

Greenway Ecological Standing Committee
Grantee Status Report

Status Report Date: November 17, 2014	
Project Title: Emerald Shiner Habitat Conservation and Restoration Study in the Upper Niagara River: Importance for Sport Fish, Common Terns and Public Education.	
Organization: State University of New York – Buffalo State	
Report Prepared By: Dr. Alicia Pérez-Fuentetaja	
Contact Information: (716) 878-4608, perezfa@buffalostate.edu	
Project Start Date: 01/01/2014	Project Anticipated Completion Date: 05/31/2017

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 1: Locate and quantify the types of habitats preferred by shiners and determine which ones are more important for reproductive success. Examine food resources for juvenile and adult shiners and their trophic position.

We have collected samples and data from selected sampling sites in the upper Niagara River (see map) from May 29th to October 20th that cover a variety of habitats: mouths of streams, islands, vertical concrete walls and bulkheads, marinas, wetlands and marshes.

The type of samples collected to address this objective (goal) is shown in the following table:

Sample Type	Sampling Regime	Number of Sites
Daytime Electrofishing	Every other week	11
Night-time Electrofishing	Once	3
Seining (larval, juveniles)	Every other week	6
Marina Sampling – larval nets	Weekly	8
Bongo nets – larval sampling	Every other week	5
Zooplankton, Chlorophyll <i>a</i> , Total Phosphorus	Every other week	3
Physico-chemistry (T, D.O., Conductivity, pH)	Weekly	13

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To determine when reproduction took place, we are in the process of dissecting adult shiners and determining gonad development as an indicator of readiness to spawn by using the gonadosomatic index (GSI). The GSI of the adults, together with the first appearance of larval emerald shiners and the locations where the larval fish were collected will provide an understanding of when the spawning occurred, how many spawning events have taken place and the habitats that the larval fish are utilizing. Field observations of these habitats and observations of juvenile emerald shiners aggregating into schools will also facilitate the identification of nursery habitats for these fish in the upper Niagara. Samples have been collected to examine available food resources for shiners: zooplankton from the river, shiners' stomachs to determine contents and shiner tissue to do stable isotope analysis of C and N ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$). These samples will be processed during the Fall/Winter months.

Objective 2: Determine if genetic differences exist among populations of emerald shiners in the upper Niagara River, eastern Lake Erie, the lower Niagara River and western Lake Ontario. This knowledge is vital in conservation biology of the species and to design a management plan for the emerald shiner.

Emerald shiners have been collected to determine genetic differences among populations in different sites (i.e., to answer the question of whether the emerald shiners in the Niagara are part of a larger population or have unique genetic markers). Three distinct periods in time have been chosen to see if there are temporal differences in the genetic make-up of the population:

Date	Location	# shiners
June 12, 2014	Eastern Lake Erie (Mouth of Cattaragus Cr., Silver Creek)	50
June 13, 2014	Upper Niagara River	50
July 14, 2014	Eastern Lake Erie (Mouth of Cattaragus Cr., Silver Creek)	50
July 15, 2014	Upper Niagara River	50
July 16, 2014	Western Lake Ontario (Wilson, NY)	50
July 17, 2014	Lower Niagara River	50
Sept. 16, 2014	Eastern Lake Erie (Mouth of Cattaragus Cr., Silver Creek)	50
Sept. 17, 2014	Upper Niagara River	50

The 400 genetic samples were prepared right after collecting the fish, preserved with RNA-later and frozen at -80°C . Shipment to the Bioinformatics Institute (Virginia Tech) for processing is in progress. Dr. Pawel Michalak has already processed a sample of emerald shiners sent to him on June 30th to prepare genetic primers to process the shiners from the four locations above.

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Objective 3: Determine water velocities at different locations used by the larvae/juveniles and adults and determine if they pose an obstacle for natural migration patterns using field and laboratory experiments. Analyze the importance of fish barriers and evaluate mitigation measures on fish passage. Design alternatives to these barriers (USACE).

This objective is part of the in-kind contribution (matching funds) of the US Army Corps of Engineers to this project. Please see attached document submitted by USACE addressing this objective.

To date the focus area of the field collection has been along the Broderick Park seawall, upstream of the shoreline recess, where emerald shiners have been observed to congregate during their upstream movement into Lake Erie. Using an Acoustic Doppler Velocimeter, point velocity measurements were collected close to the seawall, along the 250 m stretch, upstream from the shoreline recess to the starting point of Bird Island Pier. The measured velocities are in the range of 0.8-1.4 m/s which is beyond the known swimming capability of emerald shiners. These velocity values suggest that there exists a possible hydrodynamic barrier to emerald shiner movement. Also, from past studies, flow turbulence, Reynold's shear stress and eddy length scales have been identified as possible factors impacting fish swimming capability. Preliminary results from turbulence analysis indicate eddy length scales to be on the order of 0.7 – 5 times the size of emerald shiner. Therefore, the average size of the turbulent eddies in the river in this region are those that are the most energetically costly to emerald shiner movement.

Also, the first version of a 2-D numerical model detailing the hydrodynamic and physical characteristics of the upper Niagara River from Fort Erie to the northern tip of Squaw Island has been completed. Several revisions will be made to this version of the model to more accurately represent significant features along the US and Canadian shorelines. Historical flow rate and water level data provided by the New York Power Authority have been compiled and processed to identify the range of water level conditions to test in model simulations. Analysis of acoustic Doppler current profiler velocity measurements collected for the river continues. These measurements will be used to validate future model outputs. In the upcoming weeks, model simulations will be run for five base scenarios identified in the NYPA data to create depth-averaged velocity profiles for the upper Niagara River. Ultimately, these scenarios will be compared against known emerald shiner swimming abilities to evaluate hydrodynamic barriers to emerald shiner movement.

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Objective 4: Study sport fish consumption of emerald shiners and determine the importance of shiners in their diet in the upper Niagara River. Likewise, study common tern consumption of shiners and what they feed to their chicks by trophic position determination.

Sport fish will be sampled on year 2 (2015). To determine the consumption of shiners by predatory fish, a stomach lavage procedure will be performed in the field to the predators (smallmouth bass, yellow perch, etc.) following standard non-lethal procedures. The fish will be anesthetized during the lavage procedure, which involves using a syringe with a small flexible tube to gently squirt water into the stomach in order to retrieve the stomach contents. During the lavage, the fish will be anesthetized with MS-222 at a concentration of 100 mg/L to produce sedation. The sport fish will then be allowed to recover in a tank with oxygenated water and will be released back into the river.

Common terns have been obtained from the NYSDEC (Connie Adams); both chicks and adults that have died of natural causes. Tissue from these birds will be prepared for stable isotope determination ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$). NYSDEC also collects data on tern diet and we will compare our stable isotopes results with their stomach content analysis.

Objective 5: Identify key emerald shiner habitat, including mouths of tributaries and bankside vegetation. Develop a conceptual plan for habitat restoration for key habitats (in coordination with other habitat restoration projects underway by USACE, USFWS, NYSDEC, and Buffalo Niagara Riverkeeper).

We have sampled a variety of habitats in the upper river (see comment to objective 1 above) to determine what types of habitats are preferred by the emerald shiners. This sampling effort will continue during year 2 (2015) and the data will be analyzed and used to develop a conceptual plan for habitat restoration in year 3 (2016) in collaboration with USACE (matching funds to this project) that will be open for comment to the other collaborators in this project.

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Objective 6: Characterization of nearshore plant communities in key emerald shiner habitats, supplementing both existing data collected and new data being developed by Buffalo Niagara Riverkeeper as part of their ongoing Niagara River Habitat Conservation Strategy. Create a habitat quality index for the emerald shiner in the Niagara River to compare the status of different habitats in the river for shiner recruitment.

This work is scheduled for years 2 and 3 (2015-2016) and is part of the in-kind contribution of the US Army Corps of Engineers to this project (please see attached document submitted by USACE addressing this objective). This effort will include benthic mapping of vegetation and substrate in areas of particular interest using sonar data. Submersed aquatic vegetation (SAV) and substrate maps will be generated using ciBiobase. Once data are processed and maps are generated, there will be a groundtruthing effort to verify the composition of the mapped SAV beds and substrates.

The habitat quality index for emerald shiners in the river will be developed in year 3 (2016) when all data for this project have been collected and analyzed.

Objective 7: Develop materials for education and outreach in collaboration: videos, talks to interested groups and schools. Include groups traditionally excluded from environmental decision-making. In addition, provide a Geographic Information Systems (GIS) map with information on habitat use by emerald shiners to interested parties for management and restoration purposes.

An education specialist has been hired and she has prepared education materials for outreach purposes (see attached file "Shiner Factsheet") and will give a PowerPoint presentation at the River Academy Forum on Nov. 22, 2014. The outreach and education efforts will be implemented during the summer seasons of years 2 and 3.

The GIS map will be created in year 3 (2016) by SUNY-Buffalo State in collaboration with USACE utilizing the information collected in years 1 and 2.

We have met all the goals for the year 1 field season, except that the vegetation mapping will start in year 2 as explained above. Sample processing will take place during the rest of year 1 and the beginning of year 2.

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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?

We measure our progress from the beginning of the 2014 field season; the beginning of this project in the field. We have made excellent progress in identifying sampling sites in the upper Niagara River to address the objectives of this project. We have obtained the samples that we need to study the population dynamics of the emerald shiner in the upper river and their genetic make-up. We have coordinated our efforts with our collaborators to ensure that we are covering all aspects of this project. In the outreach aspect of this project, we have produced a handout to be used for education purposes at fishermen meetings, schools, fairs, open houses, forums, etc. (see attached). Also a Power Point presentation has been prepared for the same purposes, to expose the public through oral presentations to the importance of the emerald shiners in the Niagara River. Finally, a project website is in progress for the public to have electronic access to the information about the project, our activities, and the ecological importance of the emerald shiner in the upper Niagara.

The three graduate students currently working in this project have narrowed their thesis research to specific project proposals that they will be defending this Fall (2014). The topics are:

- Jacob Cochran: Larval emerald shiner population dynamics and interspecific interactions.
- Chris Osborne: Reproductive ecology and bioenergetics of the emerald shiner.
- John Lang: Genetic and morphological variation in emerald shiner populations from the Niagara River, Lake Erie and Lake Ontario.

A fourth graduate student (Steven Fleck) will be joining this group in January 2015 to study the vegetation and substrate in the upper Niagara as habitat components for emerald shiners.

Right now we are processing the samples collected during the field season. Some of the results so far are included below:

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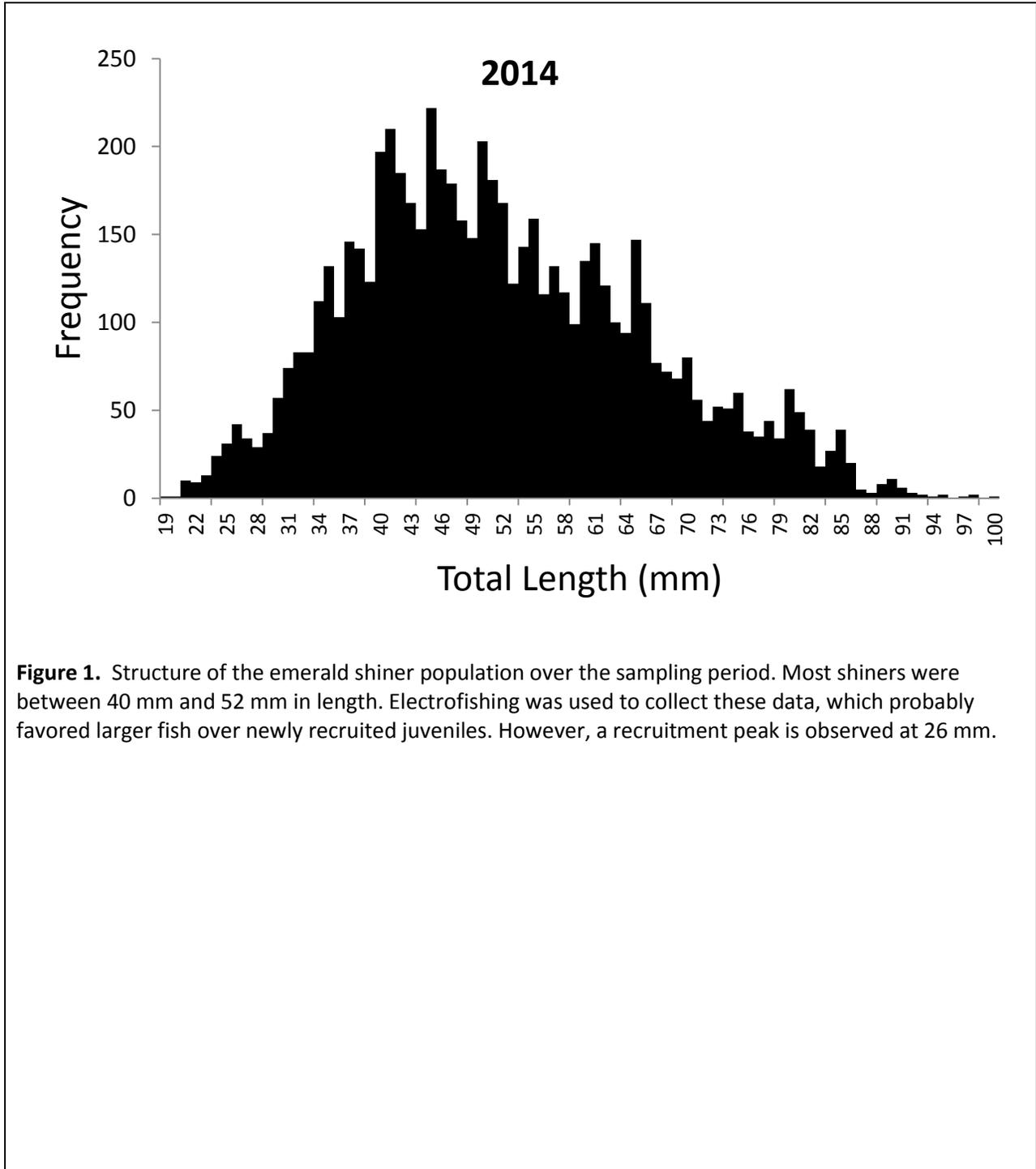


Figure 1. Structure of the emerald shiner population over the sampling period. Most shiners were between 40 mm and 52 mm in length. Electrofishing was used to collect these data, which probably favored larger fish over newly recruited juveniles. However, a recruitment peak is observed at 26 mm.

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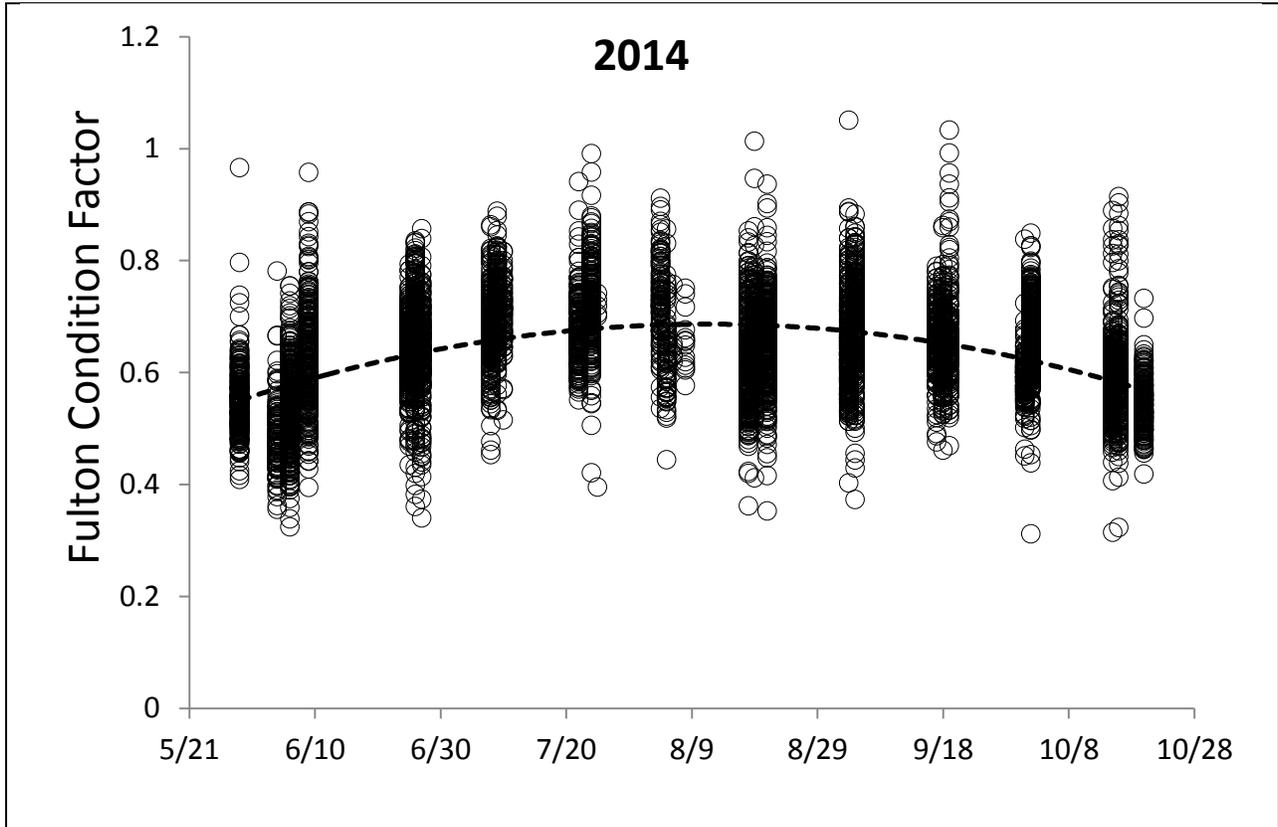


Figure 2. The condition of the emerald shiners was highest from late June to early September and lower in Spring and Fall, indicating increased resources in the river as well as favorable temperatures during summer, which precluded gonad development and reproduction.

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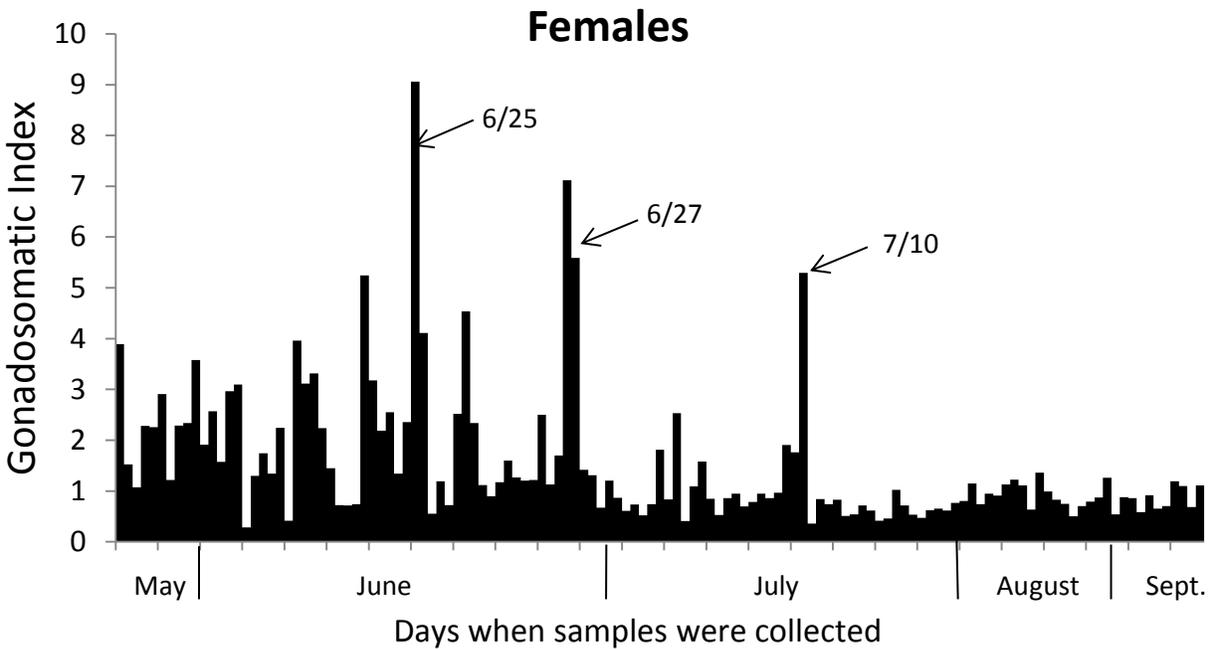


Figure 3. Female gonad weight in relation to body weight (gonadosomatic index or GSI) increased in late Spring in preparation for spawning. GSI peaked from late June to the early weeks of July, indicating a spawning event during that time period.

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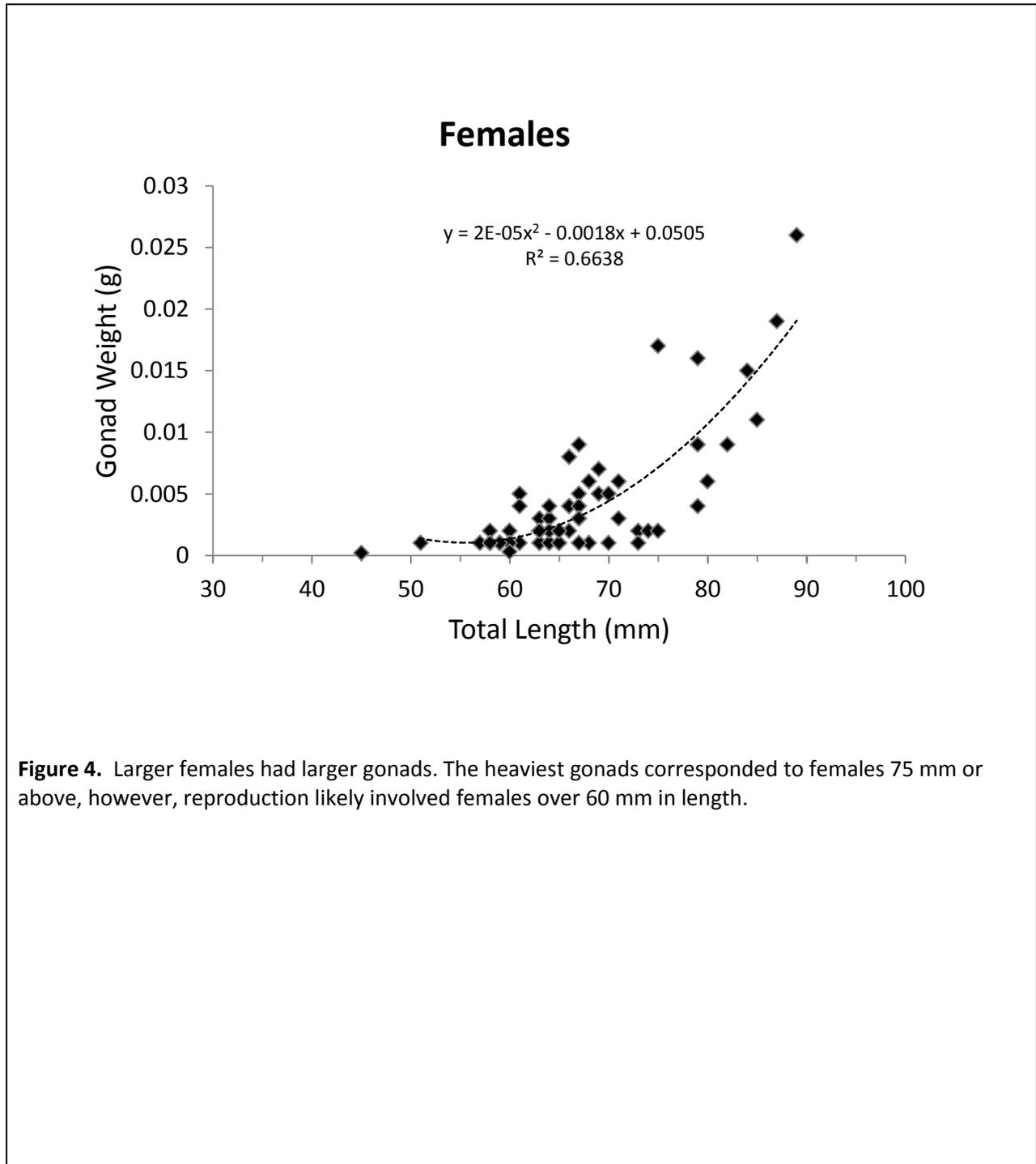


Figure 4. Larger females had larger gonads. The heaviest gonads corresponded to females 75 mm or above, however, reproduction likely involved females over 60 mm in length.

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

One of the members of our team (Daniel Potts) decided to abandon the project at the beginning of the field season to pursue other interests. He had been designated as our plant biologist in the project proposal. We addressed this challenge by calling a meeting with our collaborators to determine how best to proceed in order to address the vegetation study for this project. It was decided that because USACE is going to map the vegetation next summer (2015) in the upper Niagara, including groundtruthing, that we will obtain all the information needed to determine vegetation influence on the emerald shiner life history. In addition, a new graduate student (Steven Fleck) with background and interest in plant biology will join us in Spring 2015 to work on this aspect of the project. Steven has established connections with botanists in various museums and organizations and can get taxonomy identification help should it be needed. He also has taken an aquatic plant taxonomy course at SUNY-Oswego in early September to prepare for this task.

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

We are on schedule to complete our project at this time. However, there is a time misalignment between the annual funding period and the project dynamics; see next question.

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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.

Period from January 1, 2014 – Oct. 31, 2014

Budget Categories	GESCC-approved budget	Funds or in-kind support from other resources	Total expenses to date	Remaining balance
Salaries and Benefits	132,447.00	27,471.42	77,555.89	54,891.11
Travel			283.70	(283.70)
Equipment				-
Supplies	17,000.00		4,712.65	12,287.35
Meetings				-
Printed Material				-
Contractual	6,750.00		-	6,750.00
Consultants	34,200.00		11,044.16	23,155.84
Other	22,307.00	28,460.37	4,551.37	17,755.63
Tuition and Fees	33,000.00		13,194.66	19,805.34
Total Funds	245,704.00	55,931.79	111,342.43	134,361.57

*Indirect costs applied to expenditures through October 31, 2014 equal \$24,536.94.

*In-kind support of \$28,460.37 is applied indirect for match salaries and fb, and waived indirect.

*USACE has provided an explanation of its matching funds expenditures for this project in an attached letter.

There is a time misalignment between the annual funding period and the project seasonal dynamics, i.e., the field season starts in late Spring, when most of the personnel salaries start. In particular, this affects the salaries of students, which started working for us on June 1, 2014, and their annual salaries for year 1 should go to May 31, 2015. Because the funds come to us from January 1-Dec. 31, we need to request that the remaining funds from this year are forwarded for use next year, and so on for years 2 and 3. At the end of the three years of funding, we will complete using the funds on May 31, 2017, which will require an extension of the grant.

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

During Year 2 of this grant (2015) we will continue our emerald shiner population study in the upper Niagara sampling larvae, juveniles and adults and analyzing their genetic make-up. In addition, USACE will start mapping the aquatic vegetation and substrate composition in and around our sampling sites together with the new graduate student. Next sampling season we also plan to start sampling predatory fish stomachs to determine the proportion of emerald shiners in their diets.

The three graduate students mentioned above will be collecting additional data for their thesis projects in summer 2015.

By the end of year 2 we expect to have the results from the genetic analysis from the year 1 (2014) collections and stable isotope analysis results for shiners and common tern and water chemistry results.

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

See attached an article on the project with photos and statements from the current graduate students working with emerald shiners. This article has been published in the Buffalo State Great Lakes Center Newsletter on Nov. 3, 2014. The photographs are from summer 2014.

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List of Attachments:

1. Map of sampling sites.
2. Report from in-kind activities and matching-funds budget by USACE.
3. Outreach factsheet.
4. GLC newsletter excerpt with article about project by students and project photos.