Quagga/Zebra Mussel Biobox Monitoring Protocol*
California Department of Fish and Wildlife

*This protocol was adapted from the California Department of Fish and Wildlife's protocols for Aquatic Invasive Species Monitoring at CDFW Hatcheries.

Description of Quagga and Zebra Mussels

The quagga mussel, *Dreissena rostriformis bugensis*, and the zebra mussel, *Dreissena polymorpha*, are small, invasive mussels found only in freshwater. They look very similar to each other. They commonly have alternating light and dark brown stripes, but can also be solid light brown or dark brown. They have 2 smooth shells that are shaped a bit like the letter "D". These mussels are usually less than 2 inches in length. In new populations, most mussels are young and therefore very small (under ¼ -inch long).

Quagga Mussel
Dreissena bugensis

- Shell: D-shaped and triangular; thin, fragile; smooth or shallowly ridged; solid light to dark brown or dark concentric rings; paler near hinge
- Attaches to hard and soft surfaces

Zebra Mussel
Dreissena polymorpha

- Shell: D-shaped and triangular; thin, fragile; smooth or shallowly ridged; solid light to dark brown or striped
- Attaches to hard surfaces

Color variation in quagga and zebra mussels

Quagga and zebra mussels are freshwater mussels that can physically attach onto hard substrates. Like the mussels found clinging to the rocks along the California coastline, quagga and zebra mussels attach onto hard surfaces (e.g. pipes, screens, rock, logs, boats, etc.). They form colonies made up of many individuals attached onto an object and even onto each other. Small newly settled mussels feel like gritty sandpaper when attached to a smooth surface. Larger mussels will feel coarser (like a small pebble or sunflower seed) or be visually apparent.

Other Organisms Mistaken for Quagga/Zebra Mussels

Asian clam, Corbicula fluminea

People often mistake the very common Asian clam (also introduced) for quagga or zebra mussels. The Asian clam is widespread and abundant in California. It is brown and has ridges in concentric rings on its shells. The shells of older clams or of dead clams are white at the hinge (where the two shells join together). These clams do not attach onto surfaces. They live in mud or sand.

Asian clam

Snails and freshwater limpets

Small snails and freshwater limpets cling to hard substrates and can be mistaken for small juvenile mussels. They are similar in color and size to small quagga and zebra mussels. Snails have a spiral shape. Limpets have one shell and are flat. Quagga and zebra mussels attach on the edge of their shell and stick up and away from the surface.

Snail

Snails

Limpets

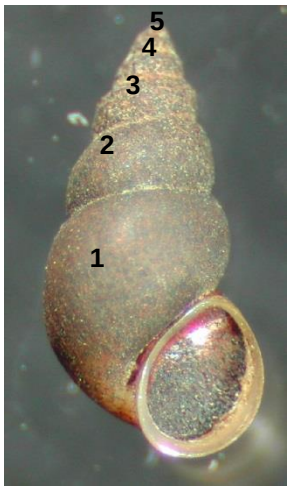
New Zealand mudsnails, Potamopyrgus antipodarum

California's waters are home to many species of small, native freshwater snails. However, the New Zealand mudsnail is an invasive snail that is similar in appearance and of great concern in California for its potential impacts to trout and salmon and the food sources they rely on. New Zealand mudsnails are parthenogenic, meaning that they reproduce clonally and do not require a second individual for reproduction. All mudsnail populations in the U.S. are believed to consist solely of females, which are born with embryos in their reproductive tract. Hence, introduction of a single snail can create a large population in a very short amount of time.

New Zealand mudsnails have a single shell that is elongated and spiraled, with 5-7 spirals when fully grown. Their size ranges from microscopic to ¼” long and their color ranges from light to dark brown. New Zealand mudsnails require expertise to accurately identify. Any snail with a whorled shell smaller than ¼" should be forwarded to CDFW’s New Zealand mudsnail expert for identification. Contact your CDFW Regional Scientist for guidance on providing a specimen.

For a map of known occurrences in California, visit: http://nas.er.usgs.gov/queries/collectioninfo.aspx?SpeciesID=1008.

Dead New Zealand mudsnail on metric ruler (5 millimeters = ~¼”).



Live New Zealand mudsnail showing operculum and spirals, numbered 1-5.

Dense colony of New Zealand mudsnails attached to the underside of a rock.

Monitoring for AIS Settlement within Bioboxes

Bioboxes are flow-through aquaria designed specifically to sample for the larval/settlement stage of quagga mussels, zebra mussels and New Zealand mudsnails. Commonly placed at a facility’s in- or outflow, check valve, or other waterline access point, a portion of a system’s water is routed into the flow-through biobox at velocities of < 5 ft/sec. Prior to settling, microscopic larvae (veligers) are suspended in the water column, and upon reaching the settlement stage, attach to surfaces. The biobox is designed to provide suitable conditions (attachment surface and flow rate) for the settlement of some AIS species, facilitating their detection.

Location(s):

Bioboxes should be installed where raw water enters or leaves a facility and/or at raw water access valves. Bioboxes should be placed on a stable surface adequate to support its weight. If the water temperature inside the biobox is more than 2° F above the water temperature within the facility or at the reservoir’s surface, the biobox must be shaded. Bioboxes should be located in areas that will not be damaged by water if the box were to

overflow. Flow rates greater than 5 ft/sec inhibit mussel and mudsnail settlement, so a flow-through system must not exceed this velocity. Individual facilities may need to modify the biobox during installment to adequately meet all flow and temperature requirements. There may also be infrastructure modifications needed to connect the biobox to individual inflow and outflow water supply.

The following design specifications meet the biobox requirements, above.

Biobox construction and assembly (Figure 1)
(Designed by Jody Rightmier, CDFW Yreka Screen Shop)

BIOBOX MATERIALS PARTS LIST: material to cover single box

1” PVC Ball Valve Female threaded ends, quarter turn design…....1 each

Nipple TBE SCH 80 1” x close PVC……..1 each

1” PVC 90 degree elbow slip x slip SCH 40……1 each

1” pipe x MIPT PVC insert male adapter……2 each

1’ PVC Tank adapter SOCXFPT NPRN Gasket……...2 each

1’ x 2” (length) SCH 40 PVC pipe……1 each

22 x 17 x 12” Grey Bins and Divider box……1 each

Snap F/DC3000 Bins & Divider box cover……1 each

Short Divider F/DC3080 (sold in 6 pk). Bins & Divider box……3 each/box

ER308L 3/32 x 36” TIG welding rod……1 each

1/2 " bolt size medium flat washer 18-8 stainless/steel……6 each

Plates slide down into “channel guides” on either side of the interior walls of the box (Figure 2) and water flows over and under the plates as it passes through the box. Plates are kept submerged with stainless steel wire and washers that allow for removal when inspecting the plates. Flow into the box is regulated by a valve on the incoming water line. The outlet is an overflow pipe that ensures the water level in the box remains at a constant level. All interior surfaces and plates are roughed up with fine (150-180 grit) sandpaper to maximize suitability for settlement.

Figure 2. Interior view of biobox plates that provide suitable surfaces for mussel and mudsnail settlement.

Monitoring frequency:

Bioboxes should be checked as needed to ensure they are operating correctly and maintaining the appropriate flow rate. A visual and tactile (touch) examination must be conducted at least quarterly, or monthly in spring through fall.

Requirements for biobox design:

- Minimum internal volume of 12 gallons
- Flow rate of 1.32 gallons/minute (> 5 ft/sec)

Monitoring procedure:

To inspect biobox, begin by closing the inflow valve. One at a time, carefully remove each plate. Do not set the plates down as small or delicate organisms could be crushed. Hold the plate over a separate container to catch any dislodged organisms, and visually inspect it. Use a magnifying glass if necessary. Next, gently run fingers over the plates to feel for any organisms. Very small quagga or zebra mussels may be more easily felt than seen. Do not leave the plates out of the water so long that they dry; examine and return to the water immediately if no suspect organisms are found. When finished with the first plate, reinsert it and inspect the remaining plates the same way. Also examine the inner walls of the biobox. If walls are transparent, look in from the outside. If not, view from above. Next, gently run fingers over the walls as with the plates. When finished, open the valve to resume appropriate flow.

Specimen Collection

If you suspect you have found a mussel, immediately contact the appropriate CDFW regional scientist. To aid identification, first take a close-up digital photograph of each specimen. Next, collect the specimen(s) and place in a vial with 70% ethanol. Label the vial with location, date, and name of collector. If ethanol is not available, place the sample in a rigid container (to prevent crushing) without water, label, and refrigerate. E-mail the photos to your CDFW regional scientist and they will attempt to identify the specimens from the photographs, but may request the actual specimen(s) to make a positive identification.

CDFW Regional Scientist Contacts

For the current list of CDFW's Regional Quagga/Zebra Mussel Scientists and their contact information, please visit CDFW's quagga/zebra mussel webpage at www.wildlife.ca.gov/mussels, or download the contact list here: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=4955.