ENVIRONMENTAL DNA

—A TOOL FOR TRACKING INVASIVE SPECIES

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Invasive species are any non-native flora or fauna that harm the ecology, economy, or human health. Due to being a major port of entry for people and goods into North America, New York is a major hub for invasive species introductions. Once a species has been introduced and established, its management becomes more expensive and complicated.

The most effective way to limit the impact of invasive species is to prevent their introduction in the first place. If that fails, the next best thing is to detect them as early as possible after introduction, so that they can be managed before they spread too widely to be fully controlled.

Here in New York, scientists, land managers and community members use several different strategies to search for invasive species at the early stages of their invasion. These strategies are commonly referred to as Early Detection and Rapid Response (EDRR). New York State relies on community scientists to report invasive species sightings into iMapInvasives, a reporting and mapping app.

In addition, New York has a network of professionals who work in local Partnerships for Invasive Species Management organizations, called PRISMs, and at state agencies. These include the Department of Environmental Conservation (DEC) and the Department of Agriculture and Markets (AGM), who help prevent and manage infestations. Despite the network's best efforts at identifying invasive species, they often go undetected and are not reported until they are well established.

Developing tools and techniques that enable early detection of invasive species is paramount to improving our ability to reduce their impact and achieve the goals of EDRR. A tool that is gaining widescale acceptance is environmental DNA (eDNA). Environmental DNA is used to detect species in the environment without having to see or capture them, by determining if their genetic material (or DNA) is present. Sources of DNA in the environment can come from skin, hair, the intestinal tract, reproductive tissue, decomposition, or other sources.

USING eDNA TO DETECT INVASIVE SPECIES IN NEW YORK

eDNA was first used as a detection tool in microbiology to describe the composition of microbial communities. Its use has expanded into other environments, including air, soil, water, etc. Now, eDNA techniques are used to take a snapshot of the species present at a single location, which would otherwise be difficult to do with traditional sampling techniques.

Environmental DNA has been used in New York to monitor for invasive species since 2014, when DEC tested for northern snakehead (an invasive fish from Asia) after an eradication effort was conducted in Ridgebury Lake, Orange County. eDNA surveys were all negative for northern snakehead DNA, building confidence that the eradication was successful. No northern snakehead have been found in this area since.

When DEC receives credible reports of northern snakehead, we survey for the fish in the reported locations. A 2019 report from an angler mobilized DEC and the United States Fish and Wildlife Service to survey part of the Hudson River using traditional methods and eDNA. The findings were all negative, and we do not think northern snakehead are in the Hudson River.

However, in 2020, an angler captured a northern snakehead in the Delaware River and DEC again responded to survey a 10-mile stretch of river. Electrofishing and eDNA sampling at the location revealed positive results, again building confidence in eDNA as a tool to detect invasive species. In 2021, an angler reported a northern snakehead at the Bashakill Wildlife Management Area (WMA) in the Delaware Basin but upstream from a tributary to the Delaware and Neversink Rivers. This WMA contains the largest freshwater wetland in southeastern New York, consisting of shallow water and lots of aquatic vegetation—ideal northern snakehead habitat. Again, DEC used electrofishing and eDNA to survey.

Electrofishing at this site is very difficult due to the shallow water and thick vegetation, and no snakehead were captured. However, the eDNA survey suggested widespread use of the wetland complex by northern snakehead.

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Erie Canal and first documented it in the Hudson River using eDNA in 2020. This is concerning because the round goby could travel upstream through the Champlain Canal into Lake Champlain and downstream to New York City.

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This was concerning because the Delaware River and Hudson River basins are connected by the Delaware and Hudson Canal, which flows directly through the WMA. If northern snakehead were to use the canal to disperse into the Hudson River basin, the remainder of the state would be at risk to a northern snakehead invasion through the Erie and Champlain canal systems.

In 2022 and 2023, DEC continued to monitor the northern snakehead distribution using eDNA and found movement towards the Delaware and Hudson Canal. During this same period, DEC staff documented successful reproduction of this invasive species by collecting snakehead fry and capturing a juvenile fish. In fall 2022, DEC installed a temporary fish barrier, but we knew that we had to install a sturdier barrier along the canal.

Throughout late 2022 and 2023, DEC contracted the installation of a temporary barrier strong enough to resist flooding and with fine-enough mesh to prevent fish from passing through. This barrier was installed in November 2023 to prevent northern snakehead from reaching the Hudson River watershed. DEC anticipates continued monitoring for snakehead in the Delaware River and Hudson River basins.

Another invasive fish species that DEC is monitoring with eDNA is the round goby. This fish was first introduced into the Great Lakes in the late 1990s and has since spread across New York State through the canal system and via bait buckets. Since 2016, the United States Geologic Survey (USGS) monitored round goby along the eastern half of the

USGS continues to monitor for round goby in the Champlain Canal, while in the lower Hudson River, DEC has documented the rapid downstream dispersal of round goby using eDNA and a long-term beach seining program. DEC successfully documented the presence of round goby in a large tidal river system, and eDNA has detected round goby further downstream than the beach seining. Although round goby can persist in water with high salinity in a controlled laboratory setting, to date, they do not seem to be colonizing the lowest reaches of the estuary where the salinity is higher.

INVASIVE PLANTS

Fish are mobile and often charismatic species, and they are frequently reported by anglers and other people who recreate or work on the water. Even without eDNA, an invasive fish will likely be reported at some point. However, invasive plants are often less familiar to those that use the water and frequently go unreported for longer periods. In addition to detecting invasive fish, eDNA can also be used to detect plant species. One high-priority invasive species in New York State that DEC has been managing is *Hydrilla verticillata*.

This is an aggressive submerged plant that can completely alter the plant community and impact boating, fishing, and swimming. Early detection of this species is critical for its local eradication and spread prevention. In 2020 and 2021, DEC performed a study to determine the distance from a known source of hydrilla that eDNA could detect. DEC worked in the Croton River

where hydrilla had been eradicated over a six-year period, but a robust population existed in a reservoir above a dam.

With this study, we found that hydrilla DNA could be detected five kilometers downstream. This result fit well with a published analysis on animal DNA transport in flowing water. However, this was the first study to show that plant DNA transport was similar to animal DNA transport. DEC is now using this model to develop upstream search areas that will help verify plant eDNA findings.

Examples of surveys for multiple species are increasing. In 2023, stakeholders in the Hudson River valley completed a pilot study using an eDNA tool, developed by Cornell University, that allows testing for the presence of 20 invasive animals and 19 plants. Twenty-one sites were surveyed in mid and late summer, and the results will help refine a sampling protocol for these invasive species.

In terrestrial environments, eDNA is in an earlier stage of development. However, both single-species surveys and community-based surveys have been increasing. In New York State, DEC, AGM, and the New York State Department of Transportation are working with Rutgers University to detect spotted lanternfly, while Cornell University is working to detect and manage the hemlock woolly adelgid.

For terrestrial surveys, novel eDNA collection techniques are required. In aquatic environments, a water sample grab is all that is required, while in terrestrial habitats eDNA must be collected from surfaces (e.g., tree trunks, leaves) by rinsing or washing and then filtering the rinse water.

DEC has analyzed the species composition of non-target animals inadvertently collected during forest pest trapping projects. These studies can help identify other emerging pests and better describe the native insect communities.

eDNA can be used to detect new invasions and monitor advancing invasion fronts. It is a powerful tool for the detection of invasive species at an earlier stage than other methods can provide. Early detection enables quicker response and management efforts. The earlier we begin managing for a new invasive species, the better chance we have to minimize their environmentalimpacts.

eDNA techniques are an example of how our strategies for detecting and managing invasive species continue to evolve as we adapt our practices based on new research and field experience. Flexibility is key when dealing with invasive species and protecting the environment.

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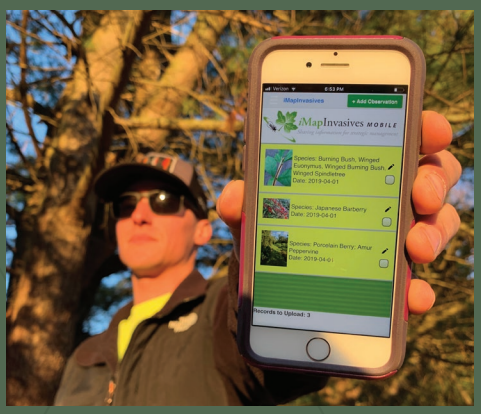

HELP US MAP INVASIVE SPECIES IN NEW YORK!

iMapInvasives is New York State's official invasive species database and mapping system used by State agencies, conservation organizations, scientists, volunteers, and the public to monitor invasive species. Conservation professionals document their surveys throughout New York using iMapInvasives, but resource managers also rely on community scientists and the public to act as "eyes-on-the-ground" and report findings in areas they know best.

Go online to report sightings and view invasive species data in your area or download the mobile app to report invasives on-the-go while exploring natural areas. Learn more at **www.nyimapinvasives.org/report** or follow us on social media @nyimapinvasives.

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