



# Dreissenid, & Limnoperna, & Corbicula, Oh My!

They are here, what can we do  
about it?

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# Outline

- What are Dreissenids, Limnoperna, and Corbicula and where to find them?
- Challenges for the system ecologically and water users
- Potential treatment options
- Recommendations



Golden Mussel (*Limnoperna fortunei*)



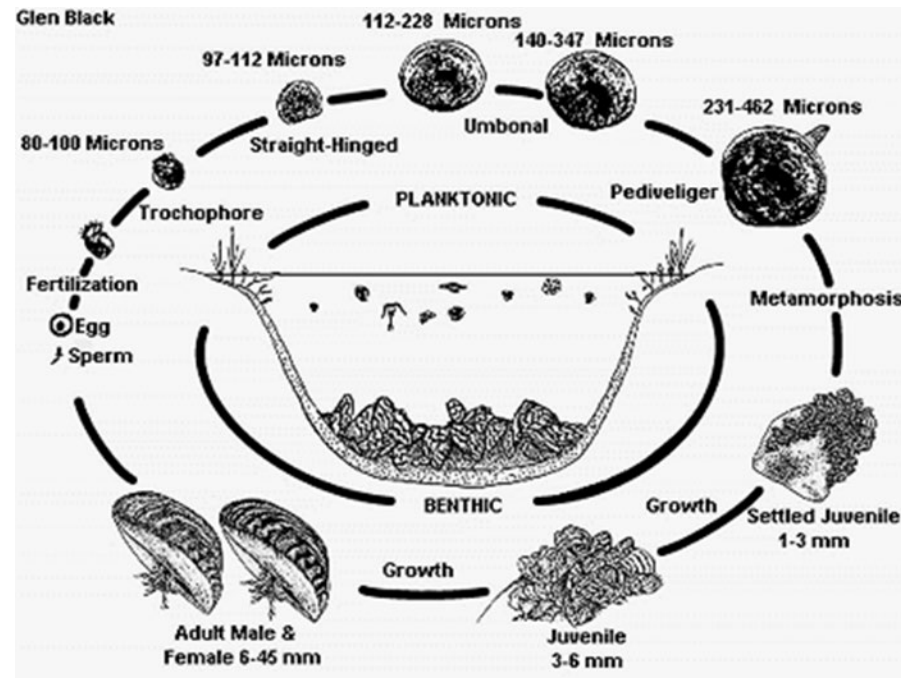
Zebra Mussel (*Dreissena polymorpha*)



Quagga Mussel (*Dreissena bugensis*)

# Aquatic Invasive Mussels: Zebra, Quagga & Golden Mussels

- Bivalve Freshwater Mussel
- Filter feeds on planktonic algae and bacteria ~1 L/day
- Attaches to hard surfaces with Byssal Threads
- Reproduce multiple times per year releasing >1 Million eggs
  - Larval form is planktonic -veliger (easily moved)
- Live 4-5 years



Golden Mussel (*Limnoperna fortunei*)



Zebra Mussel (*Dreissena polymorpha*)



Quagga Mussel (*Dreissena bugensis*)

# Maps



5 mm

Golden Mussel (*Limnoperna fortunei*) ●



Zebra Mussel (*Dreissena polymorpha*) ●



Quagga Mussel (*Dreissena bugensis*) ●



# Water Quality Limits

| Parameter                      | At Risk<br><i>Dreissenia sp.</i> | At Risk<br><i>Limnoperna sp.</i> | At Risk<br><i>Corbicula sp.</i> |
|--------------------------------|----------------------------------|----------------------------------|---------------------------------|
| Calcium Limits<br>(mg/L)       | >8                               | $\geq 1$                         | >2                              |
| pH range                       | 7.0-9.5                          | $\geq 5.5$                       | $\geq 5.4$                      |
| Salinity (‰)                   | <6                               | <15                              | <17                             |
| Oxygen limit at<br>20°C (mg/L) | >3                               | 0.5?                             | 0.5?                            |
| Temperature<br>Limit (°C)      | 0-33                             | <5-35                            | 0-38                            |
| Breeding<br>Temperature (°C)   | 12-24                            | 16-28                            | 15-30                           |

# Maps

Golden Mussel (*Limnoperna fortunei*) ●

Zebra Mussel (*Dreissena polymorpha*) ●

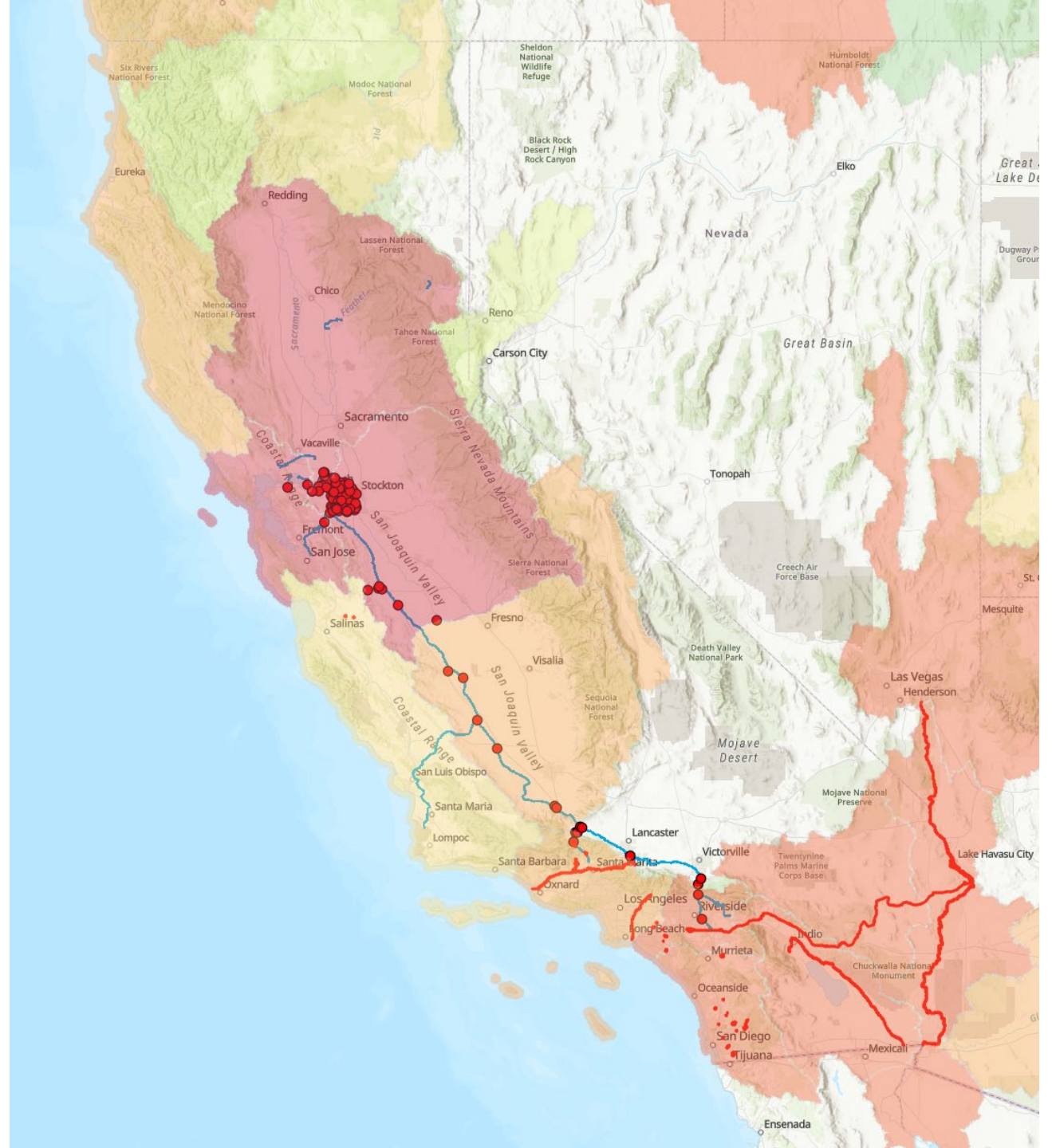


Quagga Mussel (*Dreissena bugensis*) ●



Golden Clam (*Corbicula* sp.)

## Decade intro



# Corbicula: Golden (Asian) Clam

- 1<sup>st</sup> found in Washington in 1938
  - Recently common name changed
- Colonize river, lakes and slow-moving water
- Adult are 0.5 to 1.5” in length.
- Shells have concentric ridges and can vary in color from yellowish-brown to black.
- Filter feed at higher rates than mussels
- Hermaphroditic reproduction (self fertilize)

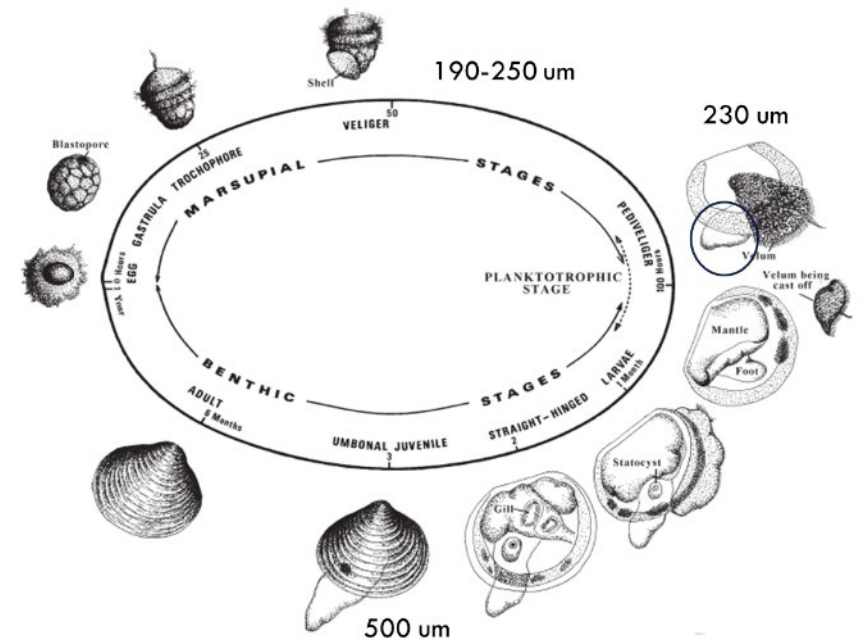
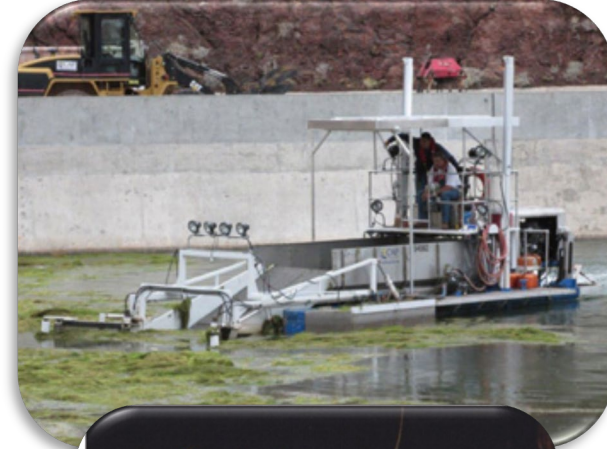


Figure 2.14. Life history of *Corbicula fluminea* in North America (larval stages redrawn from Kraemer and Galloway, 1986). The planktotrophic stage is very short and can be represented by any stage from pediveliger to late straight-hinged larvae.

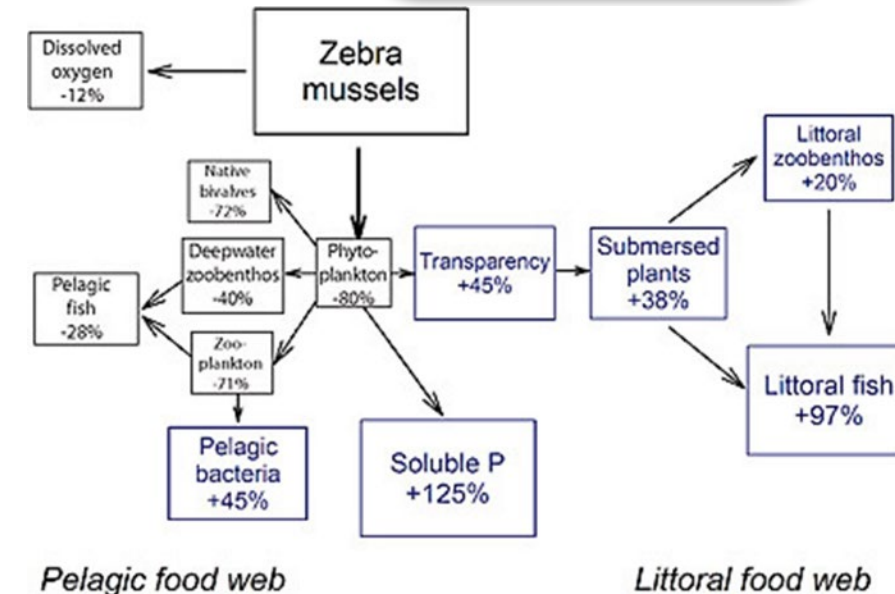


# Environmental Impacts

- Ecosystem Engineers-Habitat Alterations
  - Light penetration increases aquatic plant and algae
  - Shifts in water chemistry (Calcium, Benthic Invertebrate communities, C-N cycling)
- Bioaccumulation
- Disruption of Food Webs
- Native Species disrupted through resource depletion, competition, suffocation



Snail



# Economical Impacts: \$ Billions Annually

- Recreational opportunities
  - Loss of access
  - Operation costs
  - Water Managers budgets
    - Monitoring, WID stations
    - Closure to recreation



**Loss of beaches**



**WID Stations**



**San Justo Reservoir,  
Boat Ramp**

# Economical Impacts: \$ Billions Annually

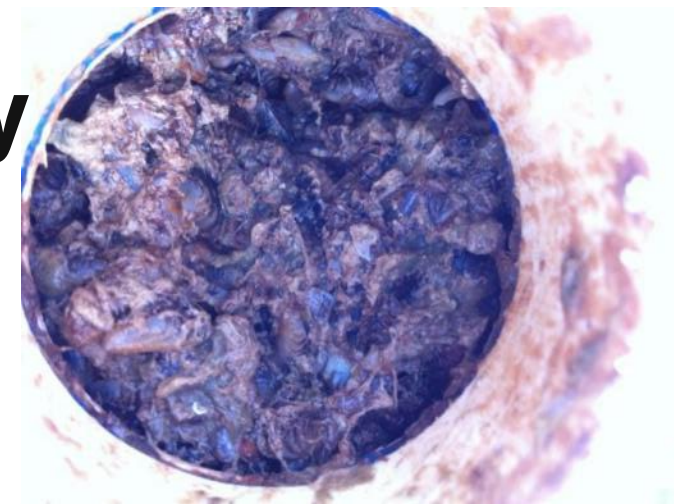
- Water Facilities Compromised
  - All infrastructure exposed to raw water
    - Heat exchangers
    - Trash racks
    - Diversion systems
    - Piping
    - Fire suppression systems



**CAP Cooling Water Heat Exchanger**



**Skinner Delta Fish Protective Facility , Wier**



# Economical Impacts: \$ Billions Annually

- Recreational opportunities
- Water Facilities Compromised
- Other Water Users
  - Hatcheries
  - Golf Courses
  - Agriculture
  - Municipalities



# Treatment Options and Examples

- Freezing
- Hot water
- Drying/Draw Downs
- Filtration
- UV
- Chemical Treatment
  - Chlorine
  - Copper
    - EarthTec, Naltrene, Copper Sulfate
    - Copper Ion Generator
  - Potassium Chloride
  - Zequanox



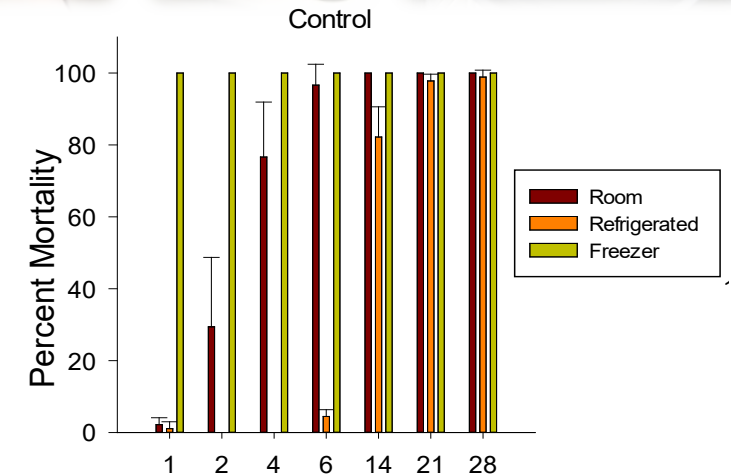
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- **Freezing**

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Mussels will not survive freezing

- Entire water body must freeze
- Good for gear
- Boat?
  - Antifreeze



# Treatment Options and Examples

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Mussels will not survive hot water >35C (95F)

- Entire water body must get that hot
  - Surface temps killed Marina infestation
- Good for gear
- Boat
  - Decontamination stations- Spray & Dip tank
  - Higher temps =shorter duration



# Treatment Options and Examples

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  - Potassium Chloride
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Mussels will not survive out of water 5-30 days

- Hot temperatures faster than cool, moist
- Good for gear and boats
- Feasible in facilities with redundancy
  - Turbines
  - Piping



# Treatment Options and Examples

- Freezing
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- Drying/Draw Downs
- **Filtration**
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Efficacy decreases with time and flow

- Sand filters, screens
- Big sand, gravel beds needed
  - Settlement basins

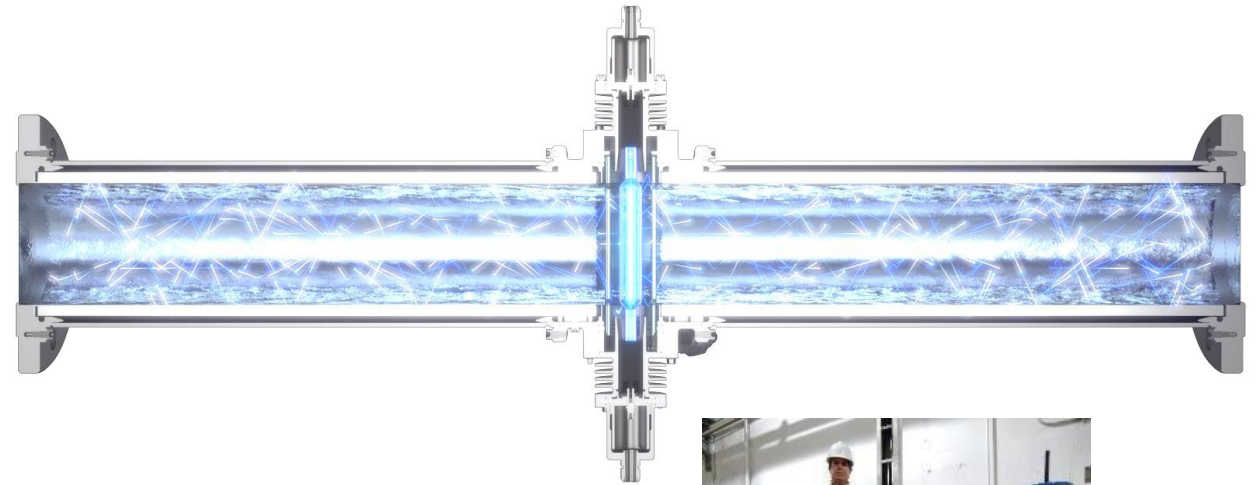


# Treatment Options and Examples

- Freezing
- Hot water
- Drying/Draw Downs
- Ground treatment
- **UV**
- Chemical Treatment
  - Chlorine
  - Copper
    - EarthTec, Naltrene, Copper Sulfate
    - Copper Ion Generator
  - Potassium Chloride
  - Zequanox

## Atlantium Medium Pressure UV-C lamp

- Prevention of settlement in flowing water
- Need filter prior to remove large particles



# Treatment Options and Examples

- Freezing
- Hot water
- Drying/Draw Downs
- Ground treatment
- UV
- **Chemical Treatment**
  - **Chlorine**
  - Copper
    - EarthTec, Naltrene, Copper Sulfate
    - Copper Ion Generator
  - Potassium Chloride
  - Zequanox

Zebras and Quaggas detect chlorine

- Prevention of settlement in flowing water (MWD)
- Long constant contact times to achieve mortality



# Treatment Options and Examples

- Freezing
- Hot water
- Drying/Draw Downs
- Ground treatment
- UV
- Chemical Treatment

- Chlorine

- **Copper**

- **EarthTec, Naltrene, Copper Sulfate**

- **Copper Ion Generator**

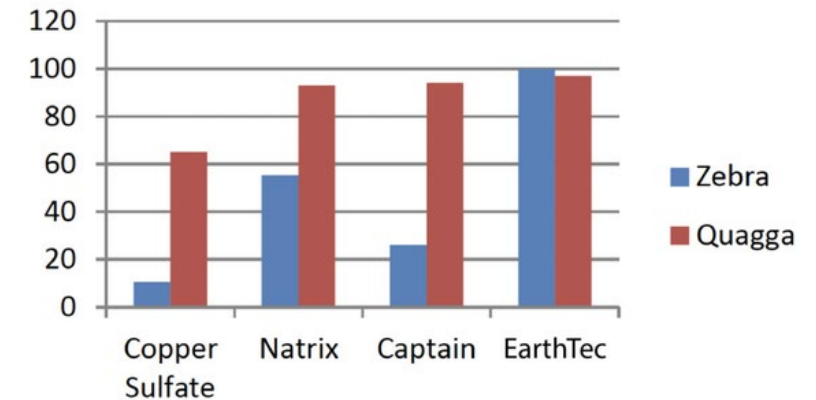
- Potassium Chloride

- Zequanox

Mussels are sensitive to copper

- Used in flowing water for settlement and eradication
- Water quality impacts efficacy

Fig. 43 - Low concentration. Average percent mortality after 96 hours of exposure to low concentration of algaecides.

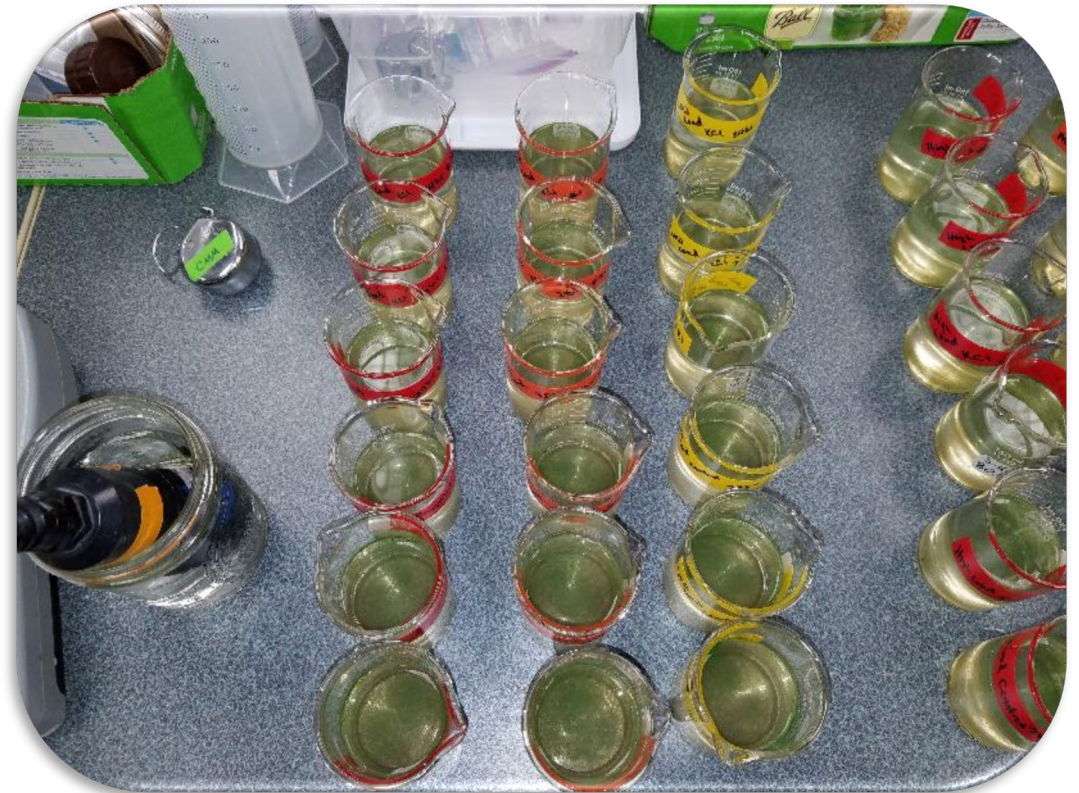


# Treatment Options and Examples

- Freezing
- Hot water
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- Ground treatment
- UV
- Chemical Treatment
  - Chlorine
  - Copper
    - EarthTec, Naltrene, Copper Sulfate
    - Copper Ion Generator
  - **Potassium Chloride (Potash)**
  - Zequanox

Mussels are sensitive to KCl

- Used for eradication standing water
- Water quality impacts efficacy

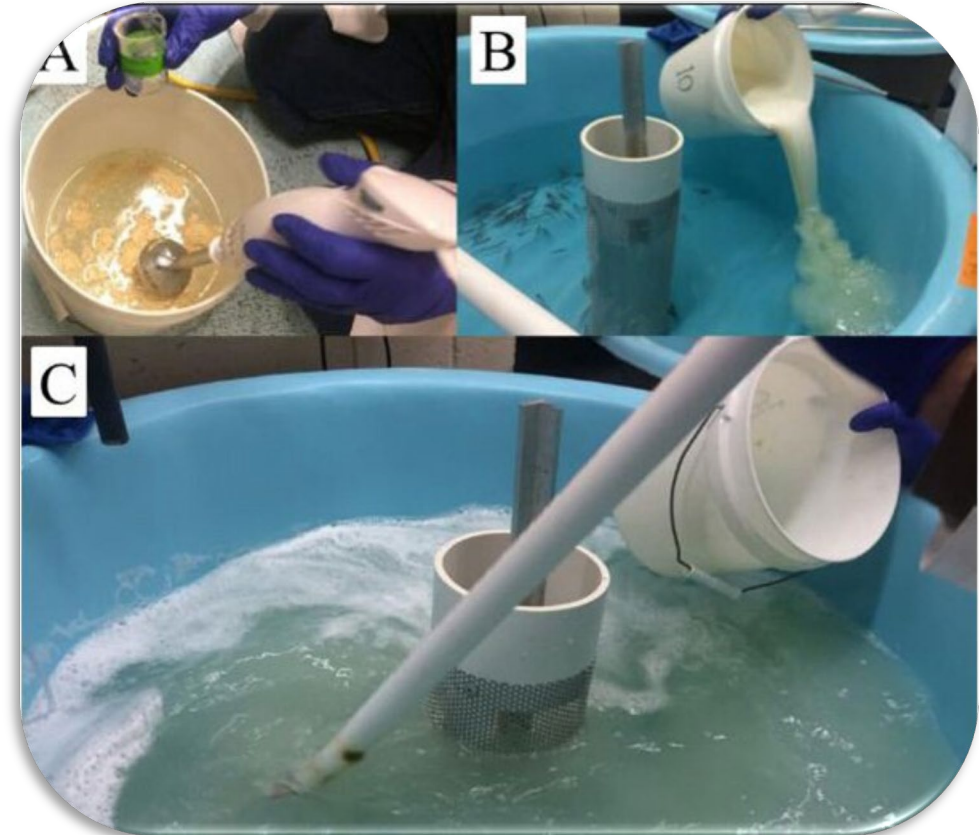


# Treatment Options and Examples

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  - **Zequanox**

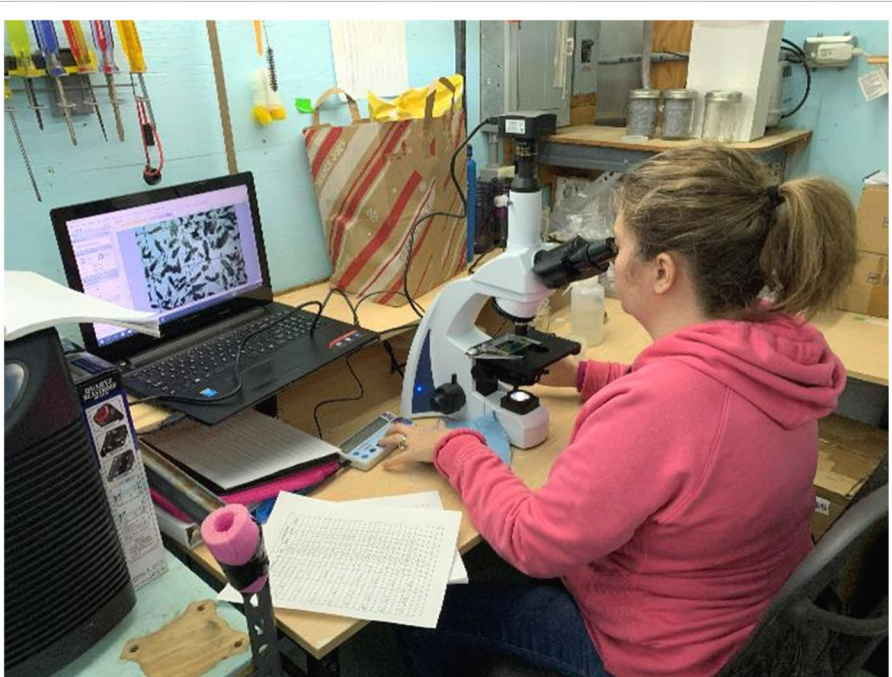
Mussels eat the dead bacteria to destroy stomach

- Used for eradication standing water, constant flow through



# Recommendations

- Prevention is the best
- Each facility and situation is different and nuanced
- Water Chemistry is important when conducting chemical treatments



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