Application to

The Greenway Ecological Fund Standing Committee

Title: **Emerald Shiner Habitat Conservation and Restoration Study in the Upper Niagara River: Importance for Sport Fish, Common Terns and Public Education.**

PROJECT SPONSOR INFORMATION

Name: Research Foundation for SUNY Buffalo State
Mailing Address: 1300 Elmwood Ave., Buffalo
State: New York 14222
Federal Id# 14-1368361

PRIMARY CONTACT (Principal Investigator):

Dr. Alicia Pérez-Fuentetaja, Associate Professor,
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Co-PRINCIPAL INVESTIGATORS:

Mark Clapsadl, Fisheries Biologist, Great Lakes Center, SUNY Buffalo State.
Dr. Randal Snyder, Professor, Biology Dept., SUNY Buffalo State.

COLLABORATORS:

Timothy DePriest, Region 9, NYS Department of Environmental Conservation (DEC).
Michael Wilkinson, Region 9, NYS Department of Environmental Conservation (DEC).
Donald Einhouse, Region 9, NYS Department of Environmental Conservation (DEC).
Andrew Hannes, Buffalo District, US Army Corps of Engineers (USACE).
Renata Kraft, Director of Greenway Planning and Landscape Architecture, Buffalo Niagara Riverkeeper.
Dr. Daniel Potts, Assistant Professor, Biology Dept., SUNY Buffalo State.
Dr. Sarah Delavan, Assistant Professor, Environmental & Water Resources Engineering Dept., SUNY Univ. at Buffalo.
Kathleen Hastings, Research Technician, Great Lakes Center, SUNY Buffalo State.

PROJECT OVERVIEW

The Niagara River Area-of-Concern (AOC) is an important migratory pathway for the emerald shiner and for birds that use the river for staging and nesting. The Niagara River AOC was designated in large part due to the effects of toxic contamination of water and sediments; however, one of the seven delisting criteria to address Degradation of Fish and Wildlife Populations Beneficial Use Impairments includes maintenance of the fish communities on the U.S. side at levels that meet the objectives of the binational fish-community agreement. Emerald shiners are an important native prey-species that fuel the food webs of sport fishes and act as a keystone species in the Niagara River ecosystem, sustaining predatory fish and piscivorous migrating birds in the Niagara flyway (the Niagara River has been designated an Important Bird Area (IPA) by BirdLife International and its partners). The emerald shiners play a paramount role in local sport fish growth and condition and are a vital food source for the brood success of the NYS threatened common tern in the Niagara River and for other migrating birds. Therefore, the health of the emerald shiner in the Niagara River ecosystem provides enormous regional ecological benefits. Information on habitat utilization and life history of the shiners is meager and in need of being addressed. Failure of these fish to reproduce or migrate in the river has important cascading effects to their predators: sport fish populations and avian species using the river. However, despite being a very prominent species sustaining the Niagara River food web, this native fish species has been subjected to widespread modifications of spawning and nursery habitats, competition with non-native fish, damming, water diversions and overall changes in water velocities along their presumed annual migration routes in and out of Lake Erie. For instance, historical river channel modifications and shoreline alterations, including installation of vertical bulkhead structures, have increased water velocity in sections of the river that shiner larvae are known to attempt to traverse in order to migrate upstream to Lake Erie, potentially jeopardizing their migration success. In the Niagara River, shiners are also commercially exploited as baitfish, being the most important species locally harvested by this industry. Our knowledge of how this species utilizes nursery habitats in the Niagara River, the timing of their migration and the factors that determine reproductive success are poorly understood and the existing information is patchy and anecdotal. Little is also known about the effects of man-made alterations within the river habitat and whether modifications can be made to these structures to better facilitate shiner passage. Emerald shiner mass mortality events are known to occur sporadically and seem related to strong year-classes and lack of available river habitat in the tributaries, where they seek warmer temperatures in the Spring, which can result in oxygen depletion (from fish respiration) and mortality. We lack basic information to manage and protect the emerald shiner, but if their abundance were to substantially diminish, the effect would cascade to valuable sport fish species (walleye, smallmouth bass, steelhead, yellow perch, muskellunge, etc.) and to protected bird species (bald eagle, common tern, common loon, etc.) and unravel efforts to restore those populations in the lower Great Lakes. In addition, being an important commercially harvested bait fish, the economic value of the emerald shiner contributes to the prosperity of the region. This project proposes to determine the shiners' use of the river for spawning, nursery habitat, pathways of migration (including high velocity areas associated with smooth surfaces of concrete piers, bulkheads, pilings etc.) and year-class formation. Results from habitat use by the shiner will be used to determine restoration needs to provide enhanced spawning and nursery areas and to diminish impediments to fish movement in the river. A trophic study will investigate food availability to larval, young-of-the-year and adult shiners as well as their contribution to the diets of sport fish, adult common terns and their offspring. The focus of this project is to determine <u>critical habitat</u> for the shiners' reproduction and migration and to evaluate the influence that these fish have on local sport fish and on the brood success of the common tern. Our results will answer questions about habitat conservation, restoration or possible modification to ensure the long-term success of emerald shiners, sport fish and common terns in the system. We will make

our results available to various stake-holders and the public through data-sharing and education activities.

Benefits to the Niagara Basin: This project proposes a comprehensive study of the life history and habitat utilization of the native emerald shiner (*Notropis atherinoides*) in the upper Niagara River and their importance in sustaining sport fish and piscivorous bird species (in particular the common tern, *Sterna hirundo*) that depend on this resource. This type of study is lacking in the Niagara River and focuses on a critical species in the river food web in need of conservation and habitat restoration. This proposal focuses on restoration and enhancement of fish and wildlife resources by analyzing threats to migration and the status of key habitats, helping restore threatened species, conserving migratory birds, and educating the public. In addition, this project addresses the delisting criteria of the Niagara Remedial Action Plan (RAP) for Fish Habitat and for Fish Communities, regarding solutions to the restricted use of habitat by emerald shiners due to water flow alterations and habitat loss, and proposing conservation strategies for this species.

Eligibility Considerations: •This project addresses the effects of water velocity and water levels in the upper Niagara River (Power Project impacts) on emerald shiner passage and migration in the river. •This project seeks to preserve the NYS threatened common tern in the Niagara River by protecting and restoring their main food source, the emerald shiner. •Our approach has a strong applied scientific foundation; it is focused on an issue in the Niagara River and includes community outreach. •Our results will contribute to long-term protection of the threatened common tern by providing critical missing information about their main food source (the emerald shiner) and providing the tools for shiner management. •This project will achieve multiple ecological goals such as investigating the emerald shiner life history and habitat utilization, shiner population dynamics and genetics, shiner contribution to sport fish diets and common tern diets and chick-rearing success, effects of man-made structures and alterations to the river that affect shiner passage (including water velocity studies at migration bottleneck-locations in the upper river), and public outreach and education regarding the importance of this key species to the river's health. •This project is multi-faceted and includes multi-stakeholder collaborations (see list of collaborators on page 1). •Our project includes two matching sources: 25% of the requested funds from SUNY Buffalo State and 65% of total funds from USACE (see budget, page 8). •The probability of success of this project is very high, since there is no information available on emerald shiners, their habitat and how they support important fish and bird species in the river, therefore, all data collected and recommendations resulting from this research and outreach efforts are novel and needed.

WORKING QUESTIONS

A. Ecology of the emerald shiner in the upper Niagara River and how they support sport fish and NYS threatened common terns

1. How do emerald shiners utilize the habitats available in the upper Niagara River for spawning, growth and maturation?
2. Are emerald shiners in the river part of one genetic population from lakes Erie and Ontario or are they genetically different depending on differences in their use of habitat in time (spring vs. fall, etc.) and space (shoreline, tributaries, etc.)?
3. What migration routes do emerald shiners use as they travel the river downstream as adults and upstream as larvae/juveniles and what bottlenecks in the river affect emerald shiners movements by increasing water

velocity? (Bottelenecks may exist at the Broderick Park pier, Peace Bridge pilings and the Black Rock Canal locks, see map locations 1, 2, 3, 4, page 9).

4. How important are the emerald shiners as food for sport fish and common terns in the Niagara River corridor?

B. Habitat availability and condition in the upper Niagara River for emerald shiners

5. What habitats are key for the success of the different life stages of the emerald shiner?
6. What types of nearshore vegetation and substrates are present in key emerald shiner habitat in the upper Niagara River?

C. Education and Outreach

7. How can this project educate the public and interested groups (fishers, birders, boaters, etc.) to achieve an understanding about the importance of the emerald shiner in the well-being of the aquatic community in the Niagara River?

PRIMARY OBJECTIVES **(**numerically related to the above questions):

1. Locate and quantify the types of habitats preferred by shiners and determine which ones are more important for reproductive success (see map of sites we initially plan to study, page 9). Examine food resources for juvenile and adult shiners and their trophic position.
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.
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 (see map locations 1, 2, 3, 4, page 9) using field and laboratory experiments. Analyze the importance of fish barriers and evaluate mitigation measures on fish passage. Design alternatives to these barriers (USACE).
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.
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).
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.
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.

OVERVIEW OF METHODS

For habitat utilization, sites indicated in the map will be selected and other sites will be added as we survey available habitat. Habitats where different life stages of shiners are found will be catalogued by their features (percent vegetation, water velocity, depth, temperature, etc.) and all the information will be entered into a Geographic Information System (GIS). Shiners will be sampled in their migration routes and habitats by using various sampling gears: bongo-nets for ichthyoplankton, seining, trapping and electrofishing. Observational data of shiner schools will also be collected. We will perform a diet analysis using stomach contents for emerald shiners and stable isotope analyses of $\delta^{13}C$ and $\delta^{15}N$ for shiners and terns. In addition, we will use calorimetry for: shiner eggs, larvae, juvenile and adult shiners, chick and adult tern's feces, feathers and muscle (from deceased terns), and plankton. Because shiner populations can change dramatically from year to year, three cohorts of emerald shiners and tern offspring will be studied during the Spring-Summer-Fall from 2014-2016 (or 2017 depending on starting month/year) (these data will be collected and analyzed by Buffalo State and NYSDEC). For discrimination of the different populations of shiners that use the river, we will collect samples from nearby (eastern Lake Erie, western Lake Ontario, lower Niagara River) populations and compare them with fish collected at various locations and different times of the year within the upper Niagara River. The samples will be analyzed using a cloning-free, next generation sequencing method for rapid identification of simple sequence repeats, or microsatellites (data collected by Buffalo State and analyzed by a subcontractor at Virginia Tech). Vegetation will be sampled using rakes and quadrats as appropriate for plant identification and biomass estimates, supplementing existing data collected by Buffalo Niagara Riverkeeper (data collected and analyzed by Buffalo State, Riverkeeper, NYSDEC). Studies of water flows will be performed in the river using hydrographic survey technologies (side scan, multibeam), hydrodynamic simulation modeling and flow velocity measurements (USACE). To determine the swimming abilities of shiners, we will perform experiments in the laboratory with different currents using flumes, an acoustic doppler velocimeter, particle imaging and laser fluorescence (data collected and analyzed by UB, USACE). Modeling and detailed engineering designs of restoration projects will be done by USACE. Educational materials, interpretation and outreach activities will be developed by Buffalo State, Riverkeeper and an education specialist.

Evidence of Consultation with the Niagara River Greenway Commission

We submitted a Consultation and Review Form for the Niagara Greenway Commission review on March 19th, 2013. We were invited to present our proposal to the Commission on May 21st, 2013 (see attached documents from the Greenway Commission, pages 14, 15). The Committee asked what the total cost of the project was. Dr. Pérez-Fuentetaja answered that the requested cost was $824,501 and that the matching funds were $809,751. Our proposal was voted unanimously "consistent" with the Greenway vision and the Committee remarked that this research "is beneficial".
Note: in this final proposal, the above amounts have changed (they are lower).

Evidence of Consultation with Affected Municipalities, Counties, or Indian Nations

N/A. Project activities will not be conducted on municipal, county or Indian Nation lands.

Evidence of Consultation with State and Federal Agencies

This project is endorsed by the New York Department of Environmental Conservation and by the US Army Corps of Engineers. Three Biologists from NYSDEC Region 9: Timothy DePriest, Michael Wilkinson and Donald Einhouse are collaborators in this project. One Biologist from USACE Buffalo District: Andrew

Hannes, is also a collaborator in this project. Letters of support from NYSDEC and USACE are attached to this document (pages 16, 17). USACE is providing matching funds of 65% of the total requested funds (approx. $498,191 in-kind) in Federal funds.

How the Project will be Operated and Maintained

Dr. Alicia Pérez-Fuentetaja will be responsible for Project Design and Execution with assistance from the co-Principal Investigators (see page 1). The collaborators will provide assistance with different aspects of the project and will facilitate access to the studies they have already performed in the Niagara River. Three Master-level students and undergraduates will provide assistance in the field and laboratory. Graduate students will produce theses and, together with the PIs and Collaborators, will also produce publications and public presentations. Reports on our progress will be submitted as required. An operation and maintenance plan is not needed for this project because we are not building any permanent physical structures.

Project Consistency with the Niagara River Greenway Plan (NRGP)

The main focus of this project is the preservation, enhancement and development of the scenic, natural and recreational resources of the Niagara Greenway, providing the tools to the community and the State to make informed and effective management decisions on a major resource in the river, the emerald shiner, facilitating economic development such as the bait fishery, recreational opportunities (as this fish provide food for sport fish and birds), and conservation for NYS threatened avian species, such as the common tern. In this sense, this project supports the Greenway ***Goals*** of Protecting and Restoring Environmental Systems and Promoting Long-term Sustainability. In particular, this project is consistent with the ***Principles*** of sustainability, ecological integrity, public well-being, restoration, authenticity, celebration through education and interpretation for the public; in addition, in this project we also have extensive partnerships with parties heavily involved in the well-being of the Niagara River and the community (Buffalo State, NYSDEC, USACE, Buffalo Niagara Riverkeeper, Univ. at Buffalo). This project also complies with the ***Criteria*** of the Greenway Commission: this project is consistent with the Greenway principles, and supports the priority status of the restoration of the river ecosystem and the interpretation and education efforts about the river's natural resources. Our focus area is in the river itself, the project has environmental soundness and will not impact the river in any way, it is implementable, we have local partners, we provide matching funds from Buffalo State of 25% and from USACE of (potentially) 65% of project cost (total cost sharing of approximately $699,101). This project builds on efforts by Buffalo Niagara Riverkeeper, USACE, NYSDEC and USFWS. This project will be highly beneficial to the Niagara Basin by providing a scientific study that could contribute to the eventual delisting of the Fish Habitat and Fish Communities targets of the Niagara River RAP. An understanding of the shiner ecology in the river will also provide the tools to manage the fishery and avoid declines of this key species.

Project Consistency with State and Federal Laws

Our project has been reviewed by NYSDEC and found consistent with State laws. We also have a valid New York State Collecting Permit to collect all life stages of the emerald shiner. Our proposed activities do not need an exemption from Federal laws.

Description of Opportunities to Obtain Matching Funds

The matching funds contribution by SUNY Buffalo State includes time of personnel that will be spent committed to this project during their salaried periods and with the associated fringe benefits (A. Pérez-Fuentetaja: 1.5 months, M. Clapsadl: one month, K. Hastings: one month) for a total value of $98,532. We also contribute boat-time with operator in different vessels for a value of $42,000. The Research Foundation of SUNY Buffalo State has waived 22% in indirect costs that will not be charged to this project for a value of $102,378. The total contribution to the matching funds by SUNY Buffalo State is $200,910. In addition (*not included in the matching funds estimate*), the Buffalo State Great Lakes Center Field Station along the Niagara River can provide at no-cost to this project: personnel time (experienced fisheries and GIS technical staff), research vessels, sampling gear, fully equipped laboratories, equipment, trucks and other vehicles, boat launch facilities and maintenance.

The US Army Corps of Engineers will assist with leverage funding for this project through the Great Lakes Remedial Action Plans (RAP) Program, in this case, in support of the Niagara River RAP. Their contribution will be in the form of assistance with the evaluation of habitat restoration sites and design of habitat improvement alternatives. Our negotiations will include the signing of a partnership agreement between USACE and SUNY Buffalo State for work in-kind to leverage 65% of the total requested project cost with Federal funding, a value of $498,191. A letter from Mr. Bryan Hinterberger, Plan Formulator for the Buffalo District, USACE, is included to describe this opportunity to obtain matching funds (see page 17).
Our total matching funds contribution is $699,101. Thus, the total matching funds opportunity is $0.912 for each $1.00 requested.

Existing costs as of 31 August 2007

There are no existing costs for this project. The Greenway funds requested will not be used to defray any obligation or costs existing prior to 31 August 2007.

Land ownership associated with project

N/A. There is no land ownership associated with this project.

Project Budget

Project Duration: Three years, from January 1st, 2014 to December 31st, 2016. Dates may be adjusted depending on when funding becomes available (see budget breakdown on next page).

Category	2014	2015	2016	Total
Senior Personnel Salaries/Wages				
Alicia Perez-Fuentetaja (summer 2 mo.)	$16,166	$16,732	$17,317	$50,215
Randall Snyder (summer 1 mo.)	$9,989	$10,339	$10,700	$31,028
Daniel Potts (summer 1 mo.)	$6,870	$7,110	$7,359	$21,340
Outreach Specialist (summer)	$7,000	$7,245	$7,499	$21,744
Course release -Alicia Perez	$3,000	$3,105	$3,214	$9,319
Subtotal salaries/wages	**$43,025**	**$44,531**	**$46,089**	**$133,645**
Student Salaries				
Three M.A. students (12 mo., $18,000/student/year)	$54,000	$55,890	$0	$109,890
Three UG students (summer)	$13,500	$13,973	$14,462	$41,934
One UG student (academic year)	$5,000	$5,175	$5,356	$15,531
Subtotal student salaries	**$72,500**	**$75,038**	**$19,818**	**$167,355**
Total Salaries	**$115,525**	**$119,568**	**$65,907**	**$301,000**
Benefits				
Alicia Perez-Fuentetaja (summer 17%)	$2,748	$2,844	$2,944	$8,537
Randall Snyder (summer 17%)	$1,698	$1,758	$1,819	$5,275
Daniel Potts (summer 17%)	$1,168	$1,209	$1,251	$3,628
Outreach Specialist (summer 17%)	$1,105	$1,144	$1,184	$3,433
M.A. students (regular 14.5%)	$7,830	$8,104	$0	$15,934
UG student (summer 5%)	$675	$699	$723	$2,097
UG student (regular AY 5%)	$250	$259	$268	$777
Course release -Alicia Perez (50.16%)	$1,505	$1,557	$1,612	$4,674
Subtotal benefits	**$16,979**	**$17,574**	**$9,801**	**$44,354**
Total Salaries and Benefits	**$132,504**	**$137,142**	**$75,708**	**$345,354**
Travel				
Travel to conference (5 people)	$0	$5,000	$5,000	$10,000
Total Travel	**$0**	**$5,000**	**$5,000**	**$10,000**
Contractual				
C and N stable isotopes ($15/sample * 450 samples/yr)	$6,750	$6,971	$7,191	$20,912
Total Contractual	**$6,750**	**$6,971**	**$7,191**	**$20,912**
Subcontracts				
Virginia Tech (M. Pawel – genetic analyses)	$16,200	$16,200	$16,200	$48,600
Univ. at Buffalo (S. Delavan – flow rates & swimming speed)	$30,000	$30,000	$30,000	$90,000
Buffalo Niagara Riverkeeper (habitat)	$18,000	$18,000	$18,000	$54,000
Total Subcontracts	**$64,200**	**$64,200**	**$64,200**	**$192,600**
Equipment				
Sampling gear (seines, dip nets, minnow traps, etc.)	$8,000	$5,000	$3,000	$16,000
Flow meter	$2,000	$0	$0	$2,000
Subtotal equipment	**$10,000**	**$5,000**	**$3,000**	**$18,000**
Supplies				
Miscellaneous supplies (bottles, vials, preservatives)	$6,000	$4,000	$4,000	$14,000
Shipping/gas	$1,000	$1,000	$1,000	$3,000
Subtotal supplies	**$7,000**	**$5,000**	**$5,000**	**$17,000**
Total Equipment and Supplies	**$17,000**	**$10,000**	**$8,000**	**$35,000**
Other Direct Costs				
Three M.A. Students' Tuition	$33,000	$34,155	$0	$67,155
Total Other	**$33,000**	**$34,155**	**$0**	**$67,155**
Total Direct Costs	$246,704	$250,497	$152,908	$650,109
Indirect costs (25%, waived from 47%)	$52,176	$41,986	$22,177	$116,339
Amount Requested	**$298,880**	**$292,483**	**$175,085**	**$766,448**
Matching Funds				
Matching Funds Buffalo State (see page 7 for justification)	$77,636	$69,778	$53,496	$200,910
Matching Funds US Army Corps of Engineers (USACE)	$166,064	$166,064	$166,063	$498,191
Total Matching Funds	**$243,700**	**$235,842**	**$219,559**	**$699,101**
TOTAL PROJECT COST	*$542,580*	*$528,325*	*$394,644*	*$1,465,549*

by Kathleen Hastings, Great Lakes Center, 2013

List of Attachments

One-page *vitae* from the three Principal Investigators:	**Page**
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Alicia Pérez-Fuentetaja

Curriculum vitae

EDUCATION

1993 Doctor of Philosophy in Aquatic Ecology and Fisheries Biology – Fulbright Scholar
State University of New York, College of Environmental Science and Forestry, Syracuse, New York.
1988 Bachelor of Science in Biology. Universidad Autónoma de Madrid, Fac. Biológicas, Madrid, Spain.

PROFESSIONAL EXPERIENCE

2006- Associate Professor and Research Scientist. Biology Dept. and Great Lakes Center. SUNY - Buffalo State.
2000-06 Assistant Professor (Aquatic Biology). SUNY- College at Fredonia.
1999 Director Kodiak Limnological Laboratory. Alaska Department of Fish and Game.
1998-99 Research Fisheries Biologist- Alaska Peninsula and Aleutian Islands. Alaska Dept. of Fish and Game.
1995-98 Postdoctoral Research Associate. York University, Toronto. (Dr. Donald J. McQueen's lab).
1994 Postdoctoral Research Associate**.** Universidad Autónoma de Madrid, Spain. (Dr. Carlos Montes' lab).

Member Lake Erie Forage Task Group since 2011:

Markham, J., M. Hosack, J. Deller, P. Kocovsky, T. MacDougall, A. Pérez-Fuentetaja, M. Thomas, E. Trometer E. Weimer and L. Witzel. 2013. Report of the Lake Erie Forage Task Group. March 2013. Presented to: Standing Technical Committee, Lake Erie Committee, Great Lakes Fishery Commission.

Markham, J., M. Hosack, J. Deller, P. Kocovsky, T. MacDougall, A. Pérez-Fuentetaja, E. Trometer, E. Weimer and L. Witzel. 2012. Report of the Lake Erie Forage Task Group. March 2012. Presented to: Standing Technical Committee, Lake Erie Committee, Great Lakes Fishery Commission.

Weimer, E., M. Hosack, J. Deller, P. Kocovsky, T. MacDougall, J. Markham, A. Pérez-Fuentetaja, E. Trometer and L. Witzel. 2011. Report of the Lake Erie Forage Task Group. March 2011. Presented to: Standing Technical Committee, Lake Erie Committee, Great Lakes Fishery Commission.

RECENT PUBLICATIONS RELATED TO THE GREAT LAKES (* Denotes students)

Pérez-Fuentetaja, A., M. D. Clapsadl, and W. T. Lee. 2013. Comparative role of dreissenids and other benthic invertebrates as links for type-E botulism transmission in the Great Lakes. In T. F. Nalepa and D. W. Schloesser [eds] Quagga and Zebra Mussels: Biology, Impacts, and Control. 2nd Edition. CRC Press: Boca Raton (*in press*)

Mackintosh*, S.A., A. Pérez-Fuentetaja, L.R. Zimmerman, G. Pacepavicius, M. Clapsadl, , M. Alaee, D. S. Aga. 2012. Analytical Performance of a Triple Quadrupole Mass Spectrometer Compared to a High Resolution Mass Spectrometer for the Analysis of Polybrominated Diphenyl Ethers in Fish. *Analytica Chimica Acta* 747:67-75.

Pérez-Fuentetaja, A., M. Clapsadl, R.G. Getchell. P.R. Bowser and W.T Lee. 2011. *Clostridium botulinum* Type E in Lake Erie: Inter-Annual Differences and Role of Benthic invertebrates. *J. Great Lakes Research* 37(2):238-244.

Pérez-Fuentetaja, A., S. Lupton*, M. Clapsadl, F. Samara*, L. Gatto, R. Biniakewitz and D.S. Aga. 2010. PCB and PBDE Levels in Wild Common Carp (*Cyprinus carpio*) from Eastern Lake Erie. *Chemosphere* 81: 541-547.

Bridoux*, M., M. Sobiechowska*, A. Pérez-Fuentetaja, K. T. Alben. 2010. Algal pigments in Lake Erie dressenids, pseudofeces and sediments, as tracers of diet, selective feeding and bioaccumulation. *J. Great Lakes Research* 36: 437-447.

Sobiechowska*, M.; Bridoux*, M.; Ferreira, A-H. F., Pérez Fuentetaja, A., Alben, K. T. 2010. Biomarkers of algal populations in phytoplankton, filamentous algae, and sediments from the eastern basin of Lake Erie 2003-2005. *J. Great Lakes Research.* 36(2): 298-311

Pérez-Fuentetaja, A., M.D. Clapsadl, D. Einhouse, P.R. Bowser, R. G. Getchell and W. T. Lee. 2006. Influence of Limnological Conditions on *Clostridium botulinum* Type E Presence in Eastern Lake Erie (Great Lakes, USA) Sediments. *Hydrobiologia*. 563 (1): 189-200.

RECENTLY FUNDED GRANTS:

U.S. EPA Great Lakes Restoration Initiative 2010. 2010-2012. $615,813. "The Lake Erie Nearshore and Offshore Nutrient Study (LENONS)". PIs: C. M. Pennuto, A. Y. Karatayev, A. Pérez-Fuentetaja, L. E. Burlakova.

U.S. EPA Great Lakes National Program Office. 2009-2010. $150,000. "The Nearshore and Offshore Lake Erie Nutrient Study (NOLENS)". PIs: C. Pennuto, A. Y. Karatayev, A. Pérez-Fuentetaja, L. E. Burlakova.

N**ew York Great Lakes Protection Fund**. 2008-2011 (Large Grants Program) $100,000. "Food-Web mediated Transport and Bioaccumulation of Flame retardants (PBDE) in Sport Fish from Eastern Lake Erie". PI: A. Pérez-Fuentetaja,Co-PIs: M.D. Clapsadl, D.S. Aga, M. Alaee. Collaborators: D. Einhouse, S. Backus.

BIOGRAPHICAL SKETCH

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EDUCATION

B.S., 1989. Cornell University. Natural Resources/ Fishery Science.
M.S., 1993. SUNY College of Environmental Science and Forestry. Fishery Science.

PROFESSIONAL APPOINTMENTS

Research Associate/Great Lakes Center Field Station Manager. Buffalo State College. Buffalo NY Sept. 2006-Present
R&D Coordinator: Chautauqua Erie Environmental Center, Department of Biology. SUNY Fredonia. Fredonia, New York. 2001-2006
Assistant Area Manager, Kodiak Island, Alaska Peninsula and Aleutian Islands: Alaska Department of Fish and Game, Kodiak, Alaska. 1998–2000
Fishery Biologist II: Alaska Department of Fish and Game, Cordova ,Alaska 1994-1998

RECENT PUBLICATIONS AND PUBLICATIONS RELEVANT TO THIS PROPOSAL

Clapsadl, M.D. 1993. An examination of habitat characteristics influencing the survival of stocked muskellunge, *Esox masquinongy*, in four St. Lawrence River Embayments. State University of New York. College of Environmental Science and Forestry, Syracuse, MS Thesis - 126 pages

Clapsadl, M.D, J.L. Markham, K.A.Kayle., C. Murray, and B. Locke. 2005. An analysis of the diet of steelhead trout in Lake Erie to provide resource managers with a basic understanding of their role in lakewide predator/prey dynamics. Final Report for Project #30181-3-J225. Great Lakes Fisheries Commission, Ann Arbor, Michigan. 24 pp

Pérez-Fuentetaja, A., **M. D. Clapsadl**, and W. T. Lee. 2013. Comparative role of dreissenids and other benthic invertebrates as links for type-E botulism transmission in the Great Lakes. In T. F. Nalepa and D. W. Schloesser [eds] Quagga and Zebra Mussels: Biology, Impacts, and Control. 2nd Edition. CRC Press: Boca Raton (in press).

Pérez-Fuentetaja, A., **M. Clapsadl**, R.G. Getchell. P.R. Bowser and W.T Lee. 2011. *Clostridium botulinum* Type E in Lake Erie: Inter-Annual Differences and Role of Benthic invertebrates. J. Great Lakes Research 37(2):238-244.

Pérez-Fuentetaja, A., S. Lupton, **M. Clapsadl**, F. Samara, L. Gatto, RBiniakewitz and D.S. Aga 2010.Current PCB and PBDE Levels in Wild Common Carp (*Cyprinus carpio*) from Eastern Lake Erie. Chemosphere 81: 541-547.

Werner, R.G., B.V. Jonckheere, **M.D. Clapsadl**, , and J. M. Farrell. 1996. Bioenergetic exploration of piscivory and planktivory during the early life history of two species of freshwater fishes. Marine and Freshwater Research. 47(2) 113-120

Werner, R.G**., M.D. Clapsadl**, B.V. Jonckheere, and J. M. Farrell. 1993. Feasability of enhancing and creating muskellunge spawning and nursery habitat. Final Report, SUNY College of Environmental Science and Forestry. Syracuse, NY.

Curriculum Vitae

Randal Jay Snyder, Ph.D.
Professor, Department of Biology, Buffalo State College, 1300 Elmwood Avenue, Buffalo, New York 14222; (P) 716-878-4314; (F) 716-878-4028; snyderrj@buffalostate.edu

Academic Degrees

1982 A.B. in Zoology with Honors, General Distinction Scholarship, UC Berkeley
1983-88 M.A. and Ph.D. in Zoology, University of California, Davis

Professional Appointments

2012 Professor of Biology, Buffalo State College, Buffalo, NY
1996-2012 Associate Professor of Biology, Buffalo State College, Buffalo, NY
1999-2008 Chairperson, Department of Biology, Buffalo State College, Buffalo, NY
1990-96 Assistant Professor of Biology, Buffalo State College, Buffalo, NY

Peer-Reviewed Publications (5 most recent)

Snyder, R.J., Wei, Y., and W.D. Schregel. 2011. Effects of thermal acclimation on tissue fatty acid composition in freshwater alewives (*Alosa pseudoharengus*). Fish Physiology and Biochemistry 38: 363-373.

Snyder, R. J., DeMarche, C.J., and D.C. Honeyfield. 2011. Impacts of changing food webs in Lake Ontario: Implications of Dietary Fatty Acids on Growth of Alewives. Aquatic Ecosystem Health & Management 14(3):1-8.

Snyder, R.J. and E.K. Murray. 2009. Influence of dietary nutrients on low temperature tolerance of freshwater alewives. Journal of Great Lakes Research 35: 473-476.

Snyder, R.J. and T.M. Hennessey. 2003. Cold tolerance and homeoviscous adaptation in freshwater alewives (*Alosa pseudoharengus*). Fish Physiology and Biochemistry 29: 117-126.

Diggins, T.P. and R.J. Snyder. 2003. Three decades of change in the benthic macroinvertebrate community and water quality variables in the Buffalo River Area of Concern. Journal of Great Lakes Research 29(4): 652-663.

Grants – Research

2012-13 Great Lakes Restoration Initiative – US EPA: "Enhanced Early Detection of Invasive Ponto-Caspian Fishes in the Great Lakes". (PI: R. Snyder, Co-PI's: L. Burlakova, D. MacNeill, A. Karatayev). $99,756.

2011-12 Illinois Natural History Survey: "Examining the Roles of Adaptive Plasticity and Invasibility of Alewife". (subcontract to R. Snyder). $11,632.

2010-12 Great Lakes Restoration Initiative – US EPA: "Evaluating Ponto-Caspian Fishes for Risk of Great Lakes Invasion". (PI: R. Snyder, Co-PI's: L. Burlakova, D. MacNeill, A. Karatayev). $111,264.

2009-11 New York Sea Grant Institute: "Improved Predictions of Condition and Growth in Alewives: Effects of Dietary Fatty Acids, Temperature, and Ration". (PI: R. Snyder). $89,713.

1994-95 Great Lakes Research Consortium: "Feeding Ecology, Growth and Bioenergetics of the Emerald Shiner, a Re-emerging Native Species in Lake Erie?" (PI: R. Snyder; Co-PI's: P.F. Sale, D.J. Stewart, and S.B. Brandt). $13,370.

May 23, 2013

Carol A. Darstein, Director, Pre Award and Contract Services
Research Foundation of SUNY-Buffalo State
1300 Elmwood Avenue
Buffalo, New York 14222

Dear Ms. Darstein:

The Niagara River Greenway Commission is pleased to support the Research Foundation of SUNY-Buffalo State's "Project Consultation and Review" package for the following project:

Emerald Shiner Habitat Conservation & Restoration Study in the Upper Niagara River

This project was deemed consistent to the Niagara River Greenway Plan as determined by the Niagara River Greenway Commission. The subjective evaluations were been based on the principals, goals and criteria that define the Niagara River Greenway Plan. I have attached the Commission's comments and questions as well as public comments received on the projects submitted during the deliberation timeframe for your use. The Commission is pleased to support the Research Foundation of SUNY Buffalo State's project proposal and wish you great success.

Respectfully,

Rob Belue

R.A. Belue
Executive Director

Cc: Ecological Standing Committee
Dr. Alicia Perez-Fuentetaja, Associate Professer

Niagara River Greenway 2136 West Oakfield Grand Island, New York 14072 (716) 733-5361 Fax (716) 773-5392
www.niagararivergreenway.org

Emerald Shiner Habitat Conservation and Restoration Study in the Upper Niagara River – *SUNY Research Foundation*

The project sponsors at Buffalo State College propose a study to increase scientific understanding of the emerald shiner population to better inform measures for the protection and conservation this ecologically important species. Very little is known currently about the ecological needs of the emerald shiner, and therefore resource protection agencies are limited in their ability to plan for conservation measures and respond to emerging issues concerning population stability. Because the shiners are the main food source for many other species of fish and wildlife, which in turn attract people to the Niagara River, a decline in the emerald shiner population would potentially affect the ecological integrity of the Niagara Greenway. New York State Department of Environmental Conservation finds the proposal to be **consistent** with the Goals, Principles and Criteria of the Niagara River Greenway Plan.

Questions Asked By Commissioners at the May 21st 2013 Meeting

Research Foundation for SUNY Buffalo State- Emerald Shiner Habitat Conservation & Restoration Study in the Upper Niagara River

1. What is the total cost of the project?
2. Comment: this research is beneficial

New York State Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources, Region 9
270 Michigan Avenue, Buffalo, New York 14203-2915
Phone: (716) 851-7010 • **Fax:** (716) 851-7053
Website: www.dec.ny.gov

Joe Martens
Commissioner

May 29, 2013

Alicia Pérez-Fuentetaja, PhD
Associate Professor & Research Scientist
Biology Dept. & Great Lakes Center
254 Science Bldg.
SUNY Buffalo State
1300 Elmwood Avenue
Buffalo, New York 14222

Dear Dr. Pérez-Fuentetaja

I am writing you to express support from NYS Department of Environmental Conservation, (DEC) Region 9 (Department) for the proposal, "Emerald Shiner Habitat Conservation and Restoration Study in the Upper Niagara River", that you have recently developed for Niagara River Greenway funding under the Ecological Standing Committee.

The department recognizes the ecological significance of the emerald shiner as an important lower trophic level species that supports the abundant fish and wildlife resources of the Niagara River. Very little is known about the ecological needs of the emerald shiner, and therefore, as a resource management agency we are limited in our ability to plan for conservation measures and respond to emerging issues concerning population stability of this species. Because the shiners are the main food source for many other species of fish and wildlife, which in turn attract people to the Niagara River, a decline in the emerald shiner population would potentially affect the ecological integrity of the Niagara Greenway.

The information that the study proposes to find will be critical as the department and other agencies and organizations consider plans for restoring fish and wildlife habitat in the Niagara River. With the current level of funding available for restoring habitat in the Niagara corridor it is essential that the process be guided by scientifically sound information if the restoration efforts are to be effective.

Please let me know how the department can provide assistance as your project continues to develop.

Sincerely,

Paul McKeown EO

Paul McKeown
Supervisor of Natural Resources,
NYSDEC Region 9

cc: Abby Snyder, Regional Director, NYSDEC Region 9
Mike Clancy, Don Einhouse, NYSDEC Region 9, Fisheries

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO NY 14207-3199

REPLY TO
ATTENTION OF: Planning Services

31 May 2013

Alicia Perez-Fuentetaja, PhD
Associate Professor & Research Scientist Biology Dept. & Great Lakes Center
SUNY Buffalo State
1300 Elmwood Ave.
Buffalo, NY 14222

Re: Opportunity for Greenway-funded project to be used as work in-kind toward a Federal Project under the USACE GLRAP Program

Dear Dr. Perez-Fuentetaja,

Thank you for your interest in collaborating with the Buffalo District concerning barriers to movement of the Emerald Shiner in the Niagara River and alternatives to promote their passage. I understand that you have received a Determination of Consistency from the Greenway Commission for your initial proposal and are now developing a more detailed proposal.

As we have discussed, through the Great Lakes Remedial Action Plans Program (GLRAP), the Corps of Engineers is authorized to provide technical, planning and engineering assistance in support of Remedial Action Plans for Great Lakes Areas of Concern. Such assistance is provided on a project-by-project basis, and requires a Partnership Agreement with a non-Federal sponsor. Formulation of alternatives to promote passage of the Emerald Shiner is an endeavor consistent with the goals of the Niagara River Remedial Action Plan, and is therefore appropriate for the GLRAP Program. Your proposed scope of work, should you be awarded funding to perform such activities, would be an appropriate form of work in-kind. This work in-kind could be used in whole or in part toward the non-Federal cost-share requirement of 35% of total project cost. 65% of total project cost would be Federally-funded and used to perform the tasks identified in a Partnership Agreement for Technical Assistance.

I look forward to future communication and wish you luck with your proposal.

Sincerely,

Bryan Hinterberger

Bryan Hinterberger
Plan Formulator, Buffalo District

Project Registration Number_____

Niagara River Greenway Commission

Consultation and Review Form

Type of Review Required: Mandatory Consultation

PROJECT SPONSOR INFORMATION

Name: Research Foundation for SUNY-Buffalo State

Mailing Address: 1300 Elmwood Ave., Buffalo

State: New York 14222

Federal Id# 14-1368361 **Charities Registration #** N/A

PROJECT TYPE

Check all that apply:

_X_ Environmental ___ Cultural/Heritage _____ Land or Water Public Access

____ Cultural _____ Trail __X__ Educational/Interpretive

____Waterfront or Land Based Development _____ Signage

____ Recreational _____ Other

Project Name: Emerald Shiner Habitat Conservation and Restoration Study in the Upper Niagara River: Importance for Sport Fish, Common Terns and Public Education.

Location: Upper Niagara River

Site Address: N/A

State: New York

Minor Civil Division(s): N/A

County: Niagara and Erie

Project Proponent Property Interest (own, lease, easement or other): N/A

AUTHORIZED OFFICIAL

Name: Carol A. Darstein Title: Director, Pre Award and Contract Services

Organization/Firm: Research Foundation of SUNY- Buffalo State

Business Address: 1300 Elmwood Avenue, BI B-24, Buffalo

State: New York **Zip Code:** 14222

Telephone Number: 716-878-3047 **Cell Number:** N/A

Fax Number: 716-878-4039

E-Mail Address: carold@rf.buffalostate.edu

PROJECT POINTS OF CONTACT

PRIMARY CONTACT (Principal Investigator):

Dr. Alicia Pérez-Fuentetaja, Associate Professor,

Biology Dept. and Great Lakes Center, SC254, 1300 Elmwood Ave., SUNY Buffalo State, Buffalo, NY 14222, Phone: (716) 878-4608, Fax: (716) 878-4028, Email: perezfa@buffalostate.edu

Co-PRINCIPAL INVESTIGATORS:

Mark Clapsadl, Fisheries Biologist, Great Lakes Center, SUNY Buffalo State.

Dr. Randal Snyder, Professor, Biology Dept., SUNY Buffalo State.

COLLABORATORS:

Dr. Daniel Potts, Assistant Professor, Biology Dept., SUNY Buffalo State.

Timothy DePriest, Region 9, NYS Department of Environmental Conservation (DEC).

Michael Wilkinson, Region 9, NYS Department of Environmental Conservation (DEC).

Donald Einhouse, Region 9, NYS Department of Environmental Conservation (DEC).

Andrew Hannes, Buffalo District, US Army Corps of Engineers (USACE).

Renata Kraft, Director of Greenway Planning and Landscape Architecture, Buffalo Niagara Riverkeeper.

Dr. Sarah Delavan, Assistant Professor, Environmental & Water Resources Engineering Dept., SUNY Univ. at Buffalo.

Dr. Lee Harper, Ornithologist, Riveredge Associates.

Katie Hastings, Great Lakes Center, SUNY Buffalo State.

PROJECT NARRATIVE

PROJECT LOCATION: This project will take place in the Niagara and Erie Counties of New York State. Sixteen locations are identified in the accompanying map in the waters of the Upper Niagara River on the US side. These are the sampling locations/habitat evaluation areas that we plan to study for our proposed project. No structures or modifications that require permits are proposed. We have a valid New York State Collecting Permit to collect all life stages of the emerald shiner. The duration of the project is three years.

PROJECT DURATION: Three years, Spring-Summer-Fall from 2014-2016 (or into 2017 depending on starting month/year).

PROJECT SUMMARY

Benefits to the Niagara Basin: This project proposes a comprehensive study of the life history and habitat utilization of the native emerald shiner (*Notropis atherinoides*) in the upper Niagara River and their importance in sustaining sport fish and piscivorous bird species (in particular the common tern, *Sterna hirundo*) that depend on this resource. This type of study is lacking in the Niagara River and focuses on a critical species in the river food web in need of conservation and habitat restoration. This proposal focuses on restoration and enhancement of fish and wildlife resources by analyzing threats to migration and the status of key habitats, helping restore threatened species, conserving migratory birds, and educating the public. In addition, this project addresses the delisting criteria of the Niagara Remedial Action Plan (RAP) for Fish Habitat and for Fish Communities, regarding solutions to the restricted use of habitat by emerald shiners due to water flow alterations and habitat loss, and proposing conservation strategies for this species.

Eligibility considerations: •This project addresses the effects of water velocity and water levels in the upper Niagara River (Power Project impacts) on emerald shiner passage and migration in the river. •This project seeks to preserve the NYS threatened common tern in the Niagara River by protecting and restoring their main food source, the emerald shiner. •Our approach has a strong applied scientific foundation; it is focused on an issue in the Niagara River and includes community outreach. •Our results will contribute to long-term protection of the threatened common tern by providing critical missing information about their main food source (the emerald shiner) and providing the tools for shiner management. •This project will achieve multiple ecological goals such as investigating the emerald shiner life history and habitat utilization, shiner population dynamics and genetics, shiner contribution to sport fish diets and common tern diets and chick-rearing success, effects of man-made structures and alterations to the river that affect shiner passage (including water velocity

studies at migration bottleneck-locations in the upper river), and public outreach and education regarding the importance of this key species to the river's health. •This project is multi-faceted and includes multi-stakeholder collaborations (see list of collaborators). •Our project includes two matching sources: 25% of the requested funds from SUNY Buffalo State and 65% of total funds from USACE (see budget). •The probability of success of this project is very high, since there is no information available on emerald shiners, their habitat and how they support important fish and bird species in the river, therefore, all data collected and recommendations resulting from this research and outreach efforts are novel and needed.

Overview: The Niagara River Area-of-Concern (AOC) is an important migratory pathway for the emerald shiner and for birds that use the river for staging and nesting. The Niagara River AOC was designated in large part due to the effects of toxic contamination of water and sediments; however, one of the seven delisting criteria to address Degradation of Fish and Wildlife Populations Beneficial Use Impairments includes maintenance of the fish communities on the U.S. side at levels that meet the objectives of the binational fish-community agreement. Emerald shiners are an important native prey-species that fuel the food webs of sport fishes and act as a keystone species in the Niagara River ecosystem, sustaining predatory fish and piscivorous migrating birds in the Niagara flyway (the Niagara River has been designated an Important Bird Area (IPA) by BirdLife International and its partners). The emerald shiners play a paramount role in local sport fish growth and condition and are a vital food source for the brood success of the NYS threatened common tern in the Niagara River and for other migrating birds. Therefore, the health of the emerald shiner in the Niagara River ecosystem provides enormous regional ecological benefits. Information on habitat utilization and life history of the shiners is meager and in need of being addressed. Failure of these fish to reproduce or migrate in the river has important cascading effects to their predators: sport fish populations and avian species using the river. However, despite being a very prominent species sustaining the Niagara River food web, this native fish species has been subjected to widespread modifications of spawning and nursery habitats, competition with non-native fish, damming, water diversions and overall changes in water velocities along their presumed annual migration routes in and out of Lake Erie. For instance, historical river channel modifications and shoreline alterations, including installation of vertical bulkhead structures, have increased water velocity in sections of the river that shiner larvae are known to attempt to traverse in order to migrate upstream to Lake Erie, potentially jeopardizing their migration success. In the Niagara River, shiners are also commercially exploited as baitfish, being the most important species locally harvested by this industry. Our knowledge of how this species utilizes nursery habitats in the Niagara River, the timing of their migration and the factors that determine reproductive success are poorly understood and the existing information is patchy and anecdotal. Little is also known about the effects of man-made alterations within the river habitat and whether modifications can be made to these structures to better facilitate shiner passage. Emerald shiner mass mortality

events are known to occur sporadically and seem related to strong year classes and lack of available river habitat, which can result in oxygen depletion (from fish respiration) and mortality. We lack basic information to manage and protect the emerald shiner, but if their abundance were to substantially diminish, the effect would cascade to valuable sport fish species (walleye, smallmouth bass, steelhead, yellow perch, muskellunge, etc.) and to protected bird species (bald eagle, common tern, common loon, etc.) and unravel efforts to restore those populations in the lower Great Lakes. In addition, being an important commercially harvested bait fish, the economic value of the emerald shiner contributes to the prosperity of the region. This project proposes to determine the shiners' use of the river for spawning, nursery habitat, pathways of migration (including high velocity areas associated with smooth surfaces of concrete piers, bulkheads, pilings etc.) and year-class formation. Results from habitat use by the shiner will be used to determine restoration needs to provide enhanced spawning and nursery areas and to diminish impediments to fish movement in the river. A trophic study will investigate food availability to larval, young-of-the-year and adult shiners as well as their contribution to the diets of sport fish, adult common terns and their offspring. The focus of this project is to determine critical habitat for the shiners' reproduction and migration and to evaluate the influence that these fish have on local sport fish and on the brood success of the common tern. Our results will answer questions about habitat conservation, restoration or possible modification to ensure the long-term success of emerald shiners, sport fish and common terns in the system. We will make our results available to various stake-holders and the public through data-sharing and education activities.

WORKING QUESTIONS

Ecology of the emerald shiner in the upper Niagara River and how they support sport fish and NYS threatened common terns

1. How do emerald shiners utilize the habitats available in the upper Niagara River for spawning, growth and maturation?
2. Are emerald shiners in the river part of one genetic population from lakes Erie and Ontario or are they genetically different depending on differences in their use of habitat in time (spring vs. fall, etc.) and space (shoreline, tributaries, etc.)?
3. What migration routes do emerald shiners use as they travel the river downstream as adults and upstream as larvae/juveniles and what bottlenecks in the river affect emerald shiners movements by increasing water velocity? (Bottelenecks may exist at the Broderick Park pier, Peace Bridge pilings and the Black Rock Canal locks, see map locations 1, 2, 3, 4).
4. How important are the emerald shiners as food for sport fish and common terns in the Niagara River corridor?

Habitat availability and condition in the upper Niagara River for emerald shiners

5. What habitats are key for the success of the different life stages of the emerald shiner?
6. What types of nearshore vegetation and substrates are present in key emerald shiner habitat in the upper Niagara River?

Education and Outreach

7. How can this project educate the public and interested groups (fishers, birders, boaters, etc.) to achieve an understanding about the importance of the emerald shiner in the well-being of the aquatic community in the Niagara River?

PRIMARY OBJECTIVES **(**numerically related to the above questions):

1. Locate and quantify the types of habitats preferred by shiners and determine which ones are more important for reproductive success (see map of sites we initially plan to study). Examine food resources for juvenile and adult shiners and their trophic position.
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.
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 (see map locations 1, 2, 3, 4) using field and laboratory experiments. Analyze the importance of fish barriers and evaluate mitigation measures on fish passage. Design alternatives to these barriers (USACE).
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 observation and trophic position determination.
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).
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.
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.

Methodology: For habitat utilization, sites indicated in the map will be selected and other sites will be added as we survey available habitat. Habitats where shiners are found will be catalogued by their features (percent vegetation, water velocity, depth, temperature, etc.) and all the information will be entered into a Geographic Information System (GIS). Shiners will be sampled in their migration routes and habitats by using various sampling gears: bongo-nets for ichthyoplankton, seining and electrofishing. Observational data of shiner schools will also be collected. We will perform a diet analysis using stomach contents for emerald shiners, field observations of common tern diets and stable isotope analyses of $\delta^{13}C$ and $\delta^{15}N$ and calorimetry for: shiner eggs, larvae, juvenile and adult shiners, chick and adult tern's feces and feathers, and plankton. Because shiner populations can change dramatically from year to year, three cohorts of emerald shiners and tern offspring will be studied during the Spring-Summer-Fall from 2014-2016 (or 2017 depending on starting month/year) (these data will be collected and analyzed by Buffalo State, Riveredge Associates, NYSDEC). For discrimination of the different populations of shiners that use the river, we will collect samples from nearby (eastern Lake Erie, western Lake Ontario, lower Niagara River) populations and compare them with fish collected at various locations and different times of the year within the upper Niagara River. The samples will be analyzed using a cloning-free, next generation sequencing method for rapid identification of simple sequence repeats, or microsatellites (data collected and analyzed by Buffalo State and contractual). Vegetation will be sampled using rakes and quadrats as appropriate for plant identification and biomass estimates, supplementing existing data collected by Buffalo Niagara Riverkeeper (data collected and analyzed by Buffalo State, Riverkeeper, NYSDEC). Studies of water flows will be performed in the river using hydrographic survey technologies (side scan, multibeam), hydrodynamic simulation modeling and flow velocity measurements. To determine the swimming abilities of shiners, we will perform experiments in the laboratory with different currents using flumes, an acoustic doppler velocimeter, particle imaging and laser fluorescence (data collected and analyzed by UB, USACE). Modeling and detailed engineering designs of restoration projects will be done by USACE. Educational materials, interpretation and outreach activities will be developed by Buffalo State, Riverkeeper and an education specialist (contractual).

How this project will advance the Niagara Greenway vision: The main focus of this project is the preservation, enhancement and development of the scenic, natural and recreational resources of the Niagara Greenway, providing the tools to the community and the State to make informed and effective management decisions on a major resource in the river, the emerald shiner, facilitating economic development such as the bait fishery, recreational opportunities (as this fish provide food for sport fish and birds), and conservation for NYS threatened avian species, such as the common tern. In this sense, this project supports the Greenway ***Goals***

of Protecting and Restoring Environmental Systems and Promote Long-term Sustainability. In particular, this project is consistent with the ***Principles*** of sustainability, ecological integrity, public well-being, restoration, authenticity, celebration through education and interpretation for the public; in addition, in this project we also have extensive partnerships with parties heavily involved in the well-being of the Niagara River and the community (Buffalo State, NYSDEC, USACE, Buffalo Niagara Riverkeeper, Univ. at Buffalo, Riveredge Assoc.). This project also complies with the ***Criteria*** of the Greenway Commission: this project is consistent with the Greenway principles, and supports the priority status of the restoration of the river ecosystem and the interpretation and education efforts about the river's natural resources. Our focus area is in the river itself, the project has environmental soundness and will not impact the river in any way, it is implementable, we have local partners, we provide matching funds from Buffalo State of 25% and from USACE of (potentially) 65% of project cost (cost sharing of approximately $809,751). This project builds on efforts by Buffalo Niagara Riverkeeper, USACE, NYSDEC and USFWS. This project will be highly beneficial to the Niagara Basin by providing a scientific study that could contribute to the eventual delisting of the Fish Habitat and Fish Communities targets of the Niagara River RAP. An understanding of the shiner ecology in the river will also provide the tools to manage the fishery and avoid declines of this key species.

How the Project will be Operated and Maintained: Dr. Alicia Pérez-Fuentetaja will be responsible for Project Design and Execution with assistance from the co-Principal Investigators. The collaborators will provide assistance with different aspects of the project and will facilitate access to the studies they have already performed in the Niagara River. Three Master-level students and undergraduates will provide assistance in the field and laboratory. Graduate students will produce theses, publications and public presentations. Reports on our progress will be submitted as required.

Estimate of Project Cost and Funding Requested

Project Duration: Three years.

Proposed Budget:

Planning	$0
Construction	$0
Acquisition	$0
Administration	$151,469
Operation and Maintenance/Year	$0
TOTAL PROJECT COST	$824,501

	Design/ Execute
Total Project Cost Includes Requested amount + SUNY Buffalo State matching funds contribution (first amount). In parenthesis, total project cost including USACE matching funds, see below*	$1,098,326 ($1,634,252)
Matching Funds 25% In-kind Contribution SUNY Buffalo State (first amount). In parenthesis, total matching funds including the first amount and USACE in-kind leverage funds, see below*	$273,825 ($809,751)
Funding Requested (Total cost minus matching funds)	**$824,501**

Matching Funds: In-kind contribution by SUNY Buffalo State includes salaries, use of various boats with different capabilities, and waived indirect costs. In addition (not included in the in-kind estimate), the Buffalo State Great Lakes Center Field Station along the Niagara River can provide at no-cost to this project: personnel time (experienced fisheries and GIS technical staff), research vessels, sampling gear, fully equipped laboratories, equipment, trucks and other vehicles, boat launch facilities and maintenance.

* We are in negotiations with USACE to leverage funding for this project through the Great Lakes Remedial Action Plans (RAP) Program, in this case, in support of the Niagara River RAP. Their contribution would be in the form of assistance with the evaluation of habitat restoration sites and design of habitat improvement alternatives. Our negotiations will include the signing of a partnership agreement between USACE and SUNY Buffalo State for work in-kind to leverage 65% of the total project cost with Federal funding (potentially additional **$535,926**).

Breakdown of funding requested for the proposed three years of this project:

Category	**Year 1**	**Year 2**	**Year 3**
Salaries/Wages and Fringe Benefits	$124,399	$128,753	$66,035
Contractual	$83,000	$83,228	$83,463
Equipment and Supplies	$12,000	$8,000	$7,000
Travel	$0	$5,000	$5,000
Master's Students Tuition (three)	$33,000	$34,155	$0
25% Indirect Cost	$54,850	$56,245	$40,374
Requested per year	**$307,249**	**$315,381**	**$201,872**

All equipment items are under $5,000 and have a short life (i.e., seines, other nets, manual flow meter, etc.)

Community and Government Support: This project proposal has received extensive and strong support from parties working towards the goals of the Greenway Commission. We have the support of the New York Department of Environmental Conservation, Region 9, in Buffalo and the Lake Erie Unit. We also have strong support from the Buffalo Niagara Riverkeeper and the US Army Corps of Engineers. Additional community support will be sought if this proposal is elected for full proposal submission.

Project Site: This project will not alter the river or public or private lands. All our activities will take place in the water (see map). No structures or modifications that require permits are proposed. We have a valid New York State Collecting Permit to collect all life stages of the emerald shiner.

by Kathleen Hastings, Great Lakes Center, 2013