Adaptability of Coastal Vegetation to Water Level Fluctuations in the Great Lakes

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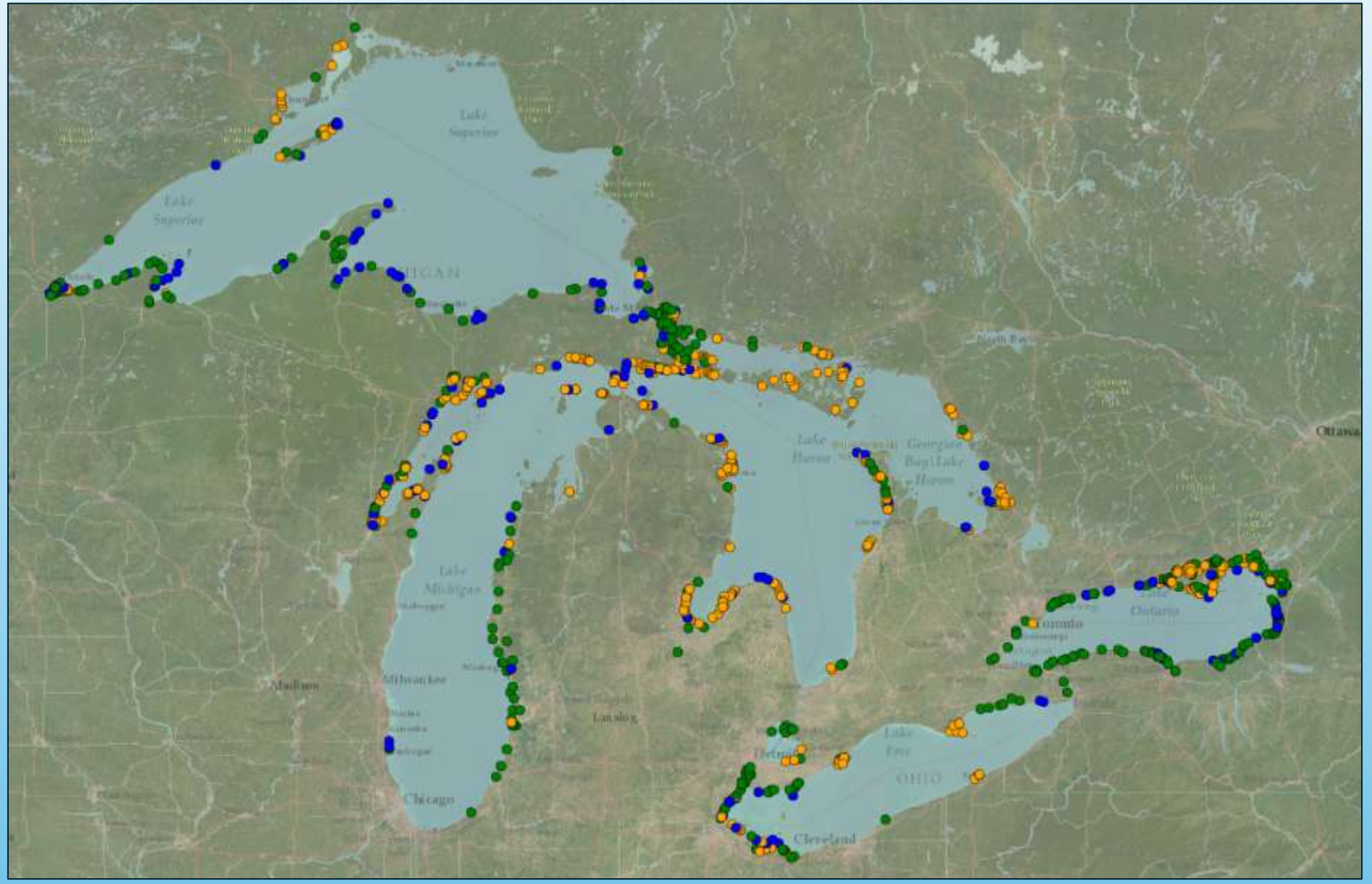
Great Lakes Coastal Wetland Monitoring Program

- Sample all coastal wetlands >4 hectares to track health and anthropogenic disturbance
- Multi-institutional
- Whole ecological perspective
  - Birds
  - Anurans
  - Fish
  - Macroinvertebrates
  - Water quality
  - Vegetation

Great Lakes Coastal Wetlands

- Characterized by having some hydrological connection to the GL
- Hydric soils
- Vegetation adapted to these conditions

Hydrogeomorphic Types



Hydrogeomorphic Types - Lacustrine

Lacustrine

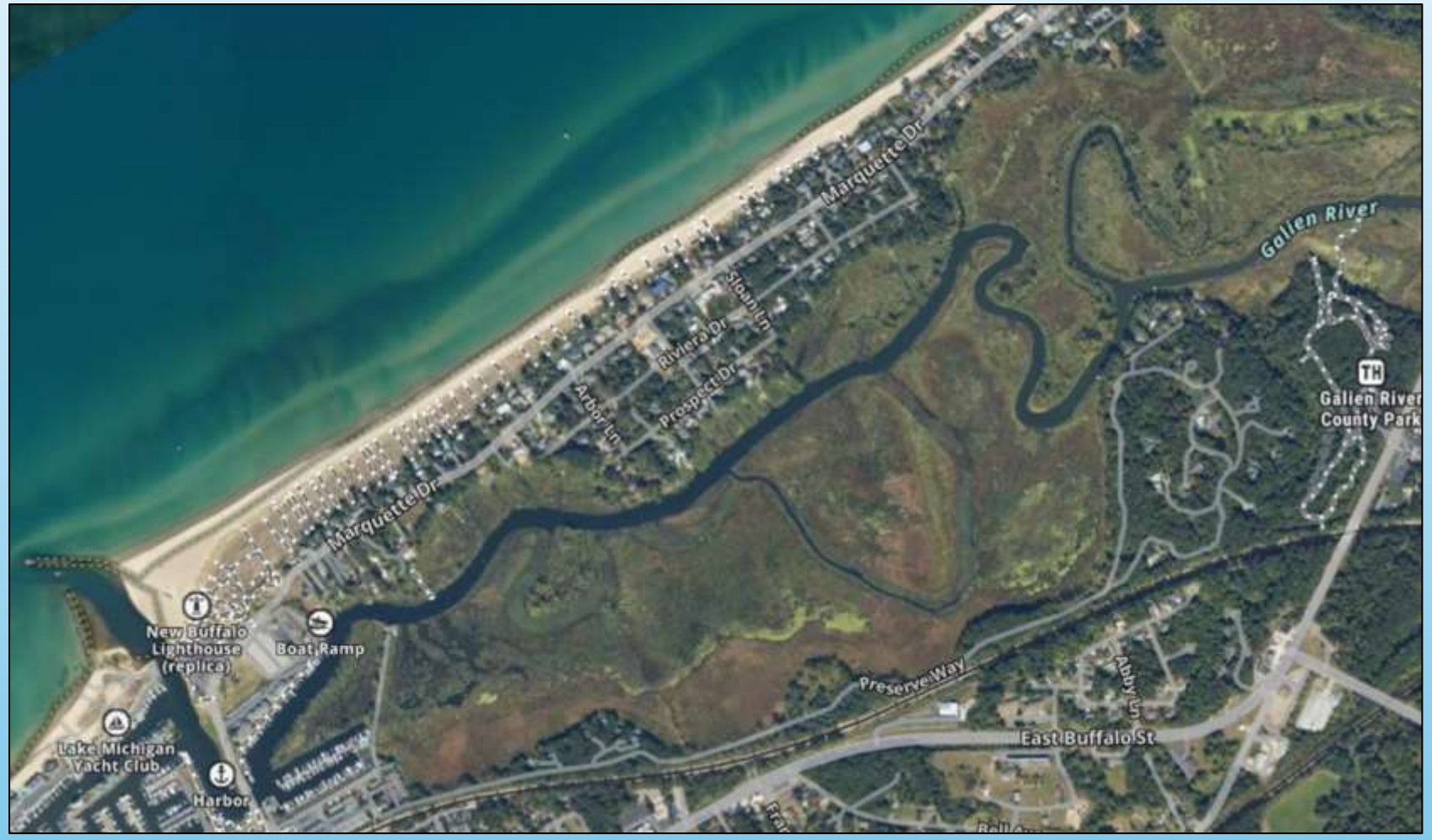
- Open influence from lake
- More wave energy
- Common in Saginaw Bay, Lake Erie, Les Cheneaux Islands

St. Ignace Wetland – St. Ignace, MI

Hydrogeomorphic Types - Riverine

Riverine

- Located along river associated with lake
- Seasonal flooding
- Thick organic matter
- Common on west side of Michigan as drowned-river mouths
- Detroit River and St. Mary's River = connecting channels, wetlands



Galien River – New Buffalo, MI

Hydrogeomorphic Types – Barrier-protected

Barrier-protected

- Located behind beach ridge
- Often connected to lake through small channel
- Common sandy shorelines especially Lake Superior
- Can become separated from lake entirely over time

Pointe Aux Chenes Marshes – Mackinac Co., MI

Vegetation Crew

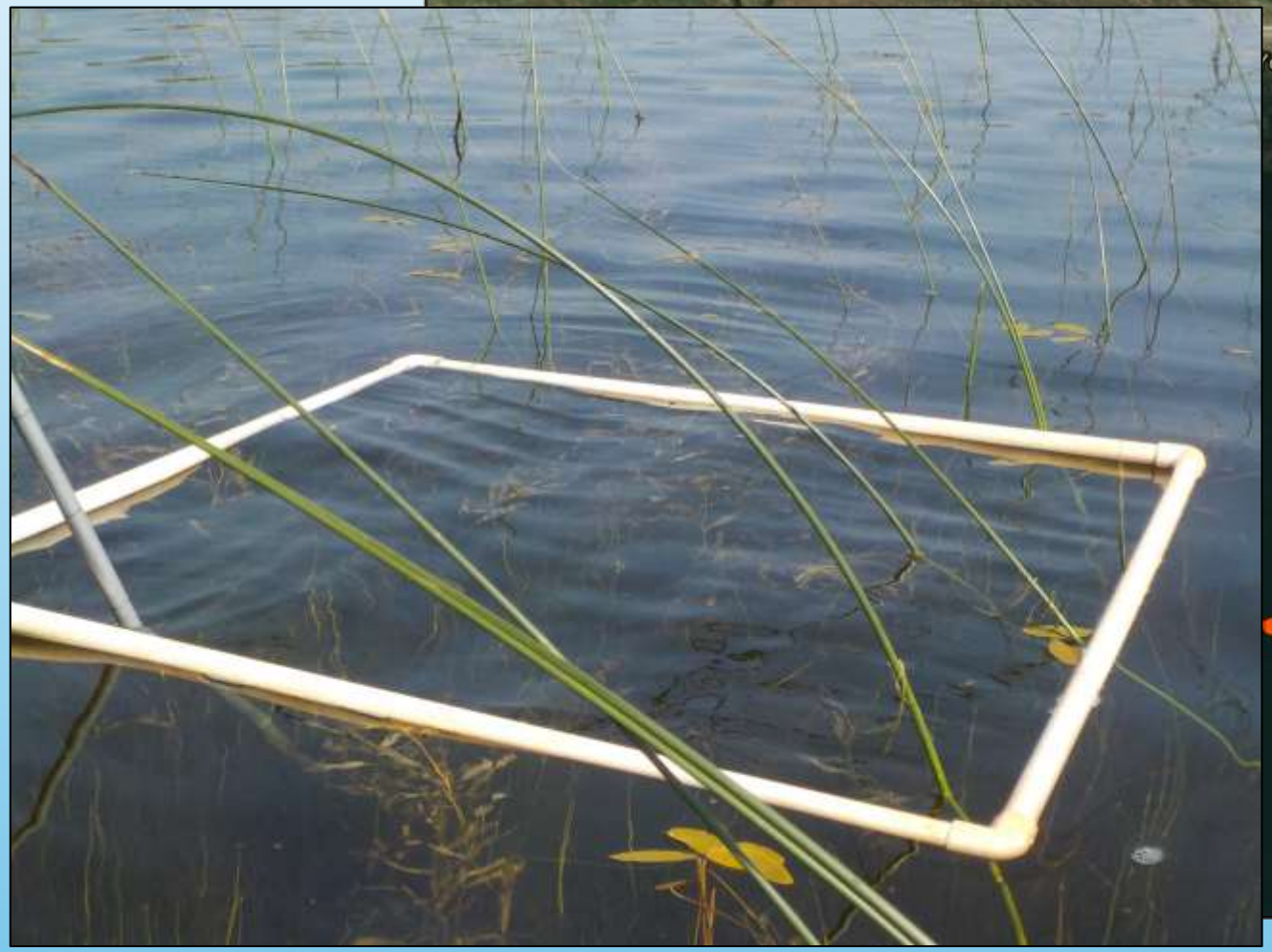
- Survey transects from upland -> open water
  - ID and quantify all species
- Broken into zones

Wet Meadow

- May or May not have standing water, but definite hydric soils
- Dominated by:
  - Sedges (*Carex, Cyperus, Scirpus spp.)*
  - Grasses (*Calamagrostis, Phalaris, Glyceria, Leersia oryzoides etc.*)
  - Forbs (*Eupatorium, Eutrochium, Solidago, Mentha, Urtica dioica* etc.)
  - Some shrubs (*Myrica, Spiraea, Cephalanthus, Alnus spp.* etc.)

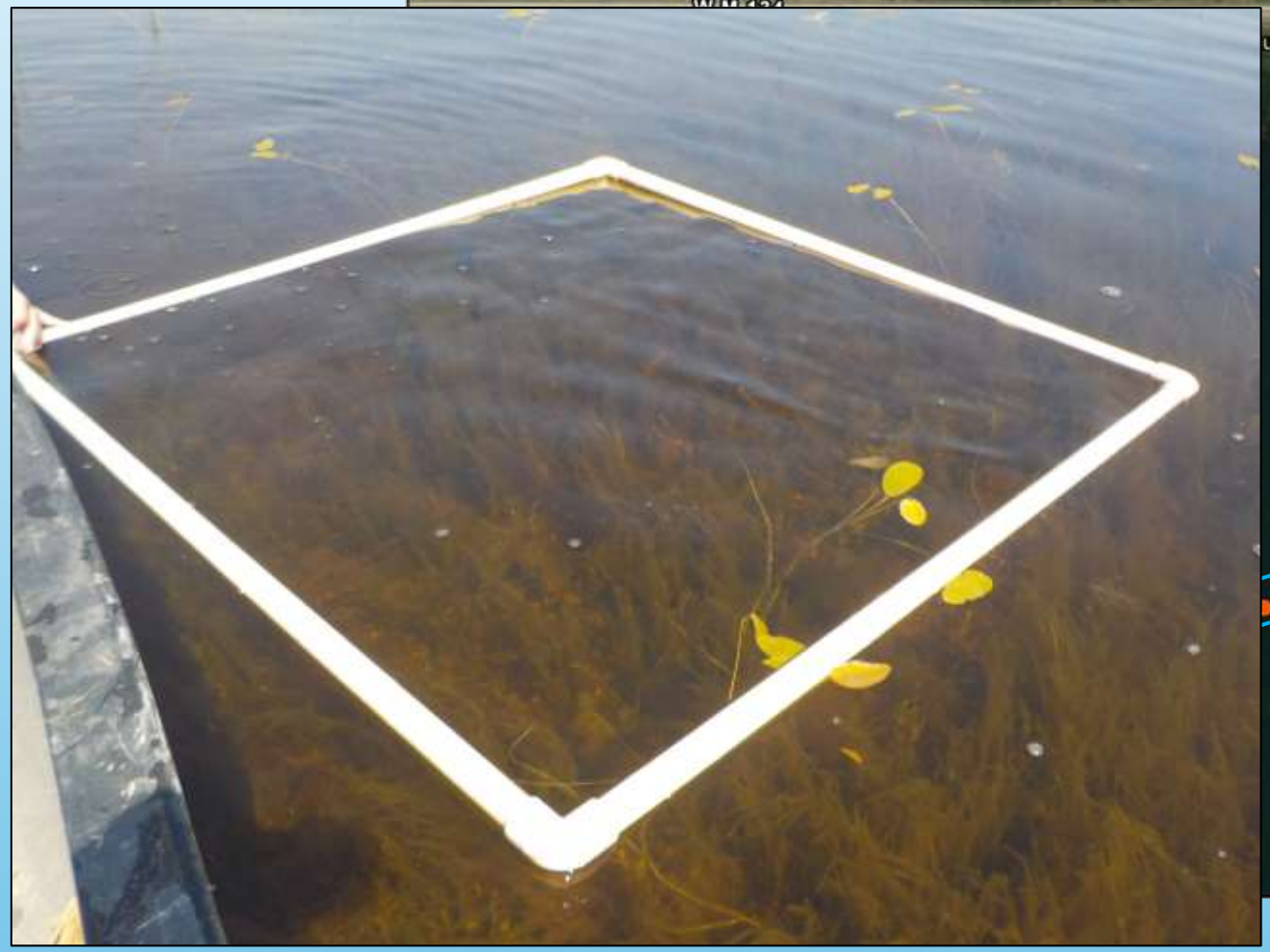
Mackinaw Creek Wetland - Hessel, MI

Emergent Marsh



- Often with persistent standing water
- Characterized by:
  - Rushes (*Schoenoplectus, Eleocharis, Juncus spp.)*
  - Cattail family (*Typha* and *Sparganium spp. etc.*)
  - Reed grass (Native and invasive *Phragmites*)
  - Arrowheads, pickerel weed (*Sagittaria, Peltandra, Pontederia spp.)*

Submergent (SAV)

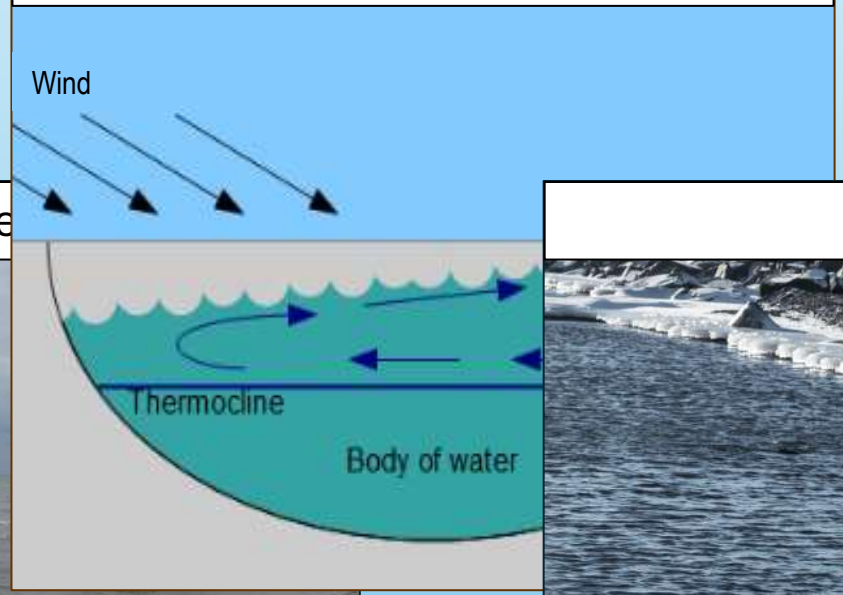


- Too deep for emergent vegetation
- Can persist through an entire lake as long as vegetation is present
- Characterized by:
  - Lillies (*Nuphar, Nymphaea, Nelumbo lutea)*
  - Pondweeds (*Potamogeton, Stuckenia* spp.)
  - Milfoil (*Myriophyllum* spp.)
  - Others (*Najas, Vallisneria, Utricularia, Elodea* spp.)

Disturbance

Natural disturbance can promote diversity – Intermediate Disturbance Hypothesis (Joseph H. Connell 1978)

Seiches

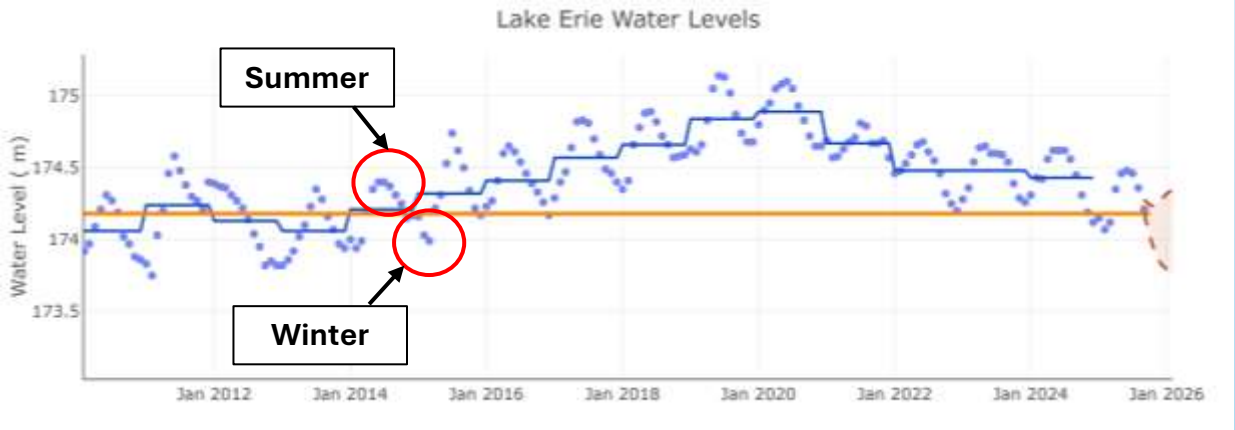


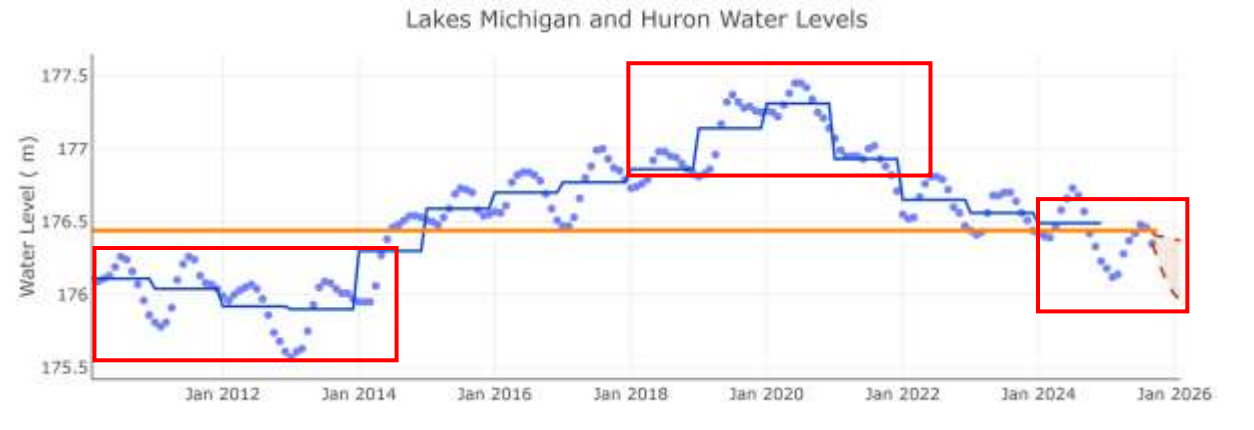
Wave Ene

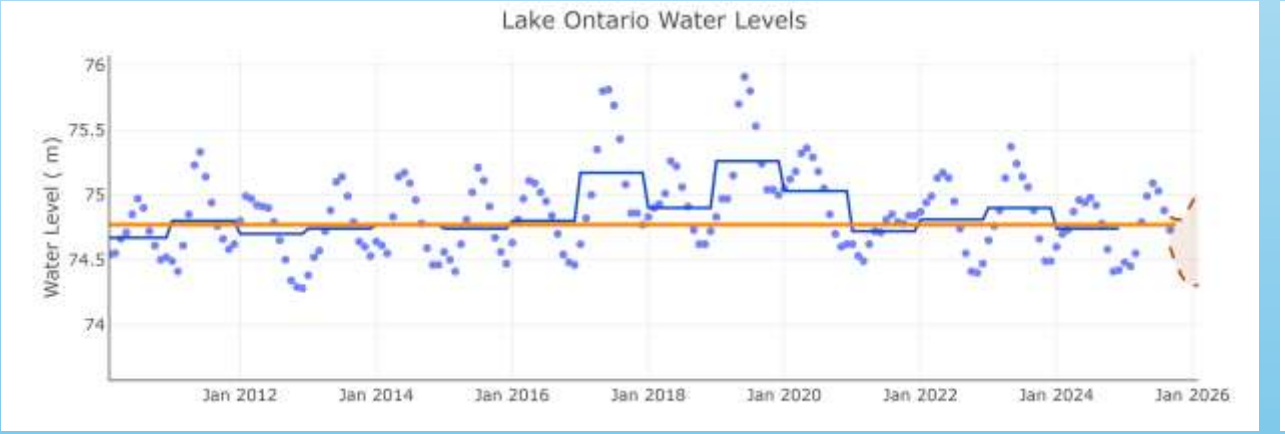
Ice Scou

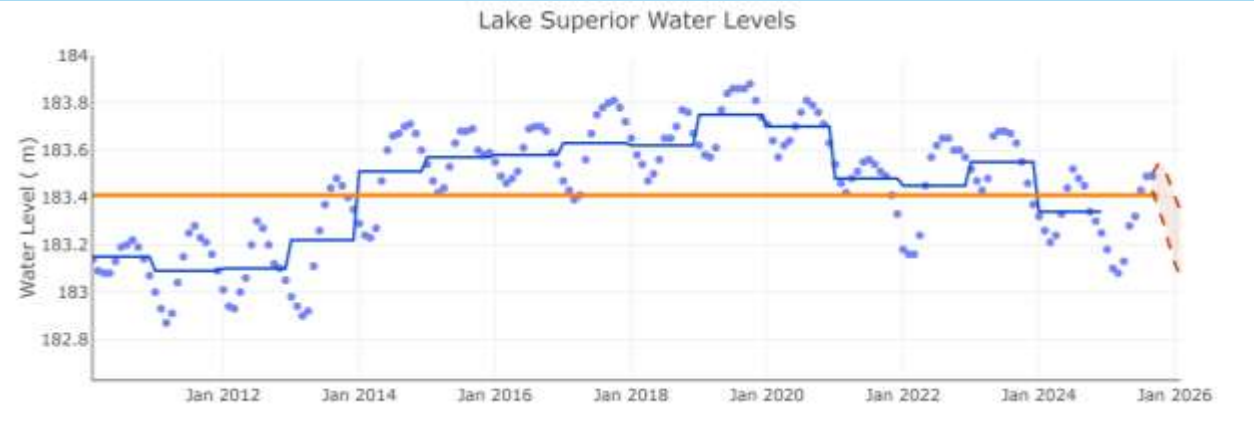
Water level fluctuations

High vs. Low water years



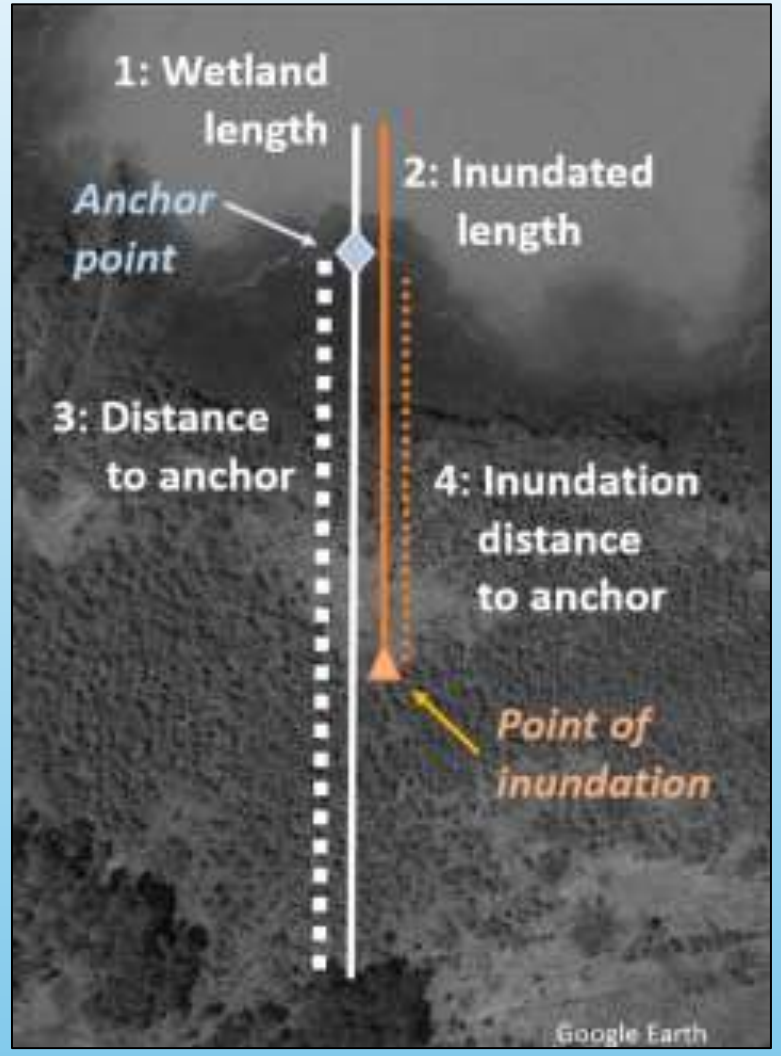






Wetland extent and zonation

- Wetland length found to decrease from low (2011-2014) to high water years (2016-2019)
- Wet meadows saw greatest loss, SAV had the least
- Lacustrine and Riverine wetlands saw landward migration of start points, barrier-protected did not



Anderson et al. 2023

Effects on wetland communities

- High water pushes back medium-high elevation species, woody and invasives
  - Includes many wet meadow species
- Low water enables germination & re-establishment of plant communities

Grabas and Rokitnicki-Wojcik, 2015; Keddy and Reznicek, 1986; Thorne et al. 2018; Wilcox, 2004

Our Observations: High water

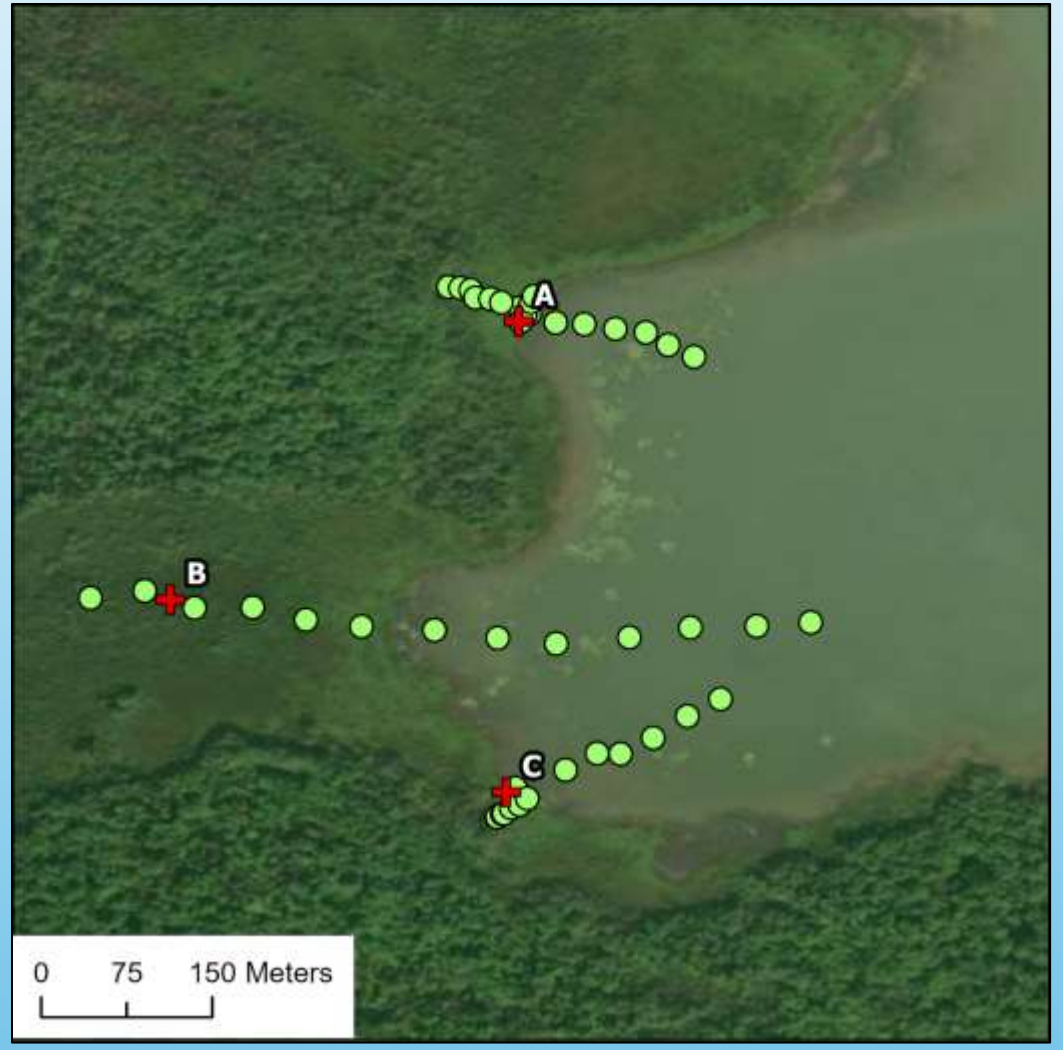
Fewer zones were present, wet meadows washed out, some invasives affected

Eagle Bay – Lake Huron 2020

Lime Island – St. Mary's River 2020

Our Observations: High water

- Forested areas flooded out and became wet meadows with dead trees
- Start points pushed landward



Our Observations: Post High water

Re-establishment of meadows, especially along emergent edge, high diversity

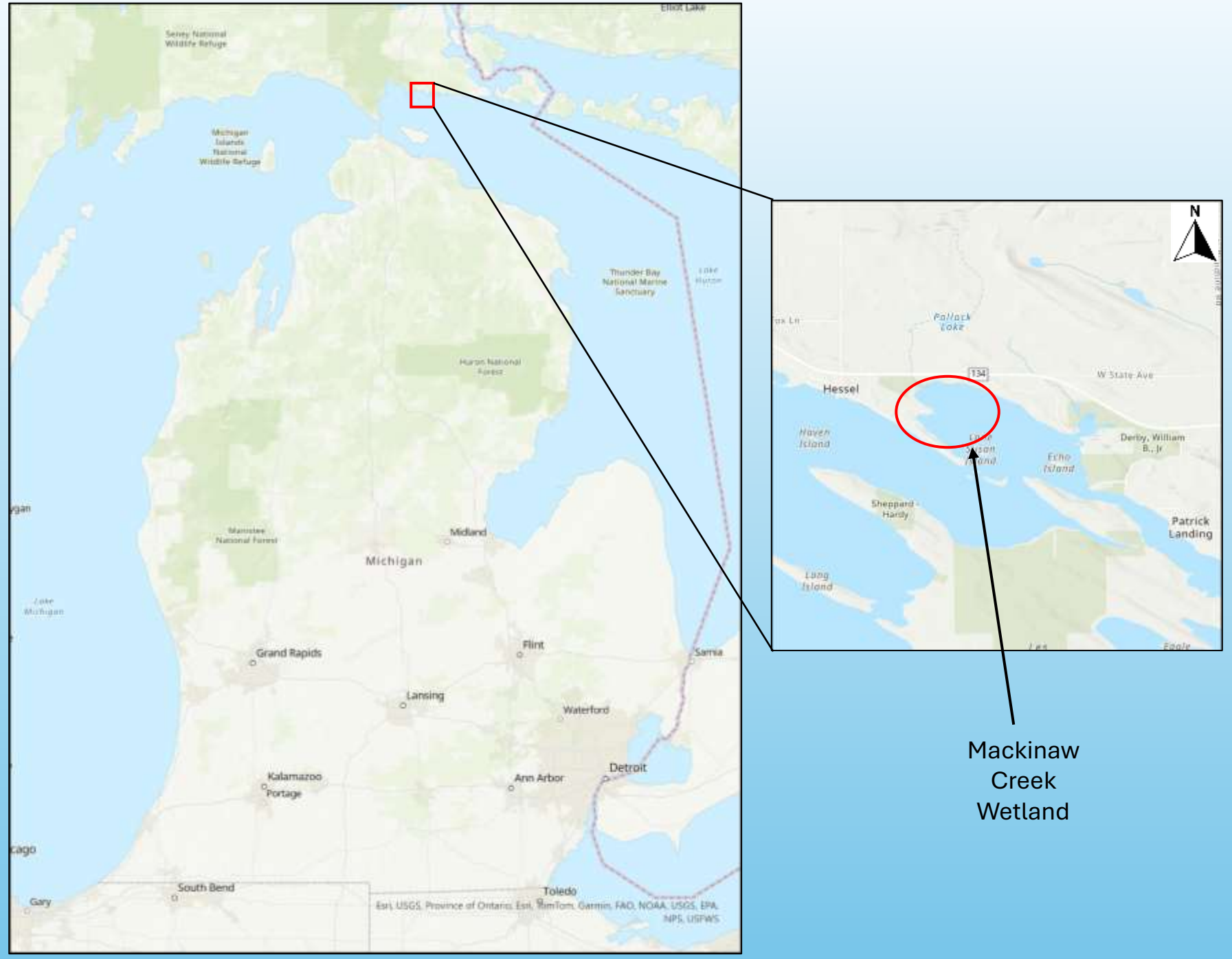
Hughes point – Lake Michigan 2023

Beavertail Bay – Lake Huron 2025

Indian Harbor Wetland

Indian Harbor Wetland

2012	2019	2024
Meadow = 43 species	Meadow = 22 species	Meadow = 64 species
Most common: Blue-joint grass Water sedge Beak rush	**Most common:** Wooly-fruited sedge Tussock sedge Small bladderwort	**Most common:** Blue-joint grass Tussock sedge Wooly-fruited sedge
Emergent = 3 species* (2 zones)	Emergent = 20 species	Emergent = 27 species
Most common: Three-square bulrush Wooly-fruited sedge Common spikerush	**Most common:** Common bladderwort Yellow pond-lily Wooly-fruited sedge	**Most common:** Giant bur-reed Hard stem bulrush Broadleaf cattail
Submergent = 8 species	Submergent = 2 species* (1 zone)	Submergent = 13 species
Most common: Sago pondweed Slender naiad Swaying bulrush	**Most common:** Algae/Chara	**Most common:** Yellow pond-lily Floating pondweed Variable-leaf pondweed


Michigan
Midland
Grand Rapids
Flint
Lansing
Waterford
Detroit
Ann Arbor
Kalamazoo
Portage
South Bend
Gary
Toledo
Sarnia
Hessel
Pallack Lake
W State Ave
Haven Island
Derby, William B., Jr
Echo Island
Sheppard Hardy
Patrick Landing
Long Island
N
Mackinaw Creek Wetland

Mackinaw Creek Wetland

2012	2019	2024
Meadow = 49 species	Meadow = 17 species* (2 zones)	Meadow = 48 species
Most common: Tussock sedge Blue-joint grass Water sedge	**Most common:** Tussock sedge Blue-joint grass Small bladderwort	**Most common:** Tussock sedge Reed canary grass Blue-joint grass
Emergent = 19 species	Emergent = 19 species* (2 zones)	Emergent = 19 species
Most common: Swaying bulrush Hard stem bulrush Tussock sedge	**Most common:** Swaying bulrush Northern water milfoil Small bladderwort	**Most common:** Swaying bulrush Narrowleaf cattail Northern water milfoil
Submergent = 11 species	Submergent = 18 species	Submergent = 14 species
Most common: Swaying bulrush Slender naiad Illinois pondweed	**Most common:** Swaying bulrush Northern water milfoil Variable-leaf pondweed	**Most common:** Swaying bulrush Slender naiad Small bladderwort

Species adaptations

Tussock formation
Tussock sedge
(*Carex stricta)*

Rhizomes
Blue-joint grass
(*Calamagrostis canadensis)*

Long slender leaves
Swaying bulrush
(*Schoenoplectus subterminalis)*

Species adaptations

Aerenchyma
Hard stem bulrush
(*Schoenoplectus acutus*)

Floating leaves
Yellow pond lily
(*Nuphar variegata*)

Floating plant
Small bladderwort
(*Utricularia minor*)

Species adaptations

Variable growth forms
Variable leaf pondweed
(*Potamogeton gramineus)*

Other notable species


Sweet gale (*Myrica gale)*


Blueflag iris
(*Iris virginica/versicolor)*


Common spikerush
(*Eleocharis palustris)*


Boneset (*Eupatorium perfoliatum)*


Water smartweed
(*Persicaria amphibia)*

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Thank you!

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