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Nearshore fish community health in the St. Marys River AOC

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Degradation of Fish Populations BUI

- Proposed Delisting Criteria
  - This beneficial use will no longer be impaired when the overall fish community health within the Area of Concern is comparable to that of a suitable reference site, as assessed using an index of biotic integrity through a minimum of two consecutive studies.

What is an Index of Biotic Integrity (IBI)?

- Scientific tool used to identify and classify faunal communities
- Biological Integrity (Clean Water Act):

  The capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species diversity and a functional organization comparable to that of natural habitats of the region (Karr and Dudley 1981)
- Biotic integrity is based on the premise that the status of living systems provides the most direct and effective measure of the integrity of water

Why Fish?

- Fish communities include species from a number of trophic levels
- Their position atop aquatic food webs provides an integrative view of the watershed environment
- Fishes are sensitive to a wide array of stressors
- Acute toxicity (missing species) and sublethal (low growth, reproductive success) effects can be evaluated

IBI History

- First IBI developed by Dr. James Karr in 1981 to describe the condition of small warm water streams in central Illinois and Indiana
- Approach has been modified many times for different regions and ecosystems, including a near shore Great Lakes IBI developed by Ken Minns and others in 1994

Parameters Used to Assess GL IBI

Species richness

- Natives
- Centrarchids
- Intolerants
- Nonindigenous
- Native cyprinids

Trophic structure

- % piscivore biomass
- % generalist biomass
- % specialist biomass

Abundance & condition

- # native individuals
- Biomass of natives (kg)
- % nonindigenous numbers
- % nonindigenous biomass

Differences in the Great Lakes IBI

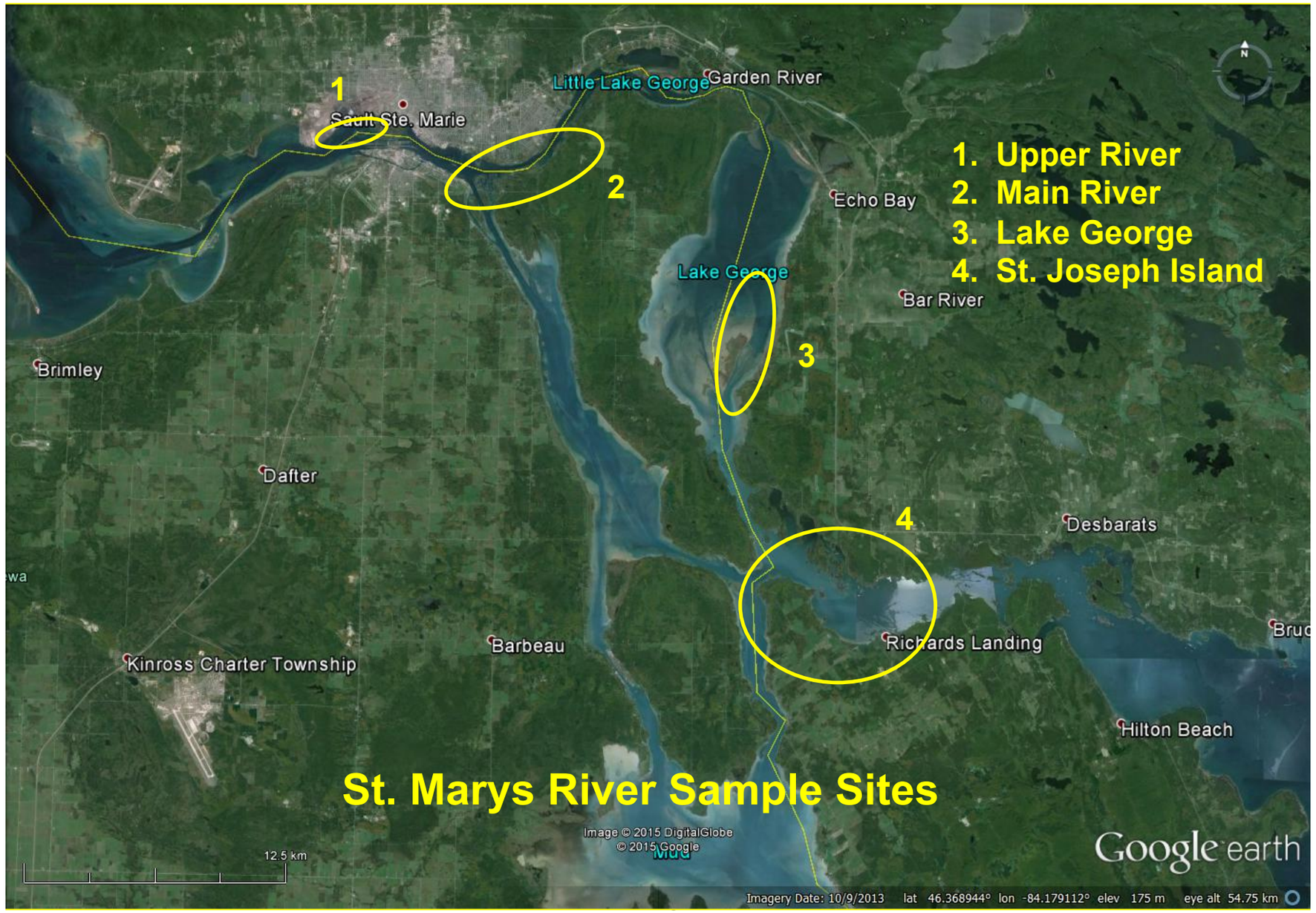
- Choice of metrics (no use of hybrids, tumours)
- No need to standardize for ecosystem size
- Greater reliance on biomass than richness; energy flow in the GL is more related to biomass than abundance
- Greater weight to non-indigenous fishes
- Changed scaling from 1-100 [GL scoring system ranges from excellent (>80) to very poor (<20)]

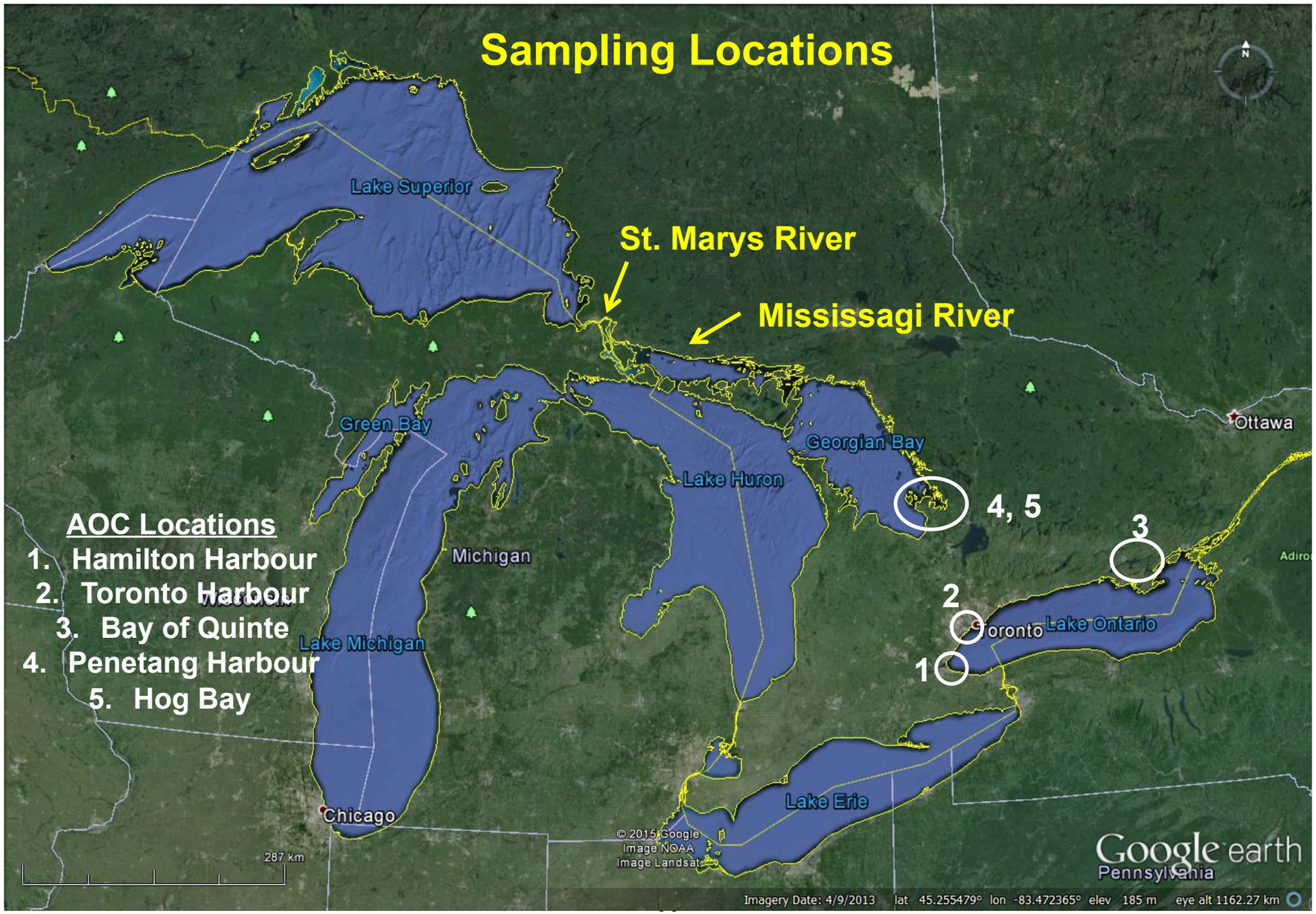
DFO-GLLFAS Near Shore Fish Community Survey Design 2014

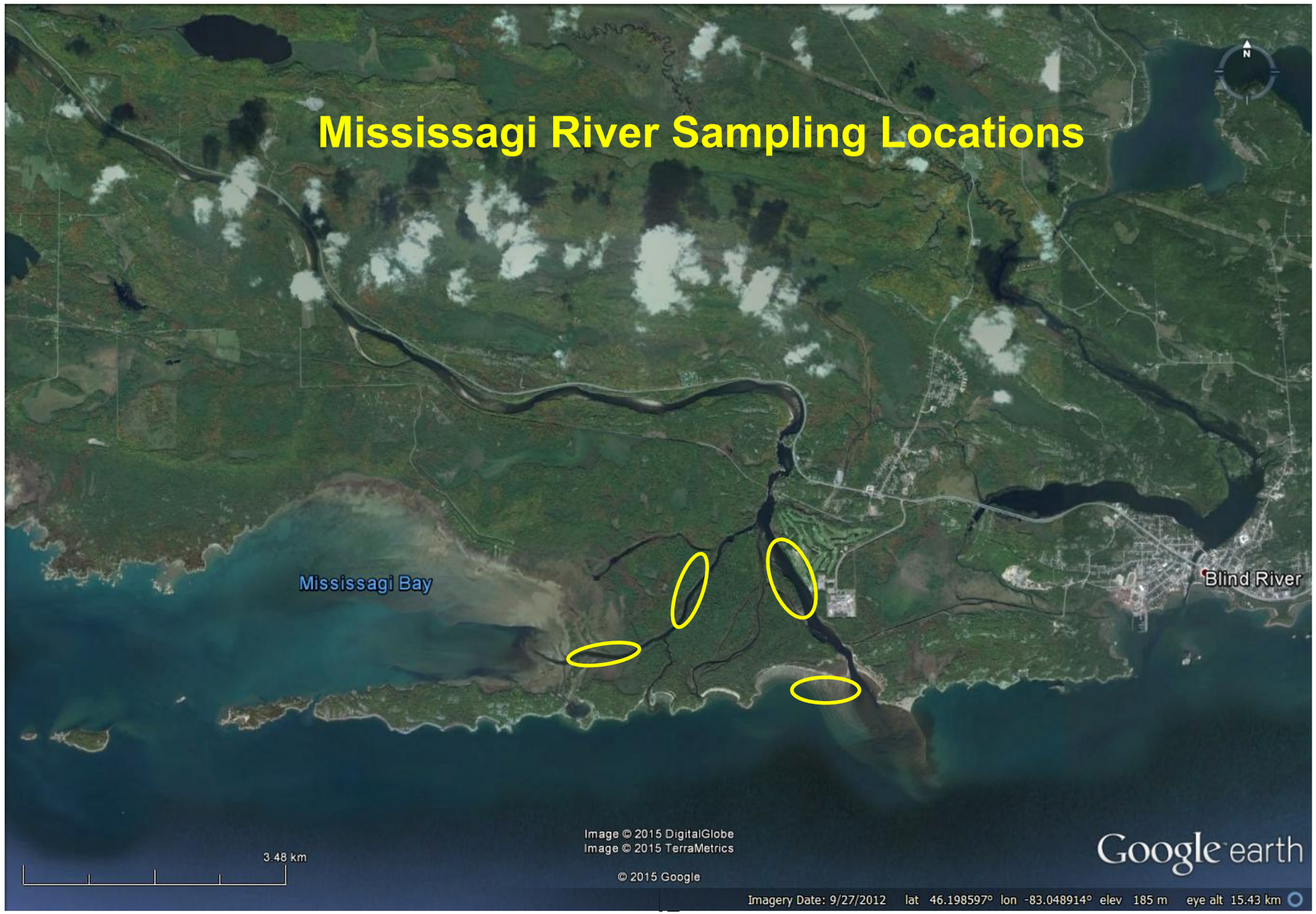
- Boat electrofishing near shore surveys
- 100 m transects, less than 2 m deep, all surveys at night
- 93 transects total fished 20 in each of St. Joseph Island, Lake George, and Upper River, 33 in the Main River
- 35 small boat trawls completed (daytime), 2-5 m depths
- Total of 37 species collected

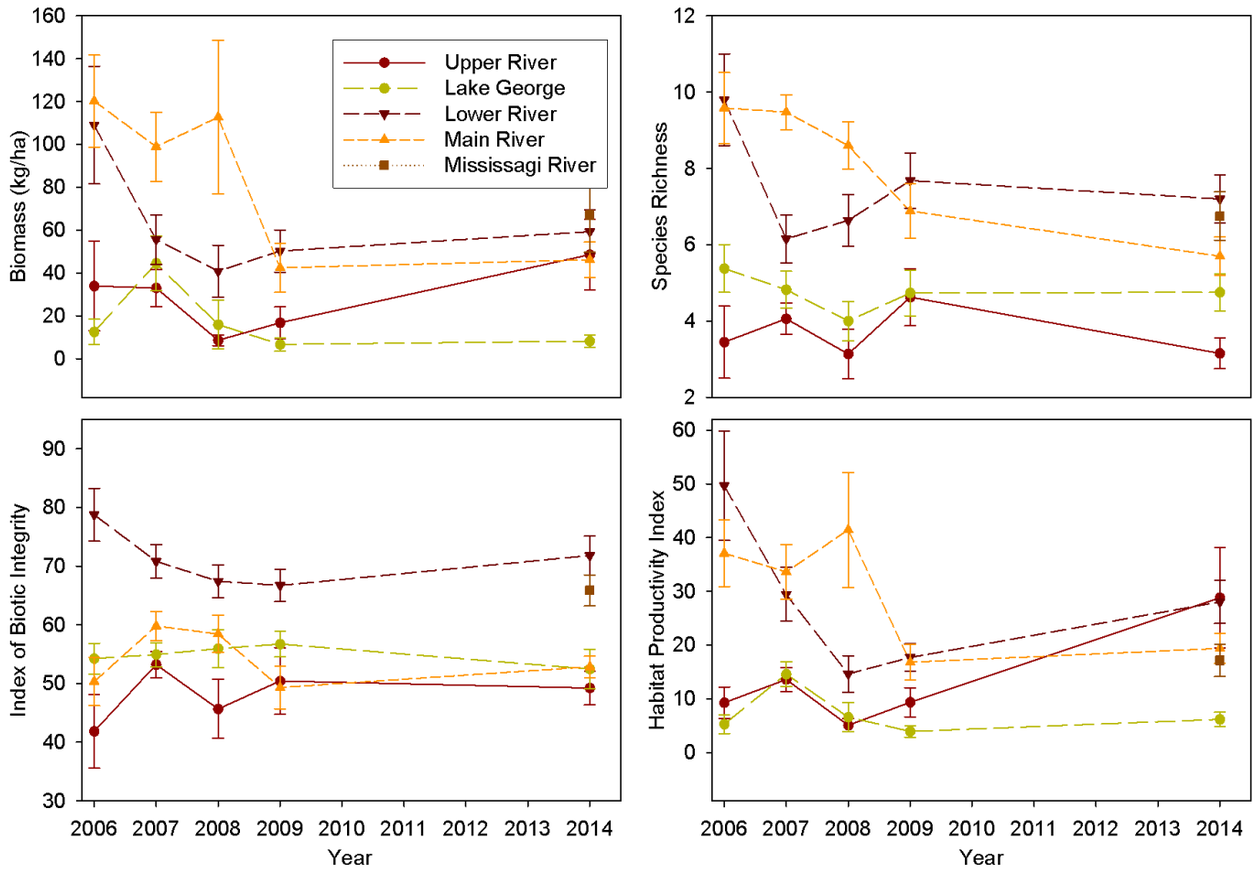
Control River for AOC Site Added:

- Added the Mississagi River as a control for the St. Marys (an AOC site) – closest large river in the area
- Total of 20 sites electrofished (night work), 26 species collected
- Total of 6 trawls completed (daytime), 2 additional species collected


1
2
3
4
1. Upper River
2. Main River
3. Lake George
4. St. Joseph Island
Sault Ste. Marie
Little Lake George
Garden River
Echo Bay
Lake George
Bar River
Brimley
Dafter
Desbarats
Barbeau
Richards Landing
Kinross Charter Township
Hilton Beach
St. Marys River Sample Sites
Image © 2015 DigitalGlobe
© 2015 Google
12.5 km
Google earth
Imagery Date: 10/9/2013 lat 46.368944° lon -84.179112° elev 175 m eye alt 54.75 km


Sampling Locations
Lake Superior
St. Marys River
Mississagi River
Green Bay
Georgian Bay
Lake Huron
Ottawa
Michigan
Lake Michigan
Toronto
Lake Ontario
Chicago
Lake Erie
Pennsylvania
AOC Locations
1. Hamilton Harbour
2. Toronto Harbour
3. Bay of Quinte
4. Penetang Harbour
5. Hog Bay
4, 5
3
2
1
287 km
© 2015 Google
Image NOAA
Image Landsat
Google earth
Imagery Date: 4/9/2013 lat 45.255479° lon -83.472365° elev 185 m eye alt 1162.27 km


Mississagi River Sampling Locations
Mississagi Bay
Blind River
Image © 2015 DigitalGlobe
Image © 2015 TerraMetrics
© 2015 Google
3.48 km
Google earth
Imagery Date: 9/27/2012 lat 46.198597° lon -83.048914° elev 185 m eye alt 15.43 km



Comparing the 4 metrics from DFO's 2006-2008 work with 2009, 2014 for biomass, species richness, IBI, and HPI.

St. Marys River	Upper river			Main river			Lake George			Lower river				Mississagi River
Metric name	2006-2008	2009	2014	2006-2008	2009	2014	2006-2008	2009	2014	2006-2008	2009	2014	Overall	2014
Biomass (kg)	0.6	0.4	1.2	2.7	1.1	1.2	0.8	0.2	0.2	1.5	1.3	1.5	1.2	1.7
Number captured	12.3	20.1	37.5	43.9	26.1	30	21.6	15.1	31.4	60.7	60	66.8	36.1	30.7
Species richness	3.6	4.6	3.2	9.2	6.9	5.7	4.8	4.7	4.8	7	7.3	7.3	6	6.8
Native species richness	3.5	4.6	3.1	8.3	6	5.2	4.8	4.7	4.3	7	7.5	7.1	5.6	6.7
Native cyprinid species richness	1	1.4	1.2	2.2	1.8	1.5	1.9	2.5	2.7	3.1	3	2.9	2	2.6
Percent piscivore biomass	3	0.12	1	8.1	0.5	3	3	8.1	8.6	28.6	15.6	26.3	8.7	39.5
Percent generalist biomass	14.5	22.2	24.6	64.6	54.1	53.2	31.8	25.5	17.9	21.9	31.5	35.2	34.9	12
Percent specialist biomass	75.1	65.9	69.4	27.4	39.6	43.8	65.2	66.3	68.5	49.5	52.8	38.4	53.8	48.5
Percent non-indigenous species by number	1.1	0	0.5	6.3	5.5	3.8	0.2	0	3.8	0	0.2	0.2	2.1	0.6
Percent non-indigenous species by biomass	5	0	1	2.3	0.8	3.7	2.2	0	9.5	0	0.1	0	2.3	4.7
Index of biotic integrity	48	50.4	49.2	56.9	49.3	52.8	54.9	56.7	52.5	70.9	66.7	71.8	56.6	65.9

The average biomass, catch in numbers, species richness per 100 m transect, and the average index of biotic integrity metrics, from the four St. Marys River sampling locations and the Mississagi River

Total Species Collected Near shore Sampling (55):

American brook lamprey
*sea lamprey
lake sturgeon
longnose gar
bowfin
*alewife
*pink salmon
*coho salmon
*Chinook salmon
*rainbow trout
*Atlantic salmon
lake whitefish
round whitefish
Cisco
*rainbow smelt
northern pike
central mudminnow
longnose sucker
white sucker

silver redhorse
shorthead redhorse
redhorse sp.
lake chub
*common carp
common shiner
golden shiner
emerald shiner
blacknose shiner
spottail shiner
rosyface shiner
sand shiner
mimic shiner
bluntnose minnow
blacknose dace
longnose dace
creek chub
silver shiner
Notropis sp.

brown bullhead
burbot
brook stickleback
*threespine stickleback
ninespine stickleback
trout-perch
white bass
rock bass
pumpkinseed
smallmouth bass
largemouth bass
yellow perch
walleye
Iowa darter
Johnny darter
logperch
Etheostoma sp.
mottled sculpin
slimy sculpin

Cumulative Species Catch

St. Marys River	2006	2007	2008	2009	2014	Mississagi River	Mississagi River Trawl	St. Marys River Trawl
Total Species Captured	37	36	31	34	37	25	9	15
Total New Species	37	5	3	4	4	3	1	0
Cumulative Species	37	42	45	49	53	56	57	57

2014 Fishing Summary

	Upper River	Main River	Lake George	Lower River	St. Marys Trawl	Mississagi River	Mississagi Trawl
Sites Fished	20	33	20	20	35	20	6
Number of Species	12	25	15	24	15	25	9
Total Catch	749	978	628	1713	1357	614	228

Summary of IBI Results:

Metric name	St. Marys River 2014	Mississagi River 2014	Hamilton Harbour 2013	Toronto Harbour 2014	Bay of Quinte 2011	Penetang Harbour 2002	Hog Bay 2002
Biomass (kg)	1.2	1.7	5.6	5.5	6.1	1.6	4.5
Number captured	36.1	30.7	18.7	19.2	63.9	30.5	26.1
Species richness	6	6.8	4.6	3.4	8.8	5.4	6.7
Native species richness	5.6	6.7	3.4	2.3	8.1	5	6.3
Native cyprinid species richness	2	2.6	0.6	0.4	0.9	1.2	1.1
Percent piscivore biomass	8.7	39.5	11.8	9.5	41.4	34.4	43.1
Percent generalist biomass	34.9	12	38.2	26.1	16.5	7.4	20.6
Percent specialist biomass	53.8	48.5	38.6	54.9	42.1	54.7	36.3
Percent non-indigenous species by number	2.1	0.6	25.8	37.9	5.9	4.5	3
Percent non-indigenous species by biomass	2.3	4.7	34.1	32.5	8.4	4.3	15.8
Index of biotic integrity	56.6	65.9	39.5	35.5	73.3	64.8	66

The average biomass, catch in numbers, species richness per 100 m transect, and the average index of biotic integrity metrics, from the four St. Marys River sampling locations and the Mississagi River

Questions?