GLIC: Implementing Great Lakes Coastal Wetland Monitoring

Semiannual Progress Report

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INTRODUCTION

This project began on 10 September 2010. Most subcontracts were signed and in place with collaborating universities by late December 2010 or early January 2011. This project has the primary objective of implementing a standardized basin-wide coastal wetland monitoring program that will be a powerful tool to inform decision-makers on coastal wetland conservation and restoration priorities throughout the Great Lakes basin. Project outcomes include 1) development of a database management system; 2) development of 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) development of background documents on the indicators.

There have been no changes to our project's objectives.

Summary of past activities:
Our primary activities in our first year involved developing our Quality Assurance Project Plan (signed March 21, 2011), developing the site selection mechanism, selecting our sites, and conducting our field work (wetland sampling), which began in late April/early May and continued through mid-September, 2011. All primary project personnel met in mid-January of 2011 to work through methods and details of all aspects of the project. During the first year, crews successfully sampled 176 sites with crew members that had completed extensive training sessions and passed all training requirements, including field sampling and identification tests. Crews then successfully entered the field data and completed quality control procedures and identified macroinvertebrate samples and entered those data.

During our second year, we revised and updated our QAPP (signed March 28, 2012), updated our site selection system to include site revisits that will help track wetland condition through time and assess year-to-year variability at the site level, and held a meeting with all project lead personnel (February 2012) to find solutions to issues that arose during our first year. In our second field season, we sampled 206 sites. Teams entered and QC'd all of the data from the second field season, and PIs resolved taxonomic issues that arose. Data managers and programmers enabled calculation of most metrics and IBIs within the project database.

During our third year, PIs worked on metrics specific to vegetation zones that currently lack IBIs. As part of this process, we began investigating the stability of metrics based on a comparison of the data from the original sampling and site re-visits. All co-PIs and many field crew leaders met in the Detroit area (January 2013). Our QAPP did not need to be updated, and all co-PIs re-signed it March 2013. Our site selection system required minor modification to better handle benchmark sites (sites of special interest for restoration or protection).
244 sites were selected for potential sampling. Of these, 32 were benchmark sites and 12 were temporal re-sample sites, with the remaining 200 sites selected by the original "random draw" that placed sites in the sampling panels. 201 of these sites were sampleable in 2013.

PROJECT ORGANIZATION

Figure 1 shows our project organization. Please note that since our project started we have had two changes in primary personnel (both approved by US EPA). Ryan Archer of Bird Studies Canada was replaced by Doug Tozer. At the Michigan Department of Environmental Quality, Peg Bostwick retired and was replaced by Anne Hokanson. No major personnel changes have taken place during this reporting period.

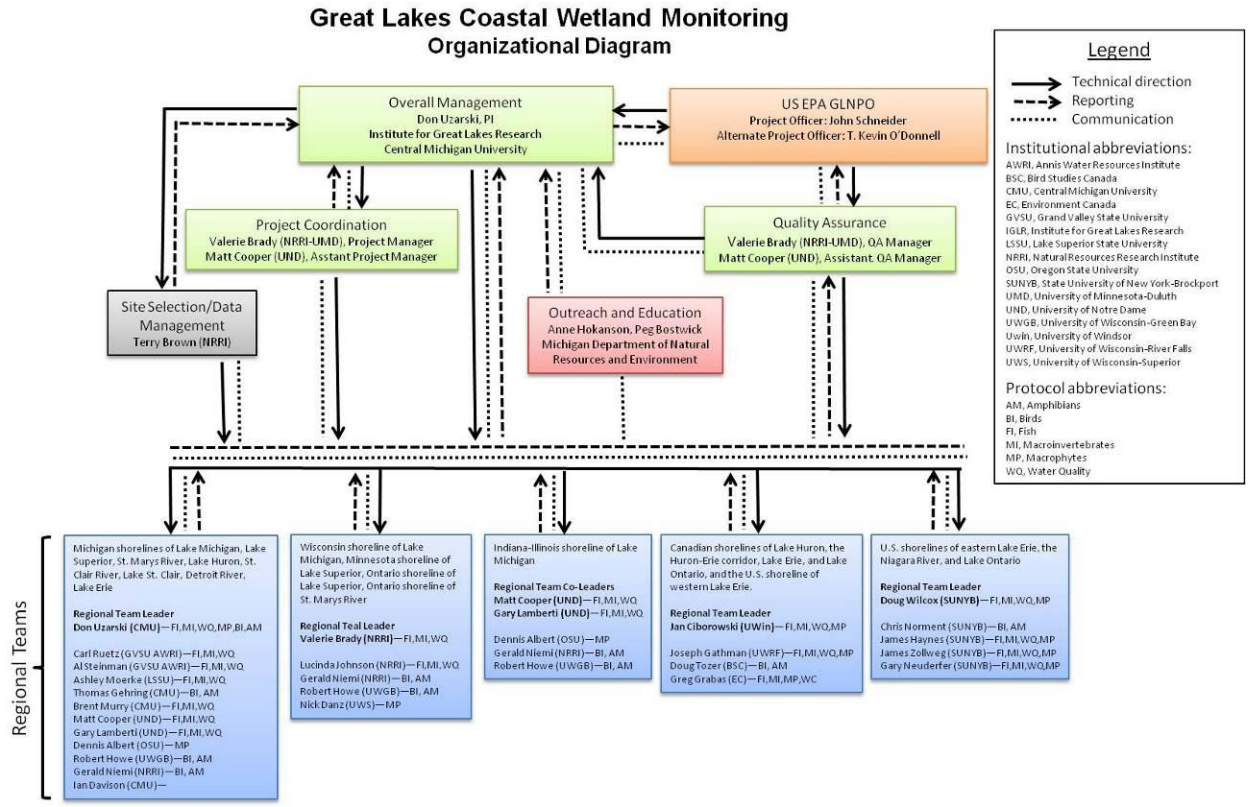

Figure 1. Organizational chart for the project showing lines of technical direction, reporting, and communication separately.

PROJECT TIMELINE

The project timeline remains unchanged and we are on-schedule (Table 1).

Table 1. Timeline of tasks and deliverables for the Great Lakes Coastal Wetland Monitoring Project.

Tasks	'10	2011				2012				2013				2014				2015			
	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
Funding received	X																				
PI meeting		X				X				X				X				X			X
Site selection system designed		X																			
Site selection implemented			X			X				X				X				X			
Sampling permits acquired			X				X				X				X				X		
Data entry system created			X	X																	
Field crew training			X	X			X	X			X	X			X	X			X	X	
Wetland sampling			X	X			X	X			X	X			X	X			X	X	
Mid-season QA/QC evaluations				X				X				X				X				X	
Sample processing & QC					X	X			X	X			X	X			X	X			X
Data QC & upload to GLNPO						X	X			X	X			X	X			X	X		X
GLAS database report		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Report to GLNPO			X		X		X		X		X		X		X		X		X		X

SITE SELECTION

Year four site selection was completed in March 2014 and was essentially the same as site selection for year three. Benchmark sites (sites of special interest for restoration or protection) can be sampled more than once in five years, and may be sites that were not on the original sampling list. The selection modification for these sites involved specifying exactly which teams will sample these sites each year, allowing bird and amphibian crews, which have greater sampling capacity, to visit these sites more often than other crews.

Original data on Great Lakes coastal wetland locations

The GIS coverage used was a product of the Great Lakes Coastal Wetlands Consortium (GLCWC) and was downloaded from http://www.glc.org/wetlands/data/inventory/glcwc_cwi_polygon.zip on December 6, 2010. See http://www.glc.org/wetlands/inventory.html for details.

Site Selection Tool, completed in 2011, minor updates in 2012 and 2013

Background
In 2011, a web-based database application was developed to facilitate site identification, stratified random selection, and field crew coordination for the project. This database is housed at NRRI and backed up routinely. It is also password-protected. Using this database, potential wetland polygons were reviewed by PIs and those that were greater than four ha., had herbaceous vegetation, and had a lake connection were placed into the site selection random sampling rotation (Table 2). See the QAPP for a thorough description of site selection criteria.

Table 2. Preliminary counts, areas, and proportions of the 1014 Great Lakes coastal wetlands deemed sampleable following Great Lakes Coastal Wetland Consortium protocols based on review of aerial photography. 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**	

Note that the actual number of sampleable wetlands will fluctuate year-to-year with lake level and continued human activity. Based on the number of wetlands that proved to be sampleable thus far, we expect that the total number of sampleable wetlands will be between 900 and 1000.

The wetland coverage we are using shows quite a few more wetlands in the US than in Canada, with an even greater percent of US wetland area (Table 2). 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, low water levels, and topography that limits the potential for coastal wetlands to migrate downslope with falling 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 identified for each site in the original GLCWC dataset. 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.

Regions

Existing ecoregions (Omernik 1987, Bailey and Cushwa 1981, CEC 1997) were examined for stratification of sites. None were found which stratified 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 dividing each lake into northern and southern components, with Lake Huron being split into three parts and Lake Superior being treated as a single region, was adopted (Figure 2). The north-south splitting of Lake Michigan is common to all major ecoregions systems (Omernik / Bailey / CEC).

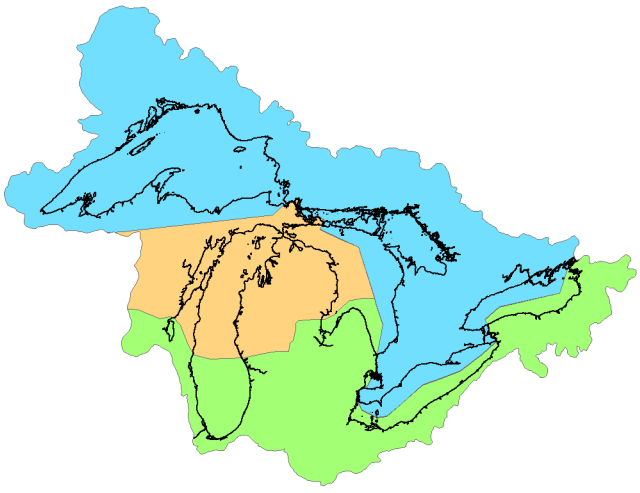

Figure 2. Divisions of lakes into regions. Note that stratification is by region *and* lake, so northern Lake Erie is not in the same region as Lake Superior, etc.

Panelization

Randomization

The first step in randomization was the assignment of selected sites from each of the project's 30 strata (10 regions x 3 geomorphic classes) 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.

In 2012, sites previously assigned to panels for sampling were assigned to sub-panels for re-sampling. The project design's five year rotation with a 10% re-sampling rate requires five panels, *A*-*E*, and ten sub-panels, *a*-*j*. 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 3.

For the first five-year cycle, sub-panel *a* will be 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, when panel *A* is being sampled for the second time, the 21 sites in sub-panel *a* of panel *E* will be candidates for re-sampling, and in 2017, when panel *B* is being sampled for the second time, the 21 sites in sub-panel *b* of panel *A* will be candidates for re-sampling.

Table 3. Sub-panel re-sampling, showing year of re-sampling for sub-panels *a*-*c*.

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

Workflow states

Each site was assigned a particular 'workflow' status. During the field season, sites selected for sampling in the current year will move through a series of sampling states in a logical order, as shown in Table 4. 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.

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 was used to exchange sites between teams for efficiency and to better assure that distribution of effort matches each team’s sampling capacity.

Table 4. Workflow states for sites listed in the Site Status table within the web-based site selection system housed at NRRI. 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 QA'd.

Name	Description	Data_level
too many	Too far down randomly-ordered list, beyond sampling capacity for crews.	-1
Not sampling BM	Benchmark site that will not be sampled by a particular crew.	-1
listed	Place holder status; indicates status update needed.	0
web reject	Rejected based on regional knowledge or aerial imagery in web tool.	-1
will visit	Will visit with intent to sample.	0
could not reach	Proved impossible to access.	-1
visit reject	Visited in field, and rejected (no lake influence, 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 QA-checked.	3

Field maps

Three-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 (using the polygons from the original GLCWC file, as modified by PIs in a few cases). 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 third page lists information from the database for the site, including tags, team assignments, and the history of comments made on the site, including information from previous field crew visits.

Browse map

The *browse map* feature allows the user to see sites in context with other sites, overlaid on either Google Maps or Bing Maps road or aerial imagery. Boat ramp locations are also shown when available. The *browse map* provides tools for measuring linear distance and area. When a site is clicked, the tool displays information about the site, the tags and comments applied to it, the original GLCWC data, links for the next and previous site (see *Shoreline ordering* and *Filter sites*), and a link to edit the site in the site editor.

2014 Site Selection

Site selection for 2014 resulted in 251 sites selected for potential sampling. Of these, 31 are benchmark sites and 13 are temporal re-sample sites, with the remaining 207 sites selected by the original "random draw" that places sites in the sampling panels. There are more than 10% benchmark sites because several teams have taken on additional sites at the special request of other agencies or groups (see *individual team reports* and *letters of support*) without sacrificing the number of random sites sampled. Benchmark and resample sites are sorted to the top of the sampling list because they are the highest priority sites to be sampled.

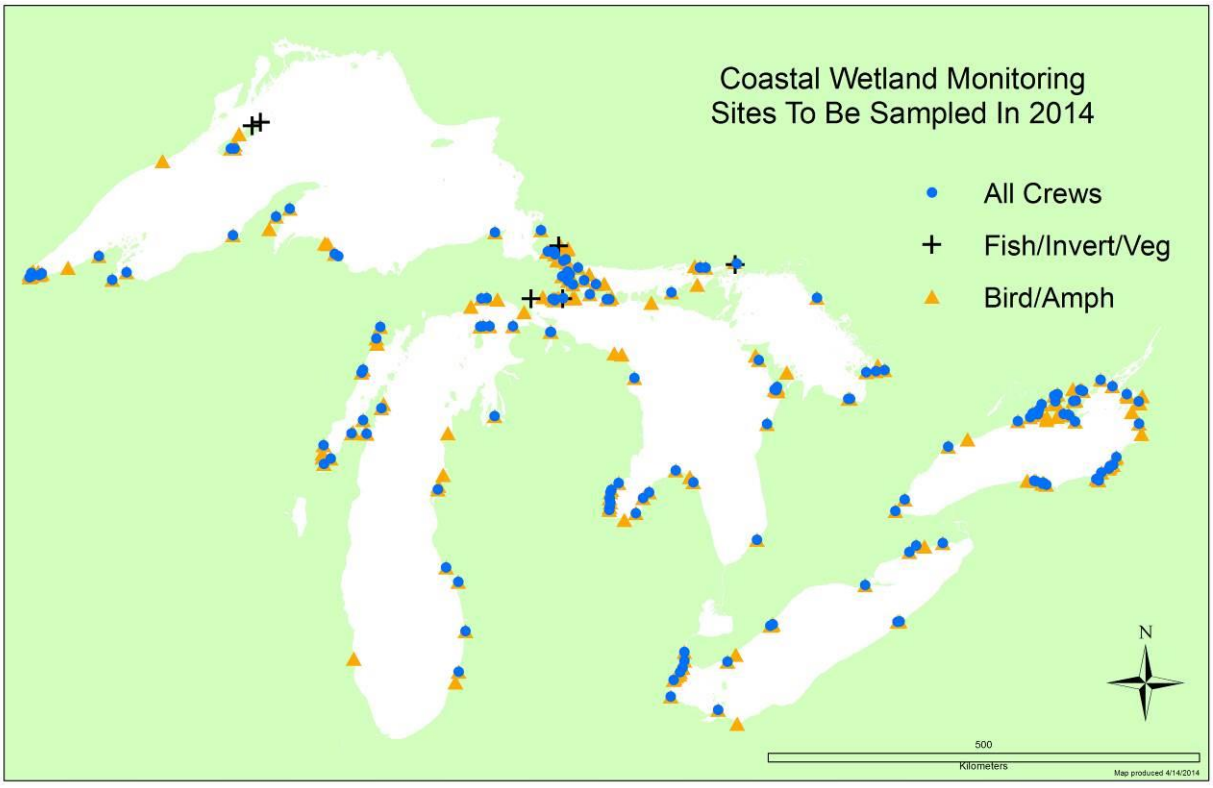

Figure 3. Locations of the 251 Great Lakes coastal wetlands to be sampled in 2014, color-coded by taxonomic groups. Sites assigned only to bird and amphibian crews (due to their greater sampling capacity) are shown with a gold triangle.

Wetlands have a "clustered" distribution around the Great Lakes due to geological differences. 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 will expand their sampling boundaries to assist neighboring over-capacity teams in order to maximize the number of wetlands sampled. The site selection and site status tools are used to make these changes.

TRAINING

All personnel responsible for sampling invertebrates, fish, macrophytes, birds, amphibians, and water quality received training and were certified prior to sampling 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 chiefs are experienced, field crew training is being handled by each PI at each regional location. All crew members still will be required to pass all training tests, and PIs will still conduct mid-season QC. As has become standard protocol, the trainers are always available via phone and email to answer any questions that arise during training sessions or during the field season.

The following is a synopsis of the training to be conducted by PIs this spring (2014): Each PI or field crew chief trains all field personnel on meeting the data quality objectives for each element of the project; this includes 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 will be required to pass all training certifications before they were allowed to work unsupervised. Those who do not pass all training aspects are only allowed to work under the supervision of a crew leader who has passed all training certifications.

Training for bird and amphibian field crews includes tests on amphibian calls, bird vocalizations, and bird visual identification. These tests are based on an on-line system established at the University of Wisconsin, Green Bay – see http://www.birdercertification.org/GreatLakesCoastal. In addition, individuals are tested for proficiency in completing field sheets, and audio testing is done to ensure their hearing is within the normal ranges. Field training will also be 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 will be trained on field and laboratory protocols. Field training includes selecting appropriate sampling locations, setting fyke nets, identifying fish, sampling and sorting invertebrates, and collecting water quality and covariate data. Laboratory training includes preparing water samples, titrating for alkalinity, and filtering for chlorophyll. Other training includes GPS use, safety and boating issues, field sheet completion, and GPS and records uploading. All crew members are required to be certified in each respective protocol prior to working independently.

Vegetation crew training also includes both field and laboratory components. Crews are trained in field sheet completion, transect and point location and sampling, GPS use, and plant curation. Plant identification will be tested following phenology through the first part of the

field season. All crew members must be certified in all required aspects of sampling before starting in the field unless supervised.

Additional training on data entry and data QC was provided by Valerie Brady and Terry Brown through a series of conference calls/webinars during the late summer, fall, and winter of 2011. All co-PIs and crew leaders responsible for data entry participated in these training sessions and each regional laboratory has successfully uploaded data. Additional training on data entry, data uploading, and data QC is being provided as needed.

Certification

To be certified in a given protocol, individuals must pass a practical exam. Certification exams are conducted in the field in most cases, either during training workshops or during site visits early in the season. When necessary, exams are supplemented with photographs (for fish and vegetation) or audio recordings (for bird and amphibian 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 are only tested on the protocols for which they are responsible. Personnel who are not certified (e.g., part-time technicians, new students, volunteers) will not be 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 selection system created by Dr. Terry Brown (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 lead PI (Uzarski), and the QA managers (Brady and Cooper).

Web-based Data Entry System

A web-based data entry system was developed in 2011 to collect field and laboratory data. The open source Django web application framework was used with the open source postgresql database as the storage back end, with a separate application for each taxonomic group. Forms for data entry are generated automatically based on an XML document describing the data structure of each taxonomic group's observations. Each data entry web form is password-protected, with passwords assigned and tracked for each individual.

Features of note include:

- fine-grained access control with individual user logins, updated every winter;
- numerous validation rules of varying complexity to avoid incorrect or duplicate data entry;
- custom form elements to mirror field sheets, e.g. the vegetation transects data grid; this makes data entry more efficient and minimizes data entry errors;
- domain-specific utilities, such as generation of fish length records based on fish count records;
- dual-entry inconsistency highlighting for groups using dual-entry for quality assurance;
- user interface support for the highly hierarchical data structures present in some groups' data.

The web-based data retrieval system for project researchers allows "raw", QC'd data to be downloaded by PIs of each taxonomic group. Additionally, most of the metric and IBI calculations have been automated and can be generated simply by re-running the scripts. The data retrieval system uses the same technologies as the data entry system. Password access is tracked separately for the data retrieval system, and is again tracked individually.

EPA GLNPO has been given access to the retrieval system and data, located at http://beaver.nrri.umn.edu/glrimon/dv/folder/. The public, if they access this site, can see summaries of numbers of sites sampled by the various crews for the different taxonomic groups. Other features are only visible to those with a password.

The data download system has been expanded with the capability of serving static files as well as tabular data queried on demand for the database server. Static file serving is used to deliver data in Excel and Access-ready formats. These datasets are intended to give fine-grained access for data analysis by PIs. These files also provide a complete backup of the project data in a format that does not require the database server to be running to allow access.

We have also developed an interactive map available as a website that will allow users to visualize and download site level attributes such as IBIs and invasive species counts for

wetlands basin wide. This web-based tool requires no specialized software on the user's system. Tools for defining a user-specified area of interest will provide results in regional and local contexts. Authorized users (i.e., agency personnel and other managers) will be able to drill down to specific within-site information to determine what factors are driving an individual site's scores.

Data is continuously backed up using a live backup system (Write Ahead Log storage from the database backend), with nightly mirroring of the backup system to a separate location (from NRRI to the UMD campus).

RESULTS-TO-DATE (2011-2013)

A total of 176 wetlands were sampled in 2011, with 206 sampled in 2012 and 201 in 2013, for an overall total of 583 Great Lakes coastal wetlands sampled in three years (Table 5). As in previous 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, Table 5). When compared to the total number of wetlands targeted to be sampled by this project (Table 2), we are achieving our goals of sampling 20% of US wetlands per year, both by count and by area. However, 65% of total sites sampled have been US coastal wetlands, with 80% of the wetland area sampled on the US side. Overall, we have sampled 61% of US coastal wetlands by count, and 60% of US coastal wetlands by area. With respect to the entire Great Lakes, the project has sampled 57% of coastal the wetlands or 58% by area.

Table 5. Counts, areas, and proportions of the 583 Great Lakes coastal wetlands sampled in 2011, 2012, and 2013 by the GLIC: Coastal Wetland Monitoring Project. Area in hectares.

Country	Site count	Site %	Site area	Area %
Canada				
2011	50	28%	3,303	13%
2012	82	40%	7,917	27%
2013	71	35%	7,125	27%
CA total	**203**	**35%**	**18,345**	**29%**
US				
2011	126	72%	22,008	87%
2012	124	60%	21,845	73%
2013	130	65%	18,939	73%
US total	**380**	**65%**	**62,792**	**71%**
Overall Totals	**583**		**81,137**	

Benchmark sites are sites that are either added to the overall site list and would not have been sampled as part of the random selection process, or are sites that are considered a reference of some type and are being sampled more frequently. Sites that would not have been sampled typically were too small, disconnected from lake influence, or are not a wetland at this time, and thus did 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 are getting many requests to provide baseline data for restoration work; this is occurring at a frequency great enough for us to have difficulty accommodating the extra effort.

As of spring 2014, we have 59 sites designated as "benchmark." Of these, 23 (39%) are to evaluate restoration efforts and 17 (28%) serve as reference sites for their area or for nearby restoration sites. Almost all benchmark sites are in the US.

Determining whether Benchmark sites would have been sampled at some point as part of the random site selection process is somewhat difficult because some 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 are 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.

We can now compile good statistics on Great Lakes coastal wetlands because we have sampled more than 50% of the medium and large, hydrologically-connected coastal wetlands on the Great Lakes. Wetlands contained approximately 25 bird species on average; some sampled benchmark sites had as few as 1 species, but richness at high quality sites was as great 50 to nearly 60 bird species (Table 6). There are many fewer calling amphibian species in the Great Lakes (8 total), and coastal wetlands averaged about 4 species per wetland, with some benchmark wetlands containing no calling amphibians (Table 6). However, there were wetlands where all 8 calling amphibian species were heard over the three sampling dates.

Table 6. Bird and calling amphibian species in wetlands; summary statistics by country. Data from 2011 through 2013.

Country	Site count	Mean	Max	Min	St. Dev.
Birds					
Can.	184	27.1	58	8	10.3
U.S.	330	22.0	53	1	12.0
Amphibians					
Can.	176	4.2	8	1	1.7
U.S.	330	3.6	7	0	1.5

Bird and amphibian data in Great Lakes coastal wetlands by lake (Table 7) shows that wetlands on most lakes averaged 20-30 bird species, with Lake Ontario coastal wetlands averaging the fewest species. The greatest number of bird species at a wetland occurred on Lake Huron, with lakes Erie, Superior, and Michigan being close seconds. These data include the benchmark sites, many of which are in need of restoration, so the minimum number of species is quite low for some of these wetlands.

Calling amphibian species counts show less variability among lakes simply because fewer of these species occur in the Great Lakes. Wetlands averaged three to four calling amphibian species regardless of lake (Table 7). Similarly, there was little variability by lake in maximum or minimum numbers of species. At some benchmark sites and cold springs no calling amphibians were detected.

Table 7. Bird and amphibian species found in Great Lakes coastal wetlands by lake. Mean, maximum, and minimum number of species per wetland for wetlands sampled in 2011, 2012, and 2013.

	Birds				Calling amphibians			
Lake	Sites	Mean	Max	Min	Sites	Mean	Max	Min
Erie	57	22.3	53	4	60	3.1	7	0
Huron	158	24.6	58	2	151	3.7	7	0
Michigan	84	24.0	51	1	78	3.7	7	0
Ontario	139	20.8	45	8	138	4.5	8	1
Superior	76	28.5	52	11	79	3.5	7	0

Means of approximately 11 and 14 fish species were collected in Canadian and US Great Lakes coastal wetlands, respectively (Table 8). 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 (US). An encouraging sign is that there are wetlands in which no non-native fish species were caught.

Table 8. Total fish species in wetlands, and non-native species; summary statistics by country for sites sampled in 2011, 2012, and 2013.

Country	Sites	Mean	Max	Min	St. Dev.
Overall					
Can.	96	10.6	23	2	4.0
U.S.	213	13.9	28	2	5.2
Non-natives					
Can.	96	0.7	3	0	0.7
U.S.	213	0.8	5	0	1.0

Combining 2011 through 2013 data, there were no non-native fish species caught at 46% of the Great Lakes coastal wetlands sampled, but 36% had one non-native species (Figure 5). More than one non-native species was captured at many fewer sites. It is important to note that the sampling effort at sites was limited to one night, so these numbers are likely quite conservative, and wetlands where we did not catch non-native fish may actually harbor them.

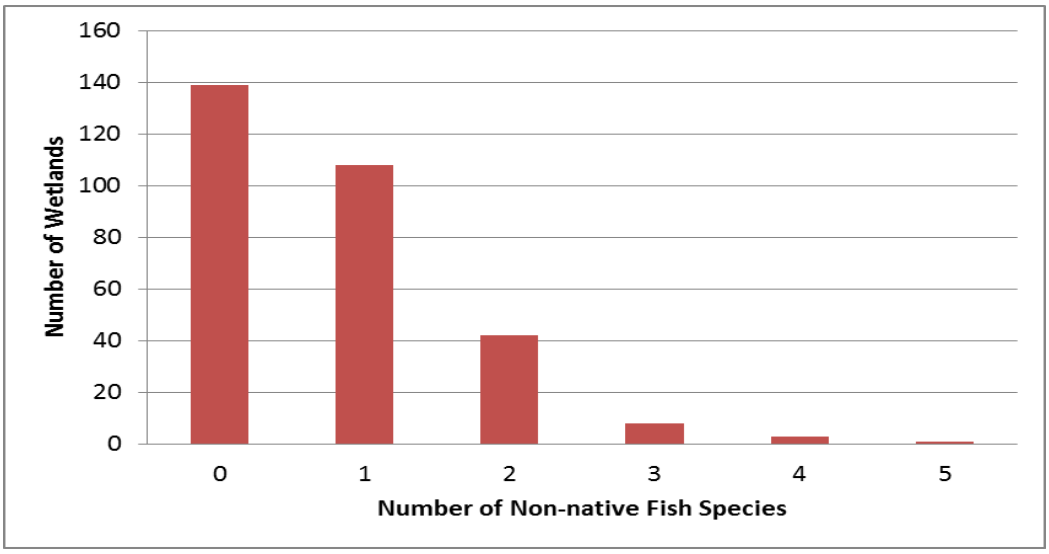

Figure 5. Number of Great Lakes coastal wetlands containing non-native fish species. Data from 2011 through 2013.

Total fish species did not differ greatly by lake, averaging 12-15 species per wetland (Table 9). Lake Ontario wetlands had the lowest maximum number of species, with the other lakes all having similar maximums of 27-28 species. Since sites in need of restoration are included, some

of these sites had very few fish species, as low as two. Lake Huron wetlands averaged the lowest mean number of non-native fish taxa. All other lakes had a similar average number of non-native fish species per wetland, about 1. Having very few or no non-native fish is a positive, however, 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, unfortunately. Our single-night net sets do not catch all fish species in wetlands, and some species are quite adept at avoiding passive capture gear. For example, common carp are known to avoid fyke nets. When interpreting fish data it is important to keep in mind the well-documented biases associated with each type of 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 9. 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, 2012, and 2013.

		Fish (Total)			Non-native		
Lake	**Sites**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**
Erie	37	12.7	27	2	1.2	4	0
Huron	95	11.8	27	2	0.4	2	0
Michigan	45	13.9	28	5	1.0	4	0
Ontario	83	12.8	23	5	0.8	3	0
Superior	41	14.8	28	3	0.9	5	0

The average number of macroinvertebrate taxa (taxa richness) per site was about 40 (Table 10), but some wetlands had more than twice this number. Sites scheduled for restoration and other taxonomically poor wetlands had fewer taxa [17 (CA) or 12 (US)]. So far we have found at least one species of non-native macroinvertebrate in every wetland we have sampled for macroinvertebrates, emphasizing the widespread distribution of non-native species throughout the Great Lakes. On a more positive note, the average number of non-native invertebrate taxa in coastal wetlands was less than 2, with a maximum of no more than 4 taxa (Table 10). Again, we must point out 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 10. Total macroinvertebrate taxa in Great Lakes coastal wetlands, and non-native species; summary statistics by country. Data from 2011, 2012, and 2013.

Country	Sites	Mean	Max	Min	St. Dev.
Overall					
Can.	111	40.1	78	17	15.2
U.S.	237	40.4	86	12	17.6
Non-natives					
Can.	111	1.2	2	1	0.4
U.S.	237	1.4	4	1	0.7

There is some variability among lakes in the mean number of macroinvertebrate taxa per wetland. Lake Erie and Ontario wetlands averaged about 35 taxa (Table 11), while lakes Huron, Superior, and Michigan averaged about 45 taxa. The maximum number of invertebrate taxa was higher in lakes Huron and Michigan wetlands (80 or more) than for the most invertebrate-rich wetlands in the other lakes, which have a maximum of about 70 taxa. Wetlands with the fewest taxa may be sites in need of restoration and have between 12 taxa (Erie) and 19 taxa (Michigan). Patterns are likely being driven by differences in habitat complexity, which may in part be due to the loss of wetland habitats on lakes Erie and Ontario from diking (Erie) and water level control (Ontario). This has been documented in numerous peer-reviewed publications. Minimum numbers, as noted above, may also be driven by benchmark sites that are slated for restoration. There is little variability among lakes in non-native taxa, although Erie and Huron had wetlands with 4 non-native macroinvertebrate taxa.

Table 11. 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 wetlands sampled in 2011, 2012, and 2013.

		Macroinvertebrates (Total)			Non-native		
Lake	Sites	Mean	Max	Min	Mean	Max	Min
Erie	41	34.9	72	12	1.6	4	1
Huron	121	43.4	80	13	1.3	4	1
Michigan	51	43.7	86	19	1.3	2	1
Ontario	85	33.8	68	12	1.2	2	1
Superior	50	44.9	69	15	1.3	2	1

On average, there were approximately 45 wetland plant (macrophyte) species per wetland (Table 12), but the maximum number was almost 90 species. Some sites were quite depauperate in plant taxa (some having almost none), particularly in highly impacted areas that were no longer wetlands but were sampled because they are designated for restoration.

Table 12. Total macrophyte species in Great Lakes coastal wetlands, invasive species and US at-risk species; summary statistics by country. Data from 2011, 2012, and 2013.

Country	Site count	Mean	Max	Min	St. Dev.
Overall					
Can.	121	46.2	87	9	17.4
U.S.	258	43.8	89	1	16.7
Invasives					
Can.	121	3.6	8	0	2.1
U.S.	258	3.3	9	0	2.1
At risk					
U.S.	258	0.1	2	0	0.35

Invasive vegetation is commonly found in Great Lakes coastal wetlands. Those that we sampled averaged 3-4 invasive species (Table 12). Note that species classified as “invasives” are often non-native as well, but do not have to be to receive that designation. For example, some cattail (*Typha*) species are considered invasive although they are native taxa. Some wetlands contained as many as 9 invasive macrophyte species, but there were wetlands in which no invasive plant species were found. Restoration groups often struggle to restore wetland sites without having invasive species become dominant.

We currently have trustworthy information about at-risk wetland vegetation for only the US side of the Great Lakes. At-risk species (federal and state-designated) were not commonly encountered during sampling, as can be seen in Table 12. The average number of at-risk species per site was nearly zero, with most sites having no at-risk species; the maximum found at a site was only two species. This may be partly due to the sampling methods, which do not include a random walk through all habitats to search for at-risk species.

Lake Huron wetlands had the greatest mean number of macrophyte species, with Lake Erie wetlands having much lower mean numbers of species than wetlands on the other Great Lakes (Table 13). Maximum species richness in Lake Erie wetlands was lower than wetlands on the other Great Lakes. Average numbers of invasive species were highest in lakes Erie and Ontario and lowest in Lake Superior wetlands. Lake Superior had the lowest maximum number of invasive macrophytes in a wetland, with all the other lakes having about the same maximum

number (7-9 species). Lake Ontario is the only lake with no sampled wetlands being free of non-native species.

Table 13. Macrophyte total species and invasive species found in Great Lakes coastal wetlands by lake. Mean, maximum, and minimum number of species per wetland. Data from 2011, 2012, and 2013.

		Macrophytes (Total)			Invasives		
Lake	**Sites**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**
Erie	48	26.6	69	1	4.4	8	0
Huron	143	53.3	89	15	2.6	7	0
Michigan	49	44.3	83	4	3.0	7	0
Ontario	93	41.1	87	13	5.2	9	1
Superior	46	43.4	78	21	1.7	5	0

Our macrophyte data have reinforced our understanding of the numbers of coastal wetlands that contain invasive plant species (Figure 6). Only 9% of 379 sampled wetlands lacked invasive species, leaving 91% with at least one. Sites were most commonly invaded by 2 – 5 plant species and 7% of sites contained 7 or more invasive species. Detection of invasive species is more likely for plants than for organisms that are difficult to collect such as fish and other mobile organisms, but we may still be missing small patches of invasives in some wetlands.

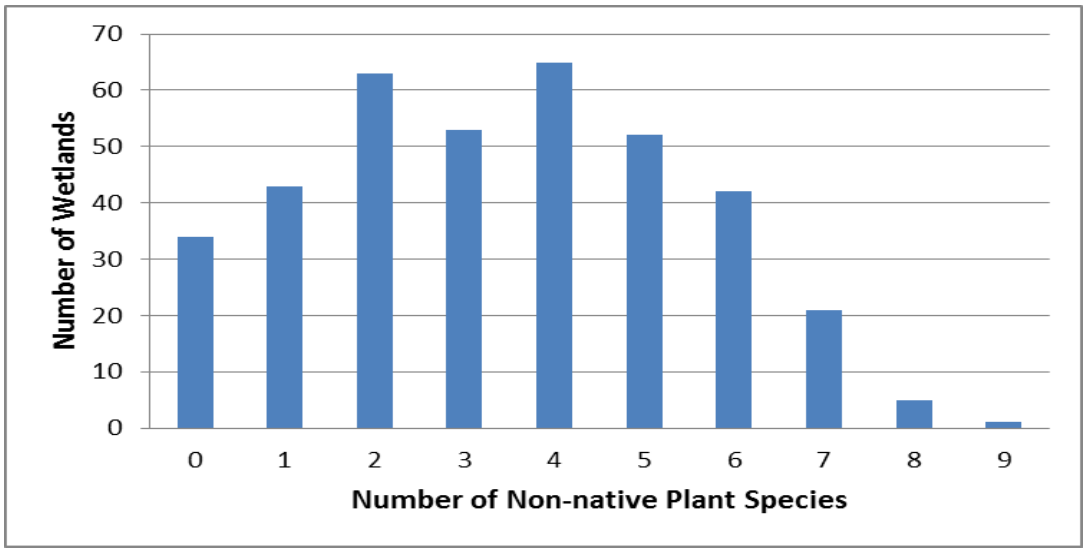

Figure 6. Number of Great Lakes coastal wetlands containing invasive plant species based on 2011 through 2013 data.

In the fall of 2012 we began calculating metrics and IBIs for various taxa. We are evaluating coastal wetland condition using a variety of biota (wetland vegetation, aquatic macroinvertebrates, fish, birds, and amphibians). Avian and amphibian 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). A bird index of biotic integrity (IBI) has now been calculated for Great Lakes coastal wetlands following the methods of Crewe and Timmermans (2005). Crew and Timmermans (2005) developed this IBI for Great Lakes coastal wetland bird communities from data collected from Bird Studies Canada's Marsh Monitoring Program. This IBI should be considered a draft because our data expand the IBI quite a bit beyond the area where it was developed. We are still analyzing whether adjustments sufficiently account for differences due to latitude across the entire Great Lakes basin.

Macrophytic vegetation (only large plants; algal species were not included) has been used for many years as an indicator of wetland condition. 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 Conservatizm (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). 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 is based largely on C scores for wetland species.

The map (Figure 7, updated and revised for this report) shows the distribution of Great Lakes coastal wetland vegetation index 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 FQI scores are concentrated in the southern Great Lakes, where there are large amounts of both agriculture and urban development, while sites with high FQI 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. Note that this IBI has been updated and adjusted since the start of the project, accounting for the shift in condition scores for a handful of sites. This adjustment was necessary to reflect changes in the taxonomic treatment of many marsh plants in the 2012 Michigan Flora and Flora of North America.

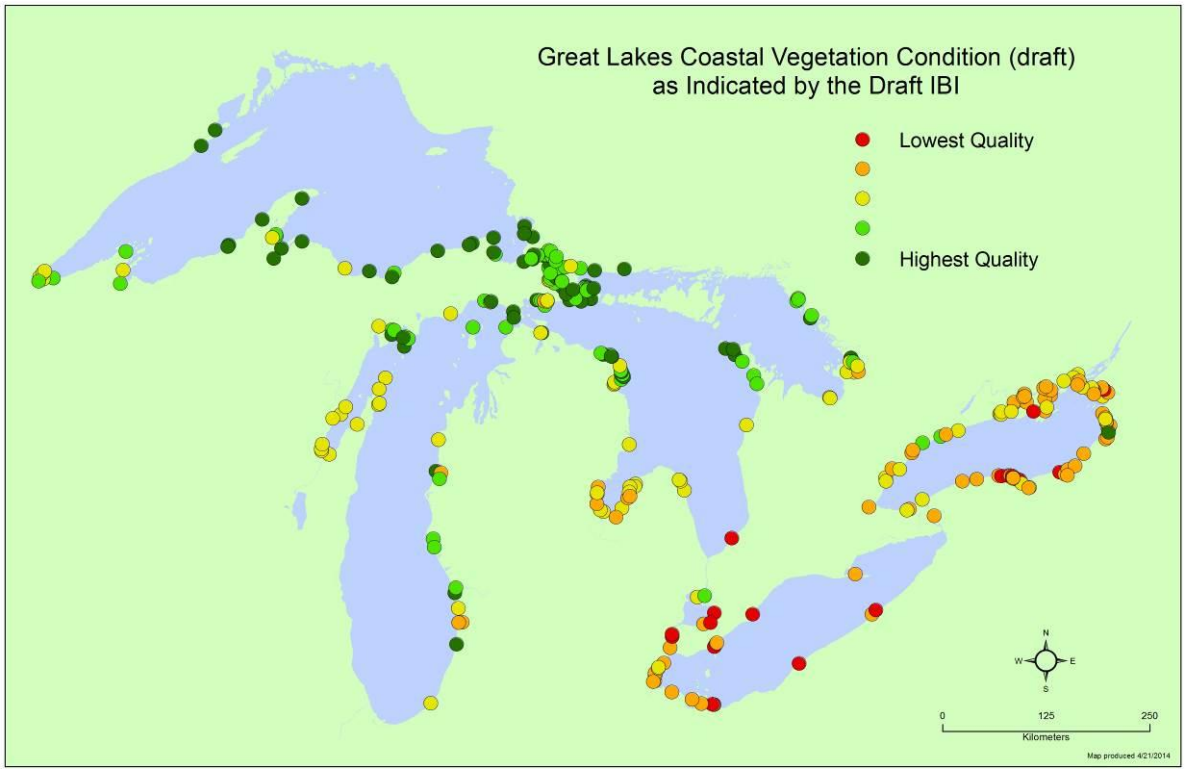

Figure 7. Condition of coastal wetland vegetation at sites across the Great Lakes. Circle color indicates vegetation quality. The indicator is labeled "draft" while the effect of recent taxonomic revisions on its values are investigated. Based on data from 2011 through 2013.

We are still investigating the effect on IBI scores of the updated Michigan Flora (2012) with new taxonomic names for many species.

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. We have calculated these IBIs for 2011, 2012, and 2013 sites that contain these habitat zones (Figure 8). Minor adjustment of metrics is continuing, so maps are not directly comparable across reports.

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. 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.

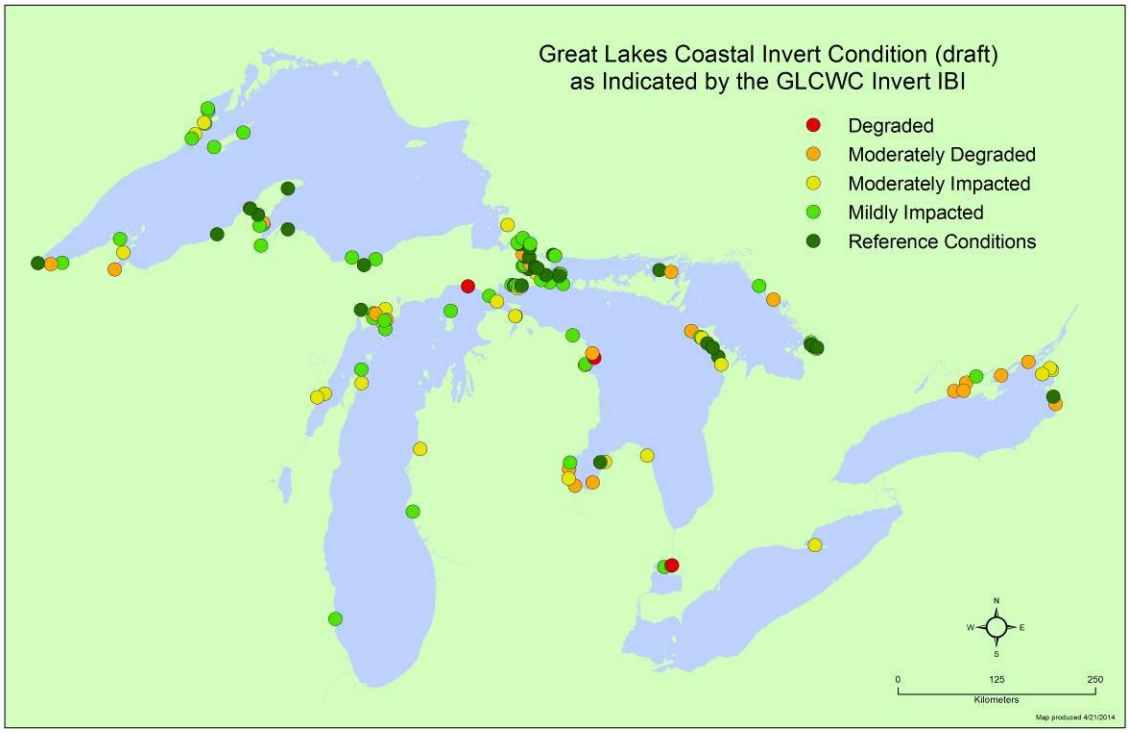

Figure 8. Condition of coastal wetland macroinvertebrate communties at sites with bulrush or wet meadow zones. The indicator is labeled "draft" while more zone IBIs are calculated. Based on data from 2011, 2012, and 2013.

We are currently able to report draft fish IBI scores for wetland sites containing bulrush and/or cattail zones (Figure 9). These are the two zone types with GLCWC validated fish IBIs. Because of the prevalence of cattail zones on in Erie and Ontario wetlands, this indicator provides more site scores than the macroinvertebrate indicator (until we validate cattail zone metrics for macroinvertebrates). Only a few wetlands rank as high quality with the fish IBI. We are still working to determine whether we have set the criteria for this indicator too stringently, or if fish communities really are relatively degraded in many areas.

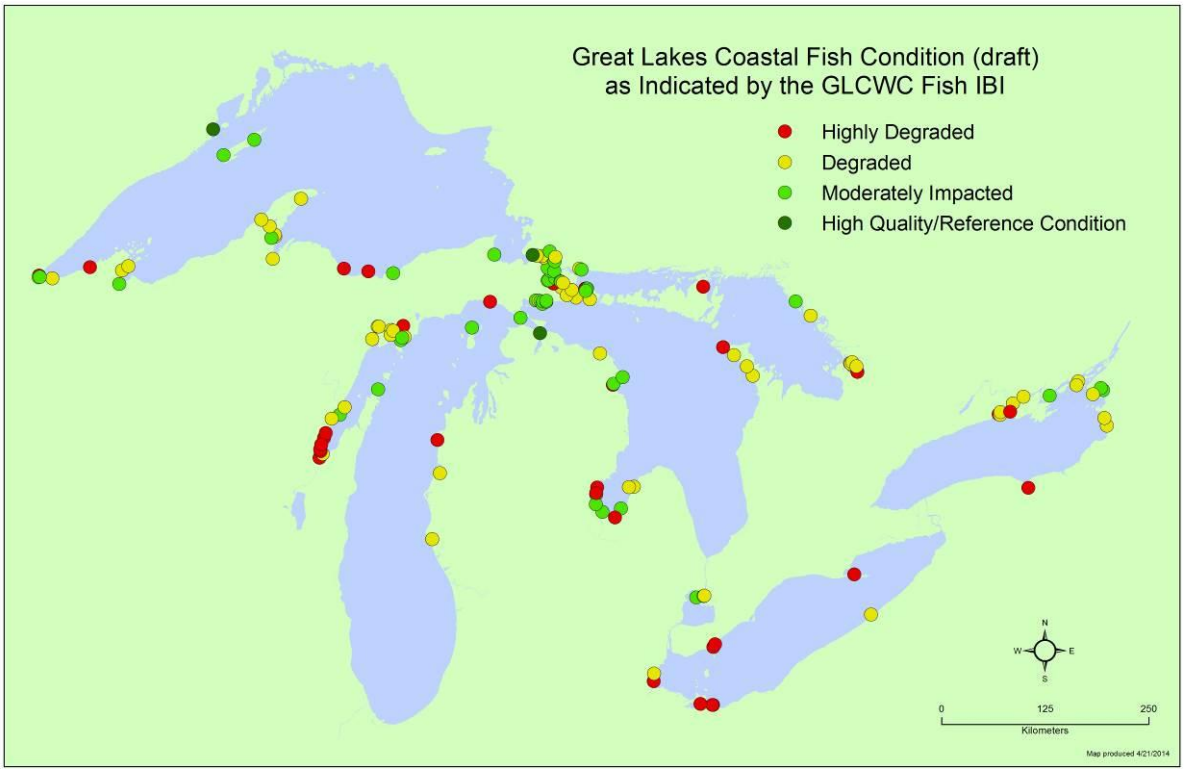

Figure 9. Condition of coastal wetland fish communties at sites with bulrush or cattail zones. The indicator is labeled "draft" while more zone IBIs are developed. Based on data from 2011 through 2013.

Presently we are using a coastal wetland bird IBI created based on guidelines presented in Crew and Timmermans (2005). There is considerable variability in bird IBI scores across the basin (Figure 10), although wetlands on lakes Erie and Ontario fare the poorest overall. However, benchmark sites also exhibit low bird IBI scores even in locations such as Duluth, on Lake Superior.

As noted above, there is little diversity in amphibians across Great Lakes wetlands. We have had some success with an amphibian indicator relying on spring peeper (*Pseudacris crucifer*) density at wetlands. It is unclear whether or not this will prove to be a reliable indicator since it is based on a single species.

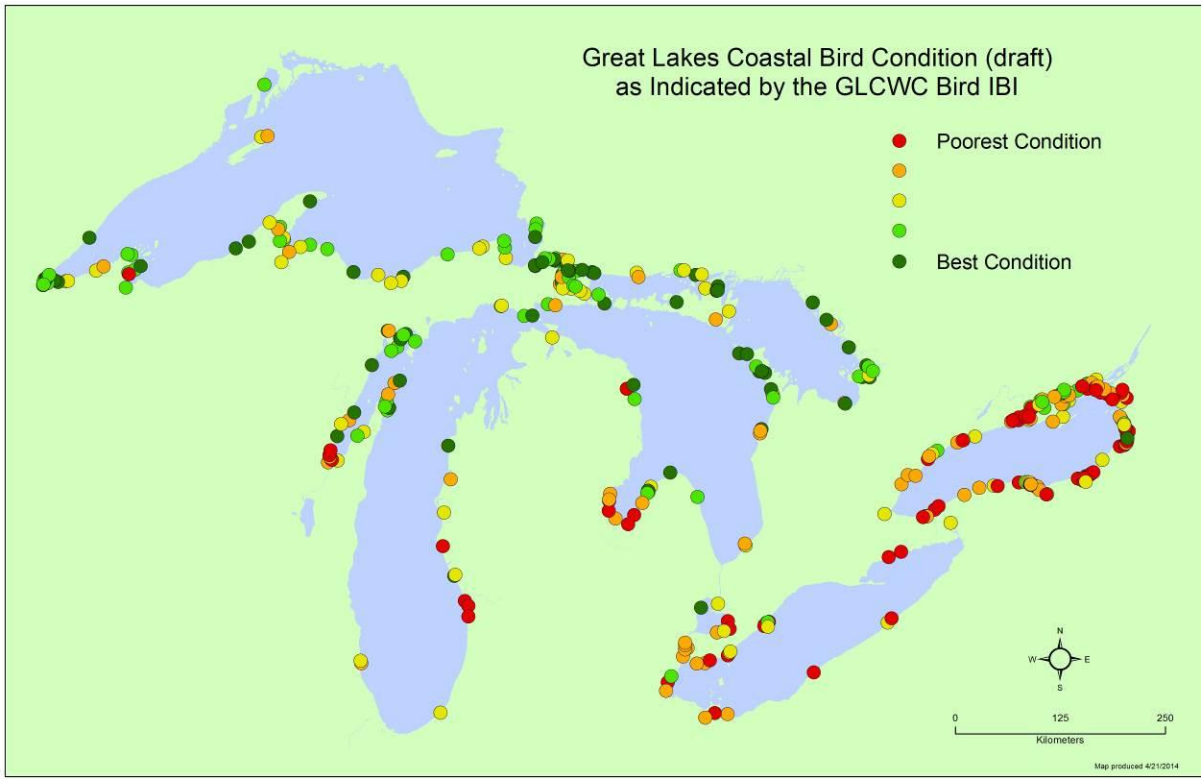

Figure 10. Condition of coastal wetland bird communties. The indicator is labeled “draft” while we explore whether enough adjustment has been made for latitute and longitude differences across the basin. Based on data from 2011 through 2013.

PUBLIC ACCESS WEBSITE

We have created a publically accessible website to inform managers, agency personnel, and the interested public about the basics of our project (Figure 11). The website's primary function is to house a web-based tool that allows varying levels of access to our results, depending on the user's data needs and who they work for.

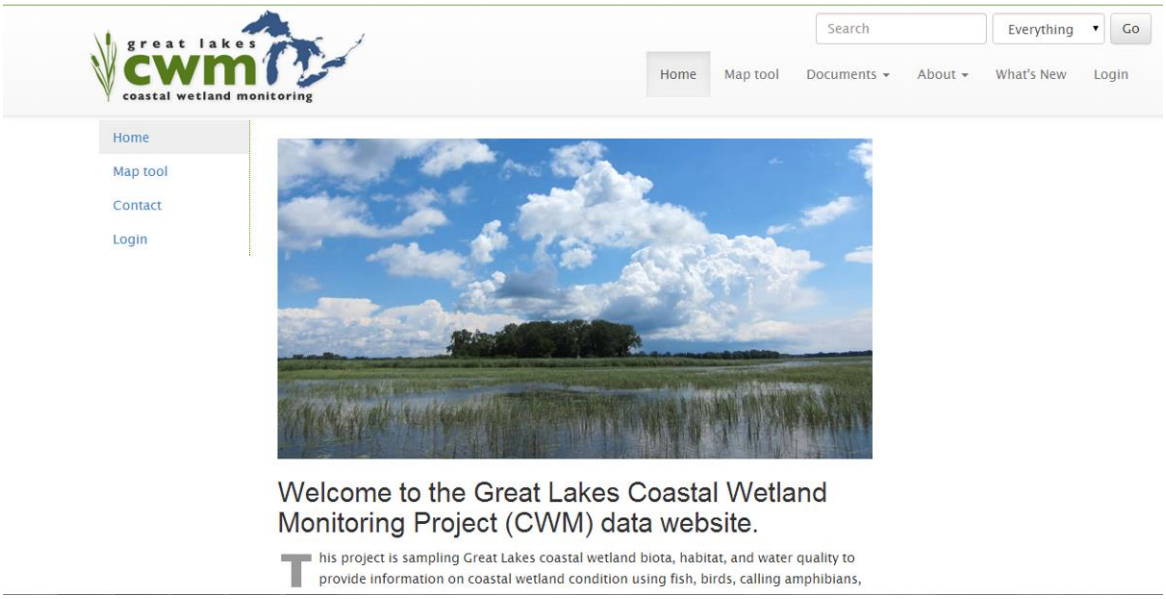

Figure 11. Front page of the new Great Lakes Coastal Wetland Monitoring public website, www.greatlakeswetlands.org.

In addition to features commonly found in map-based web interfaces (e.g., layer switching, swapping of base-maps, panning and zooming), the tool will provide custom functionality relevant to coastal wetland monitoring (Figure 12). Users will be able to examine sites ranked by Indices of Biological Integrity (IBIs) and other attributes, look at taxa lists, and peruse site information in the context of a particular region of interest, as well as whole lakes or the entire basin.

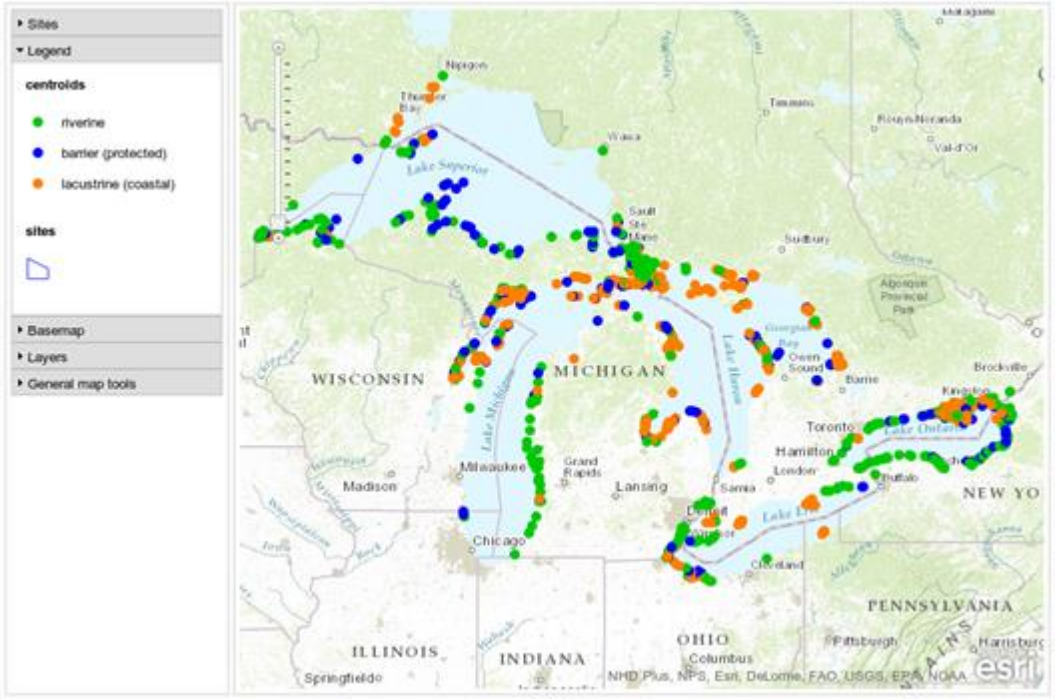

Figure 12. Default view of all sites in the database, color-coded by wetland type (riverine, barrier-protected, or lacustrine).

Users can change the coding schema for the sites shown in the display map to show what year(s) sites were sampled (Figure 13), what types of data are available for a site, and what the site condition is as indicated by the various biotic groups sampled. Users can select areas of the map to zoom to so that they can better view site information.

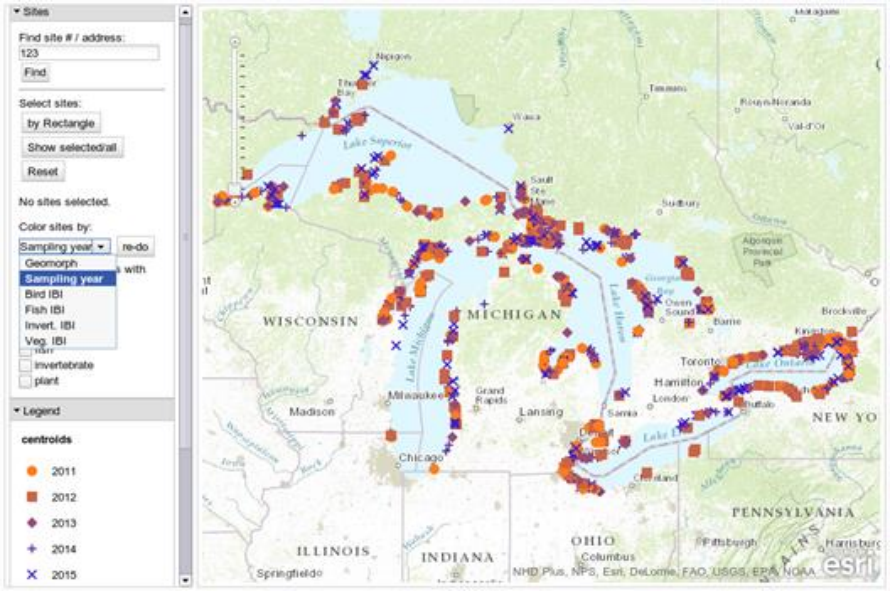

Figure 13. View by sampling year. Sites sampled in more than one year show the most recent year of sampling.

Wetland condition values can be selected for any of the IBIs currently available (fish, macroinvertebrates, or wetland vegetation) and displayed for the whole basin using the

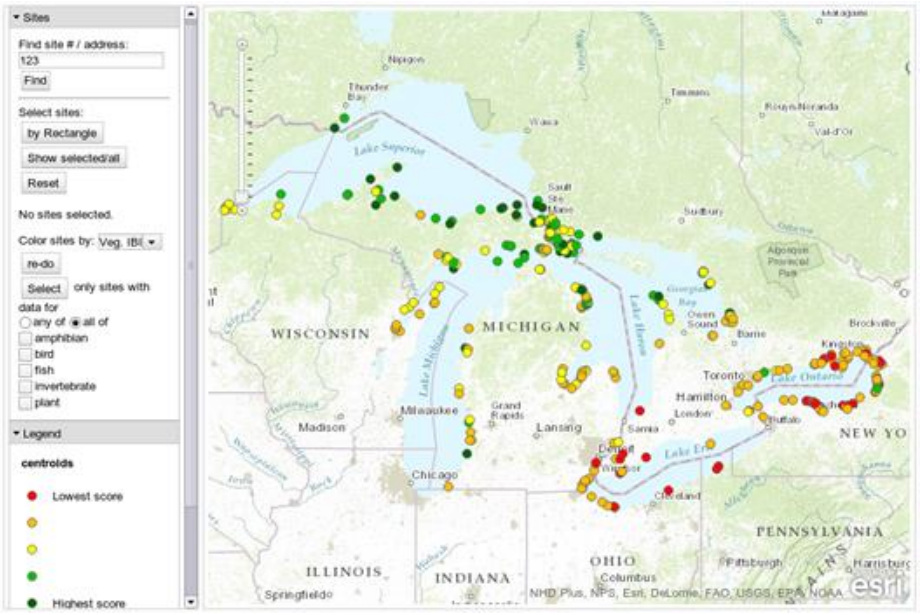

Figure 14. Wetland condition based on the wetland macrophyte IBI displaying sites for the whole basin for which there are data.

calculated normal scaling for the IBI (Figure 14).

The tool also allows users to draw a box around sites of interest at any scale, such as all of Lake Erie, or just Green Bay, or just the St. Louis River estuary (Figure 14). Once selected, any IBI can be re-scaled for just the sites on display to color-code the sites based on their range of scores. This removes the sites from the basin-wide condition narrative and simply shows the user which sites are in best to worst condition for that indicator for that area. Thus, rescaled maps must be carefully explained to others and should not be shown without explanation. The advantage is that this allows easy color-coded separation of sites that, when compared to all Great Lakes wetlands, appear to all have about the same condition scores (Figure 15 inset). By rescaling these sites, managers can see at a glance which wetlands have the highest and lowest scores for their area of management or interest (Figure 15).

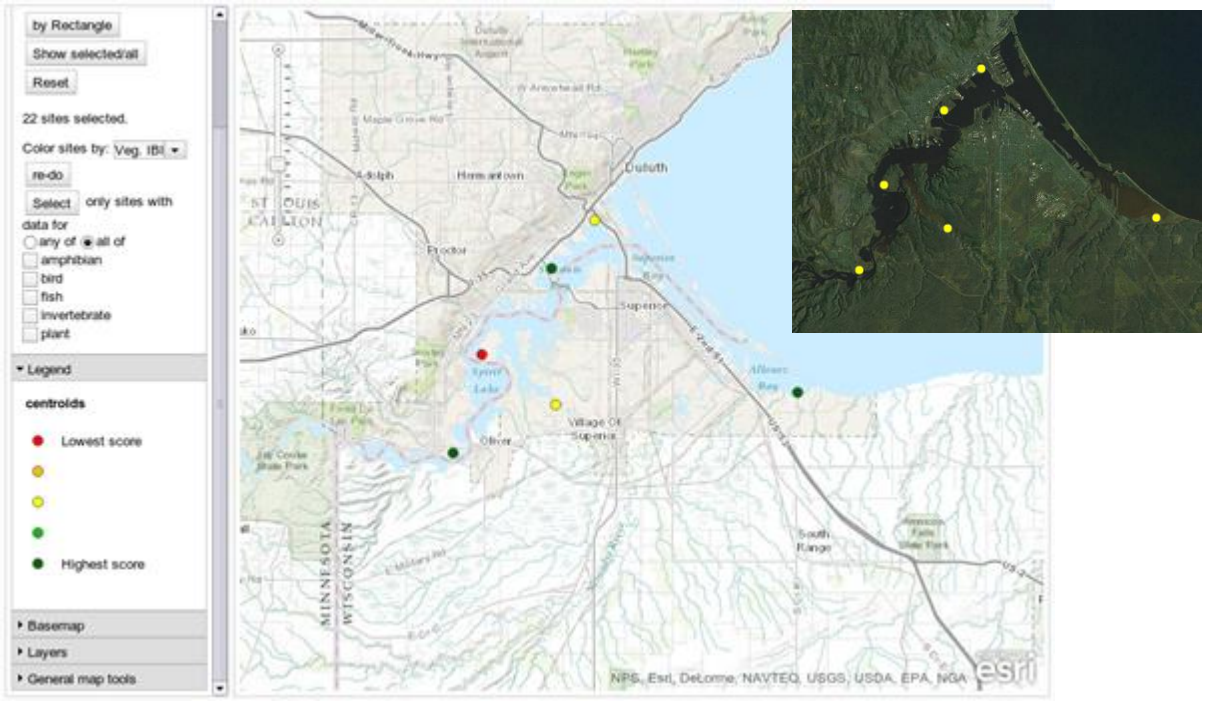

Figure 15. Wetlands in the St. Louis River estuary, Lake Superior, color-coded by wetland vegetation IBI scores that have been re-scaled for the sites shown. Inset shows original site coding for these wetlands in the context of all the wetlands across the Great Lakes.

The web tool will have different levels of access based on the type of user (e.g., general public, management, researcher, etc.). This will be controlled by user login. Depending on their level of access, users will be able to drill down at individual sites to see lists of species found (Figure 16), non-native species, IBI scores and their composite metrics, and potentially other site information.

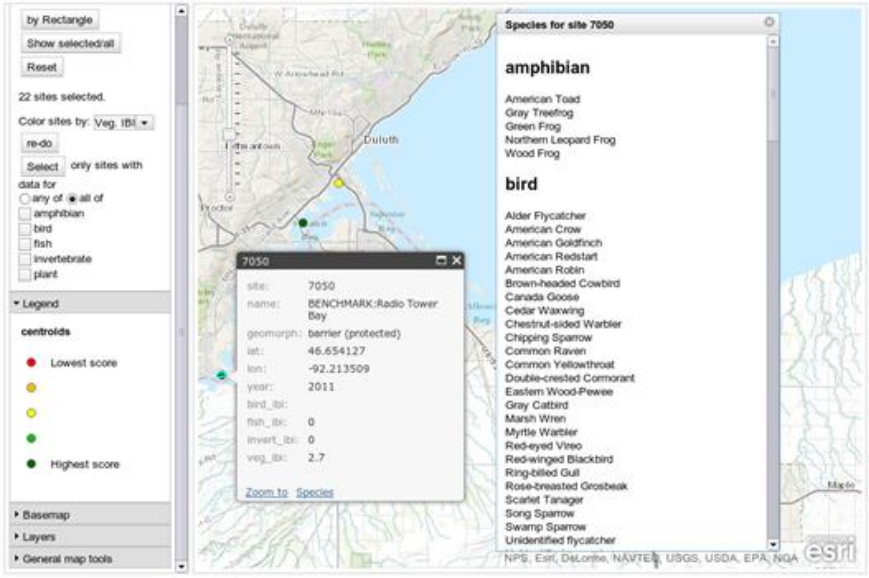

Figure 16. Example display of species lists for a specific site.

TEAM REPORTS

WESTERN REGIONAL TEAM: Jerry Niemi (Birds and Amphibians), Valerie Brady and Lucinda Johnson (Fish and Macroinvertebrates), Nicholas Danz (Vegetation), and Rich Axler (Water Quality)

Field Training

Birds and Amphibians

Training for amphibian surveys will be held on 15 April 2014 and bird crew training will take place 24 – 26 May 2014. Training involves instructing crews on how to conduct standardized field surveys, on basic travel procedures, and on appropriate field safety measures. Individuals are trained to proficiently complete field sheets and audio testing is also completed to insure that their hearing is within the normal range. Rules for site verification, safety issues including caution regarding insects (e.g., Lyme's disease), GPS and compass use, and record keeping are also included in field training to insure that the guidelines in the QAPP are being followed. All individuals involved in conducting the surveys will take and pass each of the following tests on 1) amphibian calls, 2) bird vocalization, and 3) bird visual identification that are based on an on-line system established at the University of Wisconsin, Green Bay, prior to conducting surveys – see http://www.birdercertification.org/GreatLakesCoastal. All individuals who participated in sampling in 2013 passed the required tests prior to sampling. Individuals planning to conduct

surveys in 2014 for either birds or amphibians must have taken and passed the necessary test(s) by the following dates: 1) Thursday, 20 March 2014 for amphibian surveys, and 2) Thursday, 15 May 2014 for bird surveys. Field observers who have become certified in previous years are not required to become certified again in future years.

All new and returning field observers will review the QAPP and SOPs and new personnel will complete the online certification requirements (see above) prior to conducting field surveys. The supervising PI will conduct mid-season checks by visiting survey locations and verifying that proper protocol is being implemented. All data entry and QA for bird and amphibian records will be completed (100%) by September 2014.

Fish, Macroinvertebrates, Vegetation, and Water Quality
Fish, macroinvertebrate, vegetation, and water quality sampling training will be held in Duluth, Minnesota, and Superior, Wisconsin, in mid-June 2014. A few fish/invertebrate/water quality crew members will be returning from previous seasons, but we will have a number of new field crew members this year. This year the vegetation crew will include some trained botanists who will help with the sites in the UP and Green Bay. All field technicians will be trained in and tested on all standard procedures, including a field-based fish or vegetation identification exam (depending on the crew). Training includes how to determine if a site meets project criteria, all aspects of sampling the site, proper recording of data on datasheets, GPS use and uploading, water quality sample collection and meter calibration, as well as sample processing. Safety training covers aspects of field safety including safe boating; protection against the elements, animals, insects, and plants; and what to do when things go wrong. Much of this training takes place in the field at a typical coastal site to ensure field members learn (or review) appropriate techniques. Field training will continue at the first sampling sites in Green Bay, WI, with either western team PI Brady or western team field crew chiefs Dumke and Hell supervising all crews for the entire 9 day trip.

We are in the process of obtaining sampling permits from state fisheries management agencies, parks, and various other entities (the states of Minnesota, Wisconsin, and Michigan, the National Park Service, and various state parks). The US Forest Service decided that no special permits are necessary for any sampling on their lands across the Great Lakes states. We have renewed our University of Minnesota Institutional Animal Care and Use Committee permit for fish sampling.

Site selection results

Birds and Amphibians
For 2014, a total of 59 sites have been selected to be surveyed for birds and amphibians. Of these sites, 1 site has been sampled in a previous year and is being revisited, 46 are new sites, and 12 are benchmark sites selected because they are of particular interest for restoration potential. Many of the benchmark sites are located in the St. Louis River Estuary and are in

some stage of planning for restoration work. Restoration activities for the sites are being coordinated by the Minnesota Pollution Control Agency and the US Fish and Wildlife Service, with many collaborators from multiple agencies and university research groups.

All of the 59 sites selected in 2014 were reviewed to assure that they meet the sampling requirements [e.g., lake connectivity and size requirements (>4 ha)] and were deemed safe and accessible to field crews. Based on this review, 13 sites have been rejected prior to being visited (web reject) for one of the following reasons: 1) inaccessible or unsafe to access, 2) no trespassing signs and owners could not be contacted, 3) or wetland areas were unsuitable for sampling (e.g. wetland size did not meet site selection requirements, wetland lacked connectivity to the lake, wetland contained only woody vegetation). Reconnaissance of each of the remaining wetlands is scheduled for April 2014 and will be completed prior to beginning the first round of amphibian surveys, which will begin as soon as minimum nighttime temperature requirements have been reached.

The 46 sites that will be visited and potentially sampled by bird and amphibian field crews stretch from the Duluth-Superior harbor area both northeast along the shore of Lake Superior and eastward along the south shore of Lake Superior to the eastern end of the Upper Peninsula of Michigan and into Northeast Lake Huron. In 2014, several island sites are also scheduled to be sampled, including 3 sites in Michigan (all on Isle Royale), 1 site in the St. Louis River Estuary (Spirit Lake Wetland #6), and 2 sites in Ontario (Anchor Island 2 and East Neebish Island 2).

Each of the 46 potential sites will be visited a total of four times between 01 May and 15 July. Amphibians will be sampled three times during this period and birds will be surveyed twice, once in the morning and once in the evening.

Fish, Macroinvertebrates, Water Quality, and Wetland Vegetation
Initial site selection for fish/macroinvertebrate and vegetation crews was 53 sites. Of these, 12 are over the crew capacity limit, another 6 are benchmark sites specific to bird/amphibian crews, and 5 sites are on Isle Royale, which is being sampled by the Central Basin Team this year (except for birds and amphibians, which are being sampled by the western team). In return, we agreed to pick up 10 sites in the Central Basin Team's range. Of the remaining sites, 3 have been web-rejected due to not meeting project criteria for connectivity, wetland presence, lake influence, or safe access. Thus, our teams are planning to sample a total of 27 wetlands, including 8 benchmark sites and 1 resample site during summer 2014. Field crews will begin sampling wetlands in the Green Bay area at the end of June and finish in the Duluth area in early September.

Summary of Findings for 2013

PIs and crews have quite a bit more data to work with after 3 years of sampling. Researchers, graduate students, and technical staff have been spreading the word about our project and

results at national, regional, and local conferences, meetings, and workshops. A list of these presentations has been added at the end of this report.

Birds and Amphibians

Each of the 40 sites sampled in 2013 was visited a total of four times between 01 May and 03 July. Amphibians were sampled three times during this period. A total of seven species were recorded throughout our study sites (Table 13). The average number of amphibian species recorded at each site was four, with a minimum of two species counted at seven wetland sites, including Allouez Bay, a benchmark site in Superior WI, and several highly developed locations such as Carpin Beach in Northeast Lake Huron and Neebing Marsh (also a benchmark location) in Thunder Bay, Ontario. Mud Lake, a benchmark site in the St. Louis River, on the MN side also had only two amphibian species heard. However, in several of these locations, amphibian species were found in high abundance. In both the La Pointe wetland, a barrier wetland on Madeline Island, WI and in the Bibon Lake-Flag River, a riverine wetland on the south shore of Lake Superior, seven species were observed. Spring peepers were the most abundant species observed in all wetlands sampled, accounting for nearly half of the amphibian observations and the majority of full chorus observations (Table 13). There were no observations of bull frog (*Rana catesbeiana*) or mink frog (*Rana sylvatica*) at any of the wetlands sampled by our crews. However, this is not unusual for this region of the Great Lakes because the bull frog has a more southern distribution and the mink frog prefers aquatic areas that are more acidic than those found in the coastal region of the Great Lakes.

Birds were surveyed twice during this period, once in the morning and once in the evening. There were a total of 124 species and 6,297 individual birds recorded. The 5 most abundant species observed accounted for approximately 45% of all observations. These species, in order of decreasing abundance, were red-winged blackbird (*Agelaius phoeniceus*), Canada goose (*Branta canadensis*), ring-billed gull (*Larus delawarensis*), yellow warbler (*Setophaga petechia*), and common yellowthroat (*Geothlypis trichas*).

Table 13. List of amphibians recorded during 2013 surveys. The number of individuals counted and the number of full choruses observed (# of individuals cannot be estimated) are provided for each species.

Species	#Individuals	# Obs. - Full Chorus
American toad (*Bufo americanus*)	106	3
Chorus frog (western/ boreal -*Pseudacris*)	20	0
Green frog (*Lithobates clamitans*)	243	10
Gray treefrog (*Hyla versicolor*)	212	17
Northern leopard frog (*Lithobates pipiens*)	80	2
Spring peeper (*Pseudoacris crucifer*)	613	113
Wood frog (*Lithobates sylvaticus*)	185	2
Total	**1459**	**147**

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 2013 (Table 14). Some of the most unique and important observations included secretive marsh birds such as American bittern (*Botaurus lentiginosus*), Virginia rail (*Rallus limicola*), Wilson's snipe (*Gallinago delicata*) and least bittern (*Ixobrychus exilis*). Both observations of the least bittern occurred in a riverine wetland located on Clough Island, a benchmark site located in the St. Louis River estuary. It has been several years since this species has been observed in the St. Louis River estuary and this represents either a small signal of recovery for this species or that environmental conditions may be improving in the estuary, or both. The common tern (*Sterna hirundo*), a threatened species in Minnesota and Wisconsin, was observed during our surveys in 2013. Interstate Island, located within the St. Louis River in the Duluth-Superior Harbor, is one of only three active nesting sites for this species on Lake Superior, and is where many of the observations occurred.

There were also seven species of raptor observed in 2013, including 11 bald eagle (*Haliaeetus leucocephalus*) and five osprey (*Pandion haliaetus*). In the Duluth-Superior area alone there are at least four nesting pairs of bald eagles: three nests within the St. Louis River Estuary and one within 0.5 mi of the shoreline within the city limits of Duluth. This represents continued support of the long-term recovery of these populations. Additional species of interest include: common loon (*Gavia immer*), pied-billed grebe (*Podilymbus podiceps*), sandhill crane (*Grus canadensis*), and one mute swan (an invasive, non-native species) observed on the west shore of St. Joseph Island in Northeastern Lake Huron.

Table 14. List of birds of special interest recorded during 2013 surveys. The number of individuals observed, type of wetland where observations occurred, and whether observations occurred in benchmark locations is listed for each species.

Species	# Individuals
Bald eagle (*Haliaeetus leucocephalus*)	11
Common loon (*Gavia immer*)	9
Common tern (*Sterna hirundo*)	22
Least bittern (*Ixobrychus exilis*)	2
Mute swan (*Cygnus olor*)	1
Pied-billed grebe (*Podilymbus podiceps*)	8
Sandhill crane (*Grus canadensis*)	42
Sora rail (*Porzana carolina*)	6
Virginia rail (*Rallus limicola*)	5
Great blue heron (*Ardea herodias*)	15
Belted kingfisher (*Megaceryle alcyon*)	10
Osprey (*Pandion haliaetus*)	5
Wilson's snipe (*Gallinago delicata*)	5

Birds of special concern were observed in 31 of the 40 wetland sites surveyed in 2013. Seven of the 10 benchmark sites surveyed also had birds of special concern including 5 sites in Wisconsin (Allouez Bay, Hog Island, Clough Island (3 sites around this island), and Pokegama River), 1 site in Minnesota (Mud Lake, scheduled for restoration), and 1 site in Freer Point, on Manitoulin Island, Ontario. The lack of observations of black tern, Forster's tern, and Caspian tern (all species of concern throughout the Great Lakes) is of particular concern. All of these species formerly occurred throughout the western Great Lakes region, but have been absent in recent years except as occasional migrants.

Fish, Macroinvertebrates, Water Quality, and Wetland Vegetation

Few rare species were encountered during the surveys. Notably, the plants that impressed the field crew the most were the wetlands in the Green Bay area, e.g. Dead Horse Bay wetlands, which were completely dominated by nearly impenetrable stands of the invasive *Phragmites australis*. Crews sampled live *Phragmites* in 2011. In 2012, crews arrived to find that most *Phragmites* in Green Bay coastal wetlands had been killed with an herbicide. In 2013, crews observed that some areas had been re-herbicided, but coverage appeared to be less comprehensive than in 2012 because some *Phragmites* that had been killed in 2012 was re-growing, while other stands were still dead. We are curious to see the condition of the *Phragmites* in 2014, and are collaborating with Dr. Laura Bourgeau-Chavez at Michigan Tech University on her project to document recovery of treated *Phragmites* stands in Green Bay and Saginaw Bay.

Some of the uncommon fish identified in 2013 included an unusual hybridization of longnose and shortnose gar near Green Bay, WI. These hybrids were recently confirmed by WDNR. Our team collected some in areas beyond the sampling extent of WDNR, so CWM sampling may help identify the range of hybrid gar within the Green Bay region. We plan to collect genetic samples from the gar encountered in 2014 to further investigate this phenomenon. Also found near Green Bay, WI were roseyface shiners, which are a species that are relatively uncommon in coastal margins of Northeastern WI, and prefer clear streams with very low turbidity.

There is a fair amount of disagreement among the scientific community on the correct identification of black and brown bullheads, and the degree to which these two species hybridize. In 2013 the NRRI crew sent nearly 100 black and brown bullhead genetic samples to Dr. Carl Ruetz III at Grand Valley State University for analysis. We anticipate our collaboration with Dr. Ruetz will yield a manuscript which indicates the physical traits useful for correct field identification (based on DNA agreement) within the Great Lakes basin. Effort continues on the bullhead manuscript.

Seven invasive fish species (12,410 individuals in total) were captured and identified by coastal wetland monitoring crews around the Great Lakes. The majority of invasive fish were common carp (9,240), followed by alewife (2,301), goldfish (534), round goby (278), tubenose goby (45), rainbow smelt (6), and Eurasian ruffe (6). Seventeen invasive rusty crayfish were also captured at various sites from Lakes Huron, Michigan, and Superior coastal wetlands. Turtle taxa of interest include blandings turtle occurrences in Lake Michigan and Huron watersheds, and stinkpot (common musk turtle) in coastal wetlands of Lakes Huron and Ontario. Blandings turtles are considered endangered in most of their range. The stinkpot, while not all that rare, may be sensitive to wetland disturbance and their presence could indicate good wetland conditions.

2013 Sample Processing and Data Entry

All 2013 data have been entered into the database and QC'd. This includes habitat, water quality, bird, amphibian, macroinvertebrate, vegetation, and fish data.

Metrics and Indicator Calculations

The western team has taken the lead on exploring avian and amphibian responses to landscape stressors, which be used to inform land managers about the health of coastal wetlands and the landscape stressors that affect these systems (Howe *et al.* 2007). Data that has been entered into the data management system and undergone quality control checks (2011-2013) are being used to calculate some of the metrics and indicators for wetlands. Bird and amphibian indices of ecological condition (IEC) and biotic integrity (IBI) have been calculated for the Great Lakes coastal wetlands following the methods of Crewe and Timmermans (2005). These indices were developed for Great Lakes coastal wetland bird and amphibian communities from data

collected from Bird Studies Canada's Marsh Monitoring Program (MMP), and calculations will be completed by late-March 2014.

PIs on the vegetation project have been working to analyze temporal patterns in floristic quality metrics (e.g. mean Coefficient of Conservatism, FQI). We are asking how much these metrics change from year to year in typical situations and in other cases where water level changes or human influences have been substantial through time.

Leveraged benefits

In 2013, the western team received multiple inquiries regarding data collected by our field crew on this project for specific wetland locations. WDNR requested a summary of bird, amphibian, fish, invertebrate, and aquatic vegetation data collected on and around Clough Island, one of the benchmark sites in the St. Louis River. This effort will include data collected from this project and additional sources and will be used to compare the site quality at Clough Island to other sites within the estuary and Lake Superior.

The St. Marys River Bi-national public advisory council has requested bird and amphibian data for the Pointe Louise wetland in Canada. The Keweenaw Land Trust has also requested data to document the conservation value of the Abbaye Peninsula on Lake Superior.

In summer 2013, N. Danz completed a literature review of studies involving Great Lakes coastal wetlands or floristic quality indices. He is working on a manuscript that involves investigating spatial and temporal patterns in floristic quality across the Great Lakes. Statistical analysis of floristic quality data from wetland surveys is ongoing.

Central Basin Regional Team: **Don Uzarski, Dennis Albert (Vegetation), Thomas Gehring and Robert Howe (Birds and Amphibians), Carl Ruetz (Fish), and Matt Cooper (Macroinvertebrates)**

Sample Processing and Data Entry

<u>Central Michigan University</u>
All field survey data from the 2013 season has been uploaded to the central database. 100% of the aquatic macroinvertebrate identification has been completed and all data have been entered into the online database and checked by a second person. Water quality analysis is 90% done, with Total Nitrogen being finished by mid-April. A method for determining soluble reactive phosphorus using Ion Chromatography is being developed for a secondary analysis of SRP.

Lake Superior State University

Data entry for all parameters was entered and 100% of the data have been checked following the QA/QC procedures. Jake Riley, LSSU technician and Oakland University graduate student, completed identification of the 2013 macroinvertebrate samples. Sample exchange with NRRI for QA/QC is complete.

Grand Valley State University

All field data (i.e., fish, invertebrates, and water quality) were entered and checked for quality control. Aquatic invertebrate identification of the samples collected during the 2013 field season was completed in February 2014 (and that data was entered and checked for quality control). We recently sent aquatic invertebrate samples to Central Michigan University for QC checks.

University of Notre Dame

All laboratory analyses of water samples and chlorophyll *a* were completed by December 2013. Sediment processing for percent organic matter was completed in March. Jess Kosiara spent one week at the CMU laboratory for assistance with invertebrate identification. Invertebrate identification was completed in March and data have been entered. Invertebrate samples were exchanged with CMU for QA/QC and have been re-identified for validation. Water chemistry data have been entered and QC checked by a second crew member.

Oregon State University

All 2013 data have been entered (54 sites) and quality controlled in the electronic database along with their corresponding GPS points. Floristic quality indices were calculated for all sites. Data from nine benchmark sites was shared with three organizations involved in restoration projects.

UW Green Bay

Computer data entry and quality control from the 2013 field season were completed under the guidance of Erin Giese, Data Manager for UW-Green Bay's Cofrin Center for Biodiversity. In addition to Giese, 5 student assistants and Program Assistant Kimberlee McKeefry contributed to this work.

2014 Field Season Preparations
Site Selection

A total of 61 sites were selected for the central basin regional team. Of the 61 sites selected, 13 sites are designated as benchmark sites and three sites are year 3 sites that will be revisited. For fish, invertebrates and water quality, CMU will sample up to 29 sites, GVSU will sampled 8 sites, LSSU will sample up to 12 sites, Notre Dame will sample 9 sites and 3 sites have been web rejected using the army corps of engineers oblique imagery of the Great Lakes shoreline. With

the projected higher water levels than the past three years we expect to reject fewer sites then in the past three seasons.

Central Michigan University

CMU submitted their annual scientific collector's permit report for 2013 to the MDNR in early January and is expecting to receive their 2014 permit by the end of April. CMU has also applied for a permit to sample Isle Royale National Park. CMU is preparing for the 2014 field season by ensuring all gear has received maintenance, and any needed repairs are made. Supplies are being re-ordered and stocked, and field technicians are being evaluated for hiring. CMU has five returning crew members including two field crew leaders who have been with the project for multiple years.

CMU Amphibian and Birds

Site selection for 2014 currently includes 51 wetland sites to sample for amphibians and birds. These sites are located Michigan and Ohio borders of Lakes Erie, Huron, and Michigan. Six technicians have been hired (i.e., 3 crews) to complete surveys. Training for amphibian surveys was completed at CMU on 21 March 2014. Crew members have been tested and certified for identification of frog and toad calls and proper field procedures. Amphibian surveys will likely begin by early April 2014, dependent on temperature. Training for bird surveys, procedures, and certification of bird identification will occur in April 2014 prior to sampling.

Lake Superior State University

In February, summer technician hiring was initiated. Announcements were posted and interviews were conducted, and three technicians (Brian Curell, Trevor Dunn, and Alexis Schefka) were hired by early March. Both will work alongside Brian Curell, the new lead technician. Brian worked on the crew in 2012 and 2013 and will replace Jake Riley since he is finishing his MS program.

Reporting to the MDNR for the scientific collector's permit was completed by early March and we are awaiting the collector's permit for 2014 sampling. A collector's permit may need to be filed with the Ontario Ministry of Natural Resources for the one Ontario site that is scheduled for sampling in 2014.

Grand Valley State University

GVSU completed our annual IACUC report for fish sampling (for the 2013 field season), and Ruetz is in the process of renewing the GVSU's IACUC approval for the upcoming field seasons. Ruetz applied for a scientific collector's permit to sample fish for the 2014 field season. GVSU sent in their YSI6600 sonde to the manufacturer for a "tune-up" in preparation for the upcoming field season. Travis Ellens will serve as the GVSU crew leader this year. This will be Jessica (Comben) Wesolek's last year of field sampling for the project. She will help to train Ellens.

University of Notre Dame

A renewal of the MDNR scientific collector's permit was requested and is currently pending. The original IACUC protocol has expired, a new application was submitted on April 1st to the UND Animal Care and Use Committee. Jessica Kosiara will serve as the crew leader for UND again this year. One additional technician has also been hired and will be trained in May, prior to field sampling. All field equipment will be evaluated and repaired or replaced in May. State special use permits are being acquired from the State of Michigan for sites on state land.

Oregon State University

Albert has started the review of the sites for 2014 sampling, and began photo interpretation of the 2014 sampling sites to facilitate rapid deployment of field teams during summer. Locations of approximate location of sampling transects on aerial photos will be followed by in-field location of random transect starting points. Hiring of summer crews has begun; one graduate student from OSU has been hired with a job announcement sent out for the other three staff positions. Acquisition of equipment and reservation of field vehicles has begun.

UW Green Bay

Planning for the 2014 field season began shortly after the all-hands meeting in January. Giese, Howe, and Walton attended the meeting and participated in coordination of planning with other bird/amphibian field teams. Giese and Beilke have subsequently reviewed site locations in western Lake Michigan and northern Lake Huron, establishing a schedule of site visits for sampling in spring and summer 2014.

Testing of GPS receivers was completed and two training sessions were held for field personnel on March 25th and 27th, 2014. Permission was obtained for access to privately owned wetlands in the southern half of the study area, including a permit for access to a site at Illinois Beach State Park near Zion, IL. Scouting of sites began in early April, and the first amphibian survey was completed on April 10th. Three species of frogs were recorded during this survey, but extended cold weather at the northern sites has delayed the start of additional field surveys so far this spring.

Data usage/side projects

Central Michigan University

CMU is in the process of finalizing a disturbance gradient that is similar to a published gradient by Uzarski *et al.* 2005. The new gradient will incorporate 1 km, 20 km, and watershed (for riverine sites only), land use/land cover buffers, along with 11 abiotic factors collected at each wetland site. We will be testing biotic metrics with these gradients. Each wetland "zone" has an individual disturbance gradient associated with it that encompasses the entire basin. Disturbance gradients encompass a single year's data for the purpose of metric validation in order to remove natural inter-annual variation in wetland abiotic conditions.

Lake Superior State University

In April 2014, Brian Curell and Ryan Baldwin will be finishing their senior thesis projects in conjunction with the wetlands sampling program. They are studying how physical disturbances associated with freighter traffic impact macroinvertebrate community structure, including resistance and resilience to future disturbances. Both students received supplemental funding from the LSSU Undergraduate Research Committee to conduct their research in 2013.

Grand Valley State University

GVSU (Ruetz, Wesolek, and Thum) have been collaborating with Josh Dumke (NRRI UMD) on a manuscript regarding the identification of black and brown bullheads. GVSU was primarily responsible for using genetic barcoding to identify 98 bullheads that were collected by the NRRI-UMD crew. Dr. Ryan Thum (a molecular ecologist at GVSU) has assisted by overseeing the laboratory work associated with genetic barcoding and interpretation of genetic data at no cost to the project. Wesolek did the genetic barcoding of bullheads as part of her graduate coursework. Our next step is to use nuclear DNA (i.e., microsatellites) to reconcile discrepancies in the identification of brown and black bullheads based on genetic barcoding and morphometric characteristics. Ruetz reported to the group on the status of the "bullhead" project at the January planning meeting in Midland.

UW Green Bay

The Green Bay group has been engaged in discussions about project-wide quality control issues, indicator development and data analysis. Erin Giese participated in a conference call on April 8th to discuss updates and quality assurance of field sampling by bird and amphibian field teams. Howe submitted an abstract for a collaborative presentation at the May 2014 meeting of the International Association for Great Lakes Research in Hamilton Ontario in a special session on Great Lakes environmental indicators. A new benchmark site in Door County (Bayshore Blufflands – Site 1424) was added in collaboration with a local interest group and The Nature Conservancy. The Green Bay field team also has been engaged in management and monitoring discussions involving the Cat Island Causeway benchmark site in lower Green Bay. Finally, the CWM project has been instrumental in development of a collaborative initiative to analyze habitat conditions in the Lower Fox River and Green Bay Area of Concern (AOC). Led by Wisconsin DNR's AOC coordinator Laurel Last, we (Howe and Giese) have worked with scientists and planners from the Wisconsin Department of Natural Resources and The Nature Conservancy to submit a two year proposal to USEPA to evaluate the status and future of habitat conditions in this AOC. The project aims to set specific targets for eventual de-listing of the habitat component of the AOC designation. Monitoring standards established by CWM are proposed to play a valuable role in the implementation of this de-listing process.

Oregon State University

Dennis Albert is working with Nick Danz, Joe Gathman, and Doug Wilcox on a presentation for the Joint Aquatic Science Conference, as well as a manuscript. Dennis Albert is submitting a USFWS Joint Venture proposal to use the CWM plant database in combination with historic and

rare species data to focus restoration of Saginaw Bay wetlands through invasive plant harvest. Harvest sites will be monitored for native plant and rare species response. Anaerobic digestion and pelletizing of invasive plants for conversion to biofuel will be investigated, as well as pilot restoration of threesquare bulrush.

Summary of Findings for 2013

1. No new invasive plant species were documented in Michigan, but new populations of *Phragmites australis* were found near Cheboygan on Lake Huron and locational data was shared with Michigan's Invasive Species Information Network (MISIN) and Rapid Response Team. Detailed locational data for the invasive species frog-bit (*Hydrocharis morsus-ranae*) was also provided to the team to allow them to plan future herbicide or removal treatments.

2. No expansions of the invasive species frog-bit (*Hydrocharis morsus-ranae*) were documented in either Lake Michigan or Lake Superior.

3. Both sampling teams separated *Phragmites australis* occurrences into native and invasive populations to improve tracking of invasiveness of this species. There did not seem to be any problems making this separation.

4. Signs of invasive *Phragmites australis* treatment with herbicides were seen again in the 2013 sampling season at several sites in Saginaw Bay, Lake Huron, and Lake Erie. Indications are that native plant diversity has increased following the treatments, but a more in-depth analysis will be required to document successional changes.

5. Plowing and mowing was documented at sites on Lake Huron, the St. Marys River, and Lake Michigan. Plant diversity appears to be greatly reduced by plowing, but is more difficult to evaluate with mowing, as several species can be identified to genus, but not species, as they are immature or flowers have been cut off. Sampling is often incomplete or partial at these heavily managed sites, as land owners are often unwilling to allow samplers access to the shorelines.

6. No new rare plants were encountered in any of the plots in 2013. As in 2012, several orchids were found in the coastal wetlands, including Loesel's twayblade (*Liparis loeselii*), rose pogonia (*Pogonia ophioglossoides*), grass-pink (*Calopogon tuberosus*), and hooded ladies'-tresses (*Spiranthes romanzoffiana*). None of these orchids are federally or state listed species, but as orchids they have protection from commercial harvest under state regulations.

7. Populations of rare plants were documented in 2013 plot samples at several sites along Lake Erie and on St. Clair River Delta and Lake Huron, including populations of *Sagittaria*

montevidensis (Montevidense's arrowhead) discovered in western Lake Erie, and populations of *Nelumbo lutea* (American lotus) on Lake Erie and the Saint Clair River Delta.

Eastern U.S. Regional Team: Douglas Wilcox (Vegetation), Chris Norment (Birds and Amphibians), James Haynes (Fish), and Gary Neuderfer (Macroinvertebrates)

Winter Identification, Data Entry, and Quality Assurance

The College at Brockport macroinvertebrate personnel, overseen by Dr. Gary Neuderfer, have completed all macroinvertebrate identification from 2013 sampling. Graduate students and undergraduate technicians, overseen by Dr. Douglas Wilcox and Brad Mudrzynski, have both entered and performed quality assurance checks on all data generated from the 2013 sampling season, including fish, water quality, field-level and laboratory identification of macroinvertebrates, vegetation, bird, and amphibian data.

Important 2013 Findings

The plant, fish, and bird summaries below give a coarse snapshot of wetland biotic trends within the area sampled by the Eastern US Team, mainly, the US shore of Lake Ontario. Only two plant species of conservation need were found, roundleaf sundew (*Drosera rotundifolia*) and purple pitcher plant (*Sarracenia purpurea*), both of which were found in low densities and at Cranberry Pond on the eastern shore of Lake Ontario (Table 15). Invasive plants, however, were more prevalent throughout the sampling area, with hybrid cattail (*Typha X glauca*), narrow-leaf cattail (*Typha angustifolia*), common frogbit (*Hydrocharis morsus-ranae*), curly-leaf pondweed (*Potamogeton crispus*), and Eurasian water-milfoil (*Myriophyllum spicatum*) all found in over half the sites sampled (Table 16). Some of the species, mainly the cattails and Eurasian water-milfoil, were usually in very high densities at the sites where they were found. Common reed (*Phragmites australis*) was found in comparatively few sites (Table 15) and rarely covered a large portion of the wetland, but achieved full mono-cultures where established.

Table 15: Plant species of conservation concern encountered during by The College at Brockport during 2013 sampling.

Species	Scientific Name	Percent of Sites Present	Status (NY)
Roundleaf Sundew	*Drosera rotundifolia*	5.2	Exploitatively Vulnerable
Purple Pitcher Plant	*Sarracenia purpurea*	5.2	Exploitatively Vulnerable

No fish species of conservation need were caught in 2013, while non-native or invasive species made up 24.3% of all fish caught (Table 17). Alewife (*Alosa pseudoharengus*) was the most prevalent non-native fish caught, making up 22.9% of all fish captured in 2013. This number is

skewed, however, because 99.7% of the 2013 alewife catch came from one site, Sherwin Bay. The remaining non-native fish species, including round goby (*Negobius melanostomus*), common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), and white perch (*Morone americana*) were found in many sites but rarely in high numbers.

Table 16: Invasive plant species encountered by The College at Brockport during 2013 sampling.

Species	Scientific Name	Percent of Sites Present
Hybrid Cattail	*Typha* X *glauca*	100
Narrow-Leaf Cattail	*Typha angustifolia*	100
Common Frogbit	*Hydrocharis morsus-ranae*	87.0
Curly-Leaf Pondweed	*Potamogeton crispus*	60.9
Eurasian Water-Milfoil	*Myriophyllum spicatum*	56.5
Reed Canary Grass	*Phalaris arundinacea*	39.1
Field Thistle	*Cirsium arvense*	26.1
Common Reed	*Phragmites australis*	21.7

Four New York State listed bird species of conservation concern were detected by surveyors in 2013 (Table 18). Osprey (*Pandion haliaetus*) was found in the most sites and had the greatest number observed, seven, while Blake Tern (*Chlidonias niger*) and Common Loon (*Gavia immer*) were tied for the fewest detections and total count, one each (Table 18). Surveyors did not detect any non-native or state-listed threatened amphibian species in 2013.

Table 17: Percent of sites present and percent of all fish captured of exotic or invasive fish species encountered by The College at Brockport during 2013 sampling.

Species	Scientific Name	Percent of Sites Present	Percent of All Fish Caught
Alewife	*Alosa pseudoharengus*	29.4	22.9
Round Goby	*Negobius melanostomus*	29.4	0.73
Common Carp	*Cyprinus carpio*	41.2	0.49
Goldfish	*Carassius auratus*	11.8	0.14
White Perch	*Morone americana*	11.8	0.05
	Total		**24.3**

Table 18: Percent of sites present and total detections of bird species of conservation need by The College at Brockport during 2013 sampling.

Species	Scientific Name	Percent of Sites Present	Total Observed	NYS Status
Black Tern	*Chlidonias niger*	4.0	1	Threatened
Common Loon	*Gavia immer*	4.0	1	Special Concern
Common Nighthawk	*Chordeiles minor*	8.0	3	Special Concern
Osprey	*Pandion haliaetus*	16.0	7	Special Concern

2013 Benchmark Sites and Data Sharing

The Eastern US Team sampled Braddock Bay, a large open embayment wetland near Rochester, NY as a benchmark for the second year in a row in response to a data-sharing request. The US Army Corps of Engineers is currently designing a restoration plan for Braddock Bay, and the two years of baseline data will be used to assist in determining restoration effectiveness. We also sampled nearby Buck Pond for similar restoration assessment purposes, with the data request coming from Ducks Unlimited. Both of these benchmarks also served a dual purpose in that The College at Brockport received a request from the US Fish and Wildlife Service for wetland data from within the Rochester Embayment Area of Concern to be used in assessing current conditions against delisting criteria. Cranberry Pond was also benchmarked for this purpose, and we will share data from four other Rochester Embayment sites that were sampled as randomly selected sites in 2013. Finally, our team detected the invasive water chestnut (*Trapa natans*) in six new sites along the southern and eastern shore of Lake Ontario during 2013, many of which were outside the previously recorded range. These sightings were reported immediately to various management agencies that employ rapid-response invasive removal crews to help control the current infestation and future spread.

2014 Summer Preparation and Crew Assignments

Preparation for 2014 fieldwork is underway, with the greatest focus on gearing up bird and amphibian crews, since they are the first crews in the field. Braddock Bay, Buck Pond, and Buttonwood Creek have all received a benchmark designation to collect pre-restoration data for upcoming GLRI-funded Army Corps of Engineers and Ducks Unlimited projects. Team personnel are currently filling out access permits for sites that are on state or federal property now that the site list is finalized. Most field maps, datasheets, and site schedules have been completed, again with heavy emphasis on those required for bird and amphibian sampling. Bird and amphibian training has begun; however, official certification is not complete yet.

Finally, crews are starting equipment and inventory checks to prepare for the summer fish, aquatic macroinvertebrate, water quality, and vegetation sampling.

Canadian and US Western Lake Erie Regional Team: Jan Ciborowski, Joseph Gathman, Katya Kovalenko (Water Quality, Fish and Macroinvertebrates), Janice Gilbert (Vegetation), Doug Tozer (Birds and Amphibians), and Greg Grabas (north shore of Lake Ontario – Water Quality, Fish, Macroinvertebrates, Vegetation)

Field Training

Most of the individuals who will participate in fieldwork in 2014 were involved in sampling during the 2013 field season. New recruits include one individual for the Tozer amphibian-and-bird team, (to be trained and tested at Port Rowan, ON in early April 2014 as described in the Western Team report). Four people will be collecting data for the project in 2014. Amphibian surveys are beginning late this year owing to the especially cold winter that has not yet ended and bird surveys will begin later. Cold spring weather has likely delayed the arrival and onset of bird breeding activity, especially relative to the very warm 2013 season.

Field crew members working with fishes, macroinvertebrates, and water quality sampling will receive orientation during the first week of May 2014 and will conduct pilot sampling at a local site during early May. The Windsor field crew will consist of graduate students and research assistants who conducted field sampling in 2013. The graduate students will use selected data to test hypotheses related to their thesis research. The Canadian Wildlife Service will again have 7 personnel to conduct work on Lake Ontario in 2014, two of whom will be new recruits (receiving training in April). As in previous years, training review will include GPS use, determination of whether sites meet project criteria (open water connection to lake, presence of a wetland, safe access for crew), identification of vegetation zones to be sampled, collection of water quality samples (including preprocessing for shipment to water quality labs) and calibrating and read field instruments and meters. Other review will include refresher instructions in setting, removing, cleaning and transporting fyke nets, and special emphasis on collection of voucher information (proper photographic procedures, collection of fin clips for DNA analysis, or retention of specimens for lab verification of identity), protocols for collecting and preserving macroinvertebrates using D-frame dip nets and field-picking. Crews will review field data sheet entry procedures, including changes to the data sheets implemented since last field season. All field personnel will be given refreshers in basic fish identification training.

Several team members/leaders (Jeffrey Buckley, Jasmine St Pierre , Joseph Gathman, Janice Gilbert) have taken the Royal Ontario Museum courses in fish identification that are required of at least one team member in possession of an Ontario Scientific license to collect fishes. All field team members will receive refreshers in field and lab safety training. Vegetation survey protocols will be reviewed in early June by the three wetland plant personnel who performed

assessments last year (Janice Gilbert, Dan Barcza, Carla Huebert). Vegetation assistants will be introduced to the specific vegetation sampling methodology and data recording methods outlined in the QAPP.

Site selection

New sites for 2014 have been (amphibians and birds) or are being assessed using available aerial and satellite photography. Preliminary assessments of site accessibility and suitability for sampling by the other teams are partially complete. The permit renewal applications required to conduct sampling for fishes in Canada are in progress (University of Windsor's Animal Use Care Committee, Scientific Collection of Aquatic Species (Ontario Ministry of Natural Resources), Province of Ontario's Environmental Protection Act (Ontario Ministry of Natural Resources), Species At Risk (Fisheries & Oceans Canada), and Wild Animal Collection (Ohio Department of Natural Resources). Summary reports to the permit granting agencies for 2013 collections were submitted and approved in late fall. Detailed reports are in review. Records of fishes caught were sent to local conservation and refuge managerial groups in Ontario and Ohio where appropriate.

Summary of Findings for 2013

All field data collected during the 2013 field season have been uploaded and QC'd. All fish, macroinvertebrate, macrophyte and water quality data were compiled and entered into the database and quality assured over the winter. Specimens received from companion labs (part of the reciprocal exchange of macroinvertebrate specimens to ensure consistency of identification) have been identified and returned to the sample owners.

Birds and Amphibians
Of note were 40 occurrences of 9 Ontario bird species at risk: bald eagle (3 occurrences; special concern), barn swallow (8 occurrences; threatened), black tern (1 occurrence; special concern), bobolink (4 occurrences; threatened), chimney swift (2 occurrences; threatened), common nighthawk (2 occurrences; threatened), Eastern meadowlark (8 occurrences; threatened), king rail (1 occurrence; endangered), and least bittern (11 occurrences; threatened). Also of note were 19 occurrences of chorus frog, which is listed as threatened in Canada.

Fishes and Invertebrates
Species of note were observed at several locations during the 2013 field season. One warmouth (*Lepomis gulosus*) at a wetland in Rondeau Bay. Eastern musk turtles (*Sternotherus odoratus*) were found in fyke nets at a site near Honey Harbor, Ontario. One tubenose goby was found at 5375 Green Island Island wetland (Georgian Bay of Lake Huron), confirming the range extension observed in the previous field season. Another distinctive invader, the very large 'Chinese mystery snail' (*Cipangopaludina sinensis*), was commonly observed at the Stokes Bay wetland (site 5952).

Vegetation
Small cells of invasive *Phragmites* (*P. australis*) were observed establishing footholds in the Georgian Bay wetlands (5746 Point Au-Baril and 5320 Franklin Is. in 2012). Native *Phragmites* (*P. americanus*), along with the invasive strain, were present at many sites on lakes Erie and St. Clair in 2012 and 2013.

In 2012, *Solidago houghtonii (*special concern) was found at one site. Wild rice (*Zizania aquatica*) was present at three wetlands in Lake St. Clair and Lake Erie. In 2013, the provincially-important stiff yellow flax (*Linum medium var. medium*) was observed at one wetland.

The Canadian Wildlife Service – Ontario Region is responsible for developing the Recovery Strategy and Management Plan for Multiple Turtle Species in Canada. As required under the Species at Risk Act, critical habitat is a required component of the recovery strategy for four at risk turtles: Blanding's turtle (*Emydoidea blandingii*), Eastern musk turtle (*Sternotherus odoratus*), spotted turtle (*Clemmys guttata*), and spiny softshell turtle (*Apalone spinifera*). Critical habitat is based on the suitable habitat where turtles have been observed. Examples of suitable habitat are wetlands and watercourses such as marshes, rivers, and some lakes. Incidental observations from this project, as well as other sources of turtle observations, have identified multiple suitable habitat locations for proposal as candidate critical habitats in the Recovery Strategy. The data provided from CWM and other GLRI projects were very valuable in this recovery effort.

Collaborations

Bird and amphibian project data that are scheduled to be collected by the Bird Studies Canada team (Tozer) are being supplied to the Royal Botanical Gardens, Hamilton, ON, and Presqu'ile Provincial Park, Brighton, ON. In both cases, the data are providing value-added material to on-going biodiversity monitoring efforts or specific research projects.

Vegetation team leader Janice Gilbert has given various talks on the spread of *Phragmites australis* in southern Ontario over the last two years. She has spoken to Municipalities, Cities, Conservation Authorities, Species at Risk recovery meetings, Bruce Power, various cottage associations, training workshops, and to the University of Waterloo Undergraduate Student seminar series.

Special efforts were made in 2013 to develop and foster good stakeholder relationships and to establish collaborations with local groups around the Great Lakes with whom we could interact, explain the purpose and value of the project, and possibly solicit collaborations. We made a special effort to contact the environmental liaison individuals for First Nations lands.

Telephone or e-mail contact was achieved in most instances. We are optimistic that the contacts made in 2013 will result in closer collaboration and interactions in 2014.

We engaged in discussion and/or site visits with the following individuals or groups during the 2013 field season.

- Ausable Bayfield Conservation Area, (Port Franks, ON). Liaison - Maria Veliz, Healthy Watersheds Coordinator, Ausable-Bayfield Conservation Authority, Exeter, ON. We have been in discussion to collaborate and provide information on wetland condition in the Port Franks, Ausable Channel region of the southeast shore of Lake Huron.
- US Geological Survey (Crane Creek, OH restoration project, Ottawa Wildlife Refuge). Liaison - Kurt Kowalski, US Geological Survey. We have sampled this site as a benchmark for two years and compared data with the USGS to allow the USGS to make a direct comparison of the findings of their monthly sampling program with the single-visit protocols used by our program.
- Fathom Five National Park (Tobermory, ON), Liaison - Scott Parker, Parks Canada. We have met with Dr. Parker and have arranged cooperative sampling in preparation for designation of this area as a World Heritage site. Parks Canada provided special access and boat support to especially remote sites as well as assistance with sampling. We have shared all data collected with this group.
- Old Woman Creek National Estuarine Research Center, OH. Liaison - Kristin Arend. Our agreement involves being provided with access to the site and our sharing information with the Research Center.
- Lake Huron Centre for Coastal Conservation, Goderich, ON. Liaison – Geoff Peach, Coastal Resources Manager. We are involved in data-sharing to facilitate coastal assessment, especially for the Bruce Peninsula portion of Lake Huron.
- Kensington Conservancy, Desbarats, ON (North Channel of Lake Huron). Liaison - Tanna Elliott, Executive Director. We are involved in data-sharing to facilitate coastal assessment, especially for the St. Joseph's Channel of the St. Marys River.
- Wikwemikong First Nations, Manitoulin Island, ON. Liaison - John Manitowabi. We have been in discussion and have had preliminary meetings to arrange joint sampling in 2014 and collaboration to better assess wetland condition in First Nation areas of Manitoulin Island.
- Saugeen First Nation, (southern Lake Huron, ON). Liaison – Richard Kahgee, Chief, Southampton Ontario. We have been in discussion to arrange joint sampling in 2014 and collaboration to better assess wetland condition in First Nation areas of Reserve and adjacent First Nation areas in southern Lake Huron.
- Greg Mayne (Environment Canada, Canadian co-chair, Lake Huron Binational Partnership): providing a summary report of coastal wetland condition on the west shore of the Bruce Peninsula.

- Sturgeon Bay Provincial Park (near Point Au Baril, ON): benchmark site sampled last year, possibly resampled in future.
- Seija Deschenes, Manitoulin Streams (Manitoulin Island of Georgian Bay): helping act as liaison with First Nations.

Related Research in Progress:

In 2012, fish data from Canadian vegetation-dominated wetland were analysed by Curtis Makish, Honours undergraduate thesis student to assess the effect of *Phragmites* monocultures on fish species richness and community composition. Preliminary analyses indicated that the fish assemblages caught in fyke nets adjacent to *Phragmites* beds are similar to catches made beside *Typha* beds, and were distinct from the fauna of *Schoeneplectis* beds. These data are being validated by examination of data from other Great Lakes sites collected in 2011 and 2012. Fish data are also being analysed by M.Sc. student Jeffrey Buckley to compare the consistency of classification of wetland condition using analytical metrics derived by several different investigators. Buckley is comparing the wetland IBI of Uzarski *et al*. with the fish quality indices of Seilheimer *et al*., and a new multivariate index based on the reference-degraded continuum approach.

Former Honours undergraduate thesis students Jasmine St Pierre and Alexandra Pollock have prepared publications stemming from supplemental data they collected during the 2012 field season to assess macroinvertebrate-submerged macrophyte associations. St. Pierre's research determining the extent to which zoobenthic taxa richness is affected by macrophyte structural complexity and its variability appeared in print in January 2014 (St. Pierre and Kovelenko 2014). Pollock's manuscript assessing how structural complexity influences predator prey relation-ships will be submitted for review shortly. Buckley and St Pierre will give presentations at the 2014 International Conference on Great Lakes Research.

ASSESSMENT AND OVERSIGHT

The project QAPP was approved and signed on March 21, 2011. A revised QAPP (r3) was approved and signed on March 19, 2012. The QAPP_r3 was reviewed again by project co-PIs and their technical staffs over the winter and was discussed at the January coordination meeting in Midland, MI. After review, it was determined that two areas required updates. These changes included:

1) Adding ion chromatography methods for determination of soluble reactive P (Dionex Method AN 254), total P (Dionex Method AN 254 with persulfate digestion), and ammonium (Dionex Method AN 141). These additions are contained in QAPP Table BB4.2.

2) Addition of a new wetland flora for use in Great Lakes coastal wetlands. The new flora, *The Field Manual of Michigan Flora* (Voss and Reznicek 2012) from the University of Michigan Press, incorporates the most recent taxonomic treatments of the Flora of North America and contains all wetland plants found throughout the region. All taxonomic changes in the new flora were reviewed by project plant experts over the previous field season and appropriate cross-walks were formulated to ensure data consistency among project years.

One additional change was made to the standard operating procedure for vegetation sampling:

3) Removal of the requirement to map dense areas of invasive plants that fall within 20 m of sampling transects. The project plant PIs determined that the current transect/quadrat sampling protocol is adequately assessing invasive plant expansion and this extra mapping step did not add sufficient information to warrant the extra time required.

All project co-PIs re-signed the QAPP_r4 on February 15, 2014 and our US EPA Project Officer and Quality Assurance Officer re-signed the QAPP on March 13, 2014.

Major QA/QC elements that were carried out over the previous 6 months include:

- Training of all new laboratory staff responsible for macroinvertebrate sample processing: This training was conducted by experienced technicians at each regional lab and was 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. Several members of the Central Basin Team met at Central Michigan University to discuss and come to consensus on invertebrate taxonomy that were particularly challenging for laboratory staff. This meeting has become an annual occurrence and helps to ensure accurate and consistent taxonomy among labs.

- Collection and archiving of all training/certification documents and mid-season QA/QC forms from regional labs: These documents have all been scanned to PDF and will be retained as a permanent record for the project.

- 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. This has been completed for nearly all data that has been entered into the database over the past six months and is a requirement before data are analyzed or used to calculate IBI metrics. Data that still require QC have been identified and regional labs were notified and are currently

finishing these checks. We anticipate that these checks will be complete by the end of April, 2014.

- Macroinvertebrate QC checks: Each regional lab that is processing macroinvertebrate samples has 'blindly' traded samples with the next closest regional lab. Swaps were made between labs that sampled wetlands at a similar latitude to ensure familiarity with the taxa being evaluated. Labs sent two previously processed samples with relatively high taxa diversity to their assigned QC lab, and then sent the corresponding IDs and counts to the QA managers. Each sample was contained in a single vial that was identified with a unique code that precluded the receiving lab from determining the site or vegetation zone that the sample originated from. The receiving lab then processes the sample as usual and sends the IDs and counts to the QA managers. The QA managers then compare the original IDs with the QC IDs to determine correspondence between the two labs. Inconsistencies in taxa IDs are resolved by a 3rd or 4th lab when necessary or by additional taxonomic experts, depending on the nature of the discrepancy. At present, most labs have made the required swaps for 2013 samples and many have completed the required processing. After QA managers compare original and QC taxa IDs and counts, and resolve discrepancies, they will communicate results and necessary corrections to the various labs. In the past two years, the QC swaps have identified very few inconsistencies among regional labs and all inconsistencies have been addressed.

- Mid-season QC checks: The only mid-season QC check that was required over the previous six-month period was for macroinvertebrate processing. Regional lab leaders conducted these mid-season checks and were responsible for remedying any problems that were detected. The macroinvertebrate sample swaps are an additional measure to ensure consistent taxonomy.

- Creation/maintenance of specimen reference collections: Reference collections for macroinvertebrates, fish, and plants are being created or maintained by each regional team. Macroinvertebrate reference collections, in particular, were developed or expanded over the previous six months as these samples have been processed.

- Continued efforts to refine bullhead identification: We discovered a problem with separating young-of-the-year brown and black bullheads, with at least one crew likely mis-identifying a number of these individuals in 2012. We determined better identification procedures and back-corrected identifications for those samples for which we had preserved specimens, and converted the other identifications to a combined category of "black or brown bullhead". In 2013 several crews retained specimens for microsatellite genetic analysis by co-PI Dr. Carl Ruetz's lab. Genetic analysis revealed that morphometric characteristics may not sufficiently distinguish black vs. brown bullheads in the field, especially for small fish. Crews have been directed to preserve

several individuals of all YOY bullheads at each site for identification in the laboratory, where it can be done much more accurately. However, for IBI metric development, black and brown bullheads will be combined.

- Integration of the new vegetation taxonomy: This new reference changes the names for many Great Lakes wetland plants. Project PIs and their students have now completed summarizing changes and developed a crosswalk between the former taxonomic names and the new names, which will provide both the pre-2012 and the 2012 Voss and Reznicek flora names. Floristic Quality Index scores were also updated as part of this process and these revised scores are now being used in FQI/wetland condition index computations.

- 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. These metrics were calculated over the past six months and will be archived by each regional laboratory.

- Database audit: QA managers Brady and Cooper completed a comprehensive audit of all water quality data in November 2013. A total of 452 QC flags (i.e., potential issues) were noted. The QC flags were related to 1) the use of incorrect units (345 occurrences; 77% of total), 2) incorrect calculations for total alkalinity (78; 17%), 3) questionable pH readings (21; 5%), and 4) values entered in the wrong location (6; 1%). Each of these QC flags was brought to the attention of the PI at respective regional laboratory. Nearly every one of these errors was either easily corrected in the database (e.g., change units, recalculate alkalinity values, move data to correct location), or was confirmed as accurate (pH readings). These QC flags and the corrective actions taken by regional PIs were archived. QA managers also addressed these issues with the project team at the January coordination meeting in Midland.

- Nutrient detection limits: QA managers discovered that some regional labs have been entering data that are below the analytical detection limits established in the QAPP. These higher-precision data reflect the heightened capabilities of some regional labs. Having data from multiple labs with differing detection limits can present problems when analyzing nutrient data that is near detection limit. Therefore, we developed a standard way for labs to enter their data at the precision of their lab's instrumentation and have the data management system archive and deliver both these higher-precision data and data at the standard detection limit. In other words, observations falling below the detection limits listed in the QAPP will be "brought up" to the standard level while the original data will still be available for those interested in using it.

- Bird and amphibian crews begin their field season in mid-April. All training and certification of crew members has been completed or will be completed soon, prior to crew members working independently. Records of this training and certification are being compiled and archived at each respective regional lab as well as with the project QA managers.

Water Quality QC Information

Water quality analyses for all 2013 samples have been completed. Laboratory results have passed the criteria shown below (Table 19) and all results have been entered into the data management system.

Table 19. 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 * CV) of the duplicates as a guide for accepting or rejecting the data, another measure of the variation of duplicates is RPD: RPD = ((|x1-x2|)/mean) *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 Water Quality Field Duplicates

An analysis of sample variability based on field duplicate samples is shown in Table 20. 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) or limit of detection (LOD), 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, the mean is 0.6, resulting in an RPD of 91%, 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. Table 20 summarizes the QA/QC data for 2013 and indicates that data quality objectives were met. Higher than expected RPDs were associated with a preponderance of near detection limit sample values as in previous years and the QA managers cleared the data from these analyses for inclusion in the project database.

Table 20. Sample variability expressed as relative percent difference of duplicate samples for various water quality parameters measured at regional laboratories. 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). Metrics are based on 2013 analyses. N=number of field duplicates unless noted otherwise. Only field duplicates that exceeded MDL were used in RPD calculations. N=number of field duplicates.

Analyte	MDL	Mean Value	Average RPD (%)	Max expected RPD (%)
Natural Resources Research Institute				
Chlorophyll-a	< 0.5 µg/L	7.2 (n = 8)	28.4	30
Phaeophytin	< 0.5 µg/L	4.2 (n = 8)	29.9	30
Total phosphorus	< 0.002 mg/L	33.7 (n = 8)	23.6	30
Ortho-phosphorus	< 0.002 mg/L	9.1 (n = 8)	6.3	10
Total nitrogen	< 0.010 mg/L	0.940(n = 8)	6.7	30
NH4-N	< 0.002 mg/L	0.022 (n = 8)	[A]47.8	10
NO2/NO3-N	< 0.002 mg/L	0.038 (n = 8)	24.8	10
True color	< 5 units	180 (n = 7)	2.9	10
Turbidity	< 0.4 NTU	7.6 (n = 6)	5.8	10
chloride	< 0.5 mg/L	13.4 (n = 6)	3.1	20
ANC	< 0.5 mg/L	636	1.4	10
Central Michigan U.				
NH4-N	0.01 mg/L	0.032 (n = 5)	[B]30.4	10
NO2/NO3-N	0.01 mg/L	0.114 (n = 4)	[C]32.4	10
Ortho-phosphorus	0.005 mg/L	0.008 (n = 4)	[C]22.0	10
Total phosphorus	0.03 mg/L	0.036 (n=5)	24.5	30
U. Notre Dame				
Chlorophyll-a	0.5 µg/L	5.55 (n=14)	[D]6.3; 51.7	30
Grand Valley State				
Total phosphorus	0.01 mg/L	0.030 (n = 1)	[E]21.4	30
Ortho-phosphorus	0.005 mg/L	<0.005 (n = 1)	NA	10
Total nitrogen	0.01 mg/L	0.62 (n = 1)	[E] 18.18	30
NH4-N	0.02 mg/L	0.03 (n = 1)	[E]40.0	10
NO3-N	0.01 mg/L	<0.05 (n = 1)	9.30	10

[A]7 out of 16 of the ammonium-N field replicates were near < 0.002 mg/L or 4 times the MDL (0.001 to 0.008)
[B]3 out of 5 ammonium field replicates were very close to the MDL 0.01 mg/L, which caused high RPD.
[C]2 of the 4 field replicates were very close to the MDL, which caused high RPD.
[D]The first RPD value is for duplicated analyses on the same collected samples (extraction through analysis), the second is for field duplicates (separate water samples filtered, extracted, and analyzed). This shows that the majority of variability in RPDs is due to differences between collected samples.
[E]These high RPD values resulted from duplicate samples being very close to LOD.

Required Corrective Action

The QA managers very recently discovered that one bird and amphibian crew failed to meet training and certification requirements for the 2013 field season, and to some extent for the 2012 season, and also failed to follow certain elements of bird and amphibian sampling SOPs. Discrepancies included 1) crew members not passing the online bird identification test prior to the start of field season or not passing the test at all, 2) crew members taking the online test more than the allowed number of attempts, 3) sampling birds later in the year than target guidance in the SOP, 4) not recording or uploading GPS waypoints for sampling locations, and 5) delayed and incorrect data entry and delivery of training certifications, which delayed the discovery of some of these errors.

The QA managers discussed these issues with the senior bird and amphibian co-PIs and with the project lead PI to determine an appropriate course of action. It was determined that 1) all members of this crew would be required to provide documentation of correct and timely passage of the on-line certification tests prior to being allowed to sample, 2) the co-PI responsible for the crew would increase their level of oversight compared to previous years, 3) crew members would consult with other regional crews whenever they are uncertain about a procedure, and 4) potentially compromised data will be checked by senior bird co-PIs and will be flagged or removed from the dataset if the data are not comparable to nearby similar wetlands.

Communication among Personnel

Regional team leaders and co-PIs continue to maintain close communication as the project enters into the fourth year of data collection. All major project members met in Midland, MI on January 15, 2014 to discuss and resolve methodological questions and discuss progress on IBI refinement. During this meeting, lead PI Uzarski discussed and passed along a first draft of a "methods" manuscript to all PIs. Leads for each taxonomic group (with two leads for fish and macroinvertebrates, due to the number of co-PIs) coordinated manuscript edits and returned these to Uzarski. Uzarski also discussed the development of a "new" disturbance gradient with all PI's using both land use/land cover data as well as abiotic variables collected in the field.

Good communication has also been maintained among technical staff responsible for processing macroinvertebrate samples collected in 2013. For example, many phone calls and e-mails continue to be exchanged between staff to resolve taxonomic questions as they arise. Additionally, numerous staff members have traveled to other regional labs to work side-by-side with other project taxonomists to ensure consistent IDs. We will continue to maintain this level of communication among staff members as it promotes consistency among labs.

Overall

From the QA managers' perspective, the first three years of the project were highly successful. The quality management system developed for this project has been fully implemented and is functioning well. The current version of the QAPP and SOPs (Revision 4) continues to function very well. Co-PI and QA co-manager Cooper presented the project's quality management system to the Interagency Ecological Restoration Quality Committee (oversees QA/QC systems for GLRI-funded restoration projects) via webinar on November 25, 2013. The committee determined that the project's quality assurance system would serve as a model for other similar projects supported with GLRI funds. We anticipate that very little revision of the QAPP will be required in subsequent years, though we will review each protocol carefully each year to determine whether improvements can be made.

Nearly every crew will consist of >50% returning and experienced personal in 2014, which will make the training period for 2014 very efficient, as was the case in 2013. PIs will oversee training and visit their teams during the middle of the season to ensure that all sampling is being conducted in accordance with the training and the QAPP. We are looking forward to an efficient and safe fourth field season.

LEVERAGED BENEFITS OF PROJECT

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 a 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 a number of jobs (jobs created/retained). All of these are detailed below.

Spin-off Projects

Conservation Assessment for Amphibians and Birds of the Great Lakes:
To examine the role of Great Lakes wetlands in the conservation of birds in North America, an effort has been initiated to assess the importance of these coastal wetlands as migratory or breeding grounds. A similar effort will also be initiated for amphibians, because many of the amphibians (and birds) living in these coastal wetlands have been identified as endangered (e.g. Northern Cricket Frog), threatened, or of special concern (e.g. Northern Leopard Frog) in multiple states. 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.

A recent study, targeting Sedge and Marsh Wren distributions within Great Lakes coastal wetlands, modeled habitat and landscape characteristics against presence/absence of each species at multiple spatial scales. This analysis will determine how these characteristics

influence the distribution and abundance of species breeding habitat. Classification trees were used to predict both Sedge and Marsh Wren presence and relative high abundance (≥3 wrens/site). The best classification trees (i.e. those with the lowest classification error) predict Sedge Wrens to be present in wetlands with >9% woody wetlands, and in high abundance in wetlands with <3% cattails and >4% meadow vegetation. Marsh Wrens were positively associated with emergent vegetation and cropland, and in high abundance in wetlands with >14% cattails. Probability maps were created based on best fitting models to help predict breeding habitat. These results suggest which characteristics of Great Lakes coastal wetlands are important to these two wetland-obligate bird species, and can be useful to inform management plans for these species. These models can also be developed for other obligate wetland species (Table 19) within Great Lakes wetlands.

The extensive data that have been gathered by US EPA, such as the Great Lakes Environmental Indicators project and the Great Lakes Coastal Wetlands Consortium, as well as Bird Studies Canada, will provide critical input to this assessment. The proposed large-scale modeling effort will be one of the broadest analyses in terms of sample size and geographic area. It will also serve as a valuable tool for future management decisions relating to Great Lakes wetland conservation.

Table 19. List of species considered to be either wetland obligate species (bold) or indicators of wetland condition.

Common name	**Scientific Name**	**Common name**	**Scientific Name**
Canada Goose	*Branta canadensis*	European Starling	*Sturnus vulgaris*
Mallard	***Anas platyrhynchos***	Northern Cardinal	*Cardinalis cardinalis*
Pied-billed Grebe	***Podilymbus podiceps***	**Sedge Wren**	***Cistothorus platensis***
American Bittern	***Botaurus lentiginosus***	American Goldfinch	*Carduelis tristis*
Least Bittern	***Ixobrychus exilis***	Mourning Dove	*Zenaida macroura*
Virginia Rail	***Rallus limicola***	**Alder Flycatcher**	***Empidonax alnorum***
Sora	***Porzana carolina***	Gray Catbird	*Dumetella carolinensis*
Common Moorhen		Bobolink	*Dolichonyx oryzivorus*
Sandhill Crane	***Grus canadensis***	Baltimore Oriole	*Icterus galbula*
Black Tern	***Chlidonias niger***	American Redstart	*Setophaga ruticilla*
Willow Flycatcher	***Empidonax traillii***	Bald Eagle	*Haliaeetus leucocephalus*
Marsh Wren	***Cistothorus palustris***	Northern Harrier	*Circus cyaneus*
Common Yellowthroat	***Geothlypis trichas***	Brown-headed Cowbird	*Molothrus ater*
Swamp Sparrow	***Melospiza georgiana***	Brown Thrasher	*Toxostoma rufum*
Red-winged Blackbird	***Agelaius phoeniceus***	White-throated Sparrow	*Zonotrichia albicollis*
Yellow-headed Blackbird	***Xanthocephalus xanthocephalus***	Killdeer	*Charadrius vociferus*
Common Grackle	*Quiscalus quiscula*	**American Coot**	***Fulica americana***
American Robin	*Turdus migratorius*		

North Maumee Bay Survey of Diked Wetland vs. Un-Diked Wetland: Erie Marsh Preserve is being studied as a benchmark site for the CWM project. As a benchmark site, Erie Marsh Preserve will serve as a comparison against randomly-selected project sites, and will be 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 will be compared to conditions outside of the dike, but still within the preserve. These data will also be used for post-construction comparisons to determine what biotic and abiotic changes will occur once restoration efforts have 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 are being analyzed by Kettering University and their Swedish Biogas partner to determine the amount of methane that can be generated from this invasive. These samples will be compared to their data set of agricultural crops, sewage sludge, and livestock waste that are currently used to commercially generate methane. The cattails-to-methane biofuels project is also funded (separately) by GLRI.

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 US EPA Mid-Continent Ecology Division. USEPA MED researchers are studying wetland macrophyte and wetland soil nutrient correlations. The MED laboratory is running the sediment nutrient analyses and will share the data with CWM PIs.

Comparative study of bulrush growth between Great Lakes coastal wetlands and Pacific Northwest estuaries. This study includes 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 Restoration: Braddock Bay is 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. CWM crews are collecting pre- and post-restoration data to help plan and implement restoration activities. 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. Additionally, this project will be expanded in conjunction with Ducks Unlimited to four nearby wetlands, pending funding from NOAA.

Thunder Bay AOC, Lake Superior, Wetland Restoration: Nine wetlands around Thunder Bay were sampled for macroinvertebrates, water quality, and aquatic vegetation by CWM crews

using methods closely related to CWM methods. These data will provide 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 a regional reference. All of this sampling was in addition to normal CWM sampling, and was done in collaboration with Environment Canada.

Common Tern Geolocator Project: In early June of 2013, a CWM bird team volunteered to assist Wisconsin DNR in deploying geolocator units on common terns nesting on Interstate Island, an island in the Duluth/Superior Harbor on the border between Minnesota and Wisconsin. On 12 June 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 will be removed from birds returning to nest on the island. The data collected during the year will be used to better understand the migratory routes of common terns nesting on Interstate Island. This is the first time that geolocators have been placed on common terns nesting in the Midwest. Given the status of this species in Minnesota and Wisconsin, tracking terns throughout their annual cycle will help identify locations that are important during the non-breeding portion of their life cycle.

Support of Un-affiliated Projects

CWM PIs and data managers continue to provide data and support to other research projects around the Great Lakes even though no CWM PIs are actual collaborators on these projects. Dr. Laura Bourgeau-Chavez at Michigan Tech University is working on a project to map 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 have provided her with vegetation data and sampling locations each year to assist with this effort. Dr. Bourgeau-Chavez was also just given funding to assess herbicide effectiveness against *Phragmites* in Green Bay and Saginaw Bay. CWM data are being used to find the best locations, provide baseline data, and provide pointers on site access (from field crew notes) in support of this project.

Requests for Assistance Collecting Monitoring Data

CWM PIs have received many requests to sample particular wetlands of interest to various agencies and groups. In some instances the wetlands are scheduled for restoration and it is hoped that our project can provide pre-restoration data, and perhaps also provide post-restoration data to show the beginnings of site condition improvement, depending on the timing. Such requests have come from the St. Louis River (Lake Superior), Maumee Bay (Lake Erie), and Rochester (Lake Ontario) Area of Concern delisting groups, as well as the Great Lakes National Park Service and the Nature Conservancy (sites across lakes Michigan and Huron for both groups). Several requests involve 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 US ACE project to improve wetland fish and vegetation habitat in Braddock Bay, Lake Ontario, and a New York state project to increase nesting habitat for state-endangered black tern. Many of these restoration activities are being funded through GLRI, so through collaboration we increase efficiency and effectiveness of restoration efforts across the Great Lakes basin.

At some sites, restoration is still in the planning stages and restoration committees are interested in the data CWM can provide to help them create a restoration plan. This is happening in the St. Louis River AOC, in Sodus Bay, Lake Ontario, and for the Rochester NY AOC.

Other groups have requested help sampling sites that are 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 have come 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 has 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 are working 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 also 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 is requesting 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 assess trends in the wetlands and compare data to designated delisting criteria. The NERR on Lake Erie (Old Woman Creek) has requested our monitoring data to add to their own. The University of Wisconsin Green Bay will use our data to monitor control of *Phragmites* in one of their wetlands, and hope to show habitat restoration. Thunder Bay National Marine Sanctuary (Lake Huron) has requested our data to facilitate protection and management of coastal resources within the Sanctuary.

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

Overall, CWM PIs have had many requests to sample specific wetlands. It has been challenging to accommodate all requests within our statistical sampling design and our sampling capacities.

Student Research Support

Graduate Research with Leveraged Funding:

- 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).
- 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 the wetlands of Northern and Eastern Lake Michigan: the interaction of the Harsh-Benign Hypothesis and 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)

Undergraduate Research with Leveraged Funding:

- Production of a short documentary film on Great Lakes coastal wetlands (Notre Dame University; additional funding by the UND College of Arts and Letters).
- Heavy metal and organic toxicant loads in freshwater turtle species inhabiting coastal wetlands of Lake Michigan (Notre Dame University; additional funding by the UND College of Science).
- *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).
- 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).
- 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).

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).
- Impacts of mute swan herbivory in Great Lakes coastal wetlands (Central Michigan University).
- Impacts of muskrat herbivory in Great Lakes coastal wetlands (Central Michigan University).

- Mute swan interactions with native waterfowl in Great Lakes coastal wetlands (Central Michigan University).
- 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 (Notre Dame University).
- Spatial and temporal trends in invertebrate communities of Great Lakes coastal wetlands, with emphasis on Saginaw Bay of Lake Huron (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 (*Trap 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).

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, under the Zoobenthos - macrophyte relationships in Great Lakes coastal wetlands framework). Completed.

- Effects of habitat complexity on trophic structure of macroinvertebrate communities (University of Windsor, under the Zoobenthos - macrophyte relationships in Great Lakes coastal wetlands framework). Completed.

Jobs Created/Retained (per year, except grad students):

- Principle Investigators (partial support): 14
- Post-doctoral researchers (partial support): 1 (0.25 FTE)
- Total graduate students supported on project (summer and/or part-time): 30
- Undergraduate students (summer and/or part-time): 52
- Technicians (summer and/or partial support): 25 (~12 FTE)
- Volunteers: 21

Total jobs at least partially supported: 122 (plus 21 volunteers trained)

Presentations about the Coastal Wetland Monitoring Project (inception through 2014)

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.

Bozimowski, A.A., B.A. Murry, and D.G. Uzarski. 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.

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.

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-variates 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.

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.

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.

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.

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.

Gnass-Giese, E. E., R. Howe, A. Wolf, N. Miller, and N. Walton. An ecological index of forest health based on breeding birds. 2013. Webpage: http://www.uwgb.edu/biodiversity/forest-¬-index/

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.

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.

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.

Lamberti, G.A., D.G. Uzarski, V.J. Brady, M.J. Cooper, T.N. Brown, L.B. Johnson, J.H. Ciborowski, G.P. Grabas, D.A. Wilcox, R.W. Howe, and D.C. Tozer. 2013. An integrated monitoring program for Great Lakes Coastal wetlands. Society for Freshwater Science, Jacksonville, FL.

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, and R.W. Howe. 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.

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.

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.

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.

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.

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.

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.

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of National Marine Sanctuaries
Thunder Bay National Marine Sanctuary
500 West Fletcher Street
Alpena, Michigan 49707
(989)356-8805 phone ~ (989)354-0144 fax

Dr. Donald G. Uzarski
Institute for Great Lakes Research
Central Michigan University
Brooks 217
Mount Pleasant, Michigan 48859

November 18, 2013

Dear Dr. Uzarski,

As superintendent of Thunder Bay National Marine Sanctuary (TBNMS), I would like to provide my enthusiastic support of your project, *GLIC: Implementing Coastal Wetland Monitoring*. TBNMS is located in northeastern Lake Huron and is one of 14 marine protected areas administered by NOAA's Office of Marine Sanctuaries. Although the sanctuary exclusively manages maritime archaeological resources, we are also deeply committed to preserving the sanctuary's living resources. To achieve this goal, the sanctuary depends on collaboration with university scientists and governmental agencies to conduct research aimed at better understanding the natural resources of Thunder Bay and Lake Huron. Your project will be extremely valuable in our efforts to assess the condition and value of the sanctuaries coastal habitats.

Coastal wetlands are critical to the Thunder Bay and Lake Huron ecosystem. Understanding the ecology of these areas through projects like *GLIC: Implementing Coastal Wetland Monitoring* will go a long way in ensuring that these habitats are effectively managed and preserved for future generations. Thank you for your efforts within the sanctuary and for providing preliminary data from the Thunder Bay wetlands that have already been sampled as part of your project. I look forward to our ongoing collaboration and please do not hesitate to contact me if I can be of further assistance.

Sincerely,

Jeff Gray
Superintendent

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL HEALTH AND ENVIRONMENTAL EFFECTS
RESEARCH LABORATORY
MID-CONTINENT ECOLOGY DIVISION
6201 CONGDON BOULEVARD • DULUTH, MINNESOTA 55804-2595

OFFICE OF
RESEARCH AND DEVELOPMENT

March 5, 2014

Minnesota Sea Grant
University of Minnesota Duluth
31 W. College St. Duluth MN 55812

Dear Dr. Valerie Brady,

We would like to thank the Great Lakes Indicator Consortium for their willingness to provide us with invasive species data from the Great Lakes Coastal Wetland Monitoring Project. The data will support the thesis project of Mr. Elon O'Malia, who is pursuing his master's degree in Integrated Biosciences at the University of Minnesota, Duluth.

The data will be used to help characterize the distribution of aquatic invasive species throughout the Great Lakes and connected waterways. The project goal is understand how the presence of aquatic invasive species is related to human activity, such as shipping and recreation boating. To accomplish this, we need two primary pieces of information: locations where various types of human activities occur, and locations of aquatic invasive species. Any subsequent publications, including Mr. Elon O'Malia's thesis, will include a formal acknowledgement of these data and their source.

Sincerely,

United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Great Lakes Science Center
1451 Green Road
Ann Arbor, MI 48105-2807
PH: (734) 994-3331 ● FAX: (734) 994-8780

April 3, 2014

Dr. Don Uzarski
Central Michigan University
Brooks 127
Mount Pleasant, MI 48859

I wanted to thank you for taking the time to talk to my crew and me on 3/3/14 and 3/17/14 about protocols of the coastal wetland monitoring program. We appreciated your explanation of how the protocols were developed, what some of the limitations are with the data, and the status of your efforts to develop new IBIs from the data. The QAPP and other documents that you sent us were very helpful as we consider applying similar protocols at our sites in western Lake Erie. We envision using the protocols to guide our sampling and provide a base-wide framework for our efforts.

Thank you again for your time and effort.

Dr. Kurt Kowalski
Research Wetland Ecologist

Door County Land Trust

"Preserving Door County's Finest Open Spaces and Wild Places"

12 March, 2014

Dr. Valerie Brady
Natural Resources Research Institute
University of Minnesota Duluth

Dr. Robert Howe
Dept. of Natural and Applied Sciences
University of Wisconsin-Green Bay

Dear Dr. Brady and Dr. Howe,

The Door County Land Trust requests that the Bay Shore Blufflands State Natural Area (SNA) in Door County Wisconsin be used as a benchmark site for the Great Lake Coastal Wetland Monitoring project. The DCLT has historically partnered with a number of agencies from the federal, state and local levels to expand, monitor and protect these lands. This SNA is currently the subject of a Wisconsin Coastal Management Program (WCMP) planning grant to develop a long-range conservation master plan.

This 4200-acre SNA contains a diversity of connected wetland habitats ranging from open to forested, perennial to ephemeral, also including springs, seeps, and small streams. The proposed benchmark site contains 10 acres of open wetlands and would be ideal for sampling invertebrates, birds, amphibians, vegetation and water chemistry. This particular wetland is connected to the Great Lakes through a large road culvert and ¼ mile stream which exits into Green Bay.

This data would become an important component of the WCMP baseline analysis. It would benefit the ongoing restoration and monitoring work of our longtime conservation partners including The Nature Conservancy, Soil and Water Conservation Department of Door County, US Fish and Wildlife and the Wisconsin DNR. The data would also be available for use in scientific publications.

We highly value the work that GLCWM project is performing. We appreciate that your efforts will have a profound impact on regional understanding, awareness and planning. We hope that you will consider using the Bay Shore Blufflands SNA as a benchmark site in your coastal wetland monitoring project.

Sincerely,

Jodi Milske

Jodi Milske
Stewardship Director,
Door County Land Trust

PO Box 65 • Sturgeon Bay, WI 54235 • (920) 746-1359 • (920) 854-4700 (Northern Office) • info@doorcountylandtrust.org • www.DoorCountyLandTrust.org

January 28, 2014

Dear Dr. Uzarski,

I'm contacting you as we are in need our your assistance in a current project to determine the likelihood of establishment of Asian carps within Lakes Michigan, Huron and Erie, as well as the impact such establishments may have on fishes in these systems. I have developed a multispecies, spatially-explicit individual-based model of a fish community and its prey for these lakes. The model includes 4-5 fish species that are modeled as individuals and multiple biomass pools that serve as food. One important pool includes phytoplankton. The model includes multiple habitats, including marshes, but I am having difficulty finding phytoplankton biomass values for marshes (note that juvenile Asian carps use these habitats as nursary areas). As you have sampled marshes in all three lakes, would you be willing to share this information? In paticular, we are interested in obtaining chlorophyll a values for marshes in Saginaw Bay, Lake Huron, Muskegon Lake and Western Lake Erie (if available). I will use an average chlorophyll a value to estimate biomass values of phytoplankton in the model domain and, if you have seasonal information, this will be extremely helply in calibrating the model. If you require any additional information as to how these data will be used, please let me know and I can send a more detailed description of our project.

Thank you for considering to share your data with our team. We will certainly keep you informed of our model progress and will acknowledge your contributions in any resulting manuscripts.

Sincerely,

Dr. Lori N. Ivan
lnivan@umich.eduUniversity of Michigan CILER
4840 S. State Road
Ann Arbor, Mi 48108

MichiganTech
Research Institute

www.mtri.org

October 25, 2013

EPA GLNPO,

I would like to acknowledge Valerie Brady, Terry Brown and Don Uzarski for their assistance in providing information on field monitoring sites collected under their GLIC project (GLIC: Implement Great Lakes Coastal Wetland Monitoring, PI Uzarski) for two of our projects. The first is our EPA-funded GLRI project entitled "Implementation of the Great Lakes Coastal Wetlands Consortium Mapping Protocol" Grant Number: GL-00E00559-0 (PI Bourgeau-Chavez). The GLIC CWM data have been invaluable in augmenting the field data that we've collected for training the mapping algorithm for coastal Great Lakes wetlands.

The second project their data have been instrumental in driving is for a new project funded by the University of Michigan Water Center. The GLIC CWM vegetation, amphibian and bird data they collected form the basis of this newly funded project to assess effectiveness of herbicide treatment of *Phragmites australis* on restoring habitat (PI Bourgeau-Chavez). Their existing sites and baseline data will form the basis for longitudinal studies of pre- and post-herbicide treatment analyses. We plan to collect repeated data at these sites in Green Bay and Saginaw Bay to follow the restoration of biodiversity post-treatment. We are greatly appreciative of the timeliness of data retrieval from their database and the time and effort that they have put in to help our projects.

Thank you.

Sincerely,

Laura Bourgeau-Chavez
Research Scientist
Michigan Tech Research Institute
lchavez@mtu.edu
(734) 913-6873

Environment Canada | Environnement Canada

October 7, 2013

Greg Grabas
Habitat Ecologist
Canadian Wildlife Service – Ontario
Environment Canada
4905 Dufferin St.
Toronto, ON M3H 5T4

Dear Mr. Grabas,

Environment Canada plays a key role in meeting the requirements of the Canada-US Great Lakes Water Quality Agreement. Part of these responsibilities involve assessing and reporting on the condition of Beneficial Use Impairment (BUIs) in Great Lakes Areas of Concern (AOCs), locations that have experienced historical environmental degradation.

Thunder Bay is one of nine Canadian AOCs; located on the northwestern shore of Lake Superior. Currently, there are two BUIs related to wildlife populations and habitats within the Thunder Bay AOC are not well understood – "Degradation of Fish and Wildlife Populations" and "Loss of Fish and Wildlife Habitat". Coastal wetland assessments are an integral part of determining the status of these impairments. The coastal wetland assessment framework implemented by the Great Lakes Indicator Consortium (GLIC) as part Great Lakes Restoration Initiative lends itself well to these kinds of AOC assessments.

Over the last year, Environment Canada provided funding to the University of Minnesota's Natural Resources Research Institute (NRRI) to assess coastal wetlands within the Thunder Bay AOC using the GLIC protocols. The collection of field data is expected to provide important information regarding the status of wildlife populations and habitats in the AOC. In addition, the GLIC data collected as part of the Great Lakes Restoration Initiative may be used to develop delisting criteria for the Thunder Bay AOC and monitor the future condition of these beneficial use impairments.

As the Environment Canada lead for AOCs in Lake Superior, I would like to extend my ongoing support of the GLIC program and will continue to rely on the invaluable knowledge and expertise provided by the GLIC for coastal wetlands assessments in the Great Lakes.

Sincerely,

Sara Varty
Senior RAP Program Coordinator
Great Lakes Areas of Concern
Regional Director General's Office - Ontario
Environment Canada
4905 Dufferin Street, Toronto, Ontario M3H 5T4

Canada

October 7, 2013

Mr. Greg Grabas
Habitat Ecologist
Canadian Wildlife Service – Ontario
Environment Canada
4905 Dufferin St.
Toronto, ON M3H 5T4

Dear Mr. Grabas,

Credit Valley Conservation is pleased to support the Great Lakes Restoration Initiative by permitting the Canadian Wildlife Service to conduct coastal wetland monitoring and sampling at Rattray Marsh, an Environmentally Sensitive Natural Area, Provincially Significant Wetland, and Area of Natural and Scientific Interest.

Rattray Marsh is recognized as an important coastal marsh on Lake Ontario. Having undergone ecological degradation through excess sedimentation and the introduction of exotic species, restoration efforts are now underway to restore the health of Rattray Marsh. Restoration is being undertaken in phases, and a watershed management plan for Sheridan Creek will help future efforts in reducing upstream erosion and pollution from entering Rattray Marsh. Coastal wetland monitoring at Rattray Marsh under the Great Lakes Restoration Initiative will provide valuable baseline data to compare pre- and post-restoration efforts.

It is Credit Valley Conservation's pleasure to continue collaboration with the Canadian Wildlife Service. Monitoring of Rattray Marsh under the Great Lakes Restoration Initiative will support Credit Valley Conservation's comprehensive strategy to build awareness of the environmental challenges facing the Mississauga shoreline and to find ways to restore it.

Sincerely,

Deborah Martin-Downs
Chief Administrative Officer

MINNESOTA LAND TRUST

Dr. Valerie Brady
Natural Resources Research Institute
University of Minnesota Duluth
Duluth, MN 55811

Dear Dr. Brady: October 14, 2011

This letter is in support of your work on the Great Lakes Coastal Monitoring Project. Thank you for including the St. Louis Estuary sites: 21st Ave West, 40th Ave West, and Radio Tower Bay as Benchmark sites. These sites are important large-scale habitat restoration sites for removing habitat related Beneficial Use Impairments in the Lower St. Louis River Area of Concern. Restoration of these site is a joint effort by a number of agencies and groups including Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, Minnesota Pollution Control Agency, U.S. Fish & Wildlife Service, US EPA Mid-Continent Ecology Lab and the Fond du Lac Band of Lake Superior Chippewa and the Minnesota Land Trust. Our objective is to address their degraded condition and then restore them to once again be functioning Great Lakes coastal wetlands.

The data you collect on fish, invertebrates, wetland vegetation, birds, amphibians, and water quality will help us with our effort to understand the pre-restoration condition and to evaluate how the ecological functions change following restoration actions. In addition, comparing these sites to all other Great Lakes coastal wetlands, will help to put into context their condition and their contribution to the rest of the Great Lakes ecosystem. We do hope that you will be able to sample these sites again after restoration is complete enabling a change analysis that can quantify the gains in ecosystem services these restoration projects may contribute to Lake Superior the Great Lakes basin.

These restoration projects are the result of a broad collaboration of agencies and organizations, each with their own expertise and bringing important resources to the projects. UMD-NRRI's long term commitment and participation in these projects is invaluable. The data and analysis you provide at no extra cost to us is very helpful and allows us to compare our sites to many more sites than we would have otherwise been able.

We hope that you are able to add additional restoration sites to the Coastal Monitoring project as we address additional sites as we believe this will benefit both the science based decision making involved in restoration planning and the natural resources recovery for which we all aim.

Sincerely,

Daryl Peterson
Senior Project Manager

2356 University Avenue West, Suite 240
St. Paul, Minnesota 55114
(651) 647-9590 phone • (651) 647-9769 fax
www.mnland.org

LOYOLA UNIVERSITY CHICAGO
Chicago's Jesuit University

Dr. Donald G. Uzarski, PhD, Director
Institute for Great Lakes Research
Central Michigan University
Mount Pleasant, MI 48859

March 9, 2013

Dear Dr. Uzarski,

Loyola University requests that you treat Cheboygan Marsh and Cedarville Marsh on Lake Huron, Munuscong Bay on the St. Marys River, and Galien River on southern Lake Michigan as benchmark sites for the Great Lakes Coastal Wetland Monitoring project. All of these marshes are part of a project to evaluate restoration of invasive cattail dominated wetlands by harvesting cattails and converting them to biogas.

Collecting plant, invertebrate, and fish data will allow us to compare untreated portions of these sites with our data collected on treated portions of these marshes. Your sampling will provide us with an independent baseline for evaluating the success of our restoration activities.

Our project will be treating sites the first year, followed by two years of post treatment data collection. Your five years of data collection will allow us to more effectively evaluate the plant response of our project to your longer baseline data collection.

Our analyses will incorporate your baseline data, and these will be summarized in our final report to USEPA.

Sincerely,

Nancy C. Tuchman

Nancy C. Tuchman, PhD, Director
Institute of Environmental Sustainability
Loyola University Chicago
6525 N. Sheridan Road
Chicago, IL 60626

ST. MARYS RIVER

BINATIONAL PUBLIC ADVISORY COUNCIL

March 10, 2013

Dr. Ashley Moerke
Lake Superior State University
650 W. Easterday Ave.
Sault Sainte Marie, MI 49783

Dear Dr. Moerke,

This letter is in support of your work on the Great Lakes Coastal Wetland Monitoring project. Thank you for including sites throughout the St. Marys River, along with a benchmark site in the Little Rapids area. The St. Marys River is an Area of Concern (AOC) and the Little Rapids area is proposed to undergo a restoration in 2014.

The data you and your colleagues are collecting on water quality, habitat, benthos, and fish in the St. Marys River will help scientists and managers understand trends in the health of the riverine wetlands, specifically the condition of fish and benthos, which can aid in delisting Beneficial Use Impairments for the St. Marys AOC. The 5-year dataset will be the most extensive dataset available on nearshore areas in the river and will be extremely valuable in identifying the status and condition of wetlands.

The data (water quality, habitat, benthos, and fish) that hopefully will be collected at the benchmark site in the Little Rapids area annually from 2013-2015 will be useful in evaluating changes in habitat and biological communities as a result of reconnecting flow to the historic Little Rapids area. The Little Rapids restoration project is a collaborative project among local, state, and federal agencies; however funding is limited for monitoring. Therefore this monitoring that will be provided at no extra cost to us will be very helpful.

We hope that the Great Lakes Monitoring Project will be able to continue collecting these important data on wetlands in the St. Marys River.

Sincerely,

Dr. Paula Antunes
BPAC Canadian Chair

Mike Ripley
U.S. Vice-Chair

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

January 11, 2013

Dr. Douglas Wilcox
Empire Innovation Professor of Wetland Science
108B Lennon Hall
The College at Brockport
350 New Castle Drive
Brockport, NY 14420

Dear Dr. Wilcox:

This is in regards to wetland monitoring in the Rochester area. The New York Field Office is involved in a Great Lakes Restoration Initiative project to evaluate trends in the extent and quality of wetlands in the Rochester, New York, area to address delisting criteria for the Loss of Fish and Wildlife Habitat Beneficial Use Impairment (BUI). We have water quality data from 2012 and have been using the U.S. Environmental Protection Agency's Rapid Assessment Method to determine current wetland quality.

We are currently planning our 2013 work. To support this ongoing effort, the New York Field Office is very interested in receiving all data that your group has collected in wetlands and adjacent water bodies in the vicinity of the Rochester Embayment Area of Concern. We would also be interested in receiving any data you may collect in 2013 and subsequent field seasons in the same area. Our interest sites include wetlands in and near Braddock Bay and its tributaries, Long, Buck, and Round Ponds and their tributaries, Slater Creek/Little Pond, Payne and Rose Marshes, Irondequoit Bay and its major tributaries, the nearshore area of Lake Ontario near Rochester, and the lower Genesee River. Additionally, if you were to do any work on Cranberry Pond, we are interested in having that data set, as we found interesting vegetative communities in that area. Information you provide would be very useful in our assessment of trends and relative wetland quality throughout the study area to address the BUI delisting criteria.

If additional information is needed concerning this request, please contact Dan Gefell or Anne Secord at (607) 753-9334. Thank you in advance for your time.

Sincerely,

for Patricia Cole
David A. Stilwell
Field Supervisor

United States Department of the Interior

NATIONAL PARK SERVICE

Great Lakes Network Office
Suite D
2800 Lake Shore Drive East
Ashland, WI 54806

Providing Inventory & Monitoring services to: Apostle Islands National Lakeshore, Grand Portage National Monument, Indiana Dunes National Lakeshore, Isle Royale National Park, Mississippi National River and Recreation Area, Pictured Rocks National Lakeshore, Sleeping Bear Dunes National Lakeshore, St. Croix National Riverway, and Voyageurs National Park.

Dr. Valerie Brady
Natural Resources Research institute
University of Minnesota Duluth
Duluth, MN 558 11

March 16, 2012

Dear Dr. Brady,

The National Park Service – Great Lakes Inventory and Monitoring Network (NPS-GLKN) is pleased that the Great Lakes Coastal Wetland Monitoring Project will include wetlands on NPS property. We see this as a win-win opportunity. The data you collect on amphibians, birds, fish, vegetation, and water chemistry will contribute important information to the parks, providing a current assessment of wetland condition, identifying restoration needs, and placing the parks into a regional context. The majority of the NPS wetlands selected for inclusion occur in some of the least disturbed areas of the Great Lakes, and hence will provide useful reference condition information for the project.

Six national park units within NPS-GLKN occur on Lakes Superior and Michigan (Grand Portage National Monument, Apostle Islands National Lakeshore, Isle Royale National Park, Pictured Rocks National Lakeshore, Sleeping Bear Dunes National Lakeshore, and Indiana Dunes National Lakeshore). All of these parks except Grand Portage National Monument contain wetlands that meet the project criteria. The attached documents contain location and other information on the wetlands selected and prioritized by NPS-GLKN for inclusion in the coastal wetland monitoring project.

NPS-GLKN supports the Great Lakes Coastal Wetland Monitoring Project and looks forward to collaborating with you in any way possible. Thank you for this opportunity.

Sincerely,

Joan Elias

Joan Elias
Aquatic Ecologist
715-682-0631 x224
joan_elias@nps.gov

The Nature Conservancy
Protecting nature. Preserving life.™
nature.org

Central & Western New York Chapter
1048 University Avenue
Rochester, NY 14607

October 18, 2011

Dr. Douglas Wilcox
SUNY College at Brockport

Dear Doug –

The Nature Conservancy is glad to provide a letter of support for the monitoring of coastal wetlands in the Lakeview Wildlife Management Area and in the southern portion of Sodus Bay.

In both of these locations, The Nature Conservancy is actively pursuing conservation of wetlands, either through restoration of hydrologic functions (Lakeview Wildlife Management Area) or actual protection of wetlands through land acquisition. The monitoring of the Great Lakes Coastal Wetlands Consortium will provide useful baseline information which will complement conservation efforts, and assist us in evaluating the impact of this work. We are particularly encouraged that the monitoring will span several years, and look forward to further collaboration.

Thank you for this opportunity to send a letter of support, and best regards,

David Klein
Senior Field Representative

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING

RICK SNYDER
GOVERNOR

KEITH CREAGH
DIRECTOR

March 18, 2013

Dr. Donald G. Uzarski
Institute for Great Lakes Research
Central Michigan University
Mount Pleasant, MI 48859

Dear Dr. Uzarski:

Thank you for including William C. Sterling State Park on Lake Erie (Monroe, Michigan) as a sampling site for the Great Lakes Coastal Monitoring Project in 2012. Michigan Department of Natural Resources, Parks and Recreation Division has been actively working to restore Great Lakes marsh and lakeplain prairie at the park since 2003. We are currently working on three GLRI-funded projects at the park to control invasive species, re-establish water control capability in 2 diked wetlands, and remove fill material from former lakeplain prairie and place it in a lagoon to simultaneously re-create shallow water (submergent) wetland and restore lakeplain prairie.

Please consider including Sterling State Park as a benchmark site for continued monitoring. In conjunction with our restoration work, we would appreciate as much continued monitoring as your project could provide for the next several years to help us document change in the site over time. Especially critical to our project objectives are wetland vegetation, birds (especially shorebirds), and fish. However, information on aquatic invertebrates, amphibians, and any other species groups would be very helpful as well. The interaction of aquatic invertebrate populations and shorebird use of the diked wetlands would be particularly interesting to investigate if resources were available.

Sterling State Park is located in the northern portion of the River Raisin delta adjacent to the River Raisin Area of Concern (AOC). The park provides some of the only remaining wetland habitat within or adjacent to this AOC. US Environmental Protection Agency, Michigan Department of Environmental Quality, and others have placed a high priority on delisting the River Raisin AOC, and the habitat restoration work that is ongoing at Sterling State Park is a critical step in that process.

We look forward to continuing to work with you and other partner universities and researchers to monitor the natural features at Sterling State Park.

If you have any questions, please feel free to contact me.

Sincerely,

Glenn R. Palmgren, Ecologist
Stewardship Unit
Resource Management Section
Parks and Recreation Division
517-335-4823

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING

RICK SNYDER
GOVERNOR

KEITH CREAGH
DIRECTOR

March 12, 2013

Dr. Ashley Moerke
Lake Superior State University
650 West Easterday Avenue
Sault Sainte Marie, Michigan 49783

Dear Dr. Moerke:

This letter is in support of your work on the Great Lakes Coastal Wetland Monitoring project. Thank you for including sites throughout the St. Marys River, along with a benchmark site in the Little Rapids area. The St. Marys River is an Area of Concern (AOC) and the Little Rapids area is proposed to undergo a restoration in 2014.

The data you and your colleagues are collecting on water quality, habitat, benthos, and fish in the St. Marys River will help scientists and managers understand trends in the health of the riverine wetlands, specifically the condition of fish and benthos, which can aid in delisting Beneficial Use Impairments for the St. Marys River AOC. The 5-year dataset will be the most extensive dataset available on nearshore areas in the river and will be extremely valuable in identifying the status and condition of wetlands.

The data (water quality, habitat, benthos, and fish) that hopefully will be collected at the benchmark site in the Little Rapids area annually from 2013-2015 will be useful in evaluating changes in habitat and biological communities as a result of reconnecting flow to the historic Little Rapids area. The Little Rapids restoration project is a collaborative project among local, state, and federal agencies; however funding is limited for monitoring. Therefore monitoring that can be provided at no extra cost to us will be very helpful.

We hope that the Great Lakes Monitoring Project will be able to continue collecting these important data on wetlands in the St. Marys River.

Sincerely,

Neal Godby

Neal Godby
Senior Fisheries Biologist
Northern Lake Huron Management Unit
Michigan DNR Fisheries Division
989-732-3541, ext. 5071
godbyn@michigan.gov

The Nature Conservancy
Protecting nature. Preserving life.

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20 June, 2011

Dr. Donald G. Uzarski
Director of CMU Institute for Great Lakes Research
Central Michigan University
Mount Pleasant, MI 48859

Dear Dr. Uzarski,

The Nature Conservancy requests that Erie Marsh Preserve and the adjacent wetlands in North Maumee Bay be used as a benchmark site for the Great Lakes Coastal Wetland Monitoring project. The diked portion of Erie Marsh Preserve is currently scheduled for restoration to improve habitat quality and access for fish and other aquatic organisms.

The proposed restored marsh is approximately 258 acres and would be ideal for sampling all parameters of the monitoring project (fish, invertebrates, birds, amphibians, vegetation, and water chemistry). The diked area of the preserve will be reconnected to Lake Erie to provide habitat for aquatic organisms. The data obtained within the dike could be compared to the adjacent wetlands outside of the dike to evaluate restoration success.

The use of Erie Marsh Preserve as a benchmark site will benefit The Nature Conservancy's goal to restore coastal wetlands within North Maumee Bay and the adjacent diked preserve by comparing its current and future status with other coastal sites within the basin. Furthermore, gathering data both pre- and post-restoration is very important to determine the effectiveness of the restoration. Given the proposed five year term of your project, monitoring could be continued after restoration for several years to evaluate success. Data collected from Erie Marsh could also inform restoration of diked wetlands within the entire Great Lakes basin. In addition, the use of North Maumee Bay as a benchmark site would allow The Nature Conservancy to obtain high quality data at no additional cost to our non-profit organization.

Central Michigan University will benefit from this joint endeavor by gathering data from a unique pre- and post-altered habitat. This data would also be available for use in scientific publications.

We hope that you will consider using Erie Marsh Preserve and North Maumee Bay as a benchmark in your coastal wetland monitoring project.

Sincerely,

Denny McGrath
Assistant State Director

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
101 S. Webster Street
Box 7921
Madison WI 53707-7921

Scott Walker, Governor
Cathy Stepp, Secretary
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March 15, 2013

Dr. Valerie Brady
Natural Resources Research Institue
University of Minnesota Duluth
Duluth, MN 55811

Dear Dr. Brady:

We are writing in support of your work on the Great Lakes Coastal Monitoring Project. Thank you for promising to provide us with all of the data from the wetlands you are sampling on the Wisconsin coast of Lake Superior. A defining mission of the Natural Heritage Inventory is to collect data on rare species and high quality natural communities throughout Wisconsin, and the data you provide from such a comprehensive project greatly improve our ability to accomplish this mission. The wetlands sampled during this project are considered some of Wisconsin's finest coastal wetlands and harbor many species found in very few, if any, other locations in the state. It's critical that we maintain up-to-date information on this area especially in light of threats from logging, development, invasive species and climate change. However, due to basic restraints on time and resources and the state-wide scope of our work we are often unable to survey as extensively in the Lake Superior area as we would like. We feel very fortunate, then, that you are willing to share high quality data with us so we can meet our goals for the area while also pursuing important projects elsewhere in the state.

We feel very strongly about the importance of partnerships in research and management and we see NRRI as integral to the success of a growing partnership along the southern shore of Lake Superior. The data your crews and collaborators collect on fishes, invertebrates, wetland vegetation, birds, amphibians, and water quality will not only help us better understand threatened and endangered species and their habitats, they will also be used to inform future management plans on state-owned lands and educate the public on the area's ecological significance.

The data you will provide at no extra cost allows us to meet program and department goals in a more efficient way than we would have otherwise been able. We hope that you are able to add additional sites to the Coastal Monitoring project as the project proceeds, and we look forward to future collaborations with UMD and NRRI.

Sincerely,

Erin Crain, Director
Bureau of Endangered Resources
Wisconsin Department of Natural Resources

GREAT LAKES/ATLANTIC REGION
Sarah Fleming
Regional Biologist
6631 Reeves Road, Jordan NY 13080
315-689-0179 (office) 585-683-6764 (cell)
sfleming@ducks.org

March 13, 2013

Dr. Doug Wilcox
Empire Innovation Professor of Wetland Science
108B Lennon Hall
The College at Brockport
350 New Castle Dr.
Brockport, NY 14420

Dear Dr. Wilcox,

This letter is to request the support and partnership of your lab to collect wetland monitoring data in the Rochester Embayment Area of Concern as part of our proposed project entitled "Coastal Wetlands Restoration at Braddock Bay FWMA: Phase II" where funding has been requested through National Oceanic and Atmospheric Administration as part of the Great Lakes Restoration Initiative. The goal of our current partnership is to restore sedge meadow habitat and improve wetland interspersion in the coastal marshes at Braddock Bay Fish and Wildlife Management Area. Specifically, the goal is to restore areas of Buttonwood and Salmon Creeks, and Buck Pond. The project sites were diverse and productive coastal marshes, but became predominantly dense stands of monotypic cattail because of regulated, relatively stable water levels of Lake Ontario. Presently the marshes support minimal area of native sedge meadow or emergent wetland and, thus only provide marginal habitat for fish and wildlife that rely on diverse coastal marshes to meet their life-cycle needs. The project will directly address Beneficial Use Impairments of the Rochester Embayment Area of Concern by improving quality and quantity of fish and wildlife habitat and it will address the goals of the Lakewide Management Plan by restoring ecosystems to support self-reproducing diverse biological communities.

The mission of Ducks Unlimited (DU) is to conserve, restore, and manage wetlands and associated habitats for North America's waterfowl and other wildlife. These habitats also benefit people by filtering pollutants from water, replenishing groundwater supplies, and providing flood storage during storms. DU is committed to science-based, solution-oriented conservation for waterfowl, wildlife, and people. Our science-based strategic planning guides our conservation activities. Research and monitoring is critical component of our programs to help fill knowledge gaps. Data from carefully designed research and monitoring are used to prioritize where we work, identify appropriate conservation actions, and inform policy decisions. The marriage of science and conservation ensures that each and every dollar invested in conservation programs are used as effectively and efficiently as possible.

Our current partnership and restoration goals at Braddock Bay recognize that an effective monitoring program is essential to document the short- and long-term success of the restoration efforts. Wetland succession, invasive species, ecological function, and effects of water level management will be key areas of investigation in Braddock Bay to document responses to our restoration efforts. Therefore, the monitoring efforts by you and your students will provide the scientific information needed to help address the site specific objectives and those of the International Joint Commission (IJC). The data collected should evaluate faunal linkages to habitat and connectivity enhancements, which will include monitoring potadromous fish (e.g., northern pike), as well as other key indicator avifauna and herpetofauna species. Ecosystem variables, such as vegetation and macroinvertebrate communities that are sensitive to hydrology and enhancement measures, should also be evaluated. Therefore, these data collected by your lab will provide comprehensive comparisons among projects sites that will also help in understanding of IJC water level regulation effects on coastal marsh ecology and provide guidance for long-term restoration to coastal wetland habitat in Lake Ontario to support valuable wildlife habitat. These data also will help provide an adaptive management strategy for long-term management of the Braddock Bay area by NYSDEC fish and wildlife managers.

If additional information is needed concerning our partnership request for the data you have collected and to delivery additional data collection methods for the monitoring of the Braddock Bay Coastal Wetland Restoration Project please contract Sarah Fleming at 315-689-0179 or sfleming@ducks.org.

Thank you for your partnership and support of our wetland conservation efforts.

Sincerely,

Sarah Fleming
NY Regional Biologist

Minnesota Pollution Control Agency

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March 12, 2013

Dr. Valerie Brady
Natural Resources Research Institute
University of Minnesota Duluth
Duluth, MN 55811

Dear Dr. Brady:

The Minnesota Pollution Control Agency and the Wisconsin Department of Natural Resources are the organizations responsible for delisting the St. Louis River Area of Concern (AOC). Naturally, this work requires many partnerships and various entities playing a role to accomplish this goal. This letter is in support of your work on the Great Lakes Coastal Monitoring Project.

Thank you for sampling many wetland sites within the estuary, and adding additional sites as necessary. The areas that have been impaired are important large-scale habitat restoration sites for removing habitat-related Beneficial Use Impairments in the Lower St. Louis River Area of Concern. Restoration of these sites is a joint effort by a number of agencies and groups including Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, U.S. Fish & Wildlife Service, US EPA Mid-Continent Ecology Laboratory, Minnesota Land Trust, and the Fond du Lac Band of Lake Superior Chippewa and the Minnesota Pollution Control Agency. One of our delisting objectives is to address the degraded condition of these sites and then restore them to once again be functioning Great Lakes coastal wetlands.

The data you collect on fish, invertebrates, wetland vegetation, birds, amphibians, and water quality will help us with our effort to understand the pre-restoration condition and to evaluate how the ecological functions change following restoration actions. In addition, comparing these sites to all other Great Lakes coastal wetlands will help to put into context their condition and their contribution to the rest of the Great Lakes ecosystem. We do hope that you will be able to sample these sites again after restoration is complete. This will enable us to demonstrate conclusively that the condition of these sites has improved to be on a par with other Lake Superior coastal wetlands. We also hope to quantify the gains in ecosystem services these restoration projects contribute to Lake Superior and the Great Lakes basin.

UMD-NRRI's long term commitment and competent staff are invaluable to our work. The data and analysis you provide at no extra cost to us is very helpful and allows us to compare our sites to sites across Lake Superior and the Great Lakes. We hope that you are able to add additional restoration sites to the Coastal Monitoring project as we address additional sites.

Sincerely,

Suzanne E. Hanson

Suzanne Hanson, Manager
Northeast Watershed Section
Watershed Division

SH:slm

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Division of Fish, Wildlife & Marine Resources
Bureau of Wildlife
625 Broadway, 5th Floor, Albany, New York 12233-4754
Phone: (518) 402-8920 • **Fax:** (518) 402-9027
Website: www.dec.ny.gov

Joe Martens
Commissioner

11 March 2013

Brad Mudrzynski, Research Scientist
108A Lennon Hall
The College at Brockport
Brockport, NY 14420

Dear Mr. Mudrzynski:

Thank you for your recent agreement to share with New York State Department of Environmental Conservation (DEC) the marsh bird data collected through The College at Brockport's *Great Lakes Instrumentation Collaboratory (GLIC): Implementing Great Lakes Coastal Wetlands Monitoring Project*.

Information on marsh birds observed at your monitoring sites at Lakeview Wildlife Management Area will compliment data collected by DEC's current statewide Marsh Bird Monitoring Program. All shared information will contribute to a better understanding of marsh bird population trends. Such collaboration is crucial to the conservation and management of these species and their habitat throughout New York State.

Respectfully,

Katherine A. Yard
Marsh Bird Monitoring Program Coordinator
Wildlife Diversity Unit
NYS Department of Environmental Conservation

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Fond du Lac Environmental Program

Dr. Valerie Brady
Natural Resources Research Institute
University of Minnesota – Duluth
5013 Miller Trunk Highway
Duluth, Minnesota 55811

14 March 2013

Dear Dr. Brady:

On behalf of the St. Louis River Alliance – Habitat Work Group, and as Chair of the group, I am writing in support of your work in the St. Louis River Estuary related to the Great Lakes Coastal Monitoring Project. We are particularly grateful for your willingness to add Spirit Lake and Kilchliss Meadows in the estuary to your site list. The Habitat Work Group is working with all of the groups and agencies involved in the St. Louis River Area of Concern delisting process to guide habitat restoration efforts within the estuary.

Spirit Lake and Kilchless Meadows seem to have lost the density of aquatic vegetation that they had in the past, causing them not to appear on your site list of coastal wetland sites.We have future plans to restore this area, and would like to use the data your teams collect as pre-restoration benchmarks.

The data you collect on fish, invertebrates, wetland vegetation, birds, amphibians, and water quality will help us with our efforts to understand the current conditions of the Spirit Lake area and to plan restoration actions. In addition, comparing these wetlands to all other Great Lakes coastal wetlands will help to put into context the area's condition and its contribution to the estuary and Lake Superior. We hope that you will be able to sample this area in the future after restoration is complete, allowing a comparison with pre-restoration conditions. Such an analysis will not only demonstrate habitat restoration and improvement, but also improvement in ecosystem services to the estuary and western Lake Superior.

UMD-NRRI's long-term commitment and participation in work in the St. Louis River Estuary had been very helpful. We hope that you will be able to add additional sites in the future if we identify more areas in potential need of restoration.

Please let me know if you have any questions regarding this matter.

Sincerely:

Richard D. Gitar
Water Regulatory Specialist/Tribal Inspector
Fond du Lac Reservation
Office of Water Protection

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WISCONSIN
DEPT. OF NATURAL RESOURCES

Valerie Brady, PhD, Research Associate
Natural Resources Research Institute
University of Minnesota Duluth
5013 Miller Trunk Hwy
Duluth, MN 55811

Dear Dr. Brady:

We are happy to write this letter in support of your work around Clough Island in the St. Louis River estuary related to the Great Lakes Coastal Monitoring Project. As you know, Clough Island was recently obtained by WDNR out of private ownership, and we are working to restore this largest island in the St. Louis River estuary. The island is completely surrounded by coastal wetlands, and we appreciate your willingness to alter the sampling schedule for these wetlands to obtain data from these areas before our restoration work begins.

While we believe the Clough Island coastal wetlands to be relatively unimpaired, we hope that data provided by your project can help verify this assumption and help us determine if any restoration work needs to be done as well as establish baseline conditions. Thus, the data you collect on fish, invertebrates, wetland vegetation, birds, amphibians, and water quality will help us with our effort to understand the current conditions of this area and plan any needed restoration actions.

In addition, comparing these wetlands to all other Great Lakes coastal wetlands will help to put into context the area's condition and its contribution to the estuary and Lake Superior. We hope that you will be able to sample this area in the future after restoration is complete, allowing a comparison with pre-restoration conditions. Such an analysis will not only demonstrate habitat restoration and improvement, but also improvement in ecosystem services to the estuary and western Lake Superior.

UMD-NRRI's long-term commitment and participation in work on the St. Louis River estuary has been very helpful. The data and analysis your group provides at no extra cost to us allows us to compare our sites to many more sites than we would have otherwise been able, and has freed up our budget so that we can spend more on restoration efforts.

Sincerely,

Cherie L. Hagen
Lake Superior Program Coordinator