Summary Points:

Kristi Arend, PhD is the Research Coordinator at Old Woman Creek Reserve. As lead for this Science Collaborative project, Kristi coordinated the research team, helped analyze a long term record of TP flowing into and out of her reserve's wetlands, and led the development of monitoring protocols.

Emily Kuzmick is the Coastal Training Program Coordinator at the Old Woman Creek Reserve. As Collaborative Lead for this project, Emily facilitated Project Team meetings and a Collaborative Learning Group composed of wetland management professionals to provide feedback on the project methods, results, and communication products.

Song Qian, PhD is an Associate Professor in University of Toledo's Department of Environmental Sciences. As part of this project, Song led the statistical analyses of wetland datasets, assisted in creating the monitoring guidelines and protocol, and recruited and supervised students.

Estimating Long-term Phosphorus Retention Capacity of Ohio Riverine and Coastal Wetlands

NERRS Science Collaborative webinar

March 11th, 2020

R. Ansari

Kristi Arend, Research Coordinator

Emily Kuzmick, Coastal Training Program Coordinator

Song Qian, Associate Professor

OLD WOMAN CREEK NATIONAL ESTUARINE RESEARCH RESERVE

National Estuarine Research Reserve System Science Collaborative

THE UNIVERSITY OF TOLEDO 1872

Summary Points:

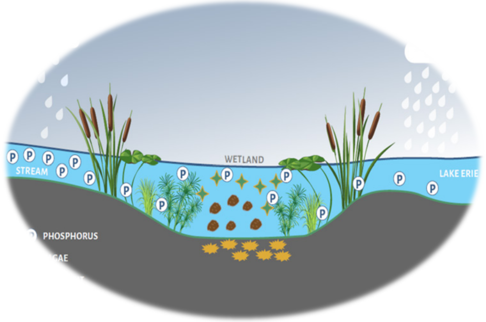
In an effort to reduce phosphorus loading fueling algal blooms, a collaboration between Old Woman Creek Reserve and University of Toledo developed a Bayesian hierarchical modeling approach to calculate the phosphorus retention capacity of wetlands with limited datasets.

In this webinar, members from the project team shared some key findings and the management implications, and explained how other practitioners could use their monitoring guide and statistical codes to calculate the nutrient retention capacity of their wetlands. In addition to taking audience questions, the team also provided some background on how their work informed an ambitious water quality initiative in Ohio.

Terminology:

- **Bayesian model**: A statistical model that allows for adapting the model and updating probabilities after obtaining new data.

Wetlands’ Role in Reducing HABs



Addressing Wetland Nutrient Retention Capacity

Evaluating and Communicating Wetland Phosphorus Retention

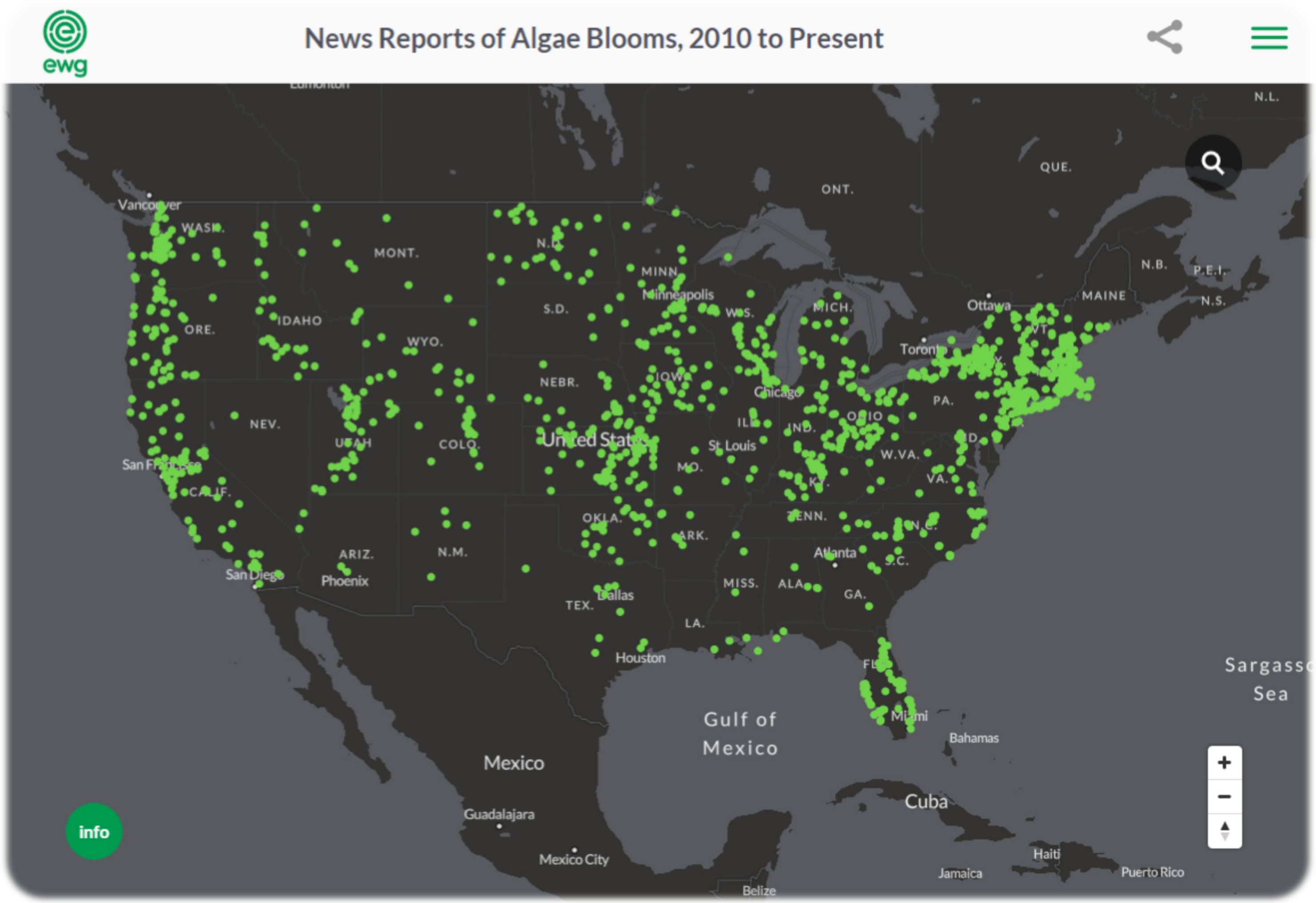
Moving the Needle on Water Quality in Lake Erie

Summary Points:

In this section of the presentation, Kristi Arend provided background on the role of wetlands in reducing harmful algal blooms, and summarized the inspiration for and first steps of the research project.

Wetlands’ Role in Reducing HABs

HABs Nationwide



Summary Points:

Harmful algal blooms occur when colonies of algae undergo rampant growth and produce toxins that have harmful effects on people and wildlife. Harmful algal blooms are a global problem, and occur in every state across the continental United States.

Wetlands’ Role in Reducing HABs

HABs in Ohio

www.kci.com

Summary Points:

The orange circled areas on the map show chronically problematic areas in Ohio. Every year these blooms occur and raise concerns for public health, impact recreational swimming and boating, and result in economic impacts.

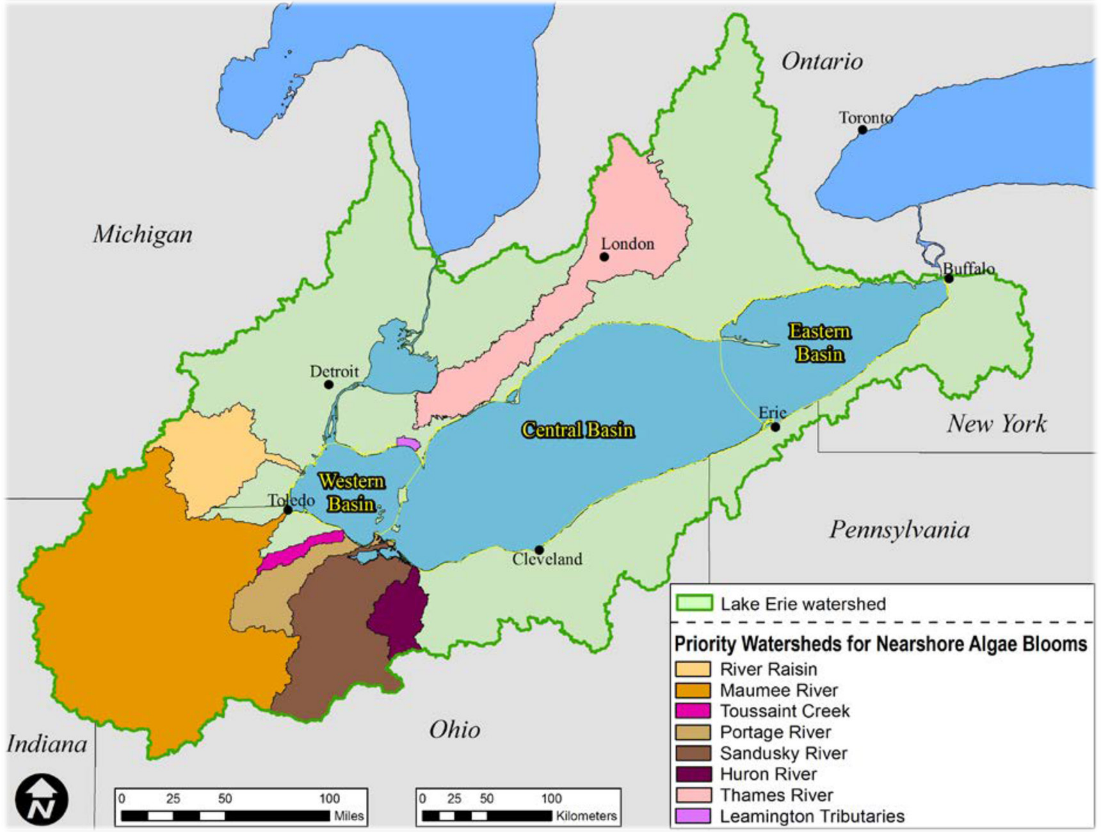
The aerial photo of Lake Erie in the top right corner of the slide shows an extensive algal bloom in 2011 that rated 10 on a severity index measuring the bloom’s total biomass, one of the largest harmful algal blooms on record. In 2014, Toledo had to close its drinking water plant due to the abundance of toxins in the water. In 2019, Lake Erie’s harmful algal bloom rated 7.3 on the severity index, with toxin concentrations measuring 50 times greater than the World Health Organization’s safe body contact limit, and 1200 times the limit for safe drinking water.

Wetlands’ Role in Reducing HABs

HABs in Ohio

US-Canada Great Lakes Water Quality Agreement

- Lake Erie phosphorus reduction targets



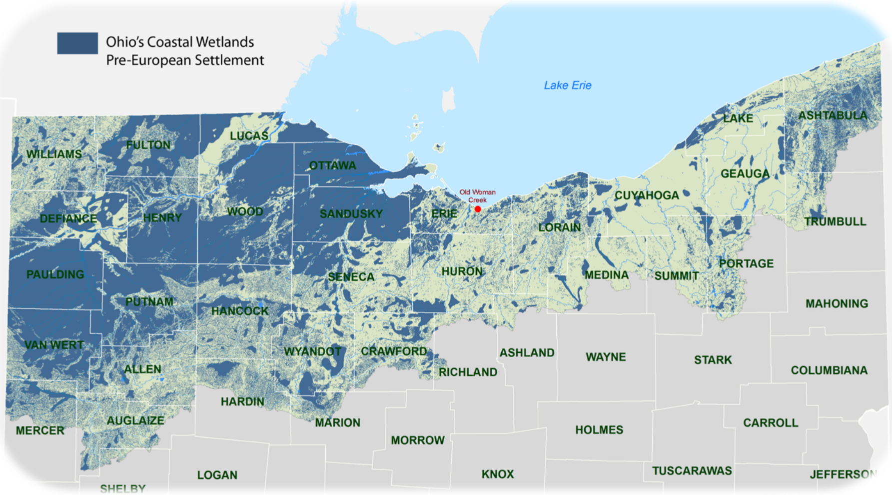
Summary Points:

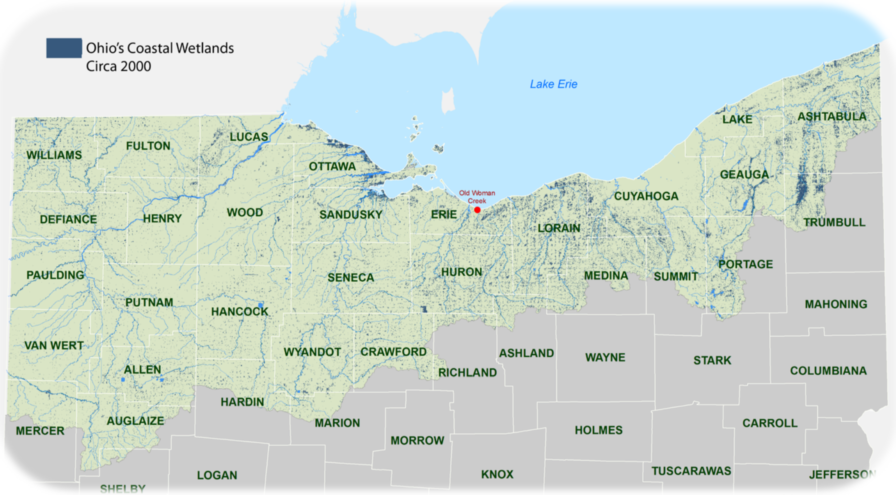
Since 1972, the United States and Canada have upheld the Great Lakes Water Quality Agreement, the purpose of which is to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes.

In 2016, an update to the Agreement added new phosphorus load reduction targets for the Western basin of Lake Erie. The new targets mandate a reduction in overall loading by 40% in terms of total phosphorus, and a reduction of soluble reactive phosphorus in target watersheds by 40%, relative to a 2008 baseline.

Wetlands’ Role in Reducing HABs

Coastal Lake Erie wetland loss





> 95% in Western basin

Summary Points:

The Western basin area is the historical location of large coastal wetland complex called the Great Black Swamp, indicated by the blue areas on the left map. Over 95 percent of the wetlands in the Great Black Swamp, which contain an abundance of fertile soil, have been lost due to development and agricultural land conversion since Europeans first settled the region in 1833.

Wetlands’ Role in Reducing HABs

Calls for wetland restoration

Summary Points:

Around 2014, following two consecutive years of severe algal blooms, editorials started appearing to encourage wetland restoration to reduce algal blooms.

BEACON EPAPER LOCAL NEWS RECORDS COLUMNS MARKETPLACE LINKS

Natural solution to algae problem in western Lake Erie

Sun, Aug 17, 2014 12:00am 0 Comments

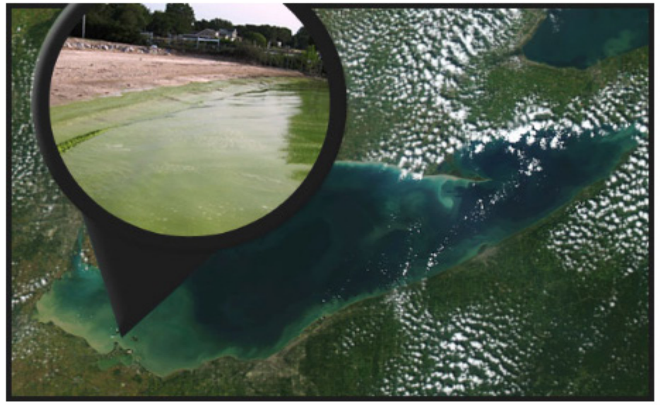


Image courtesy of NOAA

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LETTER TO THE EDITOR

Restore wetlands to solve water crises

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Our drinking-water scare has revived the debate about what to do to help prevent similar crises. Left out of this debate is where farmers are farming and where urbanites are living. We are farming and living in what once was a giant wetland that drains into Lake Erie.

Wetlands’ Role in Reducing HABs

Initial need

How much Phosphorus do wetlands retain?

?

Summary Points:

Old Woman Creek received a call in 2014 - from a partner at Ohio’s Lake Erie Nature Conservancy office - about quantifying the phosphorus retention capacity for wetlands using using long-term water quality monitoring data the Reserve had been collecting.

The pictures on the slide show examples of the types of wetlands involved in the study. Diked wetlands, as shown in the example photo on the left, are largely managed for the benefit of waterfowl, which rely on wetlands during mating season. Constructed wetlands, as shown in the example photo on the right, are generally managed for the purpose of water quality improvement as part of a treatment train.

Terminology

- **Treatment train**: A sequence of stormwater treatments designed to manage the quantity and quality of runoff.

Wetlands' Role in Reducing HABs

Objective: Quantify ecosystem service

Project Questions

- How much phosphorus can wetlands retain?
- Does retention differ among wetland types?

Realistic Expectations

- Potential contributions to nutrient reduction

Summary Points:

To begin, the team wanted to generate realistic expectations about how much wetlands could be expected to contribute to water quality improvement via nutrient reduction. Specifically, the team wanted to temper expectations that wetlands could be the silver bullet for nutrient reduction, and instead approach wetlands as one component of an overall nutrient reduction strategy.

Wetlands’ Role in Reducing HABs

Objective: Quantify ecosystem service

Project Questions

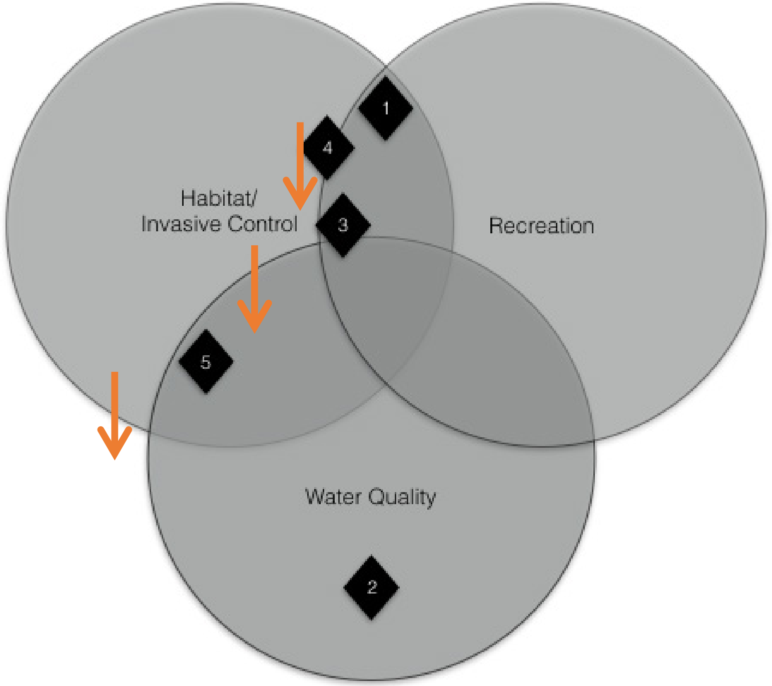
- How willing are wetland managers to prioritize water quality over other services?

Realistic Expectations

- Feasibility of restoring for water quality service

Wetland management priorities

1. Great Egret Marsh
2. Blanchard River Demonstration Farms
3. Howard Marsh
4. Ottawa National Wildlife Refuge
5. Chagrin River Watershed Partners

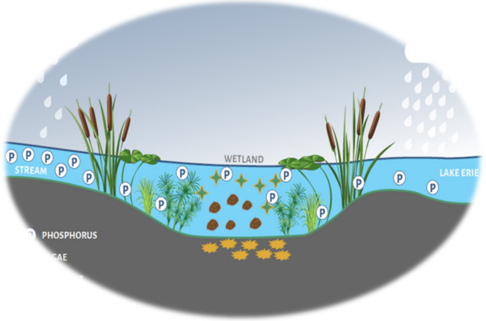


Summary Points:

Early in the project, the team realized that most wetlands are managed for invasive species control and recreation, and less so for water quality.

Wanting to be realistic, the team asked wetland managers for their insight regarding how reasonable it would be to heighten emphasis on water quality in conjunction with other management priorities.

Wetlands’ Role in Reducing HABs



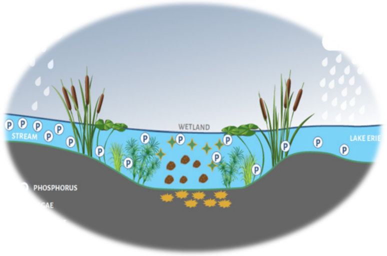
Addressing Wetland Nutrient Retention Capacity

Evaluating and Communicating Wetland Phosphorus Retention

Moving the Needle on Water Quality in Lake Erie

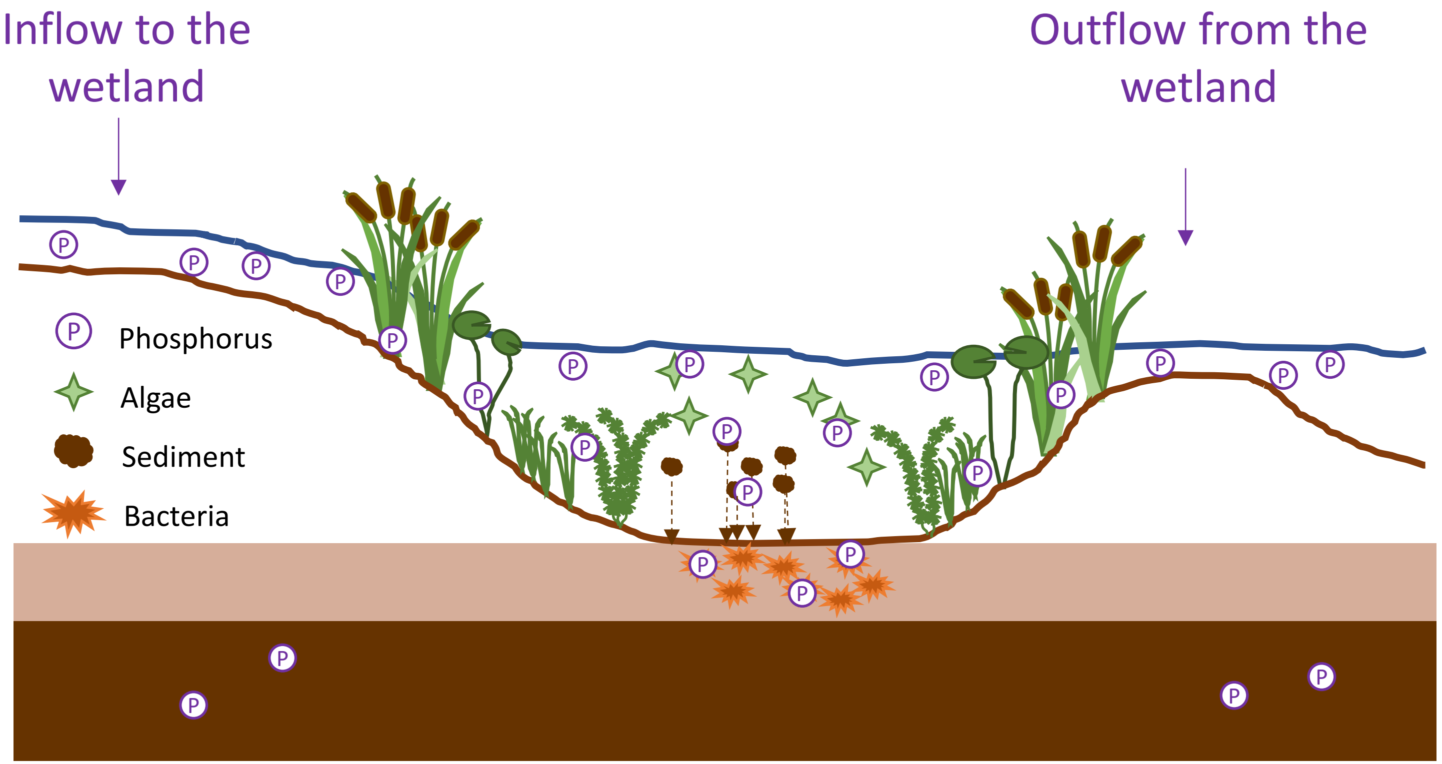
Summary Points:

In this section of the presentation, Song Qian addressed the quantitative and technical aspects of the research project.



Wetland Nutrient Retention Capacity

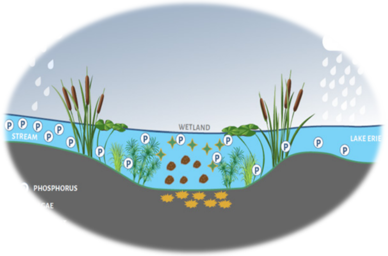
Long-term Phosphorus Retention



Summary Points:

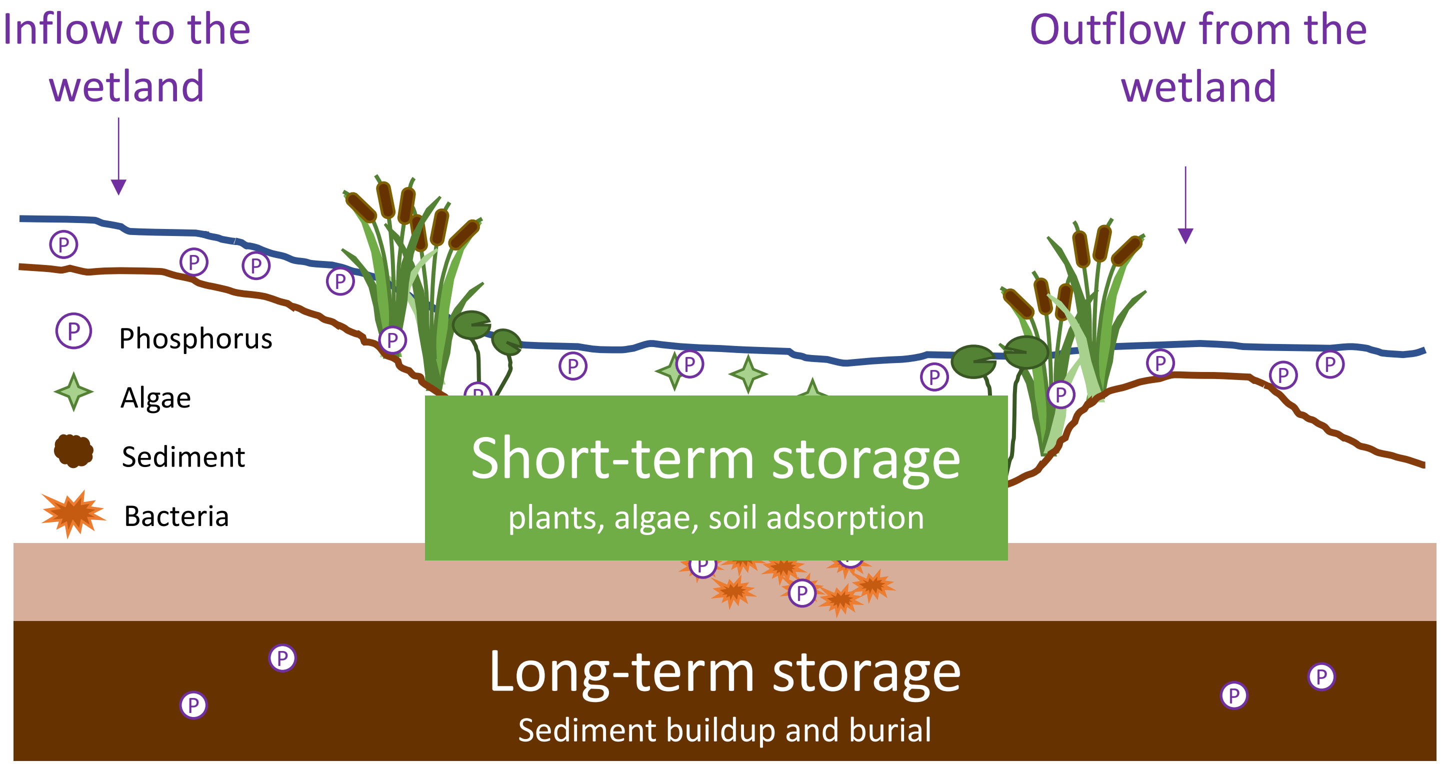
Phosphorus exists in two states in wetlands: dissolved in water or attached to solids.

Phosphorus in a wetland is absorbed by microbes and algae, thereby settling into sediment. Phosphorus in sediment is then absorbed by plants via nutrient uptake. When plants or algae absorb phosphorus, they die shortly thereafter and are decomposed by microbes, releasing phosphorus into water column.



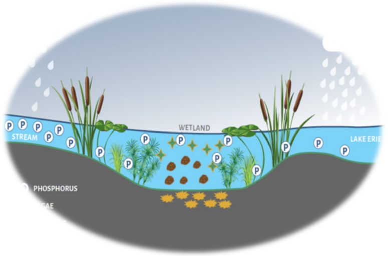
Wetland Nutrient Retention Capacity

Long-term Phosphorus Retention



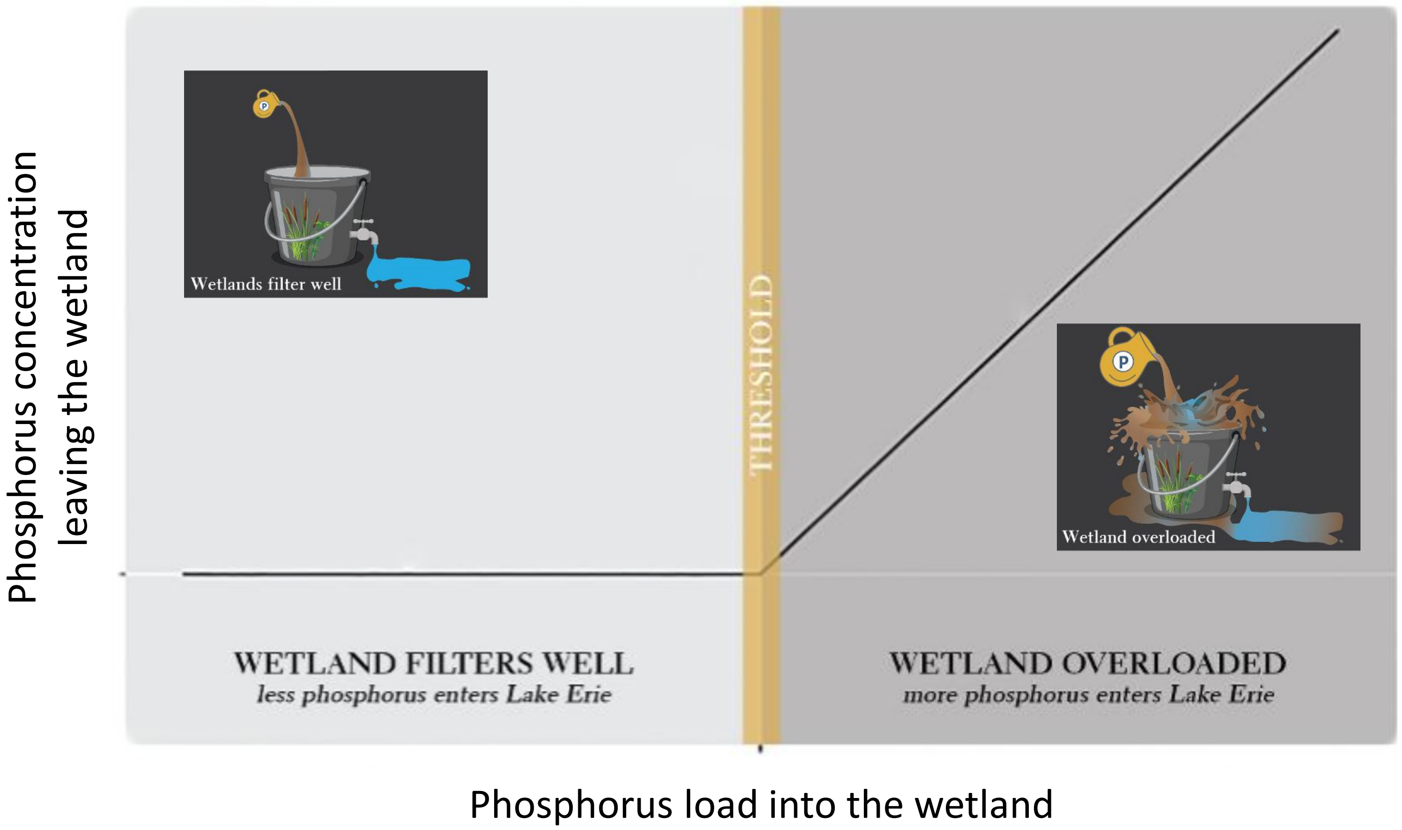
Summary Points:

In wetlands, biological components such as plants and algae retain phosphorus as short-term storage, while long-term storage is accomplished via sediment buildup and burial.



Wetland Nutrient Retention Capacity

Change-point model



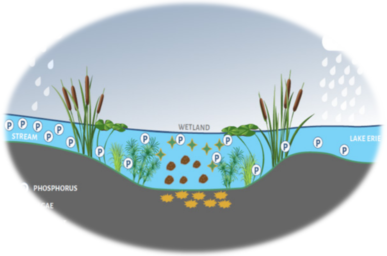
Summary Points:

If the wetland is not overwhelmed by phosphorus - i.e., below the long-term retention capacity - the majority of phosphorus entering the wetland will be stored within the wetland. Once the capacity is overloaded, the surplus will eventually be reflected in the water column, and the concentration of phosphorus leaving the wetland gradually increases as the loading rate increases.

The team developed a mathematical change-point model based on this concept, where concentration remains relatively stable until a certain loading threshold is reached, at which point the concentration continually increases as the wetland's ability to store phosphorus is overwhelmed.

Terminology

- **Loading rate**: The rate at which phosphorus enters the wetland.
- **Change point**: A mathematical representation of the maximum phosphorus retention capacity.



Wetland Nutrient Retention Capacity

Old Woman Creek Estuary

Long-term water quality data

- 2002 – present:
  Monthly System-wide Monitoring Program
- 2015 – present:
  Subdaily – daily

Wider range of inflow loading

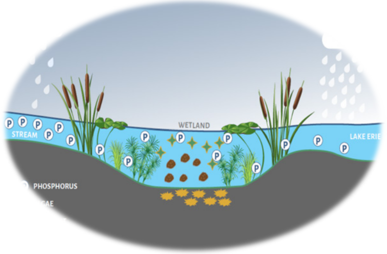
Seasonality

Larger sample size

Summary Points:

To provide accurate parameters for the model, the team needed long-term monitoring data, which Old Woman Creek had been collecting through the System-wide Monitoring Program (SWMP) since as early as 2002.

Daily data collected at the estuary inflow and outflow sites since 2015 proved to be a more useful subset of data because they formed a large data set that spanned a broader range of phosphorus loading conditions. Using this subset of data enabled the team to pair each day's concentrations for inflow and outflow. For inflow, the team calculated five-day running averages and paired those values with each day's outflow concentration.



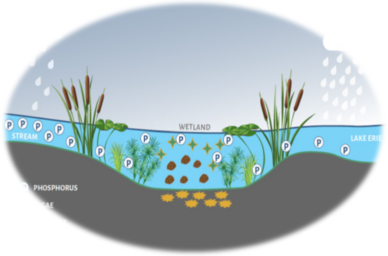
Wetland Nutrient Retention Capacity

Application to limited data sets

?

Summary Points:

Other wetlands in the study had limited data and did not have access to the same level of long-term monitoring data as Old Woman Creek. This posed a question of how the available data could be leveraged to apply the model to areas with limited data sets.

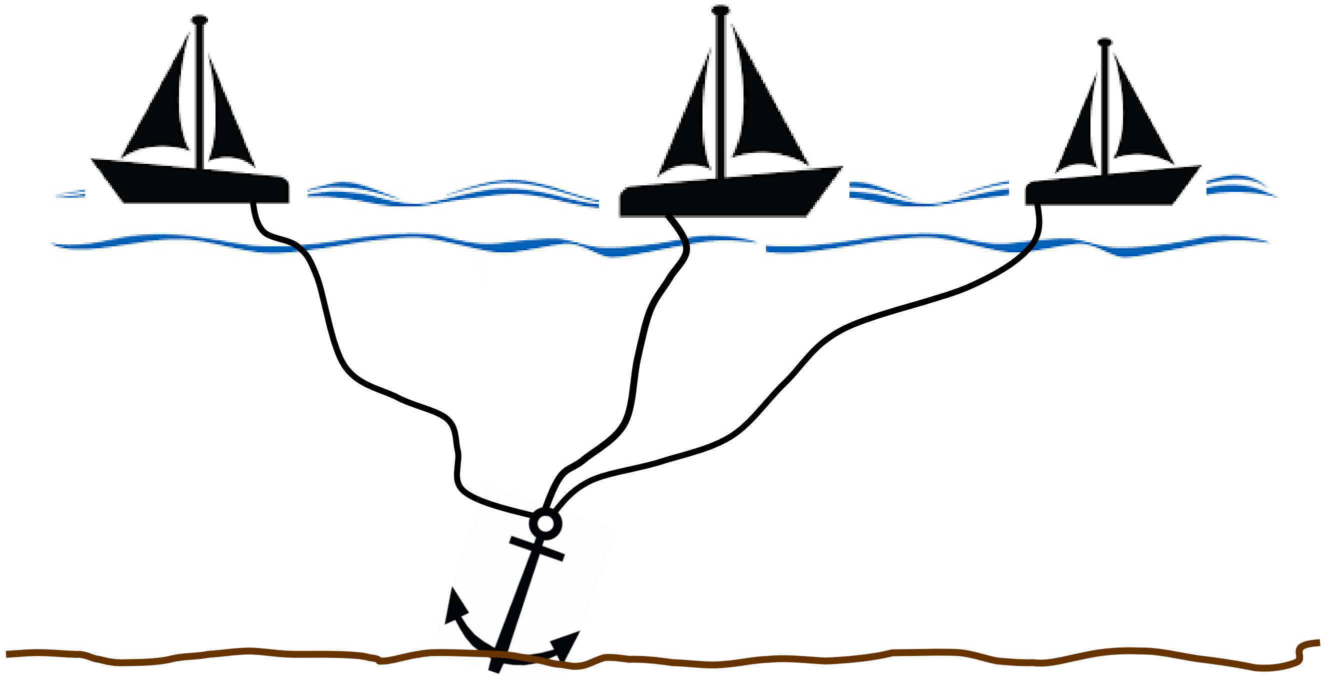


Wetland Nutrient Retention Capacity

Application to limited data sets

Long-term water quality data

- Bayesian hierarchical approach
- OWC estimate = stabilizing, starting point



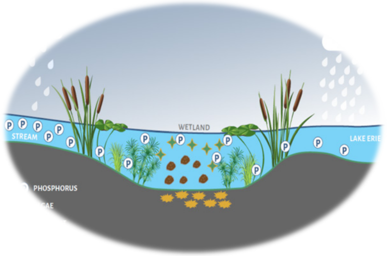
Summary Points:

In the Bayesian hierarchical model the team developed, they noted that the parameters can be highly variable depending on the quantity of available data.

As part of their approach, the team averaged the parameters across all wetlands’ available data, and used these averages as an “anchor” to constrain the model’s parameters.

Terminology

- **Bayes’ Rule**: A statistical theorem describing the probability of an event based on prior knowledge of conditions that might be related to the event.
- **Bayesian Inference**: A method of statistical inference in which Bayes’ theorem is used to update the probability for a hypothesis as more information becomes available.
- **Hierarchical Model**: A statistical model that estimates the parameters after relevant evidence is taken into account.
- **Shrinkage estimator**: A statistical method for estimating unknown parameters. It moves estimated parameters, based on data alone, towards a pre-determined center.

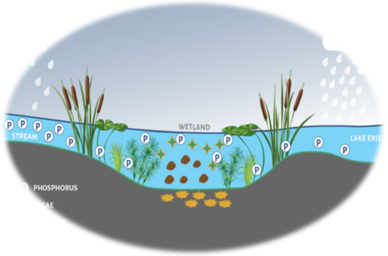


Wetland Nutrient Retention Capacity

Collaborative Approach

Summary Points:

The collaborative approach for this project involved multiple stakeholders, who were included as part of the smaller project team or larger Collaborative Learning Group.



Wetland Nutrient Retention Capacity

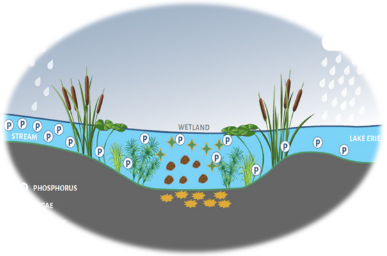
Project Team

Summary Points:

The project team included technical end users who provided data and feedback on model results, and non-technical end users who helped develop communication products.

Project Team

- Technical and non-technical end users
- Met every 2-3 months



Wetland Nutrient Retention Capacity

Collaborative Learning Group

Variety of wetland practitioners and decision-makers

- > 20 individuals: government, academic, non-governmental, private organizations
- Met quarterly

STANDING RUSH

Sea Grant
Ohio Sea Grant College Program

DUCKS UNLIMITED

National Center for Water Quality Research
HEIDELBERG UNIVERSITY

BLACK SWAMP CONSERVANCY
A LAND TRUST

Winous Point Marsh Conservancy

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

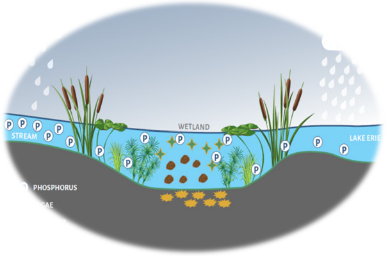
OTTAWA SOIL & WATER CONSERVATION DISTRICT

Ohio | Lake Erie Commission

Chagrin River Watershed Partners, Inc.
www.crwp.org

Summary Points:

The larger Collaborative Learning group included a broad spectrum of professional stakeholders concentrated in western Lake Erie.



Wetland Nutrient Retention Capacity

Collaborative Learning Group

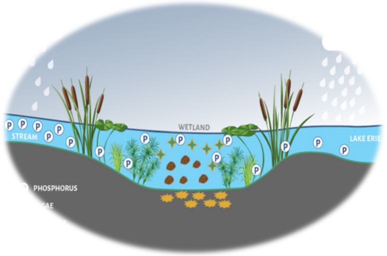
Variety of wetland practitioners and decision-makers

- Reviewed technical progress
- Advised non-technical communication products
  - Content
  - Target audience
  - Formats
  - Application
- Discussed management priorities and practices
  - Barriers and opportunities to prioritizing water quality

Summary Points:

Throughout the project, the Collaborative Learning Group reviewed technical progress in terms of data analysis and results.

During development of non-technical communication products, the Learning Group helped identify content to include, target audiences, formats, and types of products to produce. The Learning Group also advised the project team on how to apply tools and distribute them.



Wetland Nutrient Retention Capacity

Collaborative Learning Group

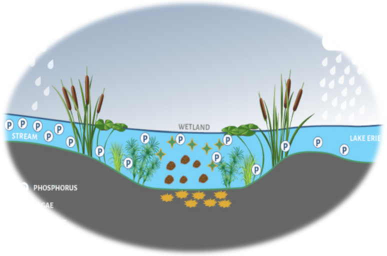
Collaborative strategies

- Live polling
- Roving flipcharts
- Prioritization
- Gap identification
- Impact/Effort table
- Pre- and post-surveys

Summary Points:

The project team employed a range of strategies during Collaborative Learning Group meetings to ensure that participants' ideas and opinions were captured and reflected in project work.

For example, when the team asked managers about their top management considerations at the beginning of project, although they ranked other management priorities higher, water quality still ranked as a top management consideration (graph shown on next slide).



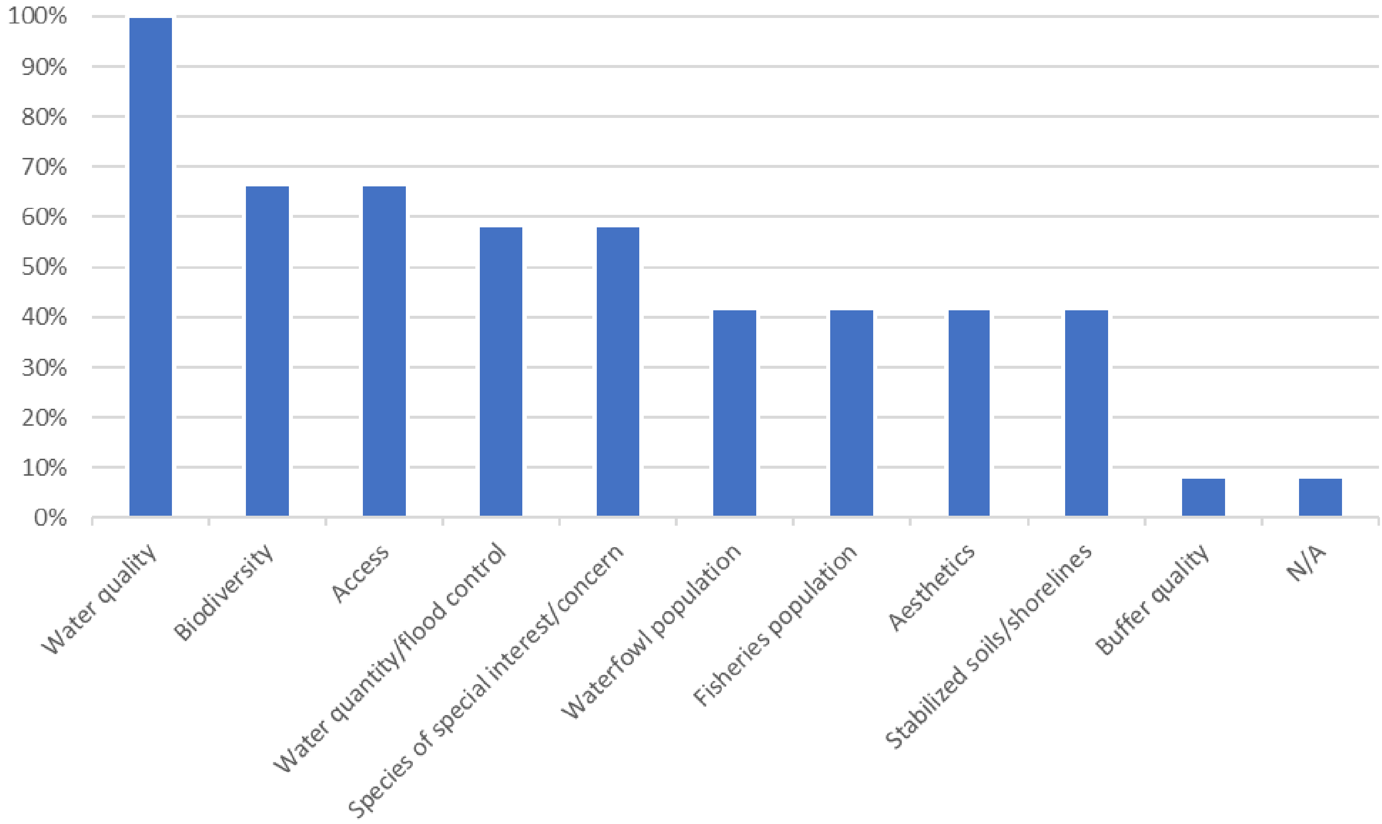
Wetland Nutrient Retention Capacity

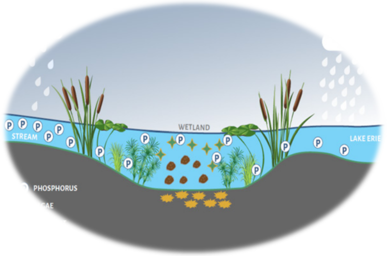
Collaborative Learning Group

Summary Points:

This graph shows managers' top considerations as indicated at the beginning of the project.

Top management considerations





Wetland Nutrient Retention Capacity

Collaborative Learning Group

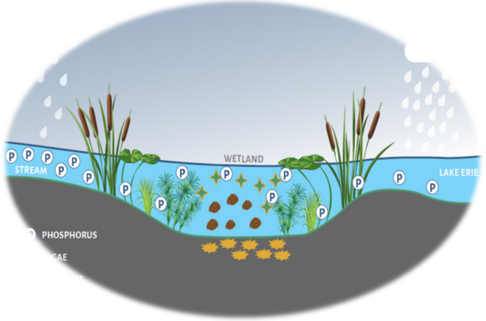
Summary Points:

The Learning Group held meetings at a number of different sites to incorporate site visits, which provided opportunities for Learning Group members to network and exchange knowledge.

Site Visits

- Networking and knowledge exchange

Wetlands' Role in Reducing HABs



Addressing Wetland Nutrient Retention Capacity

Evaluating and Communicating Wetland Phosphorus Retention

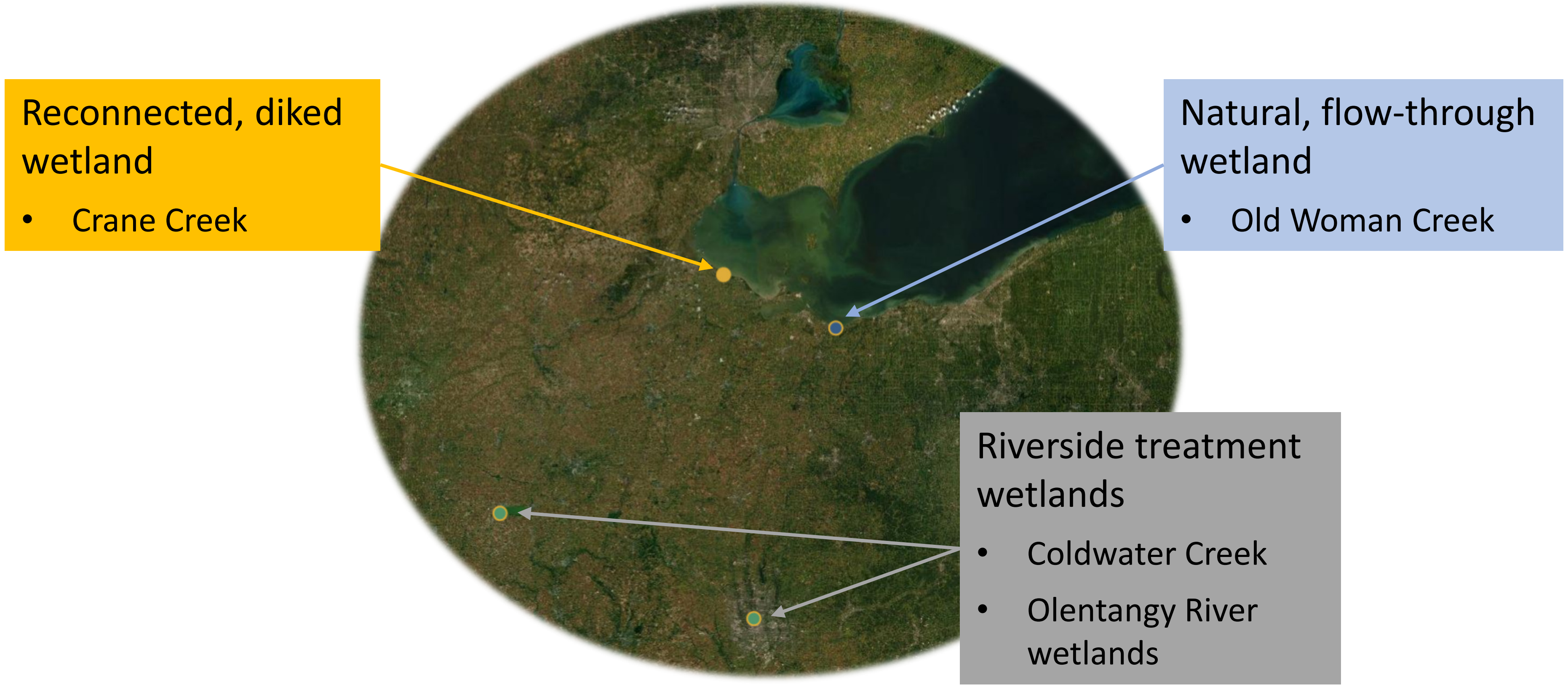
Moving the Needle on Water Quality in Lake Erie

Questions:

In this section, Song Qian presented results of the study, and Kristi and Song shared some of the products developed during the project.

Evaluating Phosphorus Retention

Data Sets



Summary Points

An ideal bayesian hierarchical model provides a framework that incorporates a large number of subject entities, e.g., wetland sites, and treats them as separate but related. In this case, incorporating multiple wetland sites allows utilization of the same model, but with site-specific coefficients describing the data.

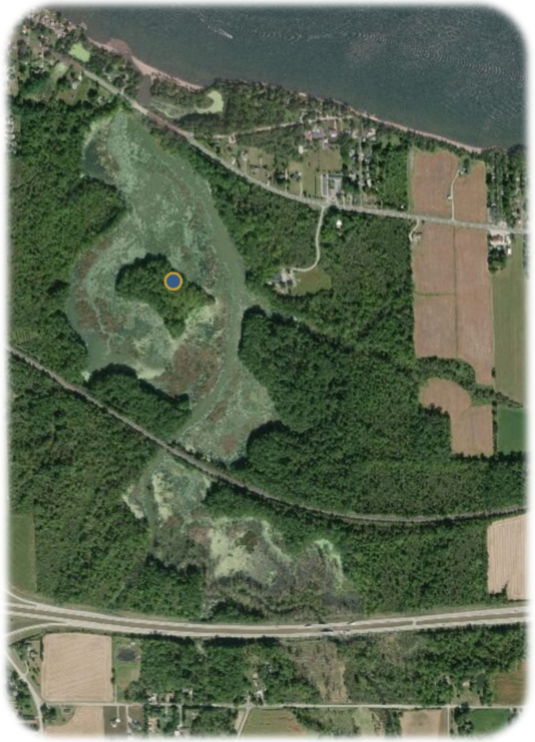
Wetlands included in the study represented different types of wetlands, including a natural, flow-through coastal wetland, a reconnected, diked coastal wetland, and two riverside treatment wetland complexes.

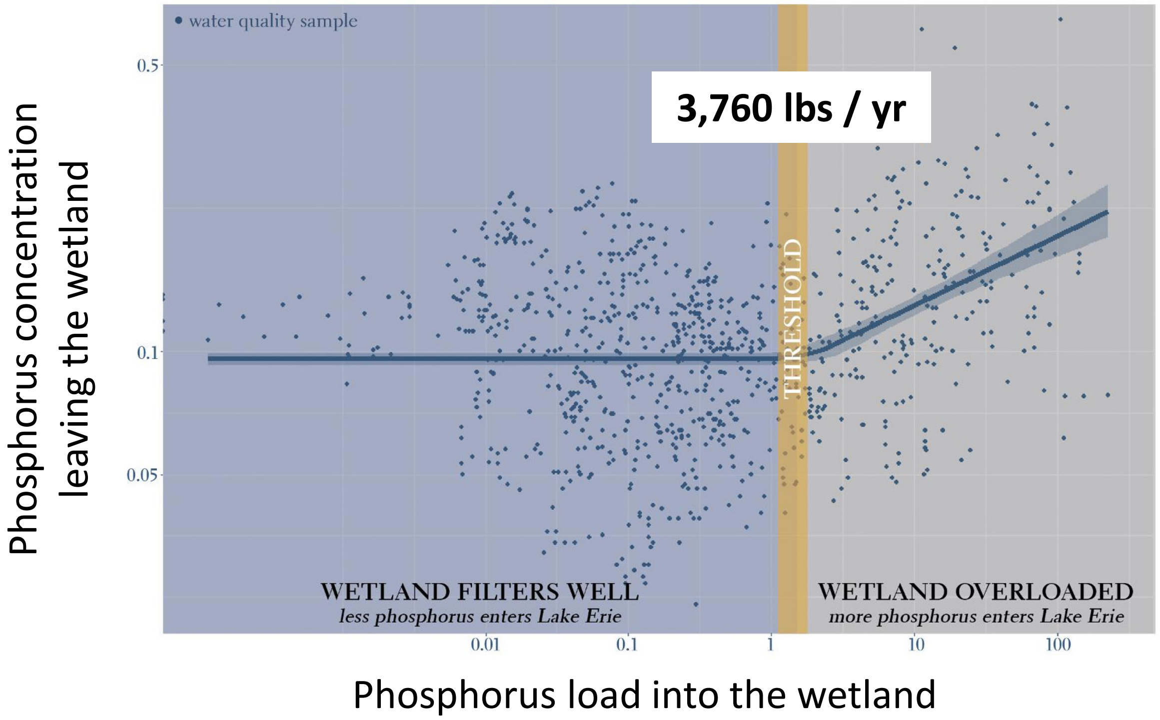
Note: The color scheme shown on the slide will be used in later slides as well.

Evaluating Phosphorus Retention

Old Woman Creek

Coastal, flow-through





Summary Points:

Old Woman Creek's data set follows the change point model, and can be used to estimate the loading threshold.

To build the model, the team broke this data set down into four seasonal data sets due to the large number of data points. Each season shows different loading point and wetland behavior, and change point varies by season.

The seasonal analysis is more likely to reflect seasonal dynamics in short-term storage as opposed to long-term storage, which occurs across multiple seasons and years.

Evaluating Phosphorus Retention

Crane Creek

Coastal, embayment

Reconnected at a single opening

- Difficult to pair inflow loading to outflow concentration

Summary Points:

The anchor estimates allowed the team to apply the model to other wetlands.

In this example, Crane Creek’s single opening made it difficult to pair inflow and outflow concentration. As a result, the model did not align well with the location.

Evaluating Phosphorus Retention

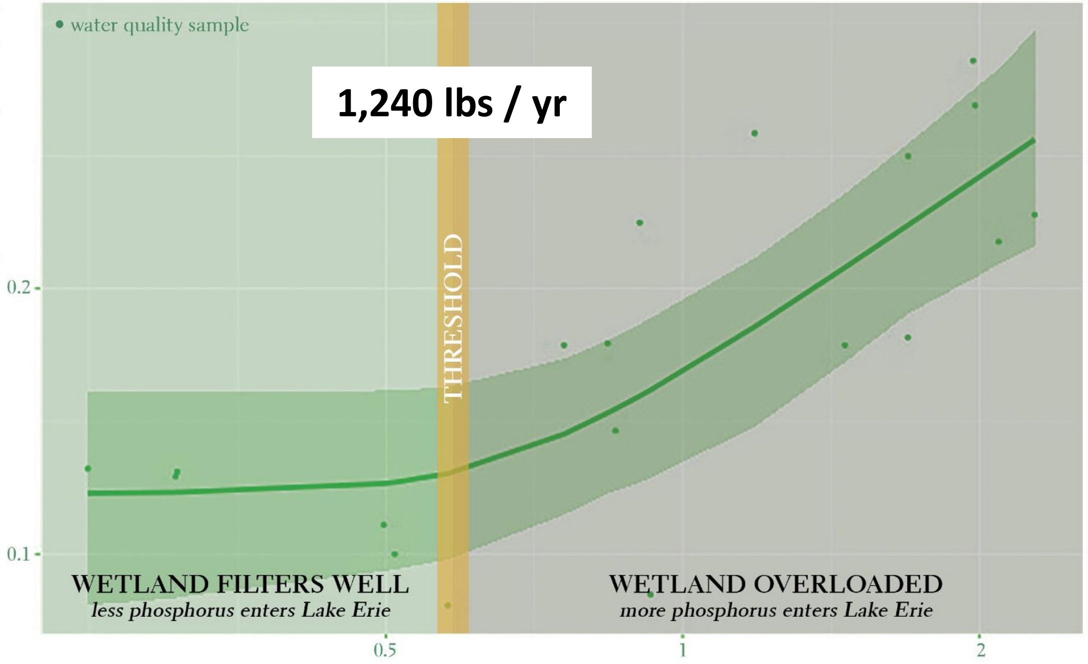
Coldwater Creek

Riverine, flow-through

Summary Points:

The Coldwater Creek location successfully used Old Woman Creek's data as the "prior" data set to implement the modeling approach.

Phosphorus concentration leaving the wetland



Phosphorus load into the wetland

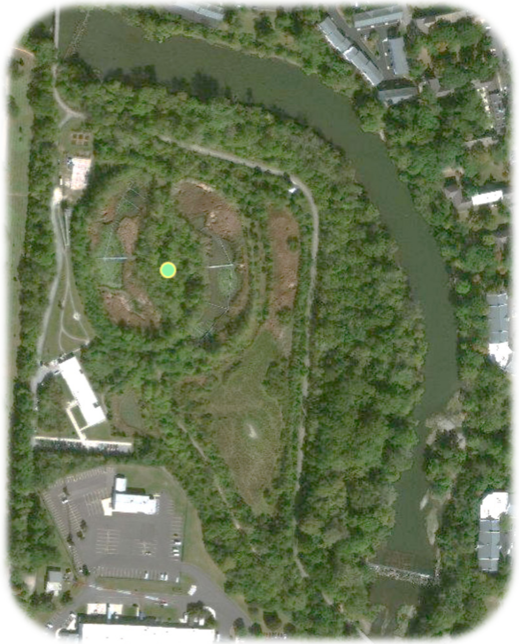
Evaluating Phosphorus Retention

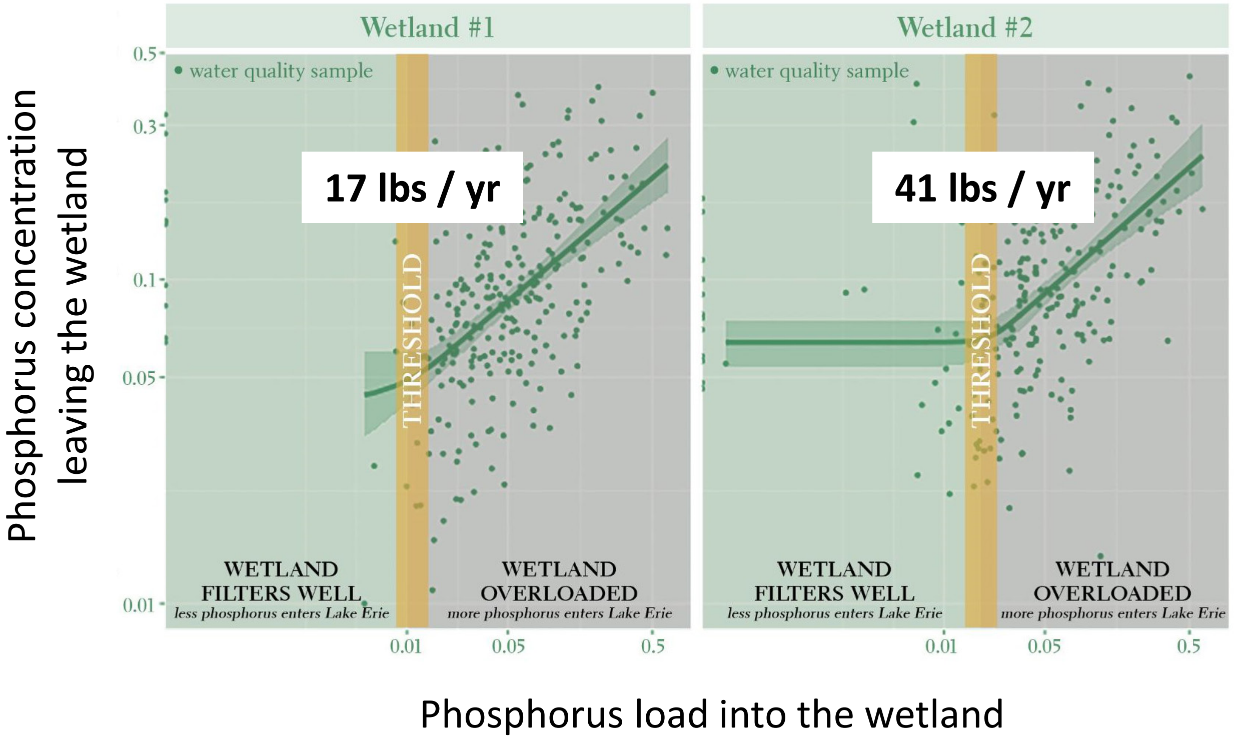
Olentangy River Experimental Wetlands

Riverine, flow-through

Summary Points:

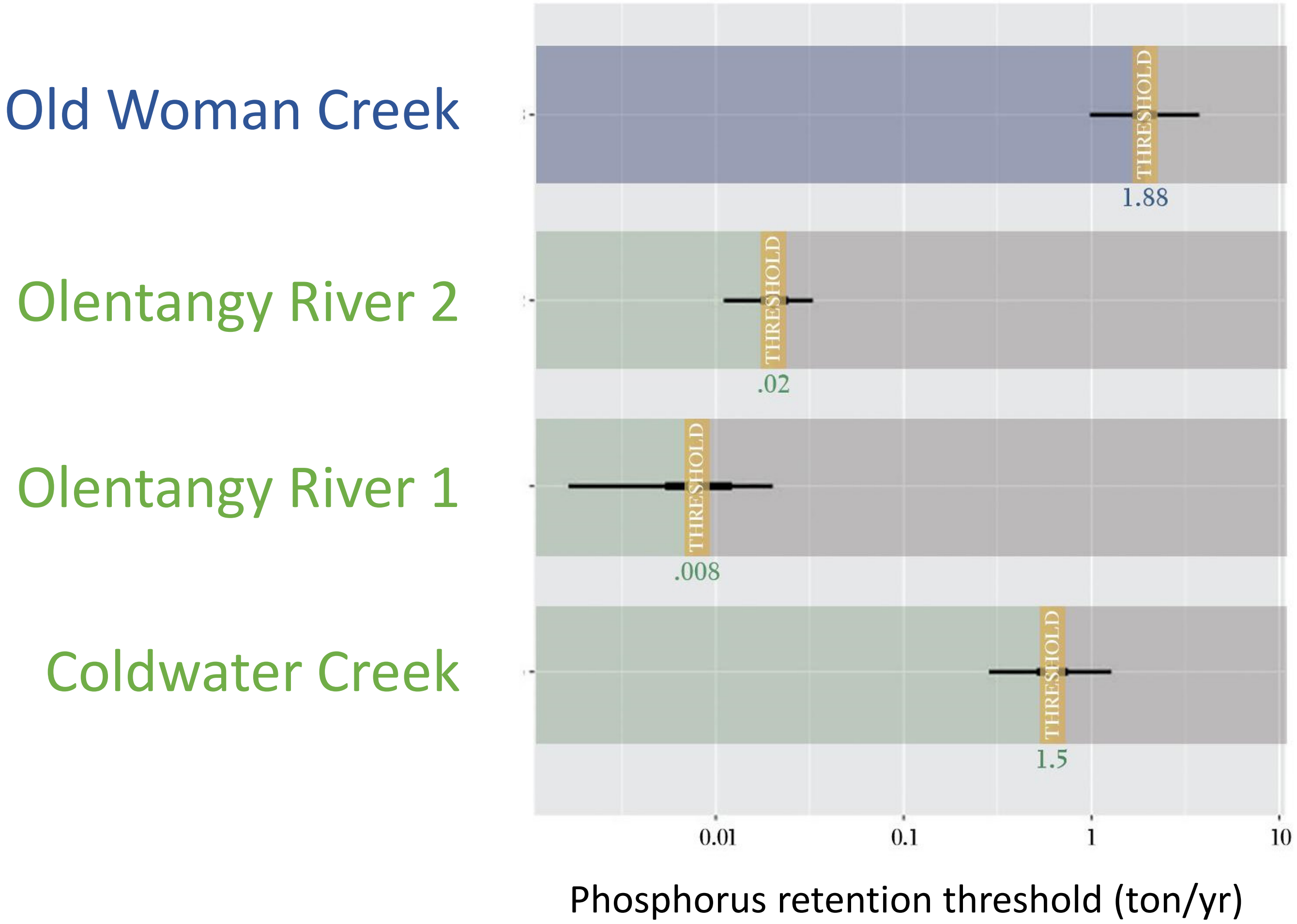
The Olentangy River site is a constructed wetland made up of two distinct wetland "cells." Both cells were consistently overloaded, meaning they showed very few instances of low loading rates. The prior model made it possible to estimate the wetlands' phosphorus retention capacity, but the estimates are less reliable.





Evaluating Phosphorus Retention

Variability in thresholds



Summary Points:

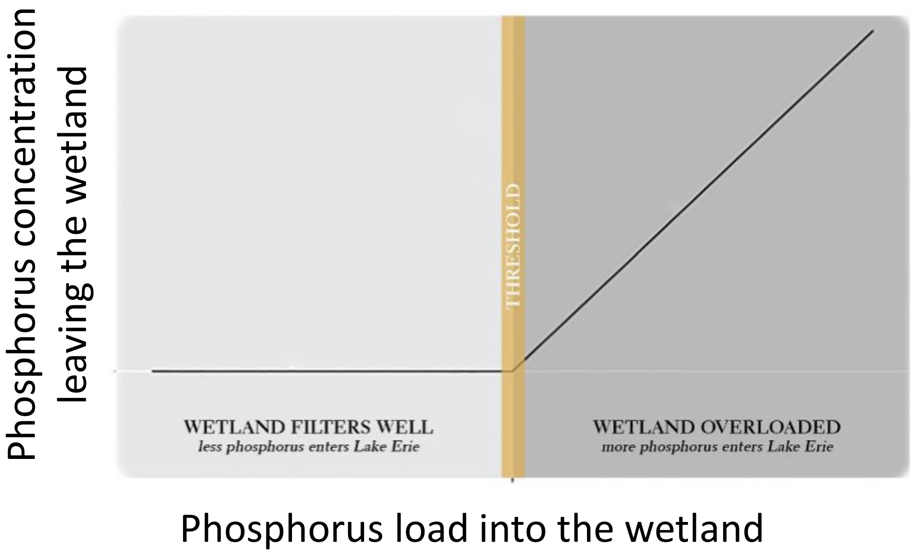
The team found that all of the wetlands behaved differently. Although normalizing the phosphorus retention capacity by wetland size would make the estimate more useful, the effective sizes of the wetlands used in this study - Old Woman Creek in particular - are unknown.

Evaluating Phosphorus Retention

Implications

Model application

- Not all wetland types suitable
  - Embayment/single connection point
  - Storm water treatment
- Data must span range of loading conditions



Summary Points:

Based on the team's analysis, not all wetlands are suitable for this type of model. Most notably, the model does not produce an accurate estimate when it is difficult or impossible to reasonably pair input and output data points in a data set.

In a similar way, the model may also not apply in the event that the wetland in question is largely dry and only receives water input during a particularly rainy season; in this scenario, data do not represent the full range of loading possibilities, instead including mostly high loading events.

Communicating Phosphorus Retention

Technical Products

Summary Points:

The code developed during the project and all the project data are available on Song Qian's GitHub page.

Publications

- Model description
- R code
  - https://github.com/songsqian/owc/tree/master/threshold

Estimating Wetland Posphorus Retention Capacity Using a Hockey Stick Model

Song S. Qian Co-authors

October 2, 2019

Abstract

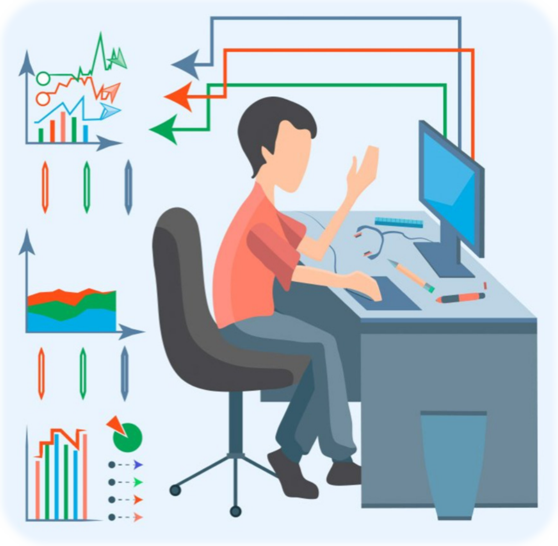
Estimating a wetland's long-term phosphorous retention capacity is often hindered by the lack of long-term monitoring data from individual wetlands. Furthermore, natural wetlands phosphorous retention capacity varies by wetland type and can be affected by other natural and anthropogenic factors such as climate and land use patterns in the drainage area. Consequently, pooling data from multiple wetlands can be problematic. Based on a general predictive model developed from the literature, we developed a Bayesian hierarchical modeling approach to estimate wetland-specific phosphorous retention capacity. The hierarchical framework reduces estimation uncertainty by shrinking the wetland-specific estimate towards the average of the same quantity from multiple wetlands, an approach that reduces the demand on sample sizes from individual wetlands and avoids several common pitfalls of using large data (data from multiple systems). The modeling framework is demonstrated using a number of wetlands in Northwest Ohio.

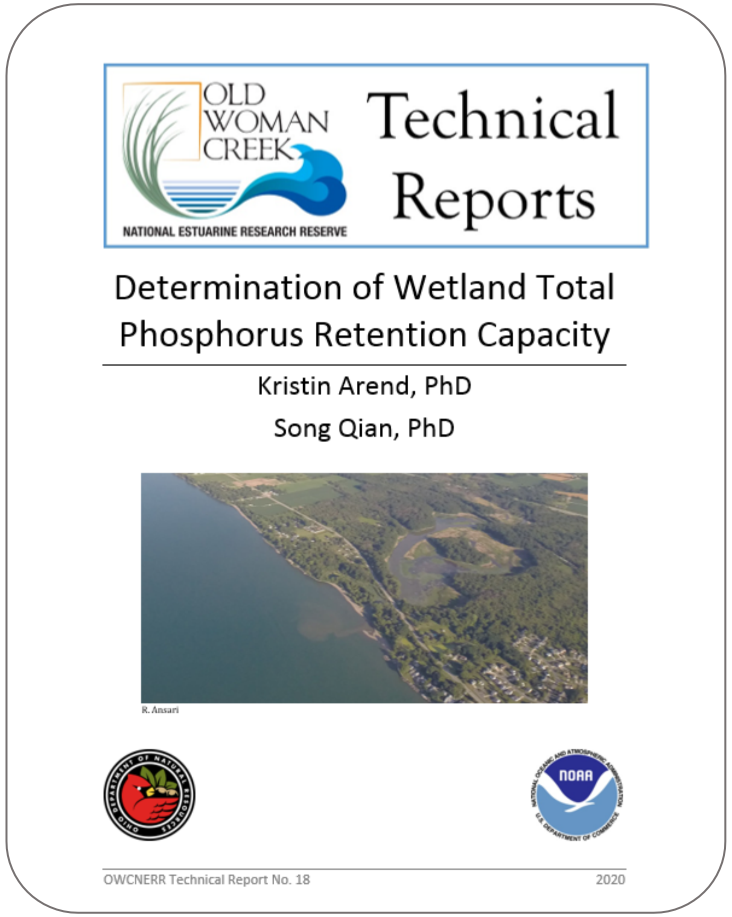
Communicating Phosphorus Retention

Technical Products

Practitioner tools

- Monitoring protocol
- Cloud-based model interface
  - https://github.com/songsqian/owc/tree/master/threshold





OLD WOMAN CREEK
NATIONAL ESTUARINE RESEARCH RESERVE

Technical Reports

Determination of Wetland Total Phosphorus Retention Capacity

Kristin Arend, PhD
Song Qian, PhD

R. Ansari

OWCNERR Technical Report No. 18 — 2020

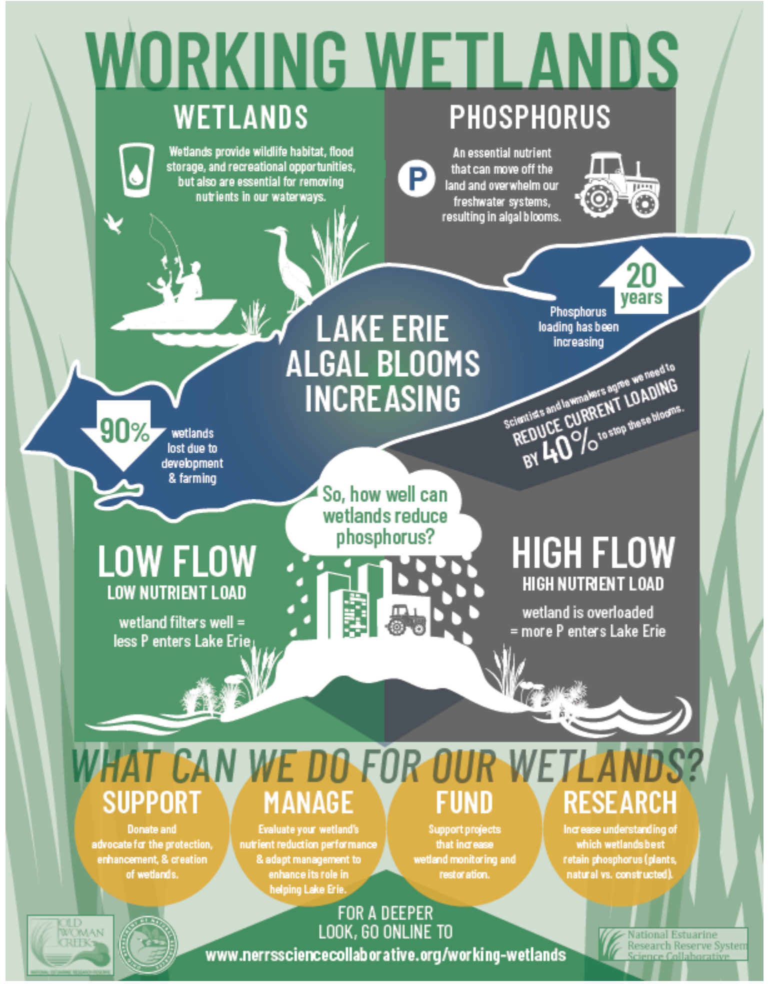
Summary Points:

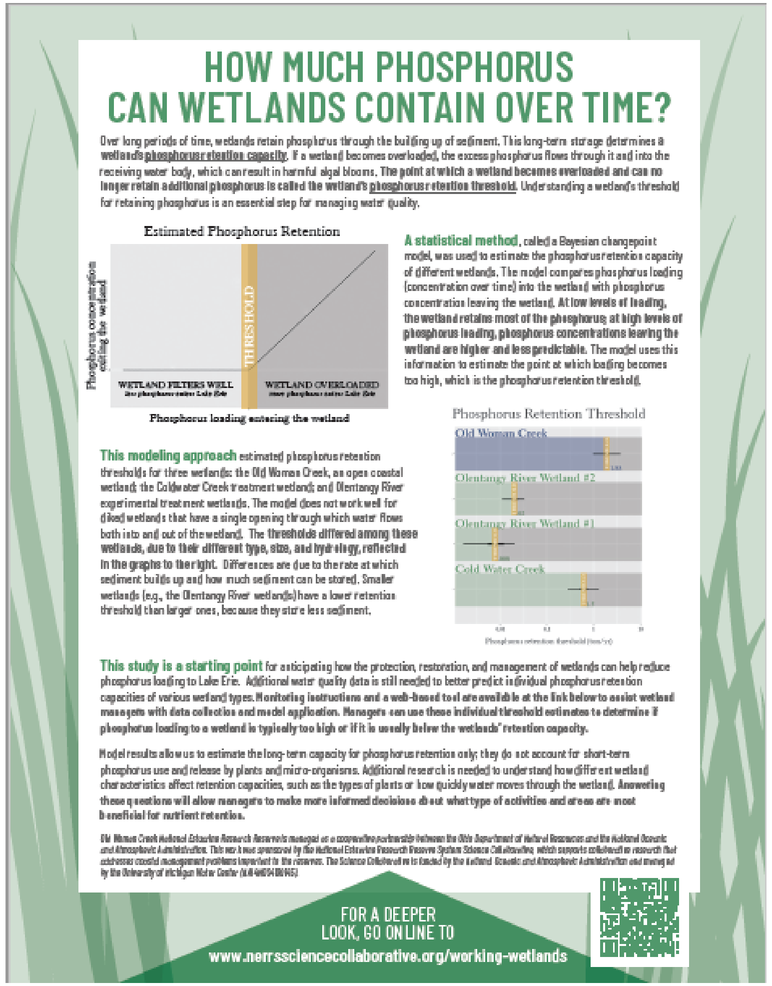
The collection of technical products includes a full example that shows how to integrate the model into Google Drive, which allows users to apply the model without using a full suite of statistical software.

The collection also provides a monitoring protocol for practitioners. Together, these tools allow practitioners to use the model without expertise in statistics or statistical modeling software.

Communicating Phosphorus Retention

Non-Technical Products





Summary Points:

The team worked with the Collaborative Learning Group to develop an infographic. The infographic is not geared toward a particular audience, but is instead intended to be accessible to people with different levels of interest or understanding of the science behind the model.

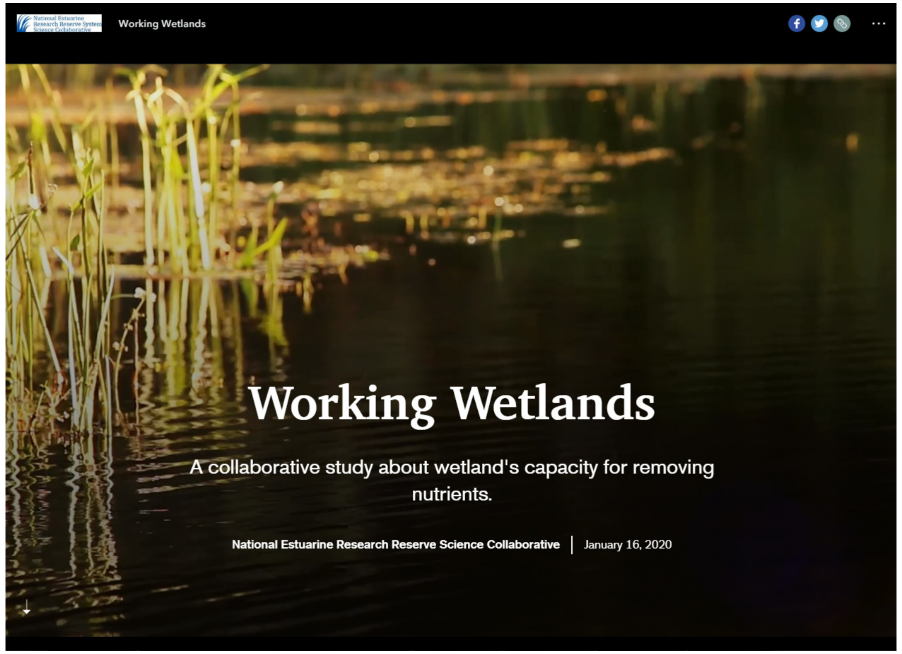
Communicating Phosphorus Retention

Non-Technical Products

www.nerrssciencecollaborative.org/working-wetlands

Story Map

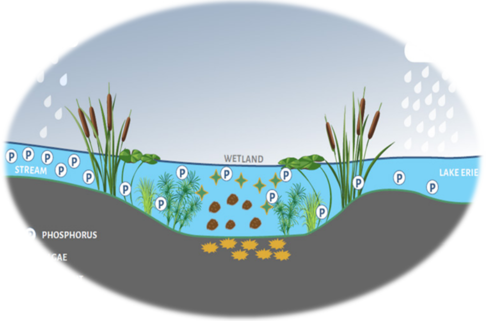
- Wetland loss and ecosystem services
- Wetland types and management priorities
- Lake Erie phosphorus and algal blooms
- Phosphorus capacity study



Summary Points:

The team also produced a story map, which is available online and allows the general public to interact with and understand the study and the science behind it.

Wetlands’ Role in Reducing HABs



Addressing Wetland Nutrient Retention Capacity

Evaluating and Communicating Wetland Phosphorus Retention

Moving the Needle on Water Quality in Lake Erie

Summary Points:

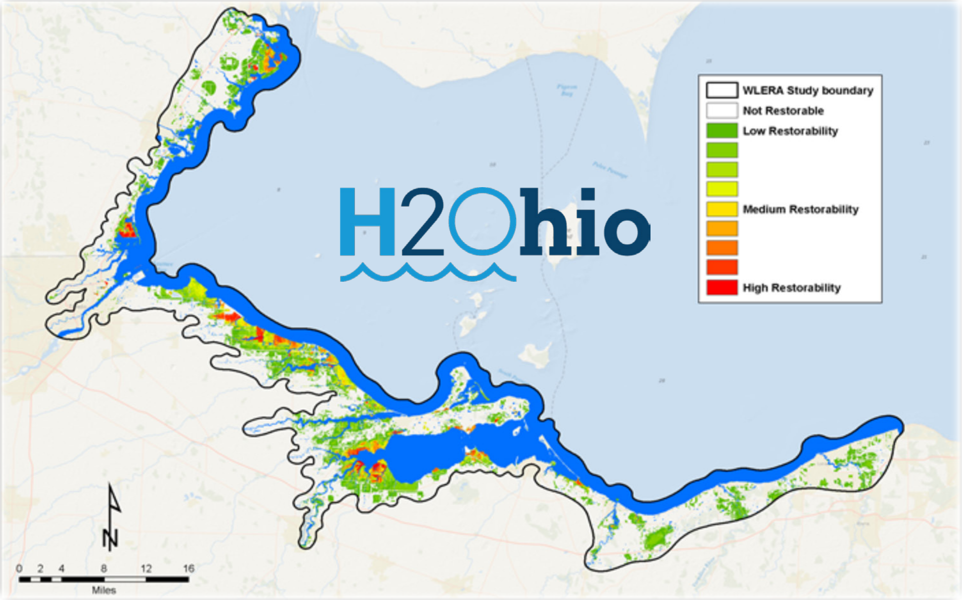
In this section, Kristi Arend shared the team’s conclusions on next steps and opportunities that have arisen, in part, due to findings and products from this project.

Moving the needle: Lake Erie

Governor’s H2Ohio Initiative

Improve Ohio’s water quality

- Reduce phosphorus loading
  - Agricultural conservation practices
  - Wetland restoration and enhancement
- Initial focus: Lake Erie basin



Summary Points:

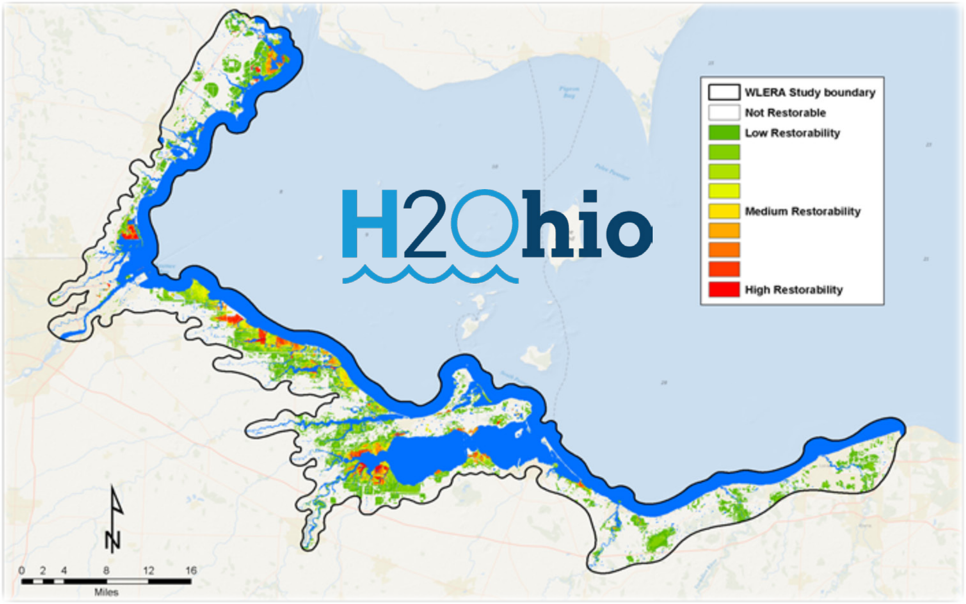
Around the same time that the project wrapped, Ohio Governor Mike DeWine announced his H2Ohio Initiative to improve Ohio’s water quality.

Moving the needle: Lake Erie

Governor's H2Ohio Initiative

Links to our project

- Understand wetland retention capacity
    - Model application and limitations
- Help develop monitoring of projects
- CLG member involvement as project managers



Summary Points:

This project's team members have immediately been able to contribute to the H2Ohio Initiative by providing data and results to administrators and managers. The team offered to make their model available, and explained its limitations and ideal applications.

Old Woman Creek is leading the effort to develop a monitoring program for projects that are put into place as part of the Initiative, which will allow participants to evaluate how successful projects are in reducing nutrient loading.

Moving the needle: Lake Erie

Building a Community of Practice

Summary Points:

The team is also looking to build a community of practice, with the goal of providing a forum for sharing practices and lessons learned.

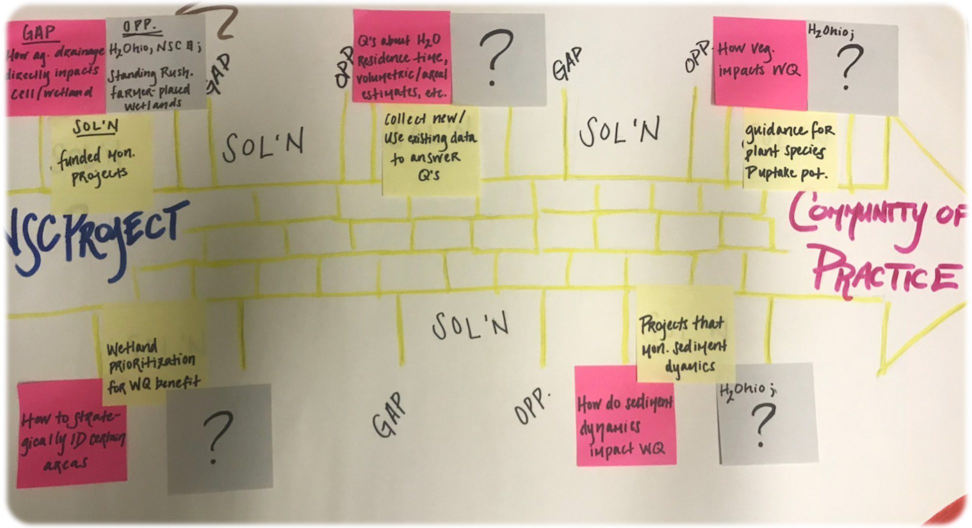
The work completed during this project represents a first step toward building a community of practice. Their work to date provided baseline collaboration for the H2Ohio initiative, and alternatively, H2Ohio is one opportunity by which this collaboration can continue through input on monitoring parameters for H2Ohio wetlands.

Moving the needle: Lake Erie

Building a Community of Practice

Identified gaps and opportunities

- Knowledge
    - Mechanisms
    - Impacts to habitat quality
- Funding
    - Research
    - Restoration
- Partnerships
    - Existing, future
    - Willing landowners



Summary Points:

Further collaboration with the Learning Group identified gaps and opportunities for understanding the role wetlands play in reducing nutrient loading.

For example, when looking at knowledge gaps, the group expressed interest in understanding the mechanisms underlying how different plant communities take up nutrients, and how soil or sediment in the area influences uptake.

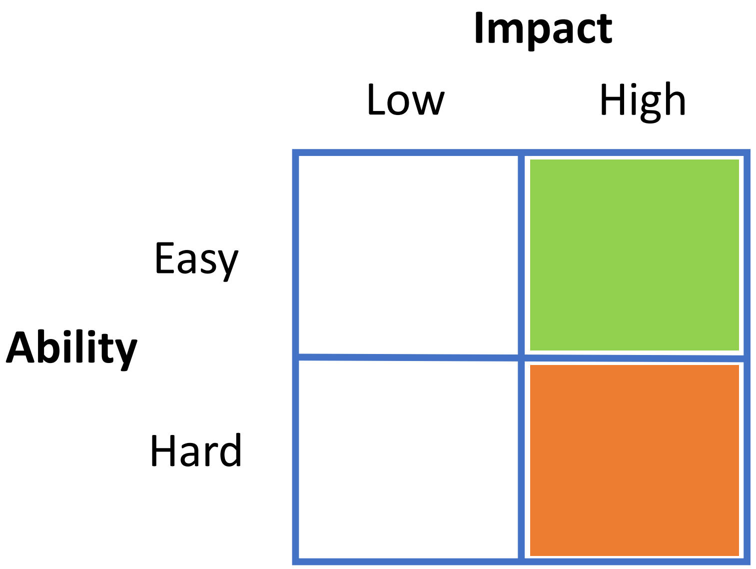
Identifying these knowledge gaps raised further questions about how introducing lower quality water into a wetland could impact habitat quality.

Moving the needle: Lake Erie

Building a Community of Practice

Prioritization

- Top three gaps/opportunities to pursue
    1. WQ impact on vegetation
    2. Plant species P uptake potential
    3. Sediment dynamics



Summary Points:

After identifying gaps and opportunities, the team asked the Collaborative Learning Group to rate them based on their potential impact and ease of accomplishment, with particular emphasis on opportunities with high impact and ease of accomplishment. This exercise yielded three key opportunities to pursue moving forward, as shown on slide.

Moving the needle: Lake Erie

Building a Community of Practice

Moving forward with CLG partners

- Apply model and results
- Foster current and future collaborations
  - H2Ohio
  - Interest from state and federal agencies, academia, and private entities
- Identify/pursue funding sources
  - GLRI, NERRS Science Collaborative, H2Ohio
- Share outcomes and lessons learned

Summary Points:

Moving forward, the team expressed a desire to have more people apply the model and results, noting that the more wetlands that are included into the hierarchical models, the better the threshold estimates will become.

Acknowledgements

Project Team

- Dr. Kristi Arend, OWC NERR (Project Lead)
- Dr. Song Qian, University of Toledo (Technical Lead)
- Emily Kuzmick, OWC NERR (Collaborative Lead)
- Bre Hohman, Erie Conservation District (Nontechnical products creator)
- Dr. Kurt Kowalski, USGS
- Dr. Ryan Winston, The Ohio State University
- Matthew Kovach, The Nature Conservancy
- Aaron Klein, City of Sandusky
- Steve Holland, ODNR Office of Coastal Management

Collaborative Learning Group

Biohabitats; Black Swamp Conservancy; Blanchard River Demonstration Farms; Chagrin River Watershed Partners; Ducks Unlimited; Heidelberg University; Kent State University; ODNR Division of Wildlife; Ohio Sea Grant; Ohio Lake Erie Commission; Ottawa NWR; Ottawa SWCD; Standing Rush, LLC; Winous Point Marsh Conservancy

Additional End-Users

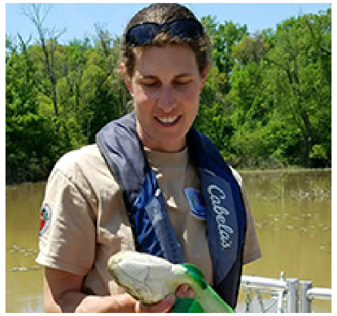
- Lake Metroparks
- Metroparks Toledo
- Ohio Wetlands Association

Additional Data Providers: Grand Lake St. Marys/Cold Water Creek: Wright State University; Olentangy River Wetland Research Park: The Ohio State University

NERRS Science Collaborative: Lynn Vaccaro, Fattimah Bolhassan, Nick Soberal

Q&A

Use the "Questions" function in the GoToWebinar console



Kristi Arend
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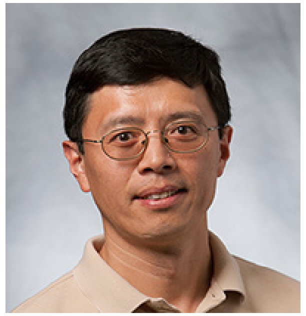
Emily Kuzmick
Coastal Training Program Coordinator
Old Woman Creek Reserve, OH



Song Qian
Associate Professor
University of Toledo

Questions:

For those using this approach in a new geography, what should they be aware of?

- **A**: In general, users need a dataset that pairs input (loading rate and concentration) and output (concentration). For most datasets we saw, people go collect data approximately once per week; for those datasets, we then aggregate those data to produce average monthly input and output. The smallest dataset we have in this study has 8 pairs of monthly input and output data.

  In terms of different geographic regions, the loading rate has been standardized so that the model can be applied in other regions. The model actually started from work in the Everglades.

What other parameters do you look at during sampling? Does that help you decide if you can combine and relate different wetlands?

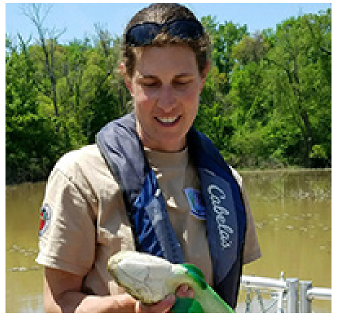
- **A**: The base assumption of the model is that the sedimentation rate is driving retention capacity, so understanding the sediment dynamic may help in terms of thinking mechanistically about what's happening. The model doesn't include anything about biological uptake or anything like that, since looking at long-term storage means focusing more on nutrient burial than biological uptake.

Is this information available to the public?

- **A**: All the data we used are available on Song's GitHub page.

Q&A

Use the "Questions" function in the GoToWebinar console



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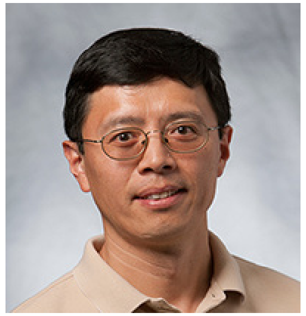

Song Qian
Associate Professor
University of Toledo

Questions:

When you look at uptake seasonally, what patterns if any did you note?

- **A**: From a long-term perspective, seasonal patterns may not be that relevant. Seasonal patterns reflected more of what was happening with short-term retention capacity dynamics, and this model is really intended to explore long-term patterns.

Does the team think there is a minimum size of wetland that can retain significant phosphorous?

- A: You can glean some idea from the results here, but in general we need more data to show trends per area, and from constructed wetlands, to say whether there is a quantifiable minimum size.

Ohio is creating wetlands - do you expect created wetlands to have more or less capacity? Can you tell based on your project results?

- **A**: Based on results from this project and Song's previous work in the Everglades, the differences among wetlands were largely based more on size and sediment dynamics than on whether the wetland is or is not constructed. Wetlands gradually become less adept at retaining phosphorus when sediment levels exceed an optimal level. In addition, different soil types have different absorption capacities; for example, mineral soil has a high nutrient absorption capacity.

Q&A

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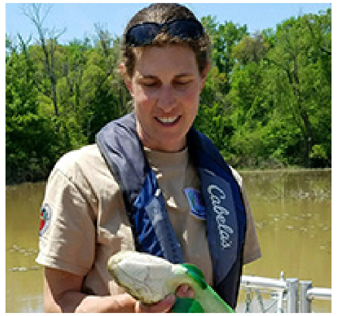

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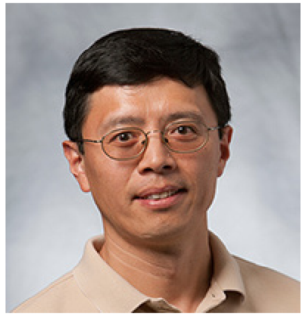

Song Qian
Associate Professor
University of Toledo

National Estuarine Research Reserve System Science Collaborative

Questions:

Given current land use practices, is it realistic to expect future data points in which nutrients are being retained in wetlands to build out observations along the ‘hockey stick’ and reduce uncertainties for the non-Old Woman Creek wetlands?

- **A**: In theory, as long as the basic mechanism doesn’t change, the model should work. Make sure to monitor during high-loading and low-loading conditions to build out both sides of the model.

Have you seen an increase in wetland invasive plants that you can associate with elevated nutrient availability?

- **A**: In the Everglades, we observed that changes in the nutrient dynamics affected the plant community. That was a concern for our work in Ohio, where we theorized that changes in nutrient availability could have negative impacts on habitat.

How does the presence of large invasive plants (Cattail, Phragmites) affect the thresholds? If you aren’t sure, what do you think might be the effect?

- **A**: Not sure, but we’re guessing that if the invasive plant species increases sediment buildup, we would expect that to increase phosphorus retention up to a certain point. This hits on some of the existing knowledge gaps we would like to address regarding mechanisms.

Is there a equation for the change point model?

- **A**: The modeling tool gives parameterized outputs, which includes the equation for the specific dataset.