RECLAMATION Managing Water in the West

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The Knowledge Stream
Research and Innovation Update

Zebra and Quagga Mussels

Preventing the spread and addressing the impacts from invasive mussels in Western U.S. waters

Bottom Line

As a high priority since 2008, Reclamation has focused invasive mussel research activities on improving early detection methods; identifying, developing, demonstrating, and implementing facilities protection technologies and strategies; and assessing ecological impacts.

For More Information

See http://www.usbr.gov/mussels/research/current.html

Contact Information

Curt Brown, Director
Research & Development Office
(303) 445-2098

Denise Hosler, Mussel Detection Program Coordinator
Technical Service Center
(303) 445-2195

Leonard Willett, LC Mussel Task Force Coordinator
LC Dams Office
(702) 494-2216

Fred Nibling, Mussel Research Coordinator (Biology)
Technical Service Center
(303) 445-2202

Joe Kubitschek, Mussel Research Coordinator (Engineering)
Technical Service Center
(303)-445-2148

Researchers are engaged in a number of mussel-related research activities through Reclamation's Research & Development (R&D) Office, Lower Colorado (LC) Region, LC Dams Office, and Technical Service Center (TSC).

Many of these activities involve collaborating with other Federal agencies, Reclamation's managing partners, and private industry.

Mussels in a cooling pipe.

Improving Monitoring and Detection

Reclamation researchers are investigating the potential of isolating and producing primary antibodies to improve detection of mussel larvae and explore the potential for other uses in controlling mussels. With Metropolitan Water District of Southern California (MWD), Reclamation continually works to improve early detection methods. Under a Cooperative Research and Development Agreement (CRADA) with Fluid Imaging Technologies, researchers also have helped identify improvements for automated mussel detection in water samples using FlowCAM® technology. Reclamation also recently provided MWD with golden mussel (*Limnoperna fortunei*) tissue samples for DNA sequencing to help develop future screening capability for this species—another invasive mussel now in South America.

Developing Zequanox™

Reclamation's R&D Office, LC Dams Office, and TSC are collaborating with Marrone Bio Innovations, Inc. (MBI) under a CRADA to develop a promising environmentally friendly treatment product derived from dead *Pseudomonas fluorescens* bacteria. Closed system field trials at Davis Dam began in 2009, and results have shown promise. In 2010, Reclamation received approval from the U.S.Environmental Protection Agency (EPA) to use Zequanox™ at impacted Reclamation facilities along the lower reaches of the Colorado River. The environmental compliance process for using this treatment in cooling water subsystems at Reclamation's Davis Dam has been completed with the environmental assessment (EA) and finding of no significant impact (FONSI). MBI has applied for EPA Section 3 Registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and approval of latest formulations is under review.

Evaluating Filtration and Ultraviolet (UV) Technologies

Reclamation is testing ballast filtration technology for cooling water system protection at Reclamation's Parker Dam. Initial results indicated near 100 percent exclusion of mussel larvae larger than 100 microns (using 40-micron filter media) and 95 percent exclusion of mussel larvae larger than 200 microns (using 80-micron filter media). We are evaluating long-term performance and operation and maintenance requirements. We also began evaluating UV treatment for cooling water system protection at Reclamation's Hoover Dam. Study plans include evaluating mussel larvae response to UV exposure and further expanding testing at Davis Dam.

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Assessing Ecological Impacts

Reclamation is continuing to assess the long-term ecological impacts related to mussel infestations, including overall post-infestation changes in water quality and interactions with other aquatic organisms in Western water bodies.

Trashrack fouling.

Testing Coatings

Since 2007, Reclamation researchers have conducted ongoing field testing of various commercially available coatings at Reclamation's Parker Dam. We have identified certain coatings systems that inhibit mussel fouling. However, the durability appears low, and we are continuing to explore technologies to improve durability. We are considering the physiochemical characteristics of mussel adhesion to further identify and develop durable coatings solutions with the desired antifouling or foul release performance features.

Other Related Activities

Monitoring and Detection Program – Reclamation's R&D Office was provided $4.5M in American Reinvestment and Recovery Act (ARRA) funding for monitoring and detection at more than 350 priority water bodies in the Western United States. In collaboration with various State resource agencies, this program uses multiple detection methods and the data serve to update the extent of known presence and obtain environmental suitability information proximate to Reclamation facilities. Early detection can provide valuable lead time (perhaps 3-5 years) to plan, budget, and implement actions to respond, mitigate, and protect facilities before being overwhelmed. Reclamation is continually exploring ways to maintain this program into the future.

Facility Vulnerability Assessments – To further assist Reclamation's regional, area, and project offices as well as our managing partners and other agencies (including the U.S. Army Corps of Engineers), staff from Reclamation's Technical Service Center and Lower Colorado Region have conducted more than 75 facility vulnerability assessments throughout the Western United States. This effort, in conjunction with early detection, has been geared toward providing site-specific information on potential mussel-related impacts to key facility features that are intended to help project management and staff anticipate and plan for those impacts should a future infestation occur.

Collaboration and Outreach – Reclamation is continually exploring collaboration opportunities with Federal and State agencies, private industry, and academia to identify, evaluate, develop, and implement new mussel management and control technologies and strategies. In addition to hosting the 17th International Conference on Aquatic Invasive Species in San Diego, California, and the 2009 Western Invasive Mussel Management Workshop in Las Vegas, Nevada, Reclamation continues to pursue technical exchange opportunities with our managing partners and the scientific community.

"Quagga mussels pose serious threats to Reclamation's infrastructure and operations at Hoover, Davis, and Parker Dams' hydroelectric generation facilities. Intakes, pipes, and strainers are becoming clogged with these creatures, reducing the abilities of these structures to pump and deliver water and generate hydropower."
- Reclamation Lower Colorado Region News Release on quagga mussels at Davis Dam, June 13, 2011

Developing Alternative Control Technologies

We are exploring several other technologies,including:

- **Pulsed pressure devices to remove mussels and/or prevent settlement on water intake structures and within pipelines**
- **Turbulence generating devices to prevent settlement within water distribution systems**
- **Fish predation as a means of supplemental mussel control where predatory species are already resident**
- **Elevated pH control strategies**
- **The potential for using certain herbicides to control mussels in irrigation systems**
- **Retroffiting trash raking systems to remove mussels**
- **Alternative fish screening technologies to maintain hydraulic and biological performance in the presence of mussels.**