New map outlines risk of zebra mussel invasion

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The spread of two invasive alien freshwater mussel species – the zebra mussel and the quagga mussel – appears to be controlled in part by calcium levels in streams and lakes and a new risk assessment based on water chemistry suggests the Great Plains and American Southwest could be next in line for invasion.

Results of the study were published this week in the online version of *Frontiers in Ecology and the Environment*, a journal of the Ecological Society of America.

The research team that developed the analysis notes that nearly 60 percent of the country, including the Plains states and the Southwest, is in a high-risk ecoregion, based on calcium levels greater than 28 milligrams per liter of water. About 21 percent of the country – including New England, most of the Southeast, and the western portions of the Pacific Northwest – are at low (12-20 mg) or very low (less than 12 mg) risk for invasion. And in about 19 percent of the country, surface waters have highly variable calcium levels and conditions may change from one lake or river to another, based on geology.

“The good news is that many of these high-risk areas don’t have a lot of lakes,” said Thom Whittier, a faculty research assistant in the Department of Fisheries and Wildlife at Oregon State University and lead author on the study. “However, these mussels seem to be working their way west and becoming established in places where they’ve never been seen.”

Until 2007, neither mussel species had been found in the western United States, but well-established quagga colonies were discovered earlier this year in Nevada's Lake Mead, and downstream in Lake Havasu and Lake Mojave, as well as the Colorado-California aqueduct. By this fall, they had been found in several reservoirs in San Diego and Riverside counties in California, as well as in Arizona, Whittier said.

Both of these invasive mussel species require more calcium than most native mussels and have difficulty becoming established in low-calcium areas. Unlike most freshwater mussels, these invasive species release their eggs into the water where they are fertilized and the larvae – called veligers – float for up to a month.

"If there isn't enough calcium in the water, you probably aren't going to get zebra or quagga mussels," Whittier pointed out. "If you have sufficient calcium, it doesn't necessarily mean you have a problem. These mussels also need colonies in still water to maintain populations over the long term. In rivers, this means there needs to be an invaded upstream lake, canal or reservoir to supply new larvae."

Zebra mussels were first found in the lower Great Lakes in the late 1980s, likely introduced to the United States through ballast water in large ships. Over the next dozen years, they spread rapidly throughout parts of the eastern U.S. and are now found in all of the Great Lakes and Lake Champlain, and in large portions of the St. Lawrence, Ohio, Mississippi, Arkansas, Tennessee, Hudson and Cumberland rivers. They also are found in numerous inland lakes in the New York and the upper Midwest.

Quagga mussels were introduced to the Great Lakes at about the same time, but spread more slowly and initially settled in deeper water. Because they spread slowly, they have received less attention from the public and from researchers. But now quagga mussels are found in all of

the Great Lakes and in shallower waters, and appear to be replacing zebra mussels.

The spread of invasive mussels from one lake to another can occur via connecting waterways – or through recreational boaters, according to Alan Herlihy, an OSU research professor in the Department of Fisheries and Wildlife.

“If people put their boat into a lake with these mussels one weekend, then take their boat out and put it into a different lake the next weekend, they may be transporting live mussel larvae or adults,” Herlihy said. “There are indications that adult mussels can live for many days out of water – especially if the weather is cool and wet.”

These invasive mussel species have caused millions of dollars in damage and untold ecological damage, the researchers point out. When the veligers eventually settle out of the water column, they often attach in large numbers to all sorts of human structures, including water intakes – which they quickly clog – as well as boats, buoys, motors, and engine cooling systems.

They also attach to, and weigh down, native freshwater clams and mussels, crayfish and even large aquatic insects like larval dragonflies. When they attach to native clams and mussels, the researchers say, these invaded compete directly for food.

“These mussels are extraordinarily prolific,” Whitter said. “A female zebra mussel may produce a million eggs a year, and when they establish a colony, they are hard to get rid of. They also filter huge volumes of water, and by consuming phytoplankton, they can dramatically change the aquatic food web of the lake, reservoir or river.”

The research team – which also includes Paul Ringold, an ecologist with

the U.S. Environmental Protection Agency, and Sue Pierson, a geographer with Indus Corp. in Corvallis, Ore. – used calcium concentration data from more than 3,000 river and stream sites across the contiguous U.S. for its study. Most of the reported occurrences of zebra and quagga mussels are in regions the researchers had classified as high-risk based on calcium levels.

Some sightings have occurred in low-risk areas, but these usually were in rivers that drain high-calcium regions. Ancient seabeds are high in calcium, the researchers say, while basaltic rock, like that found along much of the West Coast, has low calcium levels.

“If there isn’t enough calcium in the water it probably won’t kill the mussels outright,” Herlihy said, “but they don’t seem to grow well. And once they’re established, they’re horribly difficult to eradicate. Preventing their spread is without doubt the best way to go with zebra and quagga mussels.”

Some states have implemented boat washing stations at certain lakes and rivers, the researchers pointed out.

“As scientists, when we do our research, we scrub and disinfect our boots, our nets and all of our equipment,” Herlihy said. “We take this threat seriously.”

Source: Oregon State University