Hungry Goats Munch on Invasive Multiflora Rose at the Erie National Wildlife Refuge

The use of goats as a management technique has allowed staff at the Erie National Wildlife Refuge to successfully suppress troublesome populations of multiflora rose. In doing so, important native species have started reappearing which provides benefits to local wildlife and the regional ecosystem.

Story written by Melissa Althouse, Wildlife Biologist with the Erie National Wildlife Refuge

"On a global basis, the two greatest destroyers of biodiversity are, first, habitat destruction and, second, invasion by exotic species." - E.O. Wilson

The National Wildlife Refuge System is a network of lands and waters protected for the conservation of fish, wildlife, and their habitats, and to provide opportunities for the public to engage in wildlife-based recreation. In order to accomplish this, we need healthy systems across the landscape. One of the key characteristics land managers look for in management units is a high level of biodiversity. But sometimes, humans spread species to new places, and those species can drastically alter the native habitat. These invasive species thrive in a wide variety of conditions, reproduce rapidly, and don’t have any checks like predators or pests to keep their populations from exploding. Trying to control invasive species, or better yet, preventing them from establishing in the first place, is unfortunately not a one-man job. It takes a community of caring people to accomplish these sorts of inevitably large projects.

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Two years ago, the Erie National Wildlife Refuge (Erie NWR) collaborated with the Research Methods Class at Allegheny College to survey for invasive species. That project unfortunately stalled out in the planning stages due to a lack of resources, and never came to fruition. However, armed with new research documenting the effectiveness of goats as a cultural control of multiflora rose, support from the U.S. Fish and Wildlife Service’s regional Division of Natural Resources and Conservation Planning, and partner interest from the 501(c)3 nonprofit organization Allegheny GoatScape, Erie NWR was finally able to pull together the resources to execute this project.

On June 6, 2019, after almost two years of planning and gathering the proper equipment, eight goats and their guard donkey arrived at Erie NWR. Gavin Deming, Executive Director of Allegheny GoatScape, trained staff and volunteers in the setup of mobile enclosures and the basics of goat care. At the time of writing this story (mid July), the herd has gone through six management units and consumed 2.2 acres of multiflora rose—and they still have almost a month left! With its limited staff, the use of mechanical and chemical treatments is often Erie NWR’s only option, but in areas like this, these methods cannot be safely used to gain control of infestations. These goats are not only moving through quicker than staff could, but also much more efficiently and with less damage to any remaining native vegetation. Goats may be fairly indiscriminate browsers, but they have a clear preference for multiflora rose versus other lingering understory plants, like various species of beech (Fagus spp.). We’ve even encountered some Trillium—like Declined trillium (Trillium flexipes)—and a huge patch of Blue cohosh (Caulophyllum thalictroides) after the multiflora rose was cleared!

There will, of course, be follow-up work to ensure that this understory remains healthy and diverse, but these goats have been able to get a handle on an infestation that Erie NWR would not have been able to even touch on their own. Erie NWR will welcome the 2019 Research Methods Class back to repeat their transects. Students will quantify the effectiveness of various control measures including 1) goat browse only, 2) goat browse followed by herbicide application, and 3) herbicide only in our management units, though all herbicide will only be administered in areas away from surface water. This project serves to underscore the importance of partnerships in conservation work. It took many hands (and some hooves) to get this project underway, and Erie NWR couldn’t be happier to continue working with our partners in the future.

Note from iMapInvasives administrator: Data for this effort has been incorporated into the iMapInvasives database and can be viewed by any registered user of iMapInvasives by querying for treatment data located in the Erie National Wildlife Refuge. To become a registered iMapInvasives user, request a free login account at https://imapinvasives.natureserve.org/imap/login.jsp.
Invasive Quagga Mussels
Targeted for Eradication in Lancaster County Quarry

Quagga mussels are known for their ability to clog water intake pipes and compete with native species. Efforts are currently underway by the Susquehanna River Basin Commission to rid them from Billmeyer Quarry, a potential water storage site for the Susquehanna River when water levels are low during times of drought.

The Susquehanna River Basin is 27,510 square miles in size, draining water from New York and Pennsylvania to the Chesapeake Bay in Maryland. The Susquehanna River Basin Commission (SRBC) is an interstate agency tasked with managing the water resources within the Basin. In times of drought, the SRBC is able to release water from storage areas to ensure that downstream users are not affected.

In 2016, the SRBC was investigating the 29-acre Billmeyer Quarry in Bainbridge, PA (20 miles south of Harrisburg) to use as potential water storage for the Susquehanna River in times of drought. During the initial site investigation, the Pennsylvania iMapInvasives database showed that quagga mussels (*Dreissena bugensis*) were identified in the Billmeyer Quarry in 2008. Quagga mussels are an invasive species like their relatives, zebra mussels (*Dreissena polymorpha*), only more adaptable. Quagga mussels can cause fouling of intake pipes and outcompete native species for resources. They have a larval stage called ‘veligers’ that allows the young mussels to be free-floating with other plankton. The SRBC did not want to take the chance of discharging water containing veligers into the Susquehanna River and risk colonization downstream. As a result, a mitigation program was pursued to remove the quagga mussels from the quarry.

The SRBC contracted with Earth Science Laboratories, Inc. to eradicate the quagga mussels in the quarry using copper-based EarthTec QZ, which targets all mussel life stages and does not harm other aquatic organisms. In late summer 2017, SOLitude Lake Management applied EarthTech QZ three times throughout the quarry, targeting different depths to achieve necessary copper concentrations. SOLitude kept track of the effectiveness of the applications by monitoring the mortality of adult quagga mussels in cages set throughout the quarry. Three days after the first treatment, these caged mussels started to die, and all caged mussels were dead within 40 days.

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SOLitude and the SRBC observed mussels that were attached to quarry structures were open and dead. Floating mussel shells were observed throughout the quarry. Plankton samples were collected and showed all veligers were dead as well.

The SRBC then undertook a 35-day pumping test to verify the volume of water available to be discharged from the quarry into the River was 425 million gallons. This pumping test also showed that the discharge of this amount of water had minimal impact on surrounding water users. This test lowered the surface of the quarry by 60 feet. Quagga mussels in this drawdown area that had been exposed to chemical treatment were then also dewatered for six months until the heavy rains of 2018 refilled the quarry to pre-drawdown levels.

In June 2019, the SRBC started a bi-weekly seasonal monitoring program that sampled for quagga mussel environmental DNA (eDNA), which is DNA shed by an organism into its environment. For example, eDNA from a mussel could include shed skin cells from living or dead mussels as well as waste and veligers. The presence of quagga mussel eDNA would mean that some quagga mussels survived the eradication process performed by SOLitude and that additional eradication steps would need to be taken in the future by SRBC to ensure complete eradication occurs. The SRBC anticipates receiving this first round of eDNA monitoring results in winter 2020. Monitoring will continue seasonally into the near future.

Zebra mussels have already been found in the Susquehanna River downstream of the Billmeyer Quarry. Management efforts are underway to control these zebra mussels to minimize economic problems for drinking water suppliers and power plants. These management efforts will also try to curb recreational effects felt by fishermen and boaters as well as ecological effects. If quarry eradication is deemed successful, quagga mussels will no longer have the potential to enter the River here and make these existing problems worse.

If you would like more information on quagga mussel eradication or the SRBC’s monitoring program, please contact Ellyn Campbell at ecampbell@srbc.net. More details about the Billmeyer Quarry project can be found at https://www.srbc.net/our-work/programs/planning-operations/billmeyer-quarry.html.

Quagga mussel and drawing indicating how eDNA is collected. Credit (quagga mussel): Outdoorcentral.com; Credit (eDNA drawing): ACS Publications
Invasive Species Profile >>>

Quagga Mussel (Dreissena bugensis)

Species at a Glance: The quagga mussel, which some consider even more dangerous than its close relative the zebra mussel (Dreissena polymorpha), is a small, fingernail-sized, freshwater mollusk and is one of the most intrusive, prolific, and costly aquatic invaders in North America.

Identification: The shells are rounded, fan-shaped, and attached by a hinge. While they are usually 3 cm (1.2 in) long, they can reach up to 5 cm (2 in). The shell is smooth and lacks ridges, although it typically has dark concentric rings that fade to a pale coloration near the hinge. The sticky thread-like projections called byssal threads are located toward the anterior end of the shell and help them attach to other objects. Eggs hatch into round, microscopic larvae called veligers that free-float in the water column for up to five weeks before settling.

Similar Species: While the zebra mussel is similar, it is more “D”-shaped, with a prominent ridge on its ventral side that allows it to sit upright. Quagga mussels are rounded and would simply topple over if placed on their sides. The midventral line is also straight in zebra mussels and curved in quaggas. The location of their byssal threads also differs; in zebra mussels, they are located in the middle of the shell.

Habitat: Quagga mussels are found in both shallow, warm waters and deep, cool waters of freshwater lakes, reservoirs, ponds, quarries, and slow-moving or sluggish rivers. Their byssal threads attach to rocks, docks, cement, wood, and vegetation, but unlike zebra mussels they can also live and thrive directly on muddy or sandy bottoms. Quagga mussel reproduction can occur at low water temperatures, as cold as 4-9°C (39-48°F).

Spread: One female can produce up to one million eggs in a breeding season. The free-floating veligers can be scooped up undetected and transferred in bait buckets, bilge water, and live wells. Because mussels can survive out of water for up to five days, they are easily transported to other waterways on recreational boating and fishing gear.

Distribution: While native to the Black, Azov, and Caspian sea drainages, quagga mussels first appeared in the Great Lakes in Lake Erie in 1989 in contaminated ballast water. They have since spread through all of the Great Lakes, the Mississippi River drainage, and many inland lakes. In Pennsylvania, they have been found in Lake Erie, the lower Susquehanna River, and diving quarries in Northampton and Blair counties.

Environmental Impacts: Like the zebra mussel, quagga mussels clog water intake pipes and damage equipment at power and water facilities. They also harm fisheries, alter water quality, and increase the growth of harmful algae. They decrease food sources for native species by filtering large amounts of microscopic plants and animals from the water, and they accumulate contaminants in their tissues. Economic impact is in the billions of dollars.

Information for this species profile comes from “Pennsylvania’s Field Guide to Aquatic Invasive Species (2015)”.
Begin in May 2019, I started working for Berks Nature in Reading, PA, an organization that believes nature is essential to our quality of life. The organization provides environmental leadership, direct action, expertise, land use planning, advocacy, research, and education programs in accordance with the natural, historic, social, economic, and technical needs of the county and its many local communities.

An integral part of protecting the land and water in Berks County is managing and controlling invasive species that have infiltrated the area. This summer, my supervisor, Sarah Chudnovsky, introduced me to the problem of invasive species. Once I started learning more about the issue, I found it impossible to ignore. Now every time I’m in a natural area, I scan my surroundings for invasive species such as tree-of-heaven (*Ailanthus altissima*), Japanese hops (*Humulus japonicus*), purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Polygonum cuspidatum*), and many others.

One of the first properties I visited with Sarah was a streambank restoration project in the Hay Creek watershed in Scarlet’s Mill, PA. We noticed the property was infested with large monocultures of Japanese knotweed and it was clear the plant was dominating a lot of the property. However, for a while I struggled to understand what the actual problem was and how the environment was being negatively impacted. During my summer spent with Berks Nature, I began to understand the answer to my question. I started to see firsthand that without natural predators, invasive plants take away resources from native plants including sunlight, soil, space, and water. Additionally, I began to comprehend that wildlife such as insects or birds that feed on invasive plants do not receive much or any nutritional value from them, as compared to a diet comprised of native plants.

In early June, I participated in an iMapInvasives webinar training which showcased the iMapInvasives mobile app and the online version of the iMapInvasives database.

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Invasive Species as Part of Elementary Curriculum

That Pretty Little Purple Plant—Unmasking an Alien Invader in Disguise

To make a positive difference in the face of any issue, education is key. For an issue like invasive species, this story’s author makes the case that students can utilize iMapInvasives in combination with other educational curricula to understand the overall issue and also be actively engaged with making scientific observations and assisting with problem-solving.

Story written by Tamara Peffer, Environment & Ecology Content Advisor with the PA Department of Education

Observing change is something we all do without conscious effort; however, the thresholds that engrain an observation into memory vary depending on personal awareness of the issue. Unfortunately, tracking shifts in plant populations or infiltration of invasive animal species such as the spotted lanternfly is something that many outside the ecological sciences rarely, if ever, think about until the invasion has taken a firm root (pun intended) and the impacts are irreversible.

Think about your impressions you probably had as a child, riding in the car across Pennsylvania to your family vacation destination. You may have noticed the seas of green speckled with orange, pink, blue, and white interspersed along the roadway and along waterways. A few years later, you may have noticed scattered plots of pretty purple flowers standing tall in the fields and meadows. Roll your recollections forward a few more years—now the mix is more purple than green. Scroll forward to today—entire border zones are now primarily purple. Come to think of it, it’s hard to even remember when the pretty purple flowers of purple loosestrife (*Lythrum salicaria*) replaced the discrete rainbow of native flowers. Now, you may be asking yourself, when did that happen? How did this plant take over an entire ecosystem in 20-30 years? How do people track and understand phenomena such as population shift?

Encouraging development of issue awareness, content knowledge, and skills to track change, especially complex ecological system changes, and develop tiered solutions for integrated pest management requires a lens that is transdisciplinary. Fortunately, Pennsylvania’s Environment and Ecology Academic Standards and Environmental Literacy Plan actively support development of interdisciplinary skills and interdependent knowledge transfer systems to better understand how intricate ecological relationships morph over time.

Citizen science projects, like iMapInvasives, that aggregate and transfer data into spatial representations, help scientists from multiple disciplines, students, educators, and the general public be part of the frontline force in the battle against terrestrial and aquatic invasive organisms that have the potential to damage, destroy, dislocate, and/or replace our native flora and fauna.

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Map of purple loosestrife distribution across Pennsylvania, as shown in the iMapInvasives database.
In the school setting, the resources and citizen science potential of iMapInvasives can serve to facilitate age-appropriate interdisciplinary exploration of several of PA’s Chapter 4 Academic Standards, including Environment and Ecology, Science and Technology, Civics, Geography, Mathematics, and Computer Science. For example, utilizing the detection of purple loosestrife or another invasive species on or near a school campus as a multiple grade lesson springboard has the potential to weave a resilient fabric of understanding that students will internalize when the issue is based close to home.

In an effort to demonstrate ease of use and integration, the focus of this simple unit example will be on implementation with younger students (K-4). The goal is to address a BIG IDEA derived from the PA Environment and Ecology academic standard, 4.3.C—Environmental Health/Biological Diversity— “In the area where we live, there are many different plant and animal species that live together, sharing the resources of our ecosystem. When one or more species uses more than their share of food, water, air, shelter, and/or space, the health of the ecosystem may be affected.” The desired outcome is that students be able to develop and express in their own way the understanding that when any one plant takes over an area, it affects other plants as well as animals that may have used the plants that were displaced.

To first develop awareness, students at the elementary level can begin by merely exploring frequency of purple loosestrife sightings (or other invasive species local to their community) with their family. Teachers can send home simplified fact sheets and pictures of the target species sourced through the PA iMapInvasives’s Gallery of Invaders (https://www.paimapinvasives.org/gallery-of-invaders). Students can use science notebooking, journaling, or worksheets to document the number of times they see a particular plant in their travels for one week, also noting where they saw the plant(s), such as on a roadway, in a pond, on a hillside, etc. True to notebooking methodology, students should be allowed to document this in text, picture, map, or any combination of these. To expand, adding documentation of a simplified ranking for the quantity in each area into three categories—more than 10 plants, 10-5, and under five plants—helps students develop spatial and quantitative comparison skills that model systems of observation used by scientists. This simple activity also serves as a bridge into language and match skillsets, as well as helping to address a variety of science, geography, and civics standards.

Once the students complete their data collection, teachers can use the map display function in iMapInvasives to compare the student’s observations to data that has already been submitted by other citizen scientists or natural resource professionals. At this point, teachers have an opportunity to introduce careers and volunteer opportunities, asking students how they think all the information about an invasive plant got onto a particular webpage and who makes sure this information is correct. This opens the door for all students and families to actively participate as active citizen scientists.

This introductory process develops a basic awareness of both an invasive plant and a place to learn more through sound science. Now that students are familiar with the plant and the resource, they can begin researching the plant at their own pace. They can explore concepts such as how its leaves, roots, and seeds differ from native plants found in the same habitat. Spiraling out from the basic structural differences, students can then explore and compare simple natural community relationships, such as who pollinates, eats, or finds shelter in or on the invasive plant species as compared to the native species.

(Story continued on page 9.)
Lindsey-Rose Flowers, Restoration and Stewardship Coordinator with the Nine Mile Run Watershed Association

“As the Stewardship Coordinator for the Nine Mile Run Urban Stream Restoration, I use iMapInvasives to help monitor the distribution of various invasive plant species in the park. By utilizing this database, I am better able to guide my stewards’ efforts and increase our effectiveness in the area of restoration.”

After trying out the app, I found it to be very user-friendly and time-efficient. The simplicity of taking a picture, entering pertinent details about an observation, and uploading it to the database when an internet connection is available were all very straightforward.

With many updates and new additions to the iMapInvasives app and online version, I see this application being useful for landowners and citizen scientists alike. I especially see the Projects feature being useful for different sites that an organization like Berks Nature oversees as it allows for customizable data filtering.

At the end of August, I will be leaving Berks Nature to begin my third year at Susquehanna University in Selinsgrove, PA where I am continuing my studies in Earth & Environmental Sciences and Biology. As someone still new to these fields, I view mobile apps as a method to simplify tasks related to environmental science. With iMapInvasives providing a great online platform and offline mobile app, I see both as tools useful in assisting natural resource professionals in their field work related to invasive species.

To learn more about Berks Nature, check out their website at https://berksnature.org/.