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Assessing Coastal Wetland Habitat Condition on the Canadian side of the St. Marys River Area of Concern

St Marys River AOC BPAC Meeting - June 17, 2015

Angela Darwin
Canadian Wildlife Service

Presentation Overview

- Loss of Fish and Wildlife Habitat BUI Delisting Criteria
- Coastal Wetlands
  - Site Selection
- Survey Methods
- Index of Biotic Integrity
- Results
- Next Steps

Loss of Fish and Wildlife Habitat

- BUI currently listed as Impaired
- Delisting Criteria
- This beneficial use will no longer be impaired when:
  - i) coastal wetland wildlife habitat conditions within the Area of Concern are comparable to those of suitable reference sites, as assessed using an index of biotic integrity;
  - ii) rapids habitat conditions are enhanced through feasible conservation and restoration measures identified in the Stage 2 Remedial Action Plan; and
  - iii) the closely linked “Degradation of Fish Populations” BUI is no longer deemed impaired.

Why look at coastal wetlands?

- Great Lakes coastal wetlands provide many important functions including
  - storage and cycling of nutrients and organic materials carried by rivers and streams to the Lakes
  - food web production and biological productivity
  - groundwater recharge
  - habitats for a wide range of Great Lakes species
    - Macroinvertebrates cycle nutrients through the system by breaking down coarse vegetation and are food for fish and birds.
    - Majority of Great Lakes fish spend some part of their life cycle in Great Lakes coastal wetlands.
    - Birds, reptiles and amphibians use coastal wetlands as resting, feeding and nesting habitat.

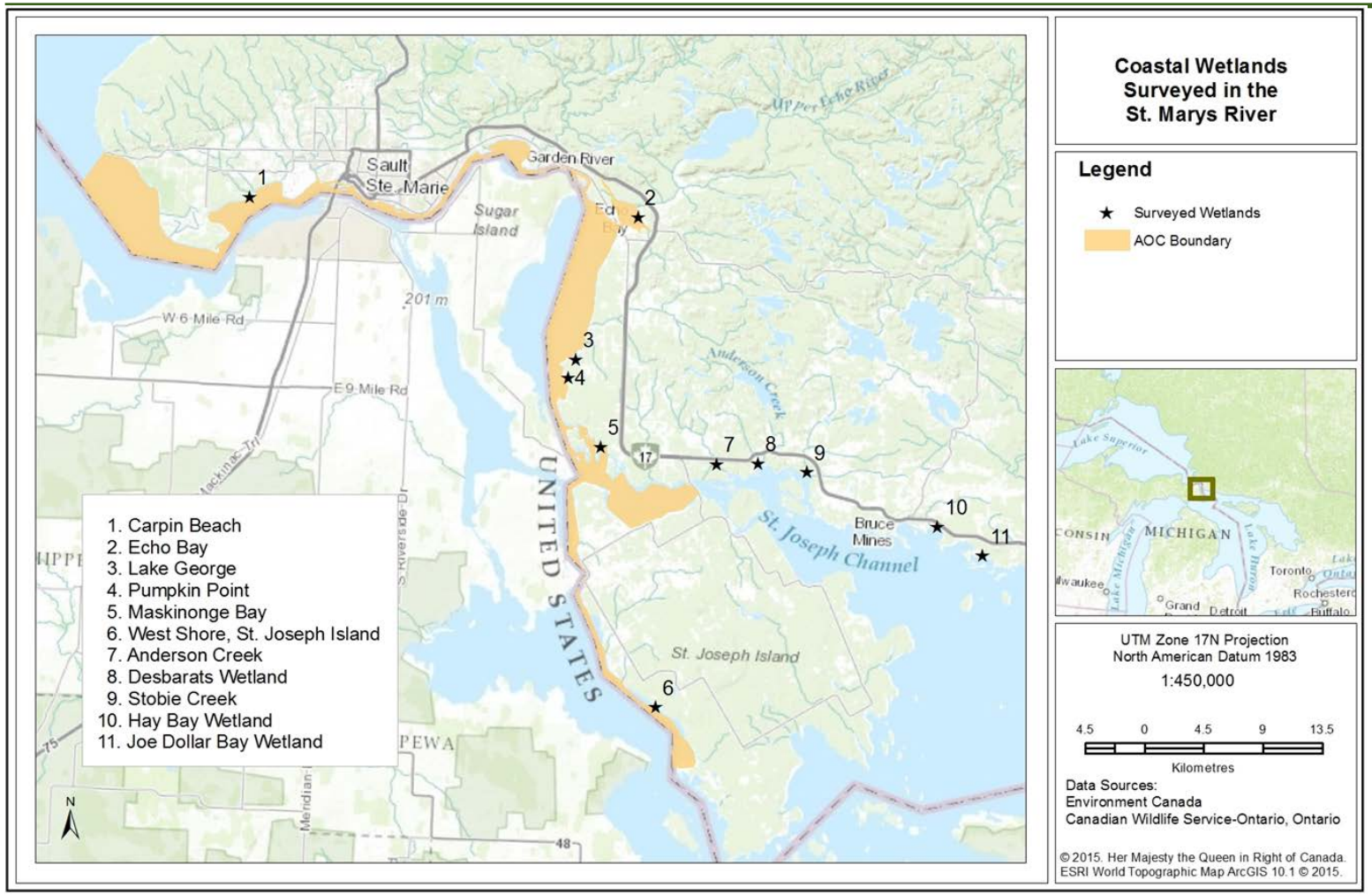
St. Marys River Coastal Wetlands

- There are many coastal wetlands in the St. Marys River
  - Range in size from <10 ha to over 500 ha
- Cannot survey all of them - selection criteria
  - Sites larger than 10 hectares (sites need to be large enough to support the sampling methodologies),
  - Sites representative of the geomorphic types (e.g., open embayment) and sizes of coastal wetlands present in the area,
  - Sites that collectively provide a geographic spread throughout the entire AOC, and
  - Sites that are accessible for surveys (e.g., if private, where landowner permission can be obtained or where access points are available close enough to the wetlands for surveys).

St. Marys River Coastal Wetlands

- 8 AOC and 4 non-AOC sites were initially selected in 2012 however not all could be surveyed (no access found) while others were not suitable for coastal wetland surveys
- As a result
  - 6 AOC and 4 non-AOC sites were partially surveyed in 2012 (scoping year)
  - 6 AOC and 4 non-AOC sites were fully surveyed in 2013 with a 5th non-AOC site partially surveyed (late addition)
  - All 6 AOC and 5 non-AOC sites were fully surveyed in 2014 and are planned for survey in 2015

St. Marys River – selected sites



Survey Methods

- Built on existing coastal wetland monitoring
  - **Water Quality** – water quality probe samples, 3-6 replicates
  - **Breeding Birds** – point counts, 3 visits per station
  - **Submerged Aquatic Vegetation** – 20 randomly placed 1 x 1 m quadrats; total cover and species-specific cover recorded
  - **Macroinvertebrates** – sweep net samples, 3 replicates of 150 inverts each; identified to lowest taxonomic group possible
  - **Amphibians** – point counts, 3 visits per station

Example of Sampling Locations

Survey Timing

Marsh Bird

Visit 1 early June

Visit 2 late June

Visit 3 early July

Amphibians

Visit 1 early May

Visit 2 early June

Visit 3 late June

Water Quality, SAV, Macroinvertebrates

Early/mid July

Lake George Coastal Wetland Sampling Stations in 2014

Sampling Locations

- Macroinvetebrate Stations
- Marsh Bird Survey Stations
- Water Quality Stations
- Amphibian Survey Stations
- Submerged Aquatic Vegetation Quadrats

UTM Zone 16N Projection
North American Datum 1983

1:15,000

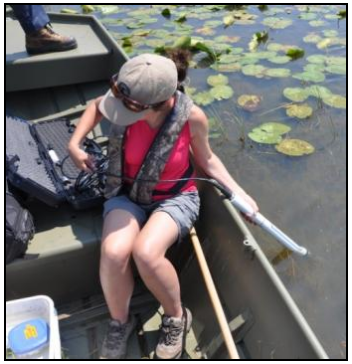
150 0 150 300 450

Metres

Data Sources:
Environment Canada
Canadian Wildlife Service-Ontario
Ontario Ministry of Natural Resources and Forestry

Water Quality

- At six stations in wetland:
  - pH, conductivity [µS/cm], temperature [°C], and turbidity [NTU] reading were taken using a multi-probe at mid-depth of the water column adjacent to emergent vegetation
- At four of the stations:
  - Sample collected for determination of Total Phosphorus
  - A composite water (combined for 4 stations) for determination of Total Nitrate Nitrogen and Total Ammonia Nitrogen



Results – Water Quality

Wetland Name	NH_3-N (mg/L)			NO_3-N (mg/L)			TP (mg/L)		
	*2012**	*2013*	*2014*	*2012**	*2013*	*2014*	*2012*	*2013*	*2014*
AOC sites									
Carpin Beach	0.03	0.04	0.04	0.13	0.16	0.18	0.02	0.02	0.02
Echo Bay	0.00	0.02	0.01	0.15	0.02	0.03	0.02	0.03	0.02
Lake George	0.03	0.02	0.01	0.05	0.06	0.10	0.04	0.03	0.02
Pumpkin Point	0.06	0.02	0.01	0.03	0.05	0.25	0.03	0.03	0.02
Maskinonge Bay	0.02	0.01	0.04	0.10	0.01	0.06	0.18	0.17	0.22
West Shore, St. Joseph Island	0.01	0.03	0.01	0.10	0.03	0.18	0.03	0.04	0.04
Non-AOC sites									
Anderson Creek	-	0.03	0.01	-	0.05	0.20	-	0.05	0.02
Desbarats Wetland	0.00	0.02	0.01	0.16	0.05	0.08	0.04	0.03	0.02
Stobie Creek	0.00	0.02	0.08	0.15	0.03	0.13	0.04	0.03	0.01
Hay Bay Wetland	0.08	0.02	0.02	0.05	0.12	0.24	0.02	0.03	0.02
Joe Dollar Bay Wetland	0.00	0.02	0.03	0.18	0.04	0.09	0.02	0.02	0.01

**methods in 2012 differ from methods used in 2013 and 2014*

TP=Total Phosphorus
NH_3-N=Total Ammonia Nitrogen
NO_3-N = Total Nitrate Nitrogen.

Results – Water Quality

Wetland Name	Turbidity (NTU)			Conductivity (µS/cm)			Water Temp (°C)			pH		
	2012	2013	2014	2012	2013	2014	2012	2013	2014	2012	2013	2014
AOC sites												
Carpin Beach	6.3	7.2	5.7	130.5	125.5	110.0	23.4	18.6	18.0	7.33	7.16	7.32
Echo Bay	4.5	8.9	7.2	115.2	84.8	84.2	25.7	22.0	21.0	8.46	8.25	7.29
Lake George	50.6	38.7	14.3	150.0	129.1	111.8	23.5	21.7	19.0	7.82	7.68	7.29
Pumpkin Point	51.3	44.9	16.5	123.1	116.9	94.0	29.1	26.7	18.4	9.13	9.02	8.09
Maskinonge Bay	1.7	1.6	2.9	110.3	105.8	106.8	24.0	24.7	18.4	8.46	8.04	7.64
West Shore, St. Joseph Island	37.9	69.3	137.1	190.0	164.9	136.2	22.9	22.7	17.1	8.46	8.11	7.88
Non-AOC sites												
Anderson Creek	-	12.8	6.6	-	133.8	120.3	-	21.8	17.5	-	7.43	7.67
Desbarats Wetland	3.2	3.6	3.2	129.3	99.3	99.5	25.5	22.9	19.0	8.09	8.04	7.46
Stobie Creek	2.5	2.8	2.8	152.8	113.6	98.8	30.7	25.5	17.5	9.23	9.12	7.36
Hay Bay Wetland	31.9	19.2	12.2	195.1	135.0	129.5	24.3	25.6	16.2	8.19	8.58	7.73
Joe Dollar Bay Wetland	8.8	2.3	2.4	156.1	135.1	133.5	26.4	25.2	19.2	8.35	8.24	7.60

Water Quality Index (WQI)

- Developed for use in all Great Lakes coastal wetlands
- Index uses parameters of turbidity, conductivity, temperature, and pH.
- Values range from -3.00 to +3.00; higher values indicate better water quality

Results – Water Quality Index

	WQI				
	2012	*2013*	*2014*	*Mean*	*Descriptor**
AOC sites					
Carpin Beach	0.55	0.69	0.92	**0.72**	Good
Echo Bay	0.63	0.56	0.86	**0.68**	Good
Lake George	-0.85	-0.51	0.33	**-0.34**	Moderately degraded
Pumpkin Point	-1.03	-0.84	0.28	**-0.53**	Moderately degraded
Maskinonge Bay	1.30	1.36	1.28	**1.31**	Very good
West Shore, St. Joseph Island	-0.90	-1.11	-1.15	**-1.05**	Very degraded
Non-AOC sites					
Anderson Creek	-	0.15	0.74	**0.45**	Good
Desbarats Wetland	0.79	0.99	1.26	**1.01**	Very good
Stobie Creek	0.56	0.85	1.42	**0.94**	Good
Hay Bay Wetland	-0.82	-0.36	0.38	**-0.27**	Moderately degraded
Joe Dollar Bay Wetland	0.01	0.97	1.22	**0.73**	Good

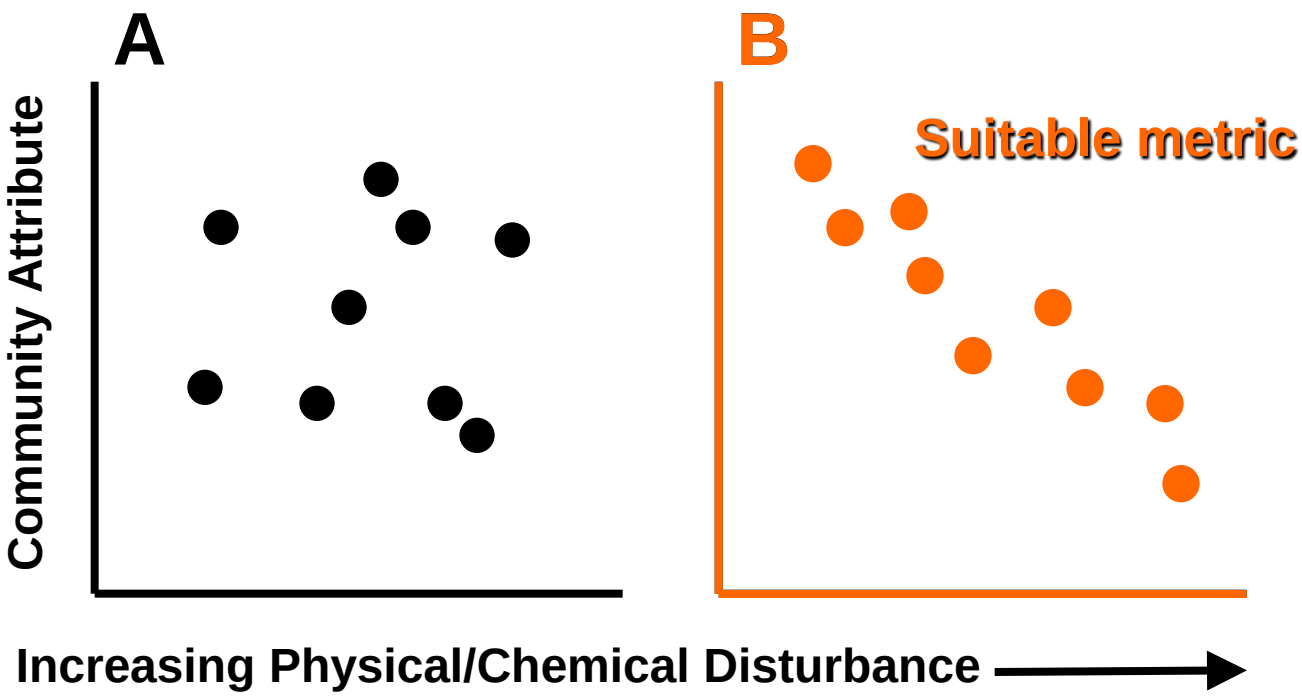
WQI Score	Qualitative Descriptor
+3 to +2	Excellent
+2 to +1	Very good
+1 to 0	Good
0 to -1	Moderately degraded
-1 to -2	Very degraded
-2 to -3	Highly degraded

Chow-Fraser (2006)

Definition of an Index of Biotic Integrity

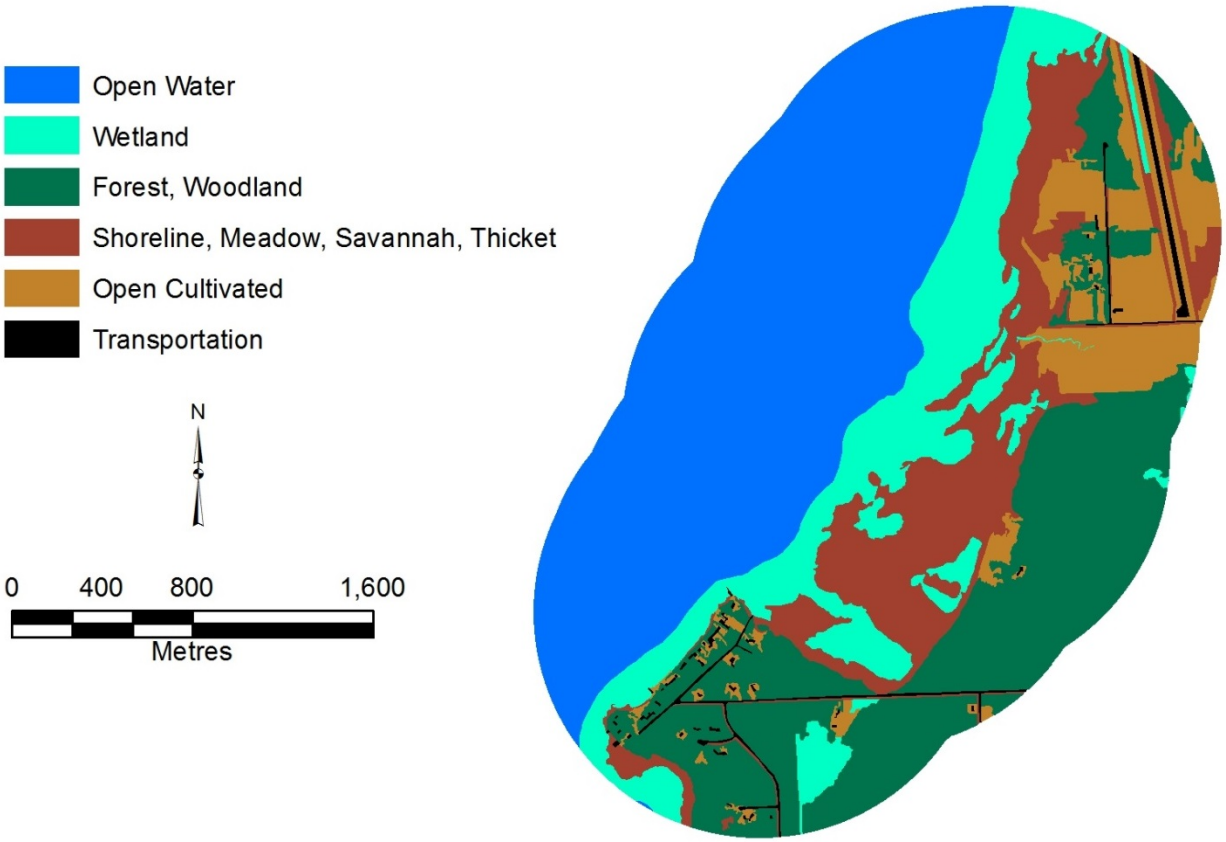
A multimetric index indicating the ability of a habitat to support and maintain a balanced, integrated, adaptive biological system having the full range of elements expected in a region’s natural habitat.

How are indices developed?



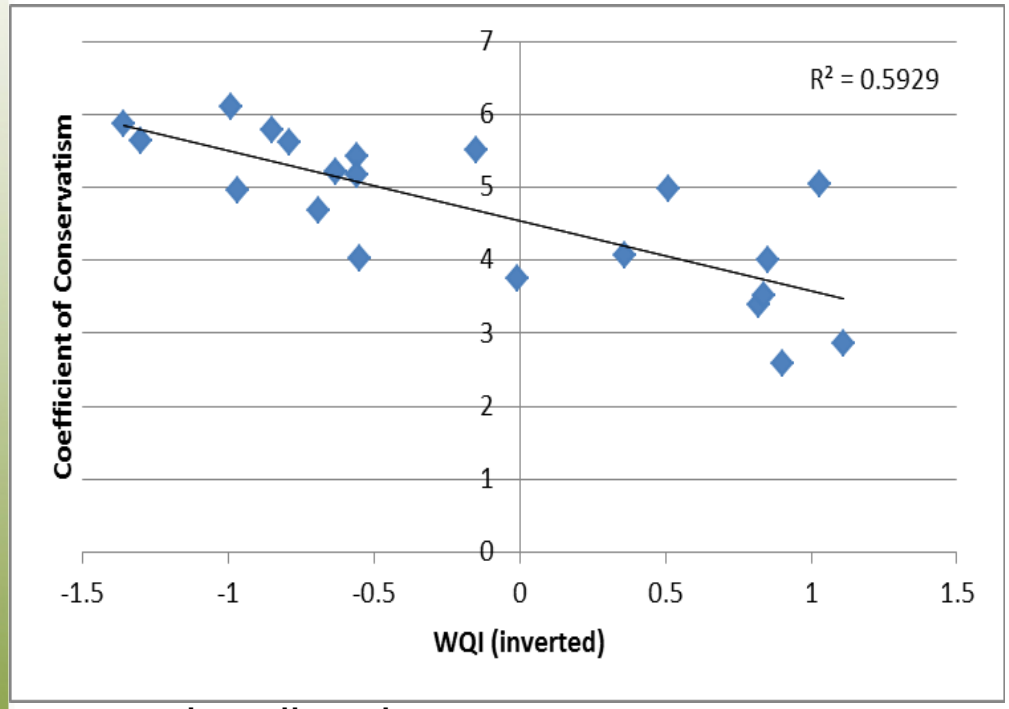
Landscape and Site Variables are Used in Disturbance Gradient

Disturbance Variable
Water Quality Variables: Turbidity, Conductivity, Water Temperature, Total Phosphorus
Landscape Attributes: % Disturbed, % Natural, % Marsh, % Swamp, % Floating/SAV
Water Quality Index
Geomorphology Index



Land use within 1,000 metres of sample stations in Lake George Wetland

Use Disturbance to Determine Suitability of Metrics



Increasing disturbance →

- When there is a significant relationship between metric and disturbance, it is a suitable metric
- Metrics get scored (Standardized)
  - Each metric is out of 10
  - Based on upper and lower values of distribution

- Use several metrics to define condition of biotic communities

Metric

Metric

Index of Biotic Integrity (IBI)

Metric

Metric

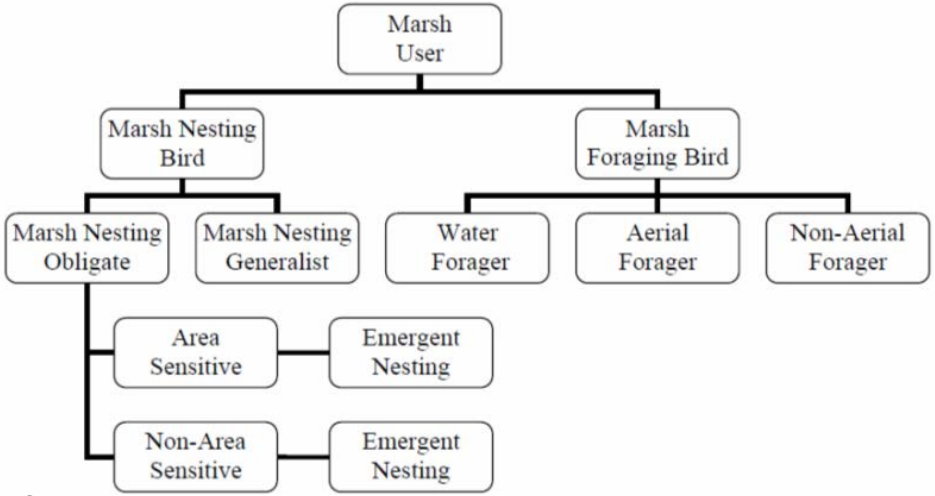
IBI scores range from 0 (worst) to 100 (best)

Results to date - caveats

- All presented Index of Biotic Integrity (IBI) values are potential values
  - An additional year of survey data is required to validate the results
- In some instances there is more than one potential IBI (based on different disturbance gradients); for simplicity only one is presented (results are often similar)

Marsh Birds

- Marsh birds are divided into categories based on marsh use
  - Species such as Red-winged Blackbird are marsh nesting generalists whereas species such as Swamp Sparrow are marsh nesting obligates
  - Black Tern, American Bittern and Least Bittern are examples of areas sensitive emergent marsh nesting obligates



Results – Marsh Birds

Wetland Name	Four-metric IBI			
	2012	*2013*	*2014*	***Mean***
AOC sites				
Carpin Beach	-	0.0	6.3	**3.1**
Echo Bay	100.0	45.4	91.7	**79.0**
Lake George	20.3	47.3	100.0	**55.9**
Pumpkin Point	-	6.3	12.5	**9.4**
Maskinonge Bay	15.6	15.6	21.9	**17.7**
West Shore, St. Joseph Island	-	10.4	12.5	**11.5**
Non-AOC sites				
Anderson Creek	-	-	15.6	**15.6**
Desbarats Wetland	20.0	10.9	17.2	**16.0**
Stobie Creek	9.4	9.4	12.5	**10.4**
Hay Bay Wetland	-	3.1	6.3	**4.7**
Joe Dollar Bay Wetland	-	17.7	14.6	**16.2**

- Echo Bay and Lake George are the only wetlands with area-sensitive marsh-nesting obligates present
- Needs more review to determine if these are most appropriate metrics to use.

Metrics:
Area-sensitive marsh nesting obligate maximum abundance
Area-sensitive emergent marsh nesting obligate maximum abundance
Area-sensitive marsh nesting obligate proportion of maximum abundance
Marsh-nesting obligate maximum abundance

Submerged Aquatic Vegetation (SAV)

- Total cover of SAV is important but so is the composition of SAV species
  - Species are identified as native or non-native
  - Some species are turbidity tolerant while other are not
  - Coefficient of Conservatism – species have higher score where there is lower disturbance tolerance and greater fidelity to a certain habitat
- In 2014, most common species were
  - Fern Pondweed (*Potamogeton robbinsii*),
  - White Water Lily (*Nymphaea odorata*),
  - Canada Waterweed (*Elodea canadensis*),
  - Vasey's pondweed (*Potamogeton vaseyi*),
  - Richardson's Pondweed (*Potamogeton richardsonii*)

Results – SAV

Wetland Name	WQ_{2014} IBI			
	2012	*2013*	*2014*	***Mean***
AOC sites				
Carpin Beach	34.3	45.5	8.5	**29.4**
Echo Bay	90.8	67.6	38.2	**65.5**
Lake George	52.4	55.4	15.9	**41.2**
Pumpkin Point	53.4	33.2	3.9	**30.2**
Maskinonge Bay	93.5	97.3	96.0	**95.6**
West Shore, St. Joseph Island	14.4	14.4	2.8	**10.6**
Non-AOC sites				
Anderson Creek	-	78.3	54.7	**66.5**
Desbarats Wetland	96.8	100.0	84.9	**93.9**
Stobie Creek	83.9	98.0	86.3	**89.4**
Hay Bay Wetland	40.4	38.1	23.1	**33.9**
Joe Dollar Bay Wetland	52.5	78.3	45.6	**58.8**

Metrics:
Number of native species
Coefficient of conservatism
Total cumulative coverage

- Some AOC and non-AOC wetlands scored high
- Some show quite a bit of variation over years
  - Likely, at least in part, due to changes in water levels

Macroinvertebrates

- Looking at proportion of certain classes or genera at each wetland
- Currently unable to develop an IBI for macroinvertebrates
  - May not have an appropriate disturbance gradient for the macroinvertebrate community
  - Variability between years may have prevented finding significant metrics
- Some changes in composition and/or abundances noted

Results - Macroinvertebrates

Wetland Name	% of each Class within Sample							
	Crustacea		Gastropoda		Insecta		Oligochaeta	
	2013	2014	2013	2014	2013	2014	2013	2014
AOC sites								
Carpin Beach	27	13	23	55	43	16	1	10
Echo Bay	38	36	13	14	41	38	1	4
Lake George 1	17	11	17	13	47	70	5	4
Pumpkin Point	47	12	14	25	34	61	2	2
Maskinonge Bay	45	47	8	16	38	23	2	9
West Shore, St. Joseph Island	10	5	20	5	60	64	7	23
Non-AOC sites								
Anderson Creek	61	33	7	11	21	44	10	9
Desbarats	24	40	7	15	62	33	4	5
Stobie Creek	38	52	12	7	45	26	2	13
Hay Bay	27	54	9	7	61	37	1	1
Joe Dollar Bay	34	19	22	23	24	35	9	13

Crustacea – freshwater amphipods, freshwater crustaceans

Gastropoda – bladder snail, ramshorn snail

Insecta – water boatmen, mayfly

Oligochaeta – aquatic worms

Results - Amphibians

- Currently unable to develop an IBI for amphibians
  - May not have an appropriate disturbance gradient for the amphibian community
- Combined 2013-2014 species composition

Wetland	American Toad	Bullfrog	Gray Treefrog	Green Frog	Mink Frog	Northern Leopard Frog	Spring Peeper	Wood Frog	Species Richness
AOC sites									
Carpin Beach	0	0	1	1	0	0	1	1	4
Echo Bay	1	0	0	1	1	1	1	1	6
Lake George	1	0	0	1	1	1	1	1	6
Pumpkin Point	1	0	0	1	0	1	1	0	4
Maskinonge Bay	1	0	1	1	1	1	1	1	7
West Shore, St. Joseph's Island	1	0	0	1	1	1	1	1	6
Non-AOC sites									
Anderson Creek	1	0	0	1	0	1	1	1	5
Desbarats Wetland	1	1	1	1	1	1	1	1	8
Stobie Creek	1	0	1	1	0	0	1	1	5
Hay Bay Wetland	0	0	1	1	0	1	1	1	5
Joe Dollar Bay	1	0	1	1	1	1	1	1	7
No. of wetlands	9	1	6	11	6	9	11	10	

Overall

- So far, no clear picture as to whether there is difference in community condition between AOC and non-AOC coastal wetlands
  - Water Quality Index – AOC wetlands range from very degraded to very good whereas non-AOC wetland range from moderately degraded to very good
  - Marsh Bird – some AOC wetlands have high IBI scores while others have lower scores
  - SAV – IBI scores are variable between years and between wetlands with AOC and non-AOC wetlands scoring high and low
  - Macroinvertebrates – variability between years and wetlands
  - Amphibians – mean species richness is similar between AOC and non-AOC wetlands

Challenges

- Changing water levels
  - Changes in available habitat, habitat composition, species composition, growth rates (e.g., of SAV)
  - Determining baseline community condition is difficult with the reality of changing water levels – increases seen each year of survey period

Lake George boat launch

Next Steps

- Complete addition year of surveys (2015)
- Validate potential IBIs (where possible)
  - Selecting most appropriate IBI (considering suitable metrics)

Acknowledgements

- Funds for this project were provided by the Government of Canada's Great Lakes Action Plan.
- Thank you to St. Marys River shoreline property owners for granting land access in support of this project