Progress Report on Testing of Commonly used Fish Screens for their Resistance to Invasive Freshwater Mussel Fouling

September 30, 2013

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Progress Report on Testing of Commonly used Fish Screens and Screen Cleaning Systems for their Resistance to Invasive Freshwater Mussel Fouling

Quagga mussels (*Dreissena bugensis*) and to a lesser extent, zebra mussels (*D. polymorpha*), have become established in the western United States. Quagga mussels were first discovered in Lake Mead, lower Colorado River, in 2007, are now widespread in the lower Colorado River basin, including water diversion canals, and are beginning to be detected in other river basins in the west. These freshwater mussels from Eurasia can clog fish screens, trash racks, intakes, etc., which then impedes water flow and impacts efficiency of fish diversion systems (Mackie and Claudi 2010).

Our objective was to test the ability of 2 commonly used fish screen systems, a cylindrical, stainless steel wedgewire screen (Intake Screens, Inc.), and a vertically traveling nylon screen (Hydrolox™; Bureau of Reclamation 2006), to resist fouling by quagga mussels. Specifically, we wished to determine fouling rates of these screen systems, and determine if current cleaning methods were adequate to keep screen mesh openings clear. We modified a pontoon boat (15 ft X8 ft) to serve as a test platform for mounting the screens (Figure 1), added a canvas cover to provide shade for the test area and moored the test platform at the Las Vegas Boat Harbor (Lake Mead, Figure 2).

Lake Mead was selected because quagga mussels are established and reproduce year round (Wong et al. 2012; Holdren et al. 2012). Quagga mussel larvae are planktonic while juveniles/adults attach to hard surfaces with byssal threads (Mackie and Claudii 2010). Abundance of larval quagga mussels, known as veligers, in the Hoover Dam area of Lake Mead was variable between 2007 and 2011 (near the marina where the test platform is moored), but veliger peaks were found to occur spring, summer, and fall (Holdren et al. 2011). Water temperatures 13 ft below the surface varied from 54 (February 2013) – 89^0 F (August 2012) and we observed a mussel die-off occurring during the late summer 2012, possibly associated with the warm temperatures. We installed the 2 screens in spring 2012 and operated these through summer 2013. The test platform was temporarily removed in April 2013 for maintenance and to add additional screen support hardware.

The ISI is a cylindrical, stainless steel, wedgewire screen (1.75 mm mesh openings) that is used in a totally submerged state for water diversion and fish protection (Figures 3, 4). These screens are kept clean with a system of stationary external and internal brushes with the screen rotating 1 or more times daily. The ISI module we are testing is 5 ft in height by 3 ft diameter, was being cleaned three times daily, and was installed about 13 ft below the surface in spring 2012. Water was drawn through the mesh by a pump that then sent it toward the tank containing the Hydrolox screen.

The Hydrolox screen is a vertically rotating, engineered polymer material that is UV resistant and corrosion free (Figures 5, 6). This screen was developed to prevent impingement and entrainment of small fishes while removing aquatic debris. The external face is smooth which reduces fish injury upon impact. Screen slot openings are small (2 mm) and by incorporating an automatic high pressure spray wash system, maintenance and cleaning are greatly reduced. Diverted water passes through the mesh while floating water born debris can be lifted and removed. The vertically rotating Hydrolox panel we are testing is not yet fitted with a spray wash, but rotates out of the water.

In spring 2012, we deployed representative screen panels about 13 ft below the surface to confirm presence of mussels, and to determine mussel fouling in the absence of movement and cleaning (Figures 10, 11). These panels were photographed seasonally (winter, spring, summer, and fall) and we will use image analysis software of both moving and stationary screen panels to evaluate and understand the ability of the screens to resist mussel fouling.

In late summer 2013, we added 2 screens, a standard type of stainless steel wedgewire screen (passive flat plate; 1.75 mm mesh) and a second Hydrolox panel that will remain totally submerged but will rotate, to try to determine the mechanism of mussel resistance. Of the new wedgewire screen panels, one is coated on the back side with a Fuji silicone coating (Figures 7-9; coating provided by A. Skaja, Bureau of Reclamation, Denver Technical Services Center), the other not coated. The front side of both screens is cleaned once daily. These types of screens are commonly used in the Sacramento River basin, California (intakescreensinc.com) and typically are not cleaned on the back or downstream side. The newly added wedgewire panels and the submerged rotating Hydrolox, in addition to the original screens and stationary panels, will be photographed seasonally. We also plan to exchange the current ISI screen with a smaller mesh (0.5 mm) module in 2014, and to test additional screen coatings.

Literature Cited

Bureau of Reclamation. 2006. Fish protection at water diversions, a guide for planning and designing fish exclusion facilities. Water Resources Technical Publication, U.S. Department of Interior, Bureau of Reclamation, Denver, CO.

Holdren, G.C., M.J Horn, and S. F. Pucherelli. 2012. The limnology of Lake Mead, Arizona-Nevada, 2011 Report of Findings. Technical Memorandum 86-68220-12-10. Technical Service Center, U.S. Department of the Interior, Bureau of Reclamation, Denver, CO.

Mackie, G.L. and R. Claudi. 2010. Monitoring and control of macrofouling mollusks in freshwater systems. CRC Press. Taylor and Francis Group, New York.

Wong, W.H., S. Gerstenberger, W. Baldwin, and B. Moore. 2012. Settlement and growth of quagga mussels (*Dreissena rostriformis bugensis* Andrusov, 1897) in Lake Mead, Nevada-Arizona, USA. Aquatic Invasions 7(1):7-19.

Figure 1.   Fish screen testing platform prior to deployment

Figure 2. Fish screen testing platform following deployment with canvas covering.

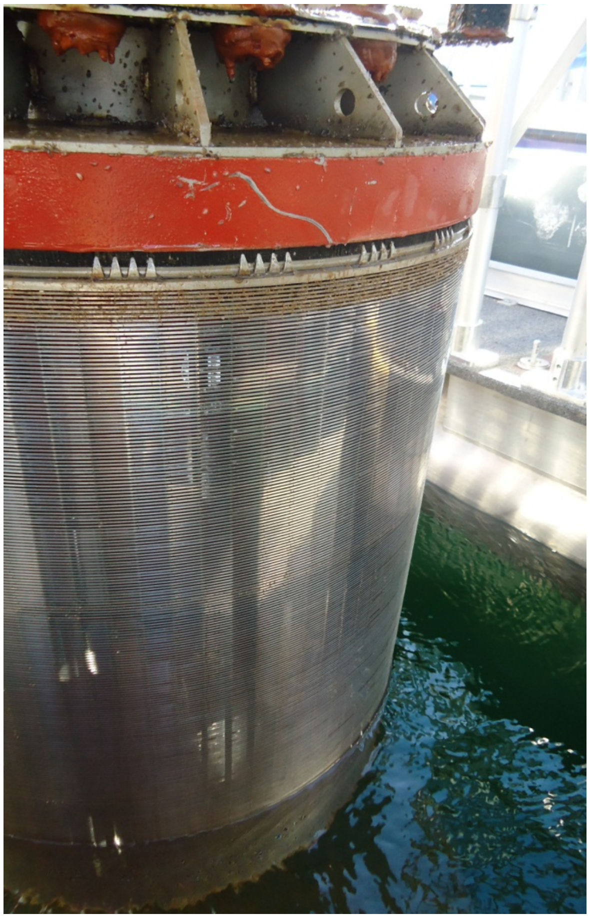

Figure 3. ISI test module raised for inspection (note cleaned screen surface).

Figure 4. ISI test module with close-up of external brush (note mussel attachment at base of brush and on screen frame)

Figure 5. Surface view of Hydrolox test module. Approximately 60% of the screen is out of the water during the rotation).

Figure 6. Close up of the Hydrolox screen (note mussel attachment at screen base and exterior box).

Figure 7. Box for holding flat plate wedgewire panels at depth (note cutout at bottom).

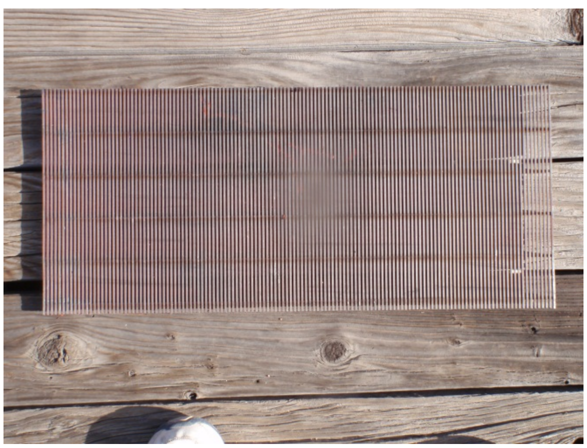

Figure 8. Front side of flat plate wedgewire panel.

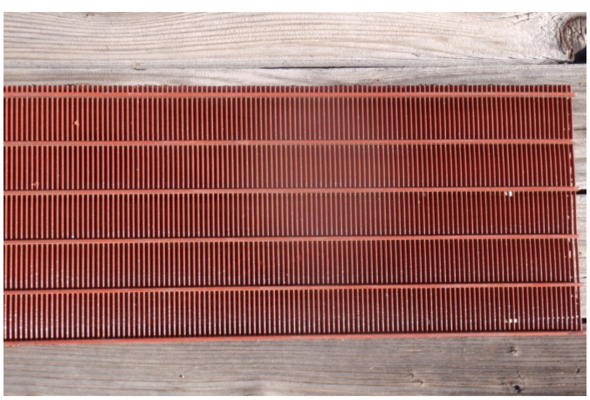

Figure 9. Back side of flat plate panel with Fuji silicone coating.

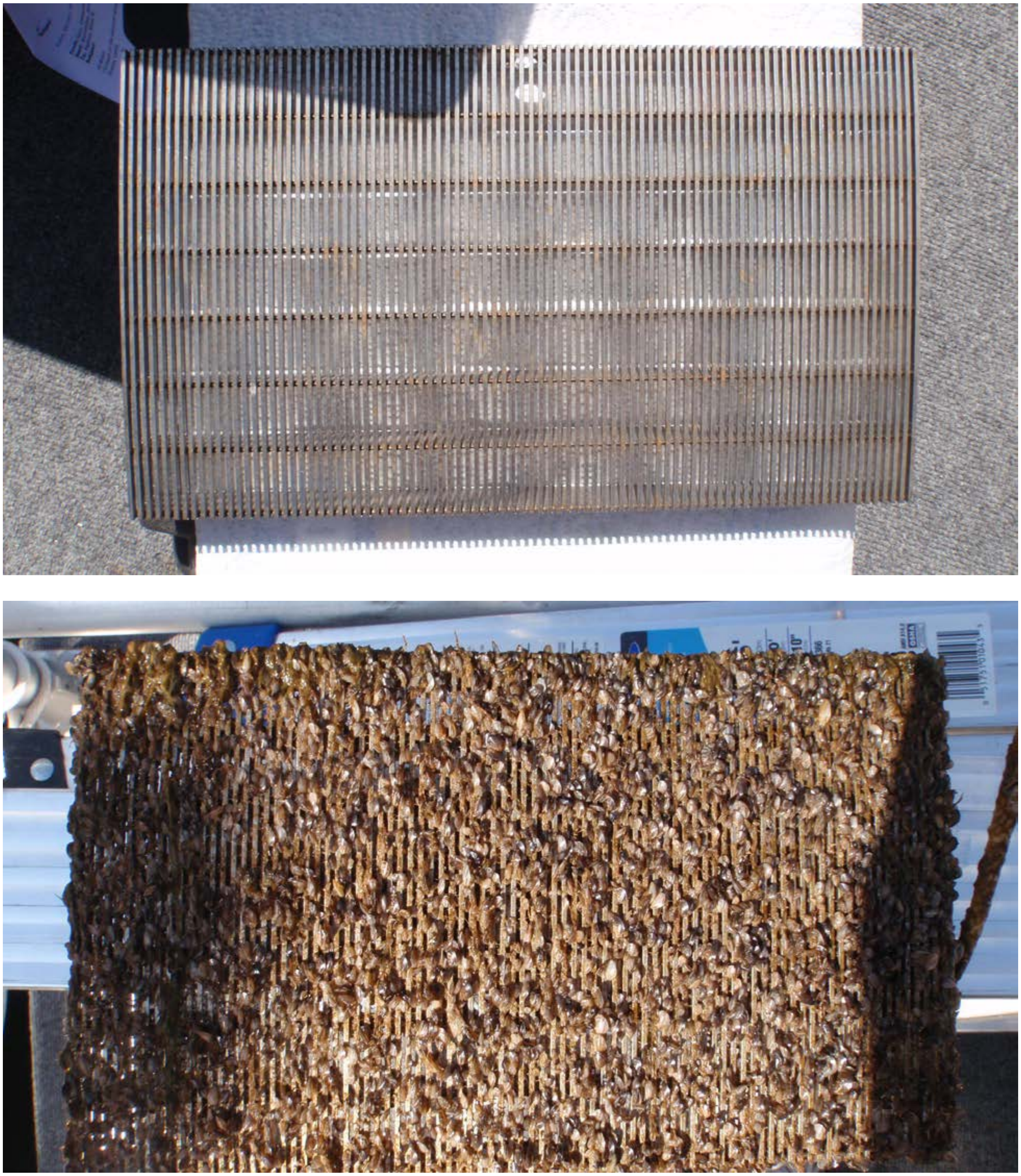

Figure 10. Stationary flat plate stainless steel wedgewire panel prior to deployment (upper photo) and following 12 months submergence (lower photo).

Figure 11. Stationary Hydrolox panel prior to deployment (upper photo) and 12 months following deployment (lower photo).