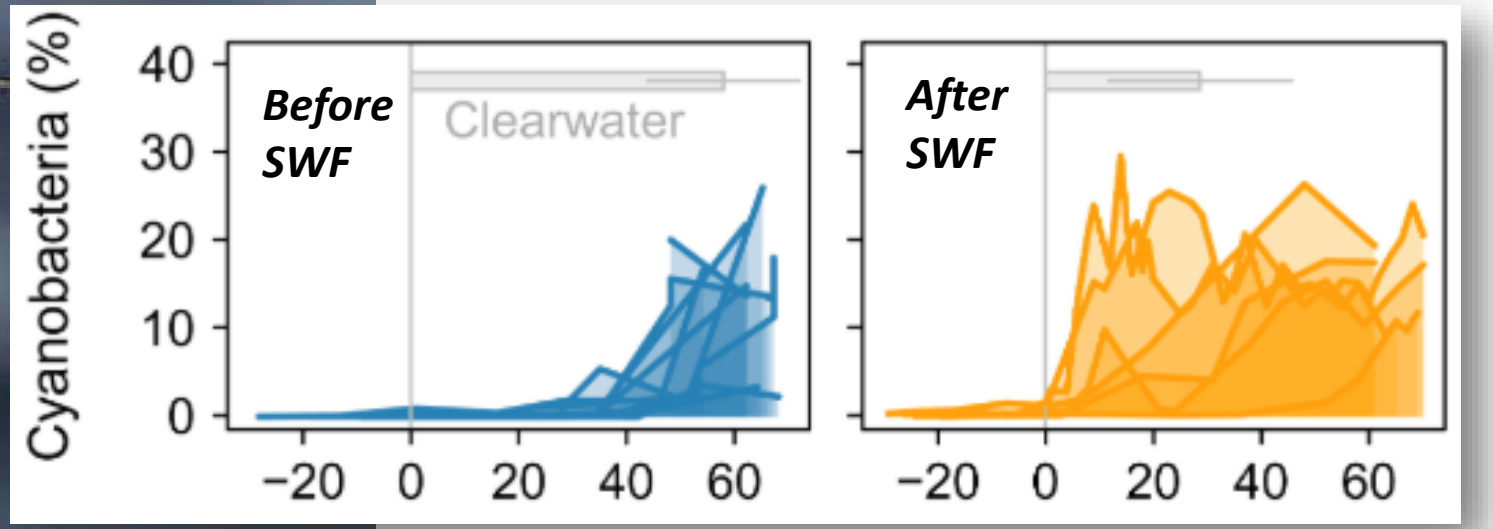
JGR-Biogeosciences

“Blue-green algae, weeds plague Madison lakes early this year”

Wisconsin State Journal, May 2023



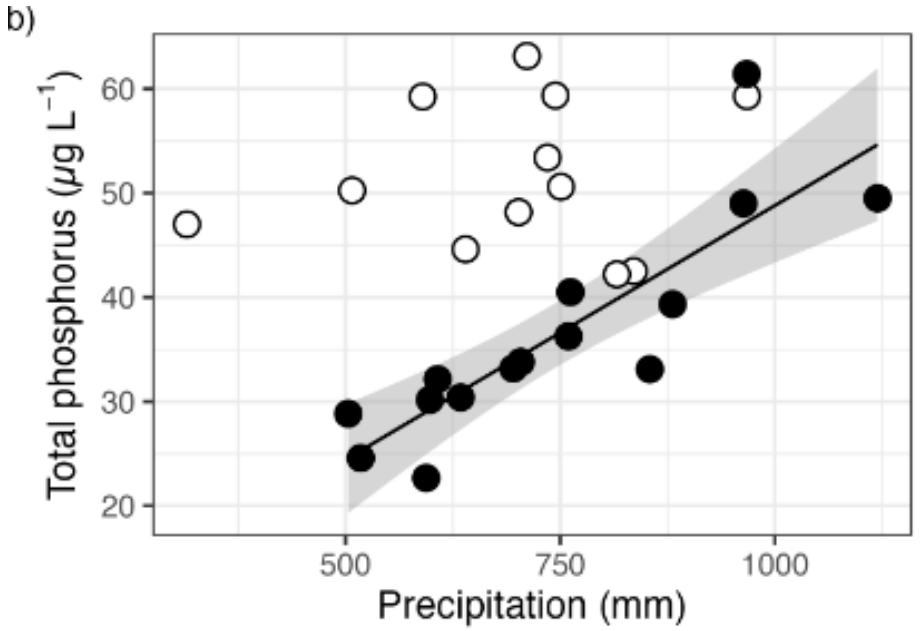
- After spiny water flea invasion, cyanobacteria dominance creeping into the spring “clear water phase”
- After zebra mussel invasion, cyanotoxin detection started earlier and lasted longer



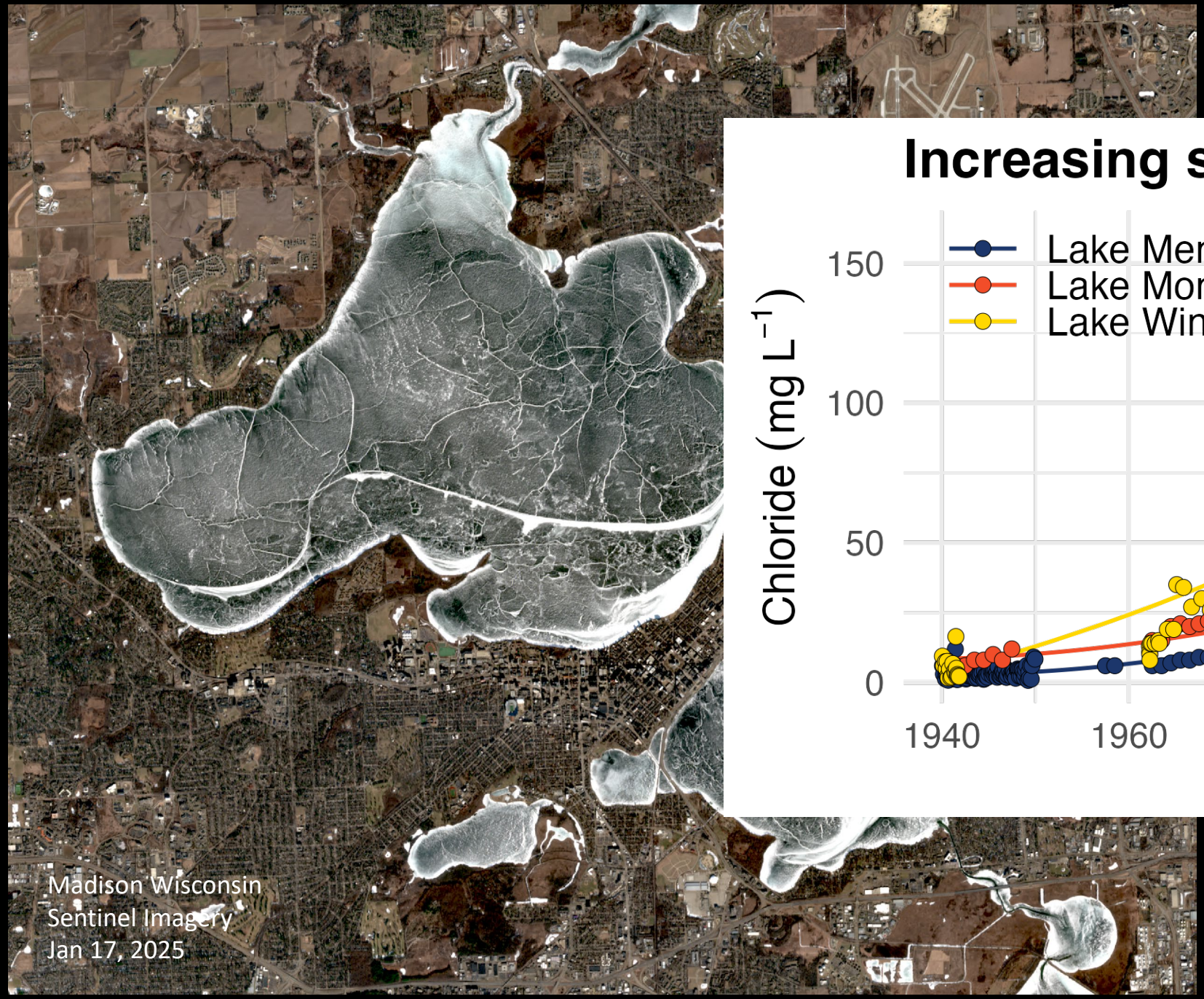
Rowher et al. (2023) *Proceedings of the National Academy of Science*

Lake Management with Climate Change

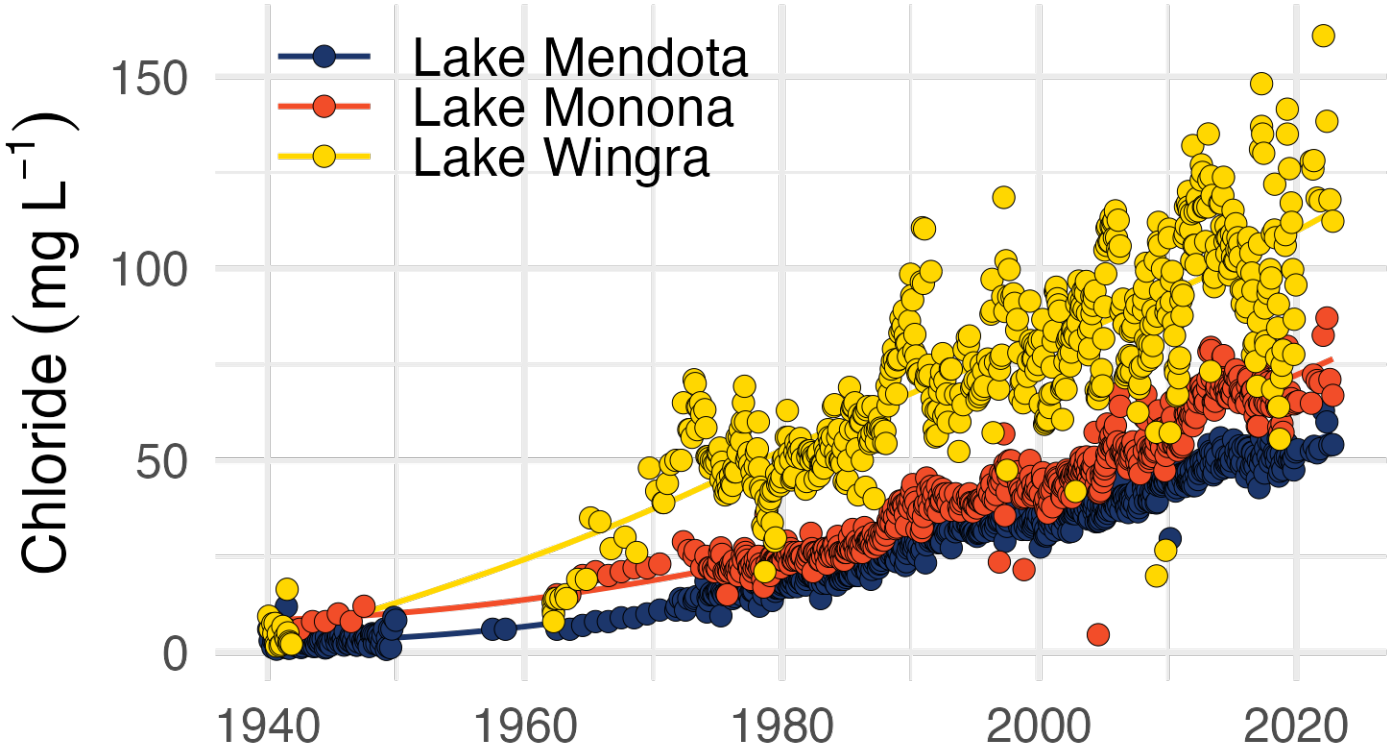
- Carp removal in Wingra very successful, sustained
- After removal, nutrient concentrations in Wingra are sensitive to precipitation
- Filamentous algae influenced by rain and zooplankton



Gorksy et al. (in review)



Increasing salinity



Data from WI DNR, city of Madison, NTL-LTER

Salt impacts water resources

- **Disruption of aquatic organismal development**
- **Effects on biogeochemical cycling**
- **Changes water density → physics**
- Plant growth and diversity
- Changes soil texture
- **Increases contaminant transport**
- Favors non-native species
- Degrades drinking water quality and infrastructure

Turning Science into Stewardship

Anticipated federal funding cuts threaten our ability to continue providing in-lake data

We remain dedicated to using our science to protect and improve the Yahara Lakes

Lake Mendota, Wisconsin (USA)

Yahara Lakes Long-Term Ecological Research

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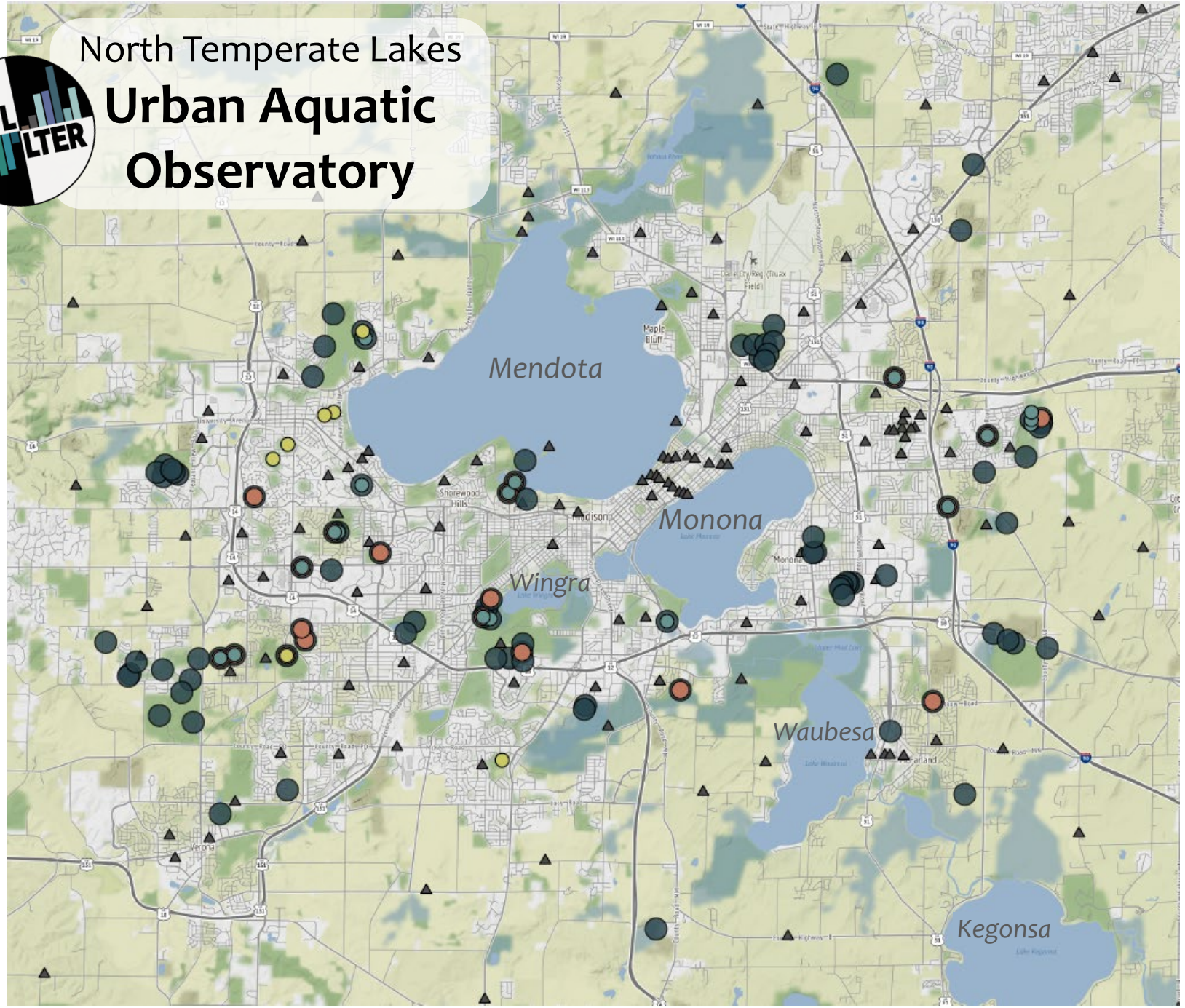
North Temperate Lakes

Urban Aquatic Observatory



heat island, canopy cover

community structure (68)

GHG, carbon stock (20)

temporal dynamics (7)

hydrology, storms (20)