Researchers seek water test for invasive species detection

July 7 2015, by Amanda Clark

Detecting invasive lake and river species using just a water sample would be a dream come true for wildlife managers and regulators in the state. And University of Maine researchers may soon make this an inexpensive reality.

Michael Kinnison, professor of evolutionary applications at the University of Maine, realized the need for an early invasive species detection system that would be more sensitive, require less specialized training and labor by field staff, present little to no threat to non-targeted species, and could be implemented at a fraction of the cost of current detection approaches.

The method now typically used for detecting the presence of invasive species is word of mouth from anglers and other concerned members of the public, followed by many hours of netting, angling and electrofishing by state biologists, says Kinnison.

Many times, reports go unverified until fish are abundant enough to be regularly caught. Current methods also are unlikely to detect the presence of invasive juveniles before they are large enough to be caught by anglers and biologists.

Kinnison is leading a project to adapt emerging environmental DNA (eDNA) approaches to detect the presence of invasive species, and other aquatic species, in Maine waters. Environmental DNA detection targets species-specific DNA material shed by aquatic organisms when they die, defecate or shed skin cells. That DNA can last up to several weeks in surrounding waters and be detected in water samples.

The pilot portion of this project, funded by the Maine Outdoor Heritage Fund, includes use of water samples to describe the extent of invasive northern pike, Esox lucius, in the Penobscot River system.

"This technology has the potential to greatly enhance detection of many aquatic species by providing a much more sensitive and cost-effective approach than current field survey approaches," he says.

According to the Maine Inland Fisheries & Wildlife Department, Northern Pike was illegally introduced into the Belgrade Chain of Lakes in the 1970s. Today, they are present in at least 16 lakes in the Kennebec, Androscoggin, and coastal river drainages and are suspected in several other locations. Managers have traced the introduction of species such as pike from illegal transport or by out-migration from lakes where they have become established. Because pike are top predators, their introduction negatively impacts the state's prized salmon

populations.

Kinnison and ecology and environmental science graduate student Lauren Turinetti refined a quantitative polymerase chain reaction (PCR) primer set, and fluorescent DNA binding probe, to detect a short but unique sequence of the northern pike DNA. The PCR amplification system turns a few original copies of pike DNA in a water sample into billions, and the fluorescent probe signals how many copies are made. Using this technique they have successfully detected pike DNA in water samples collected from Pushaw Lake in Penobscot County, Maine. The water samples they used were no bigger than a normal soda bottle (1 liter). They're now working to refine their field sampling and detection approaches to implement a wider-scale survey for pike in the Penobscot drainage.

By collecting water samples throughout the drainage the investigators hope to obtain a snapshot of how far pike have spread in places where dam removals, passage projects and repairs have improved migration of anadromous species—but also may have inadvertently opened the door to pike, says Kinnison.

Further funding by the U.S. Fish & Wildlife Service State Wildlife Grants Program via the Maine Department of Inland Fisheries and Wildlife will allow Kinnison to expand this technique to other species of special concern, including imperiled native species.

This relatively quick and inexpensive method could help Maine combat its invasive species crisis and help managers more efficiently apply their limited resources to a diversity of conservation challenges, saving valuable resources for management of invasions from the start rather than detecting them when they're already established.

The most widely referenced paper (Pimental et al. 2005) on this issue

reports that invasive species costs the United States more than $120 billion in damages every year, according to the U.S. Fish and Wildlife service. Invasive species are also a leading cause contributing to the demise of many threatened or endangered species.

The U.S. Army Corps of Engineers has adopted eDNA early detection as a core component of its invasive Asian carp monitoring program in the Great Lakes region. In 2010 alone, the federal government spent $78.5 million to prevent the introduction of carp to the Great Lakes, where they would threaten Great Lakes fisheries and endangered aquatic species.

In the future, the researchers hope to fine tune the method so it will not only determine the presence of multiple species, but also abundance.

"Right now we are using quantitative PCR to detect single species, but with the developments that are occurring, we are probably not that far down the road from being able to detect and estimate the abundance of numerous species within the same water samples," says Kinnison.

Provided by University of Maine