Investigating lake sturgeon habitat use, feeding ecology and benthic resource availability in the lower Niagara River

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Objectives

1. **Use bathymetric and habitat data obtained from USFWS’s side-scan sonar project on the lower Niagara River to create benthic habitat maps.** Using the habitat maps, **assess diversity and community structure of benthic invertebrates** in the lower Niagara River.

2. **Document habitat use, movements, and diet** of lake sturgeon in the lower Niagara River.
Create substrate map

Side scan sonar (SSS) survey by the USFWS in 2011
Create substrate map

Transfer raw sonar data into usable images (remove water column), beam angle corrections, assemble images)
Import data into ArcGIS 10
Create substrate map

What will the map show?

How many substrate classes?

→ How detailed
Preliminary Substrate Map

- Step A: Sonar Survey
- Step B: Geoprocessing of Sonar Data
- Step C: Develop Classification Scheme
- Step D: Create Habitat Map
- Step E: Assess Map Accuracy

Map with substrate classes:
- No Data
- Predominantly Sand
- Predominantly Gravel
- Silty Sand
- Silt
- Bedrock Base and Boulder
- Rocky Substrate
Assessing Map Accuracy

Underwater Videos – Grountruthing

Sediment Samples – Sieve Analysis and organic matter determination
Assessing Map Accuracy
Assessing Map Accuracy
Map Accuracy: Sieve Analysis

Ternary diagram to discriminate between the sub-ordinate substrate type as those have different characteristics, such as density, shear stress stability, and organic matter content.

Results from video images and sieve analyses proofed very good accuracy (75%) of substrate map based on side scan sonar, esp. for larger grain size.
Using the habitat maps, **assess diversity and community structure of benthic invertebrates in the lower Niagara River**

<table>
<thead>
<tr>
<th>Substrate Class</th>
<th>Area (km²)</th>
<th>Area (%)</th>
<th># Samples by area</th>
<th># Samples taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>11.8</td>
<td>43.1</td>
<td>43</td>
<td>41</td>
</tr>
<tr>
<td>Gravel</td>
<td>12.4</td>
<td>45.3</td>
<td>45</td>
<td>48</td>
</tr>
<tr>
<td>Silty Sand</td>
<td>1.4</td>
<td>5.0</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Silt</td>
<td>0.01</td>
<td>0.04</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Bedrock Base</td>
<td>1.4</td>
<td>5.0</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Rocky Substrate</td>
<td>0.2</td>
<td>0.6</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>No Data</td>
<td>0.3</td>
<td>1.2</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27.5</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>147</strong></td>
</tr>
</tbody>
</table>

147 benthic samples were collected and are currently being processed.
Using the habitat maps, **assess diversity and community structure of benthic invertebrates** in the lower Niagara River

**estimate** spatiotemporal changes in the **food availability** for Lake Sturgeon over an **entire year** (April 2014- 2015)

108 benthic samples have been obtained and are currently being processed
Preliminary results on benthos

- Bedrock and rocky substrate dominated by Dreissena mussels and amphipods throughout entire lower Niagara and Niagara bar

- Inverse relationship between Oligochaeta and Chironomid biomass and substrate size

- Hexagenia mayflies found – Indicators of good water and sediment quality!
Document habitat use and movements of lake sturgeon in the lower Niagara River.
Deployed 39 acoustic receivers

Retrieved and downloaded data from 35 receivers

Set 4 sentinel tags
Acoustic Tagging

75 lake sturgeon captured this season

Surgically implanted 30 acoustic tags
Document diet of lake sturgeon in the lower Niagara River.
Diet Analyses

**Stomach Content Analysis**
- Snapshot
- High taxonomic precision
- 33 samples collected
- All samples wet-weighed and identified

**Stable Isotope Analysis**
- Long term diet history
- Carbon sources
- Trophic position
- Over 100 samples collected
- 150 samples sent for analysis
Diet Analysis

Frequency of occurrence of prey groups

Prey Groups: Amphipoda, Round Goby, Monogenea, Chironomidae, Crayfish, Gastropoda, Dreissena, Shiners, Diptera, Hirundinea, Isopoda, Ephemeroptera...

Occurrence: 0.00 to 0.80
Values of $\delta^{15}$N and $\delta^{13}$C in lake sturgeon and prey items

- Sturgeon Fin
- Round Goby
- Crayfish
- Snail
- Dreissenids
- Oligochaetes
- Amphipods
- Chironomids
Future Tasks: Objective 1

**Benthic Habitat Map**

- Revise the substrate map
- Finish sieve and organic matter content analyses
- Add biotic and abiotic data layers to substrate map

**Assess diversity and community structure of benthic invertebrates**

- Finish taxonomic identification
- Using benthic community biological indices to prioritize habitats for conservation
- Compare current with historical data on benthic communities
- Analyze spatiotemporal changes in food availability at 3 sites
- Identify habitat of importance as feeding grounds for lake sturgeon
Future Tasks: Objective 2

**Telemetry**
- Recover and download receivers
- Analyze detection data and generate home range estimates
- Deploy acoustic releases in Spring 2015
- Tag 30 more sturgeon

**Diet Analysis**
- Collect more stomach samples in Spring
- Continue sampling benthic food resources
- Interpret stable isotope data
- Send more samples for analysis