



Return of Eels to Pickering Creek

Project Report for 2019-2020 PA Coldwater Grant

Project Summary

Like most streams in the Schuylkill River watershed, the Pickering Creek watershed has recently been overwhelmed by invasive crayfish. For Pickering Creek, the Virile Crayfish (*Faxonius virilis*) began its takeover around 2011, and by 2019 many areas of the mainstem Pickering Creek had converted to 100% Virile Crayfish at densities exceeding the historic densities of native crayfish (D.A. Lieb, unpublished data).

A team of scientists from the Western Pennsylvania Conservancy, the Pennsylvania Fish & Boat Commission, the Academy of Natural Sciences of Drexel University, and the Delaware Riverkeeper Network identified an extraordinary correlation whereby invasive crayfish within the Schuylkill River and Delaware River watersheds were only able to successfully colonize and proliferate where a native predator, the American Eel (*Anguilla rostrata*) had been eliminated or severely limited from the stream community.

Based on this empirical relationship, and the fact that American Eels have not been recorded in Pickering Creek for decades, this team of scientists began an experimental return of this native predator to the Pickering Creek watershed in 2019. The goals of this experiment were two-fold. First, the team sought to control invasive crayfish numbers and re-establish native crayfish populations through the selective predation of American Eels on naïve invasive species of crayfish. Second, the team sought to return the ecological balance of the aquatic community, including coldwater trout species, through the control of this invasive and keystone omnivore, the Virile Crayfish.

Baseline crayfish data and fish community structure were collected in 2019 prior to American Eel return to the Pickering Creek watershed, followed by the release of two separate cohorts of American Eels. First, for possible short-term impacts on invasive crayfish, approximately 500 moderate sized eels were captured from Delaware River tributaries and released in the Pickering Creek watershed in August and September 2019. Second, approximately 3600 young-of-year glass eels were reared for 6 months by the USGS-Wellsboro lab and released as small eels to re-establish American Eel populations in Pickering Creek for the next 10-20 years.

Follow-up surveys in the summer of 2020 show strong retention and survival of American Eels in the Pickering Creek watershed, although only limited dispersal one year after release. Crayfish



Figure 1. Crayfish sample from Pine Creek in 2020, where the invasive Virile Crayfish has begun to dominate the ecosystem; also collected in this sample is a young American Eel one year following its release back into the Pickering Cr watershed.

surveys reveal that the Virile Crayfish retains its dominance one year after eel release, but two native species of crayfish have been able to maintain relict populations in at least 3 tributaries.

Public Meetings

Public meetings and presentations have been held throughout the project period to share project goals and plans, and to solicit public feedback on both this project and the long-term efforts to protect and restore the Pickering Creek watershed.

Prior to project implementation, and after announcement of the grant award, the project team initiated a series of outreach efforts that included presentations at the following meetings:

<u>Date</u>	<u>Meeting & Organization</u>
5/15/19	Valley Creek Restoration Partnership
6/6/19	West Pikeland Township Environmental Advisory Committee
6/12/19	Charlestown Township Environmental Advisory Committee
6/17/19	West Pikeland Township Board of Supervisors
6/25/19	Schuylkill Township Environmental Advisory Committee

Field work began in late June 2019, and the first eel releases occurred on August 29, 2019, at a public press event at Historic Yellow Springs (yellowsprings.org). Our outreach continued through the following meetings and presentations:

<u>Date</u>	<u>Meeting & Organization</u>
8/29/19	Historic Yellow Springs, first eel releases & press event
10/10/19	Green Valleys Watershed Association Annual Dinner
11/21/19	French & Pickering Creeks Conservation Trust Seminar Series
1/9/20	Valley Forge Chapter of Trout Unlimited
3/3/20	Delaware River Basin Fish & Wildlife Cooperative

Project Outcomes

As described in the project summary, there were two primary goals for this experimental re-introduction of American Eels into the Pickering Creek watershed. First, the team sought to control invasive crayfish numbers and re-establish native crayfish populations by the selective predation of American Eels on naïve invasive species of crayfish. Second, the team sought to return the ecological balance of the aquatic community, including coldwater trout species, through the control of these invasive and keystone omnivores, the Virile Crayfish.

Although this ecosystem experiment is still relatively early in its long-term response, some of the project objectives were successfully completed. American Eels have been successfully re-established in the Pickering Creek watershed, including moderately mature eels (20-60 cm) as well as young-of-year eels (~10 cm). Although all eels are expected to successfully complete their outward spawning migration sometime in the next 30 years, with no hydropower facilities between the release point and the Atlantic Ocean, the combination of moderate sized and young-of-year eels is expected to maintain local eel populations in Pickering Creek for the next 10-20 years. As a result, a critical component of the native fish fauna has successfully been re-established in this watershed.

Similarly, the two native species of crayfish that have been in decline for much of the last decade have been documented to remain at appreciable numbers in at least 3 of the Pickering Creek tributaries. This includes an apparently new species of crayfish (presently referred to as *Cambarus (Puncticambarus)* sp.) known only from 5 watersheds in southeastern Pennsylvania. As a result, the return of American Eels to the Pickering Creek watershed is expected to play a critical role in the long-term conservation of this new crayfish species.

Yet one year after American Eels were released into the Pickering Creek watershed, the control of the invasive Virile Crayfish and the return of a native species composition and balance has not yet occurred. Virile Crayfish continue to dominate at nearly all sampling sites, and the mainstem Pickering Creek below Charlestown Road retains 100% Virile Crayfish in 2020. The project team had some hope that the mixture of small and moderate sized eels re-introduced in 2019 might result in localized reductions in Virile Crayfish at the release sites. Such reductions were not observed in 2020. As a result, it is clear that the control of the invasive Virile Crayfish will only unfold over a longer trajectory for Pickering Creek.

Sustainability

The short- and medium-term sustainability of American Eels in Pickering Creek has been assured through the complementary re-introduction of both moderate sized eels and young-of-year eels that should persist in the watershed for the next 10-20 years.

The long-term sustainability of American Eels, of native crayfish, and of a healthy and balanced aquatic community is less certain and will need concerted efforts and intervention. The Schuylkill River has seen a near-collapse of American Eel populations along its mainstem and its tributaries in the last 50 years, as documented in Pennsylvania Fish & Boat Commission surveys and in Limerick Generating Station consultant surveys. Given that this time period has seen both the removal of mainstem dams on the Schuylkill River and installation of fish-passage structures, the sharp decline in American Eels is both perplexing and alarming. While reduced abundances of young-of-year migrants from the ocean may play a role in these declines, strong and sustained populations of American Eels elsewhere in the Delaware River watershed suggest that sufficient colonization continues in the absence of migratory barriers.

As a result, a key goal over the next 10 years while eels mature and grow in the Pickering Creek watershed is to reverse the decline in American Eels through the Schuylkill River watershed and re-establish natural migration of eels to rivers and streams, including Pickering Creek. While this can be obtained, in part, through continued restoration via dam removals, some barriers to migration are likely to remain in the Schuylkill-Pickering system (e.g., Fairmount Dam, Pickering Creek dam) because of water supply functions. For these barriers, low-cost but specialized eel migration ramps and ladders will likely need to be installed and maintained during key migratory seasons. Because of the American Eel's amazing inherent ability and drive to migrate over and around both natural and human barriers, simple eel passage structures have a high likelihood of significantly boosting the overall migration of American Eels and the population trajectory within the Schuylkill River watershed. The long-term sustainability of the Pickering Creek restoration work, both for invasive and native crayfish as well as coldwater trout species, will hinge on the successful return of self-sustaining American Eel migrations throughout the Schuylkill River watershed.

Future Work in the Pickering Creek Watershed

First and foremost, the project team will continue to collect quantitative crayfish and fish data for the next few years to evaluate the success of the American Eel re-introduction experiment for attaining project goals.

As described above, additional work both in the Pickering Creek watershed and in the Schuylkill River watershed is needed to boost the natural migration of American Eels and reverse the 50-year-decline in eels for this region.

Much local work will likewise need to continue to preserve open space in the watershed, to reestablish and restore riparian corridors along all streams, and to control and remediate stormwater impacts from areas of intensive human development. Partners at Green Valleys Watershed Association, French & Pickering Creeks Conservation Trust, Historic Yellow Springs, Natural Lands, and Trout Unlimited have already successfully preserved and protected much of the watershed, but both more protection as well as restoration work will be needed to reverse declines, maintain cool and cold-water habitats, and protect the ecological integrity of this ecosystem.

Partnerships & Collaboration

The project team is proud of the successful implementation of the initial phase of this ecosystem experiment, with the success largely attributable to the unique and amazing partnerships among a host of organizations. The foundation of this work was established first with the collaborative and innovative research linking American Eels to crayfish invasions by Dr. Dave Lieb (Western Pennsylvania Conservancy & Pennsylvania Fish & Boat Commission), Dr. Rich Horwitz & Paul Overbeck (Patrick Center for Environmental Research, Academy of Natural Sciences of Drexel University), and Dr. Erik Silldorff (Delaware Riverkeeper Network). This team of organizations served as the leading partners in the project development, oversight, and implementation. The entire team from the Patrick Center for Environmental Research of Drexel University has continued to play a critical role in the development and implementation of this effort.

The USGS Northern Appalachian Research Laboratory in Wellsboro, PA, has long been a key source of novel laboratory space and innovative researchers who have been able to strengthen and expand the application of rigorous science to the preservation and restoration of aquatic ecosystems. For the current project, Dr. Heather Galbraith, Carrie Blakeslee, and Jeff Cole applied their experience and expertise to help rear and raise over 3000 young-of-year eels to the benefit of the Pickering Creek ecosystem. Unfortunately, USGS decided to permanently close this vital research facility in 2020, a decision which we deeply regret. Our research team will forever be indebted to the selfless efforts of the Northern Appalachian Research Laboratory to advance practical scientific research and partnerships to benefit freshwater ecosystems throughout the region.

The implementation of this watershed experiment has further relied on the expertise, generosity, and selfless commitment from colleagues working in the Pickering Creek watershed. These include Green Valleys Watershed Association, French & Pickering Creeks Conservation Trust, Trout Unlimited, staff and officials at West Pikeland Township, and many local landowners who shared access to the watershed's streams. A special thanks to Historic Yellow Springs for their hospitality to our research crews and for hosting the initial press event to celebrate the

return of American Eels to this watershed. Finally, fisheries biologists at Delaware Division of Fish & Wildlife and Maryland Department of Natural Resources assisted with young-of-year eel collection for rearing and release to Pickering Creek.

Accomplishments & Outputs

The project team is proud of the successful implementation of the initial phase of this ecosystem experiment. In addition to rigorous baseline data for measuring the ecosystem restoration over the next few years, our accomplishments and outputs include:

- Over 4000 native American Eels re-introduced into the Pickering Creek watershed;
- Wild trout reproduction demonstrated for at least two Pickering Creek tributaries;
- Over 60 miles of coldwater stream habitats improved by the initial restoration of native eels, and the long-term prospect of controlling invasive crayfish;
- Conservation of two native crayfish species documented, with the prospect of further restoration and rehabilitation of these coldwater ecosystems through expansion of native crayfish and the control of invasive crayfish.

Funding Support

This project has been supported, in part, by a major grant from the National Fish & Wildlife Foundation to the Delaware Riverkeeper Network, Western Pennsylvania Conservancy, and the Academy of Natural Sciences of Drexel University, and from a grant from the Coldwater Heritage Partnership on behalf of the PA Department of Conservation & Natural Resources (Environmental Stewardship Fund), the PA Fish & Boat Commission, the Foundation for Pennsylvania Watersheds, and the PA Council of Trout Unlimited.

Links to Articles & Videos

(i) Project Summary & Eel Release Video:

<https://www.youtube.com/watch?v=8ITdVrjQPWI>

(ii) Green Valleys Watershed Association Newsletter highlighting project:

https://www.greenvalleys.org/wp-content/uploads/2019/10/SL_summer2019web.pdf

(iii) News Articles on Eel Release:

- <http://yellowsprings.org/eels-released-into-pickering-creek-at-historic-yellow-springs/>
- <https://6abc.com/science/scientists-hope-to-fix-pickering-creek-ecosystem-with-slimy-eels/5501372/>
- <http://paenvironmentdaily.blogspot.com/2019/08/american-eels-reintroduced-to-pickering.html>
- https://www.pottsmmerc.com/news/eels-released-into-pickering-creek-to-help-biodiversity/article_08bfcdac-ca76-11e9-ae64-cf6d1f81d030.html?fbclid=IwAR0WpPyNd3ziEfrh4XqCiHJvWQ3XbCaODkYpcub5cKJoFDPqHEtxcwdmzsw

Photos of Pickering Creek Ecosystem Restoration Project



Figure 2. Brown Trout from Pine Creek, one of Pickering Creek tributaries with reproducing trout populations where invasive Virile Crayfish are overwhelming the stream ecosystem.



Figure 3. Crayfish sample via electrofishing from Yellow Springs tributary illustrating the dominance by invasive Virile Crayfish (right bucket) compared to native crayfish (left bucket).



Figure 4. View of Pickering Creek mainstem during electrofishing sampling of fish and crayfish during summer 2020 by the Academy of Natural Sciences of Drexel University fisheries team..



Figure 5. First release of American Eels back into the Pickering Creek watershed during August 2019. Pictured (from right) are Dr. Dave Lieb (WPC / PFBC), Peter Silldorff, Wim van Rossum, Maya van Rossum (DRN), and Dr. Erik Silldorff (DRN)



Figure 6. Carrie Blakeslee from the USGS Norther Appalachian Research Lab holding the eels reared in her lab prior to release into the Pickering Creek watershed in August 2019.



Figure 7. Dr. Erik Silldorff releasing larger eels into the Yellow Springs tributary of Pickering Creek in October 2019.