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Smarter Strategies

Though small and somewhat nondescript, quagga and zebra mussels pose a huge threat to local rivers, lakes and estuaries. Thanks to aggressive measures to prevent contamination, Santa Barbara County's waters have so far been clear of the invasive mollusks, but stewards of local waterways, reservoirs and water recreation areas remain vigilant to the possibility of infestation by these and other non-native organisms.

Now, UC Santa Barbara-based research scientist Carolynn Culver and colleagues at UCSB's Marine Science Institute are adding to this arsenal of prevention measures with a pair of studies that appear in a special edition of the North American Journal of Fisheries Management. They focus on taking an integrated approach to the management of aquatic invasive species as the state works to move beyond its current toxic, water quality-reducing methods.

"With integrated pest management you're looking for multiple ways to manipulate vulnerabilities of a pest, targeting different life stages with different methods in a combined way that can reduce the pest population with minimal harm to people and the environment," said Culver, an extension specialist with California Sea Grant who also holds an academic appointment at Scripps Institution of Oceanography. "Often there is concentrated effort on controlling one part of the life cycle, like removing adults — which are easier to see — without thinking about the larvae that are out there."

Could hungry fish fight invasive mussels?

In one [study](#), Culver and her colleagues explored whether certain species of sunfish could be used as a biological control method to help manage invasive freshwater mussels in Southern California lakes.

The quagga mussel and closely related zebra mussel are two of the most devastating aquatic pests in the United States. The small freshwater mussels grow on hard surfaces such as water pipes, and can cause major problems for water infrastructure. They can also negatively impact ecosystems and fisheries by feeding on microscopic plants and animals that support the food web. First appearing in North America in the 1980s, they appeared in California in 2007. The cost of managing these mussels is estimated at billions of dollars since their introduction into the U.S.

Culver has worked closely with lake and reservoir managers in California to help them prepare for and respond to mussel invasions. This research was needed, she said, because many of the control systems long used in other places were developed for facilities and involved chemical applications or toxic coatings that can't readily be used in California in bodies of water that serve as sources of drinking water, or are home to endangered species that could be hurt by the chemicals. That covers the majority of California locations that have mussel infestations. In San Diego, for instance, rapid colonization of the reservoirs by these mussels caused docks and buoys to sink, but conventional, toxic methods of controlling them were a cause for concern.

"Commonly used mussel control methods are problematic for San Diego reservoirs since they are primary water supply reservoirs," said study co-author Dan Daft, a water production superintendent and biologist with the city of San Diego, who found that biocontrol methods were both effective and ecologically sound for sensitive water sources.

The study found that when one species of sunfish, bluegill, was penned up in an area where mussels occur, it could significantly reduce microscopic larvae and newly settled young mussels on surfaces within the pen, and on the pen itself. This method could be one key piece of an integrated pest management strategy, and provides a new, non-chemical method for targeting early life stages of the mussels, which are hard to detect.

“Essentially you can put these fish to work in specific areas where mussels occur,” Culver said.

The researchers studied two species of resident sunfish in many infested southern California lakes, bodies of water that are human-built and nearly all serve as water supplies. Although not native to California, they were stocked into these man-made reservoirs. According to the researchers, the methods could be applied to predatory species in different places, but no other good candidates were available where they were working.

“It’s important to point out that we don’t support introducing non-native species,” Culver said.

A better way to clean your boat

The other [study](#) assessed an integrated management framework that Culver and colleagues had developed to manage biofouling — the growth of organisms such as algae, barnacles and other aquatic plants and animals that settle on hard surfaces such as piers, pilings and boat hulls — while balancing both boat operations and ecosystem health. The paper describes how, when applied as part of an integrated framework, a combination of non-toxic methods can help maintain clean boats without the use of toxic paints and coatings that are increasingly regulated due to their environmental impacts.

“Controlling the growth of these organisms is critical for boat maintenance, because they create drag that slows vessels, reduces fuel efficiency, and makes boats harder to steer,” said co-author Leigh Johnson, coastal advisor emerita with UC Cooperative Extension and former California Sea Grant Extension advisor. Johnson was instrumental in initiating the research and bringing attention to the need for a balanced biofouling control management approach. “However,” she added, “the methods used to control fouling on boats can impact water quality and increase transport of invasive species so it is important to consider all of these issues when deciding how to maintain a clean hull.”

The primary method of controlling biofouling around the world has long been toxic antifouling paints. But there are growing concerns about the impacts of currently used copper-based paints on water quality, and many countries and US states, including California and Washington, have set standards to reduce the copper levels

and leaching rates of antifouling paints. These actions, however, increase the risks of moving biofouling invasive species from place to place, including vulnerable ecosystems, such as the islands off the coast of California.

In this study, researchers tested a variety of hull coatings, California-based hull cleaning practices, and conditions in various California harbors, to identify methods that could be used in combination to control biofouling.

They found that although copper-based paints were effective when first applied, they lost effectiveness fairly quickly, and that non-native species tended to accumulate first on the toxic coatings — sometimes within just a few months. The team also showed that frequent, minimally abrasive, in-water hull cleaning was effective and did not cause an increase in fouling as reported for other hull cleaning practices. Their documentation of the time of year when different organisms were attaching to surfaces also helped to illustrate how adjusting the timing and frequency of hull cleaning could help increase its effectiveness.

Results from the study, along with other research findings, informed the development of an [integrated pest management framework](#) that boaters can adapt to different regions and specific needs.

“It’s not a one-size-fits-all approach — it’s adaptive,” Culver said. “Boaters can tailor it to local environments, regulations and boating patterns, and it can be applied in areas where toxic paints have been restricted, as well as where they continue to be used. It can help to keep boat hulls clean, while reducing impacts on water quality and transport of invasive species — three issues that often are not considered together.”

Culver and her colleagues have provided information to boat owners, resource managers, and regulators about applications of this integrated approach. There also has been interest, she said, in using the technique to inform biofouling management guidance and regulations in California and elsewhere.

About UC Santa Barbara

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