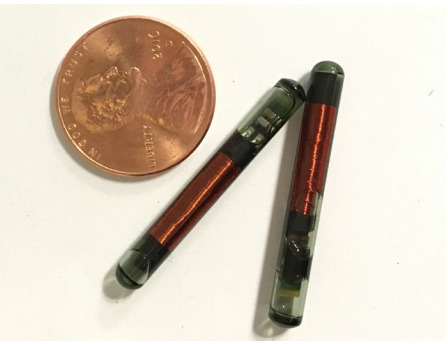
Using acoustic cameras to track native and invasive migratory species

A DIDSON unit was deployed at Bell Landing near the Ocqueoc River mouth in Presque Isle County. The camera is submerged and mounted to the steel seawall at the bottom center of the photo. Photo: Erin McCann

An adult sea lamprey is measured and weighed prior to inserting its PIT tag. Photo: Erin McCann



A close-up of the PIT tags used for species identification within the DIDSON footage. Photo: Erin McCann

CORE QUESTION:

Can data from acoustic cameras help fishery managers track the populations and spawning patterns of migratory fish species in Great Lakes tributaries?

OVERVIEW

Michigan's streams are home to two very different types of migratory species: the invasive fishes, such as harmful sea lamprey and the valuable fishes, such as the angler-friendly rainbow trout. Managers have long relied on dams to block sea lampreys from migrating up rivers and streams to reach their spawning areas. However, these dams also hinder other native species with similar migration patterns, such as the rainbow trout, which migrates at roughly the same time as the sea lamprey. Removing aged and crumbling dams is becoming a popular restoration tactic for improving habitat in Michigan rivers and streams. However, without implementing alternate control methods, these projects may leave waterways open to invading sea lamprey.

Managers also struggle to accurately count the number of adult sea lamprey entering Great Lakes tributary rivers. In smaller streams, fish officials can trap adult lampreys to estimate population size. This practice is more difficult in medium and large rivers. Being able to accurately determine population size is essential to setting appropriate sea lamprey control measures.

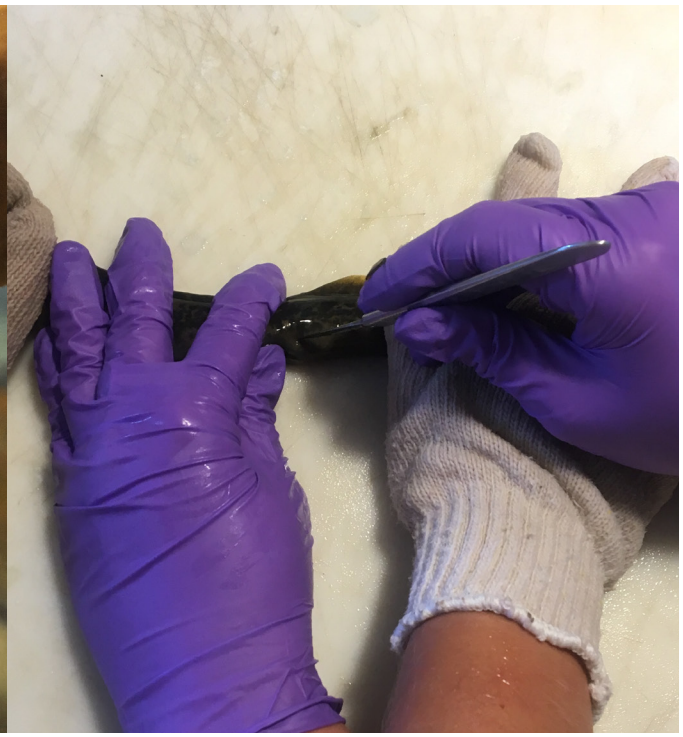
In recent years, state-of-the-art acoustic cameras (cameras which capture images using sound waves) have been deployed in two northern Michigan rivers to collect images of migrating fish. The dual-frequency identification sonar (DIDSON) cameras can image fish 40 meters away and function in cloudy or dark water. This technology has been used in other regions to estimate fish populations, gauge fish length, and determine the timing of species migration.

Two DIDSON cameras were stationed near the mouths of Michigan's Ocqueoc and Cheboygan rivers in spring 2013 and 2014. In spring 2016, the cameras were deployed once more, one in Ocqueoc River and the second in Schmidt Creek. Together, the cameras recorded 30 terabytes of raw data, enough to fill 42,000 CD-ROMs. After robust analysis, these data will help verify or update sea lamprey and trout migration schedules and population estimates developed by the U.S. Fish and Wildlife Service and Fisheries and Oceans Canada.

PROJECT DESCRIPTION

Working with the Computer Science Program at Central Michigan University, the graduate student fellow will develop a computer program that can process echograms, or images generated by the DIDSON acoustic cameras. The software will be able to distinguish between the distinctive shapes and movements of sea lampreys and rainbow trout, tallying the number of individuals from each species that passed through the cameras' ranges during the recording period.

Close-up of an adult sea lamprey's mouth. The suctioning mouth and rows of teeth allow sea lamprey to attach to their prey while using their rasping tongue in the center to penetrate the prey's skin to feed. Photo: Erin McCann



An adult sea lamprey is restrained as an incision is made to insert an electronic Passive Integrated Transponder (PIT) tag. Photo: Erin McCann

Once developed, the program will run semi-automatically, needing little regular input from human researchers until all recorded images have been processed. Then, the fellow will use the results to produce population estimates for sea lamprey and rainbow trout in the two rivers surveyed. The data should also offer insights into how closely the timing of lamprey and trout migrations overlap.

EXPECTED OUTCOMES

The data analysis will help verify or update sea lamprey and trout population estimates calculated by U.S. and Canadian fish officials. This will help resource managers determine whether or not their lamprey control measures are effective, particularly if their measures rely on dams slated for removal. Understanding overlaps and differences in migration timing for native and invasive species could help managers deploy temporary blockades that would halt lamprey movement without harming desired species.

The software will be made freely available, so other researchers can use it to understand species composition or migration timing in other Michigan and Great Lakes tributaries. This could open up new possibilities for deploying DIDSON cameras in other Great Lakes waterways or monitoring other aquatic species and behaviors.

CONTACT

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