Investigating Lake Sturgeon movement patterns, feeding ecology, and benthic resource availability in the lower Niagara River

Funded through the Ecological Greenway Fund

Final Report for 2018

Knut Mehler – Great Lakes Center
Eric Bruestle – Great Lakes Center
Alexander Karatayev – Great Lakes Center
Lyuba Burlakova – Great Lakes Center
Dimitry Gorsky – U.S. Fish and Wildlife Service
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 movement patterns, migrations, and trophic position** of lake sturgeon in the lower Niagara River.
1. Objective

Generate habitat maps and assess diversity and community structure of benthic invertebrates in the lower Niagara River.
3 physical habitat maps were generated

maps were the basis for benthic sampling design
Biological Information

Benthic samples were collected from 120 sites along the river, including invertebrates and sediment.

An underwater video clips was taken at each site for ground truthing and *Dreissena mussel* presence/absence.
Link physical habitat maps with biological information

Environmental Data Layers

Species distribution

MaxEnt
**Benthic Diversity and Biomass**

- **Mean Shannon Index:** $1.76 \pm 0.97$

- Areas with high diversity in nearshore U.S. areas, in with fine substrate, presence of macrophytes, and low flow velocity

- Low diversity in areas with invasive species being the dominant invertebrate

- Areas with high biomass in nearshore areas and river mouth, and in areas where Dreissena mussels are present

![Shannon Index and Wet Biomass Maps]
Sonar technology and underwater imagery analysis can enhance invasive *Dreissena* distribution assessment in large rivers

K. Mehlert · L. E. Burlakova · A. Y. Karatayev · Z. Biesinger · A. Valle-Levinson · C. Castiglione · D. Gorsky

Received: 31 January 2016 / Revised: 12 October 2016 / Accepted: 29 October 2016

© Springer International Publishing Switzerland 2016

**Abstract** *Dreissena* spp. are aggressive invaders of many waterbodies worldwide. However, the accurate assessment of their spatial distribution in large rivers is difficult using traditional sampling techniques such as Ponar grabs or SCUBA diving. The aim of this study was to use sonar technologies and underwater imagery (videos, still images) in tandem with traditional Ponar sampling to predict *Dreissena* presence, and produce a habitat suitability map to enhance our understanding of its spatial distribution in the lower Niagara River, New York, USA. Geo-referenced maps of environmental variables were generated using three sonar technologies: side scan sonar, multibeam sonar, and an Acoustic Doppler Current Profiler. *Dreissena* presence/absence was determined at 102 sites along a 10 km stretch using Ponar grabs supplemented by an underwater imagery. Substrate and near-bottom flow were the most important variables affecting *Dreissena* distribution. Habitats with course substrate and near-bottom flow of 0.6–0.80 m/s were predicted to be most often occupied. The habitat suitability model indicates that almost 90% of the stream bed in the river can be considered highly- or moderately suitable habitat. Our results demonstrate that supplementing traditional sampling with sonar technologies and underwater imagery can greatly improve *Dreissena* distribution assessment at the ecosystem scale.

**Keywords** *Dreissena* spp. · Large rivers · Sonar technologies · Underwater imagery · Habitat suitability modelling

**Introduction**

The exotic *Dreissena polymorpha* (Pallas 1771), the zebra mussel, and *D. rostriformis bugensis* (Andrusov
Spatial distribution of major benthic groups

Tubificidae  Naididae  Dreissena  Amphipoda
Temporal changes in the benthic community between 1983 and 2015

Abundances in upper and lower river were significantly lower in 2015 compared to 1983

- Changes in benthic community composition in the upper river between 1983 and 2015 were mainly caused by a dramatic increase of the low-tolerant to pollution caddisfly *Brachycentrus* sp. indicating improved water quality

- However, in the lower river pollution tolerant Oligochaeta dominated both 1983 and 2015 samples
Conclusion 1. Objective

- Habitat maps were created for the first time for the lower Niagara River that link physical variables with biological information.

- Species distribution maps can be used to locate potential feeding grounds for higher trophic levels, areas for restoration, translocation of rare species, and assess the spread of invasive species.

- They can also be used for various projects such as underwater structures.

- River shows signs of improvements in ecological health, however invasive species dominating the benthic community in terms of biomass.

- **But**: invasive invertebrates may facilitate higher trophic levels.

- The method for *Dreissena spatial* distribution assessment initiated during this project is now a part of the EPA long-term monitoring in the Great Lake.
2. Objective:

Lake Sturgeon Movements and Feeding Ecology in the lower Niagara River
Seasonal Residency
When we can hear them, Where are they?
Movement Conclusions

• We have identified when sturgeon are the most vulnerable to hydropower operations.
• Sturgeon activity levels and occupancy within the river is much higher in the Spring.
• This is coincident with spawning activity when water temperature is 12° C.
• There could be impacts to spawning success and egg survival.
Stable Isotope Sample Collection
Diet Conclusions

• We discovered a novel predator prey interaction.
• Invasive species, in particular round goby, are the most important prey items and could be driving the sturgeon recovery.
• As a result sturgeon in the Niagara River are reaching a higher trophic level at a younger age compared to any other system in the Great Lakes.
Round Goby: Curse or Blessing?

- Aggressive invader and strong competitor
- Can decrease benthic invertebrate abundance
- Fish egg predator
- However, Round Goby is an important prey item for higher trophic levels in the lower Niagara River
Seasonal monitoring using underwater videos
• Round goby nearly absent from nearshore by late November (6 °C) but extremely abundant in August (23 °C)

• Round gobies show strong migration patterns

• ~150,000 round gobies per ha
Major Outcomes

• Provided baseline data on the current benthic community and threatened lake sturgeon population
• Habitat maps can be used for a variety of scientific, management and community projects
• 4 papers published and 41 presentations
• Successful community outreach (festivals, schools)
• Supported 2 masters students
Acknowledgements