Mapping the Niagara River: generating multi-layer habitat maps for fish and benthic resources in the upper Niagara River

An Application for Funding Through the Ecological Greenway Fund

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Problem Statement

- The upper Niagara River (UNR) is important habitat for many aquatic species, esp. the lake sturgeon, invertebrates, turtles and native mussels

- No information about sturgeon habitat use, including feeding and spawning grounds

- No information on the distribution of benthic invertebrates and sturgeon prey

- Lack of current large-scale information of physical and biotic information in UNR which is important to improve decision making and guide habitat restoration

- Currently, there is no centralized ecological database that managers, agencies and stakeholders can access to inform their activities
Purpose

Improve the understanding of the upper Niagara River ecosystem and its biological resources which is critical for protection, restoration, and for promoting long-term sustainability.
Study Area

Upper Niagara River, including east and west branch, and Buffalo harbor
1. Collect depth, flow velocity and substrate as baseline data

Acoustic Doppler Current Profiler to obtain flow velocity data

Side Scan Sonar to obtain substrate data

Teledyne Odom ES 3 240 kHz
Seafloorsystems.com

Echosounder to obtain bathymetry data
1. Collect depth, flow velocity and substrate as baseline data mapping

Expected Results and Benefits

• Baseline data to generate maps of environmental factors (sediment, flow velocity, shear stress, depth, etc.)
• Placement of structures such as artificial spawning reefs (turtle, fish) underwater cables, pipelines and piers
• Identify areas of sediment accumulation or erosion
• Sediment and contaminant transport prediction
• Identification of flow refuges
• Detailed information necessary for permitting and regulation of future human activities such as dredging and construction projects

⇒ More effective benthic habitat management!
2. Document aquatic organisms as a measure of ecological health

• Sampling where?
  At least 100 sites (including historical sites) will be surveyed along the UNR using Ponar sampler, underwater camera and frames

• Sampling what?
  Benthic invertebrates and abiotic variables, such as water temperature, pH, sediment size, organic matter content and the presence of aquatic vegetation

• Assess community structure, pollutant-tolerance, diversity, abundance and biomass

• Compare the current status of benthic communities with historical data
2. Document aquatic organisms as a measure of ecological health

Expected Results and Benefits

• Using BMI diversity and pollutant-tolerance as an indicator of ecological health

• Estimate their value as food source (density/biomass) for higher trophic levels

• Identify depleted and species-rich areas

• Assess the success of former and ongoing habitat restoration projects by documenting changes in BMI community

• Create a reference baseline for future habitat remediation

• Information of BMI assemblages can later be used to accelerate the delisting of the BUI and eventually AOC
3. **Document the habitat use and feeding of lake sturgeon in UNR**

- Determine movement patterns and habitat use in UNR and Buffalo harbor by tagging at least 15 lake sturgeon

- Document lake sturgeon diet by using stomach content and isotope analysis to identify important prey items

- Done in coordination with US FWS office Lamar PA
3. Document the habitat use and feeding of lake sturgeon in UNR

Expected Results and Benefits

• Identify important habitats (e.g. feeding grounds, spawning grounds) used by sub-adult and adult lake sturgeon

• Develop methods to improve the conservation status of lake sturgeon

• Initiate activities to increase lake sturgeon populations

⇒ help to remove them from the New York threatened species list
Create habitat maps as a decision and management tool

- Link the physical habitat data (objective 1) with biological data (objectives 2 and 3) using ArcGIS and ecological models

- Maps will be used as management tool to identify locations of importance for habitat conservation and restoration based on the target species
4. Create habitat maps as a decision and management tool

Expected Results and Benefits

• Rapid identification of areas where potential habitat has the highest potential for restoration

• Provide a fundamental information layer for spatial and strategic resource planning

• Assess the importance, rarity and extent of habitats as habitats can be quantified
  ➔ Help facilitate restoration and monitoring efforts

• Maps can be revised when conditions are changing (e.g. discharge)

• To model the effects of different discharge scenarios on biota in the river

• Provide government, policy makers, and the public with timely datasets and data products to guide decision making
5. Develop a database by compiling data from all historic, current and future projects on the Niagara River ecosystem

<table>
<thead>
<tr>
<th>Project</th>
<th>Survey Year/Period</th>
<th>Prepared for</th>
<th>Investigator</th>
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<tbody>
<tr>
<td>A biological evaluation of the Niagara River.</td>
<td>1968</td>
<td>Ontario Ministry of Environment.</td>
<td>Veal</td>
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<td>Investigating Lake Sturgeon habitat use, feeding ecology and benthic resource availability in the lower Niagara River</td>
<td>2014-2016</td>
<td>Ecological Greenway Fund</td>
<td>Karatyev, A. E, Burlakova, L. E. Gorsky, D.</td>
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</table>

### Benthic Invertebrate Density (Ind. m²)

<table>
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<tr>
<th>Species name</th>
<th>Station</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</table>

- Project data will be linked to an interactive map showing the location, dates, purpose of the study, project results, and the performing agency
5. Develop a database by compiling data from all historic, current and future projects on the Niagara River ecosystem

**Expected Results and Benefits**

- Facilitate coordination between past, ongoing and intended projects to avoid duplication of efforts

- Allow analysis of data gaps

- Provide easy data access to a variety of stakeholders (e.g. managers, scientists, policy makers and the public) to guide decision making

- Allow the funding agencies to better coordinate and monitor activities and avoid duplication of efforts and funding
Summary

• Full coverage digital maps of physical and biotic information as baseline data

• Information of sturgeon habitat use to identify habitat of importance (feeding and spawning grounds)

• Information on benthic invertebrates to assess food resources for higher trophic levels as well as ecological health

• Combining physical and biotic information using habitat models and maps to facilitate decision making and restoration of target species

• Data base to compile information of past and current project
Already successfully applied for lower Niagara River:

Full coverage maps of bathymetry, flow velocity, and substrate in the lower Niagara River
Assessing potential feeding grounds for lake sturgeon

*Benthic biomass distribution in the lower Niagara River*
Assessing invasive species distribution and potential spread

Habitat suitability of exotic Dreissena spp.
The quantification of suitable habitat for benthic target species to support habitat restoration

Habitat suitability maps for major benthic communities in lower Niagara River
Thank you
Potential Questions

How can proposed study help restoration goals?