Application of Data Management and Decision Support Tools to Support Coastal Wetland Management in the Laurentian Great Lakes

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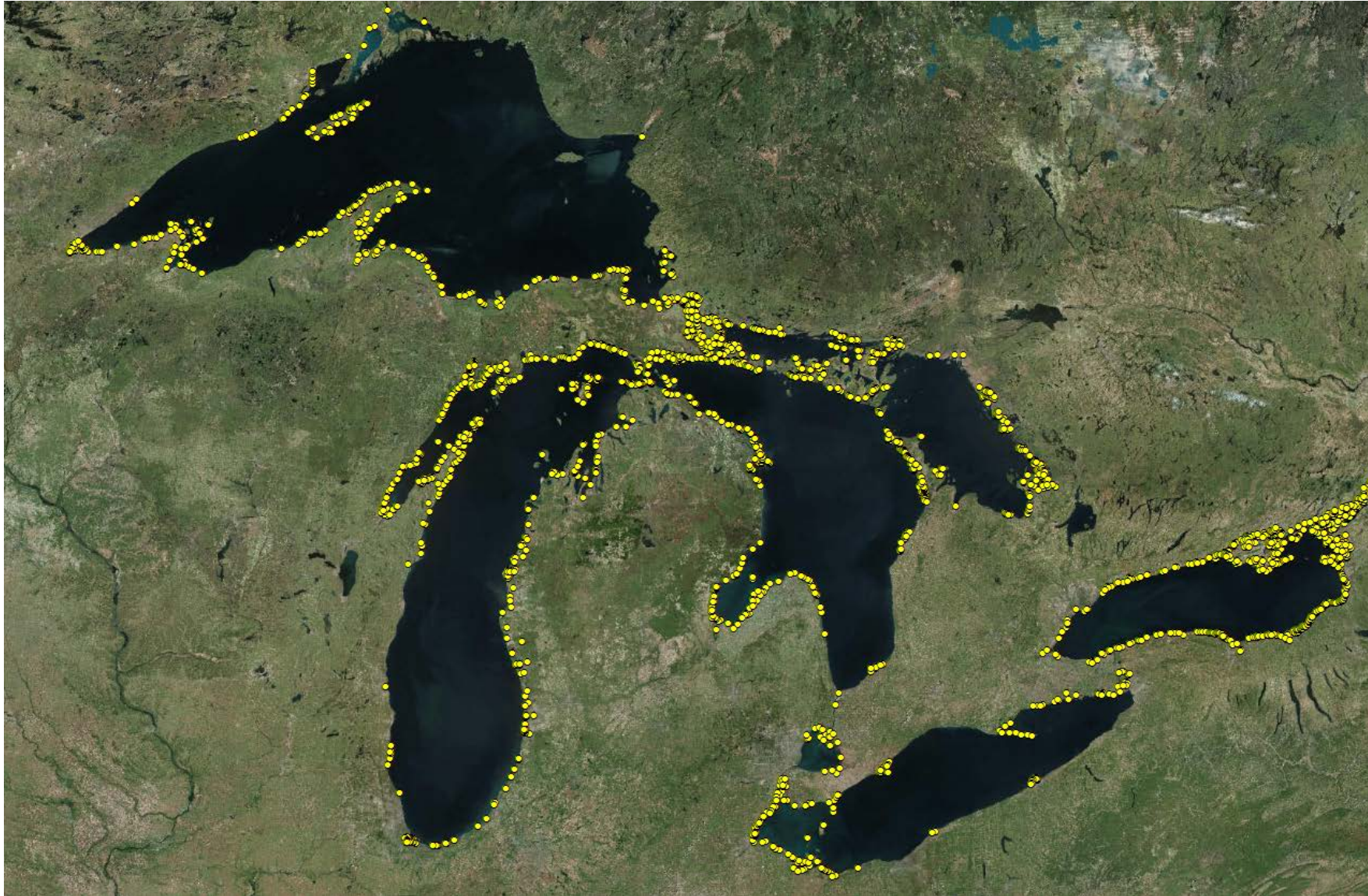
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Presentation Outline

- Great Lakes coastal wetlands
- Introduction to GLRI & Coastal Wetland Monitoring Program (CWMP)
- CWMP challenges/needs
- Data Management System
- Data evaluation tools
- Decision support tools
- Key lessons learned

Great Lakes Coastal Wetlands

Wetlands Overview:

- Total acreage: > 500,000

- ~70% of wetlands located in U.S.

- ~2,750 wetlands with:

  ➤ Surface water connection to Great Lakes

  ➤ Surface area > 10 acres

Great Lakes Restoration Initiative (GLRI)

- Launched in 2010 to "accelerate efforts to protect and restore" Great Lakes ecosystem

- Focus areas related to coastal wetlands:
  - Habitat and Species
  - Invasive Species

Focus Areas	Objectives	Commitments
Habitats and Species	Protect, restore and enhance habitats to help sustain healthy populations of native species	• Remove or bypass barriers on Great Lakes tributaries to facilitate fish passage • Protect, restore and enhance Great Lakes coastal wetlands • Protect, restore and enhance GLRI-targeted habitats in the Great Lakes basin
	Maintain, restore and enhance populations of native species	• Promote the recovery of priority federally-listed endangered, threatened and candidate species • Promote self-sustaining populations of GLRI-targeted native non-threatened and non-endangered species

Excerpted from: FY15-19 GLRI Action Plan Summary (USEPA, 2014)

Coastal Wetland Monitoring Program (CWMP)

- Objective: Implement a standardized basin-wide monitoring program that will inform decision makers on coastal wetland conservation and restoration priorities

- Timeframe: Initiated in 2010 and expected to continue through 2020 (subject to ongoing GLRI support)

- Funding Level: $20 M over ~10 years

- Scope: Great Lakes coastal wetlands that have:
  - Surface water connection to GL
  - Surface area > 10 acres

Great Lakes CWMP Organization

Funding Agency

USEPA – Great Lakes National Program Office

Kevin O'Donnell
(Project Officer)

Louis Blume
(Quality Assurance Officer)

GENERAL DYNAMICS
Information Technology

Collaborating Research Teams

Coastal Wetland Monitoring Approach

- Wetland site strata:
  - Geomorphic classes (riverine, barrier-protected, lacustrine)
  - Regions (10 total, north/south lake regions)
- Random selection of sites via panel approach (5-year rotation)
  - > 750 individual wetland sites sampled (2011-17)
  - Sites resampled at 5-year interval (at minimum)

2011   2015

Monitoring Cycle #1: ○ ————————————→ ○   } Evaluate
                                                       potential
2016   2020   temporal trends

Monitoring Cycle #2: ○ ————————————→ ○
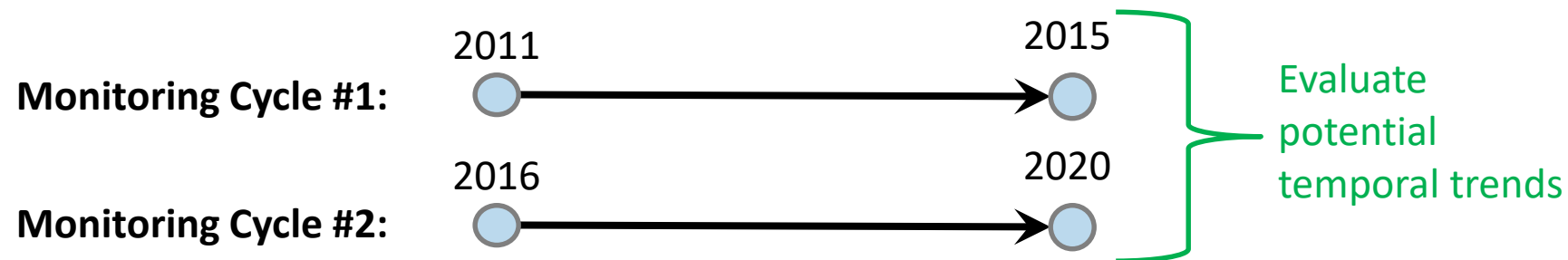
Ecological Components Monitored

Vegetation
(via transects)

Anurans
Birds
(via point surveys)

Fish
Macroinvertebrates
Water Quality
(by vegetation zone)

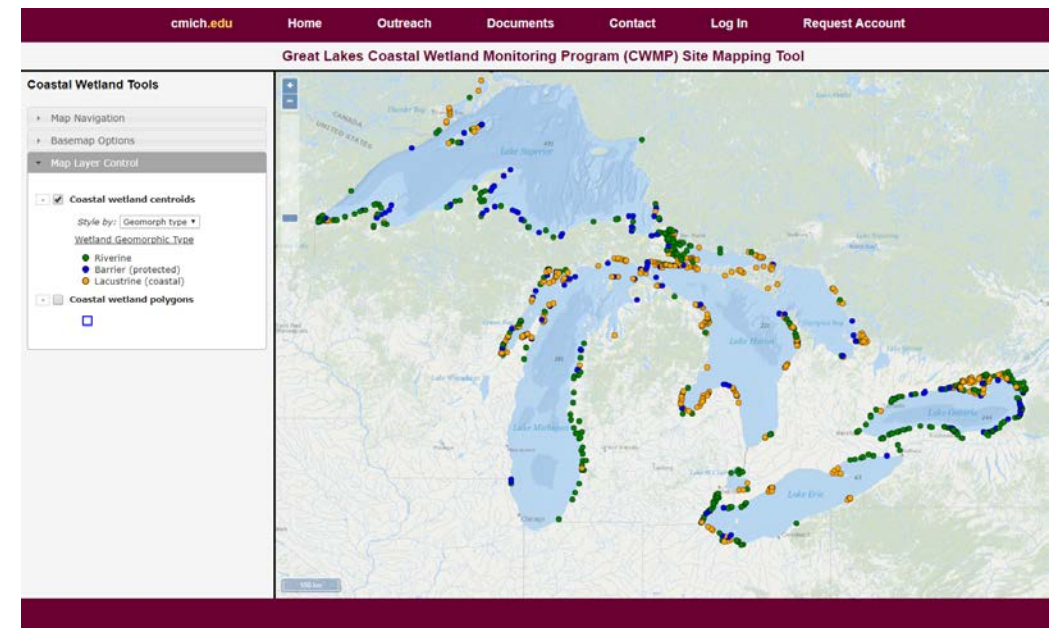# Monitoring Program Challenges & Needs

- Key challenges:
  - Coordination across large, complex research team (~16 entities)
  - Maintaining consistent data collection, storage, security
  - Data dissemination (diverse user base)
  - Raw ecological data → restoration decision support
- Program components to meet challenges:
  - Quality Assurance Project Plan
  - Established field data collection protocols (SOPs)
  - **Robust data management system**
  - **Data evaluation tools**
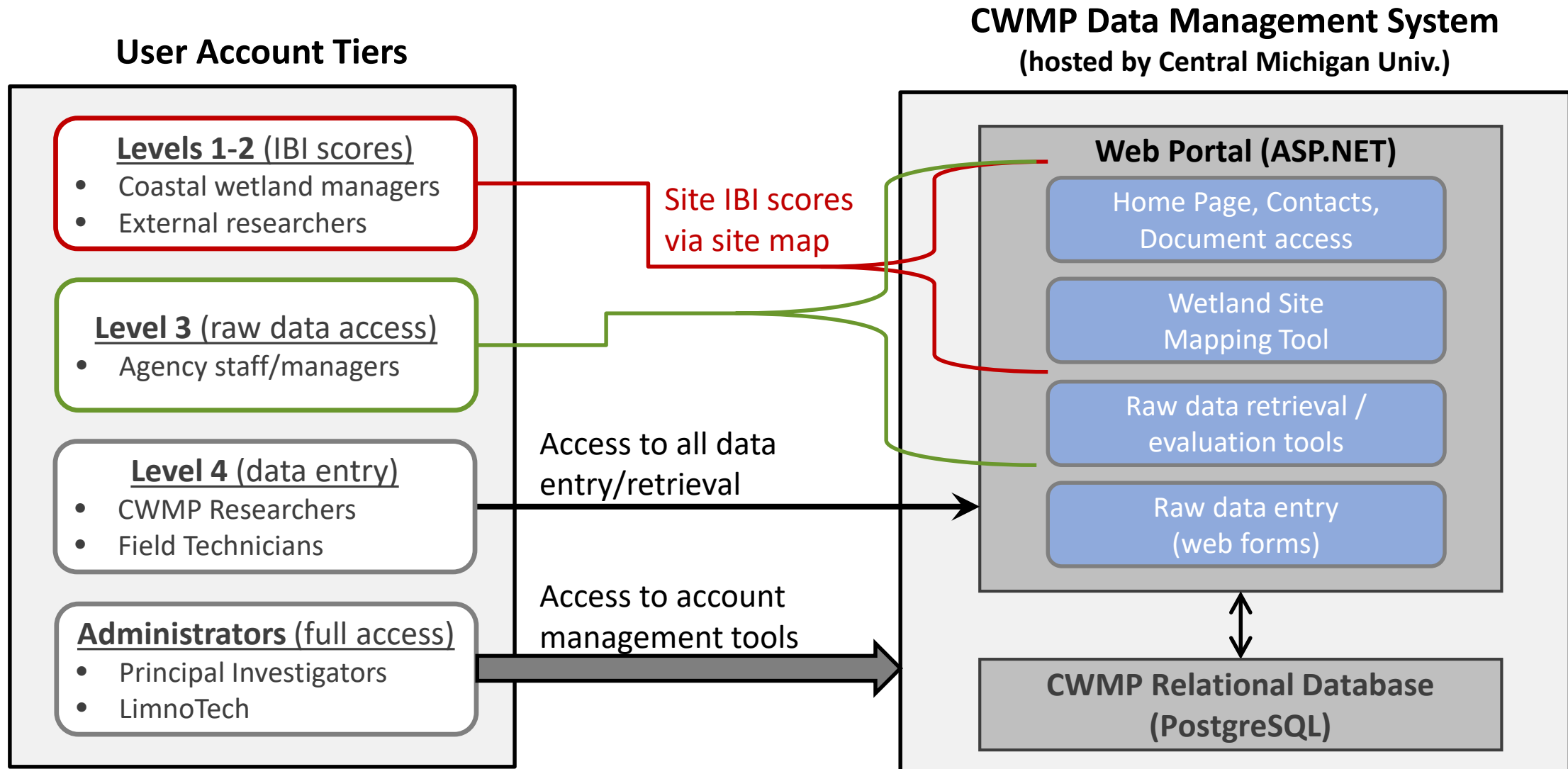 - **Restoration decision support tools**

CWMP Web Portal & Data Management System

- Centralized, web-based system for managing CWMP datasets
- Data entry, editing, retrieval, visualization
- Automation of *Index of Biotic Integrity* (IBI) scores
- Tiered user account system (5 levels)

URL: http://www.greatlakeswetlands.org/

CWMP Data Management System Architecture

User Account Tiers

CWMP Data Management System
(hosted by Central Michigan Univ.)

Levels 1-2 (IBI scores)
- Coastal wetland managers
- External researchers

Level 3 (raw data access)
- Agency staff/managers

Level 4 (data entry)
- CWMP Researchers
- Field Technicians

Administrators (full access)
- Principal Investigators
- LimnoTech

Site IBI scores via site map

Access to all data entry/retrieval

Access to account management tools

Web Portal (ASP.NET)

Home Page, Contacts, Document access

Wetland Site Mapping Tool

Raw data retrieval / evaluation tools

Raw data entry (web forms)

CWMP Relational Database (PostgreSQL)

URL: http://www.greatlakeswetlands.org/

CWMP Web Portal: Data Entry Forms

Amphibian Point Monitoring Data

○ Create new data entry   ● Edit existing data entry

Editing existing data point [**Site:** *1 (Tuscarora Bay)*, **Date:** *4/27/2015*, **Point ID:** *1*, **Entry:** *First*]   *[Request main record deletion]*

Field	Value	Description
Site List*	1 (Tuscarora Bay) ▼	*[edit]*
Select date*	4/27/2015 ▼ *[edit]*	
Point ID*	1 ▼	*Point number, 1 to 10 [edit]*
Entry*	First ▼ *[edit]*	
Waypoint*	AB0001.1.1	*Waypoint label on GPS (e.g., B1234.2; NA if missing)*
Sample*	1	*Sample number, 1 to 3*
Date*	04/27/2015	*Sampling date (in mm/dd/yyyy)*
Start Time*	21:53	*HH:MM, 24-hour format (e.g., 23:43 or 11:45)*
Time Zone*	Eastern ▼	
Crew Code*	SUNY-B ▼	
Observer*	J.Podoliak	*F.Lastname (e.g., J.Doe)*
Weather*	Dry ▼	
Cloud %*	100 ▼	*Cloud percent, 0, 10, 20, ..., 100*
Wind*	2: Slight breeze; wind felt on face; small twigs move ▼	
Air Temp:	8.1	*Air temperature (in degrees C)*
Water Temp:	10.9	*Water temperature (in degrees C)*
Noise*	0: No appreciable effect (owl calling) ▼	
Bearing*	137	*Bearing faced on point (0-360)*
Comments:		

QA Complete*: ☑ *QA has been verified on the basis of matching duplicate entries (this field is read only)*

Observations

Note: *Fields with an asterisk (*) are required; a newly added row of data will not be saved unless a valid input is entered in all required fields.*

	Taxa*	Distance*	In Front?*	Amphibian Call Code*	Individuals	
1	NLFR ▼	50-100 m ▼	☑	1: Calls not simultaneous; individuals can be accurately counted ▼	2	☐ Delete
2	SPPE ▼	0-50 m ▼	☐	3: Full chorus, calls continuous & overlapping; not reliably estimated ▼		☐ Delete
3	SPPE ▼	50-100 m ▼	☐	3: Full chorus, calls continuous & overlapping; not reliably estimated ▼		☐ Delete

General Features:

- Data entry, navigation, & editing

- Web forms match field entry sheets

- Fields generated via CWMP database

QA/QC Features:

- Data validation:
  ➢ Required inputs
  ➢ Data type
  ➢ Value ranges

- Dual record entry

CWMP Data Retrieval

Please select from the following options and then click the 'Download File(s)' button to initiate the download:

1. Export raw data in Microsoft Excel spreadsheet format (*.xslx):

- ☐ Vegetation
- ☐ Amphibian
- ☐ Bird
- ☑ Fish/invert/water quality (all)
- ☑ Sampling/zone
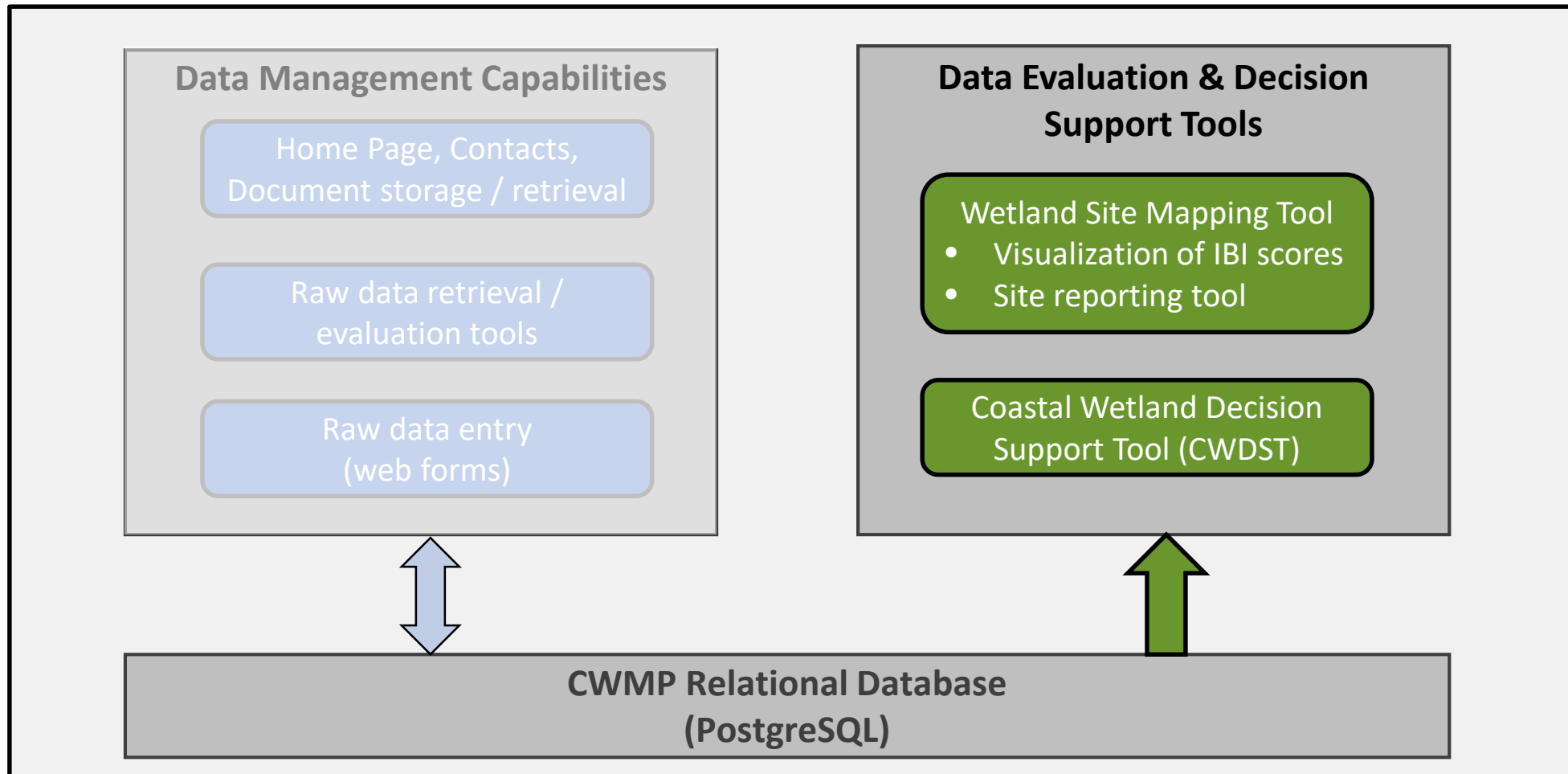- ☐ Zone habitat
- ☐ Fyke
- ☐ Water quality
- ☐ Invertebrate

- ◉ Download prior day's export (*fast*)
- ○ Download up-to-date export (*slower*)

2. Export raw data in Microsoft Access database format (*.accdb):

- ☑ Vegetation
- ☐ Amphibian
- ☑ Bird
- ☐ Fish/invert/water quality (all)
- ☐ Sampling/zone
- ☐ Zone habitat
- ☐ Fyke
- ☐ Water quality
- ☐ Invertebrate

- ◉ Download prior day's export (*fast*)
- ○ Download up-to-date export (*much slower*)

Data Retrieval Features:

- Multiple formats available:
  - ➢ Excel spreadsheet
  - ➢ MS Access database
- Exports generated nightly on server (for efficient retrieval)
- Additional data retrieval pages:
  - ➢ Results from database queries
  - ➢ Semi-annual database deliverables to GLNPO

CWMP Data Evaluation & Decision Support Tools

CWMP Web Portal

Data Management Capabilities
- Home Page, Contacts, Document storage / retrieval
- Raw data retrieval / evaluation tools
- Raw data entry (web forms)

Data Evaluation & Decision Support Tools
- Wetland Site Mapping Tool
  - Visualization of IBI scores
  - Site reporting tool
- Coastal Wetland Decision Support Tool (CWDST)

CWMP Relational Database (PostgreSQL)

Wetland Site Mapping Tool

Great Lakes Coastal Wetland Monitoring Program (CWMP) Site Mapping Tool

Coastal Wetland Tools

Map Navigation

Zoom to wetland site:

Select a site...

Zoom Full Extent

(Zooming can also be accomplished using controls on the map or by holding the 'shift' key and using the mouse to draw a rectangle over an area of interest.)

Basemap Options

Select base map:

Bing Aerial

Set opacity (Bing only):

Map Layer Control

- ✔ **Coastal wetland centroids**

  Style by: Vegetation IBI

  Vegetation IBI Score

  - 🔴 0.0 – 2.0
  - 🟡 2.0 – 3.0
  - 🟢 3.0 – 4.0
  - 🟢 4.0 – 5.0

- ☐ **Coastal wetland polygons**

Site IBI data download

Map "pop-up" reports site attributes, IBI scores, species lists

Wetland Site Information ✕

Site: 5139
Name: Buswell Bay
Geomorph: lacustrine (coastal)
Lat: 46.18537
Lon: -82.38374
Samp Year(s) : 2011, 2016
Veg IBI: 3.0
Invert IBI: 5.0
Fish IBI: 2.0

Zoom To   Species List
View Report   View Photos (13)

Customize base map

Style wetland sites based on IBI scores, class, sampling year

100 km

URL: http://www.greatlakeswetlands.org/map

Wetland Site Mapping Tool (site IBI comparison)

Great Lakes Coastal Wetland Monitoring Program (CWMP) Site Mapping Tool

Coastal Wetland Tools

- ▸ Map Navigation
- ▸ Basemap Options
- ▸ Map Layer Control
- ▸ Site Monitoring Information
- ▾ Wetland Site Comparison

[Add Extent on Map] [Clear Selections]

After clicking the above "Add Extent..." button, draw a rectangle over your area Of interest On the map To add sites To the list below. Repeat this process To add As many extents (rectangles) As you would Like, And Then compare the selected sites by clicking the "Compare Sites" button below.

Selected sites(14):

- Beaver Creek Wetland (69)
- Black Creek Wetland (79)
- Blind Sodus Bay Wetland (82)
- Deaborough Park Area Wetland (72)
- East Bay Wetland (66)

[Compare Sites]

Wetland Site Comparison

Select sites:

- ☑ Beaver Creek Wetland (69)
- ☑ Black Creek Wetland (79)
- ☑ Blind Sodus Bay Wetland (82)
- ☑ Deaborough Park Area Wetland (72)

[Select All] [Clear All]

[Update Table]

Site Comparison Table:

Site ID:	69	79	82	72	66	7027	92	62	70	76
Site Name:	Beaver Creek Wetland	Black Creek Wetland	Blind Sodus Bay Wetland	Deaborough Park Area Wetland	East Bay Wetland	East Sodus	Eighteenmile Creek Wetland	Maxwell Bay Wetland	Port Bay Wetland	Red Creek Wetland
Geomorph:	riverine	riverine	barrier (protected)	riverine	riverine	barrier (protected)	riverine	barrier (protected)	riverine	riverine
Year Last Sampled:	--	2014	2014	--	2016	2011	2011	2016	2015	2011
Fish IBI:		--	5: Reference Quality	--	5: Reference Quality	4: Mildly Impacted	5: Reference Quality	2: Moderately Degraded	5: Reference Quality	5: Reference Quality
Invert IBI:	--	--	--	--	--	--	--	--	--	--
Veg IBI:	--	2 - Low	2 - Low	--	2 - Low	2 - Low	2 - Low	2 - Low	2 - Low	2 - Low

[Close]

Compare site IBI scores for user-defined regions
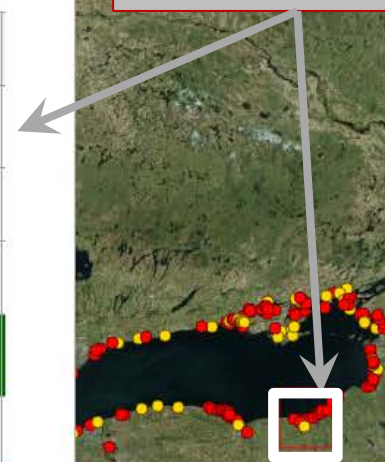
100 km

Wetland Site Reporting Tool
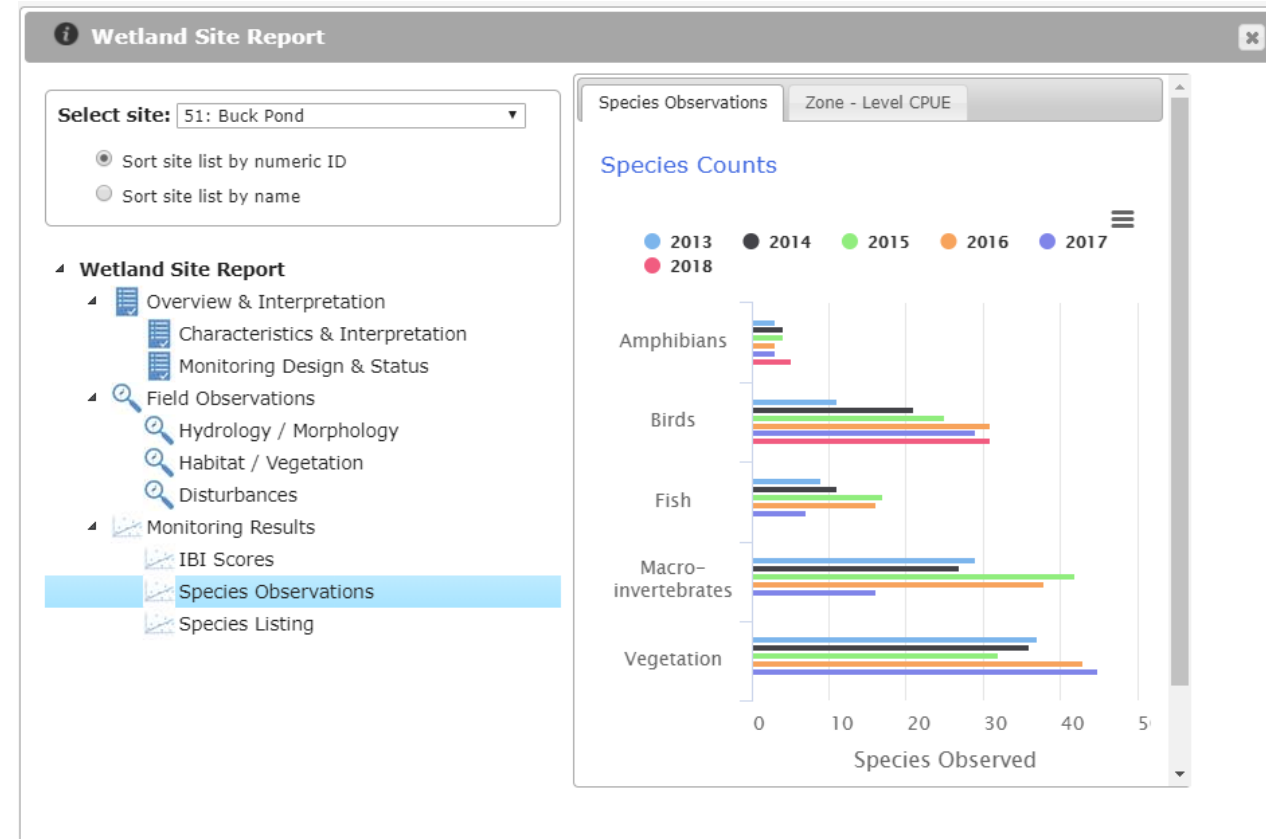

Site Reporting Tool:

- Generates 'on-the-fly' reports for any site

- "Tree" layout for navigation

- Site interpretive narratives to synthesize findings (*under development*)

- Visualization of IBI scores & species data

Site Reporting Tool – Monitoring Outcomes

Site-Level IBI Score Results
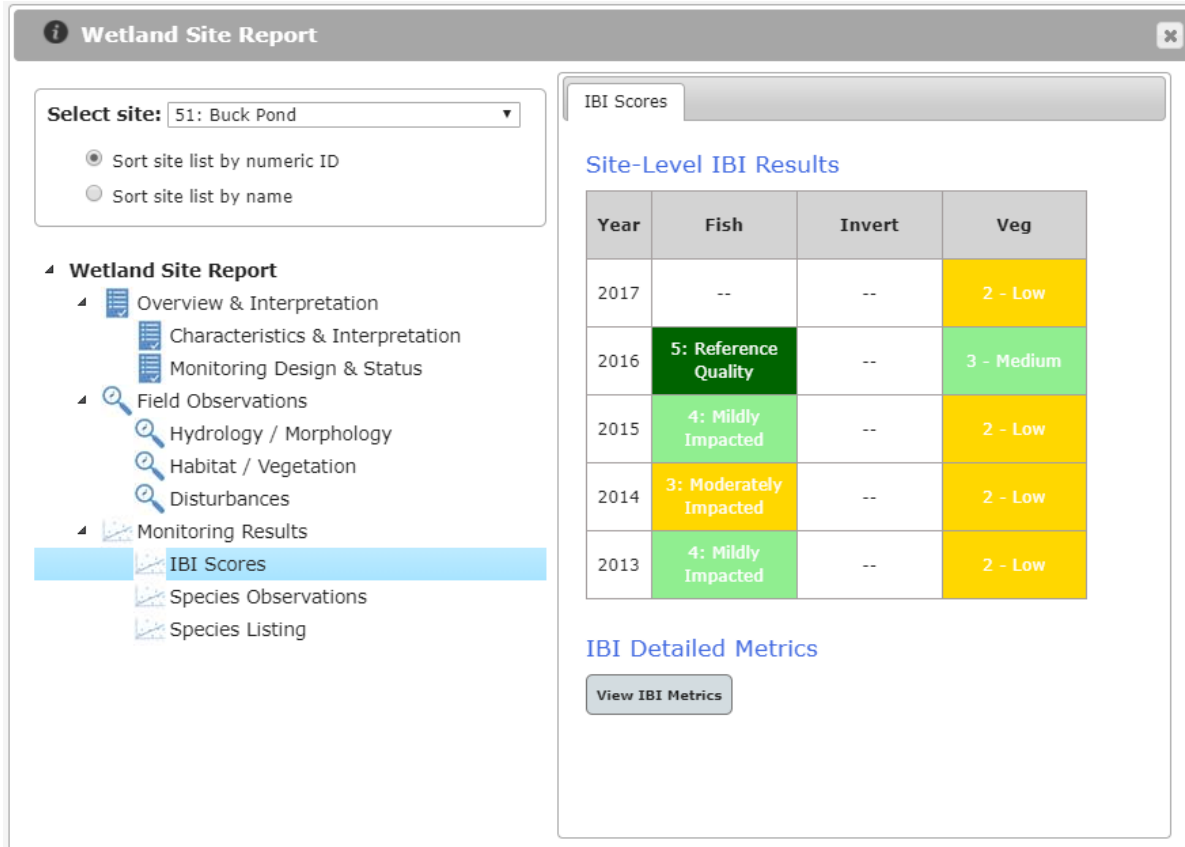
Species Counts by Monitoring Year

Coastal Wetland Decision Support Tool (CWDST)

Key Features:

- Provides coastal managers with tool to rank and prioritize sites

- Over 80 site attributes available for filtering/ranking

- Based on CWMP ecological datasets and GIS analyses

URL: http://www.greatlakeswetlands.org/DST

Coastal Wetland Decision Support Tool (CWDST)

**Supporting Datasets:**

- Wetland site delineations (polygons)

- Oblique aerial photos (USACE)

- Hydrologic disconnections & dike features

- Public & conservation lands

- Invasive *Phragmites* stands

URL: http://www.greatlakeswetlands.org/DST

Key Lessons Learned

1. Data management should be proactively planned and budgeted at program outset
   - Crucial to project efficiency, effectiveness, and ultimate success
   - Provides foundation to meet objectives
   - Especially critical for complex, diverse research programs

2. Centralized, web-based Data Management System provides significant advantages
   - Centralized storage → reduced risk of data loss / compromise
   - Streamlined data entry and validation
   - Tiered access to data products
   - "Real-time" accessibility of data
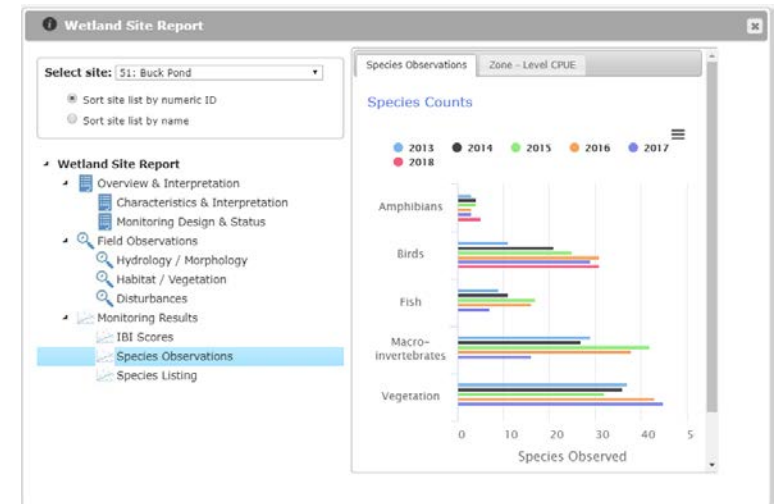
Key Lessons Learned (*continued*)

3. Decision support tools (DSTs) should be an integral component of large-scale monitoring efforts

   – Directly and efficiently support ecosystem management objectives

   – Web-based portal provides ideal platform

   – Can be conceptualized and implemented when "time is right"

     ▪ Build on foundation provided by DMS

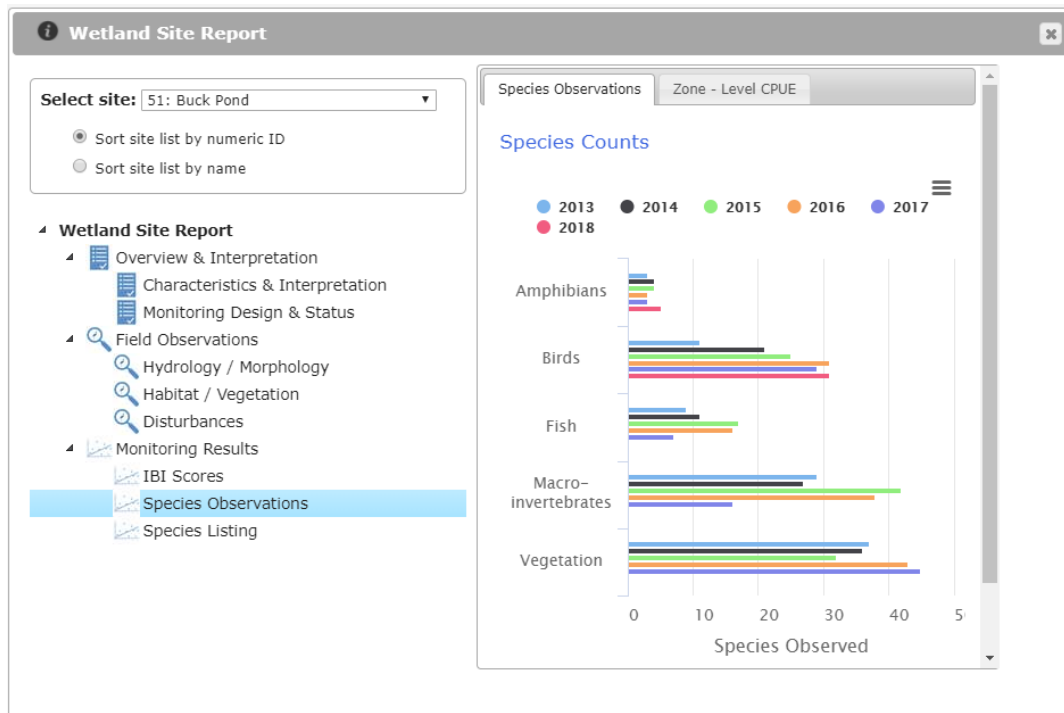   ▪ Ensure that sufficient resources are allocated for DST
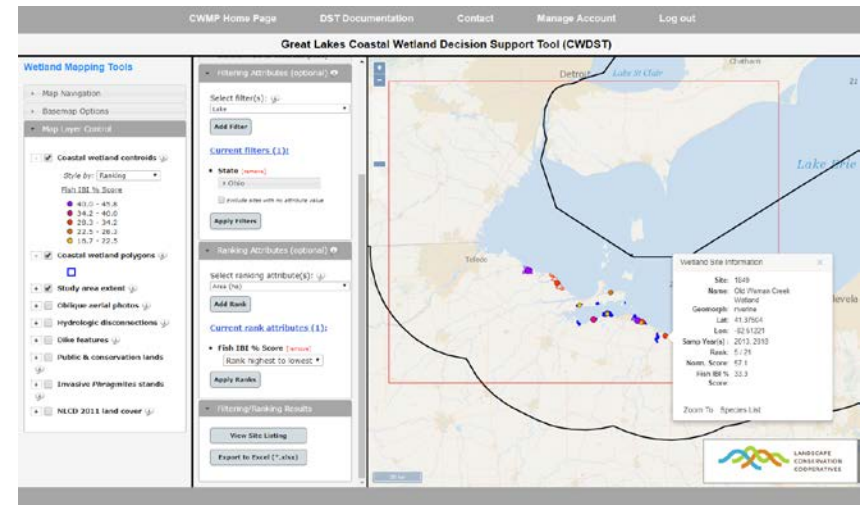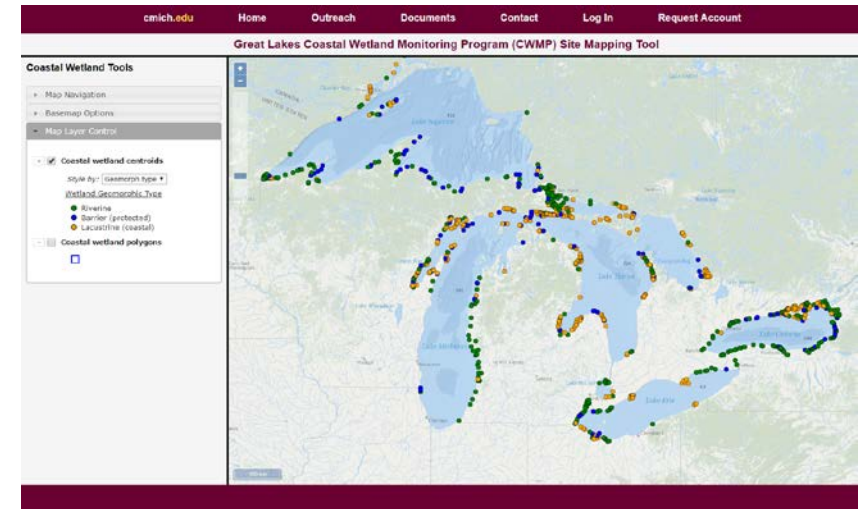
Questions?

Contact Information:

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Email: tredder@limno.com

Acknowledgements

- USEPA – Great Lakes National Program Office
- Central Michigan University
- General Dynamics Information Technology (GDIT)

CWMP Links:
- Site mapping tool:
  https://www.greatlakeswetlands.org/map

- Decision support tool:
  https://www.greatlakeswetlands.org/DST