Greenway Ecological Standing Committee
Grantee Status Report

Status Report Date: *November 23, 2015*	
Project Title: *Investigating Lake Sturgeon habitat use, feeding ecology and benthic resource availability in the lower Niagara River*	
Organization: *Great Lakes Center, SUNY Buffalo State*	
Report Prepared By: *A. Karatayev, L. Burlakova, K. Mehler, D. Gorsky, and E. Bruestle*	
Contact Information: *716-878-4504; burlakle@buffalostate.ed*	
Project Start Date: *Jan 1, 2014*	Project Anticipated Completion Date: *Dec 31, 2016*

1. Describe what progress you have made toward each of your grant objectives since your last status report. Did you meet your goals for this period? Please be specific.

Objective A: Use bathymetric and habitat data obtained from USFWS's side-scan sonar project on the lower Niagara River ***to develop benthic habitat maps****. Using the habitat maps,* ***assess diversity and community structure of benthic macro- invertebrates (BMI)*** *in the lower Niagara River.*

Objective B: ***Document diet****,* ***habitat use*** *and* ***behavior (movements and migrations)*** *of Lake Sturgeon in the lower Niagara River.*

Progress has been made throughout 2015 and the goals for the period have been met. For a detailed description of how we met the goals and the work that has been done please see below.

To classify benthic habitats, a benthic map of the entire lower Niagara River and the Niagara Bar was created using side scan sonar imagery and ArcGIS 10 software. This map has been updated and modified based on 80 underwater videos (please see section 2).

To assess the diversity and community structure of benthos, benthic invertebrates from the 147 survey sites sampled in 2014 have been processed and identified. We are currently working on classification of benthic habitats by matching the identified substrate classes with benthic community abundance and structure. In addition, we collected benthic samples and abiotic factors, such as water depth, substrate and temperature from 15 historic sites (that were surveyed in 1983) to compare the current benthic community composition with the historic community. These data will help to assess the impacts of improved water quality as well as the effect of restoration efforts over the past 30 years on the benthic community. We also took 20 nearshore benthic samples as the shoreline may be an important ecotone for rare species and a diverse invertebrate community.

Near bottom flow velocity and shear stress are important abiotic factors that affect the benthic community. Two surveys in July and August 2015 measured the flow velocity at different depths for the entire lower Niagara River (please see Fig. 4). The results will be used to create a flow map that will be added as an additional layer in our benthic habitat map.

The 60 sediment samples that were taken to determine the grain size distribution and the organic matter content of the substrate have been processed.

To estimate spatiotemporal changes in the food availability for lake sturgeon over an entire year, we continued bi-monthly sampling from three sites in 2015 (two in the Niagara River and one near the river mouth in Lake Ontario). We collected 42 samples from April 2014 to September 2014 and, another 20 benthic samples from September 2014 until March 2015.
Benthic invertebrates from the 15 historic sites, the 20 bi-monthly sampling sites and the 20 nearshore sites have been live-picked and are currently being processed in the lab.

To document diet of lake sturgeon, 170 lake sturgeon were captured between May and August 2014-2015 using baited setlines. Each setline consists of 25 baited hooks strung between two anchors and fished for 24 hrs. A total of 6-8 setlines were deployed each day in productive sturgeon capture locations. Of the 170 lake sturgeon captured, 29 stomach content analysis (SCA) samples were taken by gastric lavage, a process by which water is pumped into the stomach to induce regurgitation. Expelled stomach contents are collected on a 500 µm mesh screen and preserved in a 10% formalin solution. The samples are taken back to the laboratory for identification and weighing to determine the composition of the sturgeon diet as well as the importance of certain taxonomic groups. All 25 stomach samples collected in 2014 have been processed since our last report and the additional 29 samples collected in 2015 being processed.

Whereas SCA provides a snapshot of very recent diet history with high taxonomic precision, stable isotope analysis (SIA) gives an indication of longer-term, time-integrated diet history. For this reason, the two techniques are often used in conjunction in ecological diet studies. Stable carbon isotope ratios can identify the relative contributions of various carbon sources in the environment, littoral or pelagic, autochthonous or allochthonous. Stable nitrogen isotope ratios can estimate the trophic status of lake sturgeon when compared against the baseline food resources available. We established this baseline in 2014 by taking bi-monthly BMI samples with petite PONAR. In total, 43 BMI samples have been collected and analyzed. In 2014, 110 samples of red blood cells, plasma, and fin tissue were collected from lake sturgeon and analyzed. Thus far in 2015, over 300 lake sturgeon tissue samples have been collected and are awaiting analysis.

To document habitat use and behavior, 39 acoustic receivers was deployed, 13 outside the mouth of the river in a curtain arrangement, and 12 in groups of 4 spaced out along the river to serve as detection gates, and the remaining receivers placed in tight groups in productive sturgeon capture locations. We downloaded the data from the receivers throughout the 2015 season and will continue to monitor the receivers through the fall. In 2015, 30 acoustic tags were surgically implanted into lake sturgeon. These tags emit an ultrasonic pulse that is detected and logged by the receivers at a range of about 500 m. By knowing the locations of the receivers that detected a pulse from a tagged fish, it is possible to estimate the location of the fish. Some of the tags we used also transmit depth information. The acoustic detection database has several million records so far and continues to grow.

2. How did you measure your progress since your last status report? What kind of data have been collected to determine whether progress is being made or not being made? What results have been obtained since your last status report?

The progress for objective A is measured by the number of benthic samples that have been processed since our last status report as well as the number of invertebrates identified (please see part 1 of this report) and analyzed.

Preliminary results on the abundance (total number of organisms) and the biomass are shown in Figure 2. We found that while the density of benthic invertebrates in fine substrates was 3 times higher compared to the abundance in coarser substrates, the invertebrate biomass was higher in sand and gravel mostly due to the prevalence of invasive dreissenid mussels (Fig.1).

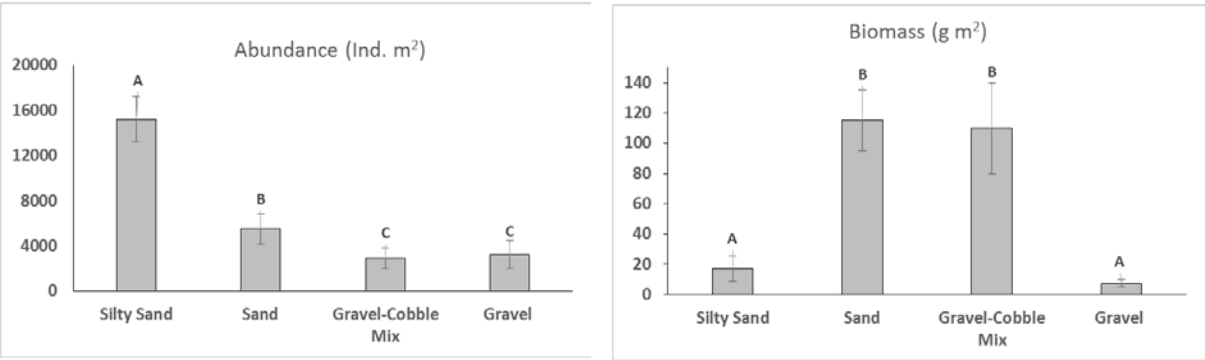

Fig. 1. Abundance and biomass of benthic invertebrates sampled from different substrate in the lower Niagara River.

Another important progress that has been made is the improvement of the substrate layer based on the analysis of the underwater videos and sediment samples. Additional physical habitat layers have been created, including a depth and bottom flow velocity. We are currently working on a bathymetry map as well as a map that will show the spatial distribution and abundance of benthic invertebrates throughout the lower Niagara River.

The physical habitat layers will be georeferenced in ArcGIS to generate maps and to facilitate overlay analysis of those maps. This will allow us to identify and locate habitats in the lower Niagara River based on a species habitat requirements. Figure 2 provides an example of how these physical habitat maps can help to locate potential sturgeon spawning habitat based on the interaction of bottom flow velocity, substrate and depth.

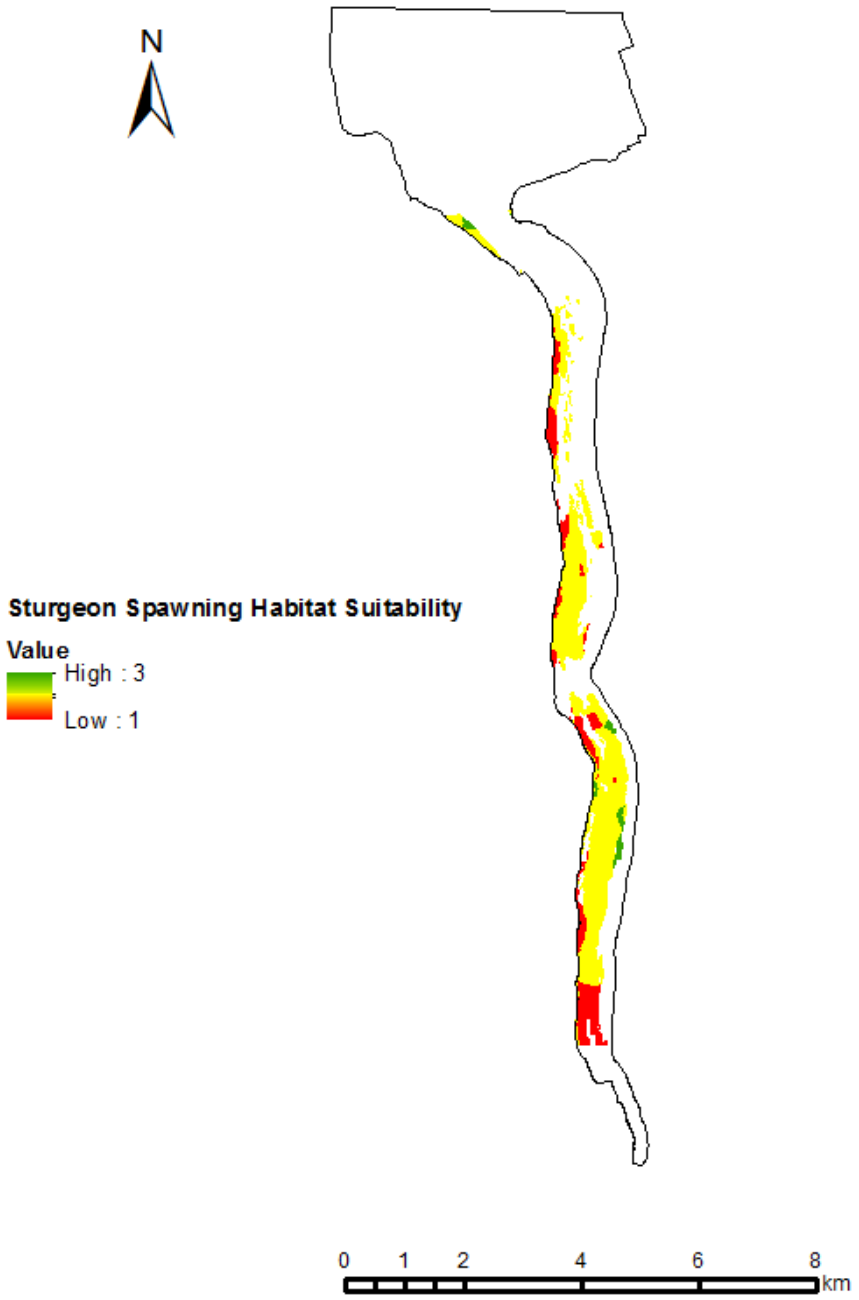

Fig. 2. Map of sturgeon spawning habitat suitability classes (blank = not suitable, 1=low suitability, 3=high suitability)

Progress for objective B is measured by the numbers of fish collected, tags implanted, and

samples collected and analyzed. This season we have captured many more sturgeon than last year and thus have more stomach and tissue samples to analyze. Preliminary stable isotope results (Figure 3) show the approximate trophic levels of sturgeon and their prey items based on their stable nitrogen isotope signature. The stable carbon isotope values indicate that sturgeon feed on these prey items throughout the year.

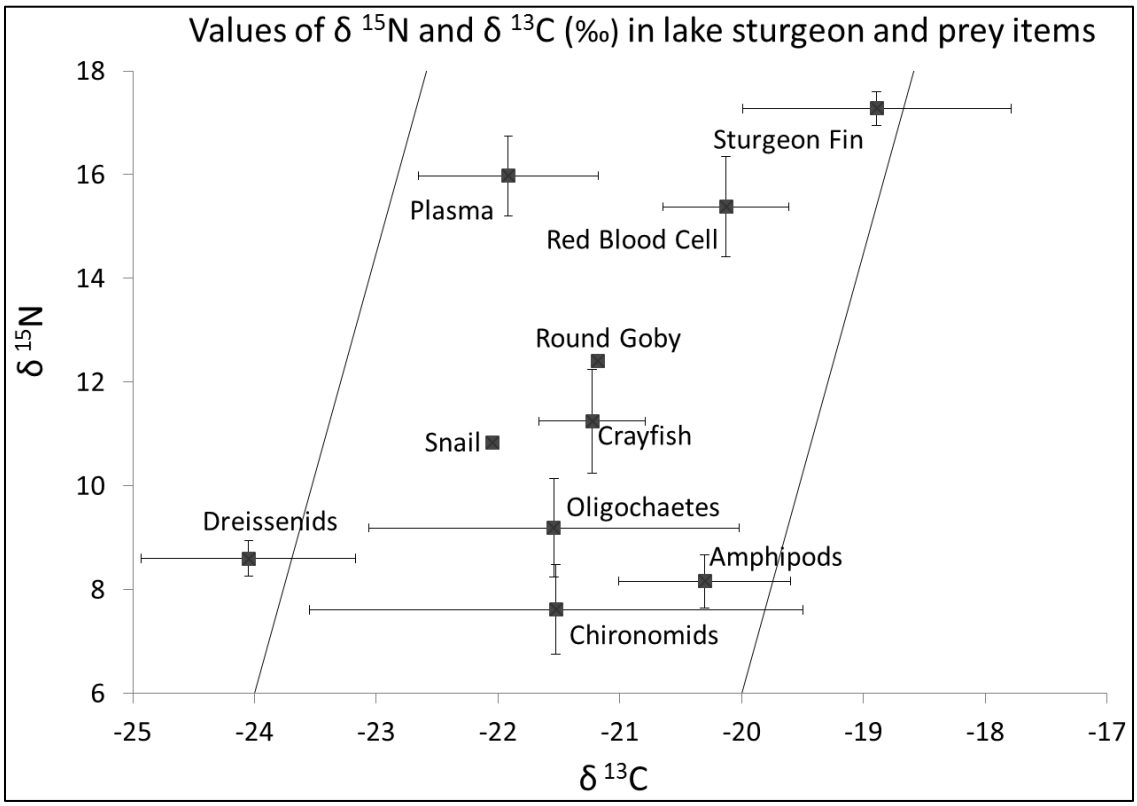

Fig. 3. Stable carbon and nitrogen isotope biplot of lake sturgeon tissue and prey items. Trend lines indicate trophic shift.

To disseminate the key findings of our study to regional and international scientific community, local community, agencies, and policy makers we presented our first year results at several international and local meetings:

1. Mehler, K., A. Karatayev, L. Burlakova, and D. Gorsky. Benthic habitat mapping using remote sensing and GIS in the Niagara River. 58th Annual Conference on Great Lakes Research. May 25-29, 2015, Burlington, Vermont.

2. Mehler, K., A. Y. Karatayev, and L. Burlakova. 2015. Long-term dynamics of *Dreissena* app. In Lake Erie: Insight for population boom and bust. Oral Presentation at Society of Freshwater Science, Annual Meeting, Milwaukee, Wisconsin USA, May 17-21th 2015.

3. Mehler, K., Burlakova, L. Karatayev, A. Y. and E. Bruestle. 2014. Using remote sensing to develop benthic habitat maps in the lower Niagara River. Poster Presentation at the 15th Annual Faculty/Staff Research and Creativity Fall Forum. Buffalo State. The State University of New York, October 29th, 2014.

4. Bruestle, E., Gorsky, D., Mehler, K., Karatayev, A.Y. and L. Burlakova. 2015. Investigating lake sturgeon habitat use and residency in the lower Niagara River. 58th Annual Conference on Great Lakes Research. May 25-29, 2015, Burlington, Vermont.

5. Bruestle, E., Gorsky, D., Mehler, K., Karatayev, A.Y. and L. Burlakova. 2014. Investigating lake sturgeon habitat use and feeding ecology in the lower Niagara River. Poster Presentation at the 15th Annual Faculty/Staff Research and Creativity Fall Forum. Buffalo State. The State University of New York, October 29th 2014.

6. Bruestle, E., Gorsky, D., Mehler, K., Karatayev, A.Y. and L. Burlakova. 2015. Lake sturgeon habitat preference and feeding ecology in the lower Niagara River. New York Chapter of the American Fisheries Society Annual Meeting. Feb 4-6, 2015, Lake Placid, New York.

7. Gorsky, D. 2015. Lake Sturgeon population in the lower Niagara River. NYS DEC Lake Ontario State of the Lake Public meeting Lockport, NY.

8. Gorsky, D. 2015. What was lost, now is found: The story of lake sturgeon recovery in the lower Niagara River. Cornel Biological Field Station at Shackleton Point, NY.

9. Gorsky, D. 2015. Restoration of Lake Sturgeon in the Great Lakes. Niagara County Fish Expo. Niagara Falls, NY.

10. Gorsky, D. 2015. Region 5 Lake Sturgeon Restoration Update. Region3/5 Coordination Meeting Basom, NY.

3. What challenges have you encountered since your last status report? How are you addressing these challenges?

A problem we still encountering is the difficulty to obtain sediment samples with a PONAR grab in areas of bedrock and gravely substrate and thus we were only able to obtain a sample at 150 out of 200 (75%) sampling sites. The southernmost part of the lower Niagara River lacks data due to the strong currents near the gorge that prevented safe and successful sampling. Therefore, those areas are currently indicated as 'no data' on the substrate map (Fig. 2). We are currently testing the efficiency of indirect sampling methods such as underwater videos to assess the benthic community from these substrates.

One major challenge to our study is the timely retrieval and download of the acoustic receivers. We have been collecting the receivers using a grapnel hook and while we have been successful in hooking most of the receivers, it takes lots of time. For receivers that we cannot find by grapnel hook, we have sent divers to locate. This has improved success, but also takes time. Additionally, there are a couple of receivers that we cannot find at all. Either the flow of the river or ice has relocated them. To address this problem, we have started fitting the receivers with acoustic releases. These releases can be triggered remotely, causing the receiver to float to the surface for recovery. This added technology is expensive upfront, but should be worth it in terms of time saved and higher receiver recovery rates.

4. Are you on schedule to complete your project in the proposed timeline? If not, please explain why you are ahead or behind schedule.

Based on the progress we have made up to this point we are certain that the project will be completed within the proposed timeline.

5. Please use the table below to report your expenditures since your last status report. Include in-kind support from other resources have you used since your last report below the table. Please explain any differences between anticipated and actual expenditures. Attach copies of any relevant receipts or invoices to this report.

Budget Categories	GESC-approved budget	Funds or in-kind support from other resources	Total expenses to date (October 31st 2015)	Remaining balance
Salaries and Benefits	133,517.00	25,670.63	131,734.43	1,782.57
Travel	7,000.00		4,281.39	2,718.61
Equipment				
Supplies	15,353.00		1,782.01	13,570.99
Meetings				
Printed Material				
Consultants	1,000.00		1,000.00	0.00
Contractual/SubAward	76,274.00		65,868.55	10,405.45
Other	0	40,224.64	-5.91	-5.91
Total Funds	**233,144.00**	**65,895.27**	**204,660.47**	**28,483.53**

This report reflects expenditures through October 2015. Subaward costs of $13,508.61 have been charged but are not captured as expenditures on this report. An additional $15,592.71 in subaward/contractual costs is encumbered.

Other sources of match include indirect costs on the match salary and fringe, along with $30,534.22 of waived IDC.

6. What progress toward your objectives do you expect to make before your next status report? Please be specific.

<u>Before the next status report we plan to:</u>

1. Continue taxonomic identification and estimation of biomass and density of BMI from the 15 historic sites and 20 nearshore samples collected in August of 2015. Also, benthic invertebrates from 25 benthic samples from the bi-monthly survey still need to be identified.

2. Link invertebrate communities with habitat information (e.g. substrate size, organic matter content, water depth, water temperature, vegetation cover) to provide data on the spatial distribution, quality and quantity of benthic resources.

3. Extrapolate the results under #2 to the entire river using the substrate map to locate benthic diversity hotspots in the river which can be assigned as feeding grounds for higher trophic levels (i.e. lake sturgeon).

4. Finish processing stomach samples and prepare and send stable isotope samples for analysis.

5. Continue to retrieve and download the data from the deployed receivers and analyze the detections to document the movements and habitat use of lake sturgeon.

6. The results of this study will be presented at international Conferences, such as the 2nd International Meeting on Biology and Conservation of Freshwater Bivalves in October 2015 and at the International Association of Great Lakes Research in spring 2016.

7. Please include 1 to 2 photographs with dates and short descriptions taken since your last project report.

Fig.4. Acoustic Doppler Current Profiler for flow velocity measurement

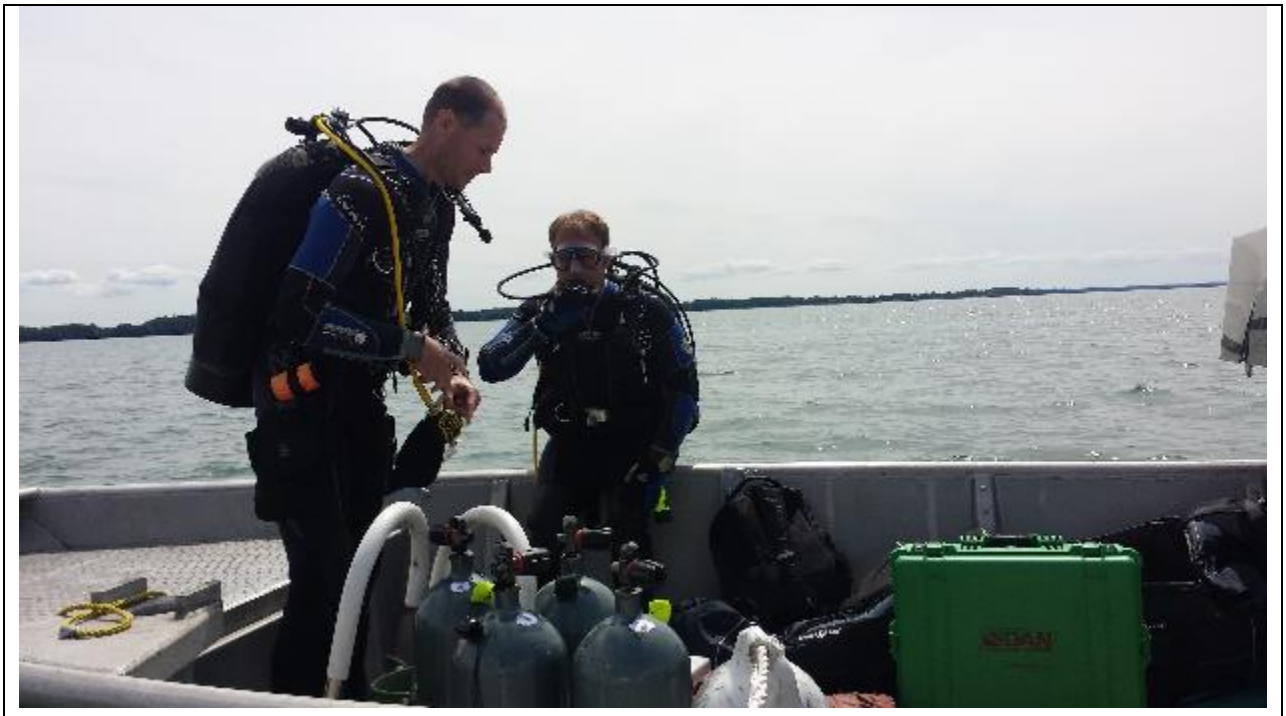

Fig. 5. Diving for receivers

Fig. 6. Dried invertebrate samples ready to be packed and sent out for analysis.