NOAA GREAT LAKES

Improving NOAA's service to the Nation through collaboration

NOAA and the GLRI:
Summary Presentations of all current NOAA projects

January 22, 2020

For additional information contact:

Rebecca Held Knoche (rebecca.held@noaa.gov)

Great Lakes RESTORATION

Focus Area 3: Nonpoint Source Pollution Impacts on Nearshore Health

- 3 Objectives:
  - Reduce nutrient loads from agricultural communities
  - Reduce untreated stormwater runoff
  - Improve effectiveness of nonpoint source control and refine management efforts (NOAA)

Objective 3.3 – Improving Effectiveness

Objective

3.3. Improve effectiveness of nonpoint source control and refine management efforts.

Commitment

- Assess achievement of Great Lakes Water Quality Agreement's Annex 4 nutrient targets.
- Evaluate effectiveness of nonpoint source projects.
- Develop new or improved approaches for reducing or preventing harmful algal blooms.

Measures of Progress

- 3.3.1.* Nutrient monitoring and assessment activities conducted.
- 3.3.2.* Nutrient or stormwater runoff reduction practices or tools developed or evaluated.

Nearshore Health Projects

Project	Presenter
Decision support tools to link P reductions to harmful algal blooms and source water protection	Hank Vanderploeg, OAR GLERL
Role of Dreissenid mussels in Transforming Nutrient Loads into HABs	Hank Vanderploeg, OAR GLERL
Runoff Risk Decision Support	Dustin Goering, NWS NCRFC
Using Tipping Points Planner to support community planning decisions	Ed Rutherford, OAR GLERL
Piloting Green Infrastructure BMPs at Clean Marinas in the Western Lake Erie Basin	Erin De Vries, University of Michigan

NOAA GREAT LAKES

Improving NOAA's service to the Nation through collaboration

Decision support tools to link P reductions to harmful algal blooms and source water protection

Henry Vanderploeg

NOAA GLRI Webinar

January 22, 2020

Great Lakes RESTORATION

Decision support tools to link P reductions to harmful algal blooms and source water protection (integrated with Ruberg's FA 5 SOAR project)

Project team: Vanderploeg, Anderson, Errera, Rowe, Ruberg, Stowe (GLERL); Godwin, Johengen, Gill (CIGLR); Doucette, Stumpf (NCCOS)

Funding: Current funding $1.95M (Active since 2013)

FA3 Objective: Improve effectiveness of nonpoint source control and refine management efforts

Measure of Progress: Nutrient monitoring and assessment activities conducted

Brief Project Description

Link the response of Great Lakes phytoplankton community composition and bloom toxicity, trajectory, and extent to changes in nutrient loading:

- Forecast response to protect source water and recreational water users from exposure to toxic algae
- Document the success of watershed nutrient runoff mitigation practices
- Develop understanding necessary for effective, long-term nutrient management plans

How we do this: (1) Remote Sensing, (2) Monitoring, (3) Models, (4) Experiments, (5) Stakeholder Engagement

Satellite Remote Sensing

NCCOS

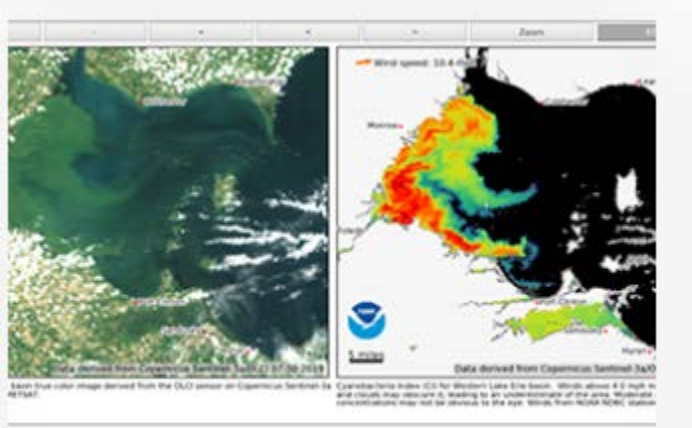
Richard Stumpf, Timothy Wynne

Satellite Remote Sensing

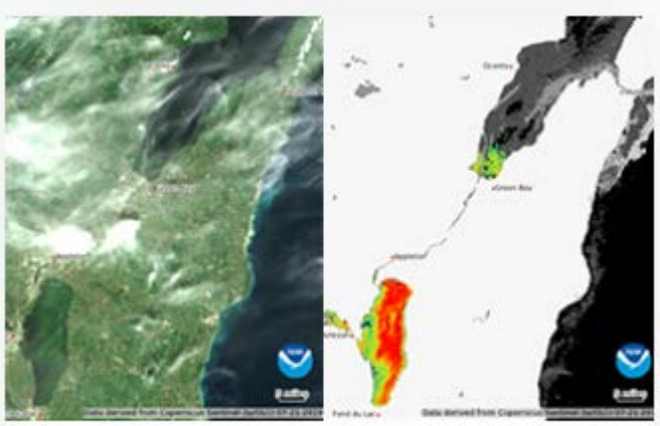
New web sites with routine cyano product (CI cyano chlorophyll biomass) for

- Western Lake Erie (including area estimate)
- Saginaw Bay
- Green Bay/Winnebago

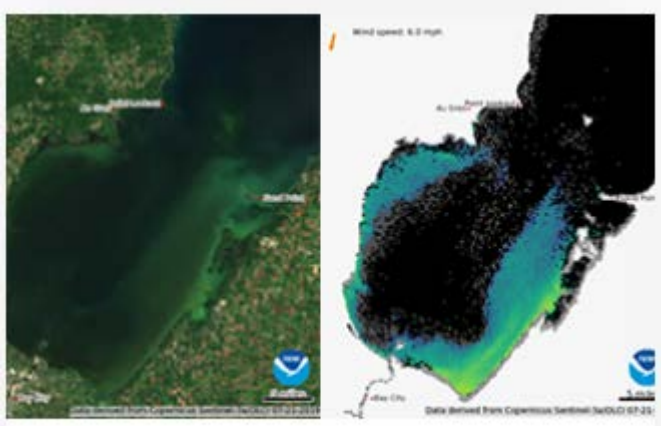
coastalscience.noaa.gov/research/stressor-impacts-mitigation/hab-monitoring-system/



Lake Erie



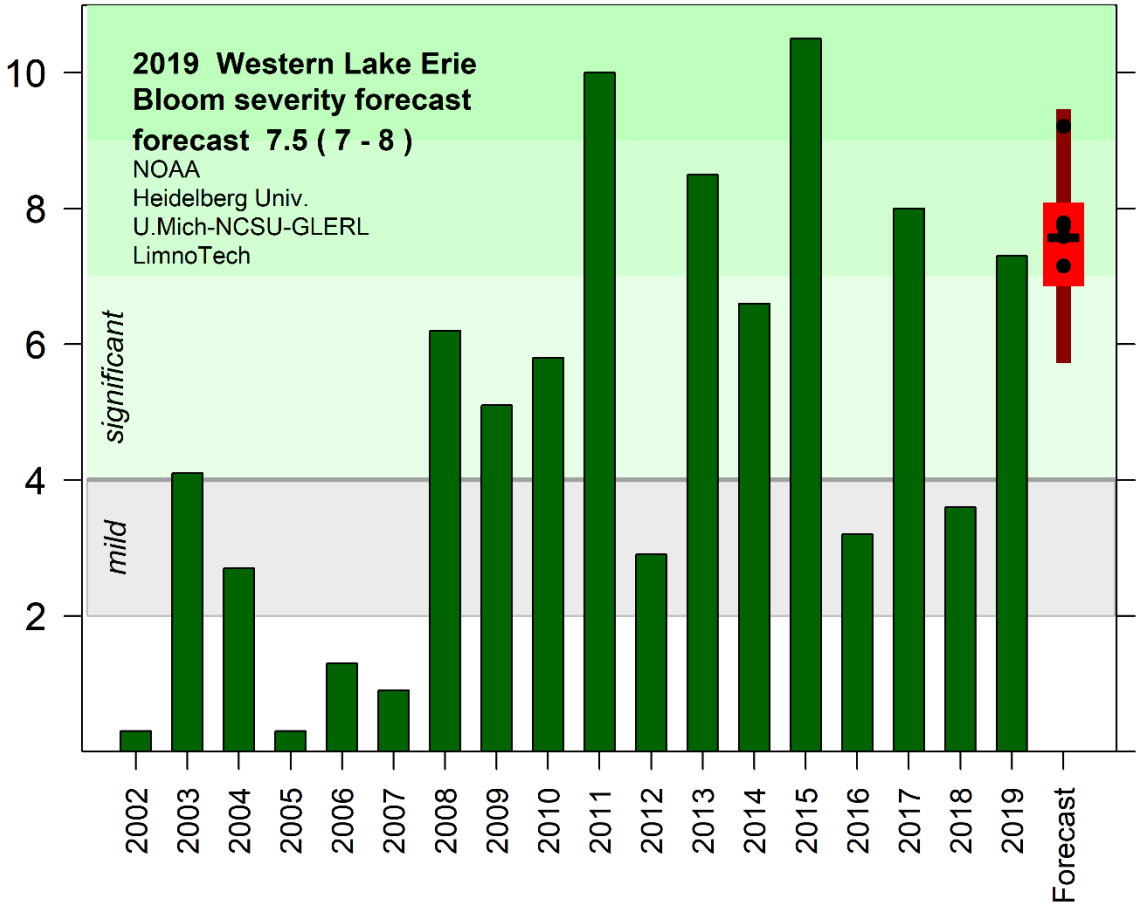
Green Bay, WI



Saginaw Bay, MI

Satellite Remote Sensing

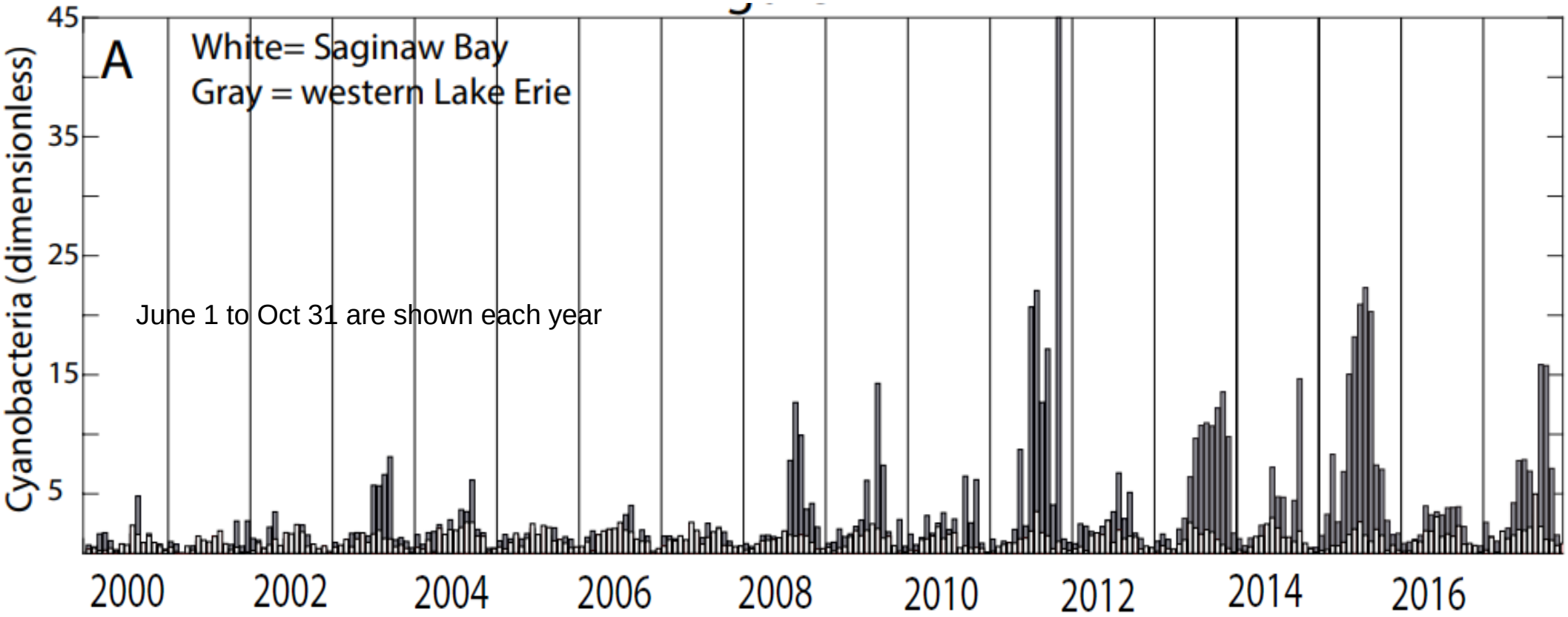
2019 seasonal analysis included assessment of changes in concentration of DRP (dissolved reactive P)



2019 Analysis: While the discharge volume and total phosphorus loads approached those in 2011, a lower concentration of TBP compared to recent years led to lower TBP loads and allowed us to avoid a 2011-sized bloom. (TBP = total bioavailable P, all DRP + ~10% of particulate P)

Satellite Remote Sensing

Completing analysis of Saginaw Bay blooms.



Satellite Remote Sensing

Next Steps

- Green Bay analysis
- New model for Lake Erie bloom
- Continued analysis across OLCI MODIS MERIS to assure accurate continuity
- Updating Sentinel-3a/3b processing (NASA/ESA calibration) S3a/3b has daily 300-m resolution
- Sentinel-2 (20 m, 5-day repeat) check usability for reliable detection of local blooms (near shore)

Monitoring

GLERL/NOAA

Reagan Errera, Hank Vanderploeg, Steve Ruberg

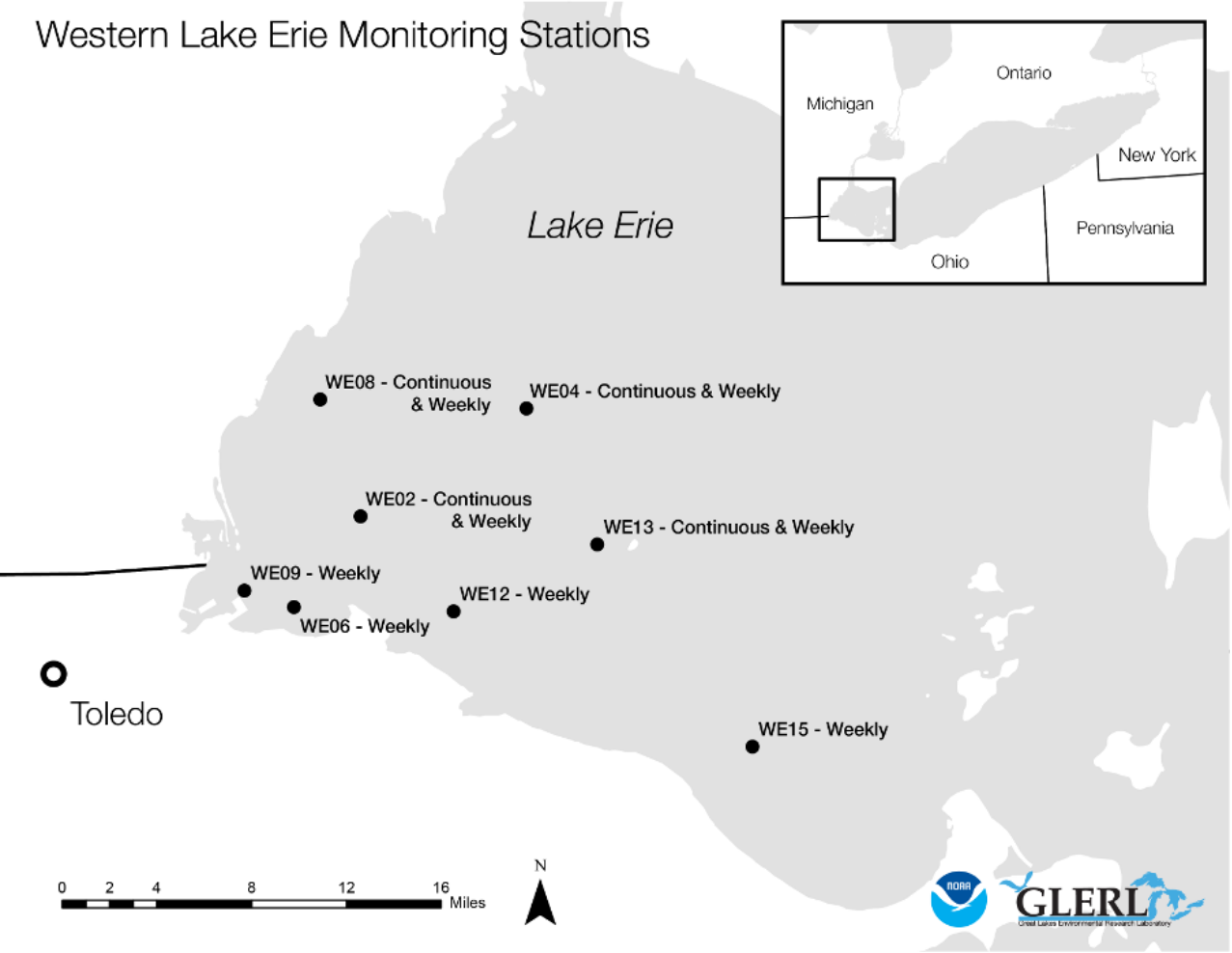
CIGLR

Tom Johengen, Casey Godwin

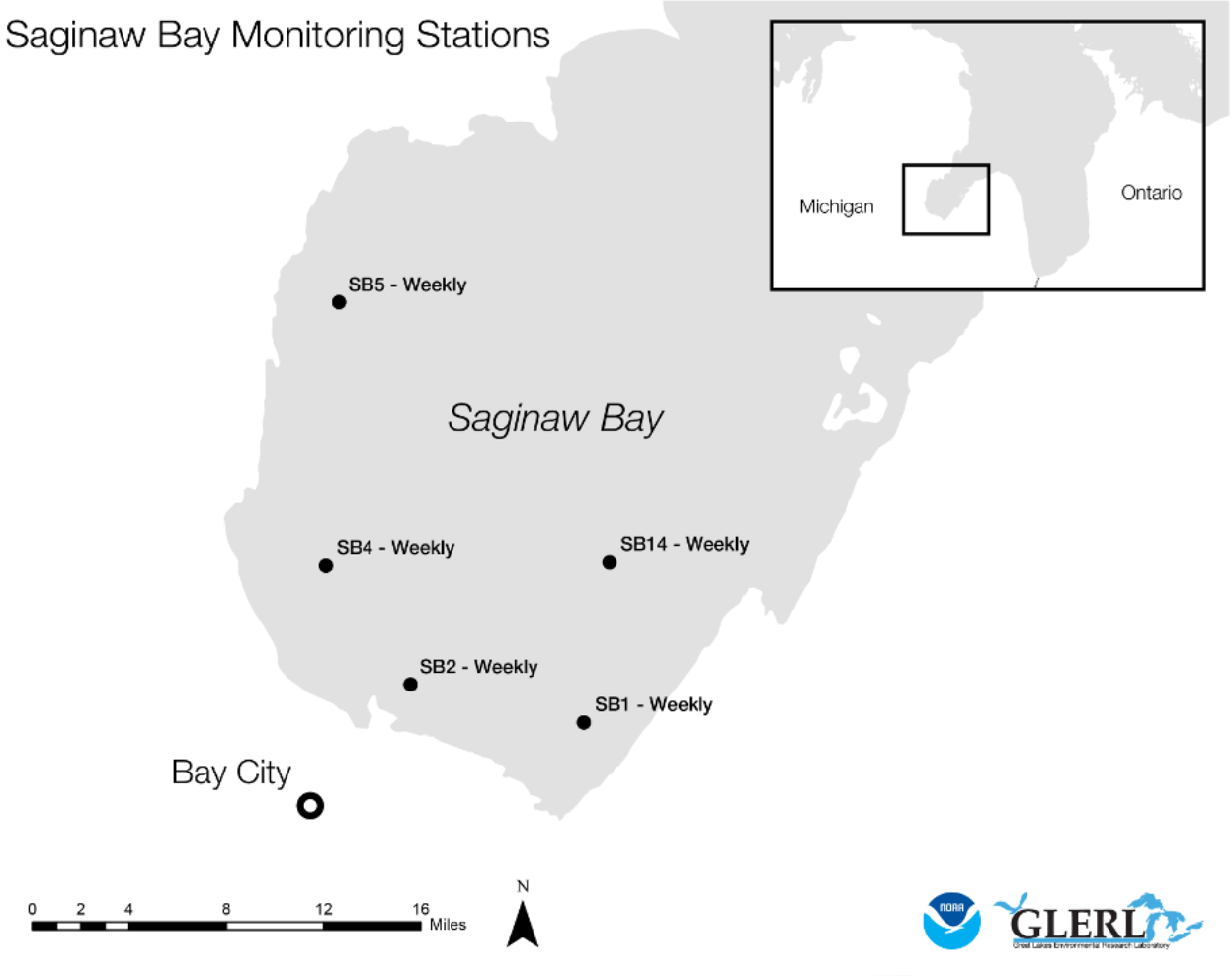
NCCOS

Greg Doucette

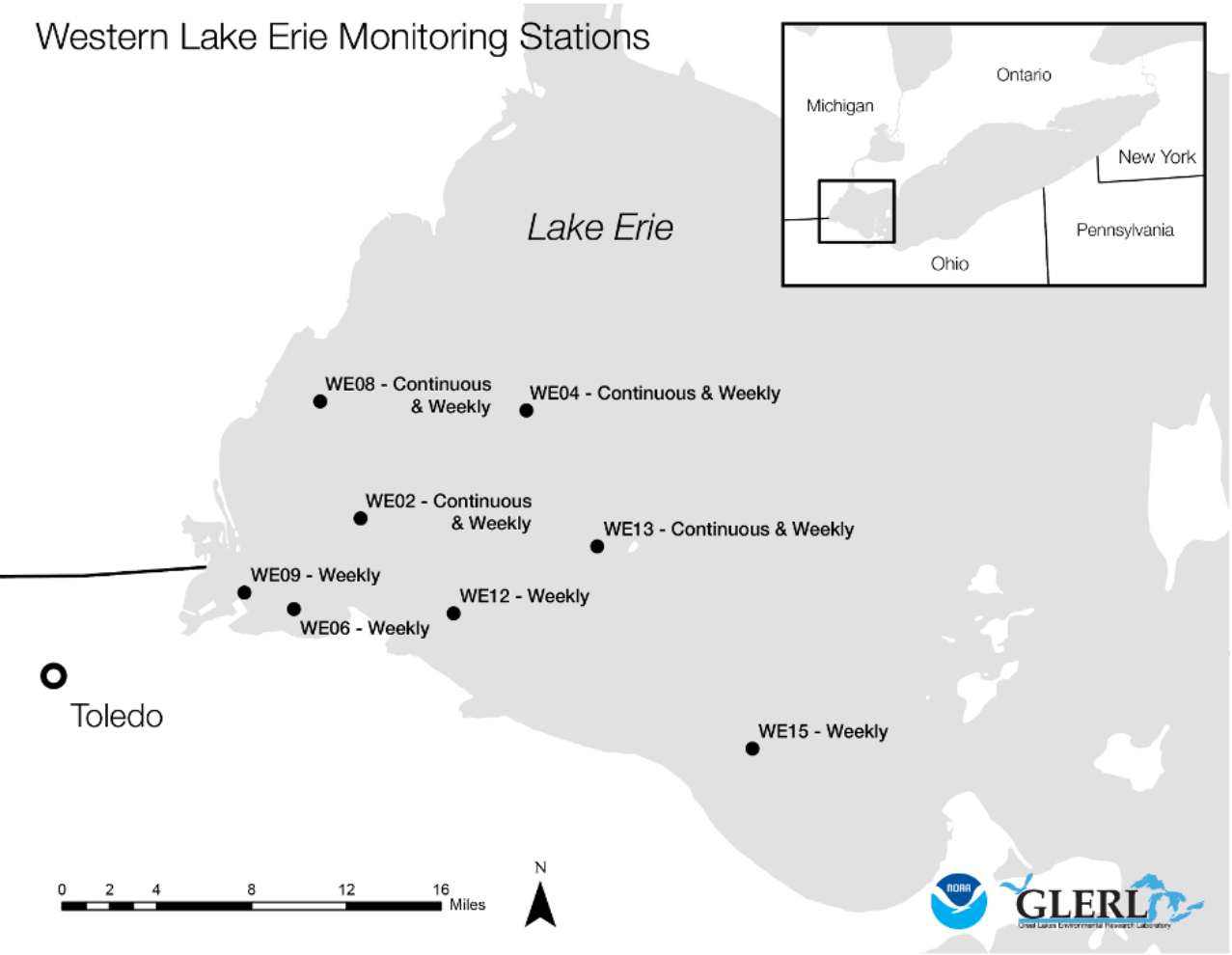
Lake Erie



Lake Huron



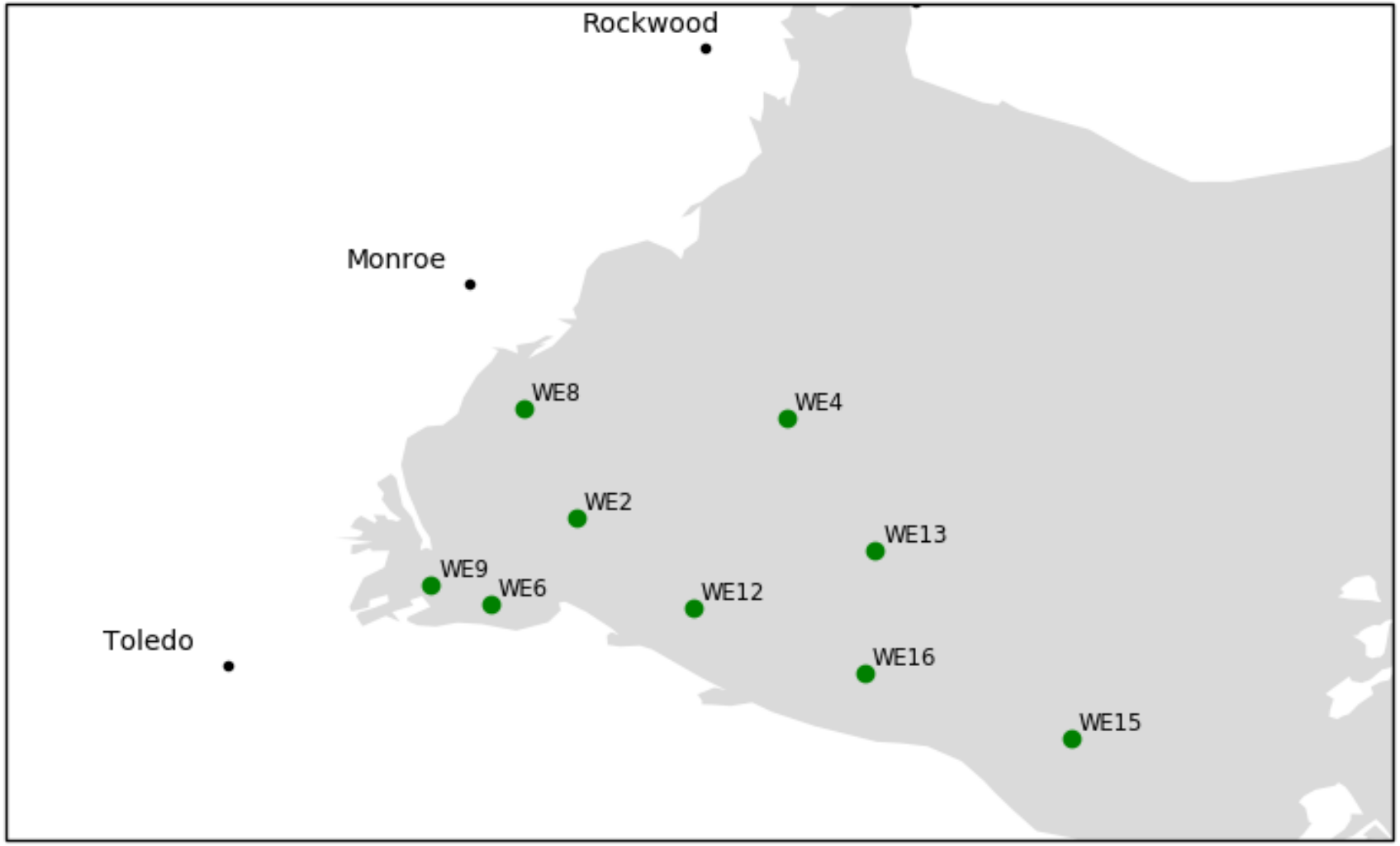
Lake Erie



Point samples:

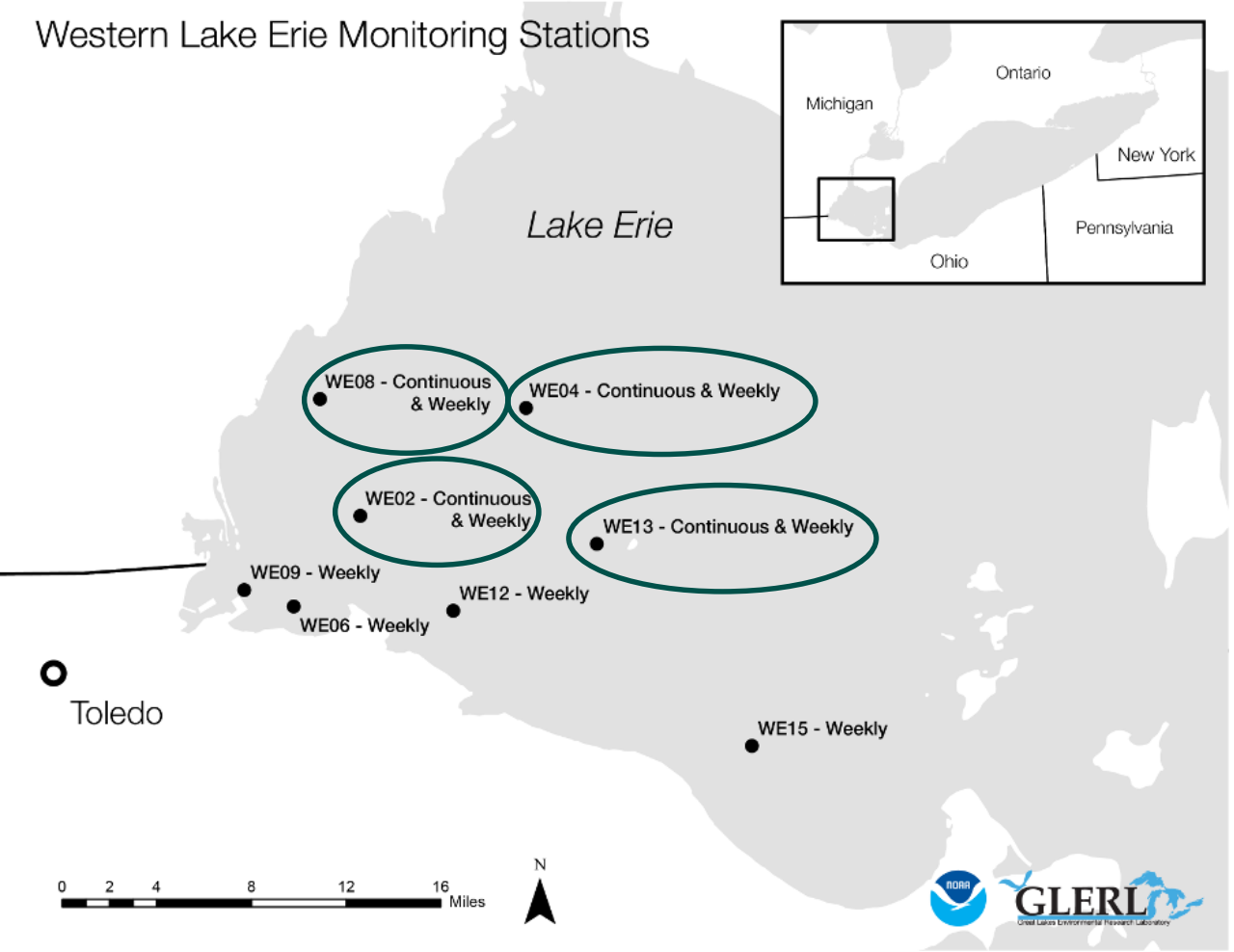
Chlorophyll a (extracted and sensor based); Phycocyanin (extracted and sensor based); Nutrients (phosphorous, nitrate, ammonium, SRP); Total and volatile suspended solids, CHN, DOC, Particulate and dissolved microcystin, phytoplankton assemblage counts, qPCR (mcyE target), CTD (temp, conductivity, depth, DO, PAR, transmission), FluoroProbe, total alkalinity & pH

Western Lake Erie Weekly Sampling
2015-06-08



- Green: 0 – 0.1 µg L^{-1}
- Yellow: 0.2 – 0.9 µg L^{-1}
- Red: ≥1 µg L^{-1}
  - 1 – 2 µg L^{-1}
  - 2 – 4 µg L^{-1}
  - 4 – 10 µg L^{-1}
  - 10 – 20 µg L^{-1}
  - > 20 µg L^{-1}

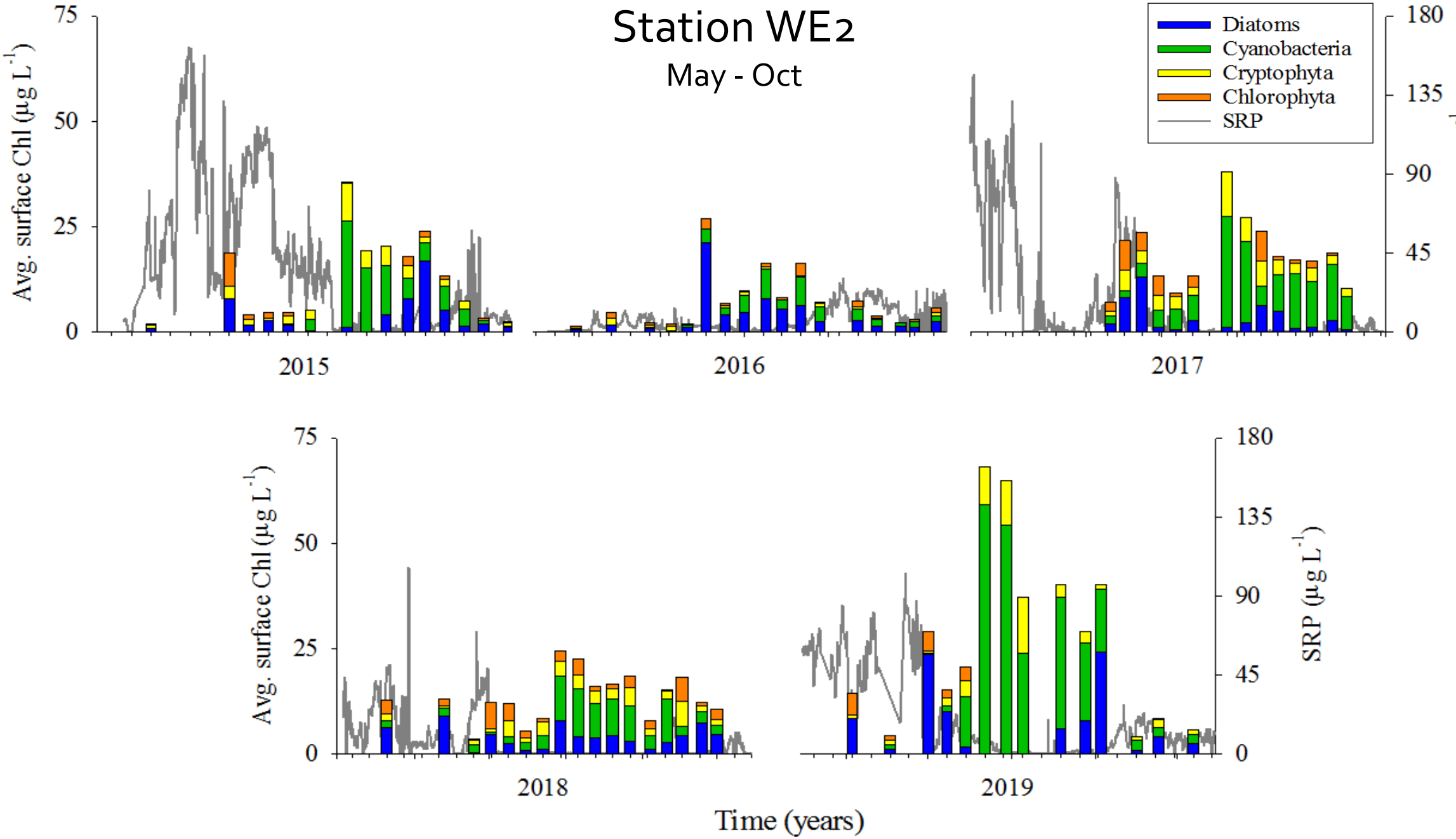
Lake Erie

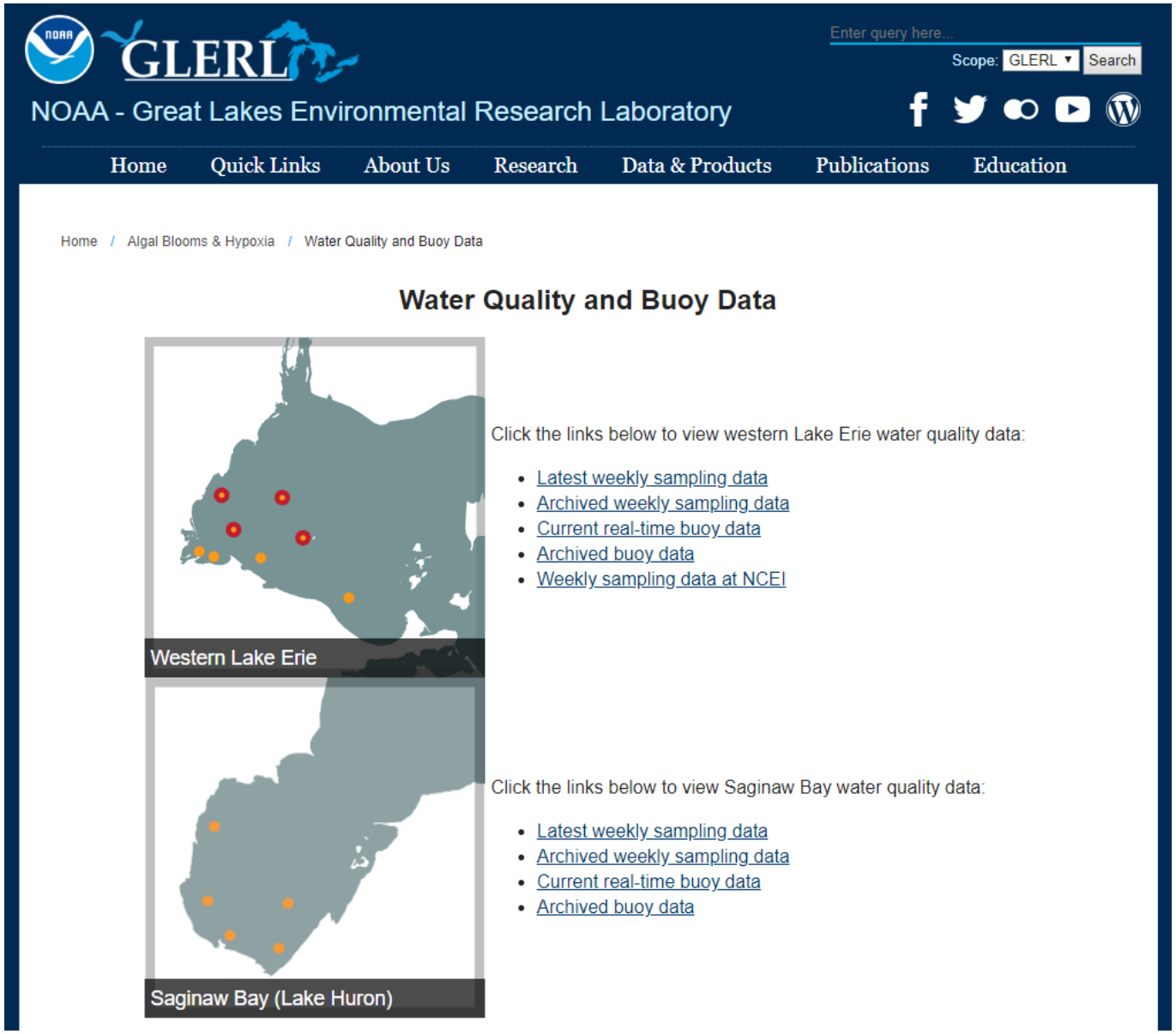


Continuous Real-time
with Seabird SUNA, YSI, Wetlabs CycleP:
Nitrate/Nitrite, SRP, Temp, Conductivity, Chlorophyll, Phycocyanin, turbidity, CDOM, pH, and DO

Station WE2

May - Oct



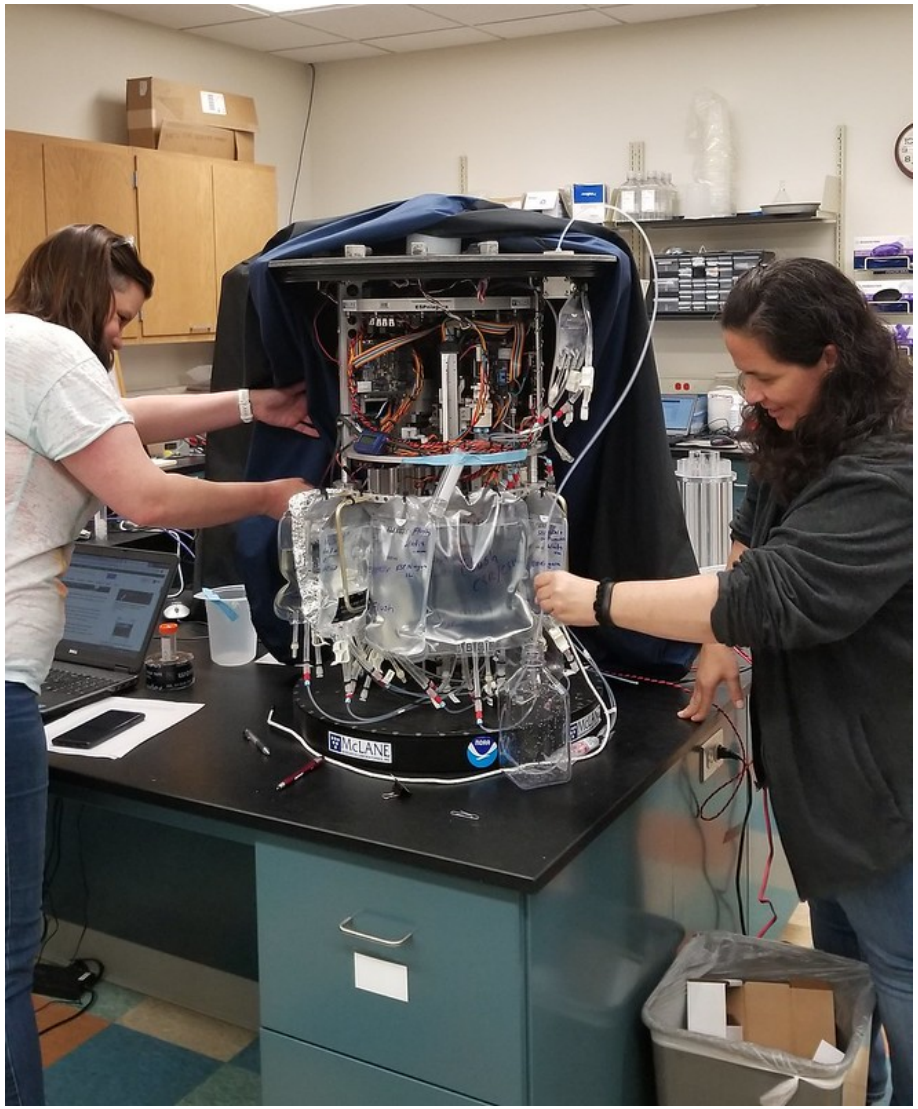


https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/habsMon.html

Or

Through an email list serve

Environmental Sample Processor - ESP



Developed by MBARI, available through McLANE

In situ collection and analysis → microcystin

Near real-time

Immunosorbent assay developed in partnership with NCCOS (Doucette and Mikulski)

Approximately 40 field samples (depends on pre-/post-controls)

At GLERL:

ESPniagara, ESPnessie*, and ESPrush*

Deployments:

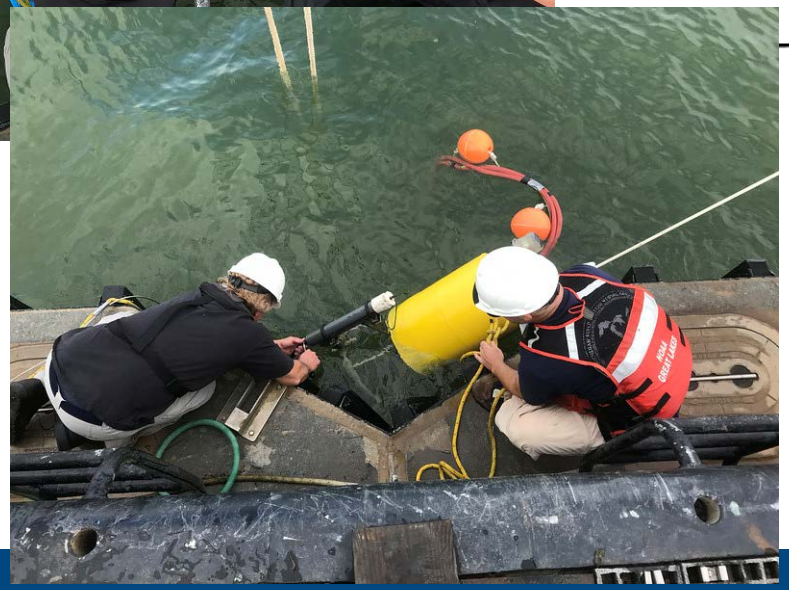
*deployed in 2019

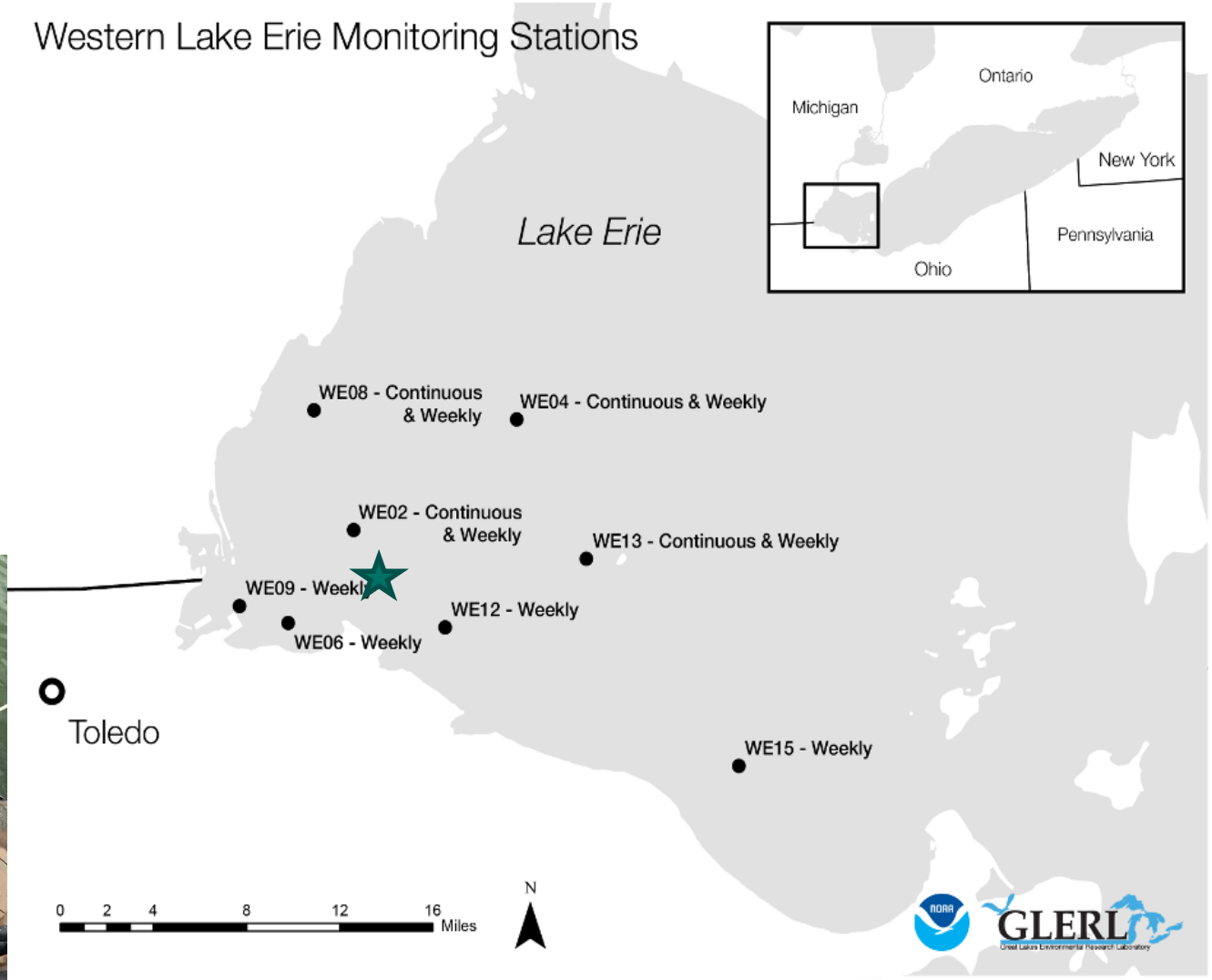
2016: Put-In-Bay, OH

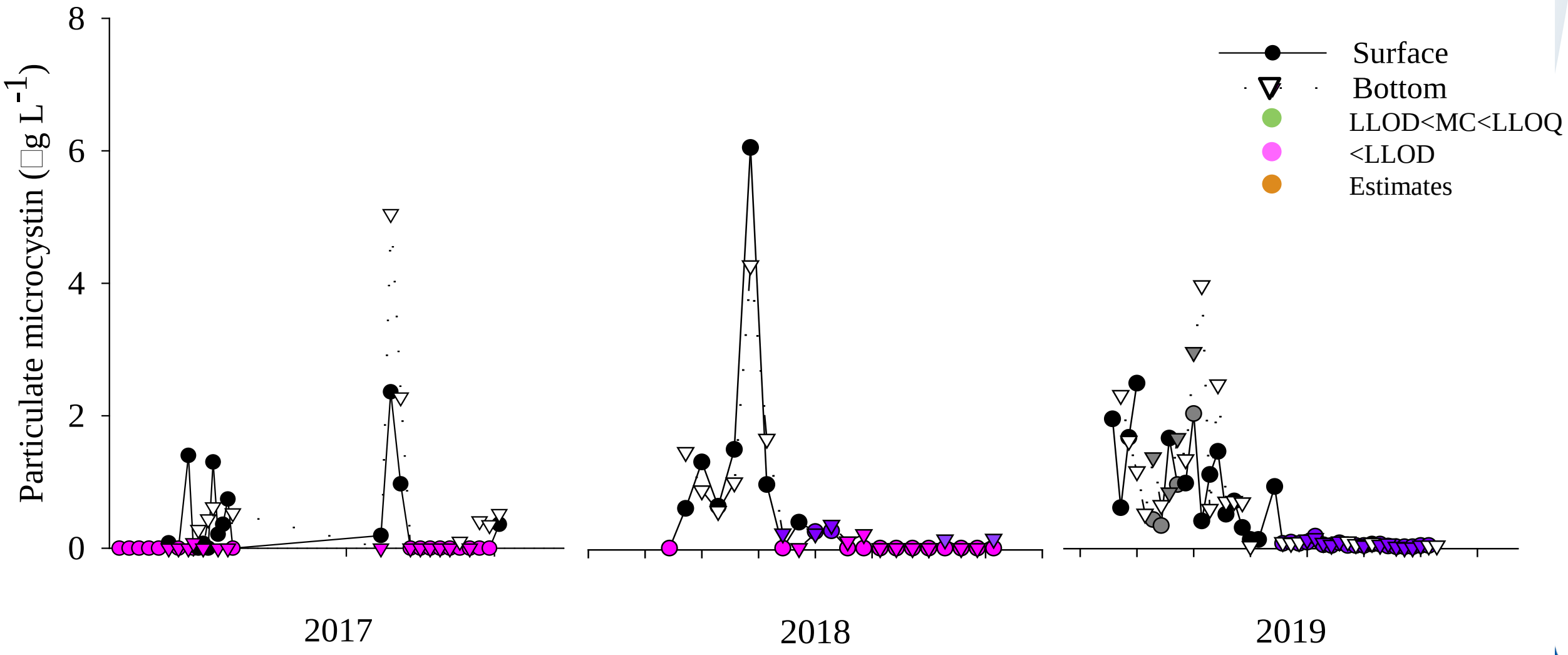
2017 – 2019: near Toledo Water Intake

Danna Palladino & Tina Mikulski

ESPniagara




Western Lake Erie Monitoring Stations
Ontario
Michigan
New York
Pennsylvania
Ohio
Lake Erie
WE08 - Continuous & Weekly
WE04 - Continuous & Weekly
WE02 - Continuous & Weekly
WE13 - Continuous & Weekly
WE09 - Weekly
WE12 - Weekly
WE06 - Weekly
Toledo
WE15 - Weekly
0 2 4 8 12 16 Miles
N


Particulate microcystin (□g L-1)
8
6
4
2
0
2017
2018
2019
Surface
Bottom
LLOD<MC<LLOQ
<LLOD
Estimates

Modeling: Development of short-term HAB forecasts

NOAA GLERL

Mark Rowe, Eric Anderson, Hank Vanderploeg, Craig Stow

CIGLR

Joe Smith

NOAA NOS

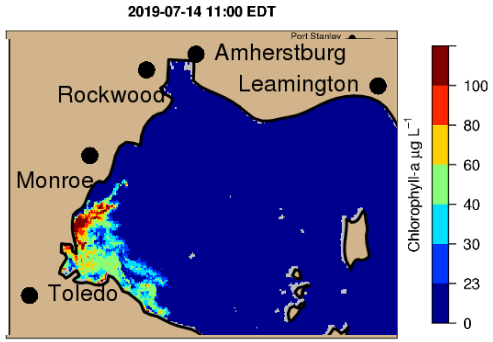
Rick Stumpf, Tim Wynne

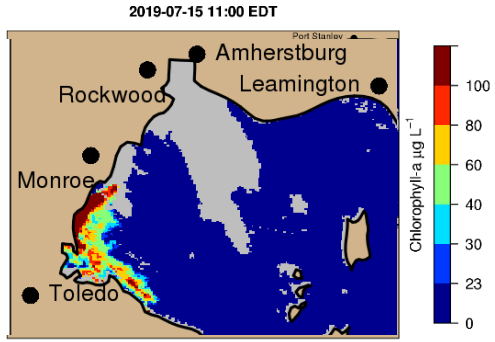
Transition of HAB Tracker to operations at NOAA COOPs

- 2019
  - COOPs re-coded HAB Tracker for operations
  - COOPs and GLERL ran HAB Tracker daily nowcast-forecast concurrently for verification using operational code and LEOFS model currents
- 2020
  - COOPs will run HAB Tracker operationally

HAB Tracker predicted HAB movement toward Monroe, July 2019

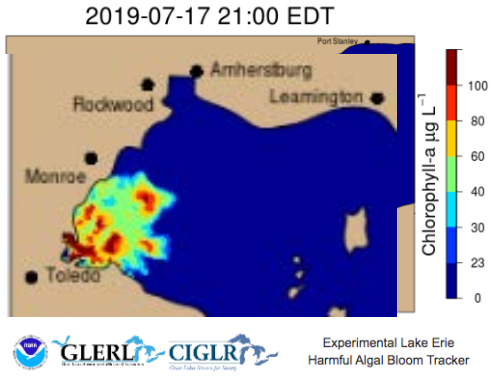
Satellite images from NOAA NOS used to initialize model



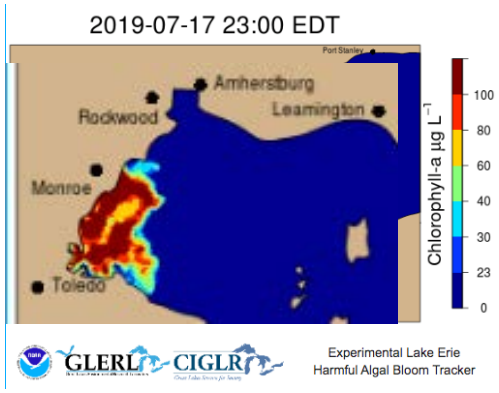


Predicted and observed bloom near Monroe on July 17

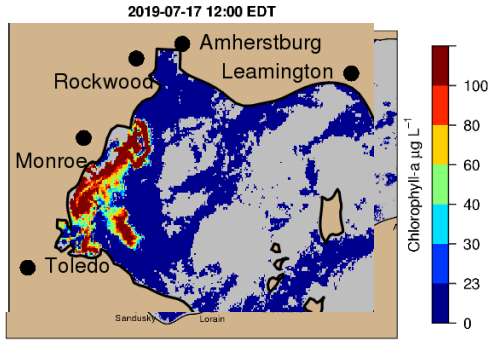
Model prediction issued 7-15



Model prediction issued 7-16

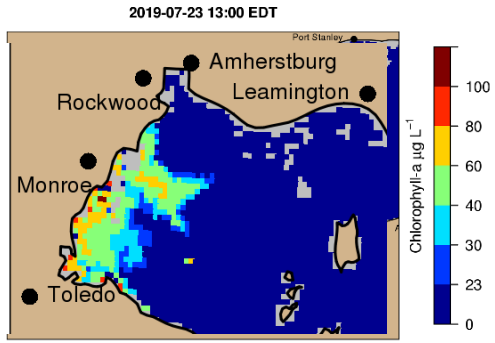


Observed 7-17



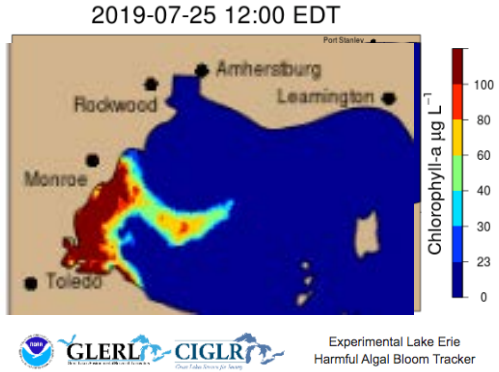
HAB Tracker predicted HAB westward movement, July 2019

Satellite image from NOAA NOS used to initialize model

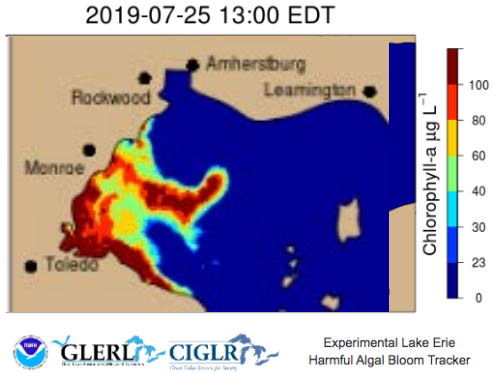


Predicted and observed bloom near Monroe on July 25

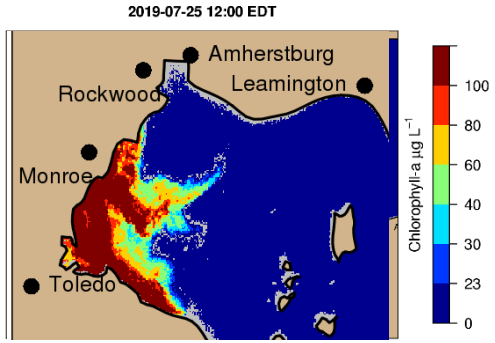
Model prediction issued 7-23



Model prediction issued 7-24



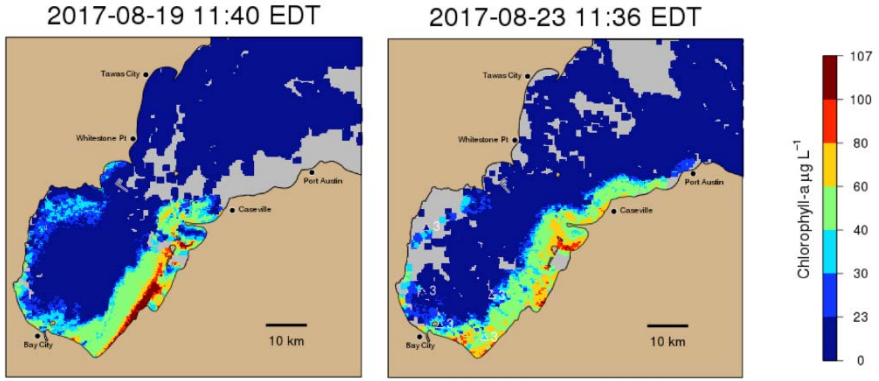
Observed 7-25



Assessment of a Saginaw Bay HAB Tracker

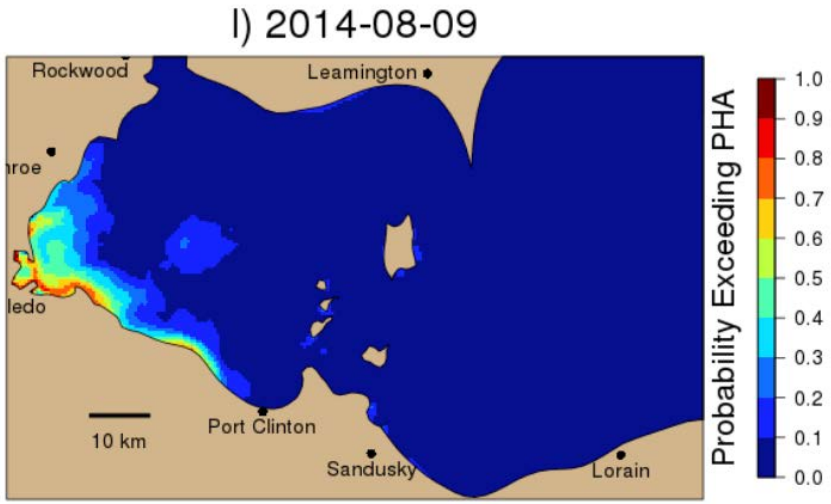
- A Saginaw Bay HAB Tracker is under assessment
- Two stakeholder meetings were conducted in 2019
- Model development and assessment are ongoing

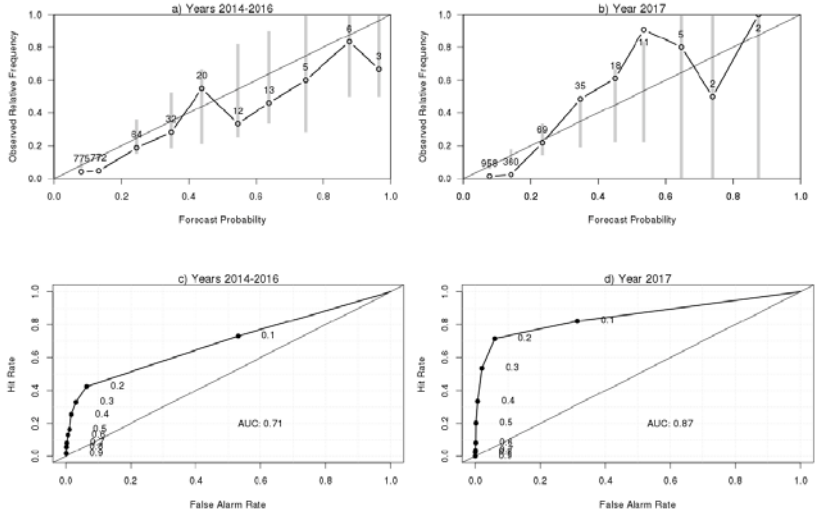
Observed progression of bloom out from the inner bay in subsequent satellite imagery from NOAA NOS



Extension of HAB Tracker to probabilistic toxin forecast

- An approach was developed and assessed to extend HAB Tracker to predict probability of exceeding 6 µg/L microcystin public health advisory level by incorporating measurements of microcystin and chlorophyll from the preceding week





Q. Liu, M. Rowe, E. Anderson, C. Stow, R. Stumpf, T. Johengen. 2019. Probabilistic forecast of microcystin toxin using satellite remote sensing, in situ observations and numerical modeling. Env. Model. Software, submitted

Experiments—Nutrients & Mussels Impacts on Growth and Buoyancy of Toxic HABs

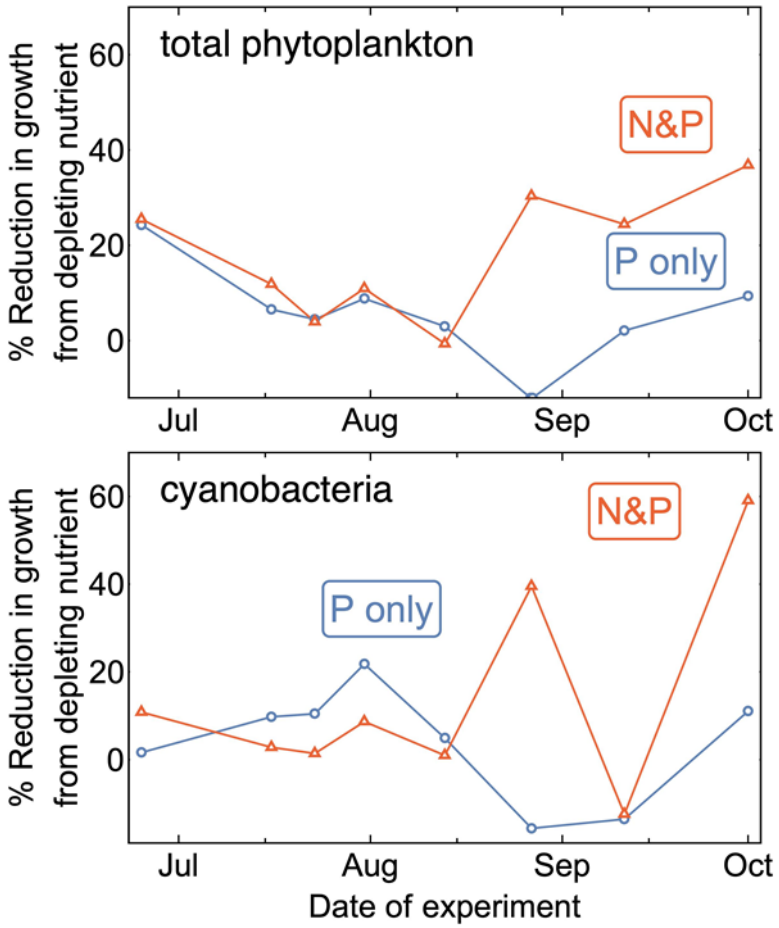
NOAA GLERL
Hank Vanderploeg, Reagan Errera, Mark Rowe

CIGLR
Casey Godwin, Tom Johengen, Paul DenUyl

University of Wisconsin, Milwaukee
J. Rudi Strickler

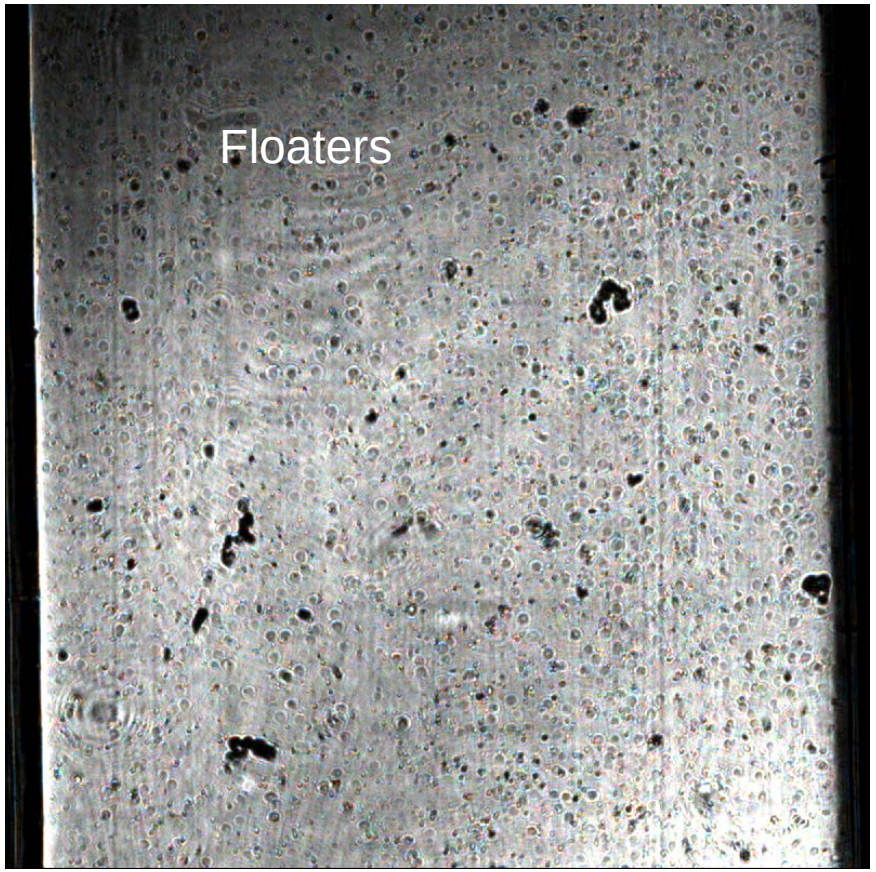
Experiments—Nutrients & Toxic HABs

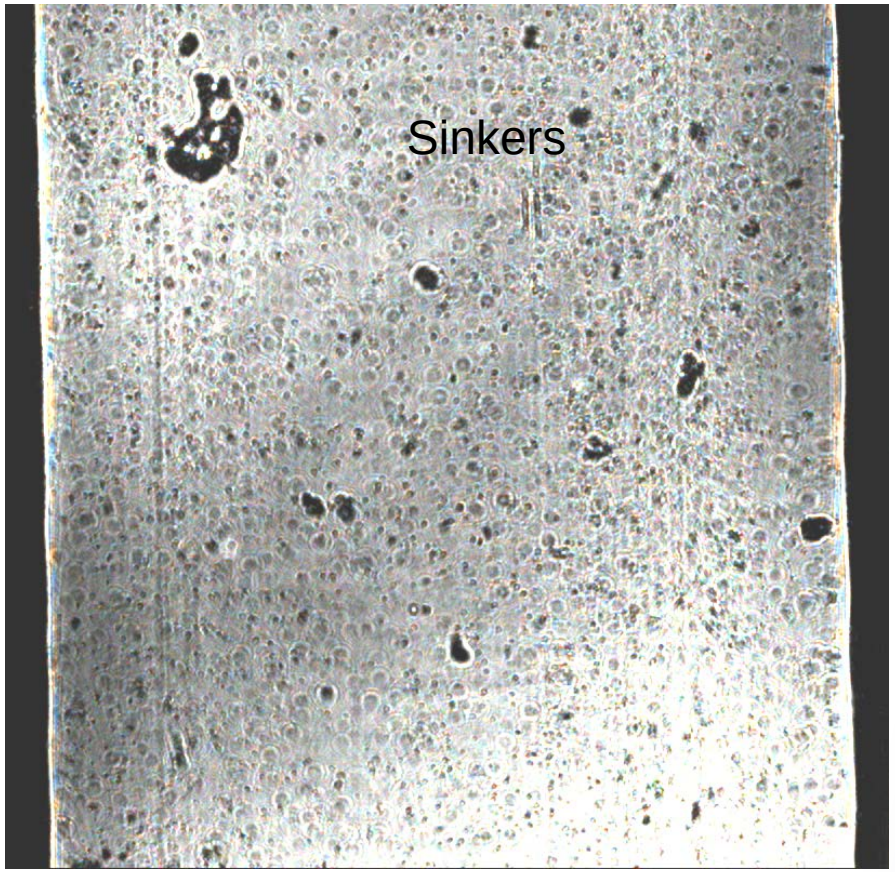
How does decreasing P, versus P+N, affect growth rates, community composition, toxicity, and buoyancy?



Will a 40% P reduction prevent toxic HABs?

Nutrient & Light History and Colony Size affect floating sinking—new HAB Tracker





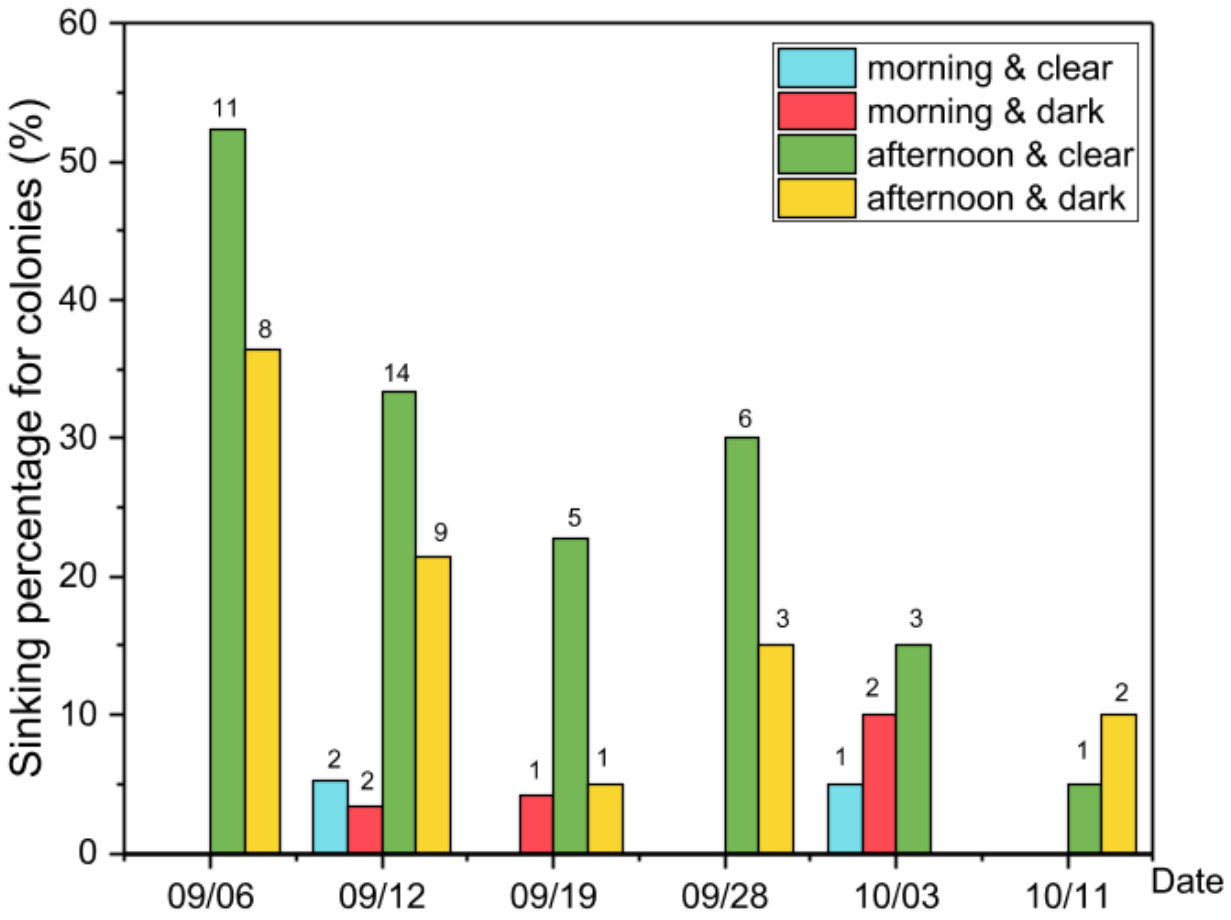


Figure 2.9 Percentage of sinking colonies based on videographic velocity measurements. Numbers on the bars represent the actual counts of sinking colonies.

Stakeholder Engagement

Co-designing HAB Forecasts with Stakeholders

- 11 Workshops including Focus Groups, Interviews, & Surveys
- >125 Individual Stakeholder Partners & HAB Data Users *(fishing, drinking water plants, agriculture, industry, boating, NGOs, water quality managers, elected officials, etc.)*
- Gill, Rowe, and Joshi (2018). Fishing in Greener Waters: Undrstanding the impact of harmful algal blooms on Lake Erie anglers and the potential for adoption of a forecast model. *Journal of Environmental Management*. 227 (2018), 248-255.

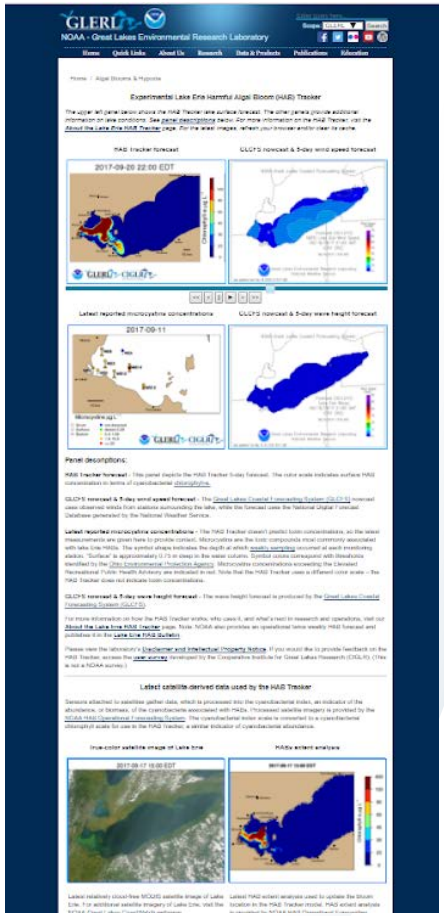
"Most of the time, we didn't know where the algae was. We'd take off at one spot, then because of the algae we would waste time, gas, and money driving around looking for a clearer spot. With the HAB Tracker, we know right where to go."

- Lake Erie Charter Captain,
2017 Focus Group Participant

Stakeholder Engagement

Co-designing HAB Forecasts with Stakeholders

- Outputs:
  - HAB forecasts designed to meet explicit stakeholder needs
  - User-tested webpages for disseminating HAB forecast information
- Outcomes:
  - Developing stakeholder partnerships *(state agencies, public water systems*) to advise on on-going forecast development, future areas of research, and outreach efforts
  - Increasing public knowledge about the Great Lakes
  - Building trust in Great lakes research and scientists



Recommendations from focus groups informed design of the HAB Tracker website.

NOAA GREAT LAKES

Improving NOAA's service to the Nation through collaboration

Role of Dreissenid Mussels in Transforming Nutrient Loads into Harmful Algal Blooms

Henry Vanderploeg

NOAA GLRI Webinar

January 22, 2020

Great Lakes RESTORATION

Role of Dreissenid Mussels in Transforming Nutrient Loads into Harmful Algal Blooms

Project Team: Henry Vanderploeg, Ashley Elgin (GLERL), Hunter Carrick (CMU), Vincent Denef (EE&B, UM) & Jeffrey Schaffer (USGS)

Funding: $491,676 FY2018

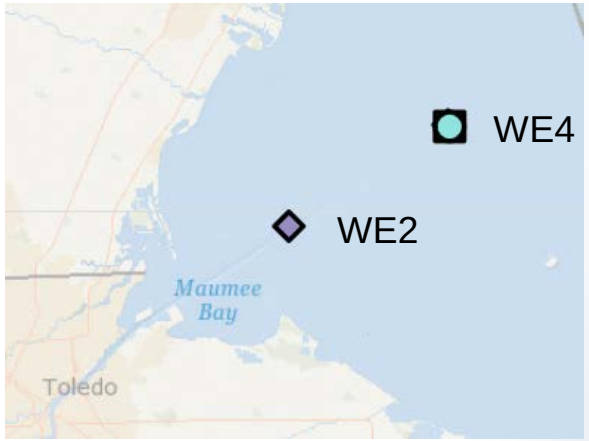
APII FA3 Objective: Reduce Nutrient loads from agricultural watersheds

MOP: "In addition GLRI partners will assess the extent to which harmful algal blooms are impacted by phosphorus loading, in-lake mixing, climate change and invasive species."

Project Description

We will use a combination of field surveys to assess dreissenid mussel abundance, seasonal condition and growth, and lab experiments to measure mussel feeding and nutrient excretion rates using Lake Erie seston and laboratory cultures to determine the impact of mussels in transforming nutrient loads into harmful algal blooms

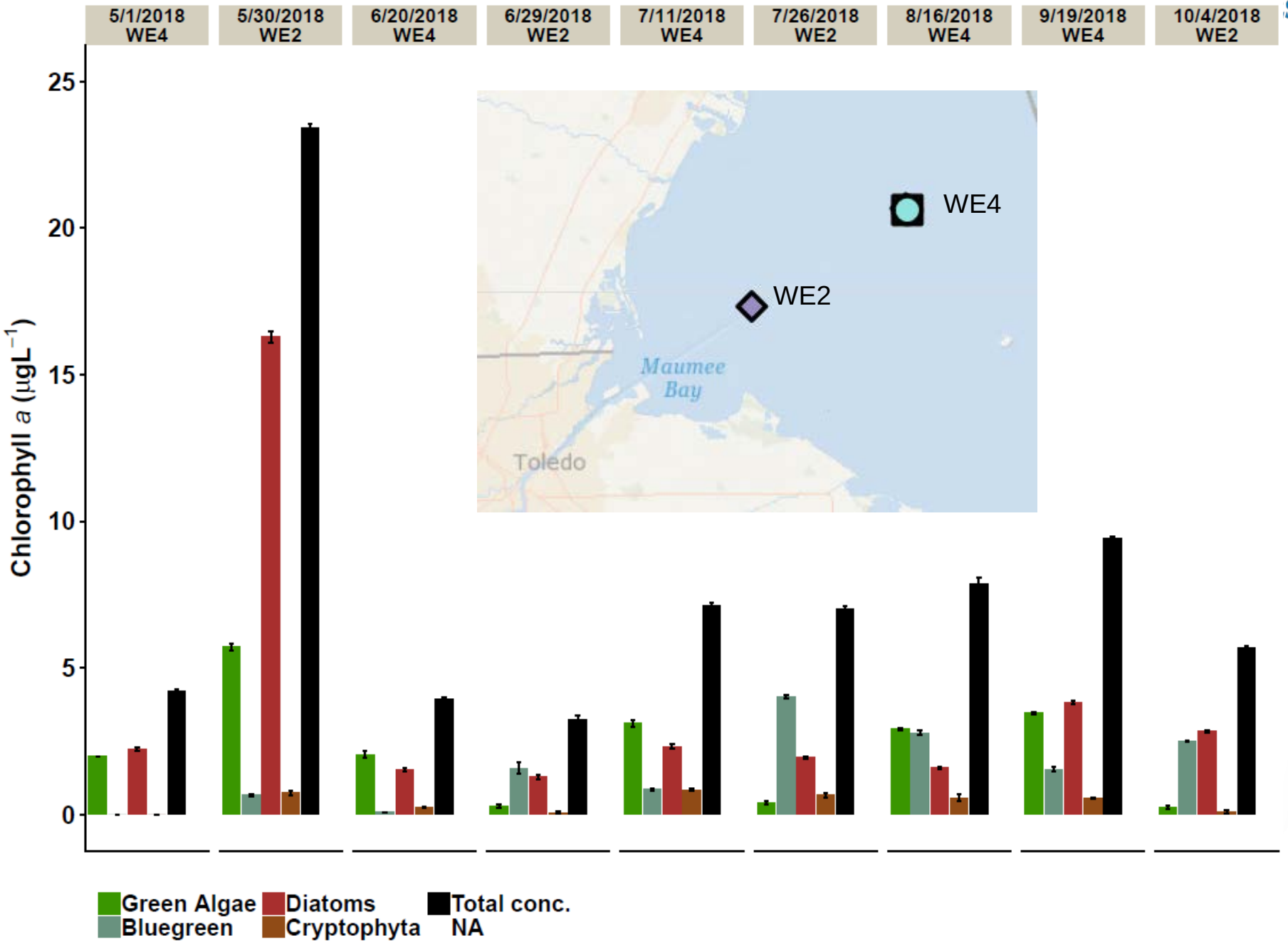
Using multiple methods to understand feeding dynamics and impacts of *Dreissena* across seasons in Lake Erie

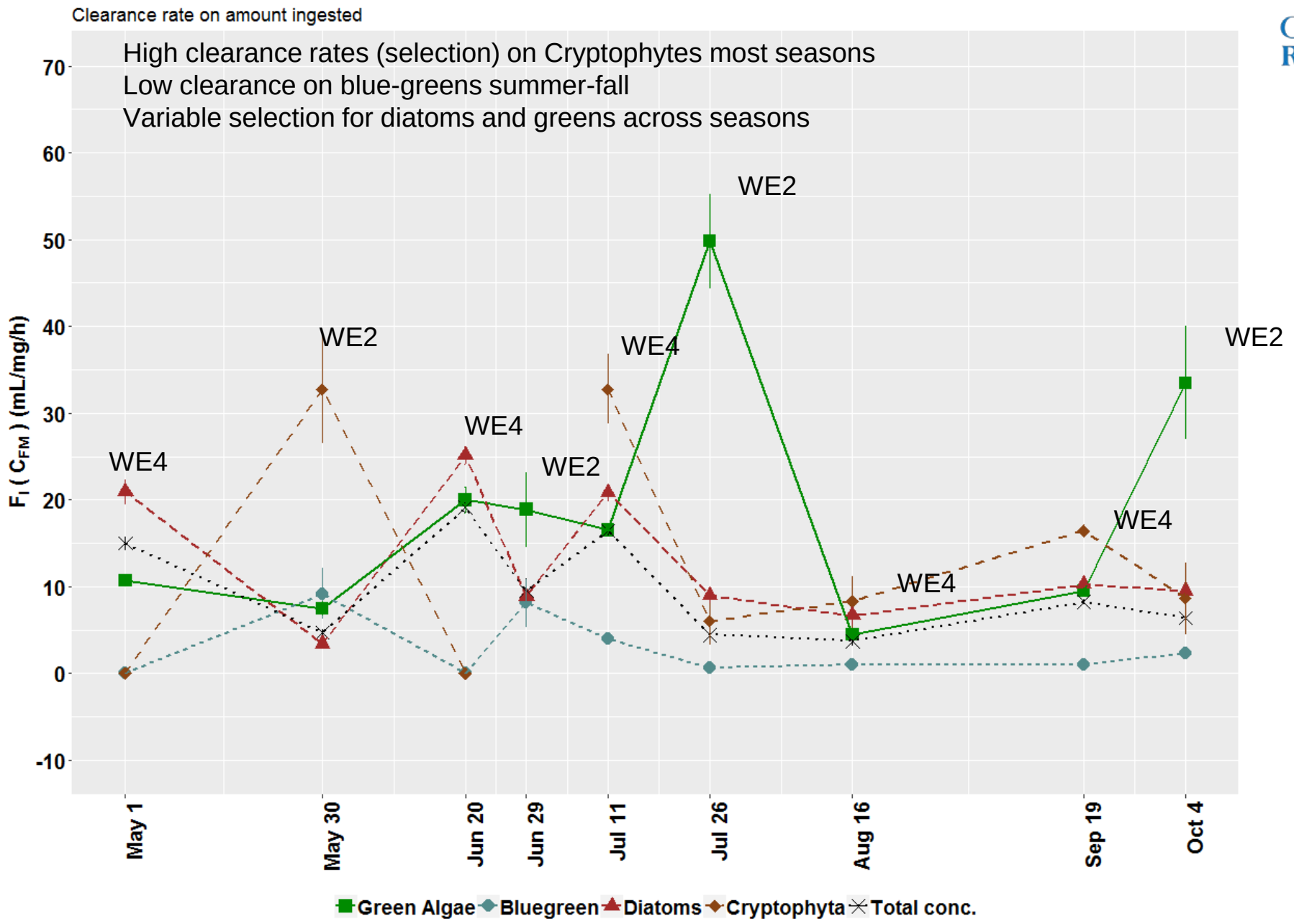


Techniques we use to measure changes in phytoplankton concentration in feeding experiments:

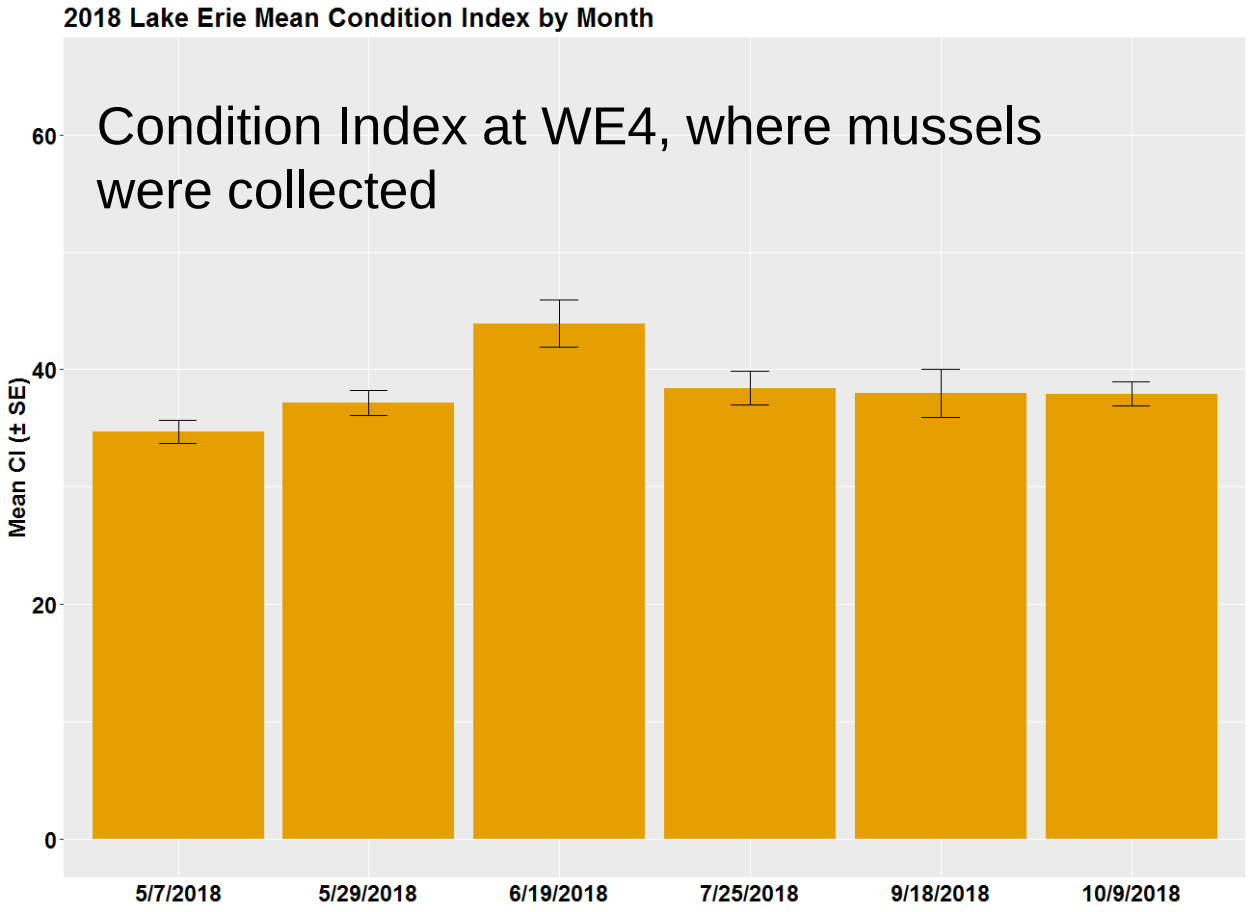
- **FluoroProbe** (spectrofluorometer)—very high precision & fast turnaround for broad categories of phytoplankton
- **Size fractioned chlorophyll**—pico (0.2- 2µm), nano (2- 20µm) & microplankton (> 20 µm)—high precision
- **FlowCAM** (digital imaging flow cytometer)—moderate precision, taxonomic resolution and time for analysis
- **Omics**—tells us what taxa including strains are there and what they are doing—precision depends on expertise and specific method.
- **Toxin concentration**—useful for following fate of toxic species
- **Light microscopy**—tedious & requires lots of time and expertise.

Mean Initial Chlorophyll−Fluoroprobe




Clearance rate on amount ingested
High clearance rates (selection) on Cryptophytes most seasons
Low clearance on blue-greens summer-fall
Variable selection for diatoms and greens across seasons
F_I (C_{FM}) (mL/mg/h)
70
60
50
40
30
20
10
0
-10
WE4
WE2
WE4
WE2
WE4
WE2
WE4
WE4
WE2
May 1
May 30
Jun 20
Jun 29
Jul 11
Jul 26
Aug 16
Sep 19
Oct 4
Green Algae
Bluegreen
Diatoms
Cryptophyta
Total conc.

Condition Index, Growth & Mortality



Changes in mussel cages May - October		
Station	Growth	Mortality
WE2	16%	57%
WE4	29%	47%

What’s next?

- Use all technologies to define selective feeding
- Relate mussel condition to food quality and feeding
- Relate nutrient excretion measured in parallel experiments with feeding rate
- Use abundance to project impact of feeding and nutrient excretion to western Lake Erie.

NOAA GREAT LAKES

Improving NOAA's service to the Nation through collaboration

Runoff Risk Decision Support Tools

Dustin Goering

NOAA GLRI Webinar

January 22, 2020

Great Lakes RESTORATION

Project Introduction

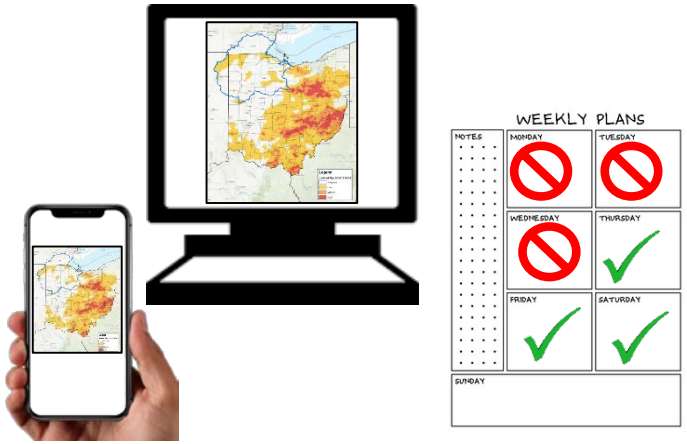
- Project Lead: Dustin Goering, NWS-NCRFC, Chanhassen, MN
- Funding: $2,013,000 for grants from FY14-FY21
- GLRI Action Plan III Focus Area 3 (Objective: 3.3, MOP: 3.3.1)

- **Project Goal**: Provide farmers and producers actionable guidance related to the *timing* of nutrient applications in the next week

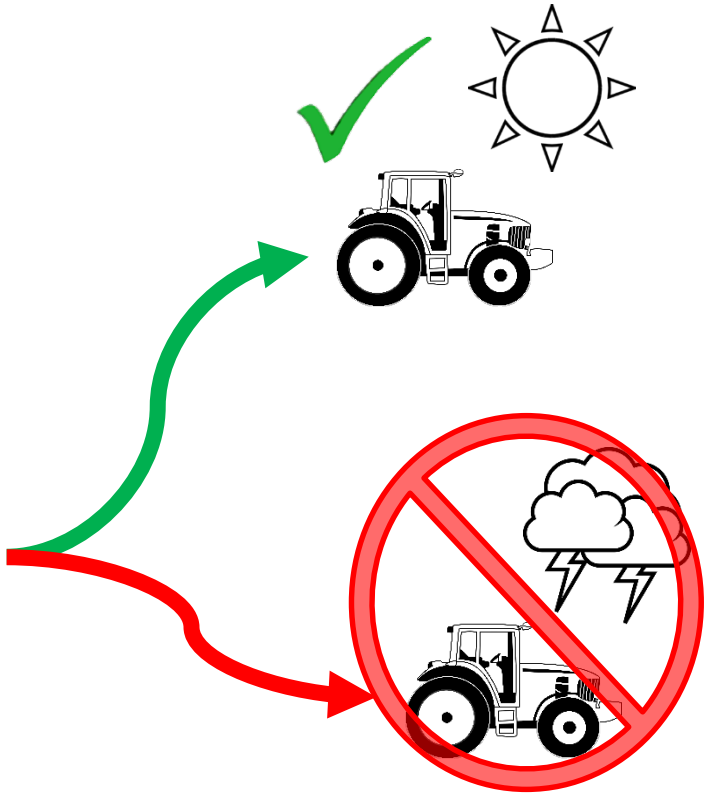
- Avoid applying shortly before rain or snowmelt causes runoff → ***Economic & Environmental benefit*** by maintaining freshly applied nutrients on ag-fields

- Runoff Risk tools founded on many federal-state-university partnerships with NWS modeling and state-owned tools/websites

Real-time National Weather Service model output sent to states



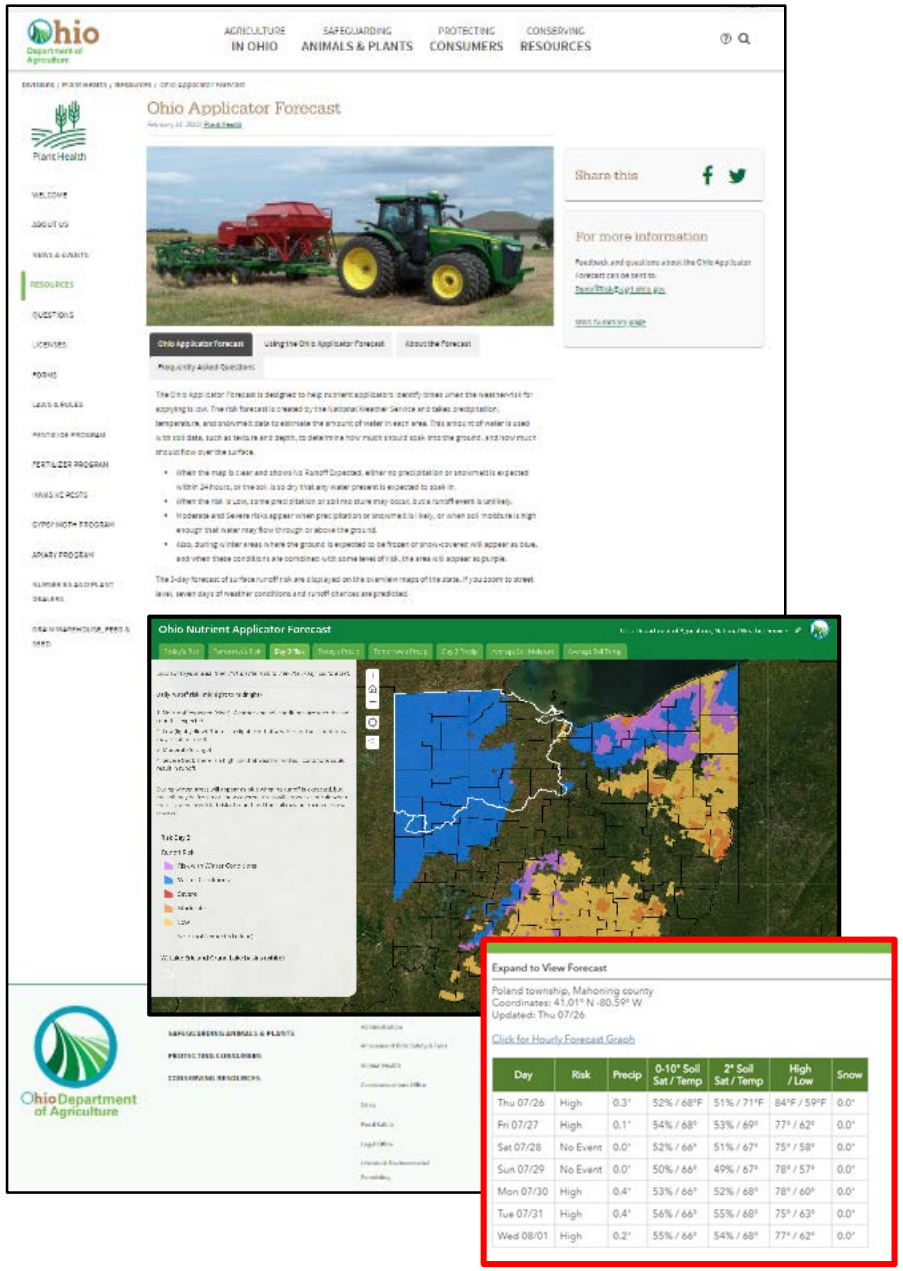
State partners provide actionable guidance to farmers and producers for free



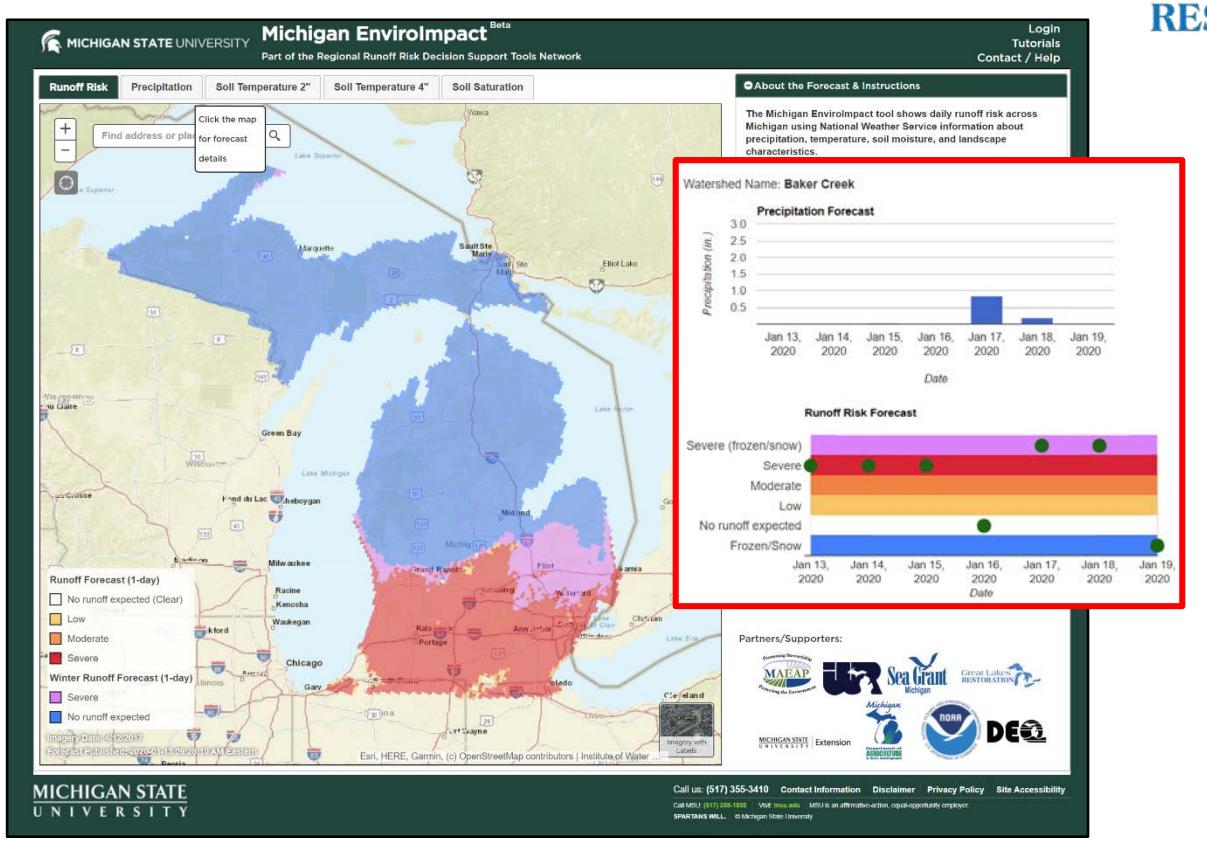
Nutrient applications scheduled to avoid unfavorable conditions

Project Description

- Many conservation practices related to nutrient reduction, however, edge-of-field monitoring indicates the timing of applications are also important to water quality ("Right Time" relates to weather as well)
- Currently 4 states with active tools (v2), more possible
- Projects with Ohio State, NOAA Sea Grant aim to quantify impact of application timing (runoff risk) on nutrient losses → nutrient reduction goals
- Development started on v3 runoff risk based on NWS National Water Model (available no earlier than FY23) → Higher resolution, outside GL footprint
- Runoff Risk is decision support only – not intended to be regulatory



Day	Risk	Precip	0-10" Soil Sat / Temp	2" Soil Sat / Temp	High / Low	Snow
Thu 07/26	High	0.3"	52% / 68°F	51% / 71°F	84°F / 59°F	0.0"
Fri 07/27	High	0.1"	54% / 68°	53% / 69°	77° / 62°	0.0"
Sat 07/28	No Event	0.0"	52% / 66°	51% / 67°	75° / 58°	0.0"
Sun 07/29	No Event	0.0"	50% / 66°	49% / 67°	78° / 57°	0.0"
Mon 07/30	High	0.4"	53% / 66°	52% / 68°	78° / 60°	0.0"
Tue 07/31	High	0.4"	56% / 66°	55% / 68°	75° / 63°	0.0"
Wed 08/01	High	0.2"	55% / 66°	54% / 68°	77° / 62°	0.0"



Visit this website: **runoffrisk.info**

For links to all state runoff risk decision support tools

NOAA GREAT LAKES

Improving NOAA's service to the Nation through collaboration

Using Tipping Points Planner to support LAMP and community planning decisions

Ed Rutherford

NOAA GLRI Webinar

January 22, 2020

TIPPING POINTS & INDICATORS

Supporting Sustainable Communities in Great Lakes States

Great Lakes RESTORATION

Project Introduction

- Ed Rutherford (Project Lead) and Doran Mason (co-PI): NOAA GLERL

- GLRI Funding:

FY10 ($467,384); FY11 ($378,501), FY12 ($323,000); FY16 ($203,784); FY19 ($432,000); FY20 ($179,116)

- GLRI Action Plan Focus Area 3 – Nearshore Health;

Objectives 3.1, 3.2 – Reduce nutrient loads from agricultural watersheds and untreated runoff from urban watersheds.

Measures of Progress – Projected phosphorus reductions from GLRI-funded projects in targeted watersheds (measured in pounds). Projected volume of untreated urban runoff captured or treated by GLRI-funded project.

Project Introduction (Cont.)

- Partners/Collaborators:
  - Mike Wiley, Catherine Riseng, Sara Adlerstein[1]; David Hyndman, Anthony Kendall, Sherry Martin, Quercus Hamlin, Jan Stevenson[2]; Brian Miller, Kara Salazar[3]; Bryan Pijanowski, Dan Walker, Lydia Utley[4]; Lucinda Johnson (University of Minnesota); Jeffrey Tyler (Fisheries Projections)
  - Sea Grant extension agents for Great Lakes states

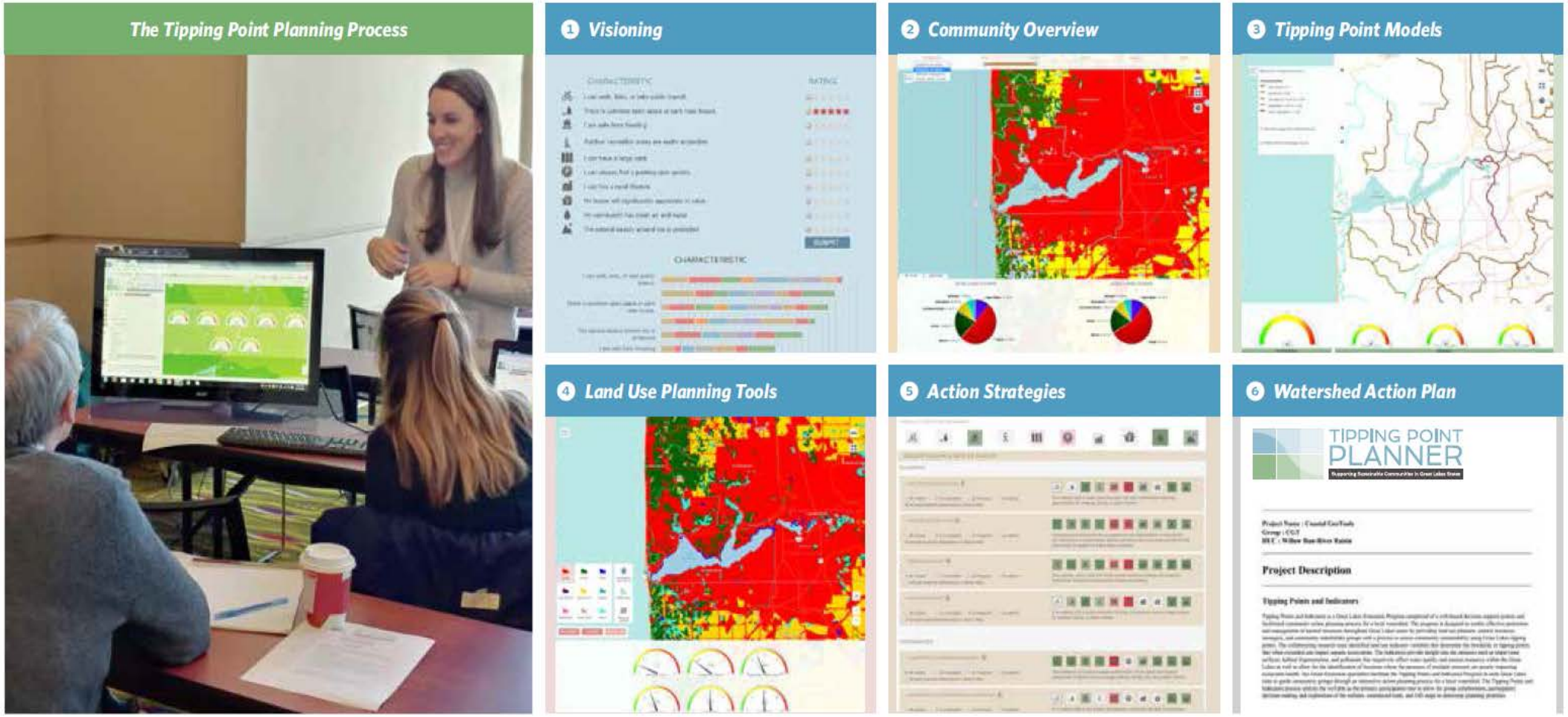
- Numerous Graduate and Undergraduate Students:

1 2 3 4

Project Description

- Project Summary
  - Developed Tipping Point Planner (TPP), an interactive decision support system;
  - TPP models relationships between land use practices and endpoints of interest;
  - TPP helps watershed leaders identify land-based activities that result in point and nonpoint source nutrients, sediment and pathogen pollution, and the impacts of such runoff on tributary streams, coastal wetlands in watersheds, and nearshore food webs;
  - Communities can use TPP to develop sustainable action plans for their watershed or community.
- Current Activities
  - Engage with target communities and LaMP teams in an effort to reduce nutrient loads to the Great Lakes.
  - Extend and apply our nutrient source and load models to GL basin. Apply our land use forecasts to hydrologic-nutrient, economic BMP and food web models.
- Outcomes / deliverables:
  - Numerous journal articles, presentations and student theses;
  - Intensive education outreach efforts in Illinois and Indiana, collaborative meetings in Ohio and Michigan.
  - Community meetings had education and visioning session with community stakeholders;
  - Action planning meetings with steering committees comprised of local experts.

Go to: www.tippingpointplanner.org !



NOAA GREAT LAKES

Improving NOAA's service to the Nation through collaboration

Piloting Green Infrastructure at Clean Marinas

Erin De Vries

NOAA GLRI Webinar

January 22, 2020

Great Lakes RESTORATION

Project Introduction

- Project Lead: Catherine Riseng, Michigan Sea Grant
- GLRI Funding: **$124,560** for two years (2019-2021)
- GLRI Focus Area 3: Nonpoint Source Pollution Impacts on Nearshore Health
  - Objective 3.2: Reduce untreated stormwater runoff.
  - Project objective: Develop user tools and design, install and monitor up to four green infrastructure practices at one or two Lake Erie coastal marinas.
- Measures of Progress: 1) Integrated visualization and decision support tool (DST); 2) Installation of on-the-ground green infrastructure practices at coastal marinas to reduce stormwater runoff and improve water quality.
- Partners: Ohio Sea Grant, Ohio Clean Marinas Program staff, and Erie Soil & Water Conservation District.

Project Description

2020

- Develop an interactive decision support tool (DST) with 3-D renderings and 360 video to be integrated into the Ideal Clean Marina map.
- Design, install, and monitor up to four green infrastructure practices (GI) at certified Clean Marinas in Western Lake Erie Basin.

2021

- Develop technical workshop, case study, educational signage and outreach materials for the Great Lakes Clean Marina Network.

❖ Notable Outcomes: 1) interactive green infrastructure DST for marinas, 2) installation of GI practices at coastal marinas.

Project Outcomes

Nearshore Health Q&A

Project	Presenter
Decision support tools to link P reductions to harmful algal blooms and source water protection	Hank Vanderploeg, OAR GLERL
Role of Dreissenid mussels in Transforming Nutrient Loads into HABs	Hank Vanderploeg, OAR GLERL
Runoff Risk Decision Support	Dustin Goering, NWS NCRFC
Using Tipping Points Planner to support community planning decisions	Ed Rutherford, OAR GLERL
Piloting Green Infrastructure at Clean Marinas	Erin De Vries, University of Michigan