

Great Lakes Coastal Wetland Monitoring Program

Semi-annual Progress Report April 1, 2026 – September 30, 2026

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INTRODUCTION

Monitoring the biota of Great Lakes coastal wetlands began as a project funded under the Great Lakes Restoration Initiative on 10 September 2010. The project had the primary objective of implementing a standardized basin-wide coastal wetland monitoring program. This team has completed three five-year rounds of monitoring. Our first five years of sampling (2011-2015) set the baseline for future sampling years and showed the power of the datasets that can be used to inform decisionmakers on coastal wetland conservation and restoration priorities throughout the Great Lakes basin.

During round one, we 1) developed a database management system; 2) developed a standardized sample design with rotating panels of wetland sites to be sampled across years, accompanied by sampling protocols, QAPPs, and other methods documents; and 3) developed background documents on the indicators. During the second round (2016-2020) we revamped our Data Management System and moved it over to servers on the Central Michigan University campus. In addition, we combated high water levels that made wetland sampling challenging and drowned out some wetlands. During round 3 (2021-2025) we completely revamped our Site Management System to update its programming and move it to the same server at CMU as the Data Management System, allowing better linkage between these two systems that are critical to running this sampling program. We also worked with GDIT to perform increased QC on all data through a Data Verification Interface (DVI) in order to deliver the highest quality data possible to EPA.

We have now completed the first summer of sampling for round 4 of monitoring the large Great Lakes coastal wetlands that are safely accessible and sampleable. Due to funding delays, work on Round 4 did not begin until late January 2026. However, because we have been doing this for 15 years, teams were ready for our 16th sampling round. What follows is an explanation of how this sampling program works, a description of how it builds on all previous years of sampling and monitoring, and reports from all teams on their field season.

SUMMARY OF SAMPLING SCHEDULE

This sampling program is based on a sampling schedule that follows phenology across the Great Lakes basin from southeast to northwest, ensuring that taxa are sampled at the appropriate time ecologically based on wetland latitude. During the winter, PIs and crew chiefs meet to discuss issues, update each other on progress, and ensure that everyone is staying on track for QA/QC. Sites are selected by March using the on-line Site Management System, and field crew training takes place from March – June, depending on sampling type. Anuran sampling typically begins in late March/early April with bird sampling beginning in April or May, and finally vegetation, fish, macroinvertebrate, and water quality sampling beginning in June. Sampling start dates are weather- and temperature-dependent. Phenology is followed across the basin so that the most southerly sites are sampled earlier than more northerly sites. In the fall and early winter data are entered into the database, unknown fish and plants are identified, and macroinvertebrates are identified. The goal is to have all data entered and QC'd by the end of March. Metrics and IBIs are calculated in April in preparation for the spring report.

Full summaries of the first two 5-year rounds of sampling have been submitted to US EPA and are available at <http://www.greatlakeswetlands.org/Reports-Publications.vbhtml>.

PROGRAM ORGANIZATION

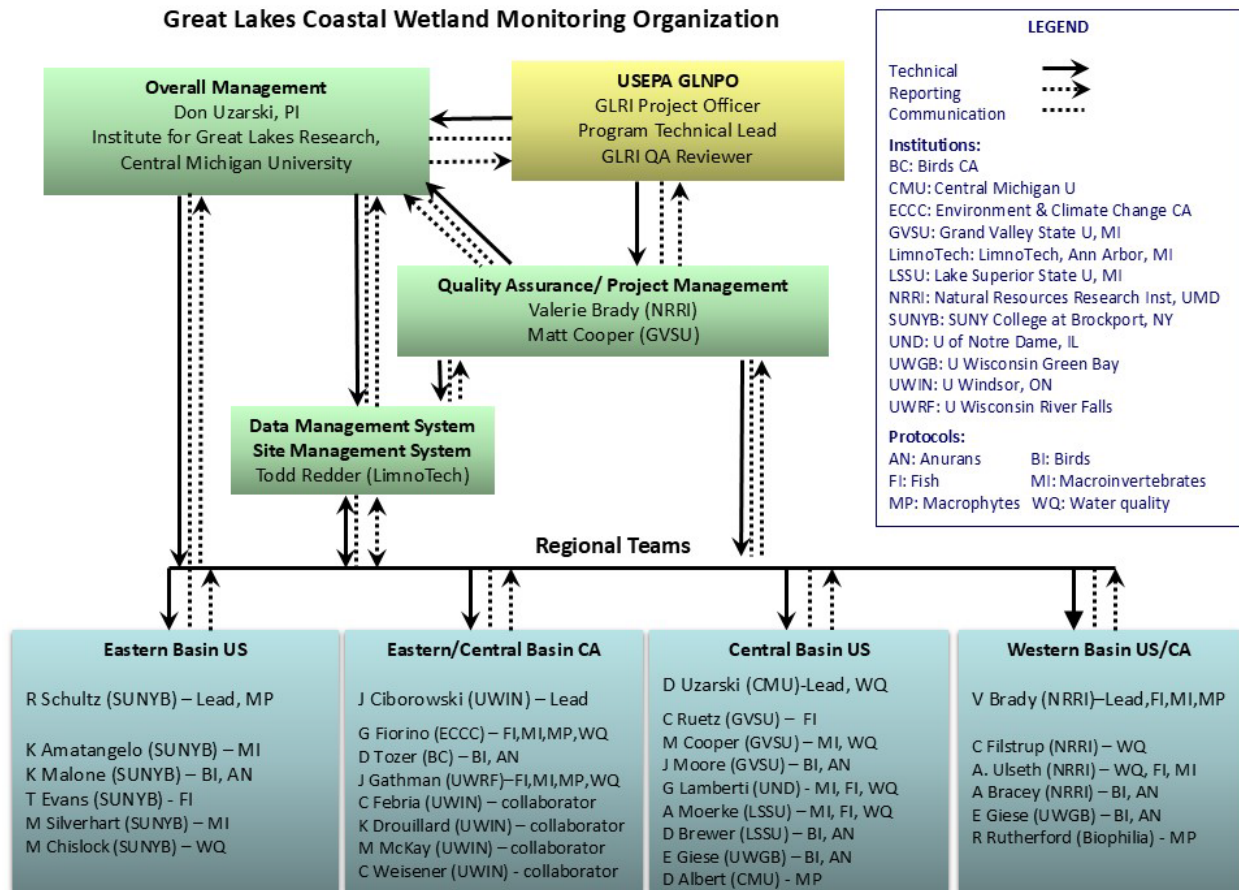


Figure 1. Great Lakes Coastal Wetland Monitoring Round 4 organizational chart.

[illegible]

Table 2a. GLRI Action Plan Measure of Progress. Wetlands are sampled during the summer.

Measure(s) of Progress – GLRI Action Plan IV	Total Progress Anticipated	Total Progress this Fiscal year (Only applicable to October report)		Progress During this Reporting Period		Total Progress to Date	
		#	%	#	%	#	%
5.2.1	800 wetlands sampled	146	20	146	20	146	20
5.2.1	800 wetlands IBI calculations	0	0	0	0	0	0

Table 2b. Work progress on outputs and outcomes for this monitoring program.

	Anticipated	This Reporting Period	Total To-Date	% Completed To-Date	Status
# Site Management System Updates	5	0	1	20%	Completed
# Data Management System Updates	5	1	1	20%	Completed
# Field Crew Trainings	5	1	1	20%	Completed
# of Mid-season QA/QC evaluations	5	1	1	20%	Completed
# Data QC and Upload	5	0	0	0%	Completed

SITE SELECTION

Year 1 of Round 4 site selection was completed in March 2026. We have completed our 5-year sampling scheme of Great Lakes coastal wetlands three times (round 1: 2011-2015; round 2: 2016-2020; round 3: 2021-2025). Differences in target wetland site lists between successive sampling rounds are most often associated with special benchmark sites or changes due to lake levels and our ability to access sites safely and with permission. Benchmark sites (sites of special interest for restoration or protection) can be sampled more than once in the five-year sampling rotation, may need to be sampled in a different year to accommodate restoration work and may be sites that were not on the original sampling list. The dramatic change in Great Lakes water levels has also affected what wetlands we are able to sample for which biota. The list of wetlands to be sampled this year (2026) was previously sampled in 2016 and 2021, with some differences due to benchmarks, safe access, water levels, and the fact that 2021 was still under Covid travel restrictions for some teams and for access to wetlands on reservation lands. Finally, we have dropped from consideration sites that have never been sampleable across the three previous sampling rounds to better indicate which sites are and are not safely sampleable.

ORIGINAL DATA ON GREAT LAKES COASTAL WETLAND LOCATIONS

The GIS coverage used as the base source for coastal wetland locations was a product of the Great Lakes Coastal Wetlands Consortium (GLCWC) and was downloaded from the Great Lakes Commission website on December 6, 2010.

SITE MANAGEMENT SYSTEM

Background

At the beginning of Round 1 (2011), a web-based database application was developed to facilitate site identification, stratified random site selection, and field crew coordination. Using this database, potential wetland polygons from the GLCWC GIS coverage were reviewed by PIs and those that were greater than four hectares, had herbaceous vegetation, had (or appeared to have) a lake connection navigable by fish, and were influenced by lake water levels were placed into the site selection random sampling rotation (Table 3). That is, these approximately 1000 wetlands became our wetland sampling universe, with minor modifications and additions and some sites being dropped due to lack of any crew ever being able to access them (the

current list includes approximately 900 wetlands). See the QAPP for a thorough description of site selection criteria. Note that the actual number of sampleable wetlands fluctuates every year with lake level, continued human activity and safe access for crews. We sample roughly one fifth of accessible wetlands per year.

Table 3. Counts, areas, and proportions of the 1014 Great Lakes coastal wetlands deemed sampleable in 2011 following Great Lakes Coastal Wetland Consortium protocols based on review of aerial photography. Crew access notes now indicate about 900 sampleable wetlands. Area in hectares.

Country	Site count	Site percent	Site area	Area percent
Canada	386	38%	35,126	25%
US	628	62%	105,250	75%
Totals	1014		140,376	

This wetland coverage shows more wetlands in the US than in Canada, with an even greater percent of wetland area in the US (Table 3). We speculate that this is partly due to poor representation of Georgian Bay (Lake Huron) wetlands in the sampleable wetland database. This area is also losing wetlands rapidly due to a combination of glacial rebound and topography that limits the potential for coastal wetlands to migrate downslope during periods of low lake levels and to recover with rising water levels. Another component of this US/CA discrepancy is the lack of coastal wetlands along the Canadian shoreline of Lake Superior due to the rugged topography and geology. A final possibility is unequal loss of wetlands between the two countries, but this has not been investigated.

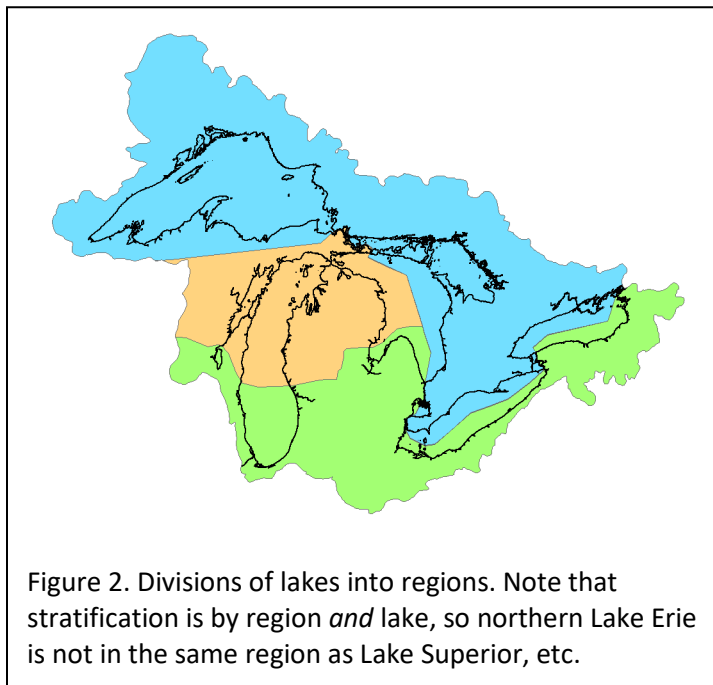
Strata

Geomorphic classes

Geomorphic classes (riverine, barrier-protected, and lacustrine) were determined for each site in the original coastal wetland GIS coverage. Many wetlands inevitably combine aspects of multiple classes, with an exposed coastal region transitioning into protected backwaters bisected by riverine elements. Wetlands were classified according to their predominant geomorphology. Note that we typically do not revisit or change the class originally assigned to a wetland during our 2011 initial site review process.

Regions

Existing ecoregions (Omernik 1987, Bailey and Cushwa 1981, CEC 1997) were examined as we sought to stratify sites to create a stratified random sampling framework. Ecoregion coverages did not stratify the Great Lakes' shoreline in a manner that captured a useful cross section of the physiographic gradients in the basin. To achieve the intended stratification of physiographic conditions, a simple regionalization was adopted that divided each lake into northern and southern components, with Lake Huron being split into three parts and Lake Superior being treated as a single region (Figure 2). The north-south splitting of Lake Michigan is common to all major ecoregion systems (Omernik / Bailey / CEC).



Panelization

Randomization

To create our stratified random wetland site sampling design, the first step was the assignment of selected sites from each of the project's 30 strata (10 regions x 3 geomorphic wetland types) to a random year or panel in the five-year rotating panel. Because the number of sites in some strata was quite low (in a few cases less than 5, more in the 5-20 range), simple random assignment would not produce the desired even distribution

of sites within each strata over time. Instead, it was necessary to assign the first fifth of the sites within a stratum, defined by their pre-defined random ordering, to one year, and the next fifth to another year, etc. All sites were assigned to panels in 2011, prior to the first round of sampling.

In 2012, sites previously assigned to panels for sampling were assigned to sub-panels for re-sampling. The project's sampling design requires that 10% of sites are re-sampled the year after they were sampled based on their main panel designation to help determine interannual variability and the effects of changing water levels. This design requires five primary panels, A-E, one for each year of a five-year rotation, and ten sub-panels, a-j, for the 10% resample sites.

If 10% of each panel's sites were simply randomly assigned to sub-panels in order a - j , sub-panel j would have a low count relative to other sub-panels. To avoid this, the order of sub-panels was randomized for each panel during site-to-sub-panel assignment, as can be seen in the random distribution of the '20' and '21' values in Table 4.

For the first five-year cycle, sub-panel a was re-sampled in each following year, so the 20 sites in sub-panel a of panel A were candidates for re-sampling in 2012. The 20 sites in sub-panel a of panel B were candidates for re-sampling in 2013, and so on. In 2016, panel A was sampled for the second time, so the 21 sites in sub-panel a of panel E became the re-sample sites. This summer (2026), panel A was sampled for the fourth time and the sites in sub-panel c of panel E were the re-sample sites. The total panel and sub-panel rotation covers 50 years.

Table 4. Sub-panel re-sampling, showing year of re-sampling for sub-panels a - c .

Main Panel	Subpanel										TOTAL
	a	b	c	d	e	f	g	h	i	j	
A: 2011 2016 2021 2026	20/2012	21/2017	21/2022	20	21	20	21	21	21	21	207
B: 2012 2017 2022 2027	20/2013	20/2018	20/2023	21	20	21	21	20	21	21	205
C: 2013 2018 2023 2028	21/2014	21/2019	21/2024	21	21	20	21	21	21	21	209
D: 2014 2019 2024 2029	22/2015	21/2020	21/2025	21	21	21	21	21	21	21	211
E: 2015 2020 2025 2030	21/2016	20/2021	21/2026	21	21	21	20	21	21	21	208

Workflow states

Each site is assigned a particular 'workflow' status. During the field season, sites selected for sampling in the current year move through a series of sampling states in a logical order, as shown in Table 5. The *data_level* field is used for checking that all data have been received and their QC status. Users set the workflow state for sites in the web tool, although some states can also be updated by querying the various data entry databases. In 2020 we ran into the problem of being unable to sample sites because of the global pandemic, Covid-19. The site status code "could not sample" was added as a workflow state in the site selection list for crews to have more options to indicate problems sampling sites. "Could not access" is used to indicate when a crew cannot safely get to a site for some reason, while "could not sample" is used to indicate the inability to sample a site even though they can get to it (e.g., water is too deep for their sampling gear; for Covid, this would be things like no access onto tribal lands, etc.).

Team assignment

With sites assigned to years and randomly ordered within years, specific sites were then assigned to specific teams. Sites were assigned to teams initially based on expected zones of logistic practicality, and the interface described in the 'Site Status' section is used to exchange sites between teams for efficiency and to better assure that distribution of effort matches each team's sampling capacity.

Field maps

Multi-page PDF maps are generated for each site for field crews each year. The first page depicts the site using aerial imagery and a road overlay with the wetland site polygon boundary. The image also shows the location of the waypoint provided for navigation to the site via GPS. The second page indicates the site location on a road map at local and regional scales. The remaining pages list information from the database for the site, including site informational tags, team assignments, and the history of comments made on the site, including information from previous field crew visits intended to help future crews find boat launches and learn about any hazards a site poses.

Table 5. Workflow states for sites listed in the Site Status table within the web-based site selection system housed at NRRRI. This system tracks site status for all taxonomic groups and teams for all sites to be sampled in any given year. Values have the following meanings: -1: site will not generate data, 0: site may or may not generate data, 1: site should generate data, 2: data received, 3: data QC'd.

Name	Description	Data_level
too many	Too far down randomly-ordered list, beyond sampling capacity for crews.	-1
Not sampling BM listed	Benchmark site that will not be sampled by a particular crew. Place holder status; indicates status update needed.	-1 0
web reject	Rejected based on regional knowledge or aerial imagery in web tool.	-1
will visit	Indicates site assignment to a team with intent to sample.	0
could not access site	Site proved impossible to access safely.	-1
could not sample	Added in 2020; indicates inability of crew to sample for some reason other than safety or lack of an appropriate wetland.	-1
visit reject	Visited in field, and rejected (no lake influence, no wetland present, etc.).	-1
will sample	Interim status indicating field visit confirmed sampleability, but sampling has not yet occurred.	1
sampled	Sampled, field work done.	1
entered	Data entered into database system.	2
checked	Data in database system QC-checked.	3

2026 SITE SELECTION

For 2026, 165 sites were selected for sampling. Of these, 14 were benchmark sites. Another 16 sites were re-sample sites and 17 were pre-sample sites, which will be re-sample sites next year (2027). Benchmark, re-sample, and pre-sample sites are sorted to the top of the sampling list because they are the highest priority sites to be sampled. By sorting next year's resample sites to the top of the list, this helps ensure that most crews sample them, allowing more complete comparison of year-to-year variation when the sites are sampled again the next year. Because this is our fourth sampling round, crews were familiar with most of the sites on the 2026 site list.

Benchmark sites are sites that are not on the site list, are special interest sites that were too far down the site list and risked not being sampled by all crews, or are sites that are considered a reference of some type and are being sampled more frequently. Sites that were not on the site list typically are too small, disconnected from lake influence, or are not a wetland at this time, and thus do not fit the protocol. These sites are added back to the sampling list by request of researchers, agencies, or others who have specific interest in the sites. Many of these sites are scheduled for restoration, and the groups who will be restoring them need baseline data against which to determine restoration success. Each year, we receive a number of requests to provide baseline data for restoration work.

We now have approximately 100 sites for which at least a portion of sampling is designated as "benchmark." Of these sites, about 40 are to evaluate restoration efforts and about a dozen serve as reference sites for their area or for nearby restoration sites. The rest are more intensive monitoring sites at which the extra data will help provide long-term context and better ecological understanding of coastal wetlands. Although most benchmark sites are in the US, several recently added benchmark sites are in Canada.

Wetlands have a "clustered" distribution around the Great Lakes due to geological and topographic differences along the Great Lakes coastline. As has happened each sampling season so far, several teams ended up with fewer sites than they had the capacity to sample, while other teams' assigned sites exceeded their sampling capacity. Within reason, teams with excess sampling capacity expanded their sampling boundaries to assist neighboring over-capacity teams in order to maximize the number of wetlands sampled. The Site Management System facilitates these changes.

TRAINING

All personnel responsible for sampling invertebrates, fish, macrophytes, birds, anurans, and water quality received training and were certified prior to this sampling program beginning in 2011. During that first year, teams of experienced trainers held training workshops at several locations across the Great Lakes basin to ensure that all PIs and crews were trained in Coastal Wetland Monitoring methods. Now that PIs and crew leaders are experienced, field crew training is being handled by each PI at each regional location, with more experienced trainers providing assistance, including in-person training by the management team, as necessary when major personnel changes take place (e.g., new field crew leader, new PI). As is true every field season, all crew members still had to pass all training tests and mid-season QCs were conducted for each team. As has become standard protocol, the trainers were always available via phone and email to answer any questions that arose during training sessions or during the field season.

The following is a synopsis of the training conducted by PIs each spring. See the individual team reports for information on how each team conducted crew training. Some crews were trained by the crew leader; some crews used only experienced personnel who had worked for the project for years and needed minimal retraining. In general, each PI or field crew leader trained all field personnel on meeting the data quality objectives for each element of the project; this included reviewing the most current version of the QAPP, covering site verification procedures, providing hands-on training for each sampling protocol, and reviewing record-keeping and archiving requirements, data auditing procedures, and certification exams for each sampling protocol. All field crew members had to pass all training certifications before they were allowed to work unsupervised. Those who did not pass all training aspects were only allowed to work under the supervision of a crew leader who had passed all training certifications.

Training for bird and anuran field crews includes tests on anuran calls, bird vocalizations, and bird visual identification. These tests are based on an online system established at the University of Wisconsin, Green Bay – see <http://www.birdercertification.org/GreatLakesCoastal>. In addition, individuals were tested for proficiency in completing field sheets, and audio testing was done to ensure their hearing is within the normal ranges. Field training was also completed to ensure guidelines in the QAPP are followed: rules for site verification, safety issues including caution regarding insects (e.g., Lyme's disease), GPS and compass use, and record keeping.

Fish, macroinvertebrate, and water quality crews were trained on field and laboratory protocols. Field training included selecting appropriate sampling points within each site, setting

fyke nets, identifying fish, sampling and sorting invertebrates, and collecting water quality and habitat covariate data. Laboratory training included preparing water samples, titrating for alkalinity, and filtering for chlorophyll. Other training included GPS use, safety and boating issues, field sheet completion, and GPS and records uploading. All crew members were required to be certified in each respective protocol prior to working independently.

Training for fish and invertebrate crews now includes specific instructions for sampling in deep water. These techniques were trialed in 2019 and found to work to allow sampling in at least somewhat deeper water than we have been sampling. Specifically, to sample invertebrates in depths greater than 1 m, D-frame dip net handles were extended and sampling was done from the boat by moving around the boat and by allowing the boat to swing around one of its anchors. To set fyke nets in deeper water, the boat can be used to set the cod end of the net and the frame can be set underwater, using rock bag anchors to weight the cod end.

Vegetation crew training also included both field and laboratory components. Crews were trained in field sheet completion, transect and point location and sampling, GPS use, and plant curation. Plant identification was tested following phenology through the first part of the field season. All crew members were certified in all required aspects of sampling before starting in the field unless supervised.

Training on data entry and data QC was provided by the leadership team through a series of conference calls/webinars during the late summer, fall, and winter of 2011, the first year of this sampling program. All co-PIs and crew leaders responsible for data entry participated in these training sessions and each regional laboratory has been successfully inputting data for many years. Additional training on data entry, data uploading, and data QC was provided in 2016 with the implementation of the updated version of the data entry/data archiving system. Training on data entry and QC continues via webinar as needed for new program staff and was done in both 2017 and 2018 as new staff joined the program. Additional training on data entry will be provided this winter due to the addition of two PIs for Round 4.

CERTIFICATION

To be certified in a given protocol, individuals must pass a practical exam. Certification exams were conducted in the field in most cases, either during training workshops or during site visits early in the season. When necessary, exams were supplemented with photographs (for fish and vegetation) or audio recordings (for bird and anuran calls). Passing a given exam certifies the individual to perform the respective sampling protocol(s). Since not every individual is responsible for conducting every sampling protocol, crew members were only tested on the

protocols for which they are responsible. Personnel who were not certified (e.g., part-time technicians, new students, volunteers) were not allowed to work independently nor to do any taxonomic identification except under the direct supervision of certified staff members.

Certification criteria are listed in the project QAPP. For some criteria, demonstrated proficiency during field training workshops or during site visits is considered adequate for certification. Training and certification records for all participants are collected by regional team leaders and copied to Drs. Brady and Cooper (QC managers) and Uzarski (lead PI). Note that the training and certification procedures explained here are separate from the QA/QC evaluations explained in the following section. However, failure to meet project QA/QC standards requires participants to be re-trained and re-certified.

DOCUMENTATION AND RECORD

All site selection and sampling decisions and comments are archived in the Site Management System (see “site selection”). These include comments and revisions made during the QC oversight process. Regional team leaders archive copies of the testing and certification records of all field crew members. Summaries of these records are also archived with the QC managers (Brady and Cooper).

WEB-BASED DATA ENTRY SYSTEM

The CWMP uses a web-based data management system (DMS) that was originally developed by NRRI in 2011 to collect field and laboratory data and was then redeveloped by LimnoTech during 2015-16. The current web-based system uses Microsoft’s Active Server Pages .NET (ASP.NET) web application framework running on a Windows Server 2019 Datacenter and hosted on a virtual machine at Central Michigan University (CMU). The open source PostgreSQL Relational Database Management System (RDMS) with PostGIS spatial extensions is used to provide storage for all CWMP data, including both the DMS and the Site Management System, on the same Windows 2019 server that hosts the web application.

The CWMP database includes collections of related tables for each major taxonomic group, including vegetation, fish and macroinvertebrates, anurans, birds and water quality parameters. Separate data entry/editing forms are created for data entry based on database table schema information that is stored in a separate PostgreSQL schema. Data entry/editing forms are password-protected and can only be accessed by users that have “Project Researcher” or

“Admin” credentials associated with their CWMP user account and permissions for specific taxa group(s).

Specific features of note for the CWMP data management system include:

- Automated processes for individual users to request and confirm accounts;
- An account management page where a limited group of users with administrative privileges can approve and delete user accounts and change account settings as needed;
- Numerous validation rules employed to prevent incorrect or duplicate data entry on the various data entry/editing forms;
- Custom form elements to mirror field sheets (e.g. the vegetation transects data grid), which makes data entry more efficient and minimizes data entry errors;
- Domain-specific “helper” utilities, such as generation of fish length records based on fish count records;
- Dual-entry inconsistency highlighting for anuran and bird groups who use dual-entry for quality assurance;
- Tools for adding new taxa records or editing existing taxa records for the various taxonomic groups; and
- GPS waypoint file (*.gpx) uploading utilities and waypoint processing to support matching of geographic (latitude/longitude) coordinates to sampling points.

The CWMP Data Management System (DMS) also provides separate webpages that allow researchers to download “raw” data for the various taxonomic groups as well as execute and download custom queries that are useful for supporting dataset review and QA/QC evaluations as data entry proceeds during and following each field season. Users from state management agencies are able to access the separate download pages for raw data and custom queries. Such organizations include GLNPO and its subcontractors and Michigan EGLE. Index of Biological Integrity (IBI) metrics are currently included as a download option based on static scores that reflect data collection through the 2024 field season. Over the past few years, a standalone .NET-based program has been developed and fully tested to automate the calculation of IBI metric scores for vegetation, invertebrates and fish on an annual (spring) schedule after data have been entered and gone through QA/QC.

Raw data downloads are available in both Microsoft (MS) Excel spreadsheet and MS Access database formats, while custom query results are available in spreadsheet format only. All available data/query export and download options are automatically regenerated every night, and users have the option of either downloading the last automated export or generating a new export that provides a snapshot of the database at the time the request is made (the former option is much faster). Currently, datasets for the major taxonomic groups must be downloaded individually; however, a comprehensive export of all pertinent data tables is generated in a single MS Access database file and provided to GLNPO on a bi-annual schedule in fall and spring of each program year.

In addition to providing CWMP researchers with data entry and download access, the CWMP data management team provides ongoing technical support and guidance to GLNPO to support its internal management and application of the QA/QC'ed monitoring datasets. GLNPO, with support from subcontractors, maintains a separate, offline version of the CWMP monitoring database within the Microsoft Access relational database framework. In addition to serving as an offline version of the database, this version provides additional querying and reporting options to support GLNPO's specific objectives and needs under GLRI. CWMP data management support staff generate and provide to GLNPO and its contractors a "snapshot" of the master CWMP PostgreSQL database as a Microsoft Access database twice per year, corresponding to a spring and fall release schedule. This database release is then used by GLNPO and its contractors to update the master version of the Microsoft Access database used to support custom querying and reporting of the monitoring datasets.

A full backup of the CWMP PostgreSQL database is created each night at 3:00 AM Eastern time using a scheduled backup with the PostgreSQL Backup software application. Nightly database backups are automatically uploaded to a dedicated folder on LimnoTech's Sharefile system where they are maintained on a 30-day rolling basis. In the event of significant database corruption or other failure, a backup version can be restored within an hour with minimal data loss. The server that houses the DMS has also been configured to use CMU's Veeam Backup Solution. This backup solution provides end-to-end encryption including data at rest. Incremental backups are performed nightly and stored at secure locations (on premise and offsite). Nightly backup email reports are generated and sent to appropriate CMU IT staff for monitoring purposes. Incremental backups are kept indefinitely and restores can be performed for whole systems, volumes, folders and individual files upon request.

RESULTS FROM PREVIOUS SAMPLING ROUNDS (2011-2025)

This project team has now completed three 5-year rounds of coastal wetland assessment, sampling approximately 600 wetlands on the US side of the Great Lakes and 300 wetlands on the Canadian side (Tables 6 and 7). Note that the total numbers in Tables 6 and 7 are not the same as the number of unique wetlands sampled because of temporal re-sampling events and benchmark sites that are sampled in more than one year per 5-year sampling round. Included below are the results from these three previous sampling rounds. Data collected during this fourth round will be tabulated and displayed similarly, providing continuity with previous monitoring. This year, teams sampled 146 wetlands (Tables 6 and 7, Figures 3 and 4).

In all years, more wetlands were sampled on the US side due to the uneven distribution of wetlands between the two countries. The wetlands on the US side also tend to be larger (see area percentages, Tables 6 and 7). Thus, each year 60-65% of total sites sampled are US coastal wetlands, with 75-80% of the wetland area sampled on the US side.

Table 6. Counts, areas, and proportions of US Great Lakes coastal wetlands sampled in Round 1 (2011 – 2015), Round 2 (2016 – 2020), Round 3 (2021 – 2025) and Round 4 (2026-2030) sampling by the Coastal Wetland Monitoring Program. Percentages are of overall total sampled each year. Area in hectares.

US	Site count	Site %	Site area	Area %
Round 1: 2011 – 2015				
US total Round 1	658	65%	116,309	77%
Round 2: 2016 – 2020				
US total Round 2	647	66%	132,470	82%
Round 3: 2021 – 2025				
US total Round 3	590	66%	117,901	79%
Round 4: 2026 - 2030				
2026	99	68%	135,483	74%
US total Round 4	99	68%	135,483	74%

Table 7. Counts, areas, and proportions of Canadian Great Lakes coastal wetlands sampled in Round 1 (2011 – 2015), Round 2 (2016 – 2020), Round 3 (2021 – 2025) and Round 4 (2026-2030) sampling by the Coastal Wetland Monitoring Program. Percentages are of overall total sampled each year. Area in hectares.

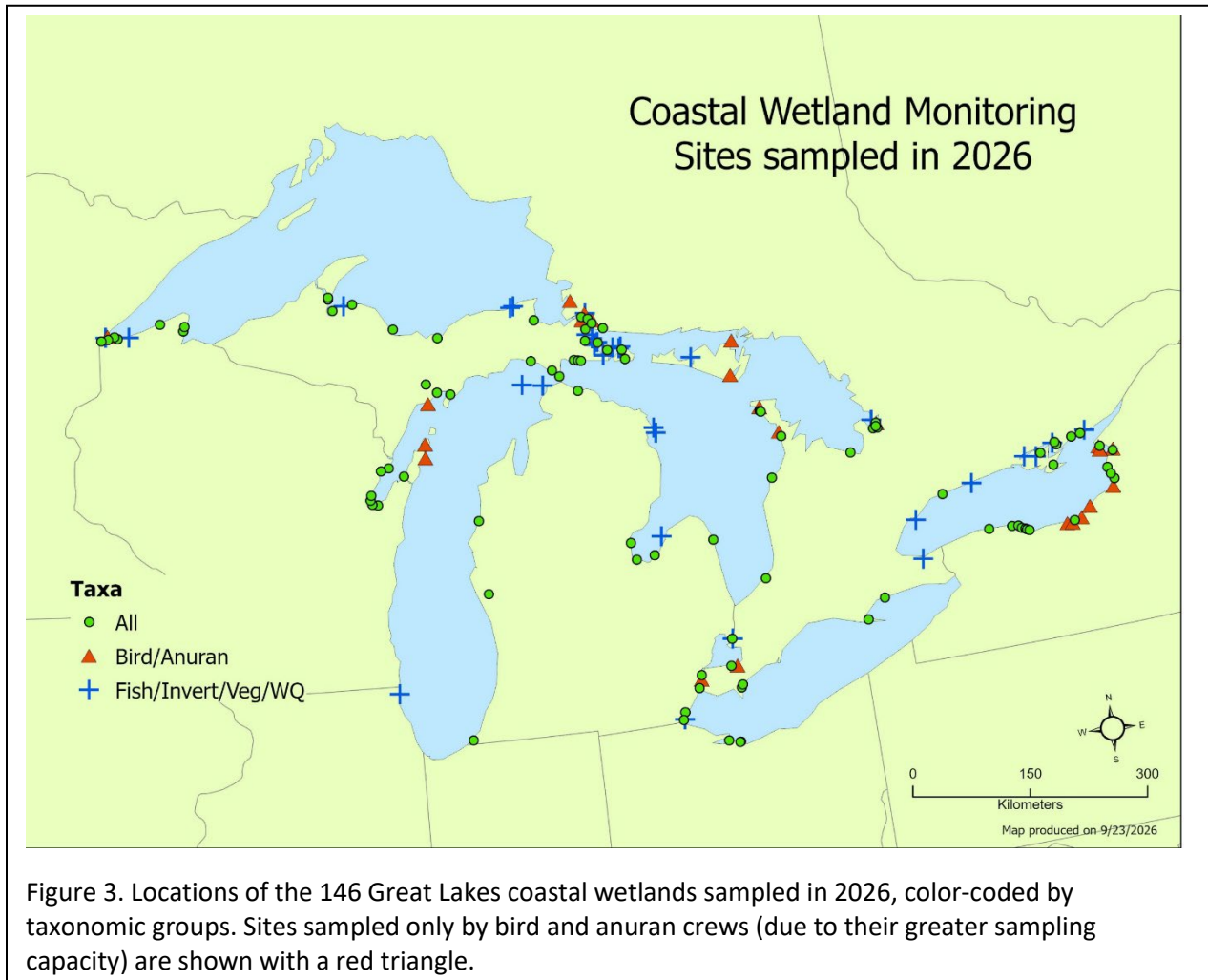
Canada	Site count	Site %	Site area	Area %
Round 1: 2011 - 2015				
CA total Round 1	352	35%	35,137	23%
Round 2: 2016 - 2020				
CA total Round 2	331	34%	31,843	18%
Round 3: 2021 - 2025				
CA total Round 3	302	34%	31,252	21%
Round 4: 2026 - 2030				
2026	47	32%	47,555	26%
CA total Round 4	47	32%	47,555	26%
Overall Totals Round 1	1010		151,446	
Overall Totals Round 2	978		164,312	
Overall Totals Round 3	890		149,153	
Overall Totals Round 4	146		183,038	

Ability to sample sites depends not only on access but also on water levels. For example, teams were able to sample more sites in 2014 due to higher lake levels on Lakes Michigan and Huron, which allowed crews to access sites and areas that have been dry or inaccessible in previous years. By 2015 water depths in some coastal wetlands had become so deep that crews had difficulty finding areas shallow enough to set fish nets in zones typically sampled for fish (cattail, bulrush, SAV, floating leaf, etc.). In 2017 Lake Ontario levels reached highs not seen in many decades. Water levels were again near historic highs in 2019 and 2020 and crews continued to report sampling challenges due to the high water, with coastal wetlands flooded out and only beginning to migrate upslope into areas that remain covered by terrestrial vegetation (shrubs, trees, etc.) or being blocked in this upslope migration by human land use or shoreline hardening. This highlights the difficulty of precisely determining the number of sampleable Great Lakes coastal wetlands in any given year, and the challenges crews face with rising and falling water levels. The pandemic also created sampling difficulties in 2020 and 2021,

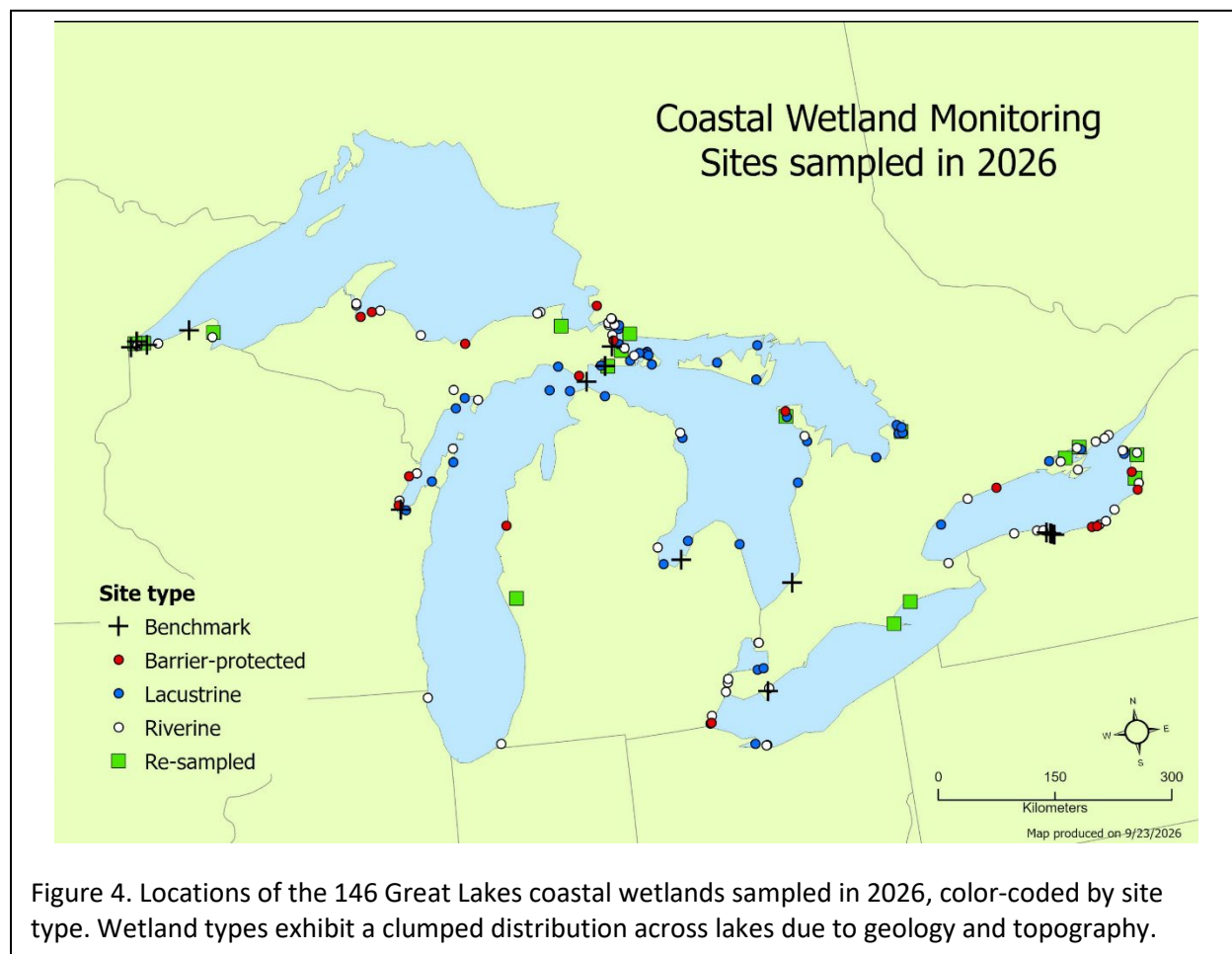
with sometimes severe restrictions on crew travel and site access. In 2021, water levels had moderated slightly and crews reported fewer difficulties in sampling. This trend continued through 2024 and 2025, with some crews finding water levels low enough in some wetlands to impact sampling due to low water, and in some areas wetland vegetation had not been able to migrate downslope enough even to keep up with dropping water levels.

The sites sampled in 2026 are shown in Figures 3 and 4 and are color coded by which taxonomic groups were sampled at the sites and by wetland types, respectively. Many sites were sampled for all taxonomic groups. Sites not sampled for birds and anurans typically were sites that were impossible to access safely, often related to private property access issues. Most bird and anuran crews do not operate from boats since they need to arrive at sites in the dark or stay until well after dark. There are also a number of sites sampled only by bird and anuran crews because these crews can complete their site sampling more quickly and thus have the capacity to sample more sites than do the fish, macroinvertebrate, and vegetation crews. In both 2022 and 2023, bird and anuran crews faced a very cold, late spring across much of the region, compressing fieldwork into a shorter timeframe. Spring of 2024 was also slow to warm up, and in some areas of the Great Lakes was followed by an unseasonably cool and wet early summer. 2025 brought even lower water levels particularly in Lakes Michigan and Huron, making fish sampling a challenge in a number of wetlands. Water levels were better in Lakes Michigan and Huron in 2026, making for easier sampling for fish.

Wetland types are not distributed evenly across the Great Lakes due to fetch, topography, and geology. Lacustrine wetlands occur in more sheltered areas of the Great Lakes within large bays or adjacent to islands (Figure 4). Barrier-protected wetlands occur along harsher stretches of coastline, particularly in sandy areas, although this is not always the case. Riverine wetlands are somewhat more evenly distributed around the Great Lakes.



Benchmark sites (Figure 4) are sites that are were not on the site list, are special interest sites that were too far down the site list and risked not being sampled by all crews, or are sites that are considered a reference of some type and are being sampled more frequently. Sites that were not on the site list typically are too small, disconnected from lake influence, or are not a wetland at this time, and thus do not fit the protocol. These sites are added back to the sampling list by request of researchers, agencies, or others who have specific interest in the sites. Many of these sites are scheduled for restoration, and the groups who will be restoring them need baseline data against which to determine restoration success. Each year, Coastal Wetland Monitoring (CWM) researchers get a number of requests to provide baseline data for restoration work.



We now have about 100 sites that are or have been sampled as a “benchmark.” Of these, about 40 are to evaluate restoration efforts and about a dozen serve as reference sites for their area or for nearby restoration sites. The rest are more intensive monitoring sites at which the extra data will help provide long-term context, help us adjust indicators to be robust against water level fluctuations, and gain better ecological understanding of coastal wetlands. Almost all benchmark sites are in the US, with a few Canadian benchmark sites recently added.

Determining whether some of these benchmark sites would have been sampled at some point as part of the random site selection process is difficult because several of the exclusion conditions are not easy to assess without site visits. Our best estimate is that approximately 60% of the 17 benchmark sites from 2011 would have been sampled at some point, but they were marked “benchmark” to either sample them sooner (to get ahead of restoration work for baseline sampling) or so that they could be sampled more frequently. Thus, about 40% of 2011 benchmark sites were either added new because they were not (yet) wetlands, are small, or

were missed in the wetland coverage, or would have been excluded for lack of connectivity. This percentage decreased in 2012, with only 20% of benchmark sites being sites that were not already in the list of wetlands scheduled to be sampled. In 2013, 30% of benchmark sites were not on the list of random sites to be sampled by CWM researchers in any year, and most were not on the list for the year 2013. For 2014, 26% of benchmark sites were not on the list of sampleable sites, and only 20% of these benchmark sites would have been sampled in 2014. These tend to be sites that are degraded former wetlands that no longer appear on any wetland coverage but for which restoration is a goal or, in a few cases, wetlands that are diked and the dike is being breached for restoration. There are a number of benchmark sites that are being sampled every year or every other year to collect extra data on these locations. At this point we are adding relatively few new sites as benchmarks each year (for 2023, only 2 new benchmarks were added; these are sites [7078, 7079] with major restorations planned for them). In 2024 we added a single new benchmark site (7080) in order to sample important wetlands on the upstream edge of the St. Louis River estuary that were missed in original site selection.

BIOTIC COMMUNITIES AND CONDITIONS (based on 2011-2025 data)

In the previous sampling rounds our team has sampled nearly 100% of the medium and large herbaceous coastal wetlands that have a surface water connection to the Great Lakes, are hydrologically influenced by lake levels, and can be safely accessed by crews in small boats. The following indicators and information are from data collected through 2025 and will serve as a good comparison for these wetlands as they are sampled in this next sampling round.

Wetlands averaged 23-27 bird species; richness at high quality sites was as great as 56 bird species (Table 8). There are many fewer calling amphibian species (anurans) in the Great Lakes (8 total), and coastal wetlands averaged 4 species per wetland, with some benchmark wetlands containing no anurans (Table 8). However, there were wetlands where 8 anuran species were heard over the three sampling dates.

Table 8. Bird and anuran species in wetlands; summary statistics by country. Data from 2011 through 2025, using only the latest year sampled for each wetland.

Country	Site count	Mean	Max	Min	St. Dev.
<i>Birds</i>					
Can.	252	26.9	53	9	10.1
U.S.	466	23.4	56	5	9.0
<i>Anurans</i>					
Can.	243	4.3	8	1	1.5
U.S.	412	4.0	7	0	1.4

Bird and anuran data in Great Lakes coastal wetlands by lake (Table 9) shows that wetlands on most lakes had an average number of bird species in the mid-twenties. The greatest number of bird species at a wetland occurred on Lake Huron with the fewest on Lake Superior. These data include some benchmark sites, many of which are in need of or are undergoing restoration, so the minimum number of species found at a site can be quite low.

Calling anuran species counts show less variability among lakes simply because fewer of these species occur in Great Lakes coastal wetlands. Wetlands averaged about four calling anuran species regardless of lake (Table 9). Similarly, there was little variability by lake in maximum or minimum numbers of species. At some benchmark sites, and occasionally during unusually cold spring weather and/or at benchmark sites, no calling anurans were heard.

Table 9. Bird and anuran species found in Great Lakes coastal wetlands by lake. Mean, maximum, and minimum number of species per wetland for wetlands sampled from 2011 through 2025, using only data from the latest year sampled for each wetland.

Lake	Sites	Birds			Sites	Anurans		
		Mean	Max	Min		Mean	Max	Min
Erie	86	25.4	54	5	83	4.2	7	1
Huron	218	24.3	56	8	192	4.1	7	0
Michigan	132	24.2	50	5	119	3.8	7	0
Ontario	196	25.4	53	6	192	4.4	8	1
Superior	86	23.4	41	5	69	3.8	7	1

An average of 9 to 13 fish species were collected in Canadian and US Great Lakes coastal wetlands, respectively (Table 10). Again, these data include sites in need of restoration, and some had very few species. On the other hand, the wetlands with the highest richness had as

many as 23 (CA) or 28 (US) fish species. The average number of non-native fish species per wetland was approximately one, though some wetlands had as many as 5. An encouraging sign is that there are wetlands in which no non-native fish species were caught in fyke nets, although some non-native fish are adept at net avoidance (e.g., common carp).

Table 10. Total fish species in wetlands, and non-native species; summary statistics by country for sites sampled from 2011 through 2025, using only data from the latest year sampled for each wetland.

Country	Sites	Mean	Max	Min	St. Dev.
<i>Overall</i>					
Can.	146	9.1	23	1	3.7
U.S.	257	13.2	28	0	4.8
<i>Non-natives</i>					
Can.	146	0.9	5	0	0.9
U.S.	257	1.1	5	0	1.1

Total fish species did not differ greatly by lake, averaging 11-13 species per wetland (Table 11). Lakes Erie and Huron had the most species of fish in a wetland, 28 species; the other lakes had a maximum of 22-26 species. Because sites in need of restoration are included, some of these sites had very few fish species or none at all. Wetlands averaged 1 non-native fish species captured. Having very few or no non-native fish is a positive and all lakes had some wetlands in which we caught no non-native fish. This result does not necessarily mean that these wetlands are free of non-natives. Our single-night net sets do not catch all fish species in wetlands, and some species are quite adept at avoiding passive capture gear. There are well-documented biases associated with each type of fish sampling gear. For example, active sampling gears (e.g., electrofishing) are better at capturing large active fish, but perform poorly at capturing smaller fish, forage fish, and young fish that are sampled well by our passive gear.

Table 11. Fish total species and non-native species found in Great Lakes coastal wetlands by lake. Mean, maximum, and minimum number of species per wetland. Data from 2011 through 2025, using only data from the most recent year sampled for each wetland.

Lake	Sites	Fish (Total)			Non-native		
		Mean	Max	Min	Mean	Max	Min
Erie	49	11.7	28	4	1.5	5	0
Huron	141	11.5	28	1	0.7	4	0
Michigan	59	12.8	26	0	1.2	5	0
Ontario	96	10.9	25	3	1.0	5	0
Superior	58	12.5	22	3	1.2	5	0

The average number of macroinvertebrate taxa (taxa richness) per site was about 37 (Table 12), but some wetlands had more than twice this number. Sites scheduled for restoration and other taxonomically poor wetlands had fewer taxa. On a more positive note, the average number of non-native invertebrate taxa found in coastal wetlands was less than 1, with a maximum of no more than 5 taxa (Table 12). Note that our one-time sampling may not be capturing all of the non-native taxa at wetland sites. In addition, some non-native macroinvertebrates are quite cryptic, resembling native taxa, and may not yet be recognized as invading the Great Lakes.

Table 12. Total macroinvertebrate taxa in Great Lakes coastal wetlands, and non-native species; summary statistics by country. Data from 2011 through 2025, using only data from the most recent year sampled for each wetland.

Country	Sites	Mean	Max	Min	St. Dev.
<i>Overall</i>					
Can.	188	36.6	65	18	10.3
U.S.	301	37.4	68	9	12.0
<i>Non-natives</i>					
Can.	188	0.8	4	0	0.9
U.S.	301	0.8	5	0	1.0

Lake Ontario wetlands had the lowest average invertebrate taxa richness at 32 taxa with Lake Superior having the greatest average richness at 43 taxa (Table 13). The maximum number of invertebrate taxa was lowest in Lake Erie wetlands (57) with the most invertebrate-rich wetlands in the other lakes having a maximum of 66-68 taxa. Wetlands with the fewest taxa are sites in need of restoration. Patterns are likely being driven by differences in habitat

complexity, which may in part be due to the loss of wetland habitats. This has been documented in numerous peer-reviewed publications.

Table 13. Macroinvertebrate total taxa and non-native species found in Great Lakes coastal wetlands by lake. Mean, maximum, and minimum number of taxa per wetland. Data from 2011 through 2025, using only data from the most recent year sampled for each wetland.

Lake	Sites	Macroinvertebrates (Total)			Non-native		
		Mean	Max	Min	Mean	Max	Min
Erie	66	33.4	57	12	1.1	5	0
Huron	164	40.4	68	13	0.6	4	0
Michigan	74	35.0	66	9	1.0	4	0
Ontario	115	32.2	59	15	0.8	3	0
Superior	70	42.9	68	23	0.6	4	0

There was little variability among lakes in non-native taxa occurrence (Table 13). In each lake there were some wetlands in which we found no non-native macroinvertebrates. As noted above, however, this does not necessarily mean that these sites do not contain non-native macroinvertebrates.

Coastal wetlands in both the US and Canada averaged about 46 wetland plant taxa in wetlands, with maximums of 100 taxa or more. However, depauperate wetlands had only 4-5 vegetation taxa (Table 14). Non-native vegetation is commonly found in Great Lakes coastal wetlands. Coastal wetlands averaged 5-6 non-native species (Table 14). Some wetlands contained as many as 17 non-native macrophyte species, but there were wetlands in which no non-native plant species were found. It is unlikely that our sampling strategy would miss significant non-native plants invading a wetland. However, small patches of cryptic or small-stature non-natives could be missed. Invasive species are a particularly important issue for restoration work. Restoration groups often struggle to keep restored wetland sites from becoming dominated by invasive plant species.

Table 14. Total macrophyte species and non-native macrophytes in Great Lakes coastal wetlands; summary statistics by country. Data from 2011 through 2025, using only data from the most recent year sampled for each wetland.

Country	Site count	Mean	Max	Min	St. Dev.
<i>Overall</i>					
Can.	194	45.5	100	5	20.1
U.S.	357	46.3	118	4	20.6
<i>Non-native</i>					
Can.	194	5.8	17	0	3.6
U.S.	357	4.6	17	0	3.7

Wetlands on Lakes Erie and Superior had the lowest mean number of macrophyte species (33, Table 15), with the other lakes' wetlands having higher mean numbers of species (43-53, Table 15). Average numbers of non-native species were highest in Lake Ontario (9 species) and lowest in Lake Superior wetlands (1 species; Table 15). Lake Superior had the lowest maximum number of non-native macrophytes in a wetland (8) and Lake Ontario had the highest maximum number with 17. There are wetlands on all lakes in which we did not detect invasive plants.

Table 15. Macrophyte total species and non-native species found in Great Lakes coastal wetlands by lake. Mean, maximum, and minimum number of species per wetland. Data from 2011 through 2025, using only data from the most recent year sampled for each wetland.

Lake	Sites	Macrophytes (Total)			Non-native		
		Mean	Max	Min	Mean	Max	Min
Erie	66	33.3	78	4	6.4	15	0
Huron	200	53.1	118	5	3.8	14	0
Michigan	88	43.6	82	4	4.5	11	0
Ontario	127	50.5	90	12	8.8	17	1
Superior	70	32.9	63	7	1.2	8	0

WETLAND CONDITION (based on 2011 – 2025)

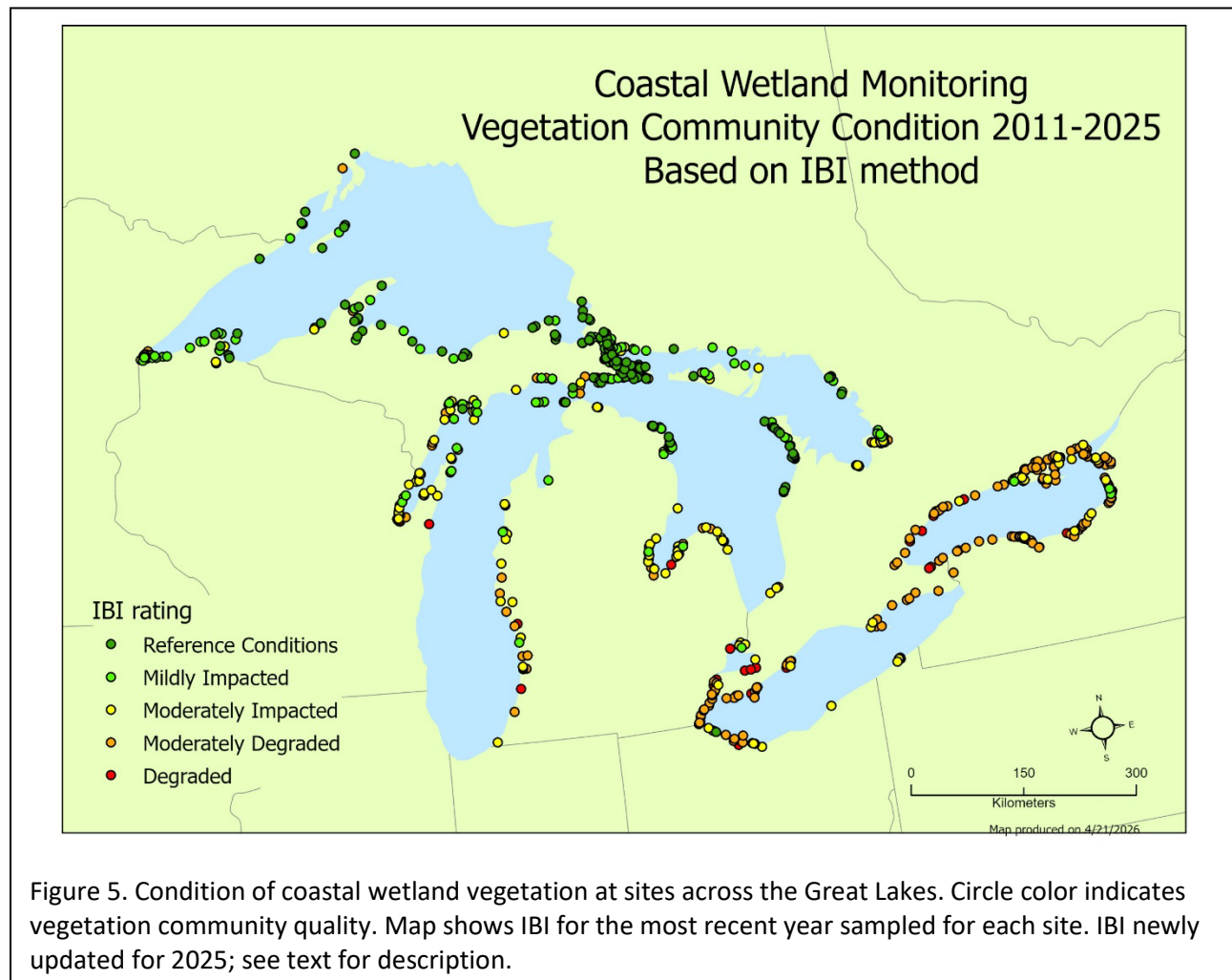
For the three previous rounds of this monitoring program, we have been evaluating coastal wetland condition using a variety of biota (wetland vegetation, aquatic macroinvertebrates, fish, birds, and anurans [calling amphibians]). In this section we present Great Lakes coastal wetland condition based on these taxa as sampled during the last three monitoring rounds. The results from this fourth round of monitoring will be presented similarly and the results below will provide a good comparison for coastal wetland condition going forward.

Macrophytic (large plants) vegetation has been used for many years as an indicator of wetland condition (algal species are not included in this monitoring program). One very common and well-recognized indicator is the Floristic Quality Index (FQI); this evaluates the quality of a plant community using all of the plants at a site. Each species is given a Coefficient of Conservatism (C) score based on the level of disturbance that characterizes each plant species' habitat. A species found in only undisturbed, high quality sites will have a high C score (maximum 10), while a weedy species will have a low C score (minimum 0). Invasive and non-native species are given a rank of 0. These C scores have been determined for various areas of the country by plant experts; we used the published C values for the midwest. The FQI is an average of all of the C scores of the species growing at a site, divided by the square root of the number of species. The CWM wetland vegetation index uses C scores for wetland species, among other metrics.

This IBI has been updated and adjusted multiple times since the start of the project. Adjustment were made to reflect changes in the taxonomic treatment of many marsh plants in the 2012 Michigan Flora and Flora of North America. In 2020 we updated the non-native species list. In 2023 we debuted the basis for the current version of the aquatic macrophyte-based IBI, originally developed by Dr. Dennis Albert. This IBI is calculated by vegetation zone, making it possible to identify the source of degradation in a wetland. In many cases the impact of land or water use can result in the level of degradation in one zone being very different than that in other zones, and identifying the degraded zones can facilitate more effective restoration efforts. The current version of this IBI was published in Dybiec *et al.* (2020). The order of lake-wide quality shows Lake Superior having the highest IBI scores, followed in order by Lake Huron, Lake Michigan, Lake Ontario, and Lake Erie.

The map (Figure 5) shows the distribution of Great Lakes coastal wetland vegetation IBI scores across the basin. Note that there are long stretches of Great Lakes coastline that do not have coastal wetlands due to topography and geology. Sites with low IBI scores are concentrated in the southern Great Lakes, where there are large amounts of both agriculture and urban

development, and where water levels are more tightly regulated (e.g., Lake Ontario), while sites with high IBI scores are concentrated in the northern Great Lakes. Even in the north, an urban area like Duluth, MN may have high quality wetlands in protected sites and lower quality degraded wetlands in the lower reaches of estuaries (drowned river mouths) where there are legacy effects from the pre-Clean Water Act era, along with nutrient enrichment or heavy siltation from industrial development and/or sewage effluent. Benchmark sites in need of restoration will also have lower condition scores.



Another of the IBIs that was developed by the Great Lakes Coastal Wetlands Consortium uses the aquatic macroinvertebrates found in several of the most common vegetation types in Great Lakes coastal wetlands: sparse bulrush (*Schoenoplectus*), dense bulrush (*Schoenoplectus*), and wet meadow (multi-species) zones (Figure 6). Shifts and revisions in taxonomy across the years

mean that the invertebrate IBIs shown in this and recent reports should not be compared to those shown in older reports. However, this IBI has been calculated for all sites with appropriate zones and invertebrate data for all years.

The lack of sites on lakes Erie and Ontario and southern Lake Michigan is due to either a lack of wetlands (southern Lake Michigan) or because these areas do not contain any of the three specific vegetation zones that GLCWC used to develop and test the invertebrate IBI. Many areas contain dense cattail stands (e.g., southern Green Bay, much of Lake Ontario), for which we do not yet have a published macroinvertebrate IBI. We are developing IBIs for additional vegetation zones to cover these sites, but these IBIs have not yet been validated so they are not included here.

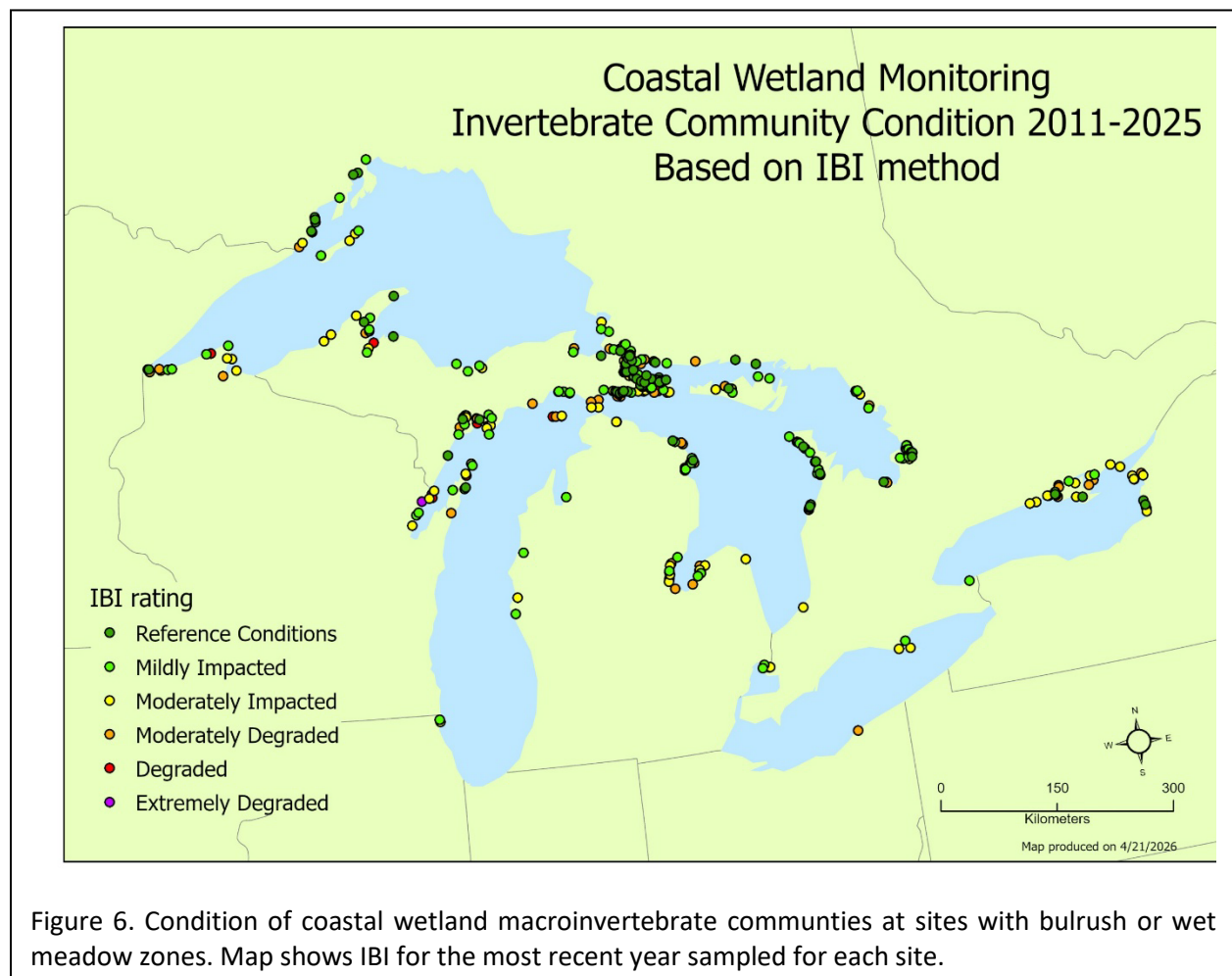
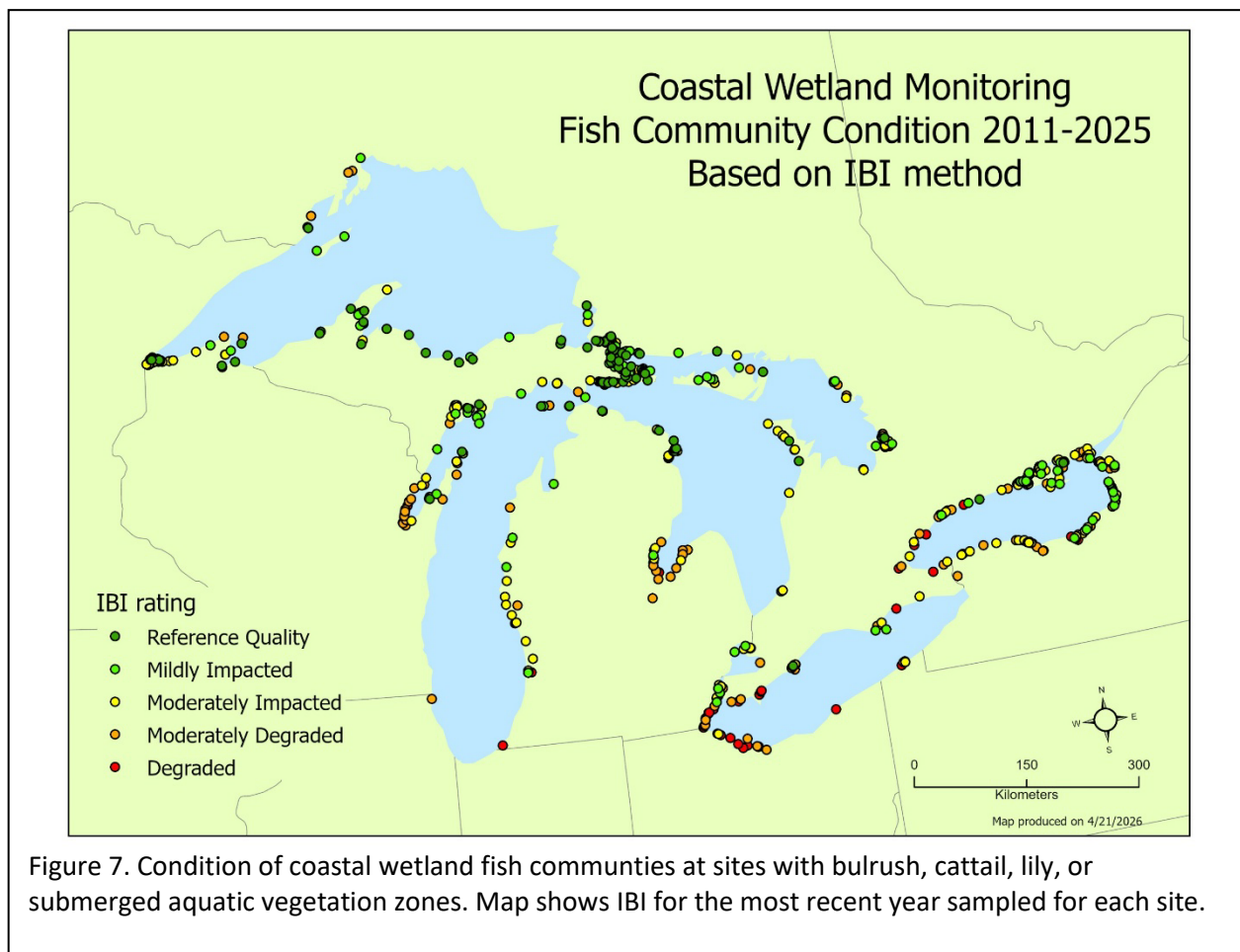


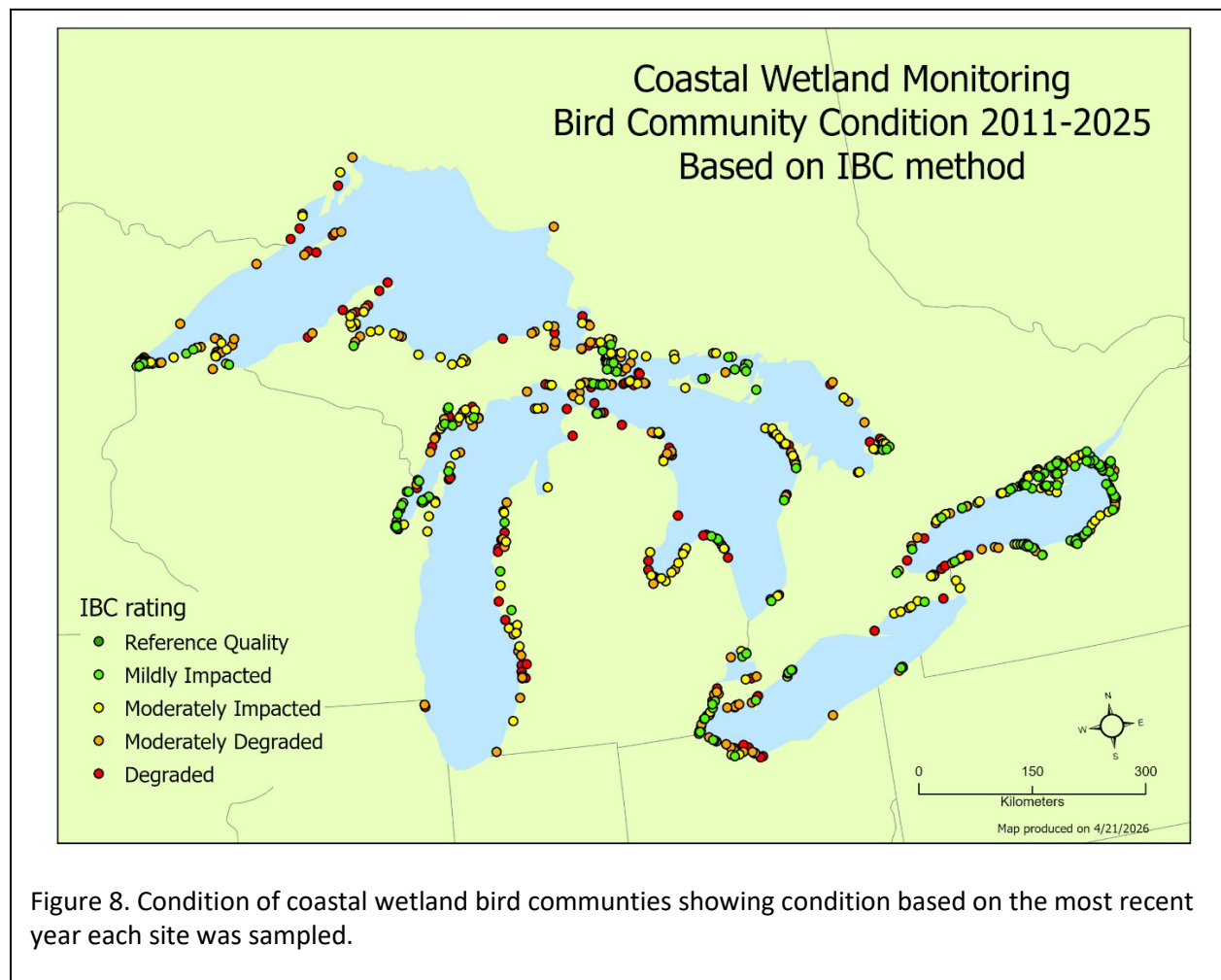
Figure 6. Condition of coastal wetland macroinvertebrate communities at sites with bulrush or wet meadow zones. Map shows IBI for the most recent year sampled for each site.

Our fish IBI scores for wetland sites now contain bulrush, cattail, lily, or SAV zones (Figure 7). Because of the prevalence of these vegetation types in wetlands throughout the Great Lakes basin, this indicator provides more site scores than the macroinvertebrate indicator. Because these are updated and adjusted indicators, the map image in this report should not be compared to fish IBI map images in previous reports. However, all sites reporting fish data from zones applicable to the new fish IBIs are shown here, regardless of the year they were sampled.



We use an Index of Biotic Condition (Howe *et al.* 2023) to show wetland condition based on bird and anuran communities. This index is relatively simple to calculate and therefore invites broader applications by state and local conservation agencies. The Index of Biotic Condition (IBC) is more stable than our previous indicator when few species are present and is more highly correlated with species richness. The highest IBC value is achieved by an “ideal” species assemblage, which might not occur in the sampled data set (i.e., in any Great Lakes coastal

wetland). In other words, using this method, biotic condition at Great Lakes wetlands based on birds (Figure 8) looks quite different than on these condition maps in previous reports and map images from older reports should not be compared to these map images.



Coastal Wetland Monitoring field teams have recorded 13 species of anurans (2 toads and 11 frogs) since 2011, but 4 of these (northern [Blanchard's] cricket frog, *Acris crepitans*; Fowler's toad, *Anaxyrus fowleri*; mink frog, *Lithobates septentrionalis*; and pickerel frog, *Lithobates palustris*) are seldom observed. Cope's gray treefrog (*Dryophytes chrysoscelis*) and eastern gray treefrog (*Dryophytes versicolor*) are sibling species that are difficult to differentiate in the field, so we combined records into a single taxon. We also did not separate geographically distinct species of chorus frogs, *Pseudacris*. Condition indicators for anurans therefore were based on 8

taxa (American toad or Fowler's Toad, *Anaxyrus spp.*; gray treefrogs, *Dryophytes spp.*; bullfrog, *Lithobates catesbeianus*; northern leopard frog, *Lithobates pipiens*; green frog, *Lithobates clamitans*; wood frog, *Lithobates sylvaticus*; chorus frogs, *Pseudacris spp.*, and spring peeper, *Pseudacris crucifer*). A ninth category combines other less-common species such as pickerel frog and mink frog (*Lithobates spp.*). Wetland condition based on anuran communities as calculated by the new IBC method is shown in Figure 9.

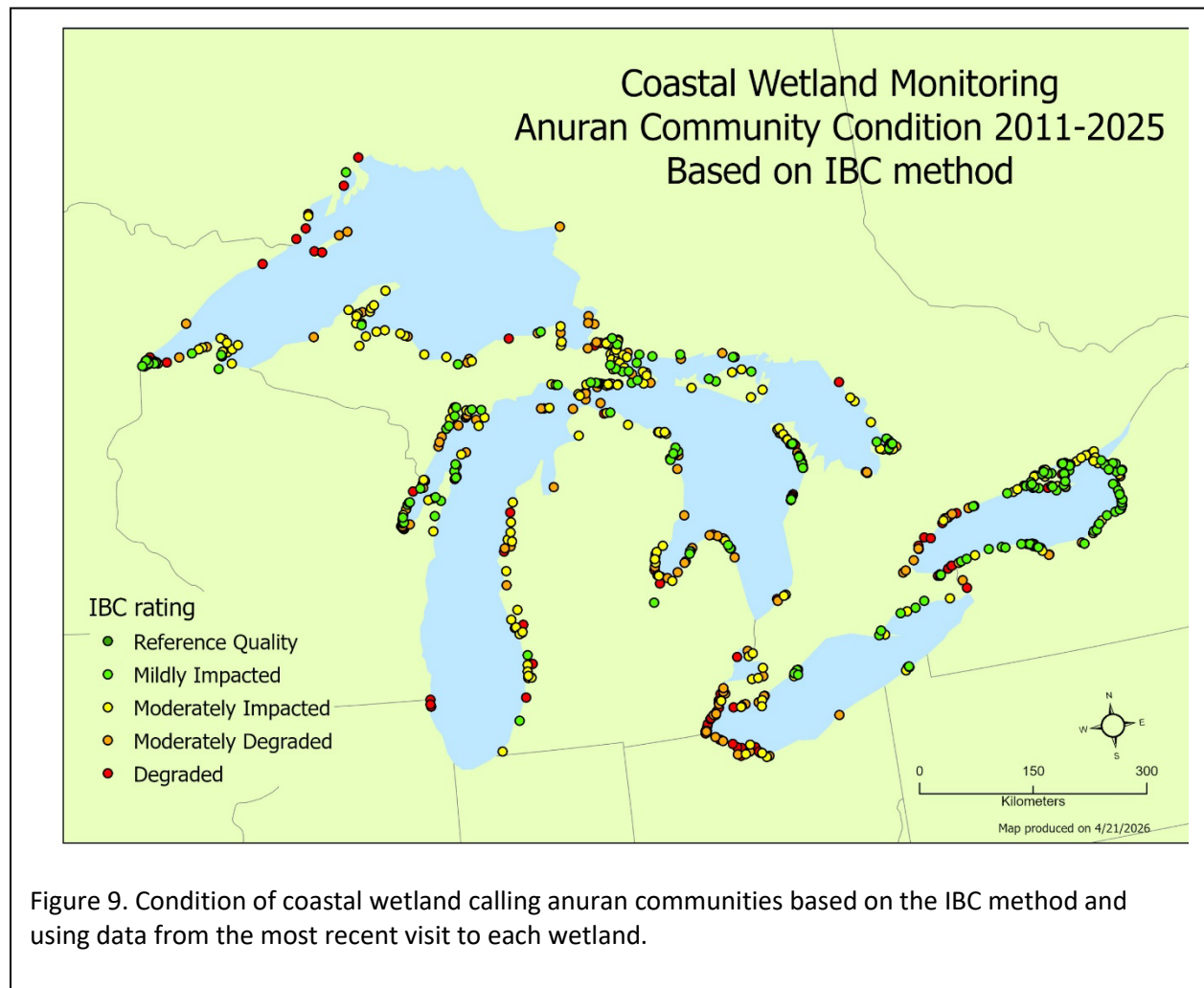


Figure 9. Condition of coastal wetland calling anuran communities based on the IBC method and using data from the most recent visit to each wetland.

Finally, we have developed a water quality and land use indicator (Harrison et al. 2019). This indicator is based on landscape stressor data and water quality data collected from each aquatic plant morphotype (Figure 10).

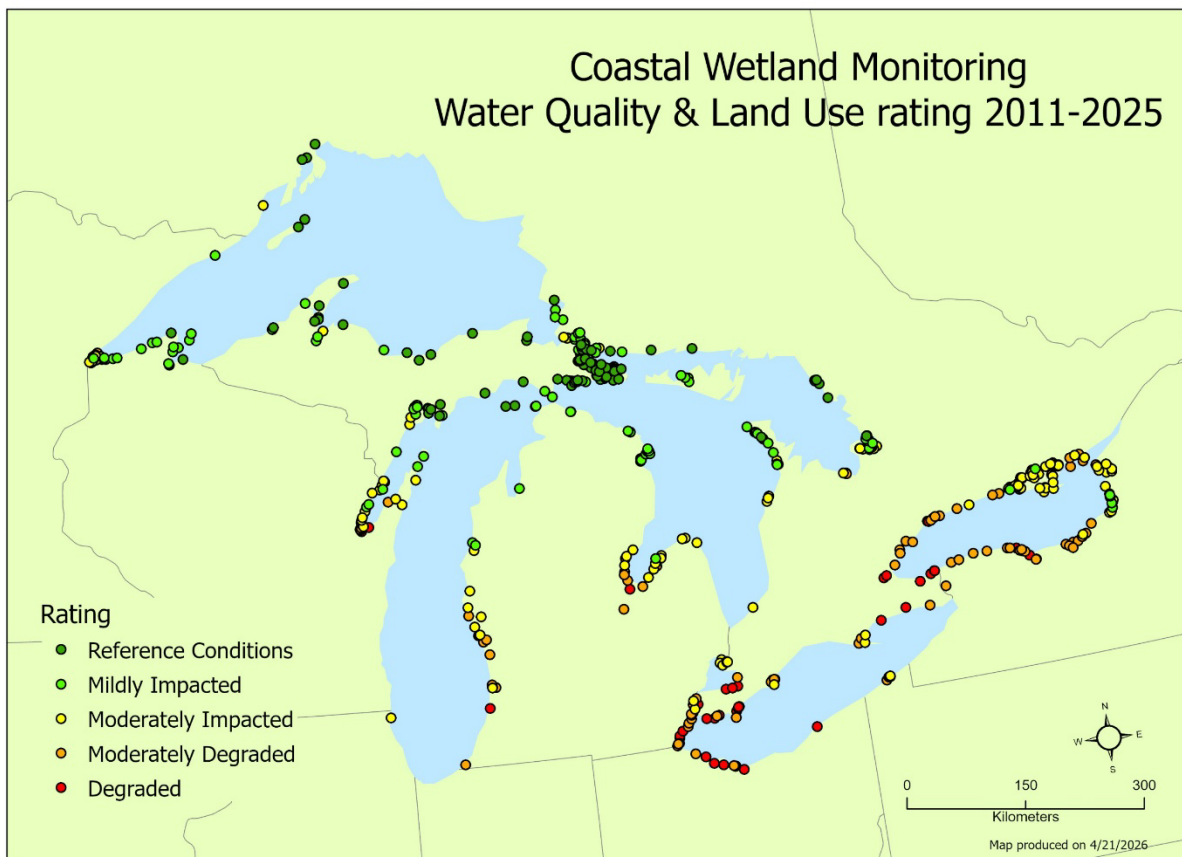
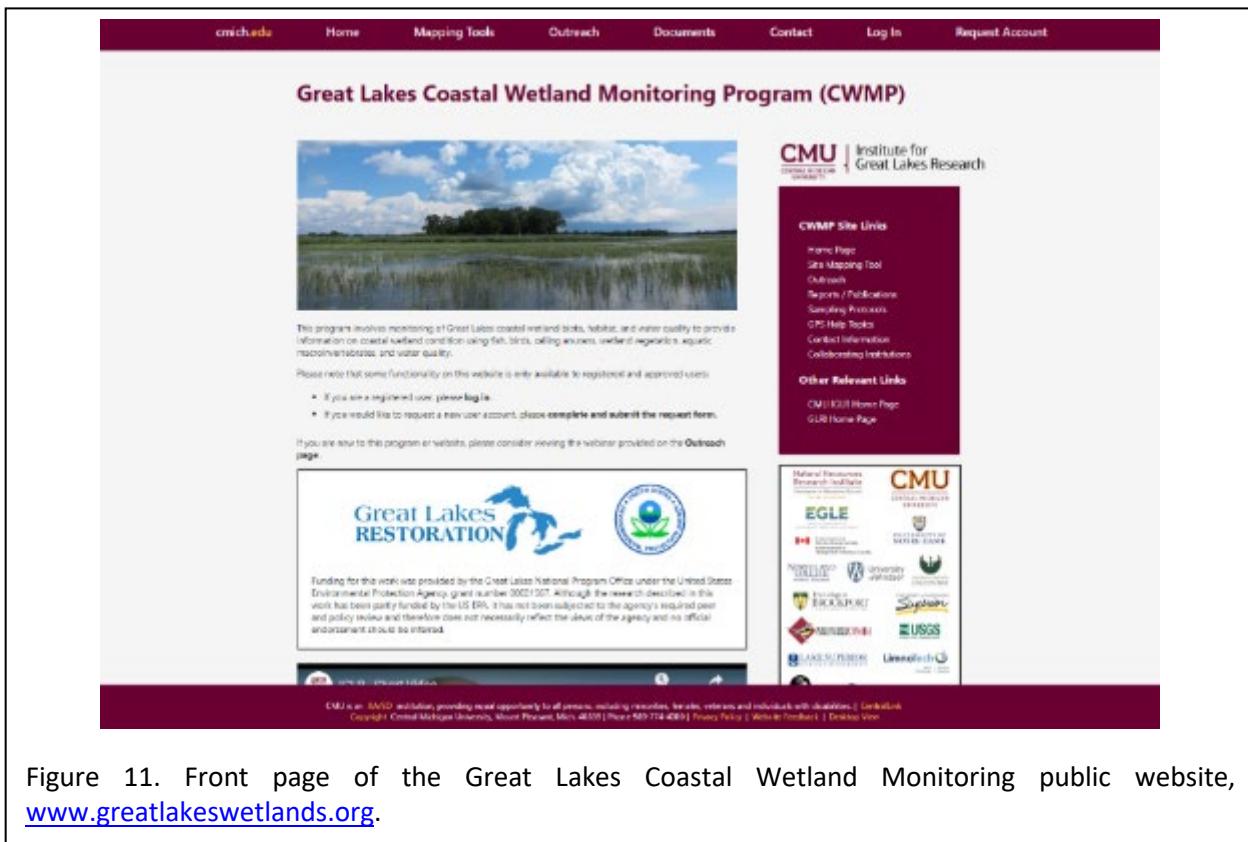


Figure 10. Disturbance gradient (SumRank) indicator. This indicator is based on landscape stressor data, site-based stressor data, and site water quality data.

PUBLIC ACCESS WEBSITE

For Round 4 monitoring we will continue to use the Coastal Wetland Monitoring Program (CWMP) website, developed and refined over the past 3 monitoring rounds. The website provides efficient access to program information and summary results for coastal managers, agency personnel, and the interested public (Figure 11). Great Lakes coastal managers and agency personnel have used the website's account management system to request and obtain accounts that provide access to the wetland site mapping tool, which includes reporting the wetland condition scores for all taxa and wetlands sampled. CWMP researchers have also obtained user accounts that provide access to data upload, entry, editing, download, mapping tools and the Site Management System. LimnoTech maintains and supports the website and

will continue to do so, modifying and enhancing it as required to meet CWMP and GLNPO needs.



The CWMP website provides a suite of interrelated webpages and associated tools that allow varying levels of access to results generated by the CWMP, depending on the user's data needs and affiliation. Webpages available on the site allow potential users to request an account and for site administrators to approve and manage access levels for individual accounts. Specific levels of access for the website are as follows:

- **Public** – this level of access does not require a user account and includes access to a basic version of the wetland mapping tool, as well as links to CWMP documents and contact information;
- **Site metrics (level 1)** – provides access to index of biological integrity (IBI) scores by wetland site via the coastal wetland mapping tool;
- **Agency/manager-basic (level 2)** - access to IBI scores and full species lists by wetland site via mapping tool;

- **CWMP scientists (level 4)** - access to data entry/editing tools (+ Level 3 capabilities); and
- **Admin** - access to all information and data included on the website plus administrative tools. A small team of CWMP principal investigators have been given “Admin” access and will handle approval of account requests and assignment of an access level (1-4).

The following sub-sections briefly describe the general site pages that are made available to all users (“Public” level) and the coastal wetland mapping tool features available to “Level 1” and “Level 2” users. User requests for CWMP datasets are handled through a formal process which involves the requestor submitting a letter detailing the request and providing assurances regarding maintaining the publication rights of the CWMP team. Additional pages and tools available to “Level 4”, and “Admin” users for exporting raw monitoring data, entering and editing raw data, and performing administrative tasks are not documented in detail in this report.

COASTAL WETLAND MAPPING TOOL

The CWMP website provides a coastal wetland site mapping tool (<http://www.greatlakeswetlands.org/Map>). The basic version is available at the “Public” access level and provides the following features and capabilities (Figure 12):

- Map navigation tools (panning, general zooming, zooming to a specific site, etc.);
- Basemap layer control (selection of aerial vs. “ocean” basemaps);
- Display of centroids and polygons representing coastal wetlands that have been monitored thus far under the CWMP;
- Capability to style/symbolize wetland centroids based on: 1) geomorphic type (default view; Figure 12), or 2) year sampled (Figure 13); and
- Reporting of basic site attributes (site name, geomorphic type, latitude, longitude, and sampling years) and general monitoring observations for the site (e.g., hydrology, habitat, disturbances).

In addition to the features made available at the “Public” access level, users with “Level 1” (*Site Metrics*) access to the website can currently obtain information regarding wetland condition scores.

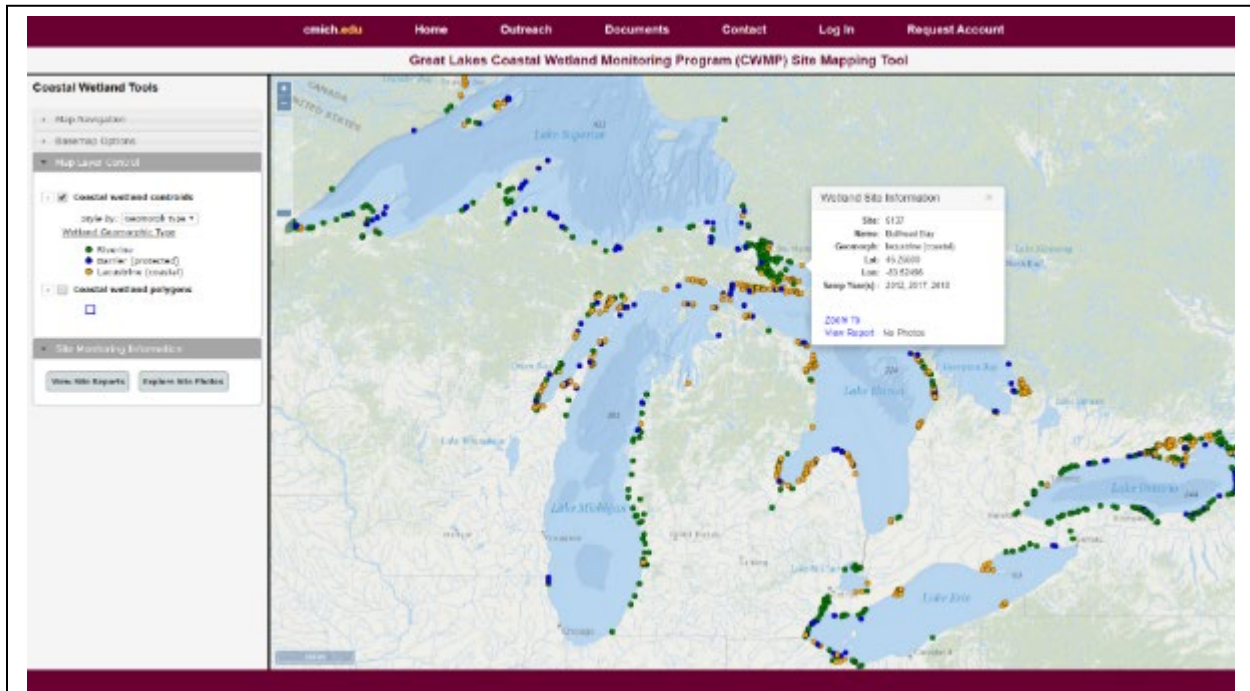


Figure 12. Coastal Wetland Mapping Tool – Public Version (geomorphic type view).

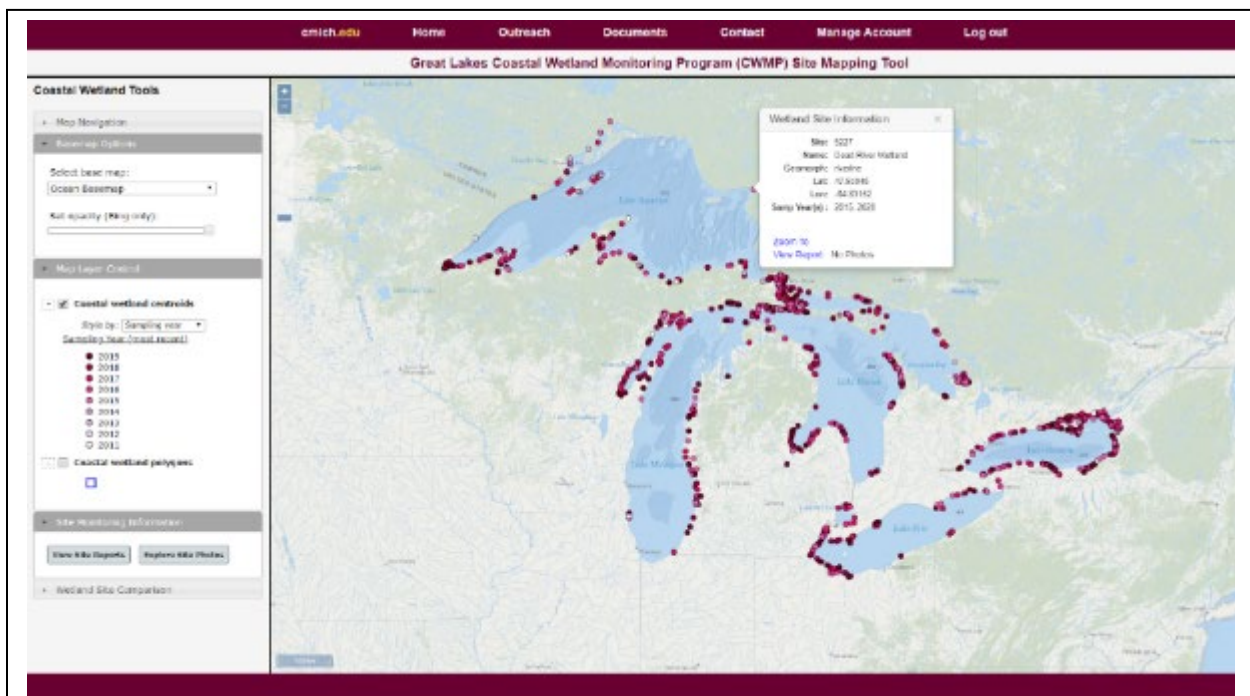


Figure 13. Coastal Wetland Mapping Tool – Public Version (sampling year view)

Wetland centroids can be symbolized based on IBI scores for a specific biological community, as well as based on geomorphic type and year sampled. For example, vegetation IBI scores calculated for individual sites can be displayed by selecting the “Vegetation IBI” option available in the “Style by:” pull-down menu (Figure 14). In addition, the actual IBI scores can be viewed by clicking on an individual wetland centroid.

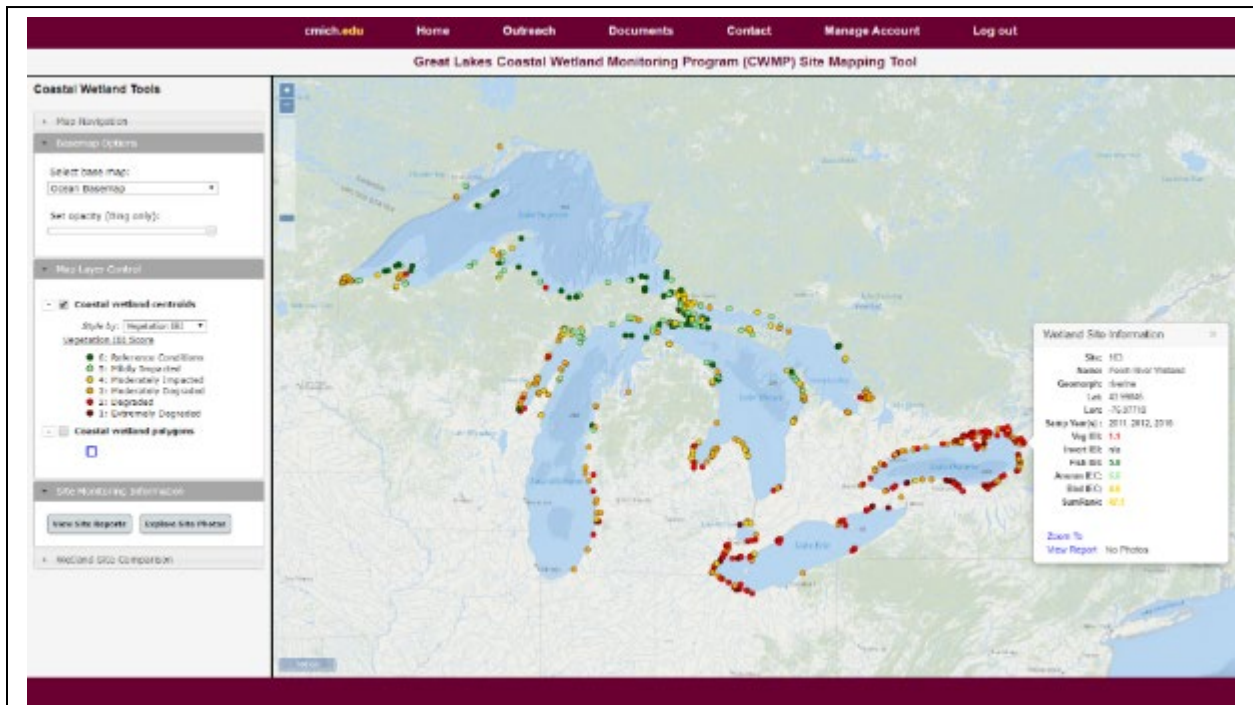


Figure 14. Coastal Wetland Mapping Tool with IBI scores displayed.

Users with “Level 2” (Agency/Manager (basic)) access to the website are provided with the same visualization options described above for the “Public” and “Level 1” access levels, but also have the capability of viewing a complete listing of species observed at individual wetland sites. Species lists can be generated by clicking on the “Species List” link provided at the bottom of the “pop-up” summary of site attributes (Figure 15), and the information can then be viewed and copied and pasted to another document, if desired.

“Level 1” and “Level 2” users may also access the following tools that are available in the site mapping tool:

- **Wetland Site Report** – a tool that provides monitoring design information, monitoring observations, and the entire matrix of condition scores on an individual site basis.

- **Wetland Site Photos** – a photo viewer that allows users to review CWMP-approved digital photos taken during site sampling events.
- **Wetland Site Comparison** – a tool that allows users to select a geographic area of interest on the map and then generate a matrix comparing characteristics and condition scores across the selected sites.

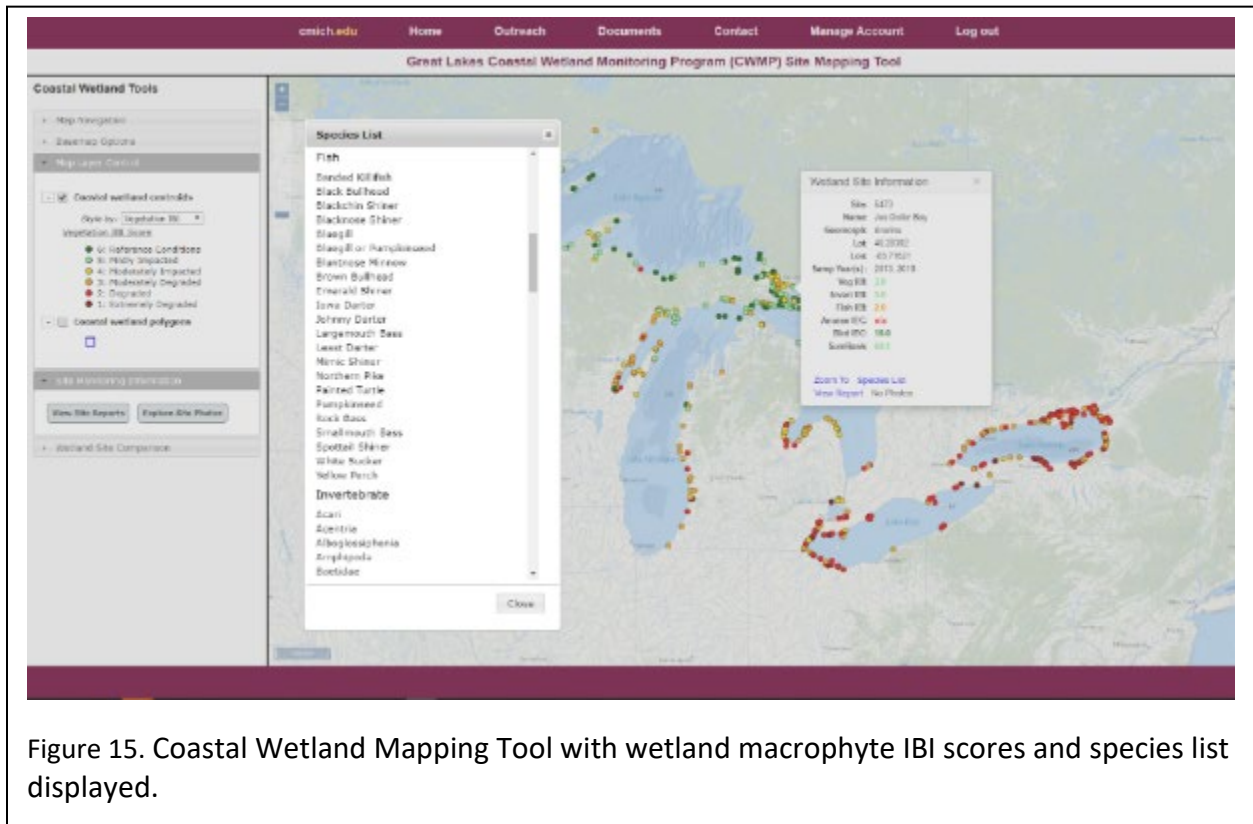


Figure 15. Coastal Wetland Mapping Tool with wetland macrophyte IBI scores and species list displayed.

OUTREACH TO MANAGERS

The website assists external users in accessing and understanding CWMP monitoring results; of particular interest to managers are site reports and photos. Michigan Department of Environment, Great Lakes and Energy (EGLE) and Central Michigan University have previously hosted workshops for wetland management professionals. These workshops focused on data collection methodology, data access, and data applications to help wetland managers better understand and use CWMP data and tools. We envision future similar workshops to ensure managers continue to make use of CWMP data.

EGLE has also been encouraging restoration practitioners to use the GLCWMP data in project planning, goal setting, and development of adaptive management plans through Michigan's interagency Voluntary Wetland Restoration (VWR) Program. There have been multiple VWR projects undergoing regulatory review by EGLE where EGLE requested that the practitioners identify if/how the GLCWMP data were used in planning or design of the project, and whether or not the project would be monitored as a benchmark site. Although there is still some uncertainty in how practitioners can or should use these data in project planning, there is momentum in the VWR Program to increase awareness and application of these results..

In 2019, a one-hour documentary on the GLCWMP was released on PBS. The documentary aired across the U.S. "Linking Land and Lakes: Protecting the Great Lakes' Coastal Wetlands" chronicled the work of all 15 universities and government agencies documenting our scientists collecting data to help restore and protect these ecosystems. The WCMU production team traveled the entire Great Lakes basin over 18 months covering 5,000 miles in Michigan, Wisconsin, Indiana, Illinois, New York, Ohio, Pennsylvania, and Ontario, Canada. More than 40 coastal wetland scientists shared their expertise in the documentary. This documentary aired on 275 PBS stations in 46 states, the Virgin Islands, and Washington D.C. beginning in July of 2020. It can be viewed at <https://www.pbs.org/video/linking-land-and-lakes-hdo22u/>.

TEAM REPORTS

WESTERN BASIN BIRD/ANURAN TEAM AT THE NATURAL RESOURCES RESEARCH INSTITUTE, UNIVERSITY OF MINNESOTA

Team Members

Dr. Annie Bracey (PI, team lead – Bird & Anuran Surveys) –permanent/year-round (returning)
Dr. Alexis Grinde (Avian Ecology Lab Director) – permanent/year-round (returning)
Josh Bednar (field tech – Anuran & Bird Surveys) – permanent/year-round (returning)
Amanda Tveite (field tech – Anuran & Bird Surveys) – Graduate Student (returning)
Isabel Dunn (field tech – Anuran & Bird Surveys) – Graduate Student (returning)
Josh Kolasch (field tech - Anuran & Bird Surveys) - Graduate Student (returning)

Training

Training for anuran surveys was held remotely in March 2026 and for bird surveys in May 2026. During the 2026 field season, two individuals conducted the anuran and bird surveys, both of whom were graduate students that surveyed during the 2025 field season. Training involved instructing individuals on how to conduct standardized field surveys, on basic travel procedures, and on appropriate field safety measures. Individuals were trained to proficiently complete field sheets. Rules for site verification, safety issues including caution regarding insects (e.g., Lyme's disease), GPS and compass use, boat safety, working near traffic or roadways, and record keeping were also included in field training to ensure that the guidelines in the QAPP were being followed.

All individuals involved in conducting the surveys had previously taken and passed each of the following tests on 1) anuran calls, 2) bird vocalization, and 3) bird visual identification via an on-line testing system established at the University of Wisconsin, Green Bay – see <http://www.birdercertification.org/GreatLakesCoastal>. Training documents, including SOPs and QAQC measures , specifically related to sampling procedures are available on the program website – see <https://www.greatlakeswetlands.org/Sampling-protocols.vbhtml>. Training documents related to field safety were provided by NRRI and were reviewed with the PI at the time of training.

Challenges and Lessons Learned

There were no significant challenges that our team encountered this field season. Our primary challenge was site accessibility, whether sites were too far from one another to justify

surveying (e.g., a single site >2+ hrs drive from all other sites) or island sites where access is challenging or restricted to daylight use (e.g. ferry service).

Site Visit List

In 2026, 26 wetlands, located in the U.S. were selected to be surveyed for birds and anurans by the western basin bird and anuran team. Although all of these sites had been surveyed at least once during the 2011-2025 project period by at least one taxonomic group, we still needed to determine accessibility and site conditions, which may have changed during this time (e.g., changes in property ownership or water levels). A total of five wetlands were marked as 'could not access site' for anurans and two of those sites could also not be accessed for birds. One wetland was listed as 'could not sample'. The majority of these situations were associated with not being able to contact land owners or due to travel safety issues or lack of roads. One wetland site was listed as a 'visit reject' because there was poor access by road and three wetland sites were listed as 'web rejects' as they did not meet sampling criteria or were clearly not accessible.

A total of 16 wetlands were sampled in 2026 for anurans and 18 sites were sampled for birds by the western basin bird and anuran team. These sites were located along the south shore of Lake Superior in Minnesota, Wisconsin, and in the upper peninsula of Michigan. Of these sites, four were designated as benchmark sites, many located within the St. Louis River in the Duluth-Superior Harbor. Four sites were designated as panel re-sample sites. The remaining sites surveyed were regular panel-year sites. Anuran surveys began April 25 and bird surveys began May 25, 2026. Anuran and bird sampling were both completed by July 05, 2026.

Panel Survey Results

The data collected in 2026 by the western basin bird and anuran team were entered and error checked into the online data entry system and completed in August 2026.

Anurans: In 2026, eight species of anurans were recorded throughout our study sites, with 241 individuals and 88 full choruses counted (Table 16). The average number of species detected per wetland was four, with a minimum of two and a maximum of seven. Spring peepers were the most abundant species detected in all wetlands sampled, accounting for 41% of the anuran observations and the majority of full chorus observations (Table 16). There were also large numbers of Green frog and Gray treefrog detections (Table 16). There were 14 Chorus Frog detections, which was higher than the previous two years. There were 22 Mink Frog detections which was similar to 2025.

Table 16. List of anurans recorded during 2026 surveys. The number of individuals counted and the number of full choruses observed (i.e., number of individuals cannot be estimated) are provided for each species.

Species	Number of Individuals	Number of Observations (Full Chorus)
American toad (<i>Anaxyrus americanus</i>)	14	14
Blanchard's cricket frog (<i>Acris blanchardi</i>)	0	0
Bullfrog (<i>Lithobates catesbeianus</i>)	0	0
Chorus frog (western/ boreal – <i>Pseudoacris triseriata</i> & <i>P. maculatas</i>)	2	0
Green frog (<i>Lithobates clamitans</i>)	100	4
Gray treefrog (<i>Hyla versicolor</i>)	17	0
Mink frog (<i>Lithobates septentrionalis</i>)	5	0
Northern leopard frog (<i>Lithobates pipiens</i>)	10	0
Spring peeper (<i>Pseudoacris crucifer</i>)	67	69
Wood frog (<i>Lithobates sylvatica</i>)	26	1
Total	241	88

Birds: Birds were surveyed twice at each site between May 25 and July 05, 2026 (Figure 16). A total of 92 identifiable species observations and 2057 individual birds were recorded. The five most abundant species observed accounted for approximately 43% of all observations. These species, in order of decreasing abundance, were Red-winged Blackbird, Canada Goose, Ring-billed Gull, Common Yellowthroat, and Song Sparrow.

Interesting bird observations: In the Western Great Lakes region there have been many observations of birds of special concern in the vicinity of the wetlands or using the wetland complexes in 2026 (Table 17). There were relatively low numbers of detections for both Virginia and Sora rails which seem to be consistent with lower observations in recent years.



Figure 16. NRRI field crew conducting appoint-count survey in the St. Louis River Estuary, Duluth, MN.

Table 17. List of birds of special interest recorded during 2025 surveys. The number of individuals observed is listed for each species.

Species	Number of Individuals
Sandhill Crane (<i>Grus canadensis</i>)	4
Pied-billed Grebe (<i>Podilymbus podiceps</i>)	2
American Bittern (<i>Botaurus lentiginosus</i>)	5
Virginia Rail (<i>Rallus limicola</i>)	0
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	8
Common Loon (<i>Gavia immer</i>)	2
Sora Rail (<i>Porzana carolina</i>)	7
Great Blue Heron (<i>Ardea herodias</i>)	4
Green Heron (<i>Butorides virescens</i>)	1
Belted Kingfisher (<i>Megaceryle alcyon</i>)	3

Wetland Condition Observations and Results

The western basin bird and anuran team does not have any noteworthy observations to report regarding wetland condition of sites sampled in 2026.

Data Processing

All bird, anuran, and point-count level vegetation surveys have been electronically scanned and digitally stored as .pdfs at NRRI. Data entry and QAQC were completed by the end of August 2026. All of the GPS coordinates associated with 2026 field sampling have been uploaded to the CWMP database. The physical data sheets from the point-count level vegetation surveys will be mailed to Doug Tozer at Bird Studies Canada for processing by November 2026.

Mid-season QC Check Findings

In-person mid-season QC checks were conducted to ensure protocols were being followed. The surveyors also reported to the PI daily during fieldwork. Surveyors also took pictures of sites where habitat was suspected to be inappropriate. These photos were then sent to the PI to verify whether the sites in question met sampling criteria or not. Surveyors also described general field conditions and any issues associated with accessing sites. Data sheets were scanned and sent to the PI periodically throughout the field season to identify any potential issues with an individual's data collection methods. Surveyors were able to effectively communicate with the PI throughout the field season and therefore there were no QC issues that arose or needed to be addressed.

Additional Funding and Projects

Nothing to report

Other Collaboration Activities

Nothing to report

Other Data Requests

No data requests have occurred since the previous semi-annual report.

Related Student Research

Isabel Dunn, a graduate student in the Water Resources Program at U of MN-Duluth analyzed bird and vegetation data collected by the coastal wetland monitoring program for her master's thesis. She successfully defended her thesis in August 2026. Her thesis focused on wetland bird species functional traits, community composition, and associated habitat characteristics as it related to remediation and restoration activities in AOC sites across the Great Lakes region. A resulting manuscript is currently being drafted and will be shared with CWMP bird and vegetation PIs.

WESTERN BASIN FISH, INVERTEBRATE AND WATER QUALITY TEAM AT THE NATURAL RESOURCES RESEARCH INSTITUTE, UNIVERSITY OF MINNESOTA

Team Members

- Dr. Valerie Brady, PI, aquatic invertebrate ecologist, QC manager (since 2011)
- Dr. Chris Filstrup, co-PI, limnologist (since 2019)
- Kristi Nixon, GIS specialist (since 2016)
- Kari Pierce, crew leader, fish, invertebrate, and water quality sampling (since 2014)
- Bob Hell, aquatic invertebrate taxonomist (since 2011)
- Holly Wellard Kelly, aquatic invertebrate taxonomist (since 2015)
- Dr. Amber Ulseth, aquatic ecosystem ecologist (since 2024)
- Brennan Pederson, crew leader, fish, invertebrate and water quality sampling (since 2023)
- Shawnee McMillan, aquatic chemist (since 2024)
- Five new summer field techs, two returning (3 years exp.), and one new undergrad student

Training

The NRRI fish/invert/WQ team held in-person safety and classroom project training from June 1-5, 2026. All participants received CPR/First Aid course completion certificates valid for 2 years. Classroom training was attended by all NRRI fish/invert/wq staff (14 participants). Classroom training material was presented by permanent staff who have been working on the Coastal Wetland Monitoring Program for >5 years. Topics covered were: field safety from environmental hazards, safe boating practices, approved scientific collection permits and responsibilities of the field teams to give prior notification to local fisheries managers and conservation officers before collecting fish from a wetland, Coastal Wetland Monitoring Program overview and introduction to Standard Operating Procedures and datasheets, GPS use and annual QC check, uploading GPS files to the program website, fish collection methods and identification, proper euthanasia and preservation methods for retained fish, water quality data and sample collection, post-collection processing of water samples (filtration and titration), daily calibration of water quality multiparameter instruments, invertebrate collection and field picking of samples, and vegetation identification and habitat quadrats. Following classroom safety and method training, we provided hands-on field safety and method training for new summer technicians during their first site visit in Green Bay, WI (June 22–29, 2026). This training was led by experienced crew leaders Bob Hell and Brennan Pederson who have worked on CWMP for 3 years or more. During hands-on training the experienced NRRI crew leaders guided new summer technicians and one student (n=6) on fish identification (with real fish

rather than pictures), selection of vegetation sampling zones, vegetation identification, setting and pulling fyke nets, and proper invertebrate collection techniques.

Challenges and Lessons Learned

The 2026 field season was, for the most part, a normal season. We only dropped three sites because they did not meet project protocols due to lack of vegetation. Most sites appear to be recovering from past low water years, although some look different than they have historically because vegetation zones have changed in size or presence.

Lessons learned this year include updating our plan for decontamination of gear between watersheds because the availability of self-service car washes is declining. For example, some self-service car washes used in the past no longer exist, so in the future we will map out existing locations prior to the trip rather than relying on past car washes. Next year, we will also update our water quality supplies to include a manual thermometer. This will serve as a field backup in case a sonde unit breaks or is forgotten, allowing us to finish analyzing water quality parameters back at the lab using other instrumentation.

Site Visit List

The NRRI fish/invert/wq team was assigned 26 sites in 2026. We sampled 23 sites in total, because we dropped 3 sites during site visits that did not meet sampling requirements. The 26 total sites consisted of 13 regular, 3 resample, 6 pre-sample, and 4 benchmark sites.

Panel Survey Results

Benchmark Sites:

1457 – First sampled on 7-6-2012 by NRRI team. Last visit on 6-26-2026 and sampled SAV for fish, invertebrates, and water quality, as well as Typha for invertebrates and water quality. The crew noted some evidence of higher water levels such as some terrestrial plants in the water near shore. This site is scheduled for restoration work performed by the US Army Corps of Engineers starting in 2027. Nets at this site (n=3) captured Channel Catfish, Emerald Shiner, Banded Killifish, Yellow Perch, Spottail Shiner, White Sucker, Logperch, YOY Gar species, Brown Bullhead, and Spottail Shiner. Invasive fish captured were YOY Common Carp (n=9), Alewife (n=7), Common Carp (n=2), and Round Goby (n=1).

1077 – First sampled on 8-5-2011 by NRRI team. Last visit on 8-10-2026 and sampled SAV and Lily for fish, invertebrates, and water quality. The crew noted this site is used heavily for recreation such as fishing and motor boating, and there were several duck hunting blinds throughout the site. Nets at this site (n=6) captured Black Bullhead, Pumpkinseed, Black

Crappie, YOY Lepomis species, Yellow Perch, Spottail Shiner, Emerald Shiner, Johnny Darter, Silver Redhorse, YOY Bullhead species, White Bass, and Rock Bass. Invasive fish captured were Tubenose Goby (n=7), Eurasian Ruffe (n=2), and Round Goby (n=10).

1071 – First sampled on 7-23-2014 by NRRI team. Last visit on 8-7-2026 and sampled SAV for fish, invertebrates, and water quality. The crew noted there was carp spawning evidence at this site. Nets at this site (n=3) captured Black Bullhead, Blacknose Shiner, YOY Lepomis species, Emerald Shiner, White Sucker, Northern Pike, Golden Shiner, Brown Bullhead, Yellow Perch, and Johnny Darter. No invasive fish were captured at this site.

7076 – First sampled on 8-9-2021 by NRRI team. Last visit on 8-24-2026 and sampled Lily for fish, invertebrates, and water quality. This site recently had restoration efforts conducted and a new large box culvert was added. The new culvert allows for more water exchange between the site and the main lake. This improvement in water exchange has also increased the average depth of the site. Nets at this site (n=3) captured Largemouth Bass, Black Crappie, Bluegill, Pumpkinseed, Yellow Perch, YOY Lepomis species, Emerald Shiner, and Tadpole Madtom. Invasive fish captured were Tubenose Goby (n=3). There were 8 Painted Turtles as bycatch in fyke nets.

Regular Panel Sites:

1079 – First sampled on 8-6-2015 by NRRI team. We re-sampled this site this year with the last visit on 8-12-2026 and sampled Lily for fish, invertebrates, and water quality, as well as Typha for invertebrates and water quality. Nets at this site (n=3) captured YOY Lepomis species, Golden Shiner, YOY Bullhead species, Rock Bass, Pumpkinseed, Black Crappie, Emerald Shiner, Yellow Perch, Bluegill, Walleye, Northern Pike, and Smallmouth Bass. Invasive fish captured were Tubenose Goby (n=9). There were 8 Painted Turtles and 1 Common Snapping Turtle as bycatch in fyke nets.

1188 – First sampled on 7-31-2015 by NRRI team. We re-sampled this site this year with the last visit on 8-3-2026 and sampled SAV for invertebrates and water quality. No nets were set due to limited size of SAV patches. Fish have only been sampled at this location once in 2016 and the crew noted a majority of this site is sand beach.

1201 – First sampled on 8-22-2013 by NRRI team. We re-sampled this site this year with the last visit on 8-14-2026 and sampled SAV for fish, invertebrates and water quality, as well as Typha for invertebrates and water quality. Nets at this site (n=3) captured Rock Bass, Pumpkinseed, YOY Lepomis species, Black Crappie, Yellow Perch, Tadpole Madtom, Largemouth Bass, and

Johnny Darter. Invasive fish captured were Tubenose Goby (n=11). There was 1 Painted Turtle as bycatch in fyke nets.

1441 – First sampled on 7-1-2014 by NRRI team. Last visit on 6-23-2026 and sampled SAV for fish, invertebrates, and water quality, as well as Typha for invertebrates and water quality. The crew noted there were active and abundant Common Carp at this site. Nets at this site (n=3) captured Largemouth Bass, Golden Shiner, Creek Chub, Yellow Perch, White Sucker, Fathead Minnow, Green Sunfish, Banded Killifish, Brook Stickleback, Black Bullhead, Bluegill, Pumpkinseed, Spottail Shiner, Emerald Shiner, YOY Gar species (Figure 17), and Freshwater Drum. Invasive fish captured were YOY Common Carp (n=288) and Threespine Stickleback (n=1). There was 1 Painted Turtle as bycatch in fyke nets.



Figure 17. A young-of-year hybrid Gar species captured by the NRRI team near Green Bay, WI (site 1441). Though not necessarily rare, the team normally captures adults rather than YOY. Almost all the Gar species near Green Bay, WI and the Fox River basin are hybrids of Longnose Gar (*Lepisosteus osseus*) and Shortnose Gar (*Lepisosteus platostomus*). Because we rarely catch Gar of these two species, we believe the hybrids have become their own self-sustaining population.

1519 – First sampled on 7-15-2011 by NRRI team. Last visit on 7-7-2026 and sampled Outer Schoen and Phragmites for fish, invertebrates, and water quality. Nets at this site (n=6) captured Rock Bass, Pumpkinseed, YOY Lepomis species, Blackchin Shiner, Bluegill, Blacknose Shiner, Banded Killifish, Yellow Perch, Smallmouth Bass, YOY Gar species, Golden Shiner, Common Shiner, Northern Pike, and Bowfin. Invasive fish captured were Round Goby (n=1). There were 2 Common Snapping Turtles as bycatch in fyke nets.

1497 – First sampled on 8-2-2011 by CMU team. Last visit on 7-9-2026 by NRRI team and sampled Wild Rice, Lily, and Typha for invertebrates and water quality. The crew did not set any

fyke nets at this site. The site was covered with Wild Rice throughout all the vegetation zones and our team protocol for Wild Rice is to not set fyke nets because they can be destructive to the vegetation.

1041 – First sampled on 7-24-2011 by NRRI team. Last visit on 8-4-2026 and sampled Typha and SAV for invertebrates and water quality. The crew did not set any fyke nets at this site because the river channel was very narrow and setting nets would have blocked the channel completely. Per the project protocol we are not to block any boat channels with our nets. This site is a very popular canoeing and kayaking spot as well.

970 – This site has never been sampled by the NRRI fish/bug team in the past but has been sampled by the NRRI bird/amphibian team. Last visit on 7-22-2026. The crew did not sample this site this year. Crew leader Brennan Pederson noted that this site was hard to access as the only road leading into the site was a private road and the opening to the lake was too small for a boat. Upon walking into the site from the beach, Pederson noted that the site was mostly all sand and there was no vegetation that met sampling protocols.

1426 – This site has never been sampled by the NRRI fish/bug team in the past but has been sampled by the UW-Green Bay bird/amphibian team. Last visit on 6-25-2026 and sampled Phragmites and Typha for fish, invertebrates, and water quality, as well as Inner Schoen for invertebrates and water quality. Nets at this site (n=6) captured Rock Bass, Northern Pike, Pumpkinseed, Largemouth Bass, Black Bullhead, Smallmouth Bass, Bowfin, Yellow Bullhead, Brown Bullhead, Yellow Perch, Banded Killifish, and Johnny Darter. Invasive fish captured were Round Goby (n=2), Threespine Stickleback (n=2), and YOY Common Carp (n=2). Invasive Crayfish captured were Rusty Crayfish (n=2). There were 9 Painted Turtles and 2 Common Snapping Turtles as bycatch in fyke nets.

1469 – First sampled on 7-1-2011 by NRRI team. Last visit on 6-27-2026 and sampled SAV for fish, invertebrates, and water quality, as well as Outer Schoen and Wild Rice for invertebrates and water quality. The crew noted there were active schools of Common Carp at this site. Nets at this site (n=3) captured Banded Killifish, Yellow Perch, Tadpole Madtom, White Sucker, Largemouth Bass, Creek Chub, Northern Pike, Common Shiner, and Spotfin Shiner. Invasive fish captured were Round Goby (n=27). There were 4 Painted Turtles as bycatch in fyke nets.

1096 – First sampled on 8-23-2011 by NRRI team. Last visit on 8-17-2026 and sampled Lily for fish, invertebrates, and water quality, as well as SAV for invertebrates and water quality. Nets at this site (n=3) captured Black Crappie, YOY Lepomis species, Common Shiner, Emerald Shiner, Yellow Bullhead, Yellow Perch, Channel Catfish, Walleye, Brown Bullhead, Pumpkinseed, White Bass, Tadpole Madtom, and Golden Shiner. Invasive fish captured were Eurasian Ruffe (n=1)

and Common Carp (n=1). There were 4 Painted Turtles and 1 Common Snapping Turtle as bycatch in fyke nets.

943 – First sampled on 7-18-2011 by NRRI team. Last visit on 7-10-2026. The crew did not sample this site this year. Crew leader Brennan Pederson noted that there was not enough water or vegetation to sample. The little water present had some lilies in it, but it was too dangerous to walk in as it was bottomless muck. This site has not been sampled since 2011 because of the small sampling area and dangerous floating bog conditions.

1745 – First sampled on 8-2-2011 by CMU team. Last visit on 7-8-2026 by NRRI team. The crew did not sample this site this year. Crew leader Brennan Pederson noted that the wetland no longer exists. The site is now a big sand flat with some cobble mixed in and no vegetation.

7033 – First sampled on 7-5-2011 by NRRI team. Last visit on 6-27-2026 and sampled Outer Schoen for fish, invertebrates, and water quality, as well as SAV for invertebrates and water quality. Nets at this site (n=3) captured Yellow Perch, White Sucker, Golden Shiner, and Banded Killifish. Low diversity in fyke nets at this site. Invasive fish captured were Round Goby (n=12). There were 2 Painted Turtles as bycatch in fyke nets.

969 – First sampled on 7-19-2011 by NRRI team. Last visit on 7-22-2026 and sampled Lily and SAV for fish, invertebrates, and water quality. The crew noted that a local said he catches Common Carp in this site while fishing. Nets at this site (n=6) captured Golden Shiner, Rock Bass, Common Shiner, Black Bullhead, Blacknose Shiner, Johnny Darter, Smallmouth Bass, Yellow Perch, White Sucker, Pumpkinseed, Creek Chub, Bluegill, Bluntnose Minnow, and Emerald Shiner. There were 3 Painted Turtles and 5 Native Crayfish as bycatch in fyke nets.

979 – First sampled on 7-21-2011 by NRRI team. Last visit on 7-25-2026 and sampled Outer Schoen for fish, invertebrates, and water quality, as well as Pontederia and SAV for invertebrates and water quality. The crew noted that the bottom substrate in a lot of the vegetation was very mucky and dangerous to walk in, so fyke nets could not be set in some of the vegetation zones. Nets at this site (n=3) captured Golden Shiner, Spottail Shiner, Rock Bass, White Sucker, Emerald Shiner, Walleye, Pumpkinseed, Yellow Perch, and Black Bullhead. Invasive fish captured were Alewife (n=19). There were 4 Painted Turtles and 1 Common Snapping Turtle as bycatch in fyke nets.

1152 – First sampled on 7-17-2011 by NRRI team. Last visit on 7-11-2026 and sampled Lily for fish, invertebrates, and water quality, as well as Typha for invertebrates and water quality. The crew noted that there was a power station just outside of this site polygon on the South side of the site. Nets at this site (n=3) captured Rock Bass, Northern Pike, Walleye, Yellow Perch,

Pumpkinseed, Largemouth Bass, Johnny Darter, White Sucker, Smallmouth Bass, and YOY Lepomis species. There were 10 Native Crayfish and 4 Painted Turtles as bycatch in fyke nets.

1698 – First sampled on 6-30-2011 by NRRI team. Last visit on 6-26-2026 and sampled Outer Schoen and Typha for fish, invertebrates, and water quality, as well as SAV for invertebrates and water quality. The crew noted that there was a sunken vehicle at this site on the Eastern side of the polygon, South of the island at the mouth of the Little Suamico River. It appeared to be very old and was mostly just the frame of the vehicle. Nets at this site (n=6) captured Banded Killifish, White Perch, Spotfin Shiner, Yellow Perch, Bluntnose Minnow, White Sucker, Common Shiner, Green Sunfish, Bluegill, Brown Bullhead, Spottail Shiner, Golden Shiner, Smallmouth Bass, Emerald Shiner, Pumpkinseed, and Hybrid Gar species. Invasive fish captured were YOY Common Carp (n=12) and Round Goby (n=4). There were 14 Painted Turtles as bycatch in fyke nets.

972 – First sampled on 7-15-2016 by NRRI team. Last visit on 7-23-2026 and sampled a Mixed Emergent zone for invertebrates and water quality. This site is a walk-in site with no boat access, but a culvert allows for lake connection. Half of the site is on Keweenaw Bay Indian Community land and some team members from their Natural Resources Department joined our team and participated in our sampling efforts at this site.

976 – First sampled on 7-22-2011 by NRRI team. Last visit on 7-24-2026 and sampled Outer Schoen for fish, invertebrates, and water quality. Nets at this site (n=3) captured Yellow Perch, Smallmouth Bass, Rock Bass, Spottail Shiner, Emerald Shiner, Black Bullhead, and Blackchin Shiner. There were 3 Painted Turtles as bycatch in fyke nets.

1076 – First sampled on 9-20-2011 by NRRI team. Last visit on 8-5-2026 and sampled Sparganium for fish, invertebrates, and water quality. Nets at this site (n=3) captured Emerald Shiner, Black Crappie, Rock Bass, YOY Lepomis species, YOY Bullhead species, Golden Shiner, Pumpkinseed, Logperch, Black Bullhead, Spottail Shiner, Tadpole Madtom, Common Shiner, and Blacknose Shiner. Invasive fish captured were YOY Common Carp (n=2). There were 4 native crayfish as bycatch in fyke nets.

1697 – First sampled on 6-28-2011 by NRRI team. Last visit on 6-23-2026 and sampled Typha and SAV for fish, invertebrates, and water quality. Nets at this site (n=6) captured Emerald Shiner, Spottail Shiner, Banded Killifish, Yellow Perch, Hybrid Gar species, YOY Bullhead species, White Sucker, Largemouth Bass, Golden Shiner, Common Shiner, Smallmouth Bass, Freshwater Drum, Brown Bullhead, Fathead Minnow, Tadpole Madtom, Spotfin Shiner, Bowfin, Pumpkinseed, Green Sunfish, Black Crappie, and Yellow Bullhead. Invasive fish captured were

White Perch (n=2), Threespine Stickleback (n=1), YOY Common Carp (n=31), and Common Carp (n=2). There was 1 Painted Turtle as bycatch in fyke nets.

Extra Sites and Data

There were no extra data or extra sites this year.

Wetland Condition Observations and Results

This summer water levels appeared lower than normal in most of the sites visited. Water depths were often shallow and there was a visible water line on the shoreline/vegetation for most sites. The western side of Lake Michigan had a more diverse mixture of vegetation zones to sample compared to the southern shore of Lake Superior. Low water levels forced us to be more selective about choosing locations to set nets and may have contributed to a higher number of zones where it was only possible to collect invertebrates. Despite seemingly lower than normal water levels, we did not encounter as much sand accumulation as we did the previous summer in western Lake Michigan. A small number of sites in Lake Michigan were missing stands of vegetation present in the past, which is perhaps a result of consecutive drought years. Most of the sites near Green Bay and Marquette remained multiple-zone sites, but it was not uncommon for us to sample only a single zone in the Lake Superior sites this year for fish.

Data Processing

As of September 2026, the NRRI fish/invert/wq team has stored invertebrate samples from 23 sites (45 zones x 3 = 135 samples) and will start processing them in 6-8 weeks. Staff have digitized field datasheets and begun entering field data into the CWMP database.

Mid-season QC Check Findings

Primary long-time crew leaders Kari Pierce, Bob Hell, and Brennan Pederson administered mid-season QC check of fish identification with crew members. In 2026, the NRRI fish/invert/wq team surveyed sites as one 3 to 4-person crew or two 4-person crews. New crew members were always working directly with experienced crew members, so the training and evaluation of new crew members was continuous. No issues were noted.

Audit and QC Report and Findings

None. QC of invertebrate samples between team labs has not occurred yet.

Additional Funding and Projects

None.

Other Collaboration Activities

PI Brady continues to collaborate with MPCA, MNDNR, and WDNR on restoration planning and evaluation for sites in the St. Louis River Estuary.

This year we collaborated with the Keweenaw Bay Indian Community to sample site 972. Two wetland researchers from their Natural Resources Department joined our crew to learn more about our sampling efforts and techniques.

John Bauman from the Michigan DNR asked our team if we captured any Banded Killifish in Lake Michigan. He wants to confirm if they are the Eastern or Western subspecies of Banded Killifish because the Eastern Banded Killifish is expanding westward into the Western Banded subspecies' native range. Our team captured some Banded Killifish and confirmed they were the Western Banded Killifish (Figure 18), native to the area. John Bauman was very appreciative of our team following up with his request and was happy to hear they were Western Banded Killifish.



Figure 18. Example of the Western Banded Killifish subspecies (*Fundulus diaphanus menona*) captured by the NRR team near Garden Bay, MI (site 1519) which are native to Lake Michigan. The Eastern Banded Killifish (*Fundulus diaphanus diaphanus*), which are native to Lake Erie and Ontario, have more vertical bands (8-10 in front of the dorsal fin, 15 total) opposed to the Western Banded Killifish (6-7 bands in front of the dorsal fin, 12-14 total).

Other Data Requests

None.

Related Student Research

None.

WESTERN BASIN VEGETATION TEAM AT THE NATURAL RESOURCES RESEARCH INSTITUTE, UNIVERSITY OF MINNESOTA DULUTH WITH BIOPHILIA CONSULTING

Team Members

- Dr. Valerie Brady, co-PI (since 2011)
- Dr. Ryne Rutherford, co-crew leader, botanist (since 2014)
- August Camp, botanist (since 2023)

Training

Long-time crew-leader Rutherford, Aquatic botanist and owner of Biophilia Consulting, took on surveying all the sites in the western basin team and was assisted by botanist August Camp in these efforts. Rutherford and Camp surveyed all sites together. Rutherford provided training to Camp consistent with the project SOP. In all field work, Rutherford and Camp were paired to ensure sampling protocols were followed correctly and to assist identifying vegetation to species level.

Challenges and Lessons Learned

The field season was routine this past year, with water levels about average allowing sites to be easily accessible and no problems encountered during field surveys.

Site Visit List

The Western Basin vegetation team visited 26 sites in 2026. All assigned sites were surveyed to help document vegetation community responses to changing water levels.

Panel Survey Results

972: Pequaming. Nice peatland site on a Tombolo. Some extensive areas of pools made crossing a challenge. The lovely dragon's mouth orchid (*Arethusa bulbosa*, Figure 19) is abundant.



Figure 19. Dragon's mouth orchid (*Arethusa bulbosa*) at Lightfoot Bay, site 970.

976 and 979: No specific comments. Nice healthy-looking wetlands, similar to previous years.

969: Huron River mouth. Small wetland patches. Similar to previous years. Wild rice recorded.

970: Lightfoot Bay (Figure 20). Peatland site with high floristic quality. Dragon's mouth orchid and *Carex michauxiana* noted, but not found in plots. Site all private, but access was not an issue. Landowners were welcoming.

1745: Ogontz. This site was entirely on private land.

Access was granted from landowners on site, but this site should probably be dropped in the future since it's mostly above the high-water mark, private and directly adjacent to yards and houses. Good species diversity in the wet meadow zone.

1519: Garden Bay. Good access from public boat launch. Steep gradient down into the bay, wetlands are small and not well developed, except for the far north part.



Figure 20. Lightfoot Bay, site 970, peatland with high floristic quality.

1497: Whitefish River. This wetland has recovered well from high water and it now contains very extensive wild rice beds. Some transects were adjusted since this wetland has changed dramatically since the early years of surveys.

943: Powell Pt. Best access from the Grand Island ferry parking lot. This site is entirely private and without water access. I met with the landowner and chatted for a long time. He is ok with surveys being conducted here, but due to the access issue, this site should be considered for removal from the project. All zones were wet meadows inland from the tree line, so its inclusion is questionable. Diversity was low.

1152: Dead River. Low diversity, good access. Similar to previous years.

7033: Oconto Marsh. This site has recovered a lot since the high-water years. First site where frogbit was discovered and it continues to persist in low abundance.

1469: Peshtigo. Frogbit has become a dominant species here in the flooded cattail beds. Wild rice has greatly increased in abundance.

1698: Little Suamico. Exceptionally diverse site, all zones were well-developed. Several non-native invasive plants were present: European frogbit, Eurasian water milfoil and curly pondweed. *Phragmites* has increased since previous surveys.

1697: Suamico. Frogbit found in low abundance

1497: Longtail Point. Accessed by a long paddle. Very little wetland present. This is a barrier island that has shifted by many 10s of meters from the initial surveys and is mostly beach with scattered ruderal species and a line of *Phragmites* along the shoreline. Evidence of a recent burn and spray treatment for *Phragmites*.

1426: Sawyer Harbor. Nearby boat launch access. Well-developed submergent zones.

1077: Allouez Bay. Well-developed wetland, no submergent zones. Purple loosestrife common.

1079: Hog Island. Well-developed zones, low overall diversity

7076: Perch Lake. High-diversity site. Recent restoration. Very far inland up the St. Louis River and basically a small lake, but the seiche still affects this part of the river.

1096: Pokegama. Nice overall site. Moderate diversity. Extensive wild rice beds.

1201: Clough Island. Small wetland patches with mostly submergent plants. Some wild rice.

1071: Cranberry River. Accessed by canoe through small beaver channels. Nice submergent and wet meadow zones.

1076: Poplar River. Canoe access on nearby bridge. All private. Landowners at the river mouth were very hostile and harassed us to leave during our paddle survey. Small wetland with no notable invasives.

1188: Pike. Tricky access at Bayfield Marina. Purple loosestrife increased in abundance from last year.

1041: Sioux River. Healthy wetland with good floristic quality.

Extra Sites and Data

N/A

Wetland Condition Observations and Results

The 2026 coastal wetland surveys were conducted at a time of near-average water levels on Lakes Michigan and Superior, and the vegetation has continued to recover since the high-water period of 2014-2020. The recovery was most apparent on Lake Michigan where the wet meadow zones are now mostly dominated by perennial grasses and sedges and contain fewer ruderal annuals than a few years ago.

Northern wild rice (*Zizania palustris*) has increased in abundance at several sites, mostly on Lake Michigan.

The continued spread of the invasive European frogbit was very notable in the Green Bay region. The first western Great Lakes record of this species was found during our surveys in 2021 and it is now a dominant species at some sites but it has not yet invaded other sites. The continued spread of this species in the region is nearly certain since much uninvaded suitable habitat occurs.

Data Processing

All vegetation data have been entered into the CWM database. QC checks were completed by Ryne Rutherford in Fall 2026.

Mid-season QC Check Findings

Nothing to report.

Audit and QC Report and Findings

Nothing to report.

Additional Funding and Projects

None.

Other Collaboration Activities

None.

Other Data Requests

N/A

Related Student Research

N/A

US CENTRAL BASIN BIRD & ANURAN TEAM AT THE COFRIN CENTER FOR BIODIVERSITY, UNIVERSITY OF WISCONSIN-GREEN BAY

Team Members

- Erin Giese, PI, bird/anuran ecologist (since 2011)
- Dr. Robert Howe, project advisor, bird/anuran ecologist, retired (since 2011)
- Dhanamalee Bandara, statistical analyst, mathematician (since 2023)
- Paolo Segre, statistical analyst, bird ecologist (since 2026)
- Four part-time summer field techs (2 since 2025, 2 since 2026)
- One part-time summer motorized boat operator (since 2026)
- One part-time student anuran data analyst (since 2026)

Training

Between February and May 2026, two part-time crew members attended approximately 12–15 trainings conducted at UW-Green Bay either in person or online to practice bird identification. During May 2026, PI Erin Giese and field crew leaders hosted five outdoor training sessions focused on bird identification, proper data sheet completion, and review of the bird SOP. One of our field technicians passed the online anuran and bird identification tests and became certified to conduct both bird and anuran surveys for this project. One field technician passed the online bird identification tests and was certified to conduct bird surveys. Our other two technicians were either already certified last year or served as an assistant this year.

Challenges and Lessons Learned

Since this project's inception in 2011, 2026 is the first year that our team did not survey sites located in the eastern Upper Peninsula of Michigan as we gained a new PI, Dustin Brewer at Lake Superior State University. Because of this, we sampled far fewer sites overall, which worked out well for us, and we learned how to manage the field season across our other projects.

We encountered a few access challenges:

- We received an approved permit to sample at site 1373 but never received permission from the site superintendent to sample. Illinois State Parks have always been challenging to get access approval over the last 16 years of this project. We had planned to survey birds only at this site, due to limited funding and capacity, however, we never received permission.
- We have sampled site 1497 off and on over the last 16 years of this project. However, 2026 is the first year that we could not survey AB1497.5 due to a change in ownership of the hotel on site. AB1497.5 was the only point of the five points here that we could previously survey anurans; however, moving forward we are no longer allowed to access this point at all. We were able to access the remaining points via kayaking for birds.

Site Visit List

Our team was assigned 21 total wetland sites: 1 in Illinois, 11 in Wisconsin, and 9 in Michigan. Of our 21 assigned sites, there were 4 pre-sample ("P") sites, 0 re-sample ("R") sites, and 1 benchmark ("B") site. We surveyed 13 sites, 6 sites were assigned as "too many," and we dropped remaining ones that were not accessible (e.g., private property).

Panel Survey Results

Our first anuran surveys of the 2026 season took place on April 16, 2026 at sites 1441, 1697, and 1698 Green Bay and Suamico, Wisconsin. Our last surveys occurred in northern Door County, Wisconsin on July 6, 2026 at sites 1426, 1678, and 1681. Cumulatively across all sites and samples, we recorded seven anuran species: American toad, spring peeper, gray treefrog, green frog, northern leopard frog, wood frog, and bullfrog, which are each relatively common and expected species in Great Lakes coastal wetlands. We did not detect any uncommon, unusual, or listed anuran species, and we did not detect chorus frog, which was last recorded by our team in 2021. At 2 of our 72 total anuran point count surveys (72 = 24 point count locations × 3 rounds), specifically site 1681, we did not detect any anurans calling.

Our first bird surveys of the 2026 season took place on May 28, 2026 at sites 1441 and 1698 in Green Bay and Suamico, WI. Our last surveys occurred in the eastern Upper Peninsula of Michigan on July 7, 2026 at site 1457. Cumulatively across all sites and samples, we recorded 96 bird species, including many target, marsh-obligate bird species: rails (Virginia Rail and Sora), Common Gallinule, bitterns (American and Least Bitterns), wrens (Marsh and Sedge), Pied-billed Grebe, Forster's Tern, Swamp Sparrow, Yellow-headed Blackbird, Blue-winged Teal, and Sandhill Crane.

Listed Bird Species:

- American Bittern: Imperiled–Vulnerable in Wisconsin (S2S3B) during breeding
 - Sites 1441, 1469
- Caspian Tern: Endangered in the state of Wisconsin, threatened in the state of Michigan
 - Sites 1457, 1497, 1469, 1681
- Common Gallinule: Threatened in the state of Michigan
 - Site 1697
- Common Loon: Threatened in the state of Michigan
 - Sites 1519, 7033
- Common Tern: U.S. Species of Concern, endangered in the state of Wisconsin, threatened in the state of Michigan
 - Sites 1457, 1697, 1732, 1745
- Forster's Tern: Endangered in the state of Wisconsin, threatened in the state of Michigan
 - Sites 1457, 1697
- Great Egret: Threatened in the state of Wisconsin
 - Sites 1457, 1469, 1497, 1519, 1697, 1732
- Least Bittern: Imperiled–Vulnerable in Wisconsin (S2S3B) during breeding, threatened in the state of Michigan
 - Site 1698
- Purple Martin: Imperiled–Vulnerable in Wisconsin (S2S3B) during breeding
 - Sites 1441, 1457, 1469, 1697, 1698, 7033
- Yellow-headed Blackbird: Critically Imperiled–Imperiled in Wisconsin (S1S2B) during breeding
 - Sites 1697, 1698

Invasive Bird Species:

- European Starling: Sites 1426, 1441, 1457, 1469, 1497, 1698
- House Sparrow: Site 1697,
- Mute Swan: Site 1497

Extra Sites and Data

Like we have done for the last several years, we collected local habitat variables at every point count location following methods outlined by Birds Canada. These data are not entered into the online CWMP DMS. Instead, hard copies are mailed to Dr. Doug Tozer with Birds Canada who then scans the data forms and conducts OCR so they may be automatically and digitally entered into a database.

Wetland Condition Observations and Results

Unlike 2018–2022, our team hardly had any issues pertaining to high water levels this season since Great Lakes levels have been dropping over the last few years. No wetland points that our team sampled was described as “drowned” (i.e., did not have any emergent plants within 100 m). In terms of wetland quality, sites 1469 and 1698 produced high quality bird species, such as American Bittern, Least Bittern, Virginia Rail, Sora, Pied-billed Grebe, and Common Gallinule. These sites contained native sedges, grasses, rushes, bulrushes and cattails and reduced invasive plants.

Data Processing

Summer anuran and bird field technicians have completed double data entry for all 2026 anuran and bird point counts and conducted QA/QC such that all double entries match.

Mid-season QC Check Findings

We were fortunate to have two returning field crew members, who helped with project continuity and expertise: Danny Erickson and Morley Remitz, our Field Crew Leaders and bird/anuran experts. Giese also regularly checked bird and anuran observations reported by all team members and addressed any issues as needed. However, because two of our team’s bird technicians were new to marsh bird surveys, Giese spent >40 hours training them on bird visual and auditory identification both online and in the field. Both Giese and Erickson accompanied our new bird experts, while Erickson and Remitz accompanied our new anuran expert for multiple surveys to ensure data were collected correctly and accurately.

Audit and QC Report and Findings

We have completed 2016-2024 QC audit work in the DVI and are working on remaining issues from 2012-2015. We will be addressing these this winter as well as working through any issues found with 2025 data.

Additional Funding and Projects

Nothing to report.

Other Collaboration Activities

Nothing to report.

Other Data Requests

Nothing to report.

Related Student Research

Former UW-Green Bay graduate student Whitney Tank continues to work with Erin Giese and Dr. Dhanamalee Bandara on developing statistical models of habitat associations with marsh obligate breeding bird species, using CWMP bird data and local habitat data collected for this project. They recently completed their first draft of a manuscript for publication in *Ecosphere*. It is currently being reviewed by multiple co-authors, including many CWMP PIs, after which they will submit to *Ecosphere*.

Since this fall, current UW-Green Bay undergraduate student Kyle Rychlik has been working with Dr. Dhanamalee Bandara and Erin Giese on repeating the same habitat association models as described above for birds but this time with anurans. Kyle is just getting started with his project, though ultimately, we aim to submit the results as a peer-reviewed scientific manuscript with CWMP PIs as co-authors.

US CENTRAL BASIN BIRD AND ANURAN TEAM AT LAKE SUPERIOR STATE UNIVERSITY

Team Members

- Dr. Dustin Brewer, PI (new 2026)
- Sam Rimatzki, crew lead (since 2025)
- Nathaniel Kilgore, field assistant (new 2026)

Training

The annual training to ensure that LSSU's bird/Anuran team were competent in survey protocols and QAPP standards occurred in April at Lake Superior State University under the supervision of the team PI Brewer. This training included trips to local wetlands to practice bird/Anuran identification. S. Rimatzki had previously obtained the bird and Anuran

identification certification. Incoming field technician, N. Kilgore, was also trained in data recording, speaker broadcasting, and the functions of handheld GPS units prior to data collection and obtained bird and Anuran identification certification during the summer. Additionally in April, PI Brewer and S. Rimatzki met with E. Eberly, from GVSU, to coordinate efforts in the Central Basin and to practice surveys in the field.

Site Visit List

The LSSU bird/Anuran team evaluated the feasibility of 53 sites in the eastern upper peninsula of Michigan, along the eastern shore of Lake Superior and northern shore of Lake Huron in Ontario, and along the northern tip of the lower peninsula of Michigan. Of these, three sites were re-samples from last year's list (5234, 833, 630), three sites were scheduled as benchmarks (1598, 792, 616), and two sites were scheduled as a pre-sample for next year (6050, 1592). The remaining 45 sites were on their regularly scheduled cycle. Eight sites were not sampled because they required significant water navigation to reach the site (5808, 1604, 833, 802, 786, 767, 619, 605). Eight sites were not sampled due to inability to acquire permission (5697, 5508, 5475, 5139, 1584, 917, 906, 774) and one was not sampled due to lack of nearby road/trail availability (5677). Two sites were web-rejected due to lacking herbaceous vegetation (5013, 597). Two sites were rejected after a site visit due to not meeting requirements for monitoring (5238, 867). Nine sites were not sampled due to the 'too many' line (7038, 5793, 5516, 5408, 878, 785, 832, 782, 751). Twenty-three sites have at least one point that that was sampled (6050, 5524, 5510, 5509, 5273, 5270, 5234, 5210, 5078, 1598, 1592, 1586, 816, 812, 815, 806, 792, 778, 660, 630, 616, 613, 590).

Panel Survey Results

Anurans were first sampled on 28 April 2026 and last sampled on 8 July 2026. Eight species were noted. Birds were first sampled on 26 May 2026 and last sampled on 2 July 2026. Over 100 bird species were heard.

Extra Sites and Data

N/A.

Wetland Condition Observations and Results

A King Rail was observed at site 806, along with American Bittern, Sora, and Virginia Rail throughout the season. Additionally, a Least Bittern was observed near downtown Cedarville, Michigan (site 630) on June 18th, 2026.

Data Processing

All 2026 data (species surveys, habitat assessments, GPS coordinates, audio recordings) have been double entered, backed up, and sent to respective parties.

Mid-season QC Check Findings

On June 3, 2026, PI Brewer completed the midseason QAQC check. This involved using field recordings to confirm that Sam Rimatzki was correctly identifying birds and anurans, and that Nathaniel Kilgore was correctly identifying anurans (the only taxa he surveyed). Throughout the field season, Brewer checked in about whether or not Sam and Nathaniel were sampling points with the correct conditions. They took pictures when in doubt and Brewer provided feedback. It was confirmed that Sam and Nathaniel sampled points with the correct conditions. Brewer also confirmed that data sheets had been filled out correctly and provided feedback to ensure the highest data quality possible going forward.

Audit and QC Report and Findings

All QC checks have been completed. Both the GPS points and the bird/Anuran data were confirmed to have been accurately collected/entered.

Additional Funding and Projects

N/A

Other Collaboration Activities

N/A

Other Data Requests

Reports about findings were sent to the following entities, per their request as a condition of sampling on their property:

- Garden River First Nation
 - Site 5078
 - Sent bird and habitat data
- Little Traverse Conservancy
 - Sites 815, 613, and 616
 - Sent bird, anuran, and habitat data
- Mountain View Resort LLC

- Site 816
- Sent bird and habitat data
- Fort St. Joseph National Historic Site of Canada – Parks Canada
 - Site 5270
 - Sent bird and habitat data

Related Student Research

Sam Rimatzki (LSSU) defended the proposal for his Master's thesis, which involves using and ground-truthing remote sensing data relevant to identification of secretive marsh bird and/or Anuran habitat (Figure 21).



Figure 21. Sam Rimatzki in the field for his Master's research.

US CENTRAL BASIN BIRD AND ANURAN TEAM AT GRAND VALLEY STATE UNIVERSITY

Team Members

- Dr. Jennifer Moore, PI (new 2026)
- Emily Eberly, crew leader (new 2026)
- Ava Sweeney, field assistant (new 2026)
- Ruby Johnson, field assistant (new 2026)

Training

Crew leader Emily Eberly (GVSU) met with PI Dr. Dustin Brewer (LSSU) and crew leader Sam Rimatzki (LSSU) at Houghton Lake Flats to complete a pre-season training. There, the two teams ensured consistent and proper protocols for both teams to follow throughout the season. GVSU held crew training in early April, led by Emily Eberly and PI Dr. Jen Moore, to ensure standardized bird and anuran sampling protocols, safety procedures, and QAPP standards. The training was held at Pomena Park in Fruitport, MI. We covered species identification prior to crew members taking the identification certification exams. Each crew member was trained in data recording and all tools needed to perform the surveys. Data collectors passed their species identification exams prior to the start of data collection for the respective species.

Challenges and Lessons Learned

N/A

Site Visit List

The GVSU bird/anuran team was assigned 16 sites. Of these, site 1267 was not sampleable because it required extensive water navigation and exceeded GVSU's resources. Site 554 was visit-rejected because there was no emergent vegetation or wetland area present to be sampled. Sites 515 and 1933 are panel benchmark sites, and site 1305 was a panel re-sample from 2025. The remaining 11 sites were regular panel sites and were successfully sampled for both anuran and bird surveys for the 2026 season (422, 442, 473, 485, 494, 1280, 1325, 1859, 1862, 1866, 1904).

Panel Survey Results

Sampling for anurans began on 19 April 2026 and ended on 11 June 2026. Eight anuran species were noted. Bird sampling began on 20 May 2026 and ended on 23 June 2026. 190 bird species were found at wetlands.

Extra Sites and Data

N/A

Wetland Condition Observations and Results

Water levels were lower this year than in previous years, producing lower amounts of emergent vegetation. GVSU experienced a wide range of wetland conditions, with some sites having consistent sightings of rare species or species of interest (site 1305- horned grebes present,

Virginia rails heard during anuran surveys), while other sites had consistently low numbers of rare species.

Data Processing

All 2026 data have been entered twice and undergone QC checks.

Mid-season QC Check Findings

GVSU crew leader E. Eberly joined the survey technicians on May 20-21 to QC both the bird and anuran surveys for three sites. Technicians were proficient in their site selection, data collection, and protocols.

Audit and QC Report and Findings

N/A

Additional Funding and Projects

N/A

Other Collaboration Activities

N/A

Other Data Requests

N/A

Related Student Research

N/A

US CENTRAL BASIN FISH, INVERTEBRATE AND WATER QUALITY TEAM

Team Members

The US Central Basin Fish, Invertebrate and Water Quality Team consists of PIs and members from the following universities:

Central Michigan University (CMU) crew:

- Dr. Donald G. Uzarski, PI (since 2011)
- Bridget Wheelock, Uzarski lab supervisor and crew leader (since 2018)
- Molly Gordon, lead invertebrate taxonomist (since 2011)
- Matthew Sand, lead water quality technician (since 2020), Uzarski lab supervisor (since 2023)
- Howard Mitchell, crew leader (new 2025), summer field technician (since 2024), water quality technician (since 2024), graduate student (since 2025)
- Taylor Dick, summer field technician and graduate student (since 2025)
- Jacob LeCaptain, summer field technician (new 2025), student lab technician (since 2024)
- Zoe Moore, summer field technician (since 2025) and graduate student (new 2026)

Annis Water Resources Institute, Grand Valley State University (GVSU) crew:

- Dr. Carl Ruetz III, PI (since 2011)
- Dr. Matthew Cooper, PI (2011)
- Emily Eberly, crew leader (since 2024)
- Ruby Johnson, summer technician (since 2025)
- Romi Becker, summer technician (new 2026)
- Joseph Cherechinski, summer technician (new 2026)

University of Notre Dame (UND) crew:

- Dr. Gary Lamberti, PI (since 2011)
- Dr. Daniele Miranda, PI (new 2026)
- Sarah Klepinger, crew leader, aquatic invertebrate taxonomist (since 2018)
- Caitlynn Day, technician (since 2024)
- Jessica Rabbitt (new 2026)

Lake Superior State University (LSSU) crew:

- Dr. Ashley Moerke, PI (since 2011)
- Connor Arnold, crew supervisor and leader (since 2023)
- Anthony Savoie, crew leader (since 2025)
- James Laperriere, undergraduate research technician (new 2026)
- Hunter McMahon, undergraduate research technician (new 2026)

Training

Central Michigan University hosted the Central Basin training at site 494 in Saginaw Bay on 16 and 17 June 2026, attended by GVSU, UND, and LSSU. Training typically takes place at site 515, but due to dangerous high winds blowing towards east Saginaw Bay, the teams switched the training site to 494 which was assigned to GVSU this year. The training was led by CMU crew leader Bridget Wheelock who has been part of the CWMP since 2012. The topics covered were

water quality collection, *in situ* data collection, GPS navigation, vegetation zone selection, invertebrate sampling and picking, fyke net setting/retrieval, and fish handling/identification. Teams conducted additional water quality processing training and certification on their own to familiarize themselves with their equipment.

Additional fish ID training was provided for the LSSU crew by lead technician (Arnold) and certified by LSSU PI (A. Moerke) at the Barch Center for Freshwater Research and Education using the center's preserved specimens. All three crew members identified at least 95% of fish correctly. GPS training also occurred before field season began. Initial field training was provided by LSSU PI (Moerke) and crew chief (Arnold) at Ashmun Bay where the crew went through equipment deployment and sample collection process and then reviewed lab protocols with the water quality lab manager.

Challenges and Lessons Learned

The CMU crew had to cut one week of fieldwork short because of wildfire smoke, and encountered more high wind days than in previous seasons. Checking wind direction was particularly important because of its influence on wave height. Before setting nets, the crew also checked the following day's forecast to assess whether conditions would allow a safe return to retrieve them. At site 1598, nets again captured thousands of shiners. The time required to count and identify the fish delayed retrieval of the remaining nets, leaving some in the water for slightly more than 24 hours. Underwater conditions presented additional safety challenges. At site 547, sampled for a separate thesis project, deep, soft muck caused crew members to sink rapidly and made it difficult to move or exit the water. At site 1592, abrupt changes in depth and unstable footing, including sinking when stepping on water lily rhizomes on the substrate, made the lily zone unsafe to sample in waders. This zone was excluded from sampling for safety reasons. These experiences reinforced the importance of assessing water depth and bottom stability and recognizing when conditions prevent safe sampling.

One of the main challenges faced by the GVSU crew this season was accessing sites that were too shallow to navigate by boat. Site 442, Purdy Bay wetland in Lake Huron was too shallow to launch their boat, so they drove along the coastline and asked multiple property owners to access their land to view the shoreline. They were able to hike into a sampleable part of the wetland to collect data with the help of cooperative property owners. Another challenge they faced this season was changing sample plans at the last minute because Saginaw Bay had an extremely windy season this year. They had to cancel their sampling plans for site 515 three times before they were finally able to access it on a calmer day. This forced them to cancel and rebook hotel rooms and drive from site 515 to another site across the state with very little

advanced planning. The key to successfully sampling backup sites when they could not access site 515 was always being prepared with a “plan B” and letting the hotel know in advance that their plans may change suddenly.

This past season taught the UND team a lot of lessons about the unpredictability of field work. While sampling site 1898, strong storms came through overnight and pushed the water east. Nets that were set in 30-50 cm of water were high and dry the next day and surrounded by 20-50 feet of knee-high mud. They’ve never seen an effect like it. Retrieving their nets and finishing sampling activities was extremely challenging. Now that they know storms can have such a dramatic effect on Lake Erie, they will pay closer attention to weather before choosing when to sample. At site 1373, smoke from Canadian wildfires moved south unexpectedly and enveloped them as they were arriving. They wore masks and completed sampling as quickly as possible. From now on, N-95 masks will be part of their field gear just in case. As the effects of climate change intensify, crews may encounter challenges and hazards that were hardly a concern just a few years ago.

Site 806 (Lake Nicolet West Shoreline Wetland) presented challenges for LSSU due to high volumes of freighter traffic and vegetation zones being directly adjacent to the commercial shipping channel. Fyke net resets were required for Dense and Sparse *Schoenoplectus* zones due to two or three nets not fishing. Both were able to fish correctly on the reset and fish data were collected. The SAV zone for 806 was also reset and failed to fish two consecutive days. Site 827 (West Tahquamenon Bay Wetland) sampling was split over a two-week period. Lily was sampled on July 13-14th, while Dense and Sparse *Schoenoplectus* were sampled on July 23rd-24th. This was due to unexpected weather delays from wind and unsafe air quality conditions from Canadian wildfires.

Site Visit List

The US Central Basin was assigned 46 sites (18 CMU, 10 GVSU, 11 LSSU, 7 UND), five of which were visit rejected and two which could not be accessed. Four sites were benchmarks (515, 616, 792 and 1598), four sites were re-sample sites (630, 827, 833, and 1305) and four sites were pre-sample sites (422, 442, 494 and 1592). Sites 515 and 616 were benchmarked because they represent high and low extremes, respectively, along the disturbance gradient and have long term data sets. Site 792 has an ongoing restoration project for wild rice and is the future site of research projects for Dr. Dustin Brewer. Site 1598 is close to the Line 5 oil pipeline in the Mackinac Straits and was requested as a benchmark to gather baseline data in the event of an oil spill.

CMU sampled 13 sites, could not access two sites, and visit rejected three sites. Site 660 was inaccessible due to a barrier being placed on the bridge where the site is normally accessed. CMU had planned on visiting site 597 but was unable to due to wildfire smoke, weather, and time constraints. Sites 566, 841, and 843 did not meet vegetation zone size requirements. Within the 13 sites, 26 zones were sampled for water quality and macroinvertebrates and 22 zones were sampled for fish.

GVSU was assigned 10 sites to sample for the 2026 season. We were able to sample all 10 sites for macroinvertebrate and water quality data. Three sites (442, 1267, and 1280) could not be sampled for fish because water was too shallow (442), water was too deep (1280), and the means of traveling with fish gear exceeded our resources (1267). Site 1305 was a panel re-sample site, and sites 494 and 422 are panel pre-sample sites to be resampled next year. Site 515 is a benchmark site and usually acts as our annual training site. The remaining six sites were regular panel sites.

The University of Notre Dame (UND) was assigned seven sites to access for 2026. Two sites were on Lake St. Clair (473 and 474), three sites were on Lake Erie (1898, 1904, and 1933), and two sites on Lake Michigan (1325 and 1373). Within these seven sites, nine zones were sampled for water and macroinvertebrates, and seven of those zones were also sampled for fish.

LSSU was assigned eleven sites to sample, two of which (sites 906 and 5078) were rejected for sampling due to lack of vegetation due to low water levels.

Panel Survey Results

Sampling started on 16 June 2026 and the last site was sampled on 13 August 2026. Table 18 lists non-native species found at sites and Table 19 lists reptiles and amphibians caught as bycatch in fyke nets.

Table 18. Non-native Species by Site

Site	Common Name	Taxa Name
422	Tubenose Goby	<i>Proterorhinus marmoratus</i>
	Common Carp (YOY)	<i>Cyprinus carpio</i>
466	Round Goby	<i>Neogobius melanostomus</i>
473	Round Goby	<i>Neogobius melanostomus</i>
	Tubenose Goby	<i>Proterorhinus semilunaris</i>
474	Round Goby	<i>Neogobius melanostomus</i>
485	Goldfish (YOY)	<i>Carassius auratus</i>
	Round Goby	<i>Neogobius melanostomus</i>

494	Round Goby	<i>Neogobius melanostomus</i>
	Goldfish (YOY)	<i>Carassius auratus</i>
515	Round Goby	<i>Neogobius melanostomus</i>
	Goldfish (YOY)	<i>Carassius auratus</i>
590	Alewife	<i>Alosa pseudoharengus</i>
613	Round Goby	<i>Neogobius melanostomus</i>
616	Round Goby	<i>Neogobius melanostomus</i>
778	Round Goby	<i>Neogobius melanostomus</i>
806	Threespine Stickleback	<i>Gasterosteus aculeatus</i>
1586	Round Goby	<i>Neogobius melanostomus</i>
	Tubenose Goby	<i>Proterorhinus marmoratus</i>
	Common Carp (YOY)	<i>Cyprinus carpio</i>
1598	Round Goby	<i>Neogobius melanostomus</i>
	Tubenose Goby	<i>Proterorhinus marmoratus</i>
1898	Common Carp	<i>Cyprinus carpio</i>
	Round Goby	<i>Neogobius melanostomus</i>
1904	Alewife	<i>Alosa pseudoharengus</i>
1933	Common Carp	<i>Cyprinus carpio</i>
	Alewife	<i>Alosa pseudoharengus</i>
	White Perch	<i>Morone americana</i>

Table 19. Reptile and Amphibian Species Captured in Fyke Nets

Site	Common Name	Taxa Name
422	Painted Turtle	<i>Chrysemys picta</i>
	Northern (Common) Map Turtle	<i>Graptemys geographica</i>
473	Musk Turtle	<i>Sternotherus odoratus</i>
	Common Snapping Turtle	<i>Chelydra serpentina</i>
	Common Map Turtle	<i>Graptemys geographica</i>
474	Common Map Turtle	<i>Graptemys geographica</i>
	Painted Turtle	<i>Chrysemys picta</i>
	Musk Turtle	<i>Sternotherus odoratus</i>
	Common Snapping Turtle	<i>Chelydra serpentina</i>
494	Painted Turtle	<i>Chrysemys picta</i>
	Common Snapping Turtle	<i>Chelydra serpentina</i>
515	Painted Turtle	<i>Chrysemys picta</i>
554	Common Snapping Turtle	<i>Chelydra serpentina</i>
590	Painted Turtle	<i>Chrysemys picta</i>
613	Painted Turtle	<i>Chrysemys picta</i>
616	Painted Turtle	<i>Chrysemys picta</i>
630	Painted Turtle	<i>Chrysemys picta</i>
767	Painted Turtle	<i>Chrysemys picta</i>
774	Painted Turtle	<i>Chrysemys picta</i>

778	Painted Turtle	<i>Chrysemys picta</i>
786	Painted Turtle	<i>Chrysemys picta</i>
792	Painted Turtle	<i>Chrysemys picta</i>
802	Painted Turtle	<i>Chrysemys picta</i>
816	Painted Turtle	<i>Chrysemys picta</i>
827	Painted Turtle	<i>Chrysemys picta</i>
833	Painted Turtle	<i>Chrysemys picta</i>
917	Painted Turtle	<i>Chrysemys picta</i>
1305	Musk Turtle	<i>Sternotherus odoratus</i>
	Painted Turtle	<i>Chrysemys picta</i>
	Common Snapping Turtle	<i>Chelydra serpentina</i>
1325	Common Map Turtle	<i>Graptemys geographica</i>
	Common Snapping Turtle	<i>Chelydra serpentina</i>
	Painted Turtle	<i>Chrysemys picta</i>
1598	Painted Turtle	<i>Chrysemys picta</i>
1604	Painted Turtle	<i>Chrysemys picta</i>
1898	Common Snapping Turtle	<i>Chelydra serpentina</i>
1904	Common Snapping Turtle	<i>Chelydra serpentina</i>
	Common Map Turtle	<i>Graptemys geographica</i>
	Painted Turtle	<i>Chrysemys picta</i>

Extra Sites and Data

Site 515 was benchmarked by Dr. Don Uzarski and site 616 by Dr. Dennis Albert because they represent high (515) and low (616) extremes along the disturbance gradient and have long term data sets. These data will be used for developing and improving our indices of biotic integrity and indices of environmental condition. Site 792 has an ongoing restoration project for wild rice and is the future site of research projects for and was requested by Dr. Dustin Brewer. Site 1598 is close to the Line 5 oil pipeline in the Mackinac Straits and was requested by Dr. Don Uzarski as a benchmark to gather historical data in the event of an oil spill.

Wetland Condition Observations and Results

Water levels on Lake Michigan and Lake Huron were slightly higher this year than in 2025. For the CMU team, sites 566, 841, and 843 could not be sampled because no wetland was present. Site 548 had only wet meadow and was too shallow for fish sampling. Site 660 was not sampled because the nearest boat launch was over 20 km away and access previously used by another team at a bridge on private land is now fenced off. Several sites had additional vegetation zones compared to those sampled in 2021. Site 1586, which previously had only a dense bulrush zone, had three zones this year (Dense Bulrush, *Typha*, and *Phragmites*) with extensive wetland vegetation throughout the polygon. Site 616 had a *Phragmites* zone in addition to the two

zones sampled in 2021. Site 786 also gained a zone, with *Sparganium* present alongside the previously sampled Dense Bulrush zone. At site 1604, the zone classified as *Typha* in 2021 was best classified as Mixed Emergent this year. As in recent years, site 1598 had abundant shiners, especially in the *Schoenoplectus* zones, with thousands of fish per net

Strong evidence of low water levels was visible in some wetlands GVSU sampled this year, particularly at site 1267 Hog Island Wetland #10 (Figure 22). One of GVSU's sites was inaccessible by boat due to low water levels, so GVSU crew hiked with gear on foot through private property access (site 442). Wetland sediment throughout our sites ranged from deep organic materials to gravel bottoms, influencing a wide array of sampling experiences.



Figure 22: Evidence of receded water levels at site 1267 on Hog Island in Lake Michigan on August 10, 2026, leaving behind bare rocks and sediment with little vegetation growth.

For the LSSU team, water levels were higher than previous years but two sites were still rejected due to lack of vegetation from low water levels. Zebra/Quagga mussels were observed at site 833 (Gogomain River Mouth) and site 792 (Munuscong River Delta) in the St. Marys River.

Data Processing

CMU is finished entering site, habitat, fyke, and all other *in situ* data. All but six reps of macroinvertebrate samples have been initially identified. Those six reps have been reserved for newly certified taxonomists to identify and then be QC'd by Molly Gordon as an additional quality check. Water quality analyses of CMU and LSSU filtered and raw water samples are

underway. Twenty-seven chlorophyll-*a* samples were mailed to UND on 28 September 2026 for processing and received on 29 September 2026 in good condition.

Sixteen chlorophyll-*a* samples were mailed from GVSU to the Lamberti Lab at the University of Notre Dame on 21 September 2026 for processing. Macroinvertebrate samples are actively being processed and ID'd by trained GVSU students. Fish/macroinvertebrate/water quality data entry is actively being entered and QC'd.

Macroinvertebrate identification at UND is about 30% complete. They are still awaiting chlorophyll-*a* samples from some teams, and these will likely be analyzed in December.

The LSSU team has completed field data entry from the 2026 field season and all data have been QC'd. Water samples from LSSU have been shipped to CMU and the LSSU chlorophyll-*a* samples have been shipped to Notre Dame on 1 September 2026. Macroinvertebrate ID has not been completed yet for summer 2026 samples, but identification will begin in November and be led by Silas Dunn, who has been identifying LSSU samples for the past 4 years. Dunn will also participate in the taxonomy workshop this fall.

Mid-season QC Check Findings

Bridget Wheelock provided the mid-season QC check for the CMU crew and observed sampling in accordance with the SOP at sites 767 and 778 the week of 3 August 2026 with no issues reported. She also observed and assisted with sampling the week of 2 June 2026. The crew correctly determined if sites and vegetation zones were sampleable, located sampling points, collected data and identified fish species.

Crew leader Emily Eberly was with the GVSU field crew during all stages of sampling and observed that sampling occurred in accordance with the SOP. Dr. Matthew Cooper worked with the field crew on 18 August 2026 at site 499, which was sampled using CWMP protocols but funded by a different source. This served as a QC check for 2026. Any fish specimens that could not be identified with 100% certainty were brought back to the lab at AWRI and keyed-out by Dr. Ruetz and Emily Eberly to ensure proper fish identification at all sites.

The mid-season check was conducted on 2 July 2026 by UND's PI, Gary Lamberti. He was largely satisfied with the crew's performance and made positive comments on their efficiency and fish ID skills.

PI Ashley Moerke provided the mid-season QC for LSSU and observed that sampling occurred in accordance with the SOP.

Audit and QC Report and Findings

Field data have not all been QC'd yet, but will be completed before spring of 2027. Data validation work for data from 2025 will be worked on over the winter, along with DVI work for 2012-2015 data.

Additional Funding and Projects

None.

Other Collaboration Activities

GVSU received additional funding this year from GEI and Audubon Great Lakes to contribute to a 2-year feasibility study on Wigwam Bay (site 499) to determine potential restoration and management options for a diked portion of the wetland. The 2026 data collection involved standard CWMP procedures for fish, macroinvertebrate, and water quality sampling at three zones within the dike system of Wigwam Bay, with 37 additional water samples collected throughout the wetland. Project partners also include NOAA and Michigan DNR. 2027 will be year two of the 2-year feasibility study and additional data will be collected using CWMP protocols.

Other Data Requests

None

Related Student Research

CMU graduate student Howard Mitchell is investigating how extreme rain events affect nutrient concentrations in Great Lakes coastal wetlands for his thesis research. This research will pair antecedent rainfall data with water quality measurements from the full CWMP monitoring record to compare nutrient concentrations following extreme rain events with those under non-extreme conditions. The study also includes May–September 2026 sampling at Site 515 in Saginaw Bay paired with daily rainfall records, to examine relationships between rainfall and nutrient concentrations within a single wetland throughout the field season.

CMU graduate student Taylor Dick is examining the zooplankton populations in Great Lakes coastal and riverine wetlands. This study compares zooplankton and aquatic macroinvertebrates at 10 wetlands on Lake Huron in the winter and summer to identify specific impacts of winter on these communities. Additionally, this research analyzes the relationship between aquatic vegetation type and zooplankton communities at each vegetation zone sampled during the CWMP 2026 season.

US CENTRAL BASIN VEGETATION TEAM AT CENTRAL MICHIGAN UNIVERSITY

Team Members

- Dr. Dennis Albert, PI, wetland vegetation ecologist/botanist (since 2011)
- Matthew Sand, CMU lab manager, wetland plants and water chemistry (since 2017)
- Bridget Wheelock, CMU Lab Supervisor, wetland plants/fish, macroinvertebrates, water quality (since 2019)
- Katlyn Groulx, plant crew leader (since 2023)
- Zoe Moore, crew leader, summer field technician (new 2026)
- Elaine Hamilton, CMU summer field technician (new 2026)

Training

Matthew Sand (7 years of crew leader experience) refreshed Katlyn Groulx (3 years of crew leader experience) and trained Zoe Moore (new field crew leader) as well as the two new technicians from June 8th – June 19th, 2026, in Mount Pleasant wetlands. Topics covered included identification of common Michigan coastal wetland macrophytes, proper use of GPS for recording waypoints, compass use to set transect bearings, estimation of percent cover, collection of plants for expert ID, and completion of datasheets; as well as SOP training and sampling logistics for the crew leaders.

Matthew Sand refreshed/trained Katlyn Groulx, Zoe Moore, and the two summer field technicians on *in-situ* vegetation protocols at Nayanguing Point Wildlife Area Wetland #2 (site 494) on June 17th and 18th, 2026. They also calibrated individual percent cover estimates.

On June 15th, 2026, the vegetation crews met with Dr. Dennis Albert via Webex to discuss the upcoming sample year and ask questions about macrophyte identification and sampling protocols. Following the meeting, crew members were tested on a subset of specimens covered in training PowerPoints and collected from Mount Pleasant wetlands. Crew leaders, Katlyn Groulx, Zoe Moore, Matthew Sand, and Bridget Wheelock all correctly identified at least 90% of the specimens.

Challenges and Lessons Learned

Due to water levels dropping from the previous high-water years in 2020 and 2021, the patterns of vegetation zonation continue to be in-flux within the wet meadow, emergent, and submergent vegetation zones. This made it difficult to judge the start waypoint in a few

wetlands. Some start waypoints had originally been located at small tree lines that are now standing dead (Figure 1). In these cases, the start waypoint was pushed back to a well-developed tree line. When samplers were unclear on how to treat zones, they consulted one of the more experienced crew leaders, Matthew Sand, for confirmation and added information about zonation in the notes section of the datasheets.

At some sites, crews experienced difficult or dangerous sampling conditions due to the drop in the water levels. At Singapore Area Wetland (1656), the water level decline made the creek a muddy river through which the canoe had to be dragged. The upper emergent zones were dangerous to sample due to thick, deep muck, and the meadow was inaccessible (Figure 23).

Both vegetation crews experienced sampling delays due to poor air quality from Canada wildfire smoke, similar to last field season. Sampling did not occur on July 15th and July 16th due to air quality being in the unhealthy to hazardous range. Both crews were able to continue sampling once air quality conditions had improved the following week.



Figure 23: Decreased water levels caused start waypoints to be moved back from small, dead tree lines (Crooked Island [548]).

Site Visit List

The Central Basin vegetation crews sampled 39 sites: 27 panel sites from 2026, 4 resampled panel sites from 2025, 4 benchmark sites, and 4 pre-sample panel sites from 2027. All sites sampled by the Central Basin crews were in the United States.

The benchmark site Indian Harbor Wetland (7061) was dropped from the 2026 sampling list due to time and travel costs. Wreck Point Island (566) was not sampled due to a lack of permission.

Panel Survey Results

In the US Central Basin, the first day of vegetation sampling took place on June 17th, 2026, and the last day of sampling took place on August 20th, 2026. Sampling was conducted in order from southern sites (Lake Erie and southeast Lake Michigan) to northern sites (Lake Superior) to sample vegetation when as many plant species as possible were identifiable and fertile.

Most anthropogenically disturbed sites (e.g., Woodtick Peninsula Wetland [1898], North Maumee Area Wetland [1933]) lacked the presence of wet meadow zones due to invasive *Typha* and *Phragmites* and generally had fewer species observations. One island site, Temperance Island Wetland (1604) along the northern Lake Michigan shoreline had very diverse wet meadow zones, but sparse or no emergent vegetation and almost no submergent vegetation due to wave energy.

Extra Sites and Data

Benchmark site East Saginaw Bay Coastal Wetland #5 (515) was sampled on August 30th, 2026. This site was selected as a benchmark to track long-term trends at a site that was highly degraded throughout earlier long-term sampling. The herbicidal treatment of invasive *Phragmites australis* in the 2024 field season, which was also noted as burned and mowed during the 2025 field season, proved difficult to maneuver through, and *Phragmites australis* persisted to the tree line (Figure 24). *Schoenoplectus pungens* was documented at the outer edge of the *Phragmites australis*.



Figure 24. Comparison between invasive *Phragmites australis* at East Saginaw Bay Coastal Wetland #5 (515B) in 2025 (top) and 2026 (bottom).

Benchmark site Mackinac Creek Wetland (616) was sampled on July 21st, 2026. This is a high-quality site that has a long history of sampling prior to the beginning of the GLRI, as well as having been regularly sampled as part of GLRI.

Benchmark site Point St. Ignace Wetland (1598) was sampled on July 22nd, 2026, to track the potential environmental changes in the Straits of Mackinac. No notable differences were observed from the last year.

Benchmark site Munuscong Lake Wetland #2,#3 Munuscong River Delta (792) was sampled from July 20th through July 22nd, 2026. This site was sampled as part of a restoration project looking at the response of invasive *Typha x glauca* (hybrid cattail) and *Hydrocharis morsus-ranae* (frogbit) to various harvest and treatment approaches. *Zizania palustris* was observed at this site but did not appear in the transects.

Wetland Condition Observations and Results

The most visible trend noted by sampling crews is that there were more mature, established emergent species present in the emergent zone, as opposed to the smaller species found the previous year. Water levels across the Central Basin were lower than normal.

Data Processing

Dr. Dennis Albert has finished the last of the plant identifications, and data entry began in September 2026. All data should be entered and quality-checked by Spring 2027.

Mid-season QC Check Findings

Matthew Sand completed mid-season QC checks at Northwest Drummond Island Wetland #2 (774) for both Katlyn Groulx and Zoe Moore on 8/4/26. Matthew Sand quality-checked Katlyn's and Zoe's sampling protocols by observing transect set ups, quadrat locations, percent cover estimates, and plant identification. No corrections were needed for either sampling crew.

Audit and QC Report and Findings

A CMU technician began entering 2026 vegetation data to GreatLakesWetlands.org in September. When the entry is completed, data will be quality-checked by Katlyn Groulx or Matthew Sand. Finally, data will be reviewed by Dr. Dennis Albert. Any data entry issues will be noted in the Spring 2027 report.

Additional Funding and Projects

None

Other Collaboration Activities

There are no external collaboration activities to report for the 2026 field season.

Other Data Requests

Site lists of species encountered/observed in 2026 will be sent to outside entities as was agreed upon to access their conservancies and properties for site sampling. Data will be sent to the Detroit River International Wildlife Refuge for Elba Island Wetland (422); the Shiawassee National Wildlife Refuge for Crooked Island Wetland (548); the Little Traverse Conservancy for Steel Creek Wetland (613), Mackinac Creek Wetland (616B), Hog Island Wetland (815), and Palmer's Point Wetland (917); and Chikaming Open Land for Galien River Wetland (1325).

Related Student Research

Central Basin vegetation data from 2026 is not currently being used for any student research.

CANADIAN CENTRAL/EASTERN BASIN BIRD AND ANURAN TEAM AT BIRDS CANADA, PORT ROWAN/LONG POINT, ONTARIO

Team Members

- Dr. Doug Tozer, PI, waterbird and anuran ecologist (since 2011)
- Jeremy Bensette, bird and anuran field crew (since 2014)
- Tim Arthur, bird and anuran field crew (since 2017)
- Tyler Hoar, bird and anuran contractor (since 2011)
- Nadine Litwin, bird and anuran contractor (since 2011)

Training

All 4 field crew members / contractors received training refreshers via Zoom or phone in early April 2026. Topics included site selection procedures and station placement guidelines; specifics of anuran and bird survey field protocols; what's involved with reporting; safety procedures; overview of data entry; and GPS procedures. All members previously showed comprehension of the topics through written and practical in-person tests and successfully completed the online anuran and bird identification tests.

Challenges and Lessons Learned

Field work in 2026 went smoothly with no noteworthy challenges. With all team members having 10+ years of experience working on the project, we are now a "well-oiled machine."

Site Visit List

We considered 48 sites for sampling in 2026, which consisted of 2 benchmark sites, 6 resample sites, 2 pre-sample sites, and 38 panel sites. We surveyed 26 of the 48 sites for anurans and/or birds. We were unable to survey 22 of the sites due to issues with obtaining landowner access or safety, or both.

Panel Survey Results

Sampling for anurans occurred from 3 April until 1 July 2026 and sampling for birds occurred from 20 May to 6 July 2026. Of note were 51 point occurrences of 8 Ontario bird species at risk or of conservation concern (Table 20).

Table 20. Ontario bird species at risk or of conservation concern observed at sites in 2026.

Species	ON-ESA/SARA Status*	No. Occurrences	
		2025 (n = 42 sites)	2026 (n = 26 sites)
American White Pelican	Special concern	0	1
Bank Swallow	Threatened	13	9
Barn Swallow	Threatened	48	23
Black Tern	Endangered	3	4
Chimney Swift	Threatened	6	1
Common Nighthawk	Threatened	6	4
Eastern Meadowlark	Threatened	3	0
Least Bittern	Threatened	18	8
Red-headed Woodpecker	Endangered	1	1
Total		98	51

*Status is the assessment of greatest concern based on Ontario's Endangered Species Act (ON-ESA) or Canada's Species at Risk Act (SARA).

Also of note were 4 occurrences of Chorus Frog, some populations of which are listed as threatened in Canada (we logged 13 occurrences in 2025, but we note that the 2026 total may increase once a small amount of remaining frog data are entered into the database). In our Oct 2025 report we listed 116 point occurrences of 9 Ontario bird species at risk or of conservation concern, whereas here we list only 98 point occurrences of 8 species. This is because Bald Eagle is now assessed as "not at risk" in Ontario and the rest of Canada, so we removed this species from the table, including 18 Bald Eagle point occurrences from 2025.

Extra Sites and Data

We sampled 2 benchmark sites in 2026: Hillman Marsh (5422) on Lake Erie, and Pinery Provincial Park (5737) on Lake Huron.

We collected additional habitat data at each bird and anuran sample point following a slightly modified version of Birds Canada's Great Lakes Marsh Monitoring Program habitat sampling protocol. These data are being collected to augment species-habitat relationship models, especially for certain marsh bird species, some of which are strongly influenced by local vegetation characteristics (i.e., within a few hundred meters of the sampling point) and are stored in an Access database on Birds Canada's secure servers in Port Rowan, Ontario.

Wetland Condition Observations and Results

We sensed that the abundance of secretive marsh birds continued to decline in 2026 compared to our observations in recent previous years. We suspect this is because lake levels continued to decrease in 2026 relative to recent previous levels. Our observations are reflected in the relationship between lake levels and the number of secretive marsh bird detections over the years, with higher lake levels generally yielding higher abundance of secretive marsh birds (see Figure 21). Our observations are also reflected in the results reported by Homan et al. (2021) and Tozer et al. (2024), who used CWMP bird data from throughout the Great Lakes across several years to show that higher lake levels generally yield higher wetland bird occurrence and abundance.

Hohman et al. (2021): <https://doi.org/10.1016/j.jglr.2021.01.006>

Tozer et al. (2024): <https://doi.org/10.1093/ornithapp/duad062>

Data Processing

All of our data have been entered into and checked in the CWMP database.

Mid-season QC Check Findings

Mid-season checks were performed in June; no issues were identified.

Audit and QC Report and Findings

No issues to report.

Additional Funding and Projects

We received additional funding to augment the bird and anuran team's capacity to complete an analysis testing the influence of invasive Mute Swans on other wetland birds based in part on CWMP data from Canada and the US. This project is described further in the next section.

Other Collaboration Activities

The CWMP bird and anuran team has been collaborating with Danielle Ethier, Bird Population Scientist at Birds Canada in Port Rowan, Ontario, to answer a timely question of conservation interest for Great Lakes wetland managers regarding invasive Mute Swans. The project uses CWMP data and other datasets to test whether the occurrence of 12 wetland bird species decreases in the presence of Mute Swans. The results will be useful to wetland and wildlife managers for guiding future Mute Swan control efforts across the Great Lakes in Canada and the U.S. The draft abstract for the paper is included at the end of this section.

The CWMP bird and anuran team is collaborating with the other CWMP teams on a book entitled "Limnology of Coastal Wetlands Associated with Large Freshwater Lakes." We are co-authoring the "Wildlife" chapter in the book, which will include various information based on CWMP data.

Other Data Requests

Nothing to report, but see student project descriptions.

Related Student Research

We are providing advice and guidance to Whitney Tank, a MSc student at University of Wisconsin—Green Bay, under the supervision of Erin Giese and Dhanamalee Bandara. Whitney has graduated, but is writing up a manuscript entitled "Coastal wetland bird habitat associations in the Laurentian Great Lakes region," which analyzes CWMP bird data and the additional point-level habitat data we've been collecting with a slightly modified version of Birds Canada's Great Lakes Marsh Monitoring Program habitat sampling protocol, described above.

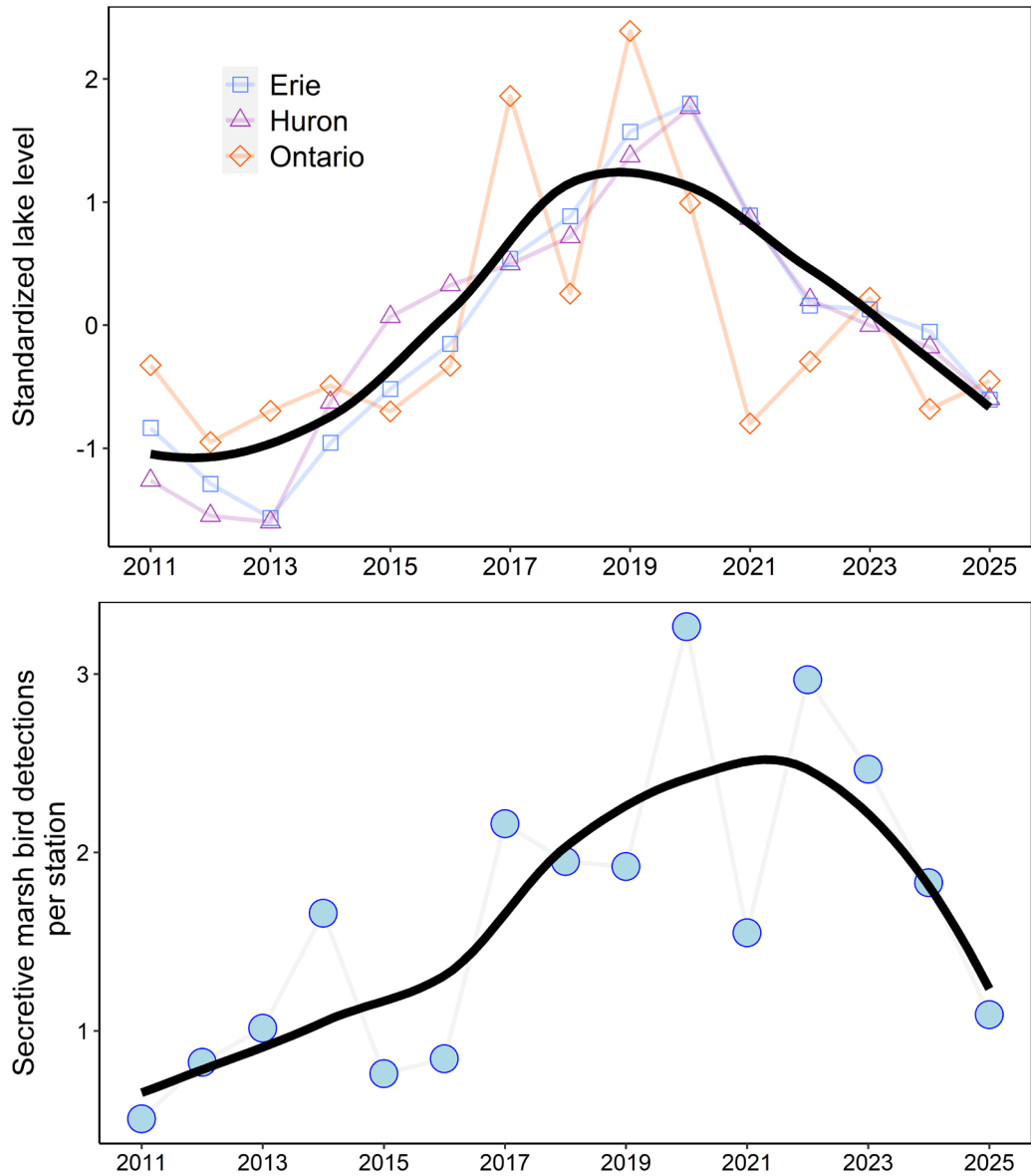


Figure 21. Above: Higher lake levels on lakes Huron, Erie, and Ontario generally yield higher numbers of detections of secretive marsh birds of conservation concern (American Bittern, American Coot, Common Gallinule, Least Bittern, Pied-billed Grebe, Sora, Virginia Rail) by the Canadian Central/Eastern basin bird survey team. This is because rising and higher lake levels inundate emergent vegetation and break up dense stands of emergent vegetation, which is preferred by most of these species. Standardized lake levels were calculated by subtracting the long-term mean for each lake from the annual mean for each lake and dividing by the standard deviation, given the reference value is the same for all lakes (International Great Lakes Datum 1985). Secretive marsh bird detections per station were calculated by summing the number of individuals observed on any of the visits to a station in each year, and dividing by the number of stations surveyed in each year.

CANADIAN CENTRAL BASIN FISH, INVERTEBRATE AND WATER QUALITY TEAM AT THE UNIVERSITY OF WINDSOR AND UNIVERSITY OF WISCONSIN RIVER FALLS

Team Members

- Dr. Jan Ciborowski (UW), PI, aquatic ecologist, (since 2011)
- Dr. Joseph Gathman (UWRF), co-PI, aquatic ecologist, team leader (since 2011)
- Li Wang (UW), GIS specialist, data/QC manager (since 2011)
- Michelle Dobrin (UW), lead invertebrate taxonomist (since 2011)
- Emilee Mancini (UW), lab and field crew member (since 2020)
- Gabriel Sanchez (UW), lab and field crew member (new 2026)

Training

Most crew members were experienced workers who have been part of the project for multiple years. Training for the one new crew member was carried out at University of Windsor in May under the supervision of Emilee Mancini, who had six years of experience in field and laboratory operations for the CWM program. Field training and supervision was also conducted throughout the summer by co-PI Joseph Gathman. All field-crew members reviewed updates to the QAPP and SOP documents, and refreshed their training in GPS use, assessment of whether sites met project criteria (open water connection to lake, presence of a wetland, safe access), identification of vegetation zones to be sampled, water quality sample collection, preprocessing and shipping to water quality labs, calibrating and reading field instruments and meters, setting, removing, cleaning and transporting fyke nets, and protocols for collecting and preserving macroinvertebrates. Field personnel were experienced in fish identification except the new crew member, who attended the Royal Ontario Museum's fish-identification training course prior to the field season.

The crew leader in 2026 was co-PI Joseph Gathman, who led the team in the field at most sites. Sampling operations were under his direct supervision, except at two sites (led by Emilee Mancini). Gathman also prescreened the suitability of sample sites, coordinated all logistics, secured accommodations, and obtained sampling permissions where necessary.

Challenges and Lessons Learned

On our first sampling trip, at the beginning of the day of our first wetland of the season, we found that our outboard motor would not start because the battery was discharged. We tried to recharge it but it would not accept the charge. Fortunately we only needed to travel a short distance in protected waters, so our smaller backup motor was sufficient for that wetland's

sampling effort, and after leaving the wetland on the second day we were able to stop to purchase a new battery before arriving at our next wetland. The lesson learned was that we should put the boat through a short trial run near campus before setting off on our first sampling trip.

One challenge that has been a consistent problem has been theft and vandalism of our stored vehicles, boats/motors, and other equipment, so in 2024 we moved the boat and vehicles to a different location that we deemed to be safer. However, during the offseason prior to summer of 2026, the catalytic converters were again stolen from one of our vehicles. The lesson learned is that we can't assume that any storage location that we can afford to pay for is safe. We may now have to try to find a better location.

During the 2026 fieldwork season we encountered more adverse-weather days than usual, including storms and wind producing difficult boating and sampling conditions. We had to adjust our schedule once or twice, but in other instances, we had to forge ahead in bad weather because of our tight schedule of traveling to and sampling 30 wetlands. Safety is always foremost in our minds, so we check weather, wind, and wave conditions carefully and plan our site-visit schedule accordingly. We have always done this, but in 2026 these concerns were especially important. The lesson was not new but was emphasized this season.

At some sites, the effects of the lake-level fluctuations of previous years continued to be observed, and to cause some difficulties. After continuous lake-level decline from the 2020 peaks to 2025, Lake Huron rose again in 2026 to reach as much as 40 cm higher than in 2025. Thus, many vegetation zones were too deep to be sampled, while other areas were shallow enough, but had still not recovered their vegetation that had disappeared during the high-water years.

Site Visit List

The UW team has capacity to sample 30 wetlands annually. We were initially assigned 30 candidate sites on lakes Erie and Huron, but several of these sites were inaccessible. Instead, we sampled four wetlands on the Canadian shore of eastern Lake Ontario that had originally been assigned to the Canadian Wildlife Service (CWS) team. Of the 30 sites sampled, 19 were located on Lake Huron, six sites were on Lake Erie (three in Ontario and three in Ohio), four sites were on Lake Ontario, and one was on the Detroit River. The Lake Ontario sites that were reassigned from CWS to us included site 5401 Hay Bay Marsh 2, 5556 Lower Napanee River 6, 5558 Lower Napanee River 5, and 5718 Parrott Bay.

All wetlands visited in 2026 were sampled for vegetation, but one was not sampled for invertebrates or water quality because it lacked flooded wetland vegetation. Eleven of the assigned wetlands were not sampled for fishes because they did not meet fish-sampling criteria (too shallow and/or insufficient vegetated area). Also, many areas at various sites that had been vegetated in the earlier, low-water years of the CWM program had become de-vegetated during high-water years and still had not recovered by 2026.

Panel Survey Results

Fishes collected over the summer largely consisted of the usual species. In Ohio, we caught one fish species designated as Endangered in the state (and designated as a Species-At-Risk in Canada): two spotted gar (*Lepisosteus oculatus*), collected at site 1859, Plum Brook Area Wetland #2. Regarding non-native species, we caught some juvenile goldfish (*Carassius auratus*) at multiple sites and found round gobies (*Neogobius melanostomus*) and tubenose gobies (*Proterorhinus semilunaris*) at a larger number of sites. Reptiles observed included many painted turtles (*Chrysemys picta*), one snapping turtle (*Chelydra serpentina*), and one northern map turtle (*Graptemys geographica*). We observed empty mussel shells at a couple of sites, likely resulting from predation but indicating possibly healthy populations there.

As compared to many earlier years we had a number of samples with relatively few invertebrates, i.e., fewer samples had 150 individuals than is usually the case. This appeared to be a result of sparse vegetation at these sites. At the time of this writing, the invertebrate samples from 10 of the 29 wetlands sampled have been processed. In the samples processed so far, non-native invertebrates included zebra mussels (*Dreissena polymorpha*) and the amphipod *Gammarus tigrinus* at one Lake Erie wetland and the snail *Bithynia tentaculata* at five wetlands. The viviparid snail, *Viviparus georgianus*, which been quite rare in our samples in previous years, was found in four of the five wetlands sampled in the Severn Sound area of Lake Huron.

Extra Sites and Data

We did not sample any extra sites in 2025.

Wetland Condition Observations and Results

2026 water levels in Lake Erie were about the same as 2025 levels, and the 2026 Lake Huron lake-level peak was almost 40 cm higher than in 2025, interrupting the continuous decline since the 2019-2020 peaks, according to the Great Lakes Water Level Dashboard managed by NOAA's Great Lakes Environmental Research Laboratory (www.glerl.noaa.gov/data/dashboard/GLD_HTML5.html).

As noted in recent years, declining lake levels had left wet meadows (even many cattail zones) too shallow/unflooded to allow us to sample them for fish or even invertebrates. In 2026, lake levels were somewhat higher than in previous years, so all but one site was sampled for invertebrates, but the effects of earlier high-water years were still present: many devegetated areas had still not yet recovered the vegetation seen in pre-peak years, making them unsuitable for fish sampling.

An onshore seiche was observed during sampling at Howdenvale Bay (5437), with water depths in the wet meadow ranging from 5–10 cm before the water receded completely. The shallow slope of the shoreline means that even a relatively small change in water level can cause the water to move a considerable distance across the wetland. Although the bay is relatively sheltered, the bare, sandy shoreline suggests that the area still receives considerable wave action. The change in water level briefly interrupted invertebrate sampling in the meadow, as the crew had to wait for the water to return before continuing (Figure 25).



Figure 25. The crew's kayak, left at the water's edge at site 5437, was found 10–20 m inland after the seiche receded.

Data Processing

All field-collected data - fishes, *in situ* water-quality, vegetation, and habitat - have been entered into the database and QC checked. GPS waypoints and site photographs have been uploaded. Our laboratory water-quality analyses are performed off-site, at the National Laboratory for Environmental Testing (NLET) in Burlington, Ontario. We have not yet received results of these tests from NLET but will enter them as soon as they are received. We have sent our chlorophyll-a samples to the Lamberti lab at the University of Notre Dame for analysis, and

data will be entered once results are returned to us. Of 144 invertebrate samples collected from 29 wetlands, all samples from 10 wetlands have been processed, and none of the data have yet been entered.

Mid-season QC Check Findings

No difficulties or anomalies were observed during mid-season checks. Crew members were always working under direct supervision of co-PI Joseph Gathman.

Audit and QC Report and Findings

All data for fishes, in situ water-quality, and habitat data have been QC'ed. Lab water quality data will be entered and QC'ed upon reception of results. Invertebrate data will be QC'ed once all samples have been processed and their data entered into the database.

Additional Funding and Projects

None to report for 2026.

Other Collaboration Activities

Hillman Marsh (5422) continues to be monitored as a benchmark site while restoration work continues on the barrier beach, which was breached and eroded during high water levels in 2019 and 2020. The restoration plan, coordinated by the Essex Region Conservation Authority (ERCA), includes construction of a hybrid barrier beach with Phase 1A of construction, building the barrier rock core, beginning in 2026. Wetland restoration has also continued alongside the barrier beach work. Native vegetation planting was completed in June 2026. In addition, there are efforts to eradicate the invasive submerged aquatic plant *Hydrilla* spotted in the diked West "Shore Bird" Cell of the marsh, and to monitor the adjacent open marsh (sampled through the CWMP) for its presence. In August 2026, CWMP sampling at Hillman Marsh was conducted in collaboration with the Healthy Headwaters Lab at the University of Windsor, the Essex Region Conservation Authority (ERCA), and Caldwell First Nation. Standard invertebrate and water-quality sampling was conducted to demonstrate CWMP methods and how the data can be used to assess the wetland as restoration of the barrier beach progresses. CWMP field sampling training was also provided to graduate students from the University of Waterloo at Hillman Marsh in June 2026. The students are conducting research in the diked West Cell of the marsh, where the invasive aquatic plant *Hydrilla* has been observed. This demonstration was conducted in the diked West Cell and was not as part of standard CWMP sampling. Standard CWMP sampling is conducted in the open bay of the marsh. Students received instruction in

CWMP sampling methods to collect their own dataset, which could be compared with the long-term CWMP dataset from the open marsh to provide additional context for their research.

Pinery Provincial Park (5737) was a requested benchmark CWMP site for 2026 by the Ausable Bayfield Conservation Authority (ABCA). Standard fish, invertebrate, and water quality sampling was conducted with ABCA partners in June 2026 to familiarize staff with the CWMP dataset and methods, and support future restoration efforts in the area.

Other Data Requests

We have not received any requests in 2026.

Related Student Research

None.

CANADIAN CENTRAL BASIN VEGETATION TEAM AT THE UNIVERSITY OF WINDSOR AND UNIVERSITY OF WISCONSIN RIVER FALLS

Team Members

- Dr. Jan Ciborowski (UW), PI, aquatic ecologist (since 2011)
- Dr. Joseph Gathman (UWRF), co-PI, aquatic ecologist, team leader (since 2011)
- Carla Huebert (UW), crew leader, plant taxonomist (since 2013)
- Li Wang (UW), GIS specialist, data/QC manager (since 2011)

Training

The crew leader in 2026 was Carla Huebert who directly conducted all vegetation field sampling. Co-PI Joseph Gathman prescreened the suitability of sample sites, coordinated all logistics, secured accommodations, and obtained sampling permissions where necessary.

Carla Huebert has led the vegetation component of the project since 2013, so only a review and refresher of protocols was needed as outlined in the QAPP. The review included instruction in GPS use, assessment of whether sites met project criteria (open water connection to lake, presence of a wetland, safe access), and identification of vegetation zones to be sampled, Carla also received refresher training and review in field data and lab entry to become familiar with changes to the database.

Challenges and Lessons Learned

Vegetation sampling was hampered at a few sites by the effects of the water-level changes of recent years. High-water conditions from a few years ago had denuded many wetland areas of their vegetation. In many wetlands, these areas have been slow to revegetate, probably because organic and fine-mineral sediment were washed away by waves during high water times. In 2026, lake levels rose somewhat, and at a handful of sites this created conditions in which submergent vegetation could be sampled by kayak, but the emergent zone was too dense to penetrate by kayak while being too deep to disembark and reembark, so either perpendicular transects were employed or the wet meadow/emergent zones had to be approached from the terrestrial side on foot, which made sampling more complicated.

Also, at a few sites, an aggressive nonnative species, Rough Manna Grass, was so dense that it was difficult to push through in order to establish transect paths. Also, the species has sharp, slicing leaf-blade edges, requiring greater care while working within the monoculture stands.

Site Visit List

The UW team has capacity to sample 30 wetlands annually. We were initially assigned 30 candidate sites on lakes Erie and Huron, but several of these sites were inaccessible. Instead, we sampled four wetlands on the Canadian shore of eastern Lake Ontario that had originally been assigned to the Canadian Wildlife Service (CWS) team. Of the 30 sites sampled for vegetation, 19 were located on Lake Huron, six sites were on Lake Erie (three in Ontario and three in Ohio), four sites were on Lake Ontario, and one was on the Detroit River. The Lake Ontario sites that were reassigned from CWS to us included site 5401 Hay Bay Marsh 2, 5556 Lower Napanee River 6, 5558 Lower Napanee River 5, and 5718 Parrott Bay.

Vegetation sampling for the UWindsor team began on June 16th, 2026, and ended on September 28th, 2026. A total of 30 sites were sampled, including 23 panel sites, 6 resample sites, and 1 benchmark site. Of these 30 sites, 17 sites were located on Lake Huron, 7 sites were on Lake Erie, 4 sites were on Lake Ontario, and 1 site each on the Detroit River and Lake St. Clair, respectively.

Panel Survey Results

Water levels rose in 2026 in both Lake Huron and Lake Ontario, while Lake Erie levels remained essentially the same as 2025. According to the U.S. Army Corp of Engineers weekly Great Lakes water level update, Lake Huron water levels had risen 15-18 cm (6-7 inches) by July compared to 2025, while Lake Ontario levels had risen 33 cm (13 inches) during that same period. Both increases were attributed to equal parts heavy winter melt runoff and spring precipitation.

The increased water levels on Lake Huron were undetectable by the vegetation team while sampling sites in various regions of the lake, nor did it affect the vegetation zones there. However, they were definitely detectable at our Lake Ontario sites, with several sites too deep to allow safe disembarking from and re-boarding our vessel, which presented challenges. Thankfully, our crew had gained several years of experience through sampling during the high water years of 2020 – 2022, so they were well accustomed to high water vegetation sampling methods.

The year 2026 marked the first year of a new cycle for the GLCWMP, and as such, the UWindsor crew re-sampled many sites that had not been sampled since 2021, which were exceptionally high water years. Accordingly, the vegetation team noticed a dramatic increase in the exposed area of many of the wetlands, particularly the wet meadow zone, due to the overall lowering of water levels in the last 5 years.

One of those sites, West Shore (6050), located on St. Joseph Island in northern Lake Huron was particularly noteworthy due to the sizeable wet meadow that was present in 2026, but barely considered a zone in 2021 due to its radically reduced size. In 2021, this wet meadow zone was measured at 4 m in length. Now, in 2026, the meadow width was measured at 38 m (Figure 26).

This year marked the first time of sampling for two sites by the GLCWMP: Howdenvale Bay (5437) and Corisande Bay 5 (5206), both on Lake Huron's Bruce Peninsula. Howdenvale Bay proved to be a standout site for the vegetation team. In addition to the carnivorous plants commonly encountered at other Bruce Peninsula sites, several uncommon taxa were also surveyed, including several rare orchids: Showy lady's slipper (*Cypripedium reginae*) and Loesel's twayblade (*Liparis loeselii*).

Corisande Bay 5 (5206) is unique in having both a Great Lakes coastal alvar and a Great Lakes coastal fen situated side-by-side. While both habitats are common and are routinely sampled in this region, this was the first instance in which both of these rare habitats were present within the same wetland polygon.



Figure 26. A battered northern Lake Huron wet meadow in 2021 (above) and the same wet meadow shown in 2026 (below). In five years, this meadow, and many others along Lake Huron have rebounded and flourished after the high-water years. West Shore (6050), Lake Huron.

The fen portion of the site was located further upslope leading to the forest edge, while the alvar portion of the polygon was nearer the shoreline. In both regions, the vegetation team observed several uncommon or rare taxa in each microhabitat

In the fen section, these included Tuberous Indian plantain (*Arnoglossum plantaginium*), Death camas (*Anticlea elegans*), and Tufted bulrush (*Trichophorum cespitosum*) were observed. In the alvar section Butterwort (*Pinguicula vulgaris*), Canada bluets (*Houstonia canadensis*), and Mistassini primrose (*Primula mistassinica*) were the veg highlights. This is the only site in our 16 years of GLCWMP sampling at which the team has encountered Butterwort.

Species at Risk:

USA:

Flat-Stemmed Pondweed (*Potamogeton zosteriformis*): Flat-stemmed pondweed was sampled for the first time at one of our Ohio sites, Plumbrook Area Wetland #3 (1862). This site has previously been sampled 3 times over a 15 year period and the species had not been recorded during any of those visits, so its presence for the first time in 2026 seems to be a promising sign. (Ohio DNR Status: Threatened).

Canada:

Swamp Rose Mallow (*Hibiscus moscheutos*): Swamp Rose Mallow was found at one of our western Lake Erie sites, Hillman Marsh (5422). It has been found there in various locations on previous site visits through the years. (Federal COSEWIC Status: Special Concern).

Tuberous Indian Plantain (*Arnoglossum plantagineum*): Tuberous Indian Plantain was surveyed for the first time at one of Lake Corisande Bay 5 (5206) on Huron's Bruce Peninsula. It was also observed during a walkaround at nearby Howdenvale Bay ((5437), but it was not recorded there in the quadrats surveyed. (Federal COSEWIC Status: Special Concern; Figure 27).



Figure 27. A flowering meadow of a Canadian species at risk, Tuberous Indian plantain (*Arnoglossum plantagineum*), Corisande Bay 5 (5206), Lake Huron.

Notable Invasive species:

Rough Manna Grass (*Glyceria maxima*): Rough Manna Grass was observed at several of our eastern Lake Ontario wetlands, and most notably at Lower Napanee River 3 (5556). Growing up to 2.7 m (9 feet) in height, this species had overtaken most of the wet meadow zones sampled, crowding out the more diminutive native species and turning the meadow into a manna grass monoculture.

Rough Manna Grass resembles another wet meadow dominant grass, Reed Canary Grass (*Phalaris arundinacea*) when trying to battle through a meadow full of it. However, Rough Manna Grass is much taller than Reed Canary Grass, and Rough Manna Grass's sharp, slicing leaf edges make it more hazardous to traverse. At site 5556, Rough Manna Grass grew tall and densely (Figure 27) that it had to be physically pushed down and precariously walked upon, rather than through.

Coltsfoot (*Tussilago farfara*): Coltsfoot was first observed in 2024 at one of our eastern Lake Ontario sites. In the two years since this first sighting by our team, it has been surveyed at several more Lake Ontario wetlands, as well as in Lake Erie and northern Lake Huron sites. The leaves somewhat resemble the native Coltsfoot species (*Petasites sp*), but the invasive Coltsfoot has been observed to outcompete the understory native species and aggressively spread due to its underground rhizome system and windblown seed dispersal method. It is recommended

that this plant be monitored for future spread, especially in our higher quality northern wetlands.



Figure 28. Invasive Rough manna grass (*Glyceria maxima*) choking out a wet meadow zone at Lower Napanee River 3 (5556), Lake Ontario.

Hydrilla (*Hydrilla verticillata*): The highly invasive submergent *Hydrilla* was found in late 2024 at one of our Lake Erie western basin sites, Hillman Marsh (5422). It was discovered by another Ontario research team in a closed wetland cell, directly adjacent to the open area of the wetland where our

sampling takes place. Remediation efforts by the local conservation authority and other organizations are currently underway in 2026. It was not found during our 2026 survey in the open, lake-connected part of the wetland, but eradication of the plant in the infested, closed cell is still incomplete.

Hillman Marsh was designated a benchmark site for our team beginning in 2024 in order to monitor the wetland's recovery as work began to reconstruct the large barrier beach, which had eroded away during the 2019 and 2020 high water years. Now, we will additionally continue to monitor the site for signs of *Hydrilla* migrating into the open, connected portion of the wetland.

Extra Sites and Data

We did not sample any extra sites in 2026.

Data Processing

All vegetation data and GPS waypoints have been entered into the database.

Mid-season QC Check Findings

No difficulties or anomalies were observed during mid-season checks, which were self-administered, because field crew leaders have at least 14 years experience with the CWM teams.

Audit and QC Report and Findings

QC will be carried out in October.

Additional Funding and Projects

None to report for 2026.

Other Collaboration Activities

Hillman Marsh (5422) continues to be monitored as a benchmark site while barrier beach reconstruction proceeds. The restoration plan, coordinated by the Essex Region Conservation Authority (ERCA), includes creation of a hybrid barrier beach, with Phase 1A of construction (beginning in 2026) consisting of building the barrier rock core. Wetland restoration has also continued in concert with the barrier beach work. Native vegetation planting was completed in June 2026. In addition, efforts are continuing to eradicate Hydrilla from the diked West “Shore Bird” Cell of the marsh, and to monitor the adjacent open marsh (sampled through the CWMP) for its presence.

Other Data Requests

No data requests were received in 2026.

Related Student Research

No additional projects to report.

CANADIAN EASTERN BASIN FISH, INVERTEBRATE AND WATER QUALITY TEAM AT CANADIAN WILDLIFE SERVICE

Team Members

- Joe Fiorino, PI, wetland ecologist (since 2016)
- Ian Smith, crew leader, fish sampling, GIS tech (since 2014)
- Hayley Rogers, team leader, vegetation sampling (since 2017)
- Albert Garofalo, field crew member, vegetation sampling (intermittent since 2018)
- Marissa Zago, field crew member, WQ/invert sampling (intermittent since 2018)
- Rishona Vemulapalli, summer student field tech, WQ/invert/fish/vegetation sampling (new 2026)

Training

Environment and Climate Change Canada – Canadian Wildlife Service (ECCC-CWS) field crew members were trained by Joe Fiorino, Ian Smith, and Hayley Rogers. The sampling protocol, use of technical equipment, occupational health and safety, and field-based decision-making were covered in detail over multiple days; staff were assessed in the field and lab for proper sample collection, data recording, GPS use, water processing, equipment calibration, and lab sample preparation and storage. An experienced staff member was paired with new personnel to reinforce project protocols and ensure high data quality.

Challenges and Lessons Learned

Water levels on Lake Ontario were higher than average (40 cm higher in August 2026 compared to August 2025), which made it impractical to set fyke nets for three zones that were sampled for water quality and invertebrates (5869-SAV, 5088-rice, 5201-SAV). In addition, we were denied permission to set nets at one site (5217) due to concerns about fish kill and fish stress associated with our work in combination with other surveys that had recently been completed at the site.

Site Visit List

As in previous years, the number of sites originally assigned to our group (14) exceeded the capacity of the ECCC-CWS field crew, so two sites were given to SUNY-Brockport (5374, 5531) and four sites were given to University of Windsor (5558, 5718, 5556, 5401).

Eight sites were sampled by ECCC-CWS. As mentioned above, we were unable to set fyke nets at Corbett Creek Marsh (5201) due to high water levels, and we were denied permission to set

nets at Crysler Point Wetland (Wesleyville Marsh) 1 (5217). Vegetation, water quality, and invertebrate sampling were conducted at all 8 sites.

Panel Survey Results

Sampling occurred August 6, 2026 to August 19, 2026. Data are currently being entered into the DMS.

Reptiles:

Painted turtles (*Chrysemys picta*) were caught at sites 5098 (9 individuals), 5496 (18), 5736 (1), and 5990 (9). A musk turtle (*Sternotherus odoratus*) was caught at site 5736 (1 individual) (Figure 29). Northern map turtles (*Graptemys geographica*) were caught at site 5990 (4 individuals) (Figure 30).

Non-native species:



Figure 29. Musk turtle caught at Pine Point Wetland (5736).

Round gobies (*Neogobius melanostomus*) were caught at sites 5098 (2 individuals), 5736 (4), 5869 (7), and 5990 (10). A goldfish was caught at site 5496 (1 individual).

Extra Sites and Data

No benchmark sites were sampled.

Continued to collect data on short-term variation in dissolved oxygen and water

levels for Dr. Jan Ciborowski (University of Windsor). These data are managed by Dr. Ciborowski's lab.



Figure 30. Northern map turtle caught at Toronto Island Wetlands 2 (5990).

Wetland Condition Observations and Results

Water levels on Lake Ontario were higher than average (40 cm higher in August 2026 compared to August 2025).

The eastern channel of Corbett Creek Marsh was observed to have an opaque, ink-black appearance with a pronounced reflective surface sheen. While the channel is typically turbid, the black coloration and surface sheen were notably atypical for the site.

Data Processing

Entry of fish and field-collected water quality and invertebrate data is currently ongoing. Records will be quality-assured by a team member with multiple years of experience working on the program, and with the data entry system. We are currently awaiting laboratory water quality results from the National Laboratory for Environmental Testing (NLET); we expect they will be ready by the end of October. Macroinvertebrate sample vials have been inventoried and will be sent to University of Windsor for identification this fall. Chlorophyll-a samples will be sent to University of Notre Dame this fall.

Mid-season QC Check Findings

No difficulties or anomalies were observed during mid-season checks.

Audit and QC Report and Findings

Data entry is currently ongoing. Records will be quality-assured by a team member with multiple years of experience working on the program, and with the data entry system. All QC issues identified between 2016 and 2025 in the Data Verification Interface have been addressed, as well as past point-matching issues.

Additional Funding and Projects

Since 2021, ECCC-CWS has worked with the International Joint Commission to update marsh bird ecological performance indicators used for adaptive management of outflow regulation on Lake Ontario. ECCC-CWS received support from the bird/anuran team in December 2021 to conduct an analysis using CWMP data, and ultimately identified six potential bird-based indicators for consideration by the IJC. This work was published in the *Journal of Great Lakes Research* in early 2023. Since then, CWS has worked with the Hydrodynamic and Ecohydraulic Section of the National Hydrological Service to utilize spatially-explicit, model-generated data pertaining to water depths, flooding patterns, and habitat extent and structure at wetland sites on Lake Ontario to develop predictive models of marsh bird abundance and richness. These predictive models are currently being used as ecological performance indicators for the ongoing expedited review of the current water-level regulation plan (Plan 2014). The associated manuscript is currently being prepared for submission to *Journal of Great Lakes Research*.

Other Collaboration Activities

ECCC-CWS collaborated with Birds Canada to test whether the occurrence of 12 wetland bird species decreased in the presence of Mute Swans at the scale of 100-m-radius plots. We expected this outcome would be more pronounced for conspicuous species that spend most of their time in open water where they are more likely to interact with Mute Swans, whereas it would be less pronounced or absent for secretive species that utilize dense vegetation for cover. We used 30 years (1995–2024) of bird monitoring data from 5,544 surveys at 746 point count locations collected by the Great Lakes Coastal Wetland Monitoring Program delivered by Central Michigan University and the Great Lakes Marsh Monitoring Program delivered by Birds Canada. We found that occurrence of conspicuous species was the same (for 3 species) or higher (5 species) in the presence of Mute Swans than in their absence, whereas the occurrence of secretive species was the same (3 species) or lower (1 species) in the presence of Mute Swans. Our results indicate no consistent pattern of reduced wetland breeding bird occurrence in association with Mute Swans in the Great Lakes region, although Mute Swans might have more subtle negative implications that are not captured by plot-level occurrence. The associated manuscript was recently submitted to the *Journal of Great Lakes Research*.

Other Data Requests

In November 2025, Meteorological Services of Canada requested transparency tube data for Canadian sites on Lake Ontario and Lake Erie (2011-2024). Their group will use these data to support the calibration of a model designed to predict light penetration in shallow waters using

remote sensing imagery, which is part of a broader study assessing the vulnerability of Great Lakes coastal wetlands under the Great Lakes Freshwater Ecosystem Initiative.

In January 2026, Canada Water Agency requested quadrat-level plant data (species records and associated coverages) and water quality data for Canadian sites on Lake Ontario (2012-2024). Data will be used to assist in classifying Great Lakes Coastal Wetlands under pressure and those of ecological significance. Water quality data and data on coverage by non-native species will be key in identifying wetlands under high pressure conditions for this effort. This classification initiative will provide a framework to help identify wetlands in Canada for conservation, protection and restoration actions.

In January 2026, Credit Valley Conservation requested wetland bird IBC values for Canadian sites on Lake Ontario (2012-2024). Data will be used to develop reference thresholds to assess the wetland bird community at a newly created coastal conservation area in Mississauga, Ontario.

In March 2026, Beacon Environmental requested wetland monitoring data for Wesleyville Marsh (5217) (2011-2025) in support of Ontario Power Generation on the proposed construction of a new nuclear power plant in Port Hope, Ontario.

In March 2026, Mississaugas of Scugog Island First Nation requested wild rice occurrence information from Canadian sites on Lake Ontario (2011-2025).

In June 2026, Meteorological Services of Canada requested plant survey data (site-level species observations) for Canadian sites on Lake Ontario, Lake Erie, and Lake Huron (2024-2025). Data will continue to be used to support the calibration of a model predicting coastal wetland vegetation response to physical drivers such as topography, water depth, hydrodynamic conditions, and wet-dry cycles. These data will also be shared with a consulting company for validation of a wetland vegetation classification project in Rondeau Bay, Lake Erie.

Related Student Research

None at this time.

CANADIAN EASTERN BASIN VEGETATION TEAM AT CANADIAN WILDLIFE SERVICE

Team Members

- Joe Fiorino, PI, wetland ecologist (since 2016)
- Ian Smith, crew leader, fish sampling, GIS tech (since 2014)
- Hayley Rogers, team leader, vegetation sampling (since 2017)
- Marissa Zago, field crew member, WQ/invert sampling (intermittent since 2018)
- Albert Garofalo, field crew member, vegetation sampling (intermittent since 2018)
- Rishona Vemulapalli, summer student field tech, WQ/invert/fish/vegetation sampling (new 2026)

Training

Environment and Climate Change Canada – Canadian Wildlife Service (ECCC-CWS) field crew members were trained by Joe Fiorino, Ian Smith, and Hayley Rogers. The sampling protocol, use of technical equipment, occupational health and safety, and field-based decision-making were covered in detail over multiple days; staff were assessed in the field for GPS use, measuring and spacing of transects, filling out datasheets properly, ensuring species coverages were recorded correctly and standardized, and collecting and taking notes for unknown plant specimens. An experienced staff member was paired with new personnel to reinforce project protocols and ensure high data quality.

Challenges and Lessons Learned

None.

Site Visit List

As in previous years, the number of sites originally assigned to our group (14) exceeded the capacity of the ECCC-CWS field crew, so two sites were given to SUNY-Brockport (5374, 5531) and four sites were given to University of Windsor (5558, 5718, 5556, 5401).

Eight sites were sampled by ECCC-CWS. Vegetation sampling was conducted at all 8 sites.

Panel Survey Results

Sampling occurred August 6, 2026 to August 19, 2026. Data are currently being entered into the DMS.

Non-native species:

Typha x glauca dominates most wetlands on Lake Ontario. Many invasive species are common (e.g., *Hydrocharis morsus-ranae*, *Myriophyllum spicatum*, *Lythrum salicaria*, *Nitellopsis obtusa*, *Phalaris arundinacea*). Notably, *Stratiotes aloides* (water soldier) was observed at Pine Point Wetland 2 (5736) (Figure 31). *Stratiotes aloides* was first detected in the Bay of Quinte in 2021



Figure 31. *Stratiotes aloides* (water soldier) observed at Pine Point Wetland 2 (5736).

and has become increasingly prevalent in the region. Several management strategies are currently being used to control *S. aloides*, including large-scale hand pulling and herbicide applications.

Extra Sites and Data

No benchmark sites were sampled and no extra data were collected.

Wetland Condition Observations and Results

Water levels on Lake Ontario were higher than average (40 cm higher in August 2026 compared to August 2025).

The eastern channel of Corbett Creek Marsh was observed to have an opaque, ink-black appearance with a pronounced reflective surface sheen. While the channel is typically turbid, the black coloration and surface sheen were notably atypical for the site.

Data Processing

Data entry is currently ongoing. Records will be quality-assured by an experienced member of the team with multiple years of experience working with the data entry system.

Mid-season QC Check Findings

No difficulties or anomalies were observed during mid-season checks.

Audit and QC Report and Findings

Data entry is currently ongoing. Records will be quality-assured by a team member with multiple years of experience working on the program, and with the data entry system. All QC issues identified between 2016 and 2025 in the Data Verification Interface have been addressed, as well as past point-matching issues.

Additional Funding and Projects

In 2024 and 2025, ECCC-CWS developed and tested a new plant-based Index of Biotic Condition (pIBC) for coastal wetlands of each of the five Laurentian Great Lakes. The pIBC shares conceptual similarities with Floristic Quality Assessment (FQA) metrics, but incorporates species-specific sensitivity and responsiveness to anthropogenic disturbance based on modeled probabilities of occurrence derived from field data. This distinguishes it from traditional FQA metrics, which rely on expert-assigned Coefficients of Conservatism and do not incorporate occurrence probability. We found that the lake-specific versions of the pIBC consistently outperformed seven other plant-based metrics, including multiple FQA variants, in predicting a composite index of water quality and land use disturbance in four of the five lakes (lakes Erie, Michigan, Ontario, and Superior), and was a close-second in the fifth (Lake Huron). The pIBC was also robust across wetlands of different hydrogeomorphic types and under different water-level conditions. The pIBC's strong performance suggests it is well suited for assessing coastal wetland condition across sites and within sites through time. Overall, this new index is a conceptually grounded and statistically robust tool for conservation practitioners that is easy to calculate and interpret. The associated manuscript has been accepted for publication in *Wetlands*.

In 2025 and 2026, ECCC-CWS investigated spatial and temporal trends of *Nitellopsis obtusa* in coastal wetlands of the Laurentian Great Lakes. In this study, a total of 511 wetlands were compared across two five-year sampling cycles (2015-2019 and 2020-2024). The number of wetlands in the Great Lakes with *N. obtusa* increased significantly from 8% of wetland sites in 2015-2019 to 15% in 2020-2024. Lake Ontario exhibited a significant increase in site-level detections (25% to 31%). While Lake Superior and Lake Huron had no detections in the first

sampling cycle, new occurrences were documented in the second. Lake Michigan and Lake Erie showed no significant change in the number of sites with *N. obtusa* between the two sampling cycles. Quadrat-level analyses revealed similar patterns; the number of quadrats with *N. obtusa* increased significantly across the Great Lakes, along with the number of quadrats where *N. obtusa* covered $\geq 50\%$ of the quadrat. Notably, Lake Ontario experienced significant increases in the number of quadrats with *N. obtusa* present and high-cover quadrats ($\geq 50\%$), whereas Lake Erie showed no significant changes overall. These findings suggest rapid colonization and proliferation of this invasive species. This study highlights key areas for future monitoring and emphasizes the importance of coordinated management strategies, early detection, and more awareness to support the conservation of Great Lakes wetland ecosystems. The associated manuscript has been accepted for publication in *Aquatic Conservation: Marine and Freshwater Ecosystems*.

Other Data Requests

In November 2025, Meteorological Services of Canada requested transparency tube data for Canadian sites on Lake Ontario and Lake Erie (2011-2024). Their group will use these data to support the calibration of a model designed to predict light penetration in shallow waters using remote sensing imagery, which is part of a broader study assessing the vulnerability of Great Lakes coastal wetlands under the Great Lakes Freshwater Ecosystem Initiative.

In January 2026, Canada Water Agency requested quadrat-level plant data (species records and associated coverages) and water quality data for Canadian sites on Lake Ontario (2012-2024). Data will be used to assist in classifying Great Lakes Coastal Wetlands under pressure and those of ecological significance. Water quality data and data on coverage by non-native species will be key in identifying wetlands under high pressure conditions for this effort. This classification initiative will provide a framework to help identify wetlands in Canada for conservation, protection and restoration actions.

In January 2026, Credit Valley Conservation requested wetland bird IBC values for Canadian sites on Lake Ontario (2012-2024). Data will be used to develop reference thresholds to assess the wetland bird community at a newly created coastal conservation area in Mississauga, Ontario.

In March 2026, Beacon Environmental requested wetland monitoring data for Wesleyville Marsh (5217) (2011-2025) in support of Ontario Power Generation on the proposed construction of a new nuclear power plant in Port Hope, Ontario.

In March 2026, Mississaugas of Scugog Island First Nation requested wild rice occurrence information from Canadian sites on Lake Ontario (2011-2025).

In June 2026, Meteorological Services of Canada requested plant survey data (site-level species observations) for Canadian sites on Lake Ontario, Lake Erie, and Lake Huron (2024-2025). Data will continue to be used to support the calibration of a model predicting coastal wetland vegetation response to physical drivers such as topography, water depth, hydrodynamic conditions, and wet-dry cycles. These data will also be shared with a consulting company for validation of a wetland vegetation classification project in Rondeau Bay, Lake Erie.

Related Student Research

None at this time.

US EASTERN BASIN BIRD AND ANURAN TEAM AT THE STATE UNIVERSITY OF NEW YORK AT BROCKPORT

Team Members

- Dr. Kathryn Amatangelo, Project PI, macroinvertebrates (since 2014)
- Matthew Silverhart, project manager, Fish PI, fish/invert/WQ crew lead (since 2020)
- Dr. Kristin Malone, Bird/Anuran PI (since 2023)
- Alexa Lashway, graduate research assistant, bird crew lead (since 2024)
- Samantha Alberino, undergraduate technician, anuran crew leader (new 2026)

Training

Both field technicians (Alexa Lashway and Samantha Alberino) were trained by PI Dr. Kristen Malone and project manager Matthew Silverhart on proper field sampling techniques, data collection and recording, GPS use, and field safety. Both technicians were accompanied by project manager Matthew Silverhart for the first Bird and Anuran samplings of the season to ensure proper sampling techniques and train the technicians. Anuran training and observation took place 17 April 2026 at site 0016 – Sandy Harbor Wetland. Bird training and observation took place 2 June 2026 at site 0051 – Little Pond Wetland. Lastly, both field technicians were trained in data entry and QC checks in the database by project manager Matthew Silverhart. Both field technicians were successfully trained, passed the Bird (Alexa Lashway) and Anuran (Alexa Lashway and Samantha Alberino) identification exams, and met pre-season training performance criteria described in the project QAPP.

Challenges and Lessons Learned

One issue encountered this season that a single site, 5374 – Greater Cataraqui Marsh, was overlooked in the planning stage due to some confusion with site swapping. Luckily, this was a presample site and it will be revisited in the 2027 field season.

Site Visit List

Of the 24 assigned sites for the Bird/Anuran team of SUNY Brockport, 23 were sampled in full and 1 could not be sampled (this is the aforementioned site 5374 that was mistakenly not sampled). 14 of the assigned sites were panel sites, 3 were resample sites from the previous year, 4 were presample sites for the following season, and 4 were benchmark sites (site 0051 was both a benchmark and a resample site). All benchmark sites were requested by SUNY Brockport PIs due to restoration projects either being planned, ongoing, or having previously

occurred at the specified sites. This information can be used to better inform and shape restoration efforts.

Panel Survey Results

Sampling of panel sites for anurans began on 17 April 2026 at site 0010 – Johnson Creek Wetland and concluded on 9 July 2026 at site 5718 – Parrot Bay Wetland 2. During the anuran sampling of panel sites, seven species of anurans were detected. Those species were American Toad, Bullfrog, Chorus Frog, Gray Treefrog, Green Frog, Northern Leopard Frog, and Spring Peeper. The species detected most frequently were the Green frogs (Figure 32), detected almost twice as frequently as the next most detected species, the Gray Treefrog (112 detections to 60 detections, respectively).



Figure 32. Green Frog observed while sampling.
Photo taken by Samantha Alberino.

Sampling of panel sites for birds began on 3 June 2026 at site 0010 – Johnson Creek Wetland and concluded on 10 July 2026 at site 5718 – Parrot Bay Wetland 2. During the bird sampling of panel sites, 70 species of birds were detected and eight of those species were classified as unidentified. One of the bird species at panel sites is listed as threatened (Least Bittern), two species (Osprey and American Bittern) are listed as species of special concern by the New York Department of Environmental Conservation (NYDEC). At most panel sites, more species of bird were detected in the AM

sampling period than the PM sampling period. The most common species detected (observations) at panel sites were the Red-winged Blackbird (712), Common Grackle (166), Swamp Sparrow (141), Yellow Warbler (137), and Common Yellowthroat (133).

Extra Sites and Data

Sampling of benchmark sites for anurans began on 21 April 2026 at site 0028 – Salmon Creek and concluded on 1 July 2026 at site 0051 – Buck Pond. During the anuran sampling of benchmark sites, six species of anurans were detected. Those species were American Toad,

Bullfrog, Gray Treefrog, Green Frog, Northern Leopard Frog, and Spring Peeper. The species detected most frequently (observations) were the Green Frog (28) and Spring Peeper (17).

Sampling of benchmark sites for birds began on 2 June 2026 at site 0051 – Buck Pond and concluded on 26 June 2026 at site 0051 – Buck Pond. During the bird sampling of benchmark sites, 47 species of birds were detected and five of those species were classified as unidentified. One of the bird species at panel sites is listed as threatened (Least Bittern) and one species is listed as species of special concern (Osprey) by the New York Department of Environmental Conservation (NYDEC). At most benchmark sites, more species of bird were detected in the AM sampling period than the PM sampling period. The most common species detected (observations) at benchmark sites were the Red-winged Blackbird (196), Common Grackle (59), Swamp Sparrow (46), Marsh Wren (41), and Yellow Warbler (38).

Wetland Condition Observations and Results

With most sampling points being accessible from nearby parks and or roads, there were not major impacts from changing wetland conditions.

Data Processing

All data collected during 2026 GLCWMP Bird/Anuran sampling has been entered and checked. The habitat forms were collected during bird sampling and were mailed to Doug Tozer in September of 2026. Digital copies have been created for backup and stored on a Teams Drive operated by SUNY Brockport.

Mid-season QC Check Findings

Mid-season QC check for the Bird/Anuran team occurred on 2 June 2026 at site 0051 – Buck Pond with project manager Matthew Silverhart administering the mid-season QC check. The crew members involved were Alexa Lashway and Samantha Alberino. The crew performed all tasks to satisfaction and there were no issues noted that needed to be addressed.

Audit and QC Report and Findings

Other than minor data entry errors, there were no large-scale errors of note for the Bird/Anuran data entry and QC.

Additional Funding and Projects

No additional funding was used for any related projects or additional sampling.

Other Collaboration Activities

There were no additional collaboration activities during the 2026 sampling season for the Bird/Anuran sampling team.

Other Data Requests

There were no additional data requests during the 2026 sampling season for the Bird/Anuran sampling team.

Related Student Research

No student research coincided with Bird/Anuran sampling this season.

US EASTERN BASIN FISH, INVERTEBRATE, AND WATER QUALITY TEAM AT THE STATE UNIVERSITY OF NEW YORK AT BROCKPORT

Team Members

- Dr. Kathryn Amatangelo, PI, Macroinvertebrate PI (since 2014)
- Matthew Silverhart, Project Manager, Fish PI, Fish/Invert/WQ crew lead (since 2020)
- Dr. Michael Chislock, Water Quality PI (since 2018)
- Dr. Thomas Evans, Fish PI (new 2026)
- Grace Trebilcock, Graduate Research Assistant, Water Quality analysis (since 2024)
- Megan Gerber, Undergraduate Research Assistant, Fish/Invert/WQ crew member (since 2025)
- Jared Friend, Undergraduate Research Assistant, Fish/Invert/WQ crew member (new 2026)
- Jillian Ray, Undergraduate Research Assistant, Fish/Invert/WQ crew member (new 2026)

Training

All field technicians were trained by Project Manager Matthew Silverhart on proper field sampling techniques, lab data collection and recording, GPS use, boat use and safety, fish identification, fyke net operation, macroinvertebrate collection and storage, and date entry. PI Dr. Michael Chislock and Project Manager Matthew Silverhart trained field technicians on proper water quality sample storage, processing, and analysis. Training took place June 16-29, 2026, at the SUNY Brockport campus and site 0016 – Sandy Harbor Wetland for field training.

All field technicians were successfully trained and met pre-season and mid-season training performance criteria described in the project QAPP. These performance checks were administered by the associated PI and Project Manager.

Challenges and Lessons Learned

This season saw a crew of one returning member and two new undergraduate field research technicians. The new dynamic of training new field technicians with no sampling experience while helping the returning crew member develop leadership skills to be used in graduate school proved difficult at times due to the differing needs of each curriculum.

Site Visit List

Of the 18 assigned sites for the Fish/Invert/WQ team of SUNY Brockport, 13 were sampled in full, while 5 could not be accessed either due to physical barriers or lack of ability to sample safely. 8 of the assigned sites were panel sites, 2 were resample sites from the previous year, 4 were presample sites for the following season, and 4 were benchmark sites (site 0051 – Buck Pond was both a benchmark and a resample site). All benchmark sites were requested by SUNY Brockport PIs due to restoration projects either being planned, ongoing, or having previously occurred at the specified sites. This information can be used to better inform and shape restoration efforts.

Panel Survey Results

Macroinvertebrate ID is taking place over the winter by project manager Matthew Silverhart and updated data on their ID will be available in the Spring 2027 report. 32 species of fish (and turtles, Figure 33) were observed during the fyke net sampling of panel sites with four of those species being listed as non-native by the New York Department of Environmental Conservation (NYDEC). The four non-native species caught during panel sampling were Common Carp, Goldfish, Round Goby, and Rudd. Panel sampling began on 18 June 2026 at site 0016 – Sandy Harbor Wetland and concluded on 04 August 2026 at site 5374 – Greater Cataraqui Marsh.



Figure 33. Research Assistant Megan Gerber measuring a Painted Turtle captured in a fyke net while sampling site 0186 – Long Carry Marsh. Photo taken by Matthew Silverhart.

Extra Sites and Data

Macroinvertebrate ID is taking place over the winter by project manager Matthew Silverhart and updated data on their ID will be available in the Spring 2027 report. 22 species of fish (and turtles) were observed during the fyke net sampling of benchmark sites with three of those species being listed as non-native by the NYDEC. The two non-native species caught during benchmark sampling were Common Carp, Goldfish, and Rudd. Benchmark sampling began on 22 June 2026 at site 0028 – Salmon Creek and concluded on 7 July 2026 at site 0053 – Little Pond Wetland. Each benchmark site was requested by PIs at SUNY Brockport to continue monitoring previous restoration efforts conducted at those sites.

Wetland Condition Observations and Results

Many of the barrier wetlands encountered have been separated from the open water of the Great Lakes basin by roads and culverts. While this is not a new occurrence, it makes it increasingly difficult to access barrier wetlands, which are still functioning, but their connectivity is continuously harder to evaluate. This, coupled with changing water levels

around the Great Lakes basin, can have impacts on the seasonal passage for fish both to and from the barrier wetlands.

A vast majority of the wetlands sampled exhibited large mats of floating *Typha spp.* which were nearly impenetrable for sampling for Fish/Invert/WQ. While they are a monodominant vegetation zone, they do not allow for any of the Fish/Invert/WQ team to sample because there is no water on top of the mat and the water beneath them is inaccessible due to the thick root structures of the vegetation. Even if you can penetrate through the mat, there is only thick muck below.

Higher water levels across Lake Ontario coastal wetlands made accessing certain wetlands difficult to impossible due to less clearance under bridges/access points. This resulted in some of the wetlands we would normally be able to access becoming listed as “could not sample”. With the higher water levels meant that some of the floating *Typha spp.* mats were submerged under enough water to sample, which meant our sampling load increased drastically.

Data Processing

At the time of this report’s submission, all water quality analysis has been completed and is waiting to be entered and QC following the submission of these reports. All field water quality data have been entered and checked. Fyke data has been entered for all sites, and the QC process is completed. Macroinvertebrate ID is to be completed over the winter and entered/QC prior to the 2026 spring report. Main record and habitat data have been entered for all sites and has had QC completed.

Mid-season QC Check Findings

Mid-season QC check for the Fish/Invert/WQ team occurred at site 0186 – Long Carry Marsh on 27 July 2026 with Matthew Silverhart and Dr. Michael Chislock administering the mid-season QC check. The crew members involved were Megan Gerber, Jared Friend, and Jillian Ray. The crew performed all tasks to satisfaction, and there were no issues noted that needed to be addressed.

Audit and QC Report and Findings

Other than minor data entry errors, there were no large-scale errors of note for the Fish/Invert/WQ data entry and QC. The QC report will need to be completed for the Invert ID following the completion of that task and entry which is anticipated to be before the 2027 spring report.

Additional Funding and Projects

There were no additional funding and projects during the 2026 sampling season for the Fish/Invert/WQ sampling team.

Other Collaboration Activities

There were no additional collaboration activities during the 2026 sampling season for the Fish/Invert/WQ sampling team.

Other Data Requests

There were no additional data requests during the 2026 sampling season for the Fish/Invert/WQ sampling team.

Related Student Research

No student research coincided with Fish/Invert/WQ sampling this season.

US EASTERN BASIN VEGETATION TEAM AT THE STATE UNIVERSITY OF NEW YORK AT BROCKPORT

Team Members

- Dr. Rachel Schultz, Vegetation PI (since 2019)
- Dr. Kathryn Amatangelo, PI, macroinvertebrate PI (since 2014)
- Matthew Silverhart, Project Manager, Fish PI, Fish/Invert/WQ crew lead (since 2020)
- Annemadison Horak, Undergraduate Technician (new 2026)
- Victoria Franks, Undergraduate Technician (new 2026)

Training

Both field technicians (Annemadison Horak and Victoria Franks) were trained by PI Dr. Rachel Schultz and project manager Matthew Silverhart on proper field sampling techniques, data collection and recording, GPS use, and canoe use and safety. Both technicians were trained by PI Dr. Rachel Schultz in plant identification and sample preservation and storage. All training took place June 08-12, 2026 at the SUNY Brockport campus and site 0016 – Sandy Creek Wetland, for field training. Lastly, both field technicians were trained in data entry and QC checks in the database by project manager Matthew Silverhart. Both field technicians were

successfully trained, passed the plant identification quiz, and met pre-season training performance criteria described in the project QAPP.

Challenges and Lessons Learned

This season saw two undergraduate technicians leading the crew. Historically, there had always been a graduate student leading an undergraduate technician for the vegetation crew. Having two undergraduate technicians co-lead the vegetation crew posed challenges not faced yet and after some time, they were able to settle into a routine and have clearly established responsibilities.

Site Visit List

Of the 18 assigned sites for the Vegetation team of SUNY Brockport, 15 were sampled in full and 3 could not be accessed (either due to physical barriers or lack of ability to sample safely). 8 of the assigned sites were panel sites, 2 were resample sites from the previous year, 4 were presample sites for the following season, and 4 were benchmark sites (site 0051 – Buck Pond was both a benchmark and a resample site). All benchmark sites were requested by SUNY Brockport PIs due to restoration projects either being planned, ongoing, or having previously occurred at the specified sites. This information can be used to better inform and shape restoration efforts.

Panel Survey Results

During the sampling of panel sites, **23** species of non-native plants were identified and **17** of those species were classified as invasive. Panel sampling began on 16 June 2026 at site 0016 and concluded on 10 August 2026 at site 0023.

Extra Sites and Data

At the benchmark sites, there were **16** non-native species identified and **12** of those species were listed as invasive species. Benchmark sampling began on 22 June 2026 at site 0028 and concluded on 9 July 2026 at site 0051. Each benchmark site was requested by PIs at SUNY Brockport to collect baseline data prior to restoration activities planned at those sites.

Wetland Condition Observations and Results

Many of the barrier wetlands encountered have been separated from the open water of the Great Lakes basin by roads and culverts. A vast majority of the wetlands sampled exhibited large mats of floating *Typha spp.* which made it difficult for vegetation crews to access the meadow portion of the transects (Figure 34). Additionally, this year the water levels along Lake

Ontario shorelines was higher, meaning the floating mats of *Typha* spp. often had 1-50cm of water on top of the mat, making traversing them even more difficult.



Figure 34. *Typha* spp. mat with water oveltop of it, showing the difficulties of traversing this habitat to obtain quadrat data. Photograph taken by Annemadison Horak at site 0066 – East Bay Wetland.

Data Processing

All data collected during 2026 GLCWMP vegetation sampling has been entered and checked.

Mid-season QC Check Findings

Mid-season QC check for the Vegetation team occurred at site 7025 on 22 July 2026 with PI Dr. Rachel Schultz administering the mid-season QC check. The crew members involved were Annemadison Horak and Victoria Franks. The crew performed all tasks to satisfaction and there were no issues noted that needed to be addressed.

Audit and QC Report and Findings

Other than minor data entry errors, there were no large-scale errors of note for the vegetation data entry and QC.



Figure 35. Canadian bluejoint meadow at Goose Pond (site 7025) on Lake Ontario. Photo by Rachel Schultz on 23 July 2026.

Additional Funding and Projects

None

Other Collaboration Activities

Vegetation data will be used in part to establish baseline values for the invasive water chestnut (*Trapa natans*) in collaboration with the Town of Greece on their Great Lakes Restoration

Community Grant Program project (SUNY Brockport subcontract), “Water Chestnut Control and Aquatic Habitat Restoration Through Community Stewardship”.

Other Data Requests

None.

Related Student Research

None

ASSESSMENT AND OVERSIGHT

The Quality Assurance Project Plan (QAPP) we will be using for the current round of this project is based on revisions and refinement of our QAPP over the past 15 years of sampling. We will be operating from the QAPP signed by EPA in early 2023. This QAPP was submitted with our successful proposal. We will, of course, continue to update this QAPP and SOPs as needed.

History of the CWMP QAPP: The original QAPP was written in the spring of 2011. Throughout the first round of the project (2011-2015), five revisions were made to the QAPP. These revisions were necessary to improve methodology, better clarify protocols, and ensure the safety of all personnel. After each revision, all co-PIs and US EPA reviewed and signed the updated document prior to commencing fieldwork. The final QAPP revision for round 1 of the project was signed in March 2015. This 2015 revision (QAPP_r5) served as the basis for the second round of monitoring (2016-2020).

For the second 5-year sampling rotation, no substantial methodological or quality assurance/quality control changes were necessary. The only changes that were required to QAPP_r5 related to the data management system. In thoroughly reviewing the QAPP and SOPs in early 2018, crews found inconsistencies between the QAPP and SOPs and another handful of minor corrections and clarifications. These fixes were incorporated into the QAPP in 2018 and PIs again signed off on the QAPP at the March 1, 2019, meeting in Michigan. The updated QAPP (QAPP_CWMII_rev 1) and SOPs were submitted to EPA in April of 2019.

For the third 5-year sampling rotation, again no substantial methodological or QA/QC changes were necessary. The QAPP was updated to reflect turnover in program personnel, to continue to strive for clarity and understandability by others and to make the QAPP more of a stand-alone document without reference to proposals or reports, and to remove inconsistencies between the QAPP and SOPs. The only substantive change was to update the water chemistry

section to better reflect the updated EPA guidance on calculating error and variability in various water chemistry measurements. This QAPP (QAPP_CWMP3_2021) was signed by PIs in the spring of 2021. The QAPP was updated in spring of 2023 (signed by all PIs) to reflect the re-creation of the Site Management System by Limnotech to be housed at Central Michigan University.

Major QA/QC elements that are on-going for this program:

- Training of all new laboratory staff responsible for macroinvertebrate sample processing: This training is conducted by experienced technicians at each regional lab and is overseen by the respective co-PI or resident macroinvertebrate expert. Those labs without such an expert sent their new staff to the closest collaborating lab for training. Macroinvertebrate IDers communicate with each other via their own email list and assist each other with difficult identifications and other questions that arise. Every few years, typically when a major identification guide is updated, IDers for all teams meet either in-person or virtually to discuss taxonomic issues and questions.
- Training of all fish, macroinvertebrate, vegetation, bird, anuran and water quality field crew members following the QAPP and SOPs. This included passing tests for procedural competence as well as identification tests for fish, vegetation, birds, and anurans. Training certification documents were archived with the lead PI and QA managers.
- GPS testing: Every GPS unit used during the field season was tested for accuracy and its ability to upload data to a computer. Field staff collected a series of points at locations that could be recognized on a Google Earth image (e.g., sidewalk intersections) then uploaded the points to Google Earth and viewed the points for accuracy. Precision was calculated by using the measurement tool in Google Earth. Results of these tests have been archived and referenced to each GPS receiver by serial number.
- Review of sites rejected after initial site visits: In cases where a site was rejected during a site visit, the reason for rejection was documented by the field crew in the site selection database. The project QA managers (Brady and Cooper) then reviewed these records to ensure consistency among crews. Occasionally, field crew leaders contacted Uzarski, Brady, or Cooper when deciding whether to reject a site. The frequency of these consultations increased in 2018 and 2019 as high water levels made sampling particularly challenging, but had returned to normal by 2020 as crews have become more accustomed to the high water levels and because water levels dropped quite a bit

in 2021 and again in 2023 due to drought across the upper Great Lakes. Water levels for some of the Great Lakes were low again in 2025 for some lakes (particularly Michigan and Huron) but more average for the other Great Lakes. 2026 saw a big water level rebound. These fluctuations continue to make sampling challenging.

- Collection of all training/certification documents and mid-season QA/QC forms from regional labs: These documents will be retained as a permanent record for the project.
- Maintenance, calibration, and documentation for all field meters: All field meters were calibrated and maintained according to manufacturer recommendations. Calibration/maintenance records are being archived at each institution.
- Collection of duplicate field samples: Precision and accuracy of many field-collected variables is being evaluated with duplicate samples. Duplicate water quality samples were collected in conjunction with approximately every 10th WQ sample collected.
- QC checks for all data entered into the data management system (DMS): Every data point that is entered into the DMS is being checked to verify consistency between the primary record (e.g., field data sheet) and the database. QC should be complete for all data by the spring semi-annual report submission each year.
- Linking of GPS points with field database: Inevitably, some errors occur when crew members type in GPS waypoint names and numbers. All non-linking points between these two databases were assessed and corrected in 2014, which took a hundred or more person-hours. We now have a more automated way to link GPS waypoints with data, crews are paying more attention to waypoint name/number accuracy, and the lat/longs for critical locations are being typed directly into the data management system. These three actions have greatly reduced number of GPS waypoints that cannot be linked to data in the DMS system.
- Mid-season QC checks: These were completed by PIs or head field crew leaders for each of the field crews to ensure that there were no sampling issues that developed after training and while crews were sampling on their own.
- Creation/maintenance of specimen reference collections: Reference collections for macroinvertebrates, fish, and plants have either been created or are being maintained and updated by each regional team. Macroinvertebrate reference collections, in

particular, were developed or expanded as these samples were processed. Vegetation reference collections are often being kept in collaboration with local herbaria.

- Data Quality Objectives (DQO) for laboratory analyses: Participating water quality laboratories have generated estimates of precision, bias, accuracy, representativeness, completeness, comparability, and sensitivity for all water quality analyses.

DATA VERIFICATION

This monitoring round will build on the enhanced data verification that was begun in 2022-2023 in collaboration with GDIT. Together we implemented a data verification protocol that we have been using to identify and resolve, or otherwise flag, issues related to data accuracy, consistency, and compliance with the Quality Assurance Project Plan (QAPP) and SOPs established for sampling the various taxa groups.

The overall goal of this process is to establish the usability of each data record to ensure that the CWMP datasets are properly communicated to and applied by end data users. Initially, approximately 120 data verification criteria (rules) were developed by GDIT (USEPA's contractor) to conduct a suite of checks for specific components of the anuran, bird, vegetation, fish, macroinvertebrate, and water quality datasets. Examples of data verification checks include:

- Identifying bird surveys that took place outside the sampling seasonal frame (e.g., after breeding season).
- Identifying fish surveys for which nets did not fish correctly and yet the crew entered data from those nets.
- Identifying vegetation surveys for which some other number of transects than three was sampled.

The data verification checks have been automated by GDIT to run against the semi-annual CWMP database release (MS Access format) that is delivered to GLNPO in May and October of each year. Each record that fails to meet specific verification criteria (such as those listed above) is flagged with an appropriate data qualifier code (e.g., "LINTC" – lack of internal consistency, or "MRV" – missing required value). The results from the automated checks are written to a set of comma-separated variable (CSV) files (i.e., one file per check type), which are delivered by GDIT to LimnoTech for integration into the CWMP DMS. LimnoTech has incorporated additional tables ("data_rev_*.") into the DMS and developed a utility application

to ingest the CSV files into those dedicated tables. The enhanced DMS provides the capability to store and manage multiple sets of data verification results, including tracking of issue resolution and the assignment of data usability flags on a record-specific basis. Verification check results are stored in a set of dedicated tables, which are readily linked to any CWMP taxa data table that the results may be associated with. This approach supports linking the raw data to verification results/flags when needed, and it also avoids burdening the raw data tables with the detailed verification information.

Due to the large variety and number of verification checks and results, a dedicated “Data Verification Interface (DVI)” tool was implemented by LimnoTech on the CWMP main website to provide a platform for CWMP team members to efficiently review and respond to individual verification results (Figure 36). The tool will allow any “Level 4” CWMP user to efficiently filter for verification results that are pertinent to their specific taxa team, to download the results to an Excel spreadsheet, and then to provide appropriate feedback for each individual result, including documenting the resolution of the issue (if any). Ultimately, each record will be assigned an appropriate data usability flag based on assessment by lead PIs.

Thus far we have addressed the data quality checks for data from 2016-2025 and have made a start on addressing these enhanced checks for data collected from 2011-2015. Data from 2026 will go through these enhanced checks in the fall of 2027.

In addition to achieving improved data quality, consistency and documentation, this effort has provided opportunities to “tune” the rules for some DV checks and to plan and implement improvements to QA/QC methods used during data entry and review of annual monitoring datasets prior to the semi-annual database releases to EPA. The DVI tool, introduced above, provides taxa teams with a streamlined approach for reviewing DV issues, applying corrections to data records (where applicable), documenting the check’s resolution status, and assigning data usability status. To complement the information that taxa teams provide on DV issue cause, resolution, and data usability, the DVI has been enhanced to provide a “post-audit” analysis of the status of individual records. Post-auditing of records is achieved by running a batch of database queries designed to replicate the logic used in the original GDIT checks. This capability allows LimnoTech, individual taxa teams and the lead PIs to identify and address any outstanding data quality gaps following the initial review effort. In addition, the post-audit assessment is being used to help identify records that cannot be fully resolved (e.g., due to missing data elements) and should be assigned a “final qualifier” that will be attached to the data records when they are distributed to end users.

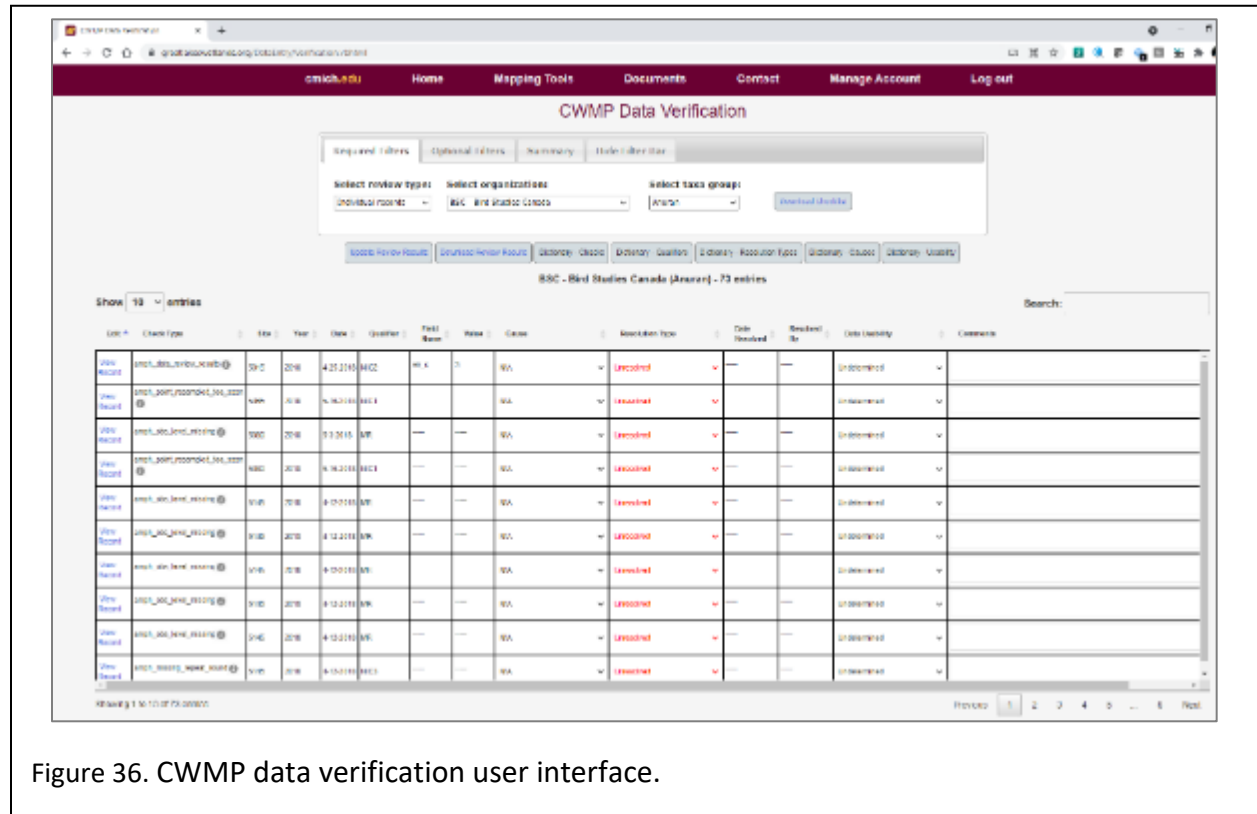


Figure 36. CWMP data verification user interface.

EXAMPLE WATER QUALITY QC INFORMATION

Laboratory Quality Assurances:

Each spring, water quality analyses and data from the previous year are obtained run through another set of quality checks. The latest round of this was for water quality data from 2025 from the NRRI Central Analytical Laboratory, Central Michigan University's Wetland Ecology Laboratory, Grand Valley State University's Annis Water Resources Institute, Brockport's water quality lab, and Environment Canada's national water quality lab. Laboratory results from 2025 have passed the criteria shown below (Table 22) or were excluded from the database.

Table 22. Data acceptance criteria for water quality analyses.

QA Component	Acceptance Criteria
External Standards (QCCS)	± 10%
Standard curve	$r^2 \geq 0.99$
Blanks	± 10%
Blank spikes	± 20%
Mid-point check standards	± 10%
Lab Duplicates	± 15% RPD* for samples above the LOQ**
Matrix spikes	± 20%

**Relative Percent Difference (RPD)*: While our standard laboratory convention is to analyze 10% of the samples in duplicate and use %RSD ($100 \times CV$) of the duplicates as a guide for accepting or rejecting the data, another measure of the variation of duplicates is RPD: $RPD = ((|x_1 - x_2|) / \text{mean}) \times 100$.

** *LOQ = Limit of Quantification*: The LOQ is defined as the value for an analyte great enough to produce <15% RSD for its replication. $LOQ = 10(S.D.)$ where $10(S.D.)$ is 10 times the standard deviation of the gross blank signal and the standard deviation is measured for a set of two replicates (in most cases).

Variability in Field Replicates (from 2025)

An analysis of field duplicate variability for samples collected in 2025 is shown in Table 23. It is important to note that for many constituents, the variability within sample sets is related to the mean concentration, and as concentrations approach the method detection limit (MDL), the variability increases dramatically. A calculation of field replicate variability with values at or near the level of detection will often result in high RPDs. For example, if the chlorophyll measurements on a set of field duplicates are 0.8 µg/L and 0.3 µg/L, mean = 0.6, resulting in a RPD of 91% ($RPD = [abs(rep\ a - rep\ b) / (rep\ a + rep\ b) / 2] \times 100$), but since the MDL is ± 0.5 µg/L, this can be misleading.

The same can occur with analyte lab duplicates, and in these instances the QA officer will determine whether data are acceptable. It is also important to note that RPD on field duplicates incorporates environmental (e.g., spatial) variability, since duplicate samples are collected from adjacent locations, as well as analytical variability (e.g., instrument drift). Therefore, RPD of field duplicates is generally higher than RPD of laboratory duplicates. Table 23 below lists average RPD values for 2025. Higher than expected average RPD values were associated with a preponderance of near detection limit values for ammonium, nitrate, and soluble reactive phosphorus (SRP), and high spatial variability for chlorophyll and turbidity. Other variables, such Total N, had values that were well above detection limits and low spatial variability; therefore, these values had much lower average RPD. Acceptance of data associated with higher-than-expected RPD was determined by the QA officers. The maximum

expected RPD values are based on the MN Pollution Control Agency quality assurance project plan provided for the Event Based Sampling Program

(<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/surface-water-financial-assistance/event-based-sampling-grants.html#for-grantees>).

Table 23. Field duplicate sample variability for 2025 in relative percent difference for water quality parameters with the acceptance criteria. The maximum expected RPD values are based on the MN Pollution Control Agency quality monitoring requirements for integrated assessments (<https://www.pca.state.mn.us/sites/default/files/wq-s1-15n.pdf>). Average RPD (n) min-max RPD.

Analyte	MDL	Maximum expected RPD	2025
Chlorophyll-a ug/L	0.5 µg/l All Labs 0.02 µg/L Brockport 1.1 µg/L UND	30	28 (16) 0-100
Total Phosphorus mg/L	0.0009 mg/L Brockport 0.006 mg/L CMU 0.0005 mg/L Env Can 0.006 mg/L GVSU 0.004 mg/L NRRI 0.0005 mg/L U Windsor	30	15 (17) 0.7-48
*Soluble Reactive Phosphorus mg/L	0.0002 mg/L Brockport 0.005 mg/L CMU 0.0002 mg/L Env Can 0.003 mg/L NRRI 0.0002 mg/L U Windsor	10	28 (17) 0-86
Total Nitrogen mg/L	0.013 mg/L Brockport 0.022 mg/L CMU 0.015 mg/L Env Can 0.02 mg/L NRRI 0.015 mg/L U Windsor	30	8 (17) 0.2-26
*NH ₄ -N mg/L	0.002 mg/L Brockport 0.01 mg/L CMU 0.005 mg/L Env Can 0.004 mg/L NRRI 0.005 mg/L U Windsor	10	29 (17) 0-164
*NO ₂ /NO ₃ -N mg/L	0.002 mg/L Brockport 0.008 mg/L CMU 0.005 mg/L Env Can 0.008 mg/L NRRI 0.005 mg/L U Windsor	10	21 (17) 0-160
True Color pt-co	0.6 CU Brockport 0.5 CU Env Can 2 CU NRRI 0.5 CU U Windsor	10	12 (12) 0-78

Table 23. Field duplicate sample variability for 2025 in relative percent difference for water quality parameters with the acceptance criteria. The maximum expected RPD values are based on the MN Pollution Control Agency quality monitoring requirements for integrated assessments (<https://www.pca.state.mn.us/sites/default/files/wq-s1-15n.pdf>). Average RPD (n) min-max RPD.

Analyte	MDL	Maximum expected RPD	2025
Chloride mg/L	0.1 mg/L CMU 0.01 mg/L Env Can 1.8 mg/L NRRRI 0.01 mg/L U Windsor	20	7 (14) 0-28

Notes:

*The variability between soluble reactive phosphorus, ammonium-N and nitrate/nitrite-N field replicates often exceeded the criteria, however many values for each were < 10 X the MDL.
Field duplicates are a second sample taken immediately after an initial sample in the exact same location to assess the site, sampling and possible temporal variability. Duplicate samples are collected in the exactly the same manner as the first sample, including the normal sampling equipment cleaning procedures. The relative percent difference (RPD) between the duplicate samples is calculated with the following equation:
$$RPD = (| \text{Result 1} - \text{Result 2} |) / ((\text{Result 1} + \text{Result 2}) / 2) \times 100$$

COMMUNICATION AMONG PERSONNEL

Coordinating and maintaining a Great Lakes basinwide monitoring effort requires close communication and collaboration across the teams from Duluth, MN, to Brockport, NY that make up this monitoring group. Regional team leaders and co-PIs will maintain close communication throughout this sampling round as they have done for the past 15 years of monitoring. Nearly all program members attended an all-hands program organizational meeting held virtually in February of 2026 to discuss the startup of our fourth sampling round. Discussions included site selection, benchmark sites, team capacities, anticipated monitoring challenges and lake levels, invertebrate and fish taxonomic changes, graduate student research plans, etc. Individual taxonomic teams held their meetings virtually just before or after the overall program meeting.

The CWMP leadership team maintains near constant communication with each other, particularly during the field season. And the lead PI (Uzarski) maintains regular contact with GLNPO program officers and technical leads. In addition, regional team leaders and co-PIs will continue to hold many virtual meetings and e-mail discussions regarding fieldwork, taxonomic changes, data analysis, indicator refinement, and publications. Most PIs plan to spend the first week of the field season in the field with their crews to ensure that all protocols are being

followed according to the standards set forth in the QAPP and SOPs and to certify or re-certify crew members.

OVERALL

The quality management system developed for this monitoring program has already been fully implemented and will continue to be followed, strengthened and improved. PIs and their respective staff members will continue to follow established protocols very closely, relying on the QAPP and SOPs as guiding documents. In past rounds, field crews have been very willing to contact their supervisors or, in many cases, the project management team when questions arose, and we anticipate that this important communication will continue.

Despite the somewhat dangerous nature of this work, injury rates have been very low across all sampling rounds. We are very proud of what our field crews accomplish safely while working on the Great Lakes from small boats and tromping around in wetlands with sometimes treacherous footing. Crews have demonstrated their ability to sample safely and accurately. This exemplary safety record is due to the leadership and safety consciousness of PIs, field crew leaders and team leaders. PIs are grateful for the willingness of their crews to work long hours day after day, to successfully sample under often adverse conditions (including a global pandemic), and to conduct that sampling in accordance with strict QA procedures.

LEVERAGED BENEFITS OF PROJECT (2010 – 2026)

During the first 3 sampling rounds (15 years), this project has generated a number of spin-off projects and serves as a platform for many graduate and undergraduate thesis topics. In addition, project PIs are collaborating with many other groups to assist them in getting data for areas that are or will be restored or that are under consideration for protection. Finally, the project supports or partially supports many jobs (jobs created/retained). All of these are detailed below.

SPIN-OFF PROJECTS (CUMULATIVE SINCE 2010)

Investigating the Use of eDNA to Determine Fish Use of Otherwise Unsampleable Habitats:

Some habitats cannot be sampled using fyke nets because of inappropriate water depth, unstable or unconsolidated bottom sediments or because that habitat is too fragile (e.g. wild rice). CoPI Valerie Brady with NRRRI researcher Chan Lan Chun investigated how well fyke net

fish catches agree with fish eDNA collected from nearby benthic sediment to determine if eDNA can be used as a surrogate in situations where fish cannot be physically collected to determine habitat use.

Macroinvertebrate Monitoring for Delisting the Degradation of Benthos Beneficial Use

Impairment in the Muskegon Lake Area of Concern: The West Michigan Shoreline Regional Development Commission, with support from the Michigan Department of Environment, Great Lakes, and Energy funded a project to conduct macroinvertebrate sampling at 2 coastal wetlands in the Muskegon Lake Area of Concern in an effort to evaluate “Degradation of Benthos” BUI in the AOC. Samples were collected in 2021 and 2023 and data from several Lake Michigan reference wetlands were used to compare the AOC restoration sites. Dr. Matt Cooper led this project with students from Muskegon Community College.

Compiling and Assessing IBI and Environmental Stress Data to Assess Habitat Condition in the

Detroit River Area of Concern (AOC): The Detroit River Canadian Clean-up (convened by Environment and Climate Change Canada and the Province of Ontario) evaluated the weight of evidence with regard to delisting several Beneficial Use Impairments in the Detroit River AOC (Degradation of Fish and Wildlife, Degradation of Benthos, and Loss of Fish and Wildlife Habitat. However, years of monitoring and assessment have failed to demonstrate clear time trends in the condition of biota (aquatic vegetation, aquatic macroinvertebrates, fishes, birds) of the Detroit River’s aquatic and riparian habitats. Attempts to evaluate indices of biotic integrity (IBIs) using the Reference Condition Approach (RCA) have been limited by an inability to achieve consensus on appropriate reference conditions. CoPIs Jan Ciborowski, Greg Grabas and Doug Tozer compiled land-based stressor data at the scale of second-order watersheds for the Detroit River AOC to let us assess how the IBI scores for sites in the Detroit River and adjacent areas (Lake Erie, Lake St. Clair, St. Clair River) vary as a function of environmental stress. We compiled all available biological monitoring datasets relating to aquatic vegetation, macroinvertebrates, fishes and birds within the study region and calculated composite measures of condition (IBIs) for each of the groups of biota and plotted the resulting scores against the stressor measures. We found provisional evidence of environmental stress thresholds for at least one IBI of each of the taxa investigated. Mapping the distribution of nondegraded vs. degraded watersheds for each of the biological groups will help the DRCC identify whether and where further remediation is necessary to allow delisting of the BUIs.

Minnesota Land Trust Natural Areas Project and Grassy Point Restoration: In 2018, the Minnesota Land Trust contracted a project with the Natural Resources Research Institute in Duluth, MN to conduct bird surveys along the St. Louis River Estuary (SLRE), within nine project

areas that were nominated for inclusion in the Duluth Natural Areas Program (DNAP). This program was created in 2002 to manage Duluth's environmentally significant areas to ensure the preservation of services and values such as habitat diversity and water quality. In addition to data collected for this project, we also included breeding bird data collected by the CWMP at benchmark sites located within the SLRE that aligned spatially with the nine DNAP project areas. Collectively these data were used to determine if the proposed land parcels included in the nomination met the criteria of qualifying as an Important Bird Congregation Area (criteria included numeric thresholds for different guilds of species). Use of these data qualified all nine parcels as meeting the Important Bird Congregation Area criteria.

These data were then used in a spin-off project with Minnesota Land Trust, where bird communities were associated with spatially-explicit environmental and habitat variables to help guide conservation and management effort in the SLRE. In this project we were also able to identify habitat availability at the landscape-level to identify specific features that are under-represented in the SLRE but likely important to avian species (specifically wetland-dependent species). These analyses have been used to guide restoration plans at specific locations within the SLRE, including Grassy Point (a wetland located in a heavily industrialized area of the SLRE). Efforts to restore this wetland site are being developed by using the habitat requirements of wetland-dependent marsh bird species as a guide and restoration goal. Grassy Point restoration was completed in the early 2020s and NRRI CWMP teams are involved in post-restoration monitoring of this site as well.

Deriving and Calibrating Environmental and Biological data for Lake Erie in Support of the Great Lakes Water Quality Agreement's Nearshore Framework: As part of the Annex 2 and Annex 7 plans of the revised GLWQA, Environment and Climate Change Canada (ECCC) and GLNPO began work to jointly develop an Integrated Nearshore Framework for the Great Lakes. The goal was to assemble scientific and technical recommendations for nearshore assessment. The assessment was expected to be used to set priorities and design an approach to identify areas of high quality for protection and areas under stress requiring restoration. ECCC and GLNPO convened several workshops beginning in 2014. In 2016, ECCC initiated a pilot project on the Canadian side of Lake Erie to come up with a workable methodology and approach to combining assessments of different condition measures. CWM coPIs Jan Ciborowski and Greg Grabas took part in a series of workshops and contributed information collected in part from CWM wetland surveys on Lake Erie. The first overall assessment of the nearshore in Lake Erie was reported in 2018. The weight of evidence indicated that there is a strong east to west gradient in nearshore condition with the highest quality habitat and biota observed in the eastern basin, and low quality in the western basin, influenced largely by seasonal occurrences of cyanobacteria. The nearshore of the Detroit River and Lake St. Clair was classified as being

of moderate quality. Insufficient data were available to assess the St. Clair River. Assessments of the condition of coastal wetland across the study area were limited by variation in the types of data collected by different programs. A future goal will be to determine how best to align data collected from other programs with information collected using the CWM protocols.

Real-Time Logging of Water Level, DO, Light, and Wind to Assess Hydrological Conditions in

Great Lakes Coastal Wetlands: The University of Windsor coordinated a project to test the hypothesis that the numbers and species of fishes caught in wetland fyke nets are related to temporal variation in dissolved-oxygen (DO), and that such DO variation is partly driven by seiche activity causing temporary movement of cool, well-oxygenated lakewater into and out of wetlands. This variation in DO may be especially important in the densely vegetated, shoreline-associated wetland zones (usually wet meadow, under high-water conditions). An SOP document was developed in spring 2019 and circulated to all field crews. Each field team was encouraged to deploy water level and DO loggers at their fyke net sites over the course of the summer. In addition to providing important basic hydrological information about the condition of coastal wetlands, the resulting Great Lakes-wide dataset will be used to help account for variation in fish catches and ultimately improve the precision of fish IBI estimates.

Bathymetry and mapping of wetlands in Point Pelee National Park during a period of

hydrologic change: In 2018 Point Pelee National Park (PPNP) received approval through the Parks Canada Conservation and Restoration Project to begin a 4-year marsh restoration project. The project was focused 1) on increasing open water habitat and interspersions within the marsh and 2) reducing invasive vegetation. Members of the Ciborowski CWM team were asked if they would be able to conduct a preliminary survey of PPNP wetlands to determine the bottom profile and distribution of submerged aquatic vegetation. There was special interest in the bathymetry of Lake Pond, whose eastern shoreline had been breached by wave action from Lake Erie during the summer as a consequence of the historically high water levels. In fall 2018 and during the 2019 field season, we conducted a benchmark survey of vegetation, aquatic invertebrates and water chemistry. We also assessed water depth, macrophyte distribution and cover and sediment characteristics throughout the wetland using the remotely-operated ROVER, which was developed for shallow-water data collection in remote locations. Water level and dissolved oxygen loggers set in place in the spring provided a full-season record of the frequency of seiches and associated changes in water quality. CWM researchers have been involved as collaborators throughout the restoration project.

Inventory and distribution of zooplankton in coastal wetlands: As part of ongoing interest in assessing the condition of CWM wetlands we began assessing the community composition of

zooplankton in the wetlands visited as part of the annual program. Pilot samples were first collected in 2017. In 2018, zooplankton samples were collected at 16 Great Lakes coastal wetlands, situated off Manitoulin Island, northern Lake Huron, the western basin of Lake Erie, the Bruce Peninsula and Georgian Bay. In each wetland, samples were collected at 3 shallow-water points along a dissolved oxygen gradient. Records of water depth, substrate characteristics and vegetation density and composition were also tabulated. The sampling methods were based on techniques proposed by Loughheed and Chow-Fraser (2002) in developing their Zooplankton Quality Index. Seven Lake Huron wetlands were sampled in 2019.

Evaluating Fish and Invertebrate Distribution in Great Lakes Coastal Wetlands - an Occupancy Modeling Approach:

Led by University of Windsor postdoctoral fellow student Martin Jeanmougin, this project involved fish PIs Joseph Gathman, Carl Ruetz, Dennis Higgs and Jan Ciborowski. Occupancy modelling is a statistical approach that allows one to estimate the probability that a taxon is present in an area and the probability that it can be detected by sampling. Applying this approach to the invertebrate and fish CWM data could help us to identify important environmental factors influencing the likelihood that selected taxa occur in particular habitats and to more accurately estimate their distribution across the Great Lakes. Also, an analysis of the detection patterns can provide important information on potential biases in the protocols we use to sample the biota. The previous work done by K. Dykstra of Grand Valley State University (Carl Ruetz's lab) for the thesis on Yellow Perch distribution was a starting point for this project.

Genetic Barcodes for Wetland Macroinvertebrates: Surveillance of aquatic macroinvertebrates in the Great Lakes is of utmost importance. However, many organisms, particularly aquatic macroinvertebrates, lack information that can assist in their identification, whether through molecular barcodes or morphological characteristics. We used previously collected aquatic macroinvertebrate samples from throughout the Great Lakes basins to generate genetic barcodes that will assist in identification of species (MOTUs) and expand the currently available molecular genetic databases. Our work targeted specific groups to improve morphological identification to lowest taxonomic levels.

Assessing Climate Vulnerability in Apostle Islands Coastal Wetlands: Funded by the National Park Service and GLRI, a team from Northland College sampled fish, macroinvertebrates, vegetation, and hydrologic variables in lagoon wetlands throughout the Apostle Islands National Lakeshore to identify species and communities that may be particularly vulnerable to climate change. This work represents an intensification of sampling effort within a sensitive and

relatively pristine area of the Great Lakes. Data from this project were analyzed in relation to CWMP data to put Apostle Islands wetlands into a broader Great Lakes context.

Functional Indicators of Coastal Wetland Condition: Funded by the USGS through a Cooperative Ecosystem Studies Unit (CESU), this pilot project ran from fall 2016 through fall of 2019 to better determine functional indicators of Great Lakes coastal wetland usage by Great Lakes fish species. Sampling was done during the spring and fall at about 15 US wetlands already being assessed for CWM indicators during the summer. Data collected focus on fish usage of wetlands and the forage base for those fish, evaluated using macroinvertebrate sampling and examination of fish gut contents. Special emphasis was placed on determining usage of wetlands by young or spawning fish.

Conservation Assessment for Amphibians and Birds of the Great Lakes: Several members of the CWM project team initiated an effort to examine the role that Great Lakes wetlands play in the conservation of amphibians and birds in North America. The Great Lakes have many large, intact freshwater wetlands in the interior portion of the North American continent. Their unique character, size, and plant composition supports populations of many species of amphibians and birds, many of which have been identified as endangered, threatened, or of special concern in North America. CWM PIs used the extensive data gathered by USEPA, such as the Great Lakes Environmental Indicators project and the Great Lakes Wetlands Consortium, as well as Bird Studies Canada, as critical input to this assessment.

The initial stages in the development of the conservation assessment were to analyze habitat and landscape characteristics associated with Great Lakes coastal wetlands that are important to wetland-obligate bird species occupying these habitats. By combining breeding bird data from the sources above and incorporating landscape variables, classification trees were developed to predict presence and relative abundance of these species across the Great Lakes Basin. These methods, outlined in Hannah Panci's thesis, 'Habitat and landscape characteristics that influence Sedge Wren (*Cisthorus platensis*) and Marsh Wren (*C. palustris*) distribution and abundance in Great Lakes Coastal Wetlands' (University of Minnesota Duluth). She compiled data for over 800 wetlands in her analysis, which provided a basis for analyzing additional wetland-obligate species.

Bird and Anuran Metrics and Indicator Calculations: Avian and anuran responses to landscape stressors can be used to inform land managers about the health of coastal wetlands and the landscape stressors that affect these systems (Howe et. al. 2007). CWMP data were used to calculate some of the metrics and indicators for these wetlands.

Influence of broadcast timing and survey duration on marsh breeding bird point count

results: Several members of the project team, with D. Tozer as lead, examined the importance of survey duration and timing of broadcast playbacks on occurrence and counts of wetland breeding birds. The results of this analysis suggest that 10-min point counts are superior to 15-min counts. This has important implications for future monitoring and cost-effectiveness. These findings were published in the *Journal of Avian Conservation and Ecology* (Tozer et al. 2017).

North Maumee Bay Survey of Diked Wetland vs. Un-Diked Wetland: Erie Marsh Preserve is being studied as a benchmark site for the CWM program. As a benchmark site, Erie Marsh Preserve serves as a comparison against randomly-selected project sites, and has been surveyed each year of the CWM project. Benchmark sampling began prior to Phase 1 of a planned restoration by The Nature Conservancy, allowing for pre- and post-restoration comparisons. In addition, biota and habitat within the diked wetlands area have been compared to conditions outside of the dike but still within the preserve. These data have also been used for post-construction comparisons to determine the biotic and abiotic changes after restoration efforts reconnected the dike to the shallow waters of Lake Erie.

Cattails-to-Methane Biofuels Research: CWM crews collected samples of invasive plants (hybrid cattail) which were analyzed by Kettering University and their Swedish Biogas partner to determine the amount of methane that can be generated from this invasive. These samples were compared to their data set of agricultural crops, sewage sludge, and livestock waste that are currently used to commercially generate methane. Results demonstrated that hybrid cattail and reed canary grass both generated adequate levels of methane for use as feedstocks for biodigestion. The result of this and other CWM data collection were summarized in the Carson *et al.* 2018 journal article. The cattails-to-methane biofuels project was also funded (separately) by GLRI.

Plant IBI Evaluation: A presentation at the 2014 Joint Aquatic Science meeting in Portland, Oregon evaluated Floristic Quality Index and Mean Conservatism score changes over time used data collected during the first three years of the GLRI study. Mean C scores showed little change between years from 2011 through 2013 due to stable water levels.

Correlation between Wetland Macrophytes and Wetland Soil Nutrients: CWM vegetation crews collected wetland soil samples and provided corresponding macrophyte data to substantially increase the number of sites and samples available to the USEPA Mid-Continent Ecology Division. USEPA MED researchers studied wetland macrophyte and wetland soil

nutrient correlations. The MED laboratory ran the sediment nutrient analyses and shared the data with CWM PIs.

Comparative study of bulrush growth between Great Lakes coastal wetlands and Pacific Northwest estuaries. This study included investigation of water level effects on bulrush growth rates in Great Lakes coastal wetlands. With leveraged funding from NSF for the primary project on bulrush ability to withstand wave energy.

Braddock Bay, Lake Ontario, Sedge Meadow and Barrier Beach Restoration: Braddock Bay was being studied as a benchmark site in conjunction with the US Army Corps of Engineers to assess the current extent of, and potential restoration of, sedge meadow and the potential of restoring the eroded barrier beach to reduce wetland loss. CWM crews collected pre-restoration data to help plan and implement restoration activities and will collect post-restoration data to help plan and implement restoration activities and assess results. The results will help build a model for future sedge meadow restoration in Lake Ontario to mitigate the harmful impacts of invasive cattails and provide habitat for fish and wildlife species.

Thunder Bay AOC, Lake Superior, Wetland Restoration: Nine wetlands around Thunder Bay were sampled for macroinvertebrates, water quality, and aquatic vegetation by CWM crews in 2013 using methods closely related to CWM methods. These data provided pre-restoration baseline data as part of the AOC delisting process. Wetlands sampled included both wetlands in need of restoration and wetlands being used as regional reference. All of this sampling was in addition to normal CWM sampling and was done with funding from Environment Canada.

Common Tern Geolocator Project: In early June 2013, the NRRI CWM bird team volunteered to assist the Wisconsin DNR in deploying geolocator units on Common Terns nesting on Interstate Island. In 2013, 15 birds between the ages of 4-9 yrs old were outfitted with geolocators. Body measurements and blood samples were also taken to determine the sex of each individual. In June of 2014, geolocators were removed from seven birds that returned to nest on the island. Of the seven retrieved geolocators, four were from female birds and three from males. The data collected during the year will be used to better understand the migratory routes of Common Terns nesting on Interstate Island. This was the first time that geolocators were placed on Common Terns nesting in the Midwest, which is important because this species is listed as threatened in Minnesota and endangered in Wisconsin. Tracking Common Terns throughout their annual cycle helps identify locations that are important during the non-breeding portion of their life cycle.

Using Monitoring Results to Improve Management of Michigan's State-Owned Coastal

Wetlands: One year project, 2016-2017, awarded to Central Michigan University by the Michigan Department of Environmental Quality. The project focused on the prioritization of high-quality and important state-owned coastal wetlands that have been monitored as part of the Great Lakes CWM program, and development of site-specific management plans for these wetlands which address diverse management goals and objectives with a broad focus including biodiversity, ecological services, habitat for fish and wildlife, climate change adaptation, and rare species.

Developing a Decision Support System for Prioritizing Protection and Restoration of

Great Lakes Coastal Wetlands: While a number of large coastal wetland restoration projects have been initiated in the Great Lakes, there remains little regional or basin-scale prioritization of restoration efforts. Until recently we lacked the data necessary for making systematic prioritization decisions for wetland protection and restoration. However, now that basin-wide coastal wetland monitoring data are available, development of a robust prioritization tool is possible and we developed a Decision Support System (DSS) to prioritize protection and restoration investments. This project, funded by the Upper Midwest and Great Lakes Landscape Conservation Cooperative, the Michigan Office of the Great Lakes, and the US Army Corp. of Engineers, developed a DSS for wetlands along the US shoreline of the Great Lakes.

Quantifying Coastal Wetland – Nearshore Linkages in Lake Michigan for Sustaining Sport Fishes:

With support from Sea Grant (Illinois-Indiana and Wisconsin programs), personnel from UND and CWM compared food webs from coastal wetlands and nearshore areas of Lake Michigan to determine the importance of coastal wetlands in sustaining the Lake Michigan food web. The project emphasis was on identifying sport fish-mediated linkages between wetland and nearshore habitats. Specifically, we (1) constructed cross-habitat food webs using stable C and N isotope mixing models, (2) estimated coastal wetland habitat use by sport fishes using otolith microchemistry, and (3) built predictive models of both linkage types that account for the major drivers of fish-mediated linkages in multiple Lake Michigan wetland types, including some wetlands sampled by the coastal wetland monitoring project. Collaborators are the University of Wisconsin – Green Bay and Loyola University Chicago.

Clough Island (Duluth/Superior) Preservation and Restoration: The Wisconsin Department of Natural Resources requested (and funded) a special report on sites sampled using CWM protocols around Clough Island within the St. Louis River Area of Concern (AOC). Their interests were to see if CWM data indicated any differences in habitat or species composition/abundances among Clough Island and other St. Louis River sites, and also how

Clough Island compared to other nearby Lake Superior coastal wetlands. The 46 page report was submitted to Cherie Hagan of the WDNR in May of 2014. Clough Island was acquired by The Nature Conservancy and they are using the data in the report for their development of conservation plans for the area.

Floodwood Pond and Buck Pond South, Lake Ontario, Wetland Pothole Restoration: Open water potholes were established in these two wetlands by The Nature Conservancy to replace openings that had filled with cattail following lake-level regulation. CWM crews collected pre- and post-restoration data as benchmark sites in both wetlands to allow TNC to assess changes.

Buck Pond West and Buttonwood Creek, Lake Ontario, Sedge Meadow Restoration: These two wetlands in the Rochester Embayment AOC were restored by a consortium involving Ducks Unlimited, The College at Brockport, NYS Department of Environmental Conservation, and the Town of Greece. CWM crews collected pre-restoration data as a benchmark site to help plan and implement restoration activities. Post-restoration data collection was also done under CWM to help assess results and help build a model for future sedge meadow restoration in Lake Ontario to mitigate the harmful impacts of invasive cattails and provide habitat for fish and wildlife species.

Salmon/West Creek, Long Pond, and Buck Pond East, Lake Ontario, Emergent Marsh Restoration: These three wetlands in the Rochester Embayment AOC were studied as benchmark sites by CWM crews to provide the U.S. Fish and Wildlife Service with pre-restoration data for projects currently in the design phase. Future CWM data collection has been requested to assist in post-restoration assessment.

Lower Green Bay and Fox River AOC: Results from the Coastal Wetland Monitoring (CWM) Project and the Great Lakes Environmental Indicators (GLEI) Project have played a central role in a \$471,000 effort to establish fish and wildlife beneficial use impairment (BUI) removal targets for the Lower Green Bay and Fox River AOC (2015-2017): 1) Protocols for intensive sampling of bird, anurans, and emergent wetland plants in the project area have followed the exact methods used in the CWM project so that results will be directly comparable with sites elsewhere in the Great Lakes. 2) Data from GLEI on diatoms, plants, invertebrates, fish, birds, and anurans and from CWM on birds and anurans have been used to identify sensitive species that are known to occur in the AOC and have shown to be sensitive to environmental stressors elsewhere in the Great Lakes. These species have been compiled into a database of priority conservation targets. 3) Methods of quantifying environmental condition developed and refined in the GLEI and CWM projects are being used to assess current condition of the AOC (as

well as specific sites within the AOC) and to set specific targets for the removal of two important BUIs (fish and wildlife populations and fish and wildlife habitats). 4) Application of the Index of Ecological Condition method (e.g., Howe et al. 2007) for measuring the condition of birds, anurans, and other fish and wildlife groups. Follow-up work was funded for 2018-2020 at \$87,000 to continue refining field monitoring methods and metrics of 40 fish and wildlife habitats and populations.

SOGL/SOLEC Indicators: CWM project PIs have developed a set of indicator metrics for the State of the Great Lakes/State of the Lakes Ecosystem Conference (SOLEC). These metrics fill a much-needed gap in quantifying responses of biotic communities to environmental stress throughout the Great Lakes. Sites for all coastal wetlands sampled by the GLEI, CWM, and Marsh Monitoring Program projects have been scored according to several complementary indices that provide information about local and regional conditions of existing wetlands.

Roxana Marsh Restoration (Lake Michigan): The University of Notre Dame (UND) team, led by graduate student Katherine O'Reilly and undergraduate Amelia McReynolds under the direction of project co-PI Gary Lamberti, leveraged the GLCWM monitoring project to do an assessment of recently restored Roxana Marsh along the south shore of Lake Michigan. Roxana Marsh is a 10-ha coastal wetland located along the Grand Calumet River in northwestern Indiana. An EPA-led cleanup of the west branch of the Grand Calumet River AOC including the marsh was completed in 2012 and involved removing approximately 235,000 cubic yards of contaminated sediment and the reestablishment of native plants. Ms. McReynolds obtained a summer 2015 fellowship from the College of Science at UND to study the biological recovery of Roxana Marsh, during which several protocols from the GLCWM project were employed. During summer 2015 sampling of Roxana Marsh, an unexpected inhabitant of the Roxana Marsh was discovered -- the invasive oriental weatherfish (*Misgurnus anguillicaudatus*). Oriental weatherfish are native to southeast Asia and believed to have been introduced to the U.S. via the aquarium trade. Although there have been previous observations of *M. anguillicaudatus* in the river dating back to 2002, it had not been previously recorded in Roxana Marsh, and little information is available on its biological impacts there or elsewhere. We used stable carbon and nitrogen isotopes, along with diet analysis, to determine the role of *M. anguillicaudatus* in the wetland food web and its potential for competition with native fauna for food or habitat resources. This discovery received media attention from the Illinois-Indiana Sea Grant College Program.

Chlorophyll-*a* Modeling: The UND team, in collaboration with Northland College, CMU, and others, investigated the drivers that influence water column chlorophyll-*a* in coastal wetlands.

Our hypothesis was that chlorophyll-*a* is related to nutrient status of wetlands and degree of development of adjoining land. Along with CWM water data, we used GIS land use and connectivity data. Specifically, we sought to answer the following questions: (1) What variables best predict chlorophyll-*a* in coastal wetlands across the entire Great Lakes basin? (2) How do these variables change across each basin (i.e., Lake Michigan, Lake Erie, Lake Ontario, Lake Superior, Lake Huron)? (3) Are there differences in predictor variables across sub-basins (e.g., Lake Erie North vs. Lake Erie South)? (4) Does wetland type (lacustrine, riverine, or barrier) change chlorophyll-*a* predictors? (5) How do other potential variables, such as vegetation zone type or year, change chlorophyll-*a* predictors?

Invasion Vulnerability Index: The UND team, in collaboration with other CWM teams, worked on a tool that predicts which aquatic invasive species from a list of 10 Great Lakes Aquatic Nuisance Species Information System (GLANSIS) watchlist species are of highest concern for prevention and early detection. We combined Habitat Suitability Indexes (HSIs) made using wetland site-specific physio-chemical measurements and potential pathway data (distance to potential introduction pathways and distance to known established populations). Ultimately, we worked to produce an interactive, exploratory tool where a wetland can be selected, and a table will appear that shows the breakdown of invasion risk by species as invasion likelihood scores. If more information is desired about how the invasion likelihood score was calculated, an attribute table will display the numerical values for each criterion in the model. One of the main concerns with invasive species is how climate change will alter habitat suitability. To accommodate this concern, we looked to include future climate change scenarios using published IPCC environmental conditions.

Invertebrate dynamics in Great Lakes coastal wetland during global change

Paolo Martins Sobrinho, in collaboration with Gary Lamberti (University of Notre Dame), assessed the direct and indirect effects of climate and land use on macroinvertebrate communities of coastal wetlands using 15 years of macroinvertebrate abundance data from the Coastal Wetland Monitoring Program (CWMP). Our main objectives were: (i) to identify potential distribution shifts, population declines, and increases, and (ii) to determine which traits mediate distinct responses across species. We characterized each taxon in terms of body size, feeding mode, trophic position, and habitat specificity, as well as their position along environmental gradients such as temperature, pH, dissolved oxygen, and turbidity. A major prediction of global change is that communities will become dominated by warm-adapted and generalist species, with profound implications for ecosystem functioning and services. We predict that distributional shifts and declines will be most evident in cold-adapted, habitat-

specialist, large-bodied taxa—particularly shredders, scrapers, and predators—as well as in species that cannot tolerate low dissolved oxygen and low pH.

Green Bay Area Wetlands: Data from the benchmark site Suamico River Area Wetland was requested by and shared with personnel from the Wisconsin Department of Natural Resources and The Nature Conservancy, who are involved in the restoration activities to re-connect a diked area with Green Bay. In 2011 NRRI sampled outside the diked area following CWM methods, and in 2013 we sampled within the diked area as a special request. The data were summarized for fish, invertebrates, water quality, birds, and vegetation and shared with David Halfmann (WDNR) and Nicole Van Helden (TNC).

Hybridizing fish: In 2013 the NRRI field crew encountered gar around the Green Bay area of Lake Michigan which exhibited mixed morphological traits of shortnose and longnose species. At that time, John Lyons at the Wisconsin Department of Natural Resources was working on a project to confirm hybrid individuals in the Fox River watershed (which drains into Green Bay, WI). Josh Dumke at NRRI contributed photos of gar captured in Green Bay during Coastal Wetland Monitoring fish surveys to John Lyons, and those contributions were acknowledged in an article: (Lyons, J., and J.T. Sipiorski. 2020. Possible large-scale hybridization and introgression between Longnose Gar (*Lepisosteus osseus*) and Shortnose Gar (*Lepisosteus platostomus*) in the Fox River drainage, Wisconsin. *American Midland Naturalist*, 183:105-115). In 2014 and 2015 Coastal Wetland Monitoring fish teams collected gar fin clips across the entire Great Lakes basin for a much more comprehensive look at species distributions and hybridization.

Management alternatives for hybrid cattail (*Typha x glauca*) 2011- 2014: Differing harvest regimes for hybrid cattail were evaluated at Cheboygan, Cedarville, and Munuscong Bay in northern Michigan with USEPA GLRI funding. At all of these sites plant data were collected by CWM and used as baseline data that was compared to control sites. Analyses demonstrated that during low-water conditions, native plant diversity was increased by harvest of hybrid cattail.

Impacts of hybrid cattail management on European frogbit (*Hydrocharis morsus-ranae*); This study, funded by MI DNR in 2016-2017 for research by Loyola Chicago and Oregon State University, studied the response of European frogbit to cattail management using CWM plant data collected in Munuscong Bay as baseline data. CWM data collected from 2011 to 2015 provided documentation of the expanding range of frogbit into the western Great Lakes. The study found that open, flooded stands of hybrid cattail provided important habitat for European frogbit, but that management to remove cattail was not effective for frogbit control.

Nutrient limitation in Great Lakes coastal wetlands: GLCWMP water quality data indicate that reactive nitrogen concentration is often much lower in wetland habitats than the adjacent Great Lake nearshore. With funding from Illinois-Indiana Sea Grant and the Wisconsin DNR we evaluated the role of nitrogen limitation on benthic algal growth in wetlands throughout Lakes Michigan, Huron, and Superior.

SUPPORT FOR UN-AFFILIATED PROJECTS

CWM PIs and data managers provided data and support to other research projects around the Great Lakes even though CWM PIs were not collaborators on these projects. Dr. Laura Bourgeau-Chavez at Michigan Tech University mapped the spatial extent of Great Lakes coastal wetlands using GIS and satellite information to help in tracking wetland gains and losses over time (Implementation of the Great Lakes Coastal Wetlands Consortium Mapping Protocol, funded by GLRI). We provided her with vegetation data and sampling locations each year to assist with this effort. Dr. Bourgeau-Chavez was also given funding to assess herbicide effectiveness against *Phragmites* in Green Bay and Saginaw Bay. CWM data were used to find the best locations, provide baseline data, and provide pointers on site access (from field crew notes) in support of this project.

Reports on new locations of non-native and invasive species: Vegetation sampling crews and PIs have been pro-active over the years in reporting new locations of invasive vegetation. Fish and macroinvertebrate PIs and crews have also realized that they may be discovering new locations of invasive species, particularly invasive macroinvertebrates. To ensure that all new sightings get recorded, we pulled all records of non-native fish and macroinvertebrates out of the database routinely and sent these records to the Nonindigenous Aquatic Species tracking website maintained by USGS (<http://nas2.er.usgs.gov/>). Wetland vegetation PIs contributed new SOLEC indicator guidelines and reports and participated in the indicator review process.

Wetland Floristic Quality in the St. Louis River Estuary: With support from WI Sea Grant 2014-2017, vegetation PI N. Danz integrated vegetation surveys from the CWM project with data from 14 other recent projects in the estuary. A new relational database was created that is being used to assess spatial and temporal patterns in floristic quality and to develop materials to inform and monitor wetland restorations in this AOC.

Coordination and Partnership with National Audubon: Per the agreement to share CWMP bird data with the National Audubon Society, we have provided data and guidance on appropriate use of these data for their project “Prioritizing coastal wetlands for marsh bird conservation in the U.S. Great Lakes”. The resulting manuscript from this project was published in the journal *‘Biological Conservation’* and per the agreement all CWMP bird and anuran co-investigators had the opportunity to contribute to the manuscript and be included as co-authors.

Targeting Invasive Plant Species in Wisconsin Coastal Wetlands: In collaboration with WI Department of Natural Resources and Lake Superior Research Institute, vegetation PIs

summarized patterns of invasive plant occurrence in Wisconsin coastal wetlands. These summaries were used to develop a more comprehensive invasive plant monitoring strategy throughout the Wisconsin basin.

Ken Euers Nature Area Post-Management Action Implementation Monitoring (Lower Green Bay & Fox River AOC): In collaboration with WI Department of Natural Resources, bird-PI E. Giese led an effort to collect data on breeding marsh birds, breeding anurans, spring migratory waterfowl, and breeding coastal birds to assess improvements in these priority populations post-management action implementation at AOC site Ken Euers Nature Area. Giese calculated CWMP's IBC metrics for anurans and marsh birds using the 2025 data for this project along with past CWMP data.

REQUESTS FOR ASSISTANCE COLLECTING MONITORING DATA

Project PIs provided monitoring data and interpretation of data for many wetlands where restoration activities were being proposed by applicants for "Sustain Our Great Lakes" funding. This program is administered by the National Fish and Wildlife Foundation (NFWF) and includes GLRI funding. Proposal writers made data/information requests via NFWF, who communicated the requests to us. Lead PI Don Uzarski, with assistance from co-PIs, then pulled relevant project data and provided interpretations of IBI scores and water quality data. This information was then communicated to NFWF, who communicated with the applicants. This information sharing reflects the value of having coastal wetland monitoring data to inform restoration and protection decisions.

In addition to the NFWF program, CWM PIs have received many requests to sample particular wetlands of interest to various agencies and groups. In some instances the wetlands were scheduled for restoration and the CWM program provided both pre and post-restoration data, to show the beginnings of site condition improvement. Such requests have come from the St. Louis River (Lake Superior), Maumee Bay (Lake Erie), and Rochester (Lake Ontario) Area of Concern delisting groups, the Great Lakes National Park Service, the Nature Conservancy (sites across lakes Michigan and Huron for both groups), as well as state natural resource departments. Several requests involved restorations specifically targeted to create habitat for biota that are being sampled by CWM. Examples include: a NOAA-led restoration of wetlands bordering the Little Rapids of the St. Marys River to restore critical spawning habitat for many native freshwater fishes and provide important nursery and rearing habitat in backwater areas; TNC-led restoration of pike spawning habitats on Lake Ontario and in Green Bay; a US Army Corps of Engineers project in Green Bay to create protective barrier islands and restore many

acres of aquatic and wetland vegetation; a USACE project to improve wetland fish and vegetation habitat in Braddock Bay, Lake Ontario; a New York state project to increase nesting habitat for state-endangered black tern; and projects in Wisconsin to restore degraded coastal wetlands on the Lake Superior shore. Many of these restoration activities were funded through GLRI, so through collaboration we increased efficiency and effectiveness of restoration efforts across the Great Lakes basin.

Even when restoration was still in the planning stages, restoration committees were interested in the data CWM could provide to help them create a restoration plan. This happened in the St. Louis River AOC, in Sodus Bay, Lake Ontario, for the Rochester NY AOC, wetlands along Wisconsin's Lake Superior shoreline, and for the St. Marys River restoration in 2015 by tribal biologists at Sault Ste Marie.

Other groups requested help sampling sites believed to be in very good condition (at least for their geographic location), or are among the last examples of their kind, and are on lists to be protected. These requests came from The Nature Conservancy for Green Bay sites (they are developing a regional conservation strategy and attempting to protect the best remaining sites); the St. Louis River AOC delisting committee to provide target data for restoration work (i.e., what should a restored site "look" like); and the Wisconsin DNR Natural Heritage Inventory requested assistance in looking for rare, endangered, and threatened species and habitats in all of the coastal wetlands along Wisconsin's Lake Superior coastline. Southern Lake Michigan wetlands have mostly been lost, and only three remain that are truly coastal wetlands. CWM PIs worked with Illinois agencies and conservation groups to collaboratively and thoroughly sample one of these sites, and the results will be used to help manage all 3 sites.

Other managers have requested data to help them better manage wetland areas. For example, the Michigan Clean Water Corps requested CWM data to better understand and manage Stony Lake, Michigan. Staff of a coal-fired power plant abutting a CWM site requested our fish data to help them better understand and manage the effects of their outfalls on the resident fish community. The Michigan Natural Features Inventory requested our data as part of a GLRI-funded invasive species mapping project. The US Fish and Wildlife Service requested all data possible from wetlands located within the Rochester, NY, Area of Concern as they assessed trends in the wetlands and compared data to designated delisting criteria. The NERR on Lake Erie (Old Woman Creek) requested our monitoring data to add to their own. The University of Wisconsin Green Bay used our data to monitor control of *Phragmites* in one of their wetlands, and to show habitat restoration. Thunder Bay National Marine Sanctuary (Lake Huron) requested our data to facilitate protection and management of coastal resources within the Sanctuary. The Wisconsin DNR requested data for Fish Creek Wetland as part of an

Environmental Impact Assessment related to a proposed Confined Animal Feeding Operation upstream of the wetland.

We received a request from the USFWS for data to support development of a black tern distribution/habitat model for the Great Lakes region. The initial effort focused on Lakes Huron, Erie and their connecting channels. Various FWS programs (e.g., Migratory Bird, Joint Venture, and Landscape Conservation Cooperatives) are interested in this model as an input to conservation planning for Great Lakes wetlands.

The College at Brockport has been notifying an invasive species rapid-response team led by The Nature Conservancy after each new sighting of water chestnut. Coupling the monitoring efforts of this project with a rapid-response team helped to eradicate small infestations of this new invasive before it became a more established infestation.

We have also received requests to do methods comparison studies. For example, USGS and Five Fathom National Marine Park both requested data and sampling to compare with their own sampling data.

STUDENT RESEARCH SUPPORT

Graduate Research with Leveraged Funding:

- Using advanced morphometrics to improve identification of Sphaeriidae (fingernail clams) of the Great lakes as informed by DNA analyses (University of Minnesota Duluth; other field crews providing specimens).
- Importance of coastal wetlands to offshore fishes of the Great Lakes: Dietary support and habitat utilization (Central Michigan University; with additional funding from several small University grants and the US Fish and Wildlife Service).
- Spatial variation in macroinvertebrate communities within two emergent plant zones in Great Lakes coastal wetlands (Central Michigan University; with additional funding from CMU).
- Invertebrate co-occurrence patterns in coastal wetlands of the Great Lakes: Community assembly rules (Central Michigan University; additional funding from CMU)
- Functional indicators of Great Lakes coastal wetland health (University of Notre Dame; additional funding by Illinois-Indiana Sea Grant).
- Evaluating environmental DNA detection alongside standard fish sampling in Great Lakes coastal wetland monitoring (University of Notre Dame; additional funding by Illinois-Indiana Sea Grant).

- Nutrient-limitation in Great Lakes coastal wetlands (University of Notre Dame; additional funding by the UND College of Science).
- A summary of snapping turtle (*Chelydra serpentina*) by-catch records in Lake Ontario coastal wetlands (with additional funding by University of Toronto).
- Evaluating a zoobenthic indicator of Great Lakes wetland condition (with additional funding from University of Windsor).
- Testing and comparing the diagnostic value of three fish community indicators of Great Lakes wetland condition (with additional funding from GLRI GLIC: GLEI II and University of Windsor).
- Quantifying Aquatic Invasion Patterns Through Space and Time: A Relational Analysis of the Laurentian Great Lakes (University of Minnesota Duluth; with additional funding and data from USEPA)
- Novel Diagnostics for Biotransport of Aquatic Environmental Contaminants (University of Notre Dame, with additional funding from Advanced Diagnostics & Therapeutics program)
- Conservation of Common Terns in the Great Lakes Region (University of Minnesota; with additional funding from USFWS, MNDNR, and multiple smaller internal and external grants).
- Distribution of yellow perch in Great Lakes coastal wetlands (Grand Valley State University; with additional funding from GVSU).
- Variation in aquatic invertebrate assemblages in coastal wetland wet meadow zones of Lake Huron, of the Laurentian Great Lakes (University of Windsor; with additional funding from the University of Windsor).
- Influence of water level fluctuations and diel variation in dissolved oxygen concentrations on fish habitat use in Great Lakes coastal wetlands (University of Windsor; with additional funding from the University of Windsor).
- Bird community response to changes in wetland extent and lake level in Great Lakes coastal wetlands (University of Wisconsin-Green Bay with additional funding from Bird Studies Canada)
- Inferential measures for a quantitative ecological indicator of ecosystem health (University of Wisconsin-Green Bay)
- Per- and polyfluorinated alkyl substances (PFAS) in Great Lakes food webs and sportfish (University of Notre Dame)
- King Rail spatial ecology and conservation in Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering and Joint Ventures).
- Secretive marsh bird ecology and conspecific attraction (Central Michigan University, with additional funding from the CMU College of Science and Engineering).

- Coastal wetland bird habitat associations in the Laurentian Great Lakes region (University of Wisconsin-Green Bay Cofrin Center for Biodiversity, with additional funding from UW-Green Bay's Heirloom Grant Fund).
- Plant introductions and community dynamics across environmental gradients in Great Lakes coastal wetlands (SUNY Brockport, with additional funding from The Lawrence C. and Gabriella S. Albanese Wetlands Conservation Student Research Support Fund).

Undergraduate Research with Leveraged Funding:

- Production of a short documentary film on Great Lakes coastal wetlands (University of Notre Dame; additional funding by the UND College of Arts and Letters).
- Heavy metal loads in freshwater turtle species inhabiting coastal wetlands of Lake Michigan (University of Notre Dame; additional funding by the UND College of Science, and ECI – Environmental Change Institute). [Online coverage](#), [TV](#) and [radio](#).
- Nitrogen-limitation in Lake Superior coastal wetlands (Northland College; additional funding from the Wisconsin DNR and Northland College).
- Patterns in chlorophyll-*a* concentrations in Great Lakes coastal wetlands (Northland College; additional funding provided by the college).
- *Phragmites australis* effects on coastal wetland nearshore fish communities of the Great Lakes basin (University of Windsor; with additional funding from GLRI GLIC: GLEI II).
- Sonar-derived estimates of macrophyte density and biomass in Great Lakes coastal wetlands (University of Windsor; with additional funding from GLRI GLIC: GLEI II presented at the International Association for Great Lakes Research annual meeting).
- Effects of disturbance frequency on the structure of coastal wetland macroinvertebrate communities (Lake Superior State University; with additional funding from LSSU's Undergraduate Research Committee; awarded Best Student Poster award at LSSU Research Symposium; presented at MI American Fisheries Society annual meeting).
- Resistance and resilience of macroinvertebrate communities in disturbed and undisturbed coastal wetlands (Lake Superior State University; with additional funding from LSSU's Undergraduate Research Committee, (presented at MI American Fisheries Society annual meeting and Midwest Fish and Wildlife Conference).
- Structure and function of restored Roxana Marsh in southern Lake Michigan (University of Notre Dame, with additional funding from the UND College of Science)
- Nutrient limitation in Great Lakes coastal wetlands (Central Michigan University, CMU Biological Station on Beaver Island)
- Effects of wetland size and adjacent land use on taxonomic richness (University of Minnesota Duluth, with additional funding from UMD's UROP program)

- Water depth optima and tolerances for St. Louis River estuary wetland plants (University of Wisconsin-Superior, with additional funding from WI Sea Grant)
- Mapping Wetland Areal Change in the St. Louis River Estuary Using GIS (University of Wisconsin-Superior, with additional funding from WI Sea Grant)
- An analysis of Microcystin concentrations in Great Lakes coastal wetlands (Central Michigan University; additional funding by CMU College of Science and Engineering).
- Bathymetry and water levels in lagoonal wetlands of the Apostle Islands National Lakeshore (Northland College; additional funding from the National Park Service). Several presentations at regional meetings and IAGLR.
- Non-native fish use of Great Lakes coastal wetlands (Northland College funding). Poster presentations by Northland College students at Wisconsin Wetland Science Meeting and IAGLR.

Graduate Research without Leveraged Funding:

- Impacts of drainage outlets on Great Lakes coastal wetlands (Central Michigan University).
- Effects of anthropogenic disturbance affecting coastal wetland vegetation (Central Michigan University).
- Great Lakes coastal wetland seed banks: what drives compositional change? (Central Michigan University).
- Spatial scale variation in patterns and mechanisms driving fish diversity in Great Lakes coastal wetlands (Central Michigan University).
- Building a model of macroinvertebrate functional feeding group community through zone succession: Does the River Continuum Concept apply to Great Lakes coastal wetlands? (Central Michigan University).
- Chemical and physical habitat variation within Great Lakes coastal wetlands; the importance of hydrology and dominant plant zonation (Central Michigan University)
- Macroinvertebrate-based Index of Biotic Integrity for Great Lakes coastal wetlands (Central Michigan University)
- Habitat conditions and invertebrate communities of Great Lakes coastal habitats dominated by Wet Meadow, and *Phragmites australis*: implications of macrophyte structure changes (Central Michigan University)
- The establishment of *Bithynia tentaculata* in coastal wetlands of the Great Lakes (Central Michigan University)
- Environmental covariates as predictors of anuran distribution in Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering)

- Impacts of muskrat herbivory in Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering).
- Mute swan interactions with native waterfowl in Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering).
- Predictive modeling of Mute Swan occurrence in Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering).
- Marshland birds in fragmented Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering).
- Estimating muskrat relative abundance with UAV's (Central Michigan University, with additional funding from the CMU College of Science and Engineering).
- Identifying factors influencing muskrat abundance in Great Lakes coastal wetlands (Central Michigan University, with additional funding from the CMU College of Science and Engineering).
- Effects of turbidity regimes on fish and macroinvertebrate community structure in coastal wetlands (Lake Superior State University and Oakland University).
- Scale dependence of dispersal limitation and environmental species sorting in Great Lakes wetland invertebrate meta-communities (University of Notre Dame).
- Spatial and temporal trends in invertebrate communities of Great Lakes coastal wetlands, with emphasis on Saginaw Bay of Lake Huron (University of Notre Dame).
- Invertebrate spatial biodiversity in coastal wetlands of the Laurentian Great Lakes (University of Notre Dame)
- Model building and a comparison of the factors influencing sedge and marsh wren populations in Great Lakes coastal wetlands (University of Minnesota Duluth).
- The effect of urbanization on the stopover ecology of Neotropical migrant songbirds on the western shore of Lake Michigan (University of Minnesota Duluth).
- Assessing the role of nutrients and watershed features in cattail invasion (*Typha angustifolia* and *Typha x glauca*) in Lake Ontario wetlands (The College at Brockport).
- Developing captive breeding methods for bowfin (*Amia calva*) (The College at Brockport).
- Water chestnut (*Trapa natans*) growth and management in Lake Ontario coastal wetlands (The College at Brockport).
- Functional diversity and temporal variation of migratory land bird assemblages in lower Green Bay (University of Wisconsin-Green Bay).
- Effects of invasive *Phragmites* on stopover habitat for migratory shorebirds in lower Green Bay, Lake Michigan (University of Wisconsin-Green Bay).

- Plant species associations and assemblages for the whole Great Lakes, developed through unconstrained ordination analyses (Oregon State University).
- Genetic barcoding to identify black and brown bullheads (Grand Valley State University).
- Coastal wetland – nearshore linkages in Lake Michigan for sustaining sport fishes (University of Notre Dame)
- Anthropogenic disturbance effects on bird and anuran communities in Lake Ontario coastal wetlands (The College at Brockport)
- A fish-based index of biotic integrity for Lake Ontario coastal wetlands (The College at Brockport)
- Modeling potential nutria habitat in Great Lakes coastal wetlands (Central Michigan University)
- Modeling of Eurasian ruffe (*Gymnocephalus cernua*) habitat preferences to predict future invasions (University of Minnesota Duluth in collaboration with USEPA MED)
- Modeling species-specific habitat associations of Great Lakes coastal wetland birds (University of Minnesota)
- The effect of urbanization on the stopover ecology of Neotropical migrant songbirds on the western shore of Lake Michigan (University of Minnesota Duluth).
- Nutrient limitation in Great Lakes coastal wetlands: gradients and their influence (Central Michigan University; with additional funding from the CMU College of Science and Engineering)
- Invasive *Phragmites australis* management (Central Michigan University; with additional funding from the CMU College of Science and Technology)
- The relationship between vegetation and ice formation in Great Lakes coastal wetlands (Central Michigan University; with additional funding from CMU College of Science and Engineering)
- PFAS accumulation by Dressenidae *spp* in Great Lakes Coastal Wetlands (Central Michigan University)
- Development of a vegetation based IBI for Great Lakes Coastal Wetlands (Central Michigan University)
- Development of a model for Great-Lakes wide invasive plant harvest for bioenergy production and nutrient recycling (Loyola Chicago and Oregon State University)
- Updating the Macroinvertebrate-based Index of Biotic Integrity for Great Lakes coastal wetlands (Central Michigan University)
- Great Lakes coastal wetland bird and anuran habitat associations (UW-Green Bay)

Undergraduate Research without Leveraged Funding:

- Sensitivity of fish community metrics to net set locations: a comparison between Coastal Wetland Monitoring and GLEI methods (University of Minnesota Duluth).
- Larval fish usage and assemblage composition between different wetland types (Central Michigan University).
- Determining wetland health for selected Great Lakes Coastal Wetlands and incorporating management recommendations (Central Michigan University).
- Invertebrate co-occurrence trends in the wetlands of the Upper Peninsula and Western Michigan and the role of habitat disturbance levels (Central Michigan University).
- Is macroinvertebrate richness and community composition determined by habitat complexity or variation in complexity? (University of Windsor, complete; Published in *Ecosphere*).
- Modeling American coot habitat relative to faucet snail invasion potential (Central Michigan University).
- Nutrient uptake by *Phragmites australis* and native wetland plants (Central Michigan University).
- Comparison of the diagnostic accuracy two aquatic invertebrate field collection and laboratory sorting methods (University of Windsor, complete).
- Validation of a zoobenthic assemblage condition index for Great Lakes coastal wetlands (University of Windsor, complete).
- Water depth-related variation in net ecosystem production in a Great Lakes coastal wet meadow (University of Windsor, complete).
- Anuran habitat use in the Lower Green Bay and Fox River Area of Concern (University of Wisconsin-Green Bay with support from GLRI/AOC funding).
- Impacts of European frog-bit invasion on wetland macroinvertebrate communities (Lake Superior State University; presented at Midwest Fish and Wildlife Conference).
- Effects of European frog-bit on water quality and fish assemblages in St. Marys River coastal wetlands (Lake Superior State University; presented at Midwest Fish and Wildlife Conference).
- Functional diversity of macroinvertebrates in coastal wetlands along the St. Marys River (Lake Superior State University; awarded Best Student Poster award at LSSU Research Symposium; presented at Midwest Fish and Wildlife Conference).
- A comparison of macroinvertebrate assemblages in coastal wetlands exposed to varying wave disturbance (Lake Superior State University; presented at MI American Fisheries Society annual meeting).

- Coastal wetlands as nursery habitat for young-of-year fishes in the St. Marys River (Lake Superior State University; presented at MI American Fisheries Society annual meeting)
- Relationship between water level and fish assemblage structure in St. Marys River coastal wetlands (Lake Superior State University; presented at MI American Fisheries Society annual meeting)
- Dominance patterns in macroinvertebrate communities in Great Lakes coastal wetlands: does environmental stress lead to uneven community structure? Northland College.
- Understanding drivers of chlorophyll-a in Great Lakes coastal wetlands. University of Notre Dame
- Evaluating fish assemblage changes throughout the summer in St. Marys River coastal wetlands (Lake Superior State University)
- Quantifying litter decomposition in wetlands of varying condition (Lake Superior State University)
- Coastal wetland anuran habitat associations in the Laurentian Great Lakes region (University of Wisconsin-Green Bay Cofrin Center for Biodiversity).

JOBS CREATED/RETAINED (AVERAGES AND CUMULATIVE OVER 3 ROUNDS)

- Principal Investigators (partial support): 20 (average per year)
- Post-doctoral researchers (partial support; cumulative): 7
- Total graduate students supported on project (part-time; cumulative): 113
- Unpaid undergraduate internship (summer, cumulative): 35
- Undergraduate students (paid; summer and/or part-time; cumulative): 194
- Technicians, jr. scientists (summer and/or partial support; cumulative): 135
- Volunteers (cumulative): 47

Total jobs at least partially supported: 469.

Students and post-doctoral researchers trained: 350.

PRESENTATIONS ABOUT THE COASTAL WETLAND MONITORING PROGRAM

(INCEPTION THROUGH 2026)

Albert, Dennis. 2013. Use of Great Lakes Coastal Wetland Monitoring data in restoration projects in the Great Lakes region. 5th Annual Conference on Ecosystem Restoration, Schaumburg, IL. July 30, 2013. 20 attendees, mostly managers and agency personnel.

Albert, Dennis. 2013. Data collection and use of Great Lakes Coastal Wetland Monitoring data by Great Lakes restorationists. Midwestern State Wetland Managers Meeting, Kellogg

Biological Station, Gull Lake, MI, October 31, 2013. 40 attendees; Great Lakes state wetland managers.

Albert, Dennis, N. Danz, D. Wilcox, and J. Gathman. 2014. Evaluating Temporal Variability of Floristic Quality Indices in Laurentian Great Lakes Coastal Wetlands. Society of Wetland Scientists, Portland, OR. June.

Albert, Dennis, et al. 2015. Restoration of wetlands through the harvest of invasive plants, including hybrid cattail and *Phragmites australis*. Presented to Midwestern and Canadian biologists. June.

Albert, Dennis, et al. 2015. Great-Lakes wide distribution of bulrushes and invasive species. Coastal and Estuarine Research Federation Conference in Portland, Oregon. November.

Amatangelo, K., D. Wilcox, R. Schultz, M. Altenritter, M. Chislock, and G. Lawrence. 2021. Application of the Great Lakes Coastal Wetlands Monitoring Program to Restoration Projects in Lake Ontario Wetlands. State of Lake Ontario Conference. March 9-11, 2021, online.

Baldwin, R., B. Currell, and A. Moerke. 2014. Effects of disturbance history on resistance and resilience of coastal wetlands. Midwest Fish and Wildlife Conference, January, Kansas City, MO.

Baldwin, R., B. Currell, and A. Moerke. 2014. Effects of disturbance history on resistance and resilience of coastal wetlands. MI American Fisheries Society annual meeting, February, Holland, MI.

Bergen, E., E. Shively, M.J. Cooper. Non-native fish species richness and distributions in Great Lakes coastal wetlands. International Association for Great Lakes Research Annual Conference, June 10-14, 2019, Brockport, NY. (poster)

Bergen, E., E. Shively, M.J. Cooper. Drivers of non-native fish species richness and distribution in the Laurentian Great Lakes. February 19-21, 2019. Madison, WI. (poster)

Bozimowski, S. and D.G. Uzarski. 2016. The Great Lakes coastal wetland monitoring program. 2016 Wetlands Science Summit, Richfield, OH. September, Oral Presentation.

Bozimowski, A.A., B.A. Murry, and D.G. Uzarski. 2012 Invertebrate co-occurrence patterns in the wetlands of northern and eastern Lake Michigan: the interaction of the harsh-benign hypothesis and community assembly rules. 55th International Conference on Great Lakes Research, Cornwall, Ontario.

- Bozimowski, A. A., B. A. Murry, P. S. Kourtev, and D. G. Uzarski. 2014. Aquatic macroinvertebrate co-occurrence patterns in the coastal wetlands of the Great Lakes: the interaction of the harsh-benign hypothesis and community assembly rules. Great Lakes Science in Action Symposium, Central Michigan University, Mt. Pleasant, MI. April.
- Bozimowski, A.A., B.A. Murry, P.S. Kourtev, and D.G. Uzarski. 2015. Aquatic macroinvertebrate co-occurrence patterns in the coastal wetlands of the Great Lakes. 58th International Conference on Great Lakes Research, Burlington, VT.
- Bozimowski, A.A. and D.G. Uzarski. 2017. Monitoring a changing ecosystem: Great Lakes coastal wetlands. Saginaw Bay Watershed Initiative Network's State of the Bay Conference.
- Bracey, A. M., R. W. Howe, N.G. Walton, E. E. G. Giese, and G. J. Niemi. Avian responses to landscape stressors in Great Lakes coastal wetlands. 5th International Partners in Flight Conference and Conservation Workshop. Snowbird, UT, August 25-28, 2013.
- Brady, V., D. Uzarski, and M. Cooper. 2013. Great Lakes Coastal Wetland Monitoring: Assessment of High-variability Ecosystems. USEPA Mid-Continent Ecology Division Seminar Series, May 2013. 50 attendees, mostly scientists (INVITED).
- Brady, V., G. Host, T. Brown, L. Johnson, G. Niemi. 2013. Ecological Restoration Efforts in the St. Louis River Estuary: Application of Great Lakes Monitoring Data. 5th Annual Conference on Ecosystem Restoration, Schaumburg, IL. July 30, 2013. 20 attendees, mostly managers and agency personnel.
- Brady, V. and D. Uzarski. 2013. Great Lakes Coastal Wetland Fish and Invertebrate Condition. Midwestern State Wetland Managers Meeting, Kellogg Biological Station, Gull Lake, MI, October 31, 2013. 40 attendees; Great Lakes state wetland managers.
- Brady, V., D. Uzarski, T. Brown, G. Niemi, M. Cooper, R. Howe, N. Danz, D. Wilcox, D. Albert, D. Tozer, G. Grabas, C. Ruetz, L. Johnson, J. Ciborowski, J. Haynes, G. Neuderfer, T. Gehring, J. Gathman, A. Moerke, G. Lamberti, C. Normant. 2013. A Biotic Monitoring Program for Great Lakes Coastal Wetlands. Society of Wetland Scientists annual meeting, Duluth, MN, June 2013. 25 attendees, mostly scientists, some agency personnel.
- Brady, V., D. Uzarski, T. Brown, G. Niemi, M. Cooper, R. Howe, N. Danz, D. Wilcox, D. Albert, D. Tozer, G. Grabas, C. Ruetz, L. Johnson, J. Ciborowski, J. Haynes, G. Neuderfer, T. Gehring, J. Gathman, A. Moerke, G. Lamberti, C. Normant. 2013. Habitat Values Provided by Great Lakes Coastal Wetlands: based on the Great Lakes Coastal Wetland Monitoring Project. Society of Wetland Scientists annual meeting, Duluth, MN, June 2013. 20 attendees, mostly scientists.

- Brady, V.J., D.G. Uzarski, M.J. Cooper, D.A. Albert, N. Danz, J. Domke, T. Gehring, E. Giese, A. Grinde, R. Howe, A.H. Moerke, G. Niemi, H. Wellard-Kelly. 2018. How are Lake Superior's wetlands? Eight years, 100 wetlands sampled. State Of Lake Superior Conference. Houghton, MI. Oral Presentation.
- Brady, V., G. Niemi, J. Dumke, H. Wellard Kelly, M. Cooper, N. Danz, R. Howe. 2019. The role of monitoring data in coastal wetland restoration: Case studies from Duluth and Green Bay. International Association of Great Lakes Research Annual Meeting, Brockport, NY, June 2019. Invited oral presentation.
- Buckley, J.D., and J.J.H. Ciborowski. 2013. A comparison of fish indices of biological condition at Great Lakes coastal margins. 66th Canadian Conference for Freshwater Fisheries Research, Windsor, ON, January 3-5 2013. Poster Presentation.
- Chorak, G.M., C.R. Ruetz III, R.A. Thum, J. Wesolek, and J. Dumke. 2015. Identification of brown and black bullheads: evaluating DNA barcoding. Poster presentation at the Annual Meeting of the Michigan Chapter of the American Fisheries Society, Bay City, Michigan. January 20-21.
- Cooper, M.J. Great Lakes coastal wetland monitoring: chemical and physical parameters as co-variates and indicators of wetland health. Biennial State of the Lakes Ecosystem Conference, Erie, PA, October 26-27, 2011. Oral presentation.
- Cooper, M.J. Coastal wetland monitoring: methodology and quality control. Great Lakes Coastal Wetland Monitoring Workshop, Traverse City, MI, August 30, 2011. Oral presentation.
- Cooper, M.J., D.G. Uzarski, and G.L. Lamberti. GLRI: coastal wetland monitoring. Michigan Wetlands Association Annual Conference, Traverse City, MI, August 30-September 2, 2011. Oral presentation.
- Cooper, M.J. Monitoring the status and trends of Great Lakes coastal wetland health: a basin-wide effort. Annual Great Lakes Conference, Institute of Water Research, Michigan State University, East Lansing, MI, March 8, 2011. Oral presentation.
- Cooper, M.J., G.A. Lamberti, and D.G. Uzarski. Monitoring ecosystem health in Great Lakes coastal wetlands: a basin-wide effort at the intersection of ecology and management. Entomological Society of America, Reno, NV, November 13-16, 2011. Oral presentation.
- Cooper, M.J., and G.A. Lamberti. Taking the pulse of Great Lakes coastal wetlands: scientists tackle an epic monitoring challenge. Poster session at the annual meeting of the National Science Foundation Integrative Graduate Education and Research Traineeship Program, Washington, D.C., May 2012. Poster presentation.

Cooper, M.J., J.M. Kosiara, D.G. Uzarski, and G.A. Lamberti. Nitrogen and phosphorus conditions and nutrient limitation in coastal wetlands of Lakes Michigan and Huron. Annual meeting of the International Association for Great Lakes Research. Cornwall, Ontario. May 2012. Oral presentation.

Cooper, M.J., G.A. Lamberti, and D.G. Uzarski. Abiotic drivers and temporal variability of Saginaw Bay wetland invertebrate communities. International Association for Great Lakes Research, 56th annual meeting, West Lafayette, IN. June 2013. Oral presentation.

Cooper, M.J., D.G. Uzarski, J. Sherman, and D.A. Wilcox. Great Lakes coastal wetland monitoring program: support of restoration activities across the basin. National Conference on Ecosystem Restoration, Chicago, IL. July 2013. Oral presentation.

Cooper, M.J. and J. Kosiara. Great Lakes coastal wetland monitoring: Chemical and physical parameters as co-variables and indicators of wetland health. US EPA Region 5 Annual Wetlands Program Coordinating Meeting and Michigan Wetlands Association Annual Meeting. Kellogg Biological Station, Hickory Corners, MI. October 2013. Oral presentation.

Cooper, M.J. Implementing coastal wetland monitoring. Inter-agency Task Force on Data Quality for GLRI-Funded Habitat Projects. CSC Inc., Las Vegas, NV. November 2013. Web presentation, approximately 40 participants.

Cooper, M.J. Community structure and ecological significance of invertebrates in Great Lakes coastal wetlands. SUNY-Brockport, Brockport, NY. December 2013. Invited seminar.

Cooper, M.J. Great Lakes coastal wetlands: ecological monitoring and nutrient-limitation. Limno-Tech Inc., Ann Arbor, MI. December 2013. Invited seminar.

Cooper, M.J., D.G. Uzarski, and V.J. Brady. A basin-wide Great Lakes coastal wetland monitoring program: Measures of ecosystem health for conservation and management. Great Lakes Wetlands Day, Toronto, Ont. Canada, February 4, 2014. Oral presentation.

Cooper, M.J., G.A. Lamberti, and D.G. Uzarski. Supporting Great Lakes coastal wetland restoration with basin-wide monitoring. Great Lakes Science in Action Symposium. Central Michigan University. April 4, 2014.

Cooper, M.J. Expanding fish-based monitoring in Great Lakes coastal wetlands. Michigan Wetlands Association Annual Meeting. Grand Rapids, MI. August 27-29, 2014.

Cooper, M.J. Structure and function of Great Lakes coastal wetlands. Public seminar of Ph.D. dissertation research. University of Notre Dame. August 6, 2014.

Cooper, M.J., D.G. Uzarski, and T.N. Brown. Developing a decision support system for protection and restoration of Great Lakes coastal wetlands. Biodiversity without Borders Conference, NatureServe. Traverse City, MI. April 27, 2015.

Cooper, M.J. and D.G. Uzarski. Great Lakes coastal wetland monitoring for protection and restoration. Lake Superior Monitoring Symposium. Michigan Technological University. March 19, 2015.

Cooper, M.J. Where worlds collide: ecosystem structure and function at the land-water interface of the Laurentian Great Lakes. Central Michigan University Department of Biology. Public Seminar. February 5, 2015.

Cooper, M.J. Where worlds collide: ecosystem structure and function at the land-water interface of the Laurentian Great Lakes. Sigurd Olson Environmental Institute, Northland College. Public Seminar. May 4, 2015.

Cooper, M.J., and D.G. Uzarski. Great Lakes coastal wetland monitoring for protection and restoration. Lake Huron Restoration Meeting. Alpena, MI. May 14, 2015.

Cooper, M.J., D.G. Uzarski, and V.J. Brady. Developing a decision support system for restoration and protection of Great Lakes coastal wetlands. Wisconsin Wetlands Association Annual Meeting. February 24-25, 2016. Green Bay, WI.

Cooper, M.J., Stirratt, H., B. Krumwiede, and K. Kowalski. Great Lakes Resilient Lands and Waters Initiative, Deep Dive. Remote presentation to the White House Council on Environmental Quality and partner agencies, January 28, 2016.

Cooper, M., Redder, T., Brady, V. and D. Uzarski. 2016. Developing a decision support tool to guide restoration and protection of Great Lakes coastal wetlands. Annual Meeting of the Wisconsin Wetlands Association, Stevens Point, WI. February. Presentation.

Cooper, M.J.. Nutrient limitation in wetland ecosystems. Wisconsin Department of Natural Resources, February 12, 2016, Rhinelander, WI.

Cooper, M.J., D.G. Uzarski and V.J. Brady. 2016. Developing a decision support system for restoration and protection of Great Lakes coastal wetlands. Wisconsin Wetlands Association Annual Meeting, Green Bay, WI. February 24-25. Oral Presentation.

Cooper, M.J.. Monitoring biotic and abiotic conditions in Great Lakes coastal wetlands. Wisconsin DNR Annual Surface Water Quality Conference. May 2016, Tomahawk, WI.

Cooper, M.J. The Depth of Wisconsin's Water Resources. Panel Discussion, Wisconsin History Tour, Northern Great Lakes Visitors Center, June 15, 2016, Ashland, WI.

Cooper, M.J.. Great Lakes Coastal Wetlands. The White House Resilient Lands and Waters Initiative Roundtable. Washington, DC, November 17, 2016.

Cooper, M.J. Translating Science Into Action in the Great Lakes. Marvin Pertzik Lecture Series. Northland College, May 2016.

Cooper, M.C., C. Hippensteel, D.G. Uzarski, and T.M. Redder. Developing a decision support tool for Great Lakes coastal wetlands. LCC Coastal Conservation Working Group Annual Meeting, Great Lakes Environmental Research Laboratory, Ann Arbor, MI, Oct. 6, 2016.

Cooper, M.J., T.M. Redder, C. Hippensteel, V.J. Brady, D.G. Uzarski. Developing a decision support tool to guide restoration and protection of Great Lakes coastal wetlands. Midwest Fish and Wildlife Conference, Feb. 5-8, 2017, Lincoln, NE.

Cooper, M.J., T.M. Redder, V.J. Brady, D.G. Uzarski. Developing a decision support tool to guide restoration and protection of Great Lakes coastal wetlands. Wisconsin Wetlands Association Annual Conference, February 28-March 2, 2017, Steven's Point, WI.

Cooper, M.J. Coastal Wetlands as Metabolic Gates, Sediment Filters, Swiss Army Knife Habitats, and Biogeochemical Hotspots. Science on Tap, Ashland, WI, March 21, 2017.

Cooper, M.J., Brady, V.J., Uzarski, D.G., Lamberti, G.A., Moerke, A.H., Ruetz, C.R., Wilcox, D.A., Ciborowski, J.J.H., Gathman, J.P., Grabas, G.P., and Johnson, L.B. An Expanded Fish-Based Index of Biotic Integrity for Great Lakes Coastal Wetlands. International Association for Great Lakes Research 60th Annual Meeting, Detroit, MI, May 15-19, 2017.

Cooper, M.J., D.G. Uzarski, and A. Garwood. Great Lakes Coastal Wetland Monitoring." Webinar hosted by Michigan Department of Environmental Quality, April 14, 2017. 78 attendees.

Cooper, M.J., A. Hefko, M. Wheeler. Nitrogen limitation of Lake Superior coastal wetlands. Society for Freshwater Science Annual Conference, May 20-24, 2018, Detroit, MI.

Cooper, M.J. The Role of Wetlands in Maintaining Water Quality. Briefing to the International Joint Commission, Ashland, WI, September 26, 2019.

Cooper, M.J., V.J. Brady, and D.G. Uzarski. Great Lakes Coastal Wetland Monitoring. Plenary Presentation, Great Lakes Coastal Wetland Symposium, Oregon, OH, September 19, 2019.

Cooper, M.J. and S. Johnson. Life on the Soggy Edges. Madeline Island Wilderness Preserve Lecture Series, Madeline Island Museum, La Pointe, WI, June 19, 2019.

Cooper, M.J., T.M. Redder, V.J. Brady, D.G. Uzarski. A data visualization tool to support protection and restoration of Great Lakes coastal wetlands. International Association for Great Lakes Research Annual Conference, June 10-14, 2019, Brockport, NY.

Cooper, M.J., V.J. Brady, and D.G. Uzarski. 2022. Detecting Human Disturbance in Coastal Wetlands Across Temporal and Spatial Scales Using Biotic Indicators. Great Lakes Coastal Symposium. Sept. 19-21, 2022. Sault Ste. Marie, MI

Cooper, M.J., V.J. Brady, and D.G. Uzarski. 2023. Monitoring Great Lakes Coastal Wetlands. Michigan Wetlands Association Annual Meeting. Sept. 12-14, 2023. Kalamazoo, MI

Curell, Brian. 2014. Effects of disturbance frequency on macroinvertebrate communities in coastal wetlands. MI American Fisheries Society annual meeting, February, Holland, MI.

Dahlberg, N., N.P. Danz, and S. Schooler. 2015. Integrating prior vegetation surveys from the St. Louis River estuary. Poster presentation at the 2015 Annual St. Louis River Summit, Superior, WI.

Dahlberg, N., N.P. Danz, and S. Schooler. 2017. 2012 Flood Impacts on St. Louis River Plant Communities. Poster presentation at St. Louis River Summit, Superior, WI.

Danz, N.P. 2014. Floristic quality of Wisconsin coastal wetlands. Oral presentation at the Wisconsin Wetlands Association 19th Annual Wetlands Conference, LaCrosse, WI. Audience mostly scientists.

Danz, N.P. Floristic Quality of Coastal and Inland Wetlands of the Great Lakes Region. Invited presentation at the University of Minnesota Duluth, Duluth, MN.

Danz, N.P., S. Schooler, and N. Dahlberg. 2015. Floristic quality of St. Louis River estuary wetlands. Oral presentation at the 2015 Annual St. Louis River Summit, Superior, WI.

Danz, N.P. 2016. Floristic quality of St. Louis River estuary wetlands. Invited presentation at the Center for Water and the Environment, Natural Resources Research Institute, Duluth, MN.

Danz, N.P. 2017. Connections Between Human Stress, Wetland Setting, and Vegetation in the St. Louis River Estuary. Oral presentation at the Wetland Science Conference, Stevens Point, WI.

Danz, N.P. 2017. 10 Things We Learned from Your Vegetation Data. Oral presentation at the St. Louis River Summit, Superior, WI.

Daly, D., T. Dunn, and A. Moerke. 2016. Effects of European frog-bit on water quality and fish assemblages in St. Marys River wetlands. Midwest Fish and Wildlife Conference, Grand Rapids, MI. January 24-27.

Des Jardin, K. and D.A. Wilcox. 2014. Water chestnut: germination, competition, seed viability, and competition in Lake Ontario. New York State Wetlands Forum, Rochester, NY.

Dumke, J.D., V.J. Brady, J. Ciborowski, J. Gathman, J. Buckley, D. Uzarski, A. Moerke, C. Ruetz III. 2013. Fish communities of the upper Great Lakes: Lake Huron's Georgian Bay is an outlier. Society for Wetland Scientists, Duluth, Minnesota. 30 attendees, scientists and managers.

Dumke, J.D., V.J. Brady, R. Hell, A. Moerke, C. Ruetz III, D. Uzarski, J. Gathman, J. Ciborowski. 2013. A comparison of St. Louis River estuary and the upper Great Lakes fish communities (poster). Minnesota American Fisheries Society, St. Cloud, Minnesota. Attendees scientists, managers, and agency personnel.

Dumke, J.D., V.J. Brady, R. Hell, A. Moerke, C. Ruetz III, D. Uzarski, J. Gathman, J. Ciborowski. 2013. A comparison of wetland fish communities in the St. Louis River estuary and the upper Great Lakes. St. Louis River Estuary Summit, Superior, Wisconsin. 150 attendees, including scientists, managers, agency personnel, and others.

Dumke, J.D., V.J. Brady, J. Erickson, A. Bracey, N. Danz. 2014. Using non-degraded areas in the St. Louis River estuary to set biotic delisting/restoration targets. St. Louis River Estuary Summit, Superior, Wisconsin. 150 attendees, including scientists, managers, agency personnel, and others.

Dumke, J., C.R. Ruetz III, G.M. Chorak, R.A. Thum, and J. Wesolek. 2015. New information regarding identification of young brown and black bullheads. Oral presentation at the Annual Meeting of the Wisconsin Chapter of the American Fisheries Society, Eau Claire, Wisconsin. February 24-26. 150 attendees, including scientists, managers, agency personnel, and others.

Dunn, T., D. Daly, and A. Moerke. 2016. Impacts of European frog-bit invasion on Great Lakes wetlands macroinvertebrate communities. Midwest Fish and Wildlife Conference, Grand Rapids, MI. January 24-27.

Dykstra, K.M., C.R. Ruetz III, M.J. Cooper, and D.G. Uzarski. 2018. Occupancy and detection of yellow perch in Great Lakes coastal wetlands. Poster presentation at the Annual Meeting of the Society for Freshwater Science, Detroit, Michigan. May 20-24.

Dykstra (Emelander), K.M., C.R. Ruetz III, M.J. Cooper, and D.G. Uzarski. 2018. Occupancy and detection of yellow perch in Great Lakes coastal wetlands: preliminary results. Poster

presentation at the annual meeting of the Michigan Chapter of the American Fisheries Society, Port Huron, Michigan. February 13-14.

Elliot, L.H., A.M. Bracey, G.J. Niemi, D.H. Johnson, T.M. Gehring, E.E. Gnass Giese, G.P. Grabas, R.W. Howe, C.J. Norment, and D.C. Tozer. Habitat Associations of Coastal Wetland Birds in the Great Lakes Basin. American Ornithological Society Meeting, East Lansing, Michigan. Poster Presentation. 31 July-5 August 2017.

Elliott, L.H., A. Bracey, G. Niemi, D.H. Johnson, T. Gehring, E. Giese, G. Grabas, R. Howe, C. Norment, and D.C. Tozer. 2018. Hierarchical modeling to identify habitat associations of secretive marsh birds in the Great Lakes. IAGLR Conference, Toronto, Canada. Oral Presentation. 18-22 June 2018.

Fraley, E.F. and D.G. Uzarski 2017. The relationship between vegetation and ice formation in Great Lakes coastal wetlands. 60th Annual Meeting of the International Association of Great Lakes Research. Detroit, MI. Poster.

Fraley, E.F. and D.G. Uzarski. 2016. The Impacts of Ice on Plant Communities in Great Lakes Coastal Wetlands. 7th Annual Meeting of the Michigan Consortium of Botanists, Grand Rapids, MI. October. Poster.

Gathman, J.P. 2013. How healthy are Great Lakes wetlands? Using plant and animal indicators of ecological condition across the Great Lakes basin. Presentation to Minnesota Native Plant Society. November 7, 2013.

Gathman, J.P., J.J.J. Ciborowski, G. Grabas, V. Brady, and K.E. Kovalenko. 2013. Great Lakes Coastal Wetland Monitoring project: progress report for Canada. 66th Canadian Conference for Freshwater Fisheries Research, Windsor, ON, January 3-5, 2013. Poster Presentation.

Gilbert, J.M., N. Vidler, P. Cloud Sr., D. Jacobs, E. Slavik, F. Letourneau, K. Alexander. 2014. *Phragmites australis* at the crossroads: Why we cannot afford to ignore this invasion. Great Lakes Wetlands Day Conference, Toronto, ON, February 4, 2014.

Gilbert, J.M. 2013. Phragmites Management in Ontario. Can we manage without herbicide? Webinar, Great Lakes *Phragmites* Collaborative, April 5, 2013.

Gilbert, J.M. 2012. *Phragmites australis*: a significant threat to Laurentian Great Lakes Wetlands, Oral Presentation, International Association of Great Lakes Wetlands, Cornwall, ON, May 2012

Gilbert, J.M. 2012. *Phragmites australis*: a significant threat to Laurentian Great Lakes Wetlands, Oral Presentation to Waterfowl and Wetlands Research, Management and Conservation in the Lower Great Lakes. Partners' Forum, St. Williams, ON, May 2012.

Gil de LaMadrid, D., and N.P. Danz. 2015. Water depth optima and tolerances for St. Louis River estuary wetland plants. Poster presentation at the 2015 Annual St. Louis River Summit, Superior, WI.

Gnass Giese, E.E. 2015. Great Lakes Wetland Frog Monitoring. Annual Lower Fox River Watershed Monitoring Program Symposium at the University of Wisconsin-Green Bay, Green Bay, Wisconsin. April 14, 2015. Oral Presentation.

Gnass Giese, E.E. 2015. Wetland Birds and Amphibians: Great Lakes Monitoring. Northeastern Wisconsin Audubon Society meeting at the Bay Beach Wildlife Sanctuary, Green Bay, Wisconsin. February 19, 2015. Oral Presentation.

Gnass Giese, E.E., R.W. Howe, N.G. Walton, G.J. Niemi, D.C. Tozer, W.B. Gaul, A. Bracey, J. Shrovnal, C.J. Norment, and T.M. Gehring. 2016. Assessing wetland health using breeding birds as indicators. Wisconsin Wetlands Association Conference, Radisson Hotel & Convention Center, Green Bay, Wisconsin. February 24, 2016. Poster Presentation.

Gnass Giese, E., R. Howe, A. Wolf, and G. Niemi. 2017. Breeding Birds and Anurans of Dynamic Green Bay Coastal Wetlands. State of Lake Michigan Conference, Green Bay, Wisconsin. Oral Presentation. 8 November 2017. Gnass Giese, E.E., R.W. Howe, A.T. Wolf, N.A. Miller, and N.G. Walton. An ecological index of forest health based on breeding birds. 2013. Webpage: <http://www.uwgb.edu/biodiversity/forest-index/>

Gnass Giese, E.E., R.W. Howe, A.T. Wolf, N.A. Miller, and N.G. Walton. 2014. Using Bird Data to Assess Condition of Western Great Lakes Forests. Midwest Bird Conservation and Monitoring Workshop, Port Washington, Wisconsin. Poster Presentation. 4-8 August 2014. Gnass Giese, E.E. 2013. Monitoring forest condition using breeding birds in the western Great Lakes region, USA. Editors: N. Miller, R. Howe, C. Hall, and D. Ewert. Internal Report. Madison, WI and Lansing, MI: The Nature Conservancy. 44 pp.

Gnass Giese, E.E. Wetlands! Introduction to Water Science Course. University of Wisconsin-Green Bay, Green Bay, Wisconsin. 22 September 2023.

Gnass Giese, E.E. 2024. Great Lakes Coastal Wetland Monitoring Program: Long-term Applications. Water Resource Conference. Panama City, Panama. Oral Presentation. 11 January 2024.

Gnass Giese, E.E. 2024. Great Lakes Coastal Wetland Monitoring Program: Long-term Applications. The Wildlife Society Conference. Green Bay, Wisconsin. Oral Presentation. 28 February 2024.

- Gunsch, D., J.P. Gathman, and J.J.H. Ciborowski . 2018. Variation in dissolved-oxygen profiles along a depth gradient in Lake Huron coastal wet meadows relative to vegetation density and agricultural stress over 24 hours. IAGLR Conference, Toronto, Canada. Poster Presentation. 18-22 June 2018.
- Gurholt, C.G. and D.G. Uzarski. 2013. Into the future: Great Lakes coastal wetland seed banks. IGLR Graduate Symposium, Central Michigan University, Mt. Pleasant, MI. March.
- Gurholt, C.G. and D.G. Uzarski. 2013. Seed Bank Purgatory: What Drives Compositional Change of Great Lakes Coastal Wetlands. 56th International Association for Great Lakes Research Conference, Purdue University, West Lafayette, IN. June.
- Harrison, A.M., M.J. Cooper, and D.G. Uzarski. 2019. Spatial and temporal (2011-2018) variation of water quality in Great Lakes coastal wetlands. International Association for Great Lakes Research. Brockport, NY. Presentation.
- Hefko, A.G., M. Wheeler, M.J. Cooper. Nitrogen limitation of algal biofilms in Lake Superior coastal wetlands. International Association for Great Lakes Research Annual Conference, June 10-14, 2019, Brockport, NY. (poster)
- Hein, M.C. and Cooper, M.J. Untangling drivers of chlorophyll a in Great Lakes coastal wetlands. International Association for Great Lakes Research 60th Annual Meeting, Detroit, MI, May 15-19, 2017.
- Hirsch, B. E.E. Gnass Giese, and R. Howe. 2021. Anuran Occurrences in High and Low Water within the Lower Green Bay & Fox River AOC. Wisconsin Wetlands Association Conference, Virtual. Poster Presentation. February 2021.
- Hohman, T., B. Howe, E. Giese, A. Wolf, and D. Tozer. 2019. Bird Community Response to Changes in Wetland Extent and Interspersion in Great Lakes Coastal Wetlands. Heckrodt Birding Club Meeting, Menasha, Wisconsin. Oral Presentation. 6 August 2019.
- Hohman, T.R., R.W. Howe, A.T. Wolf, E.E.Gnass Giese, D.C. Tozer, T.M. Gehring, G.P. Grabas, G.J. Niemi, and C.J. Norment. 2019. Bird Community Response to Changes in Wetland Extent and Interspersion in Great Lakes Coastal Wetlands. Presented at the 62nd Annual Meeting of the International Association of Great Lakes Research (IAGLR), 12 June 2019, Brockport, NY.
- Houghton, C.J., C.C. Moratz, P.S. Forsythe, G.A. Lamberti, D.G. Uzarski, and M.B. Berg. 2016. Relative use of wetland and nearshore habitats by sportfishes of Green Bay. 59th International Conference on Great Lakes Research, Guelph, Ontario Canada. May. Oral Presentation.

- Howe, R.W., R.P. Axler, V.J. Brady, T.N. Brown, J.J.H. Ciborowski, N.P. Danz, J.P. Gathman, G.E. Host, L.B. Johnson, K.E. Kovalenko, G.J. Niemi, and E.D. Reavie. 2012. Multi-species indicators of ecological condition in the coastal zone of the Laurentian Great Lakes. 97th Annual Meeting of the Ecological Society of America. Portland, OR.
- Howe, B., E. Giese, A. Wolf, and B. Kupsky. 2019. Restoration Targets for Great Lakes Coastal Wetlands in the Lower Green Bay & Fox River AOC. International Association for Great Lakes Research, Brockport, New York. Oral Presentation. 12 June 2019.
- Howe, R.W., G.J. Niemi, N.G. Walton, E.E.G. Giese, A.M. Bracey, V.J. Brady, T.N. Brown, J.J.H. Ciborowski, N.P. Danz, J.P. Gathman, G.E. Host, L.B. Johnson, K.E. Kovalenko, and E.D. Reavie. 2014. Measurable Responses of Great Lakes Coastal Wetland Biota to Environmental Stressors. International Association for Great Lakes Research Annual Conference, Hamilton, Ontario (Canada). May 26-30, 2014. Oral Presentation.
- Howe, B., A. Wolf, E. Giese, V. Pappas, B. Kupsky, M. Grimm, and N. Van Helden. 2018. Lower Green Bay & Fox River Area of Concern Wildlife and Habitat Assessment Tools. AOC RAP Meeting, Green Bay, Wisconsin. Oral Presentation. 25 April 2018.
- Howe, B., A. Wolf, E. Giese, V. Pappas, B. Kupsky, M. Grimm, and N. Van Helden. 2018. Assessing the Fish and Wildlife Habitat BUI for the Lower Green Bay and Fox River Area of Concern. Annual Great Lakes Areas of Concern Conference, Sheboygan, Wisconsin. Oral Presentation. 16 May 2018.
- Howe, R.W., A.T. Wolf, and E.E. Gnass Giese. 2016. What's so special about Green Bay wetlands? Wisconsin Wetlands Association Conference, Radisson Hotel & Convention Center, Green Bay, Wisconsin. February 23-25, 2016. Oral Presentation.
- Howe, R.W., N.G. Walton, E.G. Giese, G.J. Niemi, and A.M. Bracey. 2013. Avian responses to landscape stressors in Great Lakes coastal wetlands. Society of Wetland Scientists, Duluth, Minnesota. June 2-6, 2013. Poster Presentation.
- Howe, R.W., N.G. Walton, E.E.G. Giese, G.J. Niemi, N.P. Danz, V.J. Brady, T.N. Brown, J.J.H. Ciborowski, J.P. Gathman, G.E. Host, L.B. Johnson, E.D. Reavie. 2013. How do different taxa respond to landscape stressors in Great Lakes coastal wetlands? Ecological Society of America, Minneapolis, Minnesota. August 4-9, 2013. Poster Presentation.
- Howe, R.W., A.T. Wolf, J. Noordyk, and J. Stoll. 2017. Benefits and outcomes of Green Bay restoration: ecosystem and economic perspectives. Presented at the Summit on the Ecological and Socio-Economic Tradeoffs of Restoration in the Green Bay, Lake Michigan, Ecosystem (July 18-20, 2017).

- Howe, R.W., A.T. Wolf, and E.E. Giese. 2016. Proposed AOC de-listing process. Presentation to Lower Green Bay and Fox River AOC stakeholders. 16 December 2016.
- Howe, R.W., A.T. Wolf, and E.E. Giese. 2017. Lower Green Bay & Fox River Area of Concern: A Plan for Delisting Fish and Wildlife Habitat & Populations Beneficial Use Impairments. A paper presented to AOC Technical Advisory Group. 3 August 2017.
- Johnson, L., M. Cai, D. Allan, N. Danz, D. Uzarski. 2015. Use and interpretation of human disturbance gradients for condition assessment in Great Lakes coastal ecosystems. International Association for Great Lakes Research Conference, Burlington, VT.
- Johnson, Z., M. Markel, and A. Moerke. 2019. Functional diversity of macroinvertebrates in coastal wetlands along the St. Marys River. Midwest Fish and Wildlife Conference, Cleveland, OH.
- Kneisel, A.N., M.J. Cooper, and D.G. Uzarski. 2016. The impact of *Phragmites australis* invasion on macroinvertebrate communities in the coastal wetlands of Thunder Bay, MI. Institute for Great Lakes Research, 4th Annual Student Research Symposium, Central Michigan University, Mt. Pleasant, MI. February. Oral Presentation.
- Kneisel, A.N., M.J. Cooper, and D.G. Uzarski. 2016. Impact of *Phragmites* invasion on macroinvertebrate communities in wetlands of Thunder Bay, MI. 59th International Conference on Great Lakes Research, Guelph, Ontario Canada. May. Oral Presentation.
- Kosiara, J.M., M.J. Cooper, D.G. Uzarski, and G.A. Lamberti. 2013. Relationships between community metabolism and fish production in Great Lakes coastal wetlands. International Association for Great Lakes Research, 56th annual meeting. June 2-6, 2013. West Lafayette, IN. Poster presentation.
- Kneisel, A.N., M.J. Cooper, and D.G. Uzarski. 2017. The impact of *Phragmites australis* invasion on Great Lakes coastal wetlands. 60th International Conference on Great Lakes Research, Detroit, MI. May. Presentation.
- Kneisel, A.K., M.J. Cooper, D.G. Uzarski. 2018. Coastal wetland monitoring data as a resource for invasive species management. ELLS-IAGLR Big Lakes Small World Conference. Évian, France. September. Poster.
- Kosiara, J.K., J.J. Student, and D.G. Uzarski. 2017. Exploring coastal habitat-use patterns of Great Lakes yellow perch with otolith microchemistry. 60th International Conference on Great Lakes Research, Detroit, MI. May. Presentation.
- Kosiara, J.M., J. Student and D.G. Uzarski. 2016. Assessment of yellow perch movement between coastal wetland and nearshore waters of the Great Lakes. 59th International Conference on Great Lakes Research, Guelph, Ontario Canada. May. Oral Presentation.

- Kowalke, C.J. and D.G. Uzarski. 2019. Assessing the competitive impacts of invasive round goby on lake whitefish in northern Lake Michigan. International Association for Great Lakes Research. Brockport, NY. Poster.
- Lamberti, G.A., D.G. Uzarski, V.J. Brady, M.J. Cooper, T.N. Brown, L.B. Johnson, J.J. Ciborowski, G.P. Grabas, D.A. Wilcox, R.W. Howe, and D. C. Tozer. An integrated monitoring program for Great Lakes coastal wetlands. Society for Freshwater Science Annual Meeting. Jacksonville, FL. May 2013. Poster presentation.
- Lamberti, G.A. Pacific Salmon in Natal Alaska and Introduced Great Lakes Ecosystems: The Good, the Bad, and the Ugly. Department of Biology, Brigham Young University. Dec 5, 2013. Invited seminar.
- Lamberti, G. A. The Global Freshwater Crisis. The Richard Stockton College of New Jersey and South Jersey Notre Dame Club. November 18, 2014.
- Lamberti, G. A. The Global Freshwater Crisis. Smithsonian Journey Group and several University Alumni Groups. March 1, 2015.
- Lamberti, G.A. The Global Freshwater Crisis. Newman University and Notre Dame Alumni Club of Wichita. September 28, 2016.
- Lamberti, G.A. The Global Freshwater Crisis. Air and Wastewater Management Association and Notre Dame Alumni Club of Northeastern New York. December 2, 2016.
- Lamberti, G.A. The Global Freshwater Crisis: Lessons for the Amazon. Association of University Alumni Clubs. Iquitos, Peru. September 9, 2019.
- Lamberti, G. A. Pacific Salmon in Natal Alaska and Introduced Great Lakes Ecosystems: The Good, the Bad, and the Ugly. Annis Water Resources Institute, Grand Valley State University. December 12, 2014.
- Lamberti, G.A., M.A. Brueseke, W.M. Conard, K.E. O'Reilly, D.G. Uzarski, V.J. Brady, M.J. Cooper, T.M. Redder, L.B. Johnson, J.H. Ciborowski, G.P. Grabas, D.A. Wilcox, R.W. Howe, D.C. Tozer, and T.K. O'Donnell. Great Lakes Coastal Wetland Monitoring Program: Vital resources for scientists, agencies and the public. Society for Freshwater Science Annual Meeting. Raleigh, NC. June 4-9, 2017. Poster.
- Langer, T.A., K. Pangle, B.A. Murray, and D.G. Uzarski. 2014. Beta Diversity of Great Lakes Coastal Wetland Communities: Spatiotemporal Structuring of Fish and Macroinvertebrate Assemblages. American Fisheries Society, Holland, MI. February.

- Langer, T., K. Pangle, B. Murray, D. Uzarski. 2013. Spatiotemporal influences, diversity patterns and mechanisms structuring Great Lakes coastal wetland fish assemblages. Poster. Institute for Great Lakes Research 1st Symposium, MI. March.
- Lemein, T.J., D.A. Albert, D.A. Wilcox, B.M. Mudrzynski, J. Gathman, N.P. Danz, D. Rokitnicki-Wojcik, and G.P. Grabas. 2014. Correlation of physical factors to coastal wetland vegetation community distribution in the Laurentian Great Lakes. Society of Wetland Scientists/Joint Aquatic Sciences Meeting, Portland, OR.
- MacDonald, J.L., L.S. Schoen, J.J. Student, and D.G. Uzarski. 2016. Variation in yellow perch (*Perca flavescens*) growth rate in the Great Lakes. 59th International Conference on Great Lakes Research, Guelph, Ontario Canada. May. Oral Presentation.
- Makish, C.S., K.E. Kovalenko, J.P. Gathman, and J.J.H. Ciborowski. 2013. invasive phragmites effects on coastal wetland fish communities of the Great Lakes basin. 66th Canadian Conference for Freshwater Fisheries Research, Windsor, ON, January 3-5, 2013. Poster Presentation.
- Markel, M., Z. Johnson, and A. Moerke. 2019. A comparison of macroinvertebrate assemblages in coastal wetlands exposed to varying wave disturbance. March 13-15, Gaylord, MI.
- McReynolds, A.T., K.E. O'Reilly, and G.A. Lamberti. 2016. Food web structure of a recently restored Indiana wetland. University of Notre Dame College of Science Joint Annual Meeting, Notre Dame, IN.
- Miranda, D.A., Zachritz, A.M., Whitehead, H.D., Peaslee, G.F., Cressman, S. R., Lamberti, G.A. PFAS Permeates Native and Introduced Salmonids from Lake Michigan, USA. Joint Aquatic Sciences Meeting, Grand Rapids, MI. May 2022.
- Miranda, D.A., Zachritz, A.M., Whitehead, H.D., Peaslee, G.F., Cressman, S. R., Lamberti, G.A., A Survey of Sportfish for Per-and Polyfluoroalkyl Substances (PFAS): An Emerging Contaminant in the Great Lakes. Portage, IN, October 2022
- Miranda, D.A., Zachritz, A.M., Whitehead, H.D., Peaslee, G.F., Cressman, S. R., Lamberti, G.A. "PFAS in Prey and Predator Fish from Lake Michigan", USA. SETAC North America 43 rd. Annual Meeting. November 2022.
- Miranda, D.A., Zachritz, A.M., Whitehead, H.D., Cressman, S., Klepinger, S., Peaslee, G.F. Lamberti, G.A. "Biomagnification of PFAS in Lake Michigan food web". Colleges of Science and Engineering Joint Annual Meeting, Notre Dame IN. December 9, 2022.
- Miranda, D.A., PFAS in Lake Michigan Fish, Annual Great Lakes Conference, Institute of Water Research– Michigan State University MI. March 7, 2023.

- Moerke, A. 2015. Coastal wetland monitoring in the Great Lakes. Sault Naturalist meeting, Sault Sainte Marie, MI; approximately 40 community members present.
- Monks, A., S. Lishawa, D. Albert, B. Mudrzynski, D.A. Wilcox, and K. Wellons. 2019. Innovative management of European frogbit and invasive cattail. International Association for Great Lakes Research. Brockport, NY
- Moore, L.M., M.J. Cooper, and D.G. Uzarski. 2017. Nutrient limitation in Great Lakes coastal wetlands: gradients and their influence. 60th International Conference on Great Lakes Research, Detroit, MI. May 17. Presentation.
- Mudrzynski, B.M., N.P. Danz, D.A. Wilcox, D.A. Albert, D. Rokitnicki-Wojcik, and J. Gathman. 2016. Great Lakes wetland plant Index of Biotic Integrity (IBI) development: balancing broad applicability and accuracy. Society of Wetland Scientists, Corpus Christi, TX.
- Mudrzynski, B.M., D.A. Wilcox, and A. Heminway. 2012. Habitats invaded by European frogbit (*Hydrocharis morsus-ranae*) in Lake Ontario coastal wetlands. INTECOL/Society of Wetland Scientists, Orlando, FL.
- Mudrzynski, B.M., D.A. Wilcox, and A.W. Heminway. 2013. European frogbit (*Hydrocharis morsus-ranae*): current distribution and predicted expansion in the Great Lakes using niche-modeling. Society of Wetland Scientists, Duluth, MN.
- Mudrzynski, B.M. and D.A. Wilcox. 2014. Effect of coefficient of conservatism list choice and hydrogeographic type on floristic quality assessment of Lake Ontario wetlands. Society of Wetland Scientists/Joint Aquatic Sciences Meeting, Portland, OR.
- Mudrzynski, B.M., K. Des Jardin, and D.A. Wilcox. 2015. Predicting seed bank emergence within flooded zones of Lake Ontario wetlands under novel hydrologic conditions. Society of Wetlands Scientists. Providence, RI.
- Newman, W.L., L.P. Moore, M.J. Cooper, D.G. Uzarski, and S.N. Francoeur. 2019. Nitrogen-Fixing Diatoms as Indicators of Historical Nitrogen Limitation in Laurentian Great Lakes Coastal Wetlands. Society for Freshwater Science. Salt Lake City, UT. Presentation.
- O'Donnell, T.K., Winter, C., Uzarski, D.G., Brady, V.J., and Cooper, M.J. 2017. Great Lakes coastal wetland monitoring: moving from assessment to action. Ecological Society of America Annual Conference. Portland, OR. August 6-11. Presentation.

- O'Donnell, T.K., D.G. Uzarski, V.J. Brady, and M.J. Cooper. 2016. Great Lakes Coastal Wetland Monitoring: Moving from Assessment to Action. 10th National Monitoring Conference; Working Together for Clean Water, Tampa, Florida. May. Oral Presentation.
- O'Reilly, K.E., A. McReynolds, and G.A. Lamberti. Quantifying Lake Michigan coastal wetland-nearshore linkages for sustaining sport fishes using stable isotope mixing models. Annual Meeting of the Ecological Society of America. Baltimore, MD. August 9-14, 2015.
- O'Reilly, K.E., A. McReynolds, C. Stricker, and G.A. Lamberti. Quantifying Lake Michigan coastal wetland-nearshore linkages for sustaining sport fishes. State of Lake Michigan Conference. Traverse City, MI. October 28-30, 2015.
- O'Reilly, K.E., A. McReynolds, C. Stricker, and G.A. Lamberti. 2016. Quantifying Lake Michigan coastal wetland-nearshore linkages for sustaining sport fishes. Society for Freshwater Science, Sacramento, CA.
- O'Reilly, K.E., A. McReynolds, C. Stricker, and G.A. Lamberti. 2016. Quantifying Lake Michigan coastal wetland-nearshore linkages for sustaining sport fishes. International Association for Great Lakes Research, Guelph, ON.
- O'Reilly, K.E., J.J. Student, B.S. Gerig, and G.A. Lamberti. 2019. Metalheads: What can sport fish otoliths reveal about heavy metal exposure over time? Annual Meeting of the Society for Freshwater Science, Salt Lake City, UT.
- Otto, M., J. Marty, E.G. Gnass Giese, R. Howe, and A. Wolf. Anuran habitat use in the Lower Green Bay and Fox River Area of Concern (Wisconsin). University of Wisconsin-Green Bay Academic Excellence Symposium, Green Bay, Wisconsin. April 6, 2017. Poster Presentation.
- Otto, M., J. Marty, E.G. Gnass Giese, R. Howe, and A. Wolf. Anuran habitat use in the Lower Green Bay and Fox River Area of Concern (Wisconsin). Green Bay Conservation Partners Spring Roundtable Meeting, Green Bay, Wisconsin. April 25, 2017. Poster Presentation.
- Redder, T.M., D.G. Uzarski, V.J. Brady, M.J. Cooper, and T.K. O'Donnell. 2018. Application of data management and decision support tools to support coastal wetland management in the Laurentian Great Lakes. National Conference on Ecosystem Restoration. New Orleans, LA. August 26-30, 2018. Oral Presentation.
- Reisinger, L. S., Pangle, K. L., Cooper, M. J., Learman, D. R., Uzarski, D. G., Woolnough, D. A., Bugaj, M. R., Burck, E. K., Dollard, R. E., Goetz, A., Goss, M., Gu, S., Karl, K., Rose, V. A., Scheunemann, A. E., Webster, R., Weldon, C. R., and J., Yan. 2017. The influence of water currents on community and ecosystem dynamics in coastal Lake Michigan. 60th International Conference on Great Lakes Research, Detroit, MI. May. Presentation.

- Reisinger, A. J., and D. G., Uzarski. 2017. Natural and anthropogenic disturbances affect water quality of Great Lakes coastal wetlands. 60th International Conference on Great Lakes Research, Detroit, MI. May. Presentation.
- St.Pierre, J.I., K.E. Kovalenko, A.K. Pollock, and J.J.H. Ciborowski. 2013. Is macroinvertebrate richness and community composition determined by habitat complexity or variation in complexity? 66th Canadian Conference for Freshwater Fisheries Research, Windsor, ON, January 3-5, 2013. Poster Presentation.
- Schmidt, N. C., Schock, N., and D. G. Uzarski. 2013. Modeling macroinvertebrate functional feeding group assemblages in vegetation zones of Great Lakes coastal wetlands. International Association for Great Lakes Research Conference, West Lafayette, IN. June.
- Schmidt, N.C., N.T. Schock, and D.G. Uzarski. 2014. Influences of metabolism on macroinvertebrate community structure across Great Lakes coastal wetland vegetation zones. Great Lakes Science in Action Symposium, Central Michigan University, Mt. Pleasant, MI. April.
- Schock, N.T. and D.G. Uzarski. Stream/Drainage Ditch Impacts on Great Lakes Coastal Wetland Macroinvertebrate Community Composition. 55th International Conference on Great Lakes Research, Cornwall, Ontario.
- Schock N.T., Uzarski D.G., 2013. Habitat conditions and macroinvertebrate communities of Great Lakes coastal habitats dominated by wet meadow, *Typha* spp. and *Phragmites australis*: implications of macrophyte structure changes. International Association for Great Lakes Research Conference, West Lafayette, IN. June.
- Schock, N.T., B.A. Murry, D.G. Uzarski 2014. Impacts of agricultural drainage outlets on Great Lakes coastal wetlands. Great Lakes Science in Action Symposium, Central Michigan University, Mt. Pleasant, MI. April.
- Schock, N.T., Schuberg, D.H., and Uzarski, D.G. 2015. Chemical and physical habitat gradients within Great Lakes coastal wetlands. 58th International Association for Great Lakes Research Conference, Burlington, VT. May.
- Schoen, L.S., J.J. Student, and D.G. Uzarski. 2014. Reconstruction of fish movements between Great Lakes coastal wetlands. American Fisheries Society, Holland, MI. February.
- Sherman, J.S., T.A. Clement, N.T. Schock, and D.G. Uzarski. 2012. A comparison of abiotic and biotic parameters of diked and adjacent open wetland complexes of the Erie Marsh Preserve. 55th International Conference on Great Lakes Research, Cornwall, Ontario.

- Sherman, J.J., and D.G. Uzarski. 2013. A Comparison of Abiotic and Biotic Parameters of Diked and Adjacent Open Wetland Complexes of the Erie Marsh Preserve. 56th International Conference on Great Lakes Research, West Lafayette, IN. June.
- Sierszen, M., Schoen, L., Hoffman, J., Kosiara, J., and D. Uzarski. 2017. Support of coastal fishes by nearshore and coastal wetland habitats. 60th International Conference on Great Lakes Research, Detroit, MI. May. Presentation.
- Sierzen, M., L. Schoen, J. Hoffman, J. Kosiara and D. Uzarski. 2018. Tracing multi-habitat support of coastal fishes. Association for the Sciences of Limnology and Oceanography-Ocean Sciences Meeting. Portland, OR. February 2018. Oral Presentation.
- Smith, D.L., M.J. Cooper, J.M. Kosiara, and G.A. Lamberti. 2013. Heavy metal contamination in Lake Michigan wetland turtles. International Association for Great Lakes Research, 56th annual meeting. June 2-6, 2013. West Lafayette, IN. Poster presentation.
- Stirratt, H., M.J. Cooper. Landscape Conservation Design for the Great Lakes. International Union for the Conservation of Nature World Conservation Congress, September 6-10, 2016, Honolulu, Hawai'i.
- Thoennes, J., and N.P. Danz. 2017. Mapping Wetland Areal Change in the St. Louis River Estuary Using GIS. Poster presentation at the St. Louis River Summit, Superior, WI.
- Town, K.M. and R.E. Schultz. 2025. Modeling the richness of non-native vegetation in Great Lakes coastal wetlands. Rochester Academy of Science 51st Annual Fall Scientific Paper Session, Geneseo, NY.
- Town, K.M. and R.E. Schultz. 2025. Factors Influencing Non-Native Plant Richness and Abundance in Laurentian Great Lakes Coastal Wetlands. Society of Wetland Scientists Annual Meeting, Providence, RI.
- Town, K.M. and R.E. Schultz. 2025. Factors influencing the presence and prevalence of non-native plant species in Lake Ontario coastal wetlands. New York State Wetlands Forum Annual Conference, Rochester, NY.
- Town, K.M. and R.E. Schultz. 2024. Vegetation dynamics along wetland-upland edges in Lake Ontario coastal wetlands. Rochester Academy of Science 50th Annual Fall Scientific Paper Session, Brockport, NY.
- Town, K.M. and R.E. Schultz. 2024. Patterns of Plant Species Introductions in Lake Ontario Coastal Wetlands. The Northeast Natural History Conference, Albany, NY.

Tozer, D.C., and S.A. Mackenzie. Control of invasive *Phragmites* increases breeding marsh birds but not frogs. Long Point World Biosphere Research and Conservation Conference, Simcoe, Ontario, Canada. Oral Presentation. 8 November 2019.

Tozer, D.C., M. Falconer, A. Bracey, E. Giese, T. Gehring, G. Grabas, R. Howe, G. Niemi, and C. Norment. 2018. Detecting and monitoring elusive marsh breeding birds in the Great Lakes. IAGLR Conference, Toronto, Canada. Oral Presentation. 18-22 June 2018. (INVITED).

Trebitz, A., J. Hoffman, G. Peterson, G. Shepard, A. Frankiewicz, B. Gilbertson, V. Brady, R. Hell, H. Wellard Kelly, and K. Schmude. 2015. The faucet snail (*Bithynia tentaculata*) invades the St. Louis River Estuary. St. Louis River Estuary Summit, Superior, Wisconsin. Mar. 30 – Apr. 1.

Tuttle, E., T.N. Brown, D.A. Albert, and *T.J. Lemein. 2013. Comparison of two plant indices: Floristic Quality Index (FQI) and an index based on non-native and invasive species. Annual Society of Wetland Scientists Conference, Duluth, MN. June 4, 2013.

Unitis, M.J., B.A. Murry and D.G. Uzarski. 2012. Use of coastal wetland types by juvenile fishes. Ecology and Evolutionary Ecology of Fishes, Windsor, Ontario. June 17-21.

Uzarski, D.G. 2011. Great Lakes Coastal Wetland Monitoring for Restoration and Protection: A Basin-Wide Effort. State Of the Lakes Ecosystem Conference (SOLEC). Erie, Pennsylvania. October 26.

Uzarski, D.G. 2011. Coastal Wetland Monitoring: Background and Design. Great Lakes Coastal Wetland Monitoring Meeting. MDEQ; ASWM. Acme, Michigan. August 29.

Uzarski, D.G., N.T. Schock, T.A. Clement, J.J. Sherman, M.J. Cooper, and B.A. Murry. 2012. Changes in Lake Huron Coastal Wetland Health Measured Over a Ten Year Period During Exotic Species Invasion. 55th International Conference on Great Lakes Research, Cornwall, Ontario.

Uzarski, D.G., M.J. Cooper, V.J. Brady, J. Sherman, and D.A. Wilcox. 2013. Use of a basin-wide Great Lakes coastal wetland monitoring program to inform and evaluate protection and restoration efforts. International Association for Great Lakes Research, West Lafayette, IN. (INVITED)

Uzarski, D.G. 2013. A Basin Wide Great Lakes Coastal Wetland Monitoring Plan. Region 5 State and Tribal Wetlands Meeting: Focusing on Wetland Monitoring and Assessment around the Great Lakes. October 31. Kellogg Biological Station, Hickory Corners, MI.

- Uzarski, D.G. 2013. Great Lakes Coastal Wetland Assessments. Lake Superior Cooperative Science and Monitoring Workshop. September 24-25. EPA Mid-Continent Ecology Division Lab, Duluth, MN.
- Uzarski, D.G. 2013. A Basin-Wide Great Lakes Coastal Wetland Monitoring Program. 5th National Conference on Ecosystem Restoration. July 29-August 2. Schaumburg, IL.
- Uzarski, D.G., Cooper, M.J., Brady, V., Sherman, J.J., and D.A. Wilcox. 2013. Use of a Basin Wide Great Lakes Coastal Wetland Monitoring Program to inform and Evaluate Protection and Restoration Efforts. 56th International Conference on Great Lakes Research, West Lafayette, IN.
- Uzarski, D., M. Cooper and V. Brady. 2014. Implementing a Basin-wide Great Lakes Coastal Wetland Monitoring Program. Webinar for Sustain Our Great Lakes, Jan. 29, 2014. On-line webinar for Great Lakes researchers, managers, agency personnel, and environmental groups. Attendance approximately 400.
- Uzarski, D.G., Schock, N.T., Schuberg, D.H., Clement, T.A., and Cooper, M.J. 2015. Interpreting multiple organism-based IBIs and disturbance gradients: Basin wide monitoring. 58th International Conference on Great Lakes Research, Burlington, VT. May.
- Uzarski, D.G., N. Schock, T.M. Gehring, and B.A. Wheelock. 2016. Faucet snail (*Bithynia tentaculata*) occurrence across the Great lakes basin in coastal wetlands. 59th International Conference on Great Lakes Research, Guelph, Ontario Canada. May. Oral Presentation.
- Uzarski, D.G., V.J. Brady, M.J. Cooper, D.A. Wilcox, A.A. Bozimowski. 2017. Leveraging landscape level monitoring and assessment program for developing resilient shorelines throughout the Laurentian Great Lakes. Society of Wetland Scientists Annual Meeting. San Juan, Puerto Rico. June. Presentation.
- Uzarski, D.G., V.J. Brady, and M.J. Cooper. 2017. The Great Lakes Coastal Wetland Monitoring Program: Seven Years of Implementation. 60th International Conference on Great Lakes Research, Detroit, MI. May. Presentation.
- Uzarski, D.G. 2017. Emerging Issues in Wetland Science. Michigan Wetland Association Conference. Gaylord, Michigan. Plenary Presentation.
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