

By David Britton, Ph.D.

Conservation in a Quagga-mire

Dealing with zebra and quagga mussel invasions



David Britton/USFWS

This zebra mussel cluster was pulled from Lake Oologah, Oklahoma. The tiny but invasive mussel has steadily spread from the Great Lakes.

An Ecological Cancer

Zebra and quagga mussels are notorious. They invade our waters like an ecological cancer. Incipient populations of zebra and quagga mussels exhibit rapid, uncontrolled growth and tend to invade new, otherwise healthy areas. They permanently damage or destroy these systems. What's worse, zebra and quagga mussels are spread by contact. They are chronically debilitating, with the power to cause permanent, irreparable damage.

Individual zebra and quagga mussels do not appear formidable. They are only about an inch or less long, with

alternating dark and light stripes. In large numbers, however, they are unstoppable. When healthy, they attach to hard surfaces and live in dense clusters where they glue themselves to each other and other hard surfaces using sticky threads. In this way they form enormous populations that can cover all hard surfaces. Densities exceed 100,000 mussels per square meter. They attach to rocks, dock pilings, beer cans, bottles, logs, boat hulls and outboards, ropes, anchors, turtles, crustaceans, clams, insects, shopping carts—any hard surface submerged in water.

The History of the Problem

In the 1980s, transatlantic ships supplied goods and grains to Eastern Europe. These ships returned to North America carrying ballast water contaminated with aquatic invaders. Some have argued that zebra and quagga mussels came attached to anchors and chains as well. Zebra and quagga mussels were unintentionally released into the Great Lakes system and discovered in 1988 and 1989 respectively; although no one recognized that these were actually two different species until a year or two later. Zebra mussel populations exploded, reaching a vast distribution in the Great Lakes by 1990. They spread through connected waterways like metastatic cancer, into the Mississippi drainage, reaching St. Louis, Missouri by 1991 and New Orleans, Louisiana by 1993.

How they Spread

Zebra mussels from the Great Lakes spread rapidly downstream. An artificial connection between the Great Lakes and the Mississippi River drainages allowed for rapid range expansion of these insidious invaders without delay after their original introduction. The Chicago Sanitary and Ship Canal, originally designed to move Chicago's sewage waste away from Lake Michigan, provided the same gateway for the Great Lakes' aquatic invaders into the Mississippi system. Downstream spread was inevitable. Mussel larvae are suspended in the water, and travel wherever the flow takes them. The infested Mississippi River then served as a conduit for zebra mussels to reach all areas connected via navigable waterways. Adult zebra mussels spread upstream to other rivers attached to boats and barges. Since the 1980s, zebra mussels have

invaded much of the eastern United States, including the Mississippi, Missouri, Tennessee, Ohio, and Arkansas rivers as well as the Great Lakes and the St. Lawrence Seaway.

Quagga mussels initially invaded North America at a slower pace than zebra mussels. They remained restricted mostly within the Great Lakes until 2007, when quagga mussels were discovered in the lower Colorado River at Lake Mead. It is likely that quagga mussels came attached to a houseboat brought from the Great Lakes. From there, they immediately spread following the flow of water. Just as a medical transfusion can spread disease-laden blood from one human body to another, artificial diversions of water from the Colorado River swiftly transferred these virulent invaders to otherwise unreachable water bodies and associated drainages in southern California and Arizona. Meanwhile, trailered boats have spread them, albeit more slowly, into more isolated systems. Quagga mussels have also been detected in unconnected waters in Colorado and Utah.

Impacts

There are economic and ecologic effects from mussel invasions—and both are negative. Anglers and others who use water for recreation can tell you that zebra and quagga mussels are a nuisance. They foul hulls, intakes, props, dock lines, and

anything else submerged in water. They are known to clog cooling water intakes in outboards and lower units, which can lead to permanent damage and costly repairs. Crappie and bass anglers in Oklahoma have their monofilament lines regularly cut by sharp mussels. Bait buckets become unrecognizable as such because of a dense mussels encrustation. A floating dock submerged in winter became unable to support the weight of snow on the roof combined with dense zebra mussel encrustation below.

Zebra and quagga mussels are not just a nuisance to those who use our waters for recreation. They are also problematic for industrial facility operations that use raw water to supply utilities for our communities. Zebra and quagga mussels substantially reduce flow in large pipes and clog smaller diameter pipes in cooling and fire suppression systems in power plants. They clog screens and pipes in water treatment facilities. Expensive routine maintenance is needed to keep water flowing. Authorities in the Columbia River basin have estimated that



Quagga mussels infest this piece of marine equipment, pulled from Lake Mead, Nevada.

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costs to install chlorination systems to keep mussels out of pipes could be as high as \$2 million for some raw water sources. They estimate that recurring operational costs could equal or exceed \$100,000 per year for a single facility. MSNBC reported that the Metropolitan Water District of Southern California expects to spend between \$10-\$15 million in a single year to control quagga mussels in their systems. In the Great Lakes area, congressional researchers have estimated that the power industry spent over \$3 billion to control zebra and quagga mussels between 1993-1999. Of course, such costs are passed on to you in your utility bills. The combined economic impact to industries, businesses, and communities may have exceeded \$5 billion during that six-year span.

The economic costs are terrible, but the ecologic costs may be worse.

Zebra and quagga mussels filter water for plankton to eat, and they are especially good at it. Clear water doesn't necessarily mean healthy water. Plankton is the base of the aquatic food web and nutrient-rich waters are naturally murky. Water clarity increases dramatically following a mussel invasion. Removing algae can have a cascading effect that impacts the entire food web from zooplankton to large top-predator fishes. Over the last decade, water clarity has increased prominently in Lake Michigan while populations of crustacean species of the genus *Diporeia* have decreased by over 95 percent. These crustaceans are part of the zooplankton that feed on algae. They are, in turn, fed upon by smaller fish, which are fed upon by larger fish. A dramatic reduction in algae has likely driven a cascade leading to the reduced catch seen in commercial and

recreational fishing in Lake Michigan in recent years. In the West, this is alarming because western water supports many threatened and endangered fish species like the humpback chub (see *Eddies* Summer 2008) and razorback sucker that might not be able to withstand a zebra or quagga mussel invasion. Following the introduction of zebra and quagga mussels, populations of native freshwater mussels in Lake St. Clair and the western basin of Lake Erie have plummeted. It seems that our native fauna may be unable to compete. It's a simple fact that once zebra or quagga mussels invade a system it will never be the same.

QZAP

The Western Regional Panel on Aquatic Nuisance Species created a Quagga-Zebra Mussel Action Plan for Western U.S. Waters, recently approved by the federal Aquatic Nuisance Species Task Force. This plan, affectionately called QZAP, identifies priority actions to thwart the mussels' spread and control existing populations. Specific prevention strategies include mandatory inspection and decontamination at infested waters; continued development of effective watercraft and equipment inspection and decontamination protocols and standards; adoption of protocols and standards in the western states; establishment and implementation of strong, consistent law enforcement programs; and development of a risk-assessment model for water bodies. QZAP also provides strategies for early detection and monitoring, rapid response, containment, and control of existing populations, as well as outreach and education. Many state and federal agencies have already begun implementing QZAP at all jurisdictional levels. The public can help by learning about zebra and quagga mussels (and other aquatic



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Any hard surface, including marine equipment, is potential habitat for invasive mussels. This piece of encrusted gear was pulled from Lake Oolagah, Oklahoma.

invaders) and take the simple steps necessary to prevent unintentional spread.

Stopping the Spread

No cure exists for zebra or quagga mussels. Only two eradication attempts have been successful, one in Virginia and one in Nebraska, both in isolated small ponds where mussels were poisoned. This method is not feasible in larger systems, flowing systems, or in systems used for drinking water. Those of us who use waters that currently have zebra or quagga mussels will have to get used to them. Research has focused on controlling these mussels, to keep water flowing, rather than eradicating them in open waters, which is a more daunting task. Preventing further spread is our best hope at the moment.

Although we are essentially powerless to stop downstream spread, we can prevent overland spread on trailered boats. This mode is much slower and quite preventable. Boaters should know that zebra and quagga mussels could survive several days out of water if conditions are humid and cool. As predicted by laboratory studies, we now know that they can survive long enough in air to travel from one of the Great Lakes to Lake Mead, a distance of approximately 1,800 miles. Boaters should always clean their equipment thoroughly, drain all standing water, and dry everything before moving to other waters. If boats are kept in infested waters, they should be



Quagga mussels encrust a penstock gate at Davis Dam on Lake Mohave, Arizona.

Bureau of Reclamation

professionally cleaned with 140°F, high-pressure water before transport.

Remember, zebra and quagga mussels are an ecological disease. Most of us understand the importance of personal health and hygiene. We accept the necessity to bathe. We wash our hands, brush our teeth, and maybe even floss on occasion. When it comes to our own bodies we are careful not to let disease find an easy way in. This is common sense. As you go about your business, keep in mind that water bodies, like human bodies, are also vulnerable to invasion. They can be healthy or diseased. And like many nasty human diseases, currently we have no cure for zebra and quagga mussels. ♦



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