Invasive crayfish sabotages its own success, study says

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Why are invasive rusty crayfish declining in some lakes and booming in others? A new study led by a University of Illinois researcher explains. Credit: Eric Larson, University of Illinois

Since they were first released as live bait in the mid-twentieth century, rusty crayfish have roamed lake bottoms in northern Wisconsin, gobbling native fish eggs, destroying aquatic plants, and generally wreaking havoc on entire lake ecosystems. Today, in some lakes, traps can routinely pull up 50 to 100 rusty crayfish at a time, compared to two or three native species. But in other lakes nearby, populations seem to be declining. In a new study published in *Ecology*, scientists document the crash and explain what could be behind it.

"Some researchers have long proposed that invasive species should experience periods of population growth followed by periods of population decline, but very few have documented declines and even fewer have suggested a reason," says Eric Larson, assistant professor in the Department of Natural Resources and Environmental Sciences at the University of Illinois and lead author on the study.

Understanding when and why invasive species populations crash could help managers decide when and where to apply control efforts. After all, invasive species cost the U.S. economy more than $120 billion dollars annually in control and lost grazing, crop yield, and tourism revenue. Could land managers simply wait out some invasions? Larson thinks it's worth finding out.

Key to measuring population declines is a long-term view of invasive species population dynamics over time, but those kinds of datasets are rare. That's why Larson paired up with David M. Lodge, director of the Atkinson Center for a Sustainable Future at Cornell University. He has been keeping tabs on the rusty crayfish in northern Wisconsin lakes throughout his career, starting in 1983 at the University of Wisconsin and continuing through moves to the University of Notre Dame and Cornell.

"This analysis would have been impossible without our many years of

data collection, highlighting how essential long term studies are for describing and ultimately understanding environmental changes," Lodge says.

For the *Ecology* study, Larson and his colleagues analyzed population trends in 17 lakes from 1972 to 2017 and found that about half were experiencing population declines. The reason? Muck.

In the mid-2000s, the team sent cameras roving along underwater transects to characterize the bottom of each lake. Adding that information to the population dataset, the researchers found rusty crayfish populations declined only in lakes with mucky and sandy bottoms. In those with more rocks, boulders, and cobble, crayfish populations stayed steadily high or continued to arc upward over time.

"The rusty crayfish wants to be in rocky substrate," Larson explains. "It uses that rock to avoid predation by fish or even wading birds, river otters, or raccoons. If it doesn't have that rock, it uses aquatic plants as secondary habitat as shelters to avoid predators."

And that's where the rusty crayfish sabotages itself.

Larson describes rusty crayfish as highly active lakebed engineers. As they forage and burrow, they constantly turn over rocks and uproot plants. They also clip stems as they hunt among leaves for bugs and snails.

With millions of crayfish in a lake, their impact on aquatic plants is huge. In many lakes in the study area, aquatic plants have been almost completely wiped out.

"From a condition decades ago where 50-60 percent of our trap locations in some lakes had plants, it's now about 5 percent. It's a pretty big

reduction of coverage," Larson says.

Essentially, by destroying the aquatic plants, crayfish in lakes without rocky substrates removed their only refuge from predators.

Although the study represents a unique mechanistic view of invasive species population decline, Larson cautions that the underlying cause may be more complex than just rock versus muck.

"Other mechanisms besides habitat quality could be contributing," he says. "We'd like to know what impact parasites and predatory fish are having. We'd also like to study more of the effects of climate on these crayfish from year to year through lake temperatures, drought, and duration of ice cover."

In environmental research, the answers are rarely simple, but documentation of invasive species decline should be cause for celebration.

In many cases, however, it might be too late. Changes to the lake ecosystem over half a century are not easily undone. In earlier studies, Lodge and his colleagues showed aquatic plant seed reserves might not be adequate to recover even if rusty crayfish collapse. That's why Larson doesn't endorse a "do nothing" approach, even for species that are shown to be declining on their own. Instead, he stresses the importance of prevention when it comes to invasive species introduction and spread.

"Rusty crayfish has invaded and done its damage in northern Wisconsin, but we have a whole pool of invaders that could do similar things. Prevention is far better than the cost of control and eradication, which often doesn't work. And then we're stuck with these impacts."

The article, "Habitat explains patterns of population decline for an

invasive crayfish," is published in *Ecology*.

More information: Eric R. Larson et al, Habitat explains patterns of population decline for an invasive crayfish, *Ecology* (2019). DOI: 10.1002/ecy.2659

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