Golden Mussel Mitigation in California's State Water Project

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Div. Operations & Maintenance

CRB Meeting

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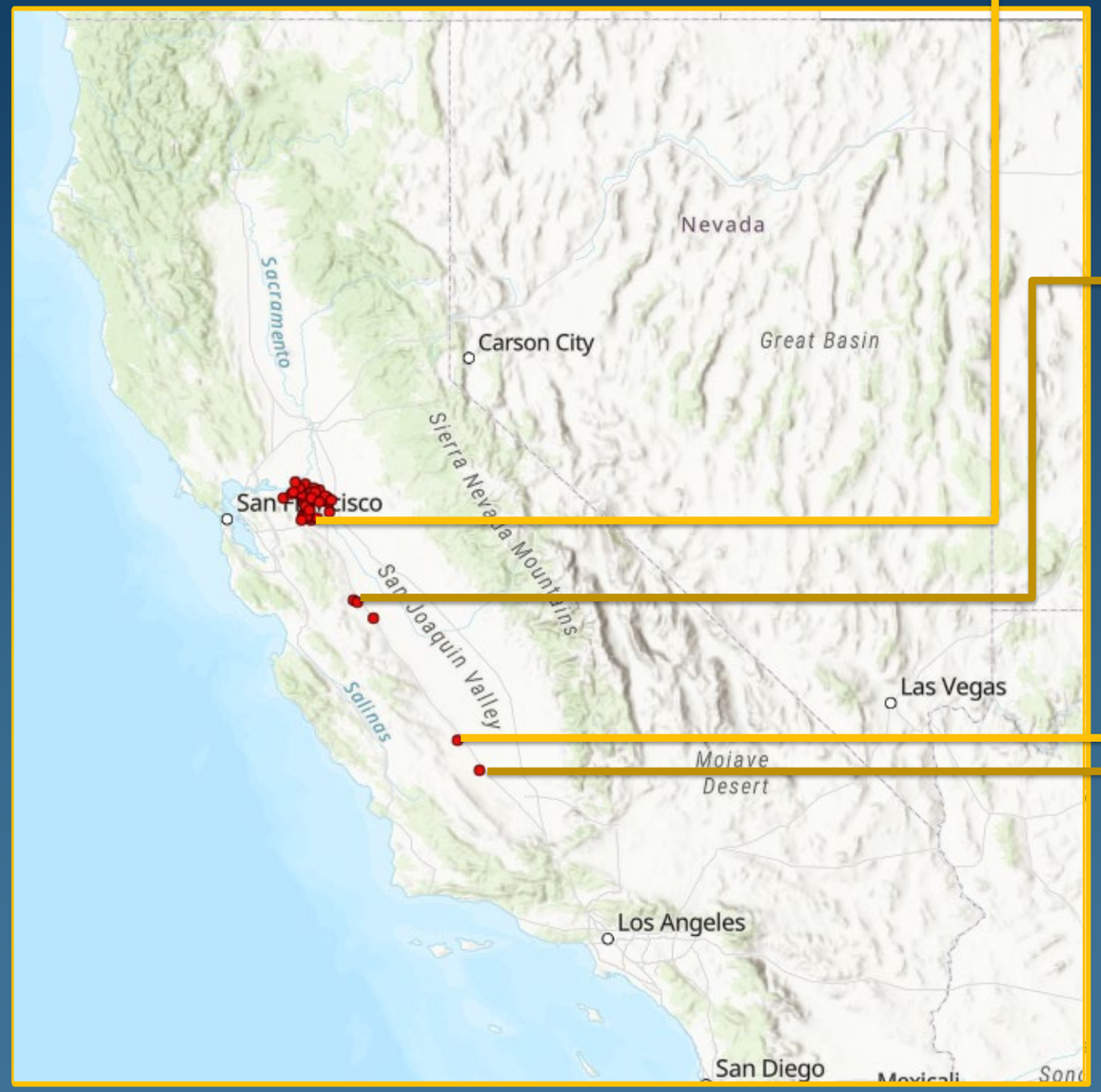
The State Water Project (SWP)

- Largest state-owned multi-purpose water project in the U.S.
- Conveys 2.1 MAF per year to 27 million people and 750,000 acres of farmland
- 30 storage facilities
- 20 pumping plants
- 3 pumping-generating power plants
- 6 hydroelectric power plants
- 1 salmonid fish hatchery
- +700 miles of open aqueduct & pipelines

California's major water projects
SWP shown in red

Golden Mussel Detections in the SWP



O'Neill Forebay buoy

Skinner Fish Facility louvers

Las Perillas Pumping Plant discharge line

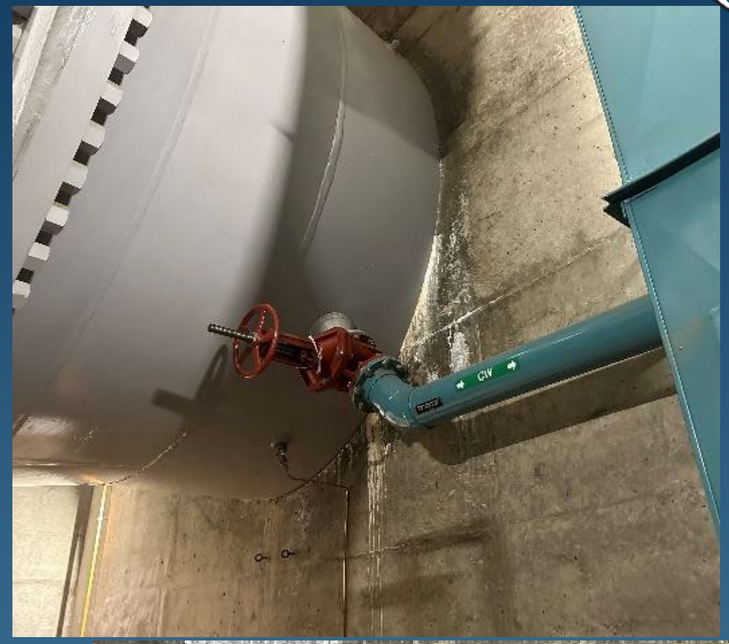
Check 24 radial gate

SWP Facility Mitigations

- Formation of the “Golden Mussel Strike Team”
  - Environmental Scientists, Engineers, Plant Operators and Mechanics, consultants & contractors
  - Develop near-term and long-term response plans

SWP Facility Mitigations

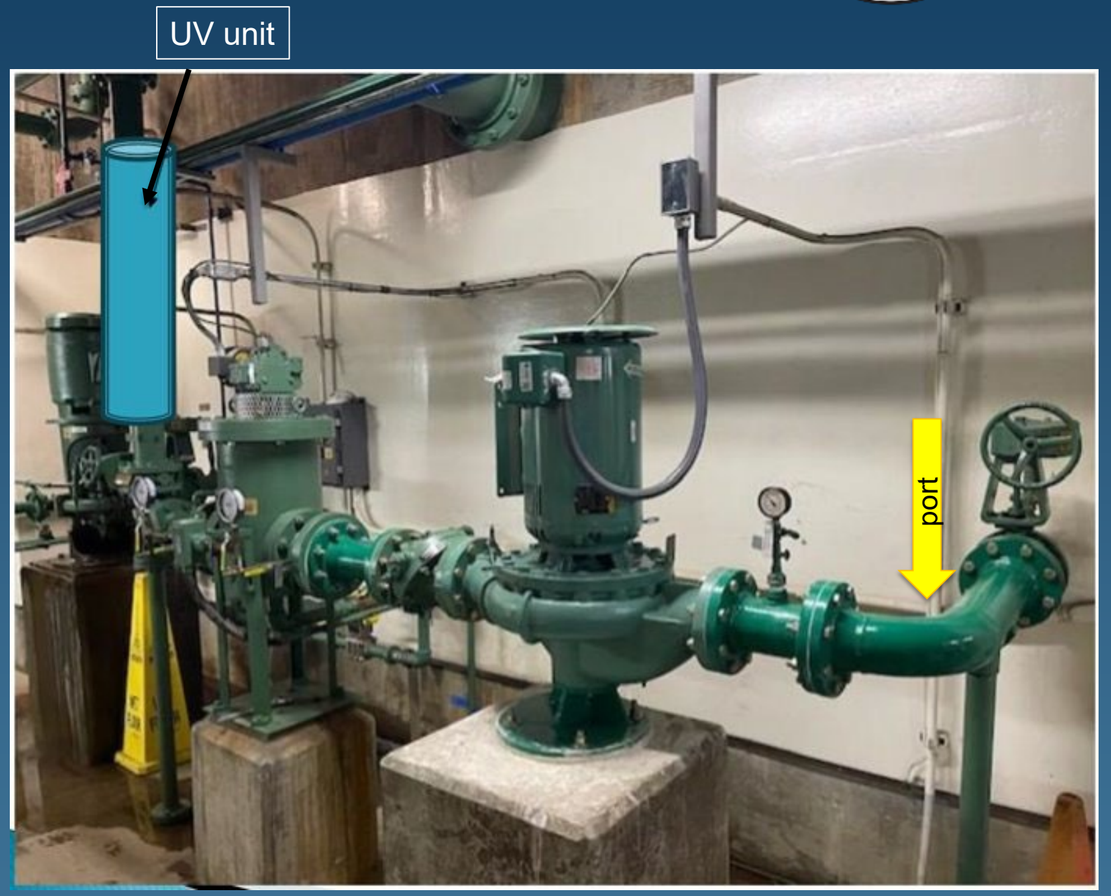
- "Near-Term Response"
  - 5 "at risk" facilities located immediately downstream of infestations
    - 1 fish diversion facility with fish screens & holding tanks
    - 3 pumping plants
    - 1 pumping-generating plant (hydro-plant with pump back ops)
  - Focused on systems less tolerant to biofouling
    - Smaller diameter and embedded piping
    - Unit cooling water, service water, and fire water systems
  - Mitigations include medium pressure UV systems, chemical injection, hot water treatment
    - 3D Laser Scanning of interior of facilities to aid engineering design



SWP Facility Mitigations

<u>Example of Intake Line Set-up</u>

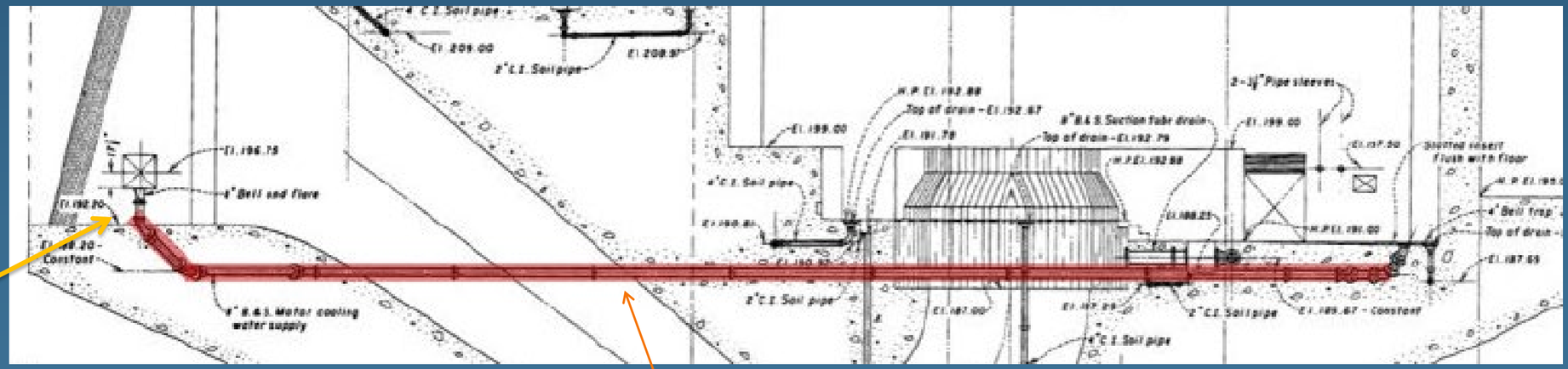
- Chemical injection port
  - Treat pipe section between forebay and UV unit
- Medium Pressure UV Units
  - Install as far upstream in the pipeline as possible
  - 1st Unit to be installed to serve as a pilot study
    - Refine power needs and recalculate overall power load
    - Validation testing with upstream/downstream bio-boxes



SWP Facility Mitigations

<u>Be Aware of Challenges!</u>

- Insufficient power or lack of 480v power
  - 1.5 years to construct and install transformer
- Submerged or inaccessible intakes
- Embedded pipelines



Submerged intake behind trashrack

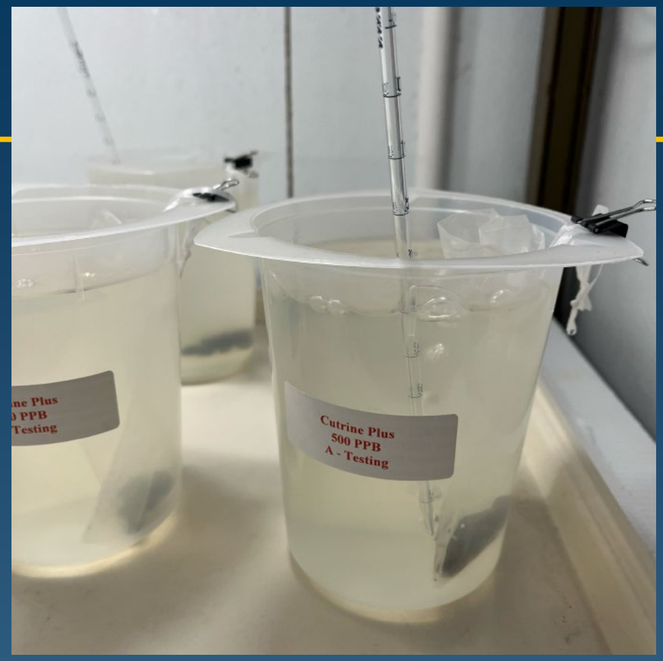
110 ft embedded cooling supply line

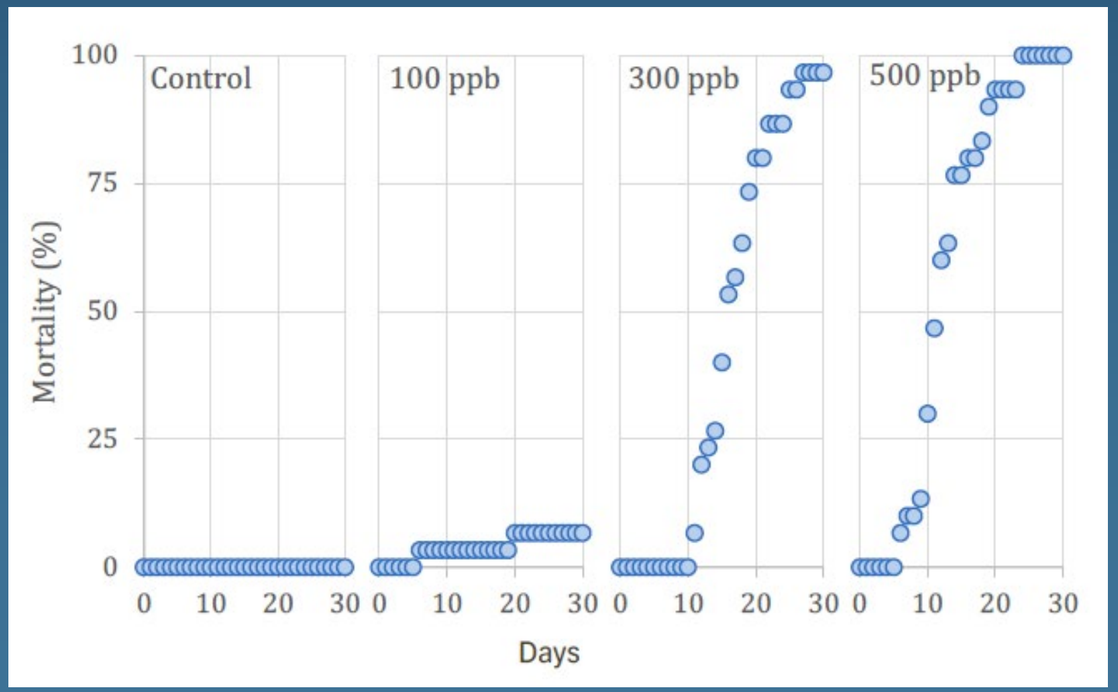
Monitoring and Research

- Golden, Quagga & Zebra mussel Monitoring
  - eDNA, veligers, settled adults
  - Filter samples, plankton samples, settlement plates, facility inspections
  - Weekly to monthly to seasonal monitoring
- Population Dynamics
  - Planned Studies:
    - Spawning Season
    - Seasonal Settlement and Density Changes
    - Mussel Growth Rates

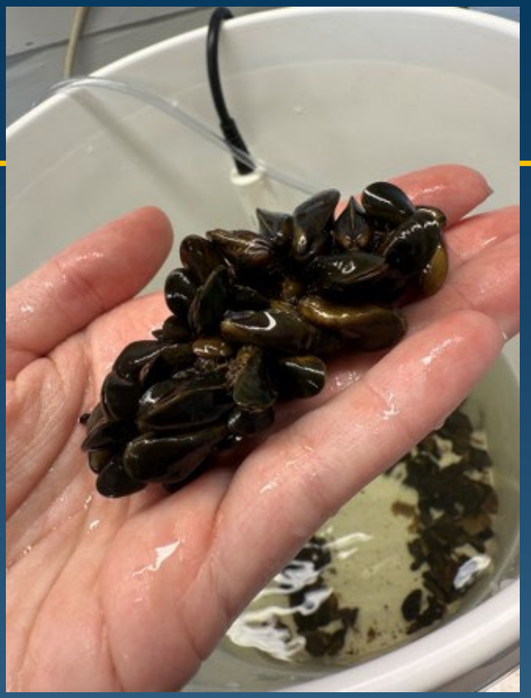
Chemical Treatment Research

- Limited research on chemical control of Golden Mussel
- Copper Exposure Trial
  - Adult mussels exposed to copper pesticides for 30 days
  - EarthTec QZ and Cutrine Plus
  - 3 copper concentrations (100, 300, 500 ppb)
  - 30-Day Results:
    - 100 ppb = 0% - 7% mortality
    - 300 ppb = 94% - 97% mortality
    - 500 ppb = 100% mortality
    - EarthTec QZ = 24 days to 100% mortality
    - Cutrine Plus – 28 days to 100% mortality
  - Need to test on new settlement
  - Calculating treatment cost estimates (in process)
    - Small diameter pipeline treatments only





Chemical Treatment Research



- Mobile Mussel Lab
  - Installed at Skinner FF in April 2025
  - Flow-through system using aqueduct water
  - Ready source of veligers once spawning begins
  - Veliger and adult chemical exposure testing
    - Hot water, copper, sodium hypochlorite
      - Hot water submersion trials underway
    - Chlorine and copper exposure trials on veligers and young settlers
      - waiting for high veliger counts

SWP Facility Mitigations - Beyond 2025

- Refine chemical treatment methods and seasonality
  - Based on mussel density, spawning cycle, and system tolerance

- Design and install protections at remaining SWP facilities
  - Priority to unit cooling water, service water, and fire water systems
  - Develop mitigations for other equipment in contact with raw water
    - Turnouts, trashracks, traveling screens, stop logs, WQ station intake lines and instrumentation, etc.

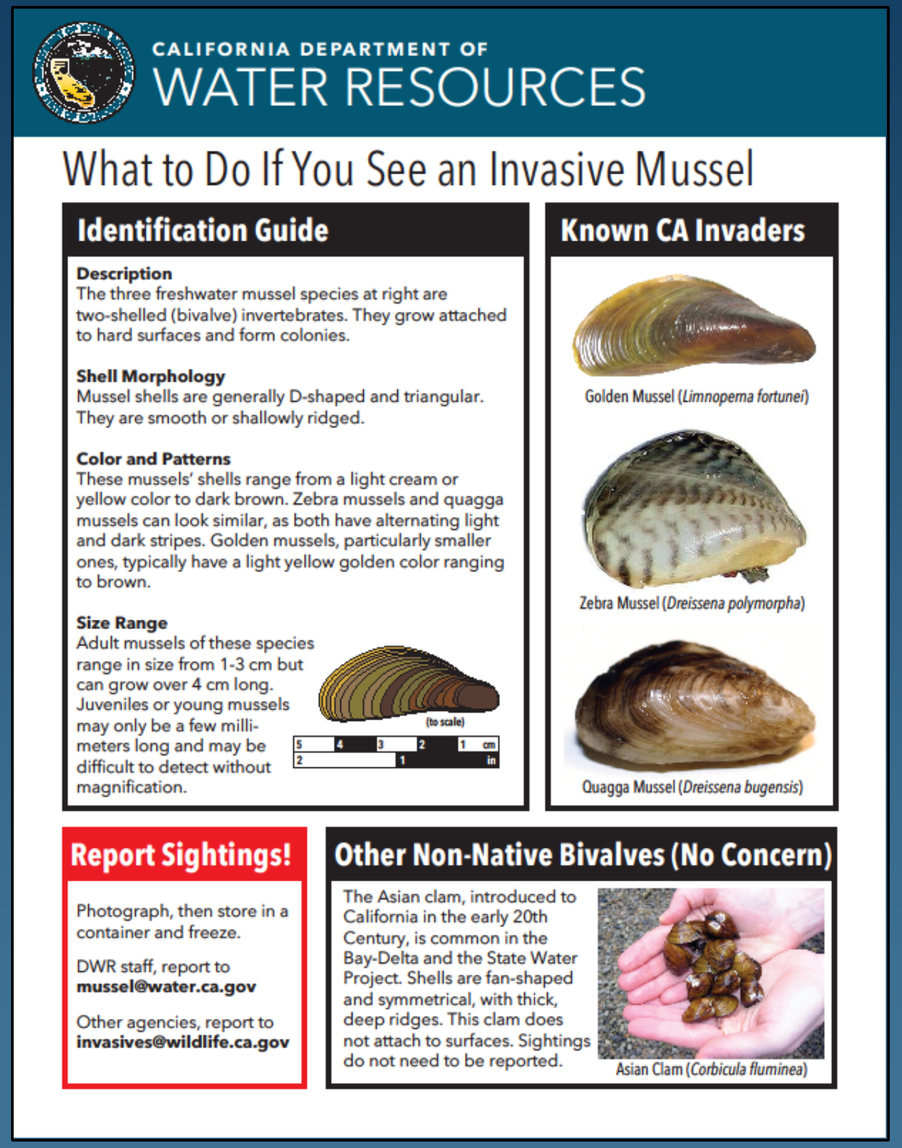
Thank you!

Resources:

DWR Mussel Program Email:
mussel@water.ca.gov

DWR Invasive Mussel Website:
https://water.ca.gov/mussels

DWR Golden Mussel Video:
https://www.youtube.com/watch?v=6diVXnmsU4Q



CALIFORNIA DEPARTMENT OF
WATER RESOURCES

What to Do If You See an Invasive Mussel

Identification Guide

Description
The three freshwater mussel species at right are two-shelled (bivalve) invertebrates. They grow attached to hard surfaces and form colonies.

Shell Morphology
Mussel shells are generally D-shaped and triangular. They are smooth or shallowly ridged.

Color and Patterns
These mussels' shells range from a light cream or yellow color to dark brown. Zebra mussels and quagga mussels can look similar, as both have alternating light and dark stripes. Golden mussels, particularly smaller ones, typically have a light yellow golden color ranging to brown.

Size Range
Adult mussels of these species range in size from 1-3 cm but can grow over 4 cm long. Juveniles or young mussels may only be a few millimeters long and may be difficult to detect without magnification.

(to scale)

5 4 3 2 1 cm
2 1 in

Known CA Invaders

Golden Mussel (*Limnoperna fortunei*)

Zebra Mussel (*Dreissena polymorpha*)

Quagga Mussel (*Dreissena bugensis*)

Report Sightings!

Photograph, then store in a container and freeze.

DWR staff, report to **mussel@water.ca.gov**

Other agencies, report to **invasives@wildlife.ca.gov**

Other Non-Native Bivalves (No Concern)

The Asian clam, introduced to California in the early 20th Century, is common in the Bay-Delta and the State Water Project. Shells are fan-shaped and symmetrical, with thick, deep ridges. This clam does not attach to surfaces. Sightings do not need to be reported.

Asian Clam (*Corbicula fluminea*)