Welcome to

A NIAGARA RIVER EVENING:

Fish and Wildlife

The webinar will begin shortly.

Some general reminders before we begin:

- You are automatically muted for the webinar.
- Communicate any technical difficulties in the chat box.
- Questions entered in the Q&A box will be answered at the end of the webinar.

The webinar is being recorded and will be available at **getinvolved.npca.ca/Niagara-river-fish-wildlife** (access via QR code).

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A NIAGARA RIVER EVENING:
Fish and Wildlife

Presenters:
Dr. Andrew Drake - Fisheries & Oceans Canada
Shane de Solla - Environment & Climate Change Canada

May 14, 2024

LAND ACKNOWLEDGEMENT

Photo Credits: S. McIntyre

WELCOME

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Photo Credits: N. Green

INTRODUCTIONS

MARK CHAMBERS
ECCC

MELISSA LEE
MECP

NATALIE GREEN
NPCA

SYDNEY MCINTYRE
NPCA

DR. ANDREW DRAKE
DFO

SHANE DESOLLA
ECCC

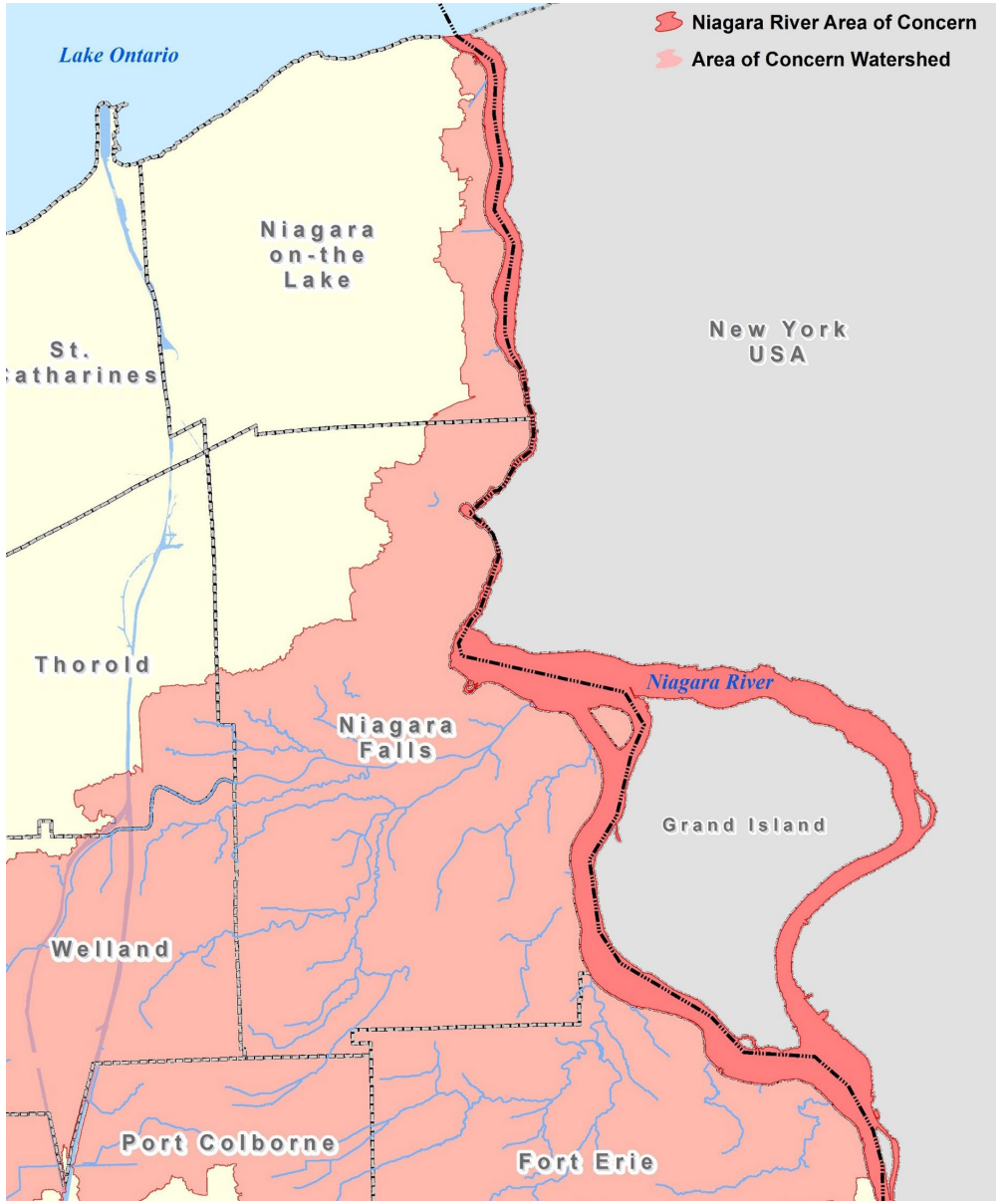
EARLY PROBLEMS

- Niagara River noted as a problem area in early 1900s
  - Sewage was the main issue
  - Bacteria led to health issues and waterborne diseases
- Pollution crisis of the Great Lakes in 1950s-1970s
  - People thought Lake Erie was dying
  - Love Canal tragedy
  - Bald eagle populations nearly decimated due to pesticides

Photo Credits: J. Gunthrie, Niagara Frontier

NIAGARA RIVER: AOC & RAP

- One of the 43 AOCs
- RAP Team made from various community partners
- Main Issues: Water quality & habitat loss
- Separate RAPs on each side of the River



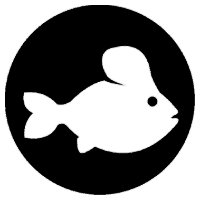
TRACKING THE PROGRESS: BENEFICIAL USE IMPAIRMENTS

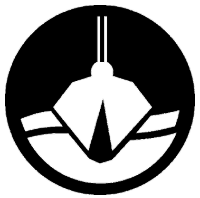

Restrictions on Fish Consumption


Eutrophication or Undesirable Algae


Restrictions on Drinking Water Consumption


Degradation of Fish & Wildlife Populations


Fish Tumours


Restrictions on Dredging


Degradation of Benthos


Degradation of Plankton Populations

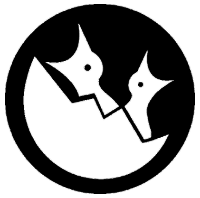

Degradation of Aesthetics


Beach Closings

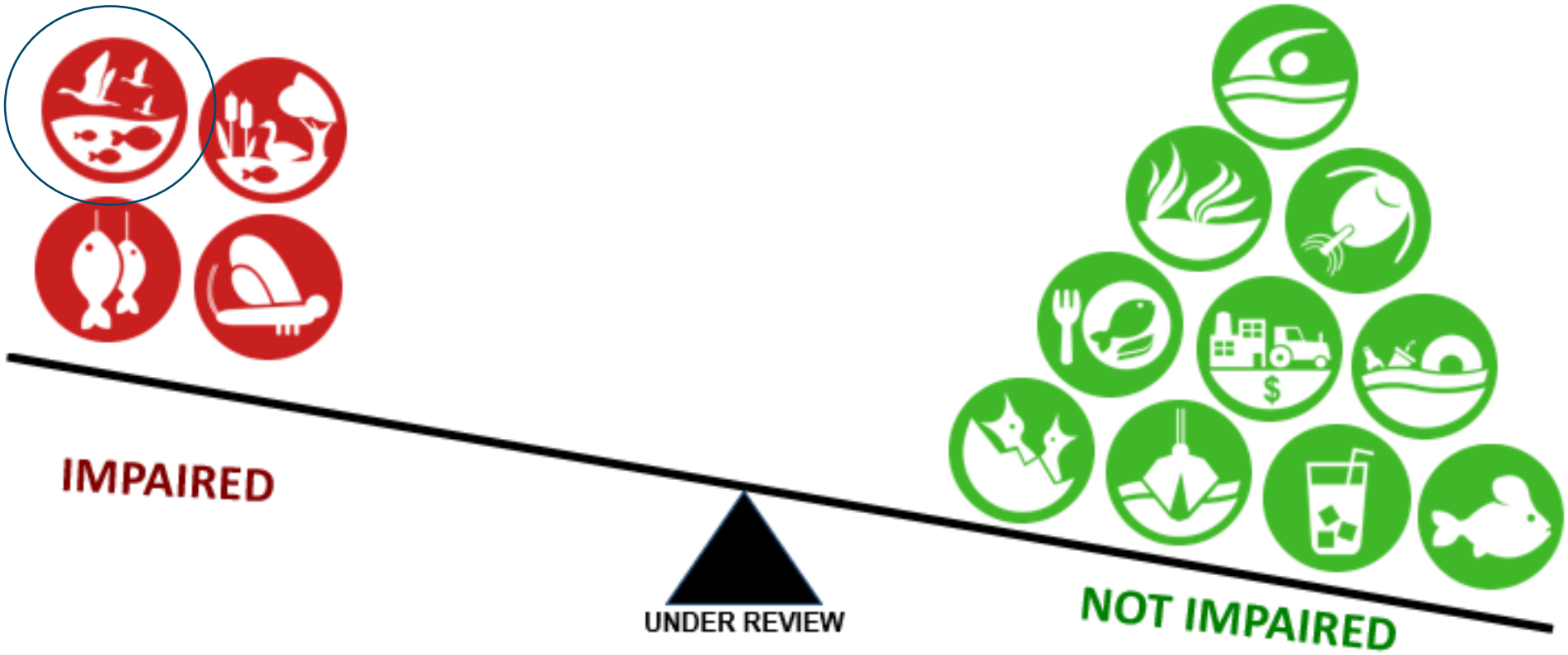
Added Costs to Agriculture or Industry


Tainting of Fish Flavour


Loss of Fish & Wildlife Habitat


Bird or Animal Deformities/ Reproduction Problems

TRACKING THE PROGRESS: BENEFICIAL USE IMPAIRMENTS








Assessment of Fish Populations Beneficial Use Impairment in the Niagara River

D. Andrew R. Drake, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada

Fisheries and Oceans Canada

Acknowledgements

- Robin Gáspárdy, Jason Barnucz (DFO)
- Natalie Green (NPCA)
- Mark Chambers (ECCC)
- Tom MacDougall, Stephen Marklevitz (OMNRF)

Fisheries and Oceans Canada

The Problem

- **1900’s**: Long history of industrial development in Niagara River watershed; GLWQA led to water quality improvements in 1970-80’s
- **1993**: Remedial Action Plan indicates Niagara River fish communities generally healthy; some concerns regarding Lake Sturgeon, Northern Pike, Emerald Shiner; significant concerns regarding Welland River watershed
- **1990’s-2000’s**: Substantial remediation and barrier removal in Welland River
- **2012**: Clarified that Areas of Concern should only apply to ‘Waters of the Great Lakes’
- **2013-2023**: Field and analytical research to determine the degree of fish community impairment in Niagara River proper

How to Assess Fish Community Response to Environmental Change?

- "*Multiple lines of evidence indicate similarity between the Niagara River fish community and expectations based on the adjoining Great Lakes*"

- **<u>The Problem</u>**: most connecting channels (reference sites) were impaired; lack of suitable baseline

- **<u>The Solution</u>**: determine the similarity of Niagara River fish community to the species composition of adjacent Great Lakes, after accounting for riverine species and habitats

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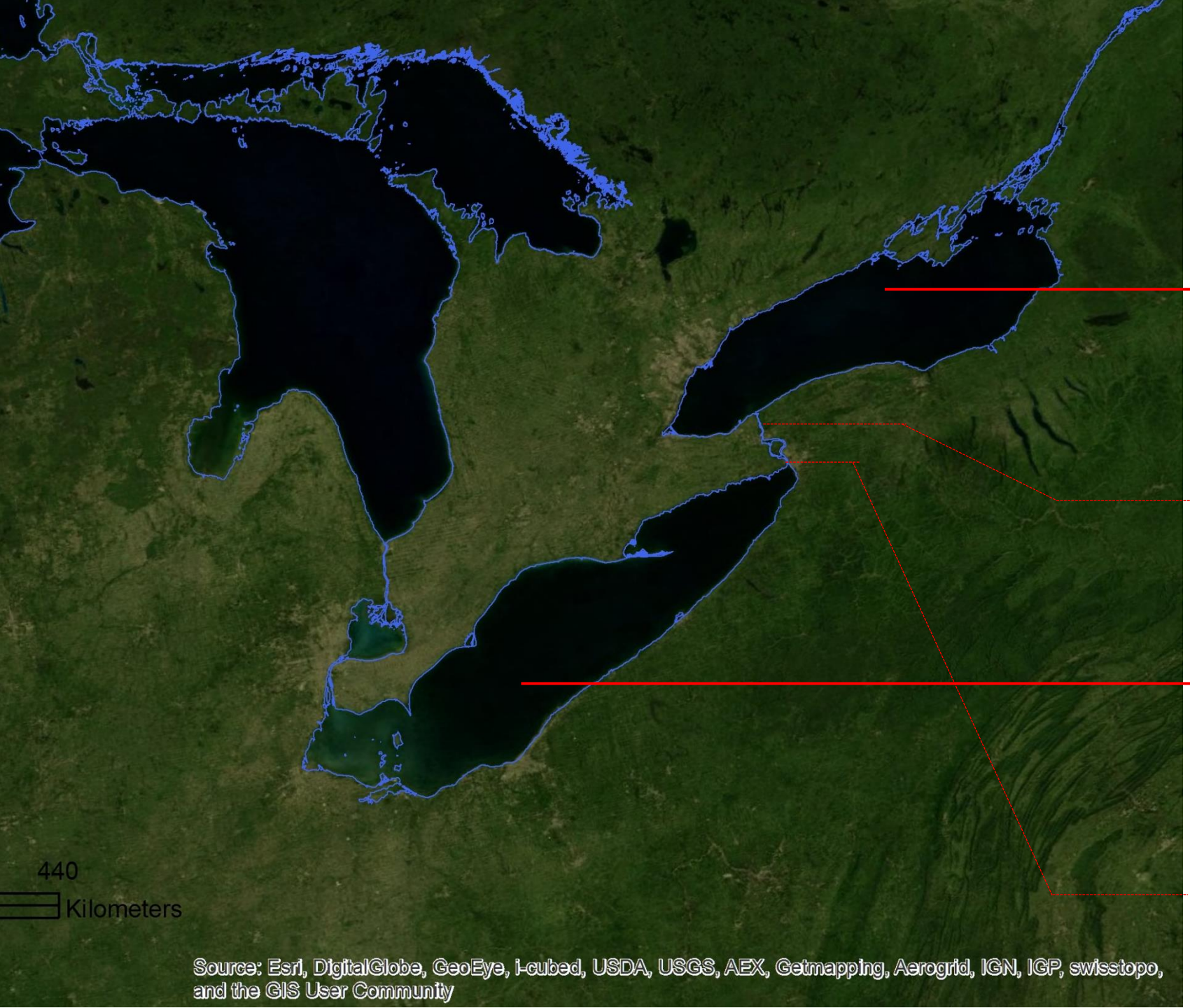


Lake Ontario drainage

123 total fish species
56 spp. not expected in lower river
(geographic proximity, rarity, habitat)

67 species expected in lower river

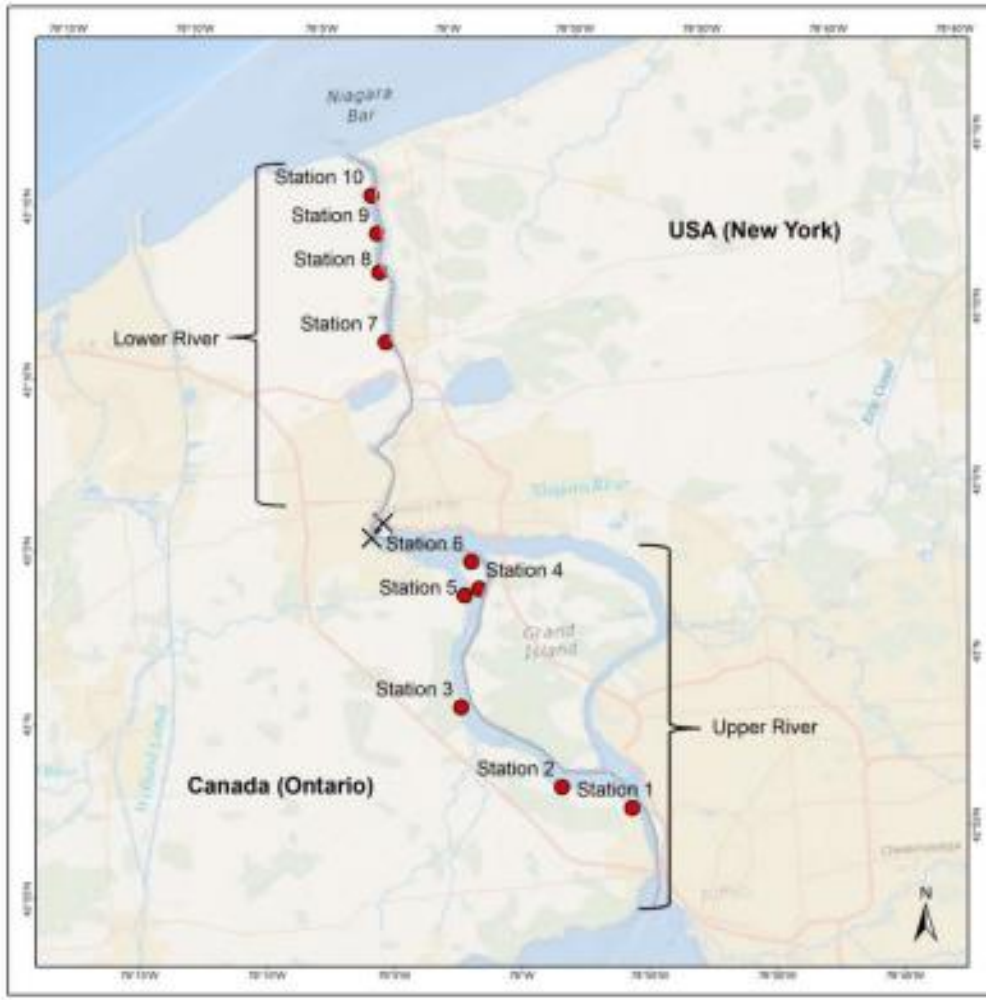
Lake Erie drainage

134 total fish species
60 spp. not expected in upper river
(geographic proximity, rarity, habitat)

74 species expected in upper river

How to Determine Species Composition of Upper and Lower River?

- 2015-2017, seasonal (spring, summer, fall) boat electrofishing survey with 21’ Smith Root boat electrofisher
- Ten index sites (six upper, four lower)
- Each station fished with 2 x 500 m transects, 2m depth contour, direction of flow, ~1800 W, ~6,000 electrofishing seconds per site
- Supplemented with expert judgement survey to fill in missing species (e.g., other available agency catch records)



Gaspardy et al. 2020, “Nearshore fish community assessment of the upper and lower Niagara River, 2015-2017”

How to Determine Species Composition of Upper and Lower River?

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How to Determine Species Composition of Upper and Lower River?

- Fish species processing:
  - Identify all captured fishes to species, or nearest level of taxonomic resolution
  - Voucher (physical or digital) of each species per site
  - Total count per species, and min-max total length per site
- Majority released unharmed

Gaspardy et al. 2020, “Nearshore fish community assessment of the upper and lower Niagara River, 2015-2017”

Overall Boat Electrofishing Results (2015-2017)

Sampling Summary

Total Fishes Captured	41 365
Number of Species Captured	65
Total Effort (s)	499 494
Mean CPUE/Site (fishes/second)	0.081

~139 hrs

White Sucker (26%)
Emerald Shiner (21%)
Yellow Perch (12%)

60% of total catch

Gaspardy et al. 2020, “Nearshore fish community assessment of the upper and lower Niagara River, 2015-2017”

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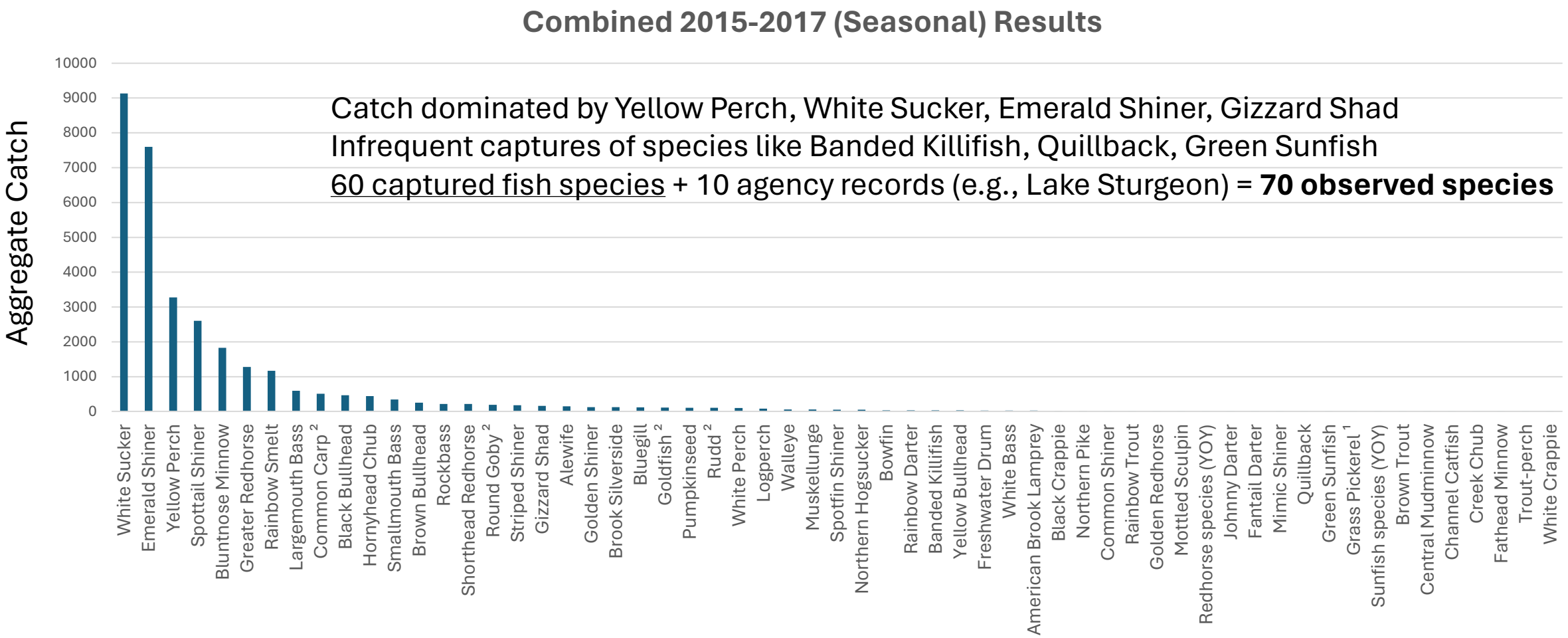
Upper River Fish Community Results



Catch dominated by Yellow Perch, White Sucker, Emerald Shiner, Gizzard Shad
Infrequent captures of species like Banded Killifish, Quillback, Green Sunfish
60 captured fish species + 10 agency records (e.g., Lake Sturgeon) = **70 observed species**

Gaspardy et al. 2020, “Nearshore fish community assessment of the upper and lower Niagara River, 2015-2017”

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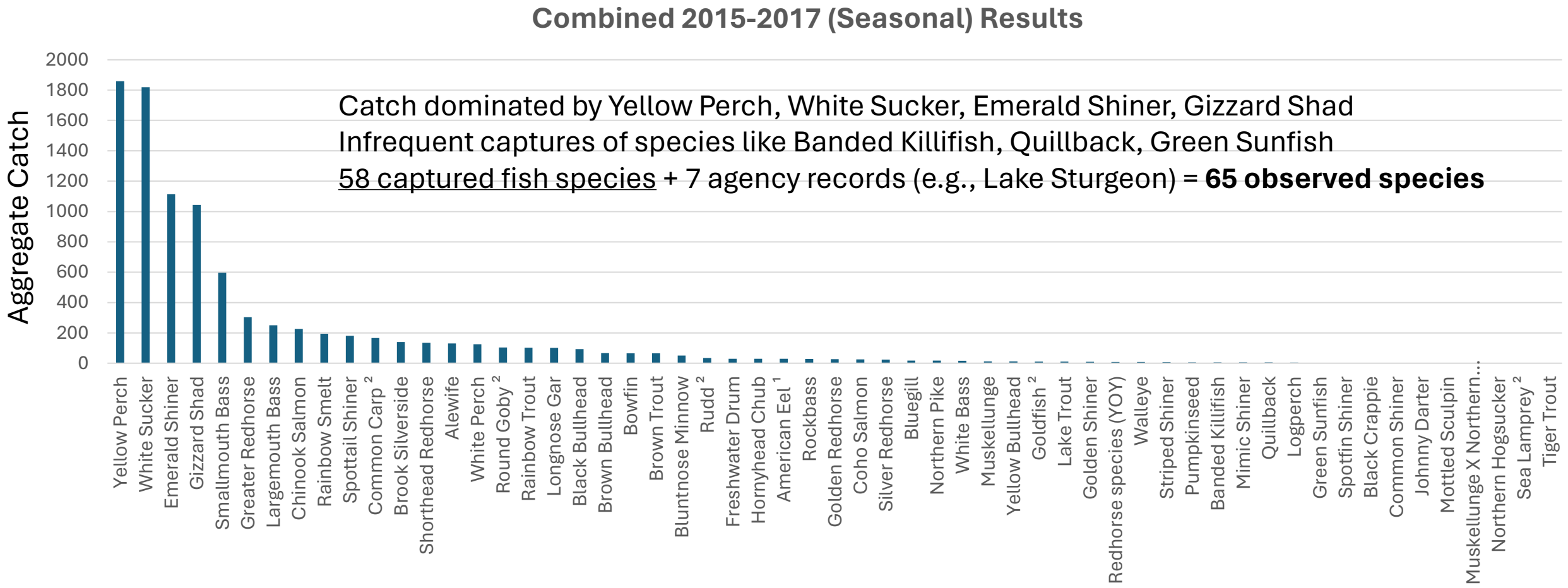
20

Lower River Fish Community Results



Catch dominated by Yellow Perch, White Sucker, Emerald Shiner, Gizzard Shad
Infrequent captures of species like Banded Killifish, Quillback, Green Sunfish
58 captured fish species + 7 agency records (e.g., Lake Sturgeon) = **65 observed species**

Gaspardy et al. 2020, “Nearshore fish community assessment of the upper and lower Niagara River, 2015-2017”

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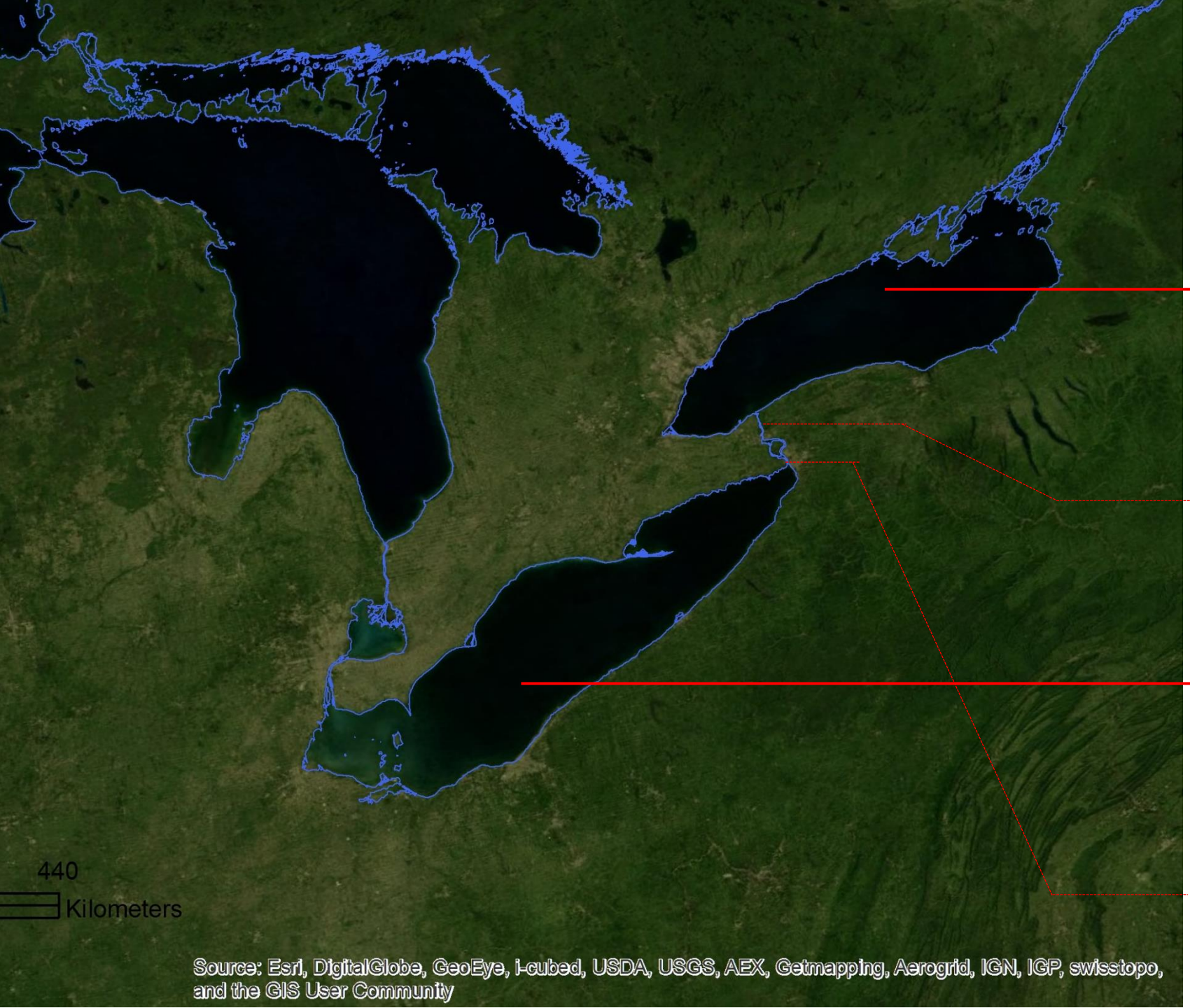
36
94 95 96 97


17
18
41 42 43 44 45 46 47


Model # 118-E40



Results of Community Similarity Analysis

Lake Ontario drainage

123 total fish species
67 species expected in lower river

65 species detected, 97% similarity

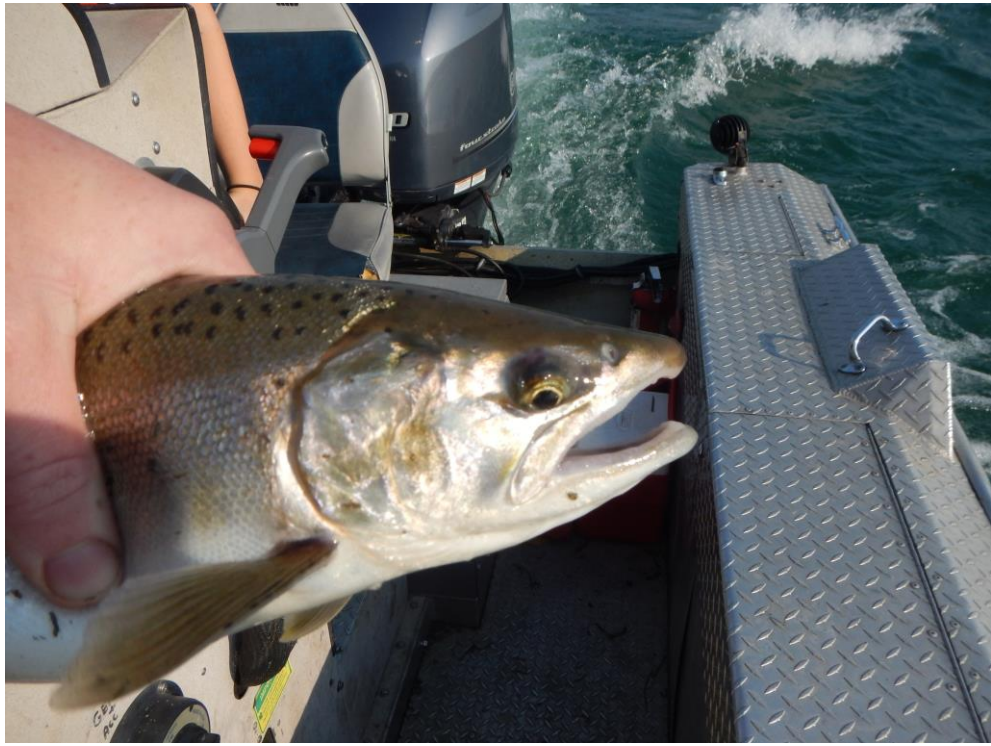
Lake Erie drainage

134 total fish species
74 species expected in upper river

70 species detected, 95% similarity

Conclusions – Similarity Analysis

- Niagara River high compositional similarity (≥ 95%) with adjacent Great Lakes fish communities, once riverine species are accounted for (compositional, likely trophic, functional similarities)
- "Missing" species likely undetected due to sampling challenges (Silver Lamprey, Brindled Madtom, Blackside Darter, Tubenose Goby)
- Total number of detected species greater than expected = some species using river sporadically (e.g., Lake Whitefish, Stonecat, Bigmouth Buffalo, Central Stoneroller)
- Analysis does not account for relative abundance patterns; lack of historical baseline challenging



Other Indicators of Fish Population Improvement

- 2020 OMNRF Recreational Fishing Survey in Niagara River
    - Niagara River supports provincially valuable fisheries
    - Smallmouth Bass in the Upper Niagara River, Rainbow Trout and Lake Trout in the Lower Niagara River
    - Catches in these fisheries two or more times greater than neighbouring waterbodies.
    - Walleye catches in Upper River similar to those observed in Lake Erie's eastern basin and Bay of Quinte
    - Collective Muskellunge catches throughout the river were similar to Muskellunge fisheries in the Detroit River and Lake St. Francis.

Thank you

- andrew.drake@dfo-mpo.gc.ca

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Shared Species (Upper & Lower, *n* = 48)

Alewife	Mimic Shiner
Banded Killifish	Mottled Sculpin
Black Bullhead	Muskellunge
Black Crappie	Northern Hogsucker
Bluegill	Northern Pike
Bluntnose Minnow	Pumpkinseed
Bowfin	Quillback
Brook Silverside	Rainbow Smelt
Brown Bullhead	Rainbow Trout
Brown Trout	Redhorse species (YOY)
Common Carp [2]	Rockbass
Common Shiner	Round Goby [2]
Emerald Shiner	Rudd [2]
Freshwater Drum	Shorthead Redhorse
Gizzard Shad	Smallmouth Bass
Golden Redhorse	Spotfin Shiner
Golden Shiner	Spottail Shiner
Goldfish [2]	Striped Shiner
Greater Redhorse	Walleye
Green Sunfish	White Bass
Hornyhead Chub	White Perch
Johnny Darter	White Sucker
Largemouth Bass	Yellow Bullhead
Logperch	Yellow Perch

Lower Only (*n* = 8)

American Eel [1]
Chinook Salmon
Coho Salmon
Lake Trout
Longnose Gar
Sea Lamprey [2]
Silver Redhorse
Tiger Trout

Upper Only (*n* = 10)

American Brook Lamprey
Central Mudminnow
Channel Catfish
Creek Chub
Fantail Darter
Fathead Minnow
Grass Pickerel [1]
Rainbow Darter
Trout-perch
White Crappie

Environment and Climate Change Canada
Environnement et Changement climatique Canada
Canada

Wildlife Populations
Colonial Waterbirds

S.R. de Solla, Environment and Climate Change Canada
K. D. Hughes, Broadwing Biological Consulting

A Niagara River Evening - May 14, 2024



Colonial Waterbirds Sentinel Species

- Two colonial waterbird species, Herring Gulls (HERG) and Double-crested Cormorants (DCCO), that breed and forage within the NR AOC were selected.
- Both species feed at the top of the food chain and, as largely fish eaters, have a close connection to the water.
- Vital for assessing local contaminant conditions in the AOC.
- For several decades, HERGs have been used as avian sentinel species for Great Lakes contaminants monitoring which allows for an assessment of changes in exposure over time.

Colonial Waterbirds Populations

Two components to this assessment:

1) Artificial incubation of cormorant eggs in the laboratory to assess embryonic viability and deformity frequencies

(e.g., are eggs viable and do the embryos develop normally?)

2) Analysis of contaminants in gull and cormorant eggs to evaluate spatial and temporal trends in colonial waterbirds

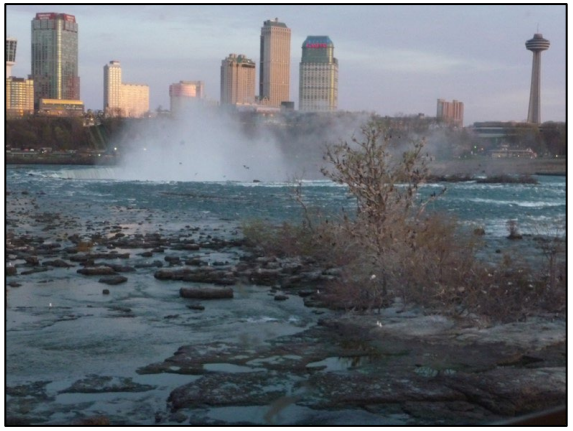
assess against contaminant threshold concentrations that might result in population-level effects.

Artificial Incubation of Eggs

- Artificial incubation of eggs in the lab examines importance of intrinsic factors (e.g., contaminants) that may induce mortality and impact bird populations.
- Unincubated DCCO eggs were collected from nests containing a single egg and placed in an incubator for artificial incubation in 2018 and 2019.
- At pipping, embryos were assessed for viability and deformities.
- Similar work was conducted at other Great Lakes AOCs including Hamilton Harbour, Thunder Bay, and St. Marys River.

Contaminants-Temporal Trends in Eggs

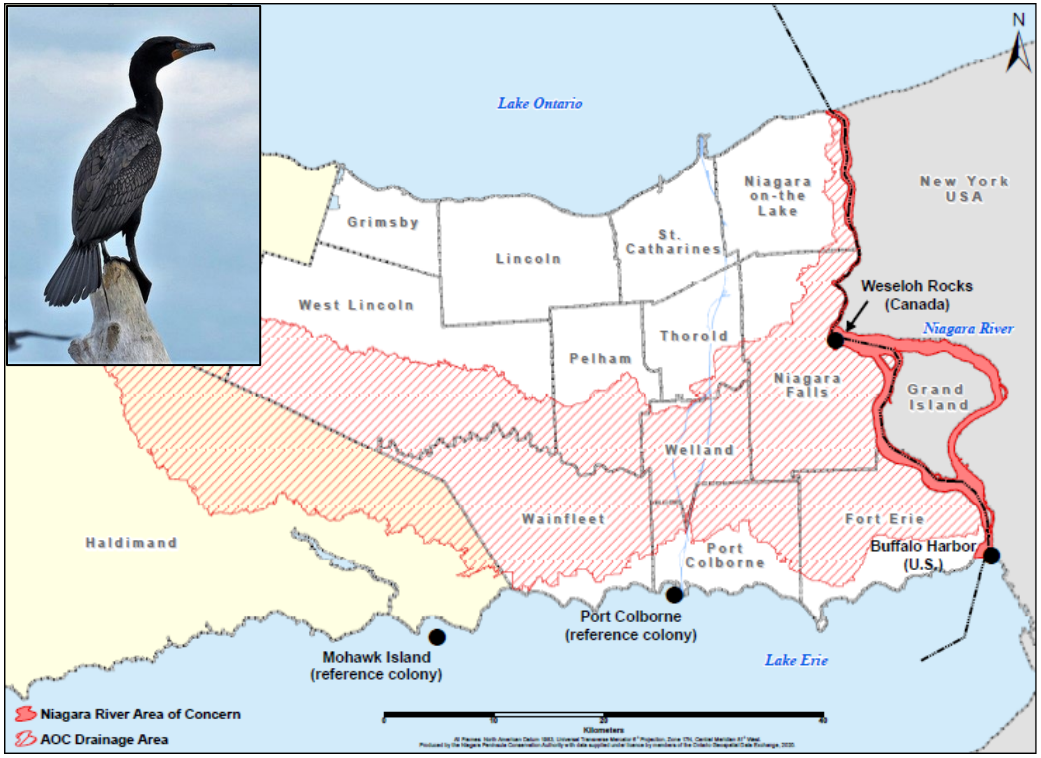
- As part of the Great Lakes Herring Gull Monitoring Program, annual collections of Herring Gull eggs have been conducted at a nesting site at the top of Niagara Falls (Weseloh Rocks) since 1979 for contaminants monitoring.
- However from 2015-2017, it was not possible to access this nesting site (by helicopter) to continue egg collections due to high water levels.
- A new site was selected for monitoring in 2018 and 2019 at Buffalo Harbor, on the NR in New York, where both HERGs and DCCOs nest.
- Contaminants in eggs from this site reflect local environmental conditions within the AOC since birds would feed on NR fish in the upper part of river and downstream.
- Allows for continued assessment of long term contaminant trends in gulls.



Contaminants-Spatial Trends in Eggs

- HERG and DCCO eggs were collected from Buffalo Harbor in 2018 and 2019 for contaminants.
- Eggs from Niagara AOC were compared to two upstream reference sites in Lake Erie (Port Colborne and Mohawk Is).

- For contaminant analysis, HERG eggs were collected from Port Colborne and Mohawk Is. and DCCO eggs were collected from Port Colborne.
- For the embryonic viability assessment, DCCO eggs were collected from Mohawk Is.



Map credit: T. Gaade, NPCA

Artificial Incubation Results

- Embryonic viability was equal to 85% in DCCOs from Buffalo Harbor overall in 2018 and 2019 and was similar to the reference colony on eastern LE.
- Deformity frequencies were similar in embryos between the two colonies in both years combined.

Colony	Year	Total No. Eggs	% Viability	No. Deformities	% Deformities
Buffalo Harbor	2018	27	81%	1	4%
	2019	30	90%	1	3%
Overall		**57**	**85%**	**2**	**4%**
Mohawk I.	2018	13	85%	0	0%
	2019	21	76%	0	0%
Overall		**34**	**80%**	**0**	**0%**

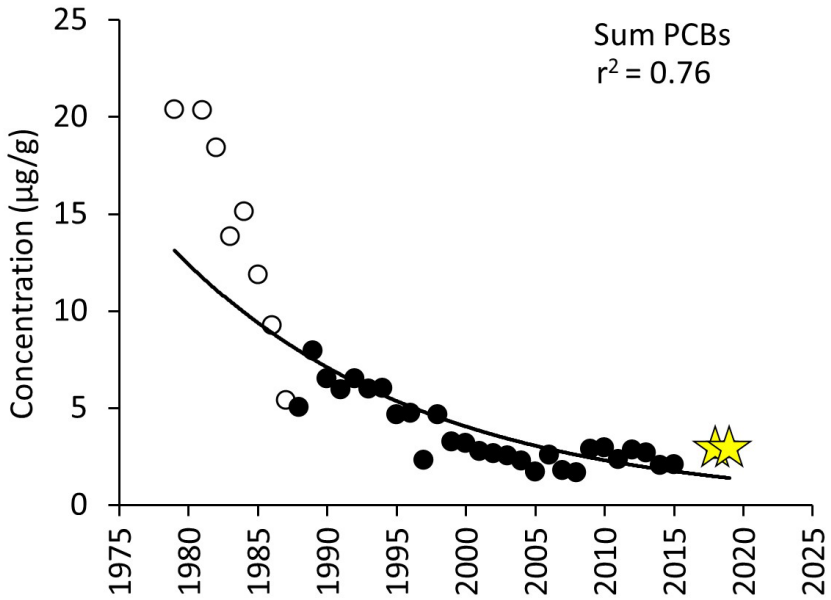
Egg viability in cormorants is considered to be not impaired.

Contaminants-Temporal Trends PCBs & Other Compounds

- Large and significant declines in several contaminants, including PCBs, were found in gull eggs from the AOC from 1979-2019

- How do trends in gull eggs from Buffalo Harbor in 2018 and 2019 ★ compare to those from Weseloh Rocks since 1979?

- A large and significant decline in PCBs was found in gull eggs from Weseloh Rocks from 1979-2015 with concentrations beginning to plateau in the 2000s.
- PCBs in Buffalo Harbor eggs aligned well with those from Weseloh Rocks.

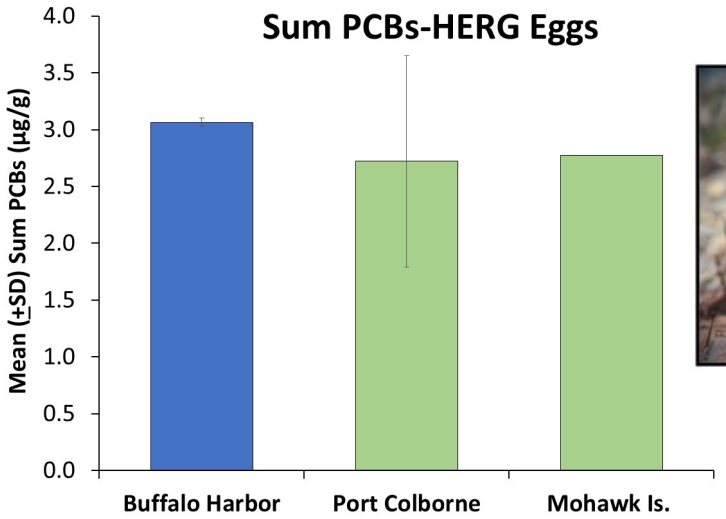


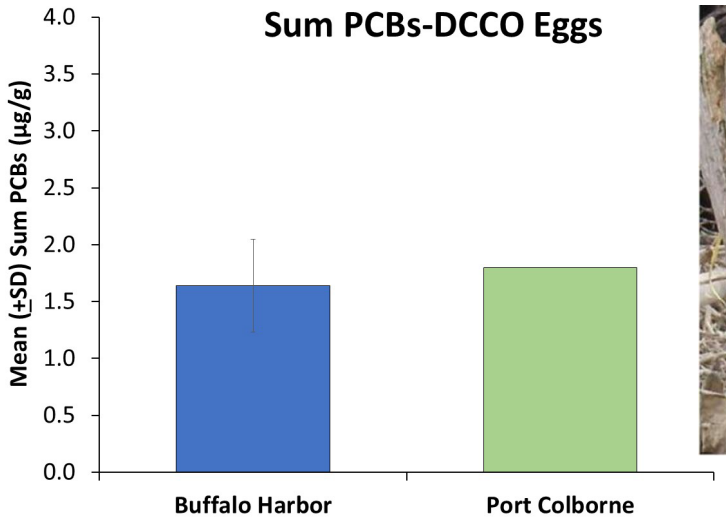
Contaminants-Temporal Trends
Mercury

- For mercury, a different pattern was found.
- While a significant decline in mercury concentrations was found in Weseloh Rocks eggs from 1981-2015, this decline was no longer significant when Buffalo Harbor eggs were included in the analysis.
- May be related to a general upward trend in mercury concentrations in fish and gull eggs from Lake Erie and well beyond effects associated with the AOC (also consistent with upward trend at Weseloh Rocks from 2005).
- Overall, suggests that mercury concentrations in gulls have remained stable over time in the AOC.

Contaminants-Spatial Trends PCBs & Other Compounds

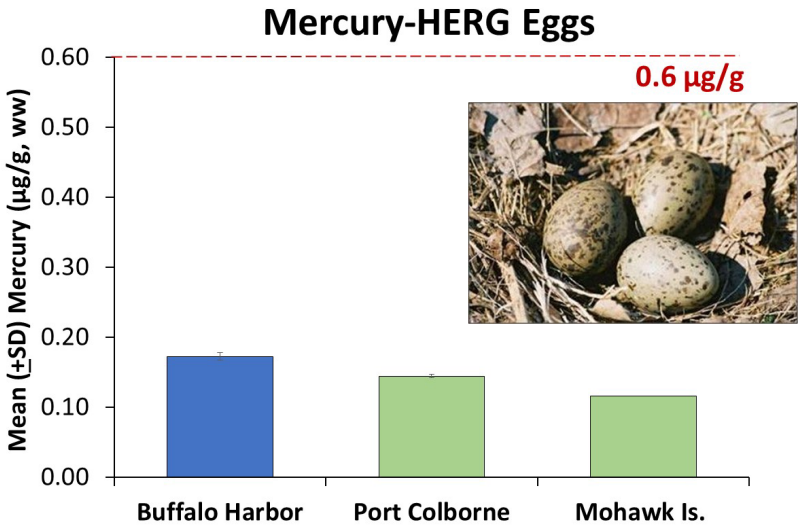
- Similar PCB concentrations were found in eggs between the AOC site & reference sites.
- Pesticides and flame retardants showed similar spatial patterns between study sites.

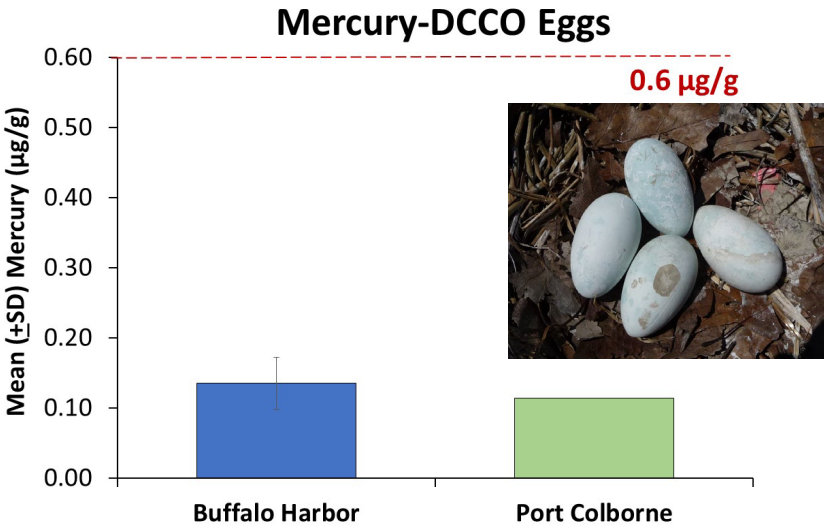




Contaminants-Spatial Trends
Mercury

- Higher mercury concentrations were found in HERG eggs from Buffalo Harbor compared to the two reference sites.
- Similar mercury concentrations were found in DCCO eggs between the two sites.
- Importantly, mercury concentrations in both species were well below the threshold concentration (0.6 µg/g) that might result in population-level effects and birds' ability to reproduce.





Wildlife Populations Conclusions

- ✓ Egg viability was similar between DCCO eggs at the NR AOC site (Buffalo Harbor) vs the upstream LE reference site in two study years.
- ✓ Temporal trends indicate that contaminant concentrations have declined (e.g., PCBs) or are stable (i.e., mercury) between the late 1970s/early 1980s to 2019.
- ✓ Spatial trends indicate that, for the majority of contaminants, concentrations in eggs are the same as those at the upstream LE reference site.
- ✓ For mercury, significantly higher concentrations were found in gull eggs from the AOC colony; however, mercury burdens were well below those associated with population-level effects in colonial waterbirds.

Recommendation: All wildlife-related goals have been met for this beneficial use in the Niagara River AOC.

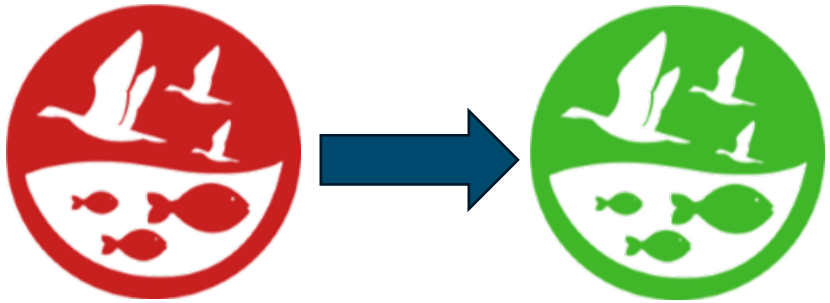
Acknowledgements

D. Crump, K. Williams, G Barrett, P Martin, D Moore all helped for egg collection or project design

The National Wildlife Research Centre did the analyses

Funded by the Great Lakes Action Plan, Environment and Climate Change Canada

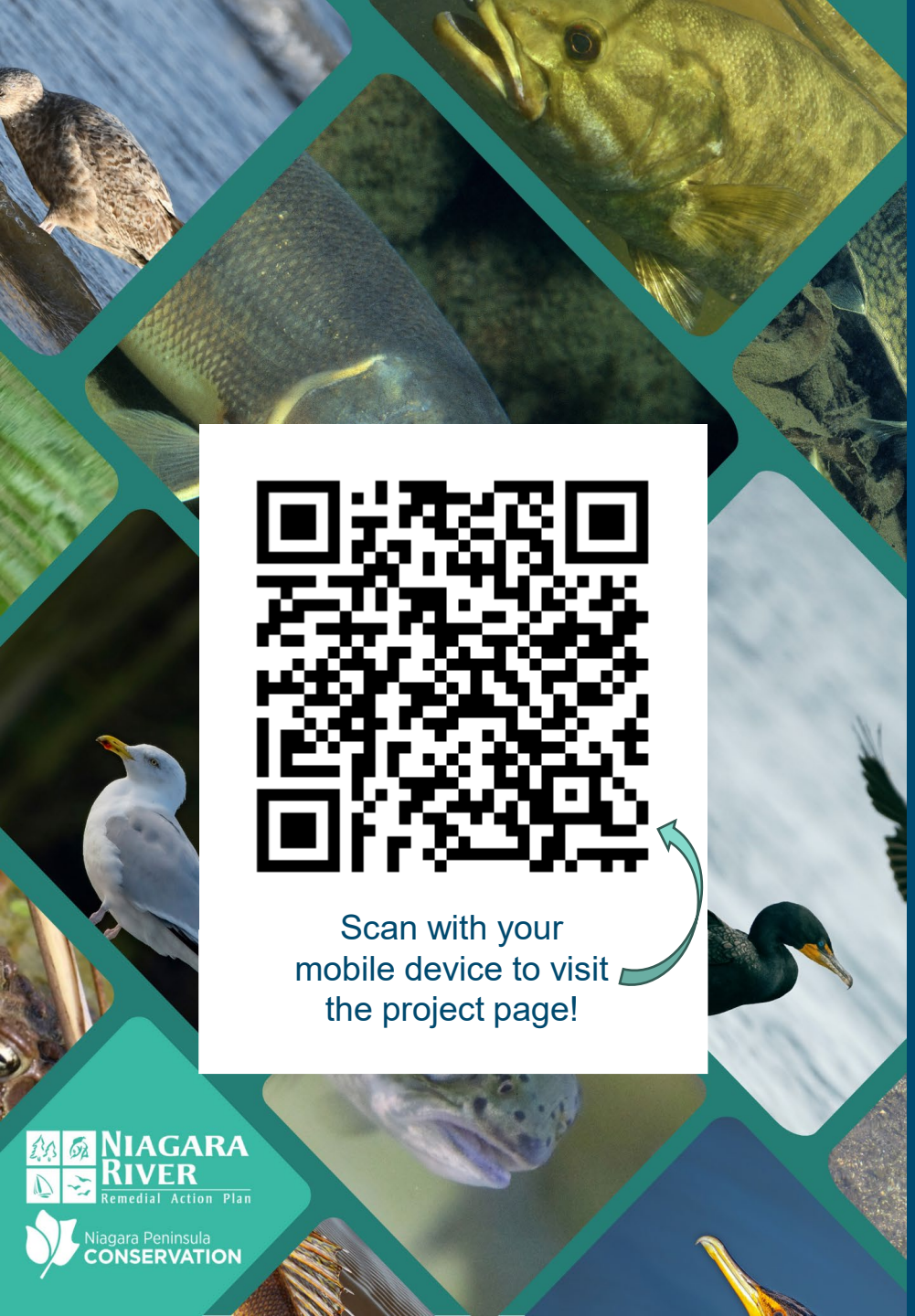
RECOMMENDATION



To officially change the status of the Degradation of Fish and Wildlife Populations BUI to NOT IMPAIRED

Q&A PERIOD

Please enter your questions directly into the Q&A box (not the chat).



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NIAGARA RIVER Remedial Action Plan

Niagara Peninsula CONSERVATION

THANK YOU

- Webinar presentations will be posted on the online engagement portal: **getinvolved.npca.ca/Niagara-river-fish-wildlife**
- Provide your feedback on the recommendation until MAY 31, 2024
- Let us know what you thought about this webinar through the Zoom follow-up survey