New tool shows progress in fighting spread of invasive grass carp in Great Lakes

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A strike team uses an electrofishing boat and nets on the Sandusky River to capture and remove grass carp from the Lake Erie watershed. UToledo has been working on the water for years with state and federal agencies to keep the invasive fish at bay before it's too late. Credit: University of Toledo

New research reveals the progress scientists at The University of Toledo are making in their ongoing efforts to capture and remove invasive grass carp from the Great Lakes.

Researchers based at the UToledo Lake Erie Center created a new way to estimate the abundance of invasive "sleeper" species in freshwater ecosystems and help guide management strategies.

Using data collected during their efforts to remove invasive grass carp from Lake Erie and its tributaries, the aquatic ecologists and environmental statisticians developed a model that can be used to estimate the amount of any rare fish early in the invasion process.

Right now, invasive grass carp are relatively rare and difficult to catch.

Published in the journal *Biological Invasions*, the paper lays out foundational work to determine how many grass carp are likely present at one time in the Sandusky River in Ohio, which flows into Lake Erie and is the largest source of grass carp production in the Great Lakes.

UToledo strike teams have been working for years with state and federal agencies to keep invasive grass carp at bay before it's too late.

Scientists and students use electrofishing boats and a variety of nets to remove adult grass carp so the threatening fish population can't spread to other Great Lakes. The teams also sample grass carp eggs during spawning seasons in several rivers to learn when and where they are spawning.

Estimates from the new model show that from 2018 to 2020, there were probably less than 200 grass carp residing in the Sandusky River: 183 in 2018, 164 in 2019 and 167 in 2020. Overall during that time period, the strike teams captured 96 grass carp in 64 events out of 380 attempted removal events.

"As we capture new grass carp, we can refine the estimate each year to describe trends in the number of fish," said Dr. Christine Mayer, a

professor in the Department of Environmental Sciences at UToledo's Lake Erie Center. "This will help determine how effective our control strategies have been at reducing the population and preventing them from reproducing or spreading."

Mayer said more recent preliminary results suggest that the number of fish in the river has gone down, signaling progress against the invasive species.

"Our control work is the most likely explanation for the reduced number of grass carp," Mayer said. "More grass carp have been removed from the Sandusky River than any other location and more effort has been put into the Sandusky than any other location."

Native to eastern Asia and introduced to the U.S. in the 1960s for pond control, grass carp feed on vegetation. They pose a risk to wetlands and the fish, birds, reptiles and amphibians who use that habitat, but grass carp do not eat plankton and are unlikely to compete directly with native fish. Grass carp do not jump and are primarily herbivorous.

Wild adult grass carp pose significantly different risks to the Lake Erie ecosystem than bighead carp and silver carp, which are the two invasive carp species of greatest concern in the Mississippi River basin. Both bighead carp and silver carp consume plankton, and if these species were to make their way into the Great Lakes basin, they would compete for the same source of food that ecologically and economically important native fish species need to survive. Silver carp are well-known for their jumping ability.

"One of the goals of carrying out research on grass carp is to provide information about how other invasive carp species might behave if they ever arrive in the Great Lakes," Mayer said.

The new model created at UToledo can be used for estimating the number of any rare species, including endangered or threatened species targeted with conservation strategies.

But in this case, the researchers are focused on an invasive species with the aim to keep it rare, prevent its spread and maybe even eliminate it from the system altogether.

"Working with a rare species makes it difficult to estimate the numbers in the population, and standard statistical techniques are not appropriate," said Dr. Song Qian, a professor in the UToledo Department of Environmental Sciences. "And data generated from control strategies, such as removing invasive species, are usually not suited to conventional statistical modeling approaches."

Oftentimes, fish populations are estimated using a "mark and recapture" procedure where fish are initially captured and marked in some way, such as a fin clip, and then released. In subsequent sampling, the ratio of marked-vs.-unmarked fish can be used to quantify the total number present. However, this process only works when the target species is abundant, which does not hold true for grass carp.

UToledo scientists came up with a way to use species-control data to quantify abundance.

"Our model modifies another popular estimation approach," Qian said. "We have included experimentally measured data on the probability of detecting grass carp with the field gear used on the project in order to isolate the estimate of numbers present. Typically, the probability of finding a species goes up as it becomes more abundant. Therefore, providing independent information on the probability of detection was crucial to obtaining a valid estimate for this rare species."

More information: Ana Gouveia et al, A restructured Bayesian approach to estimate the abundance of a rare and invasive fish, *Biological Invasions* (2023). DOI: 10.1007/s10530-023-03006-6

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