Coming to a Place Near You: Quagga and Zebra Mussels

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Paul Berg, PE, CH2M HILL

Sharook Madon, Ph.D., CH2M HILL (San Diego)

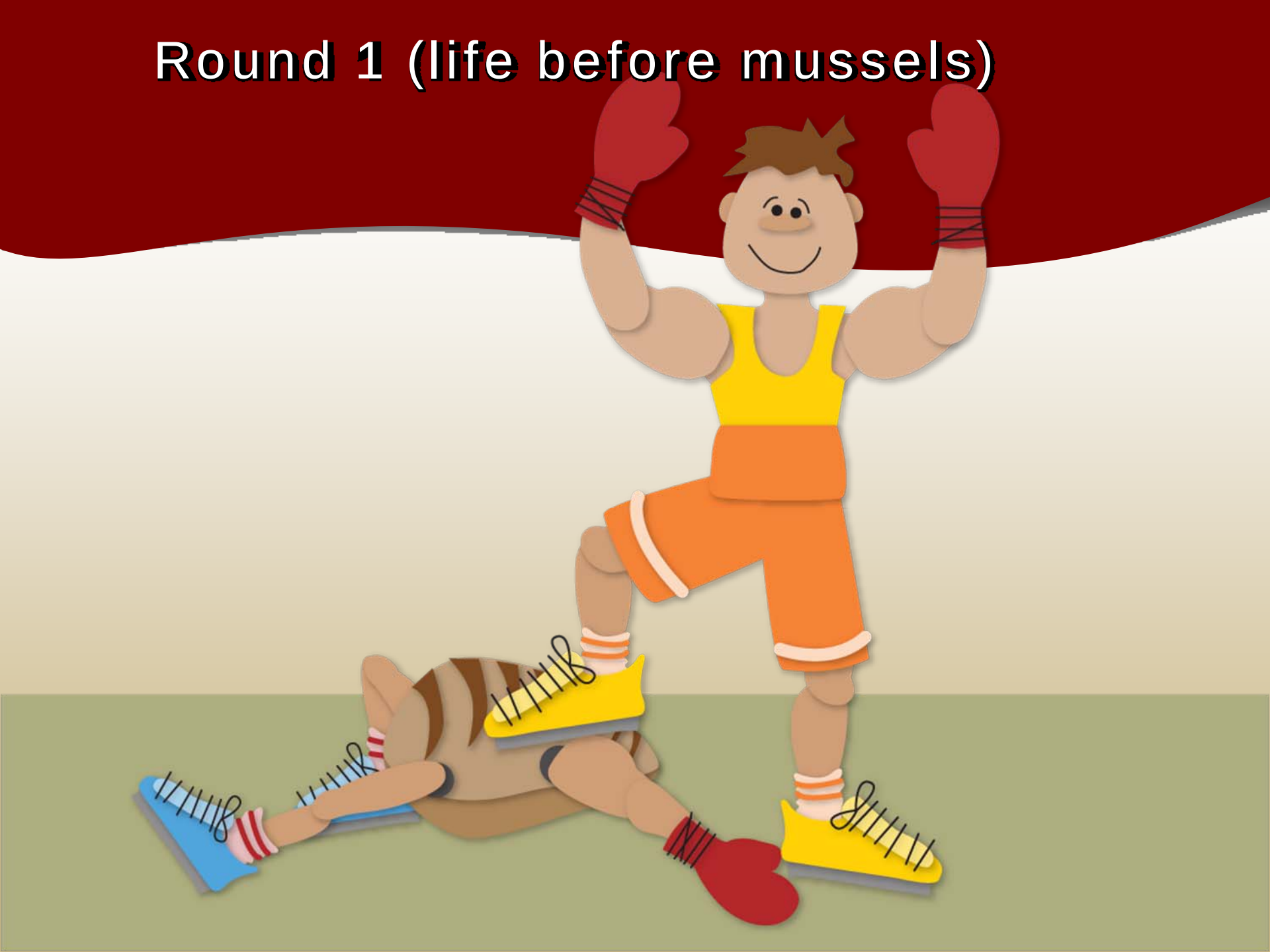
Dale Gabel, PE, CH2M HILL (Denver)

CH2MHILL

Title fight

- Round 1
  (Life before mussels)
- Round 2
  (Range, biology, & impacts)
- Round 3
  (Taking on the challenge)
- Round 4
  (Northwest bound?)

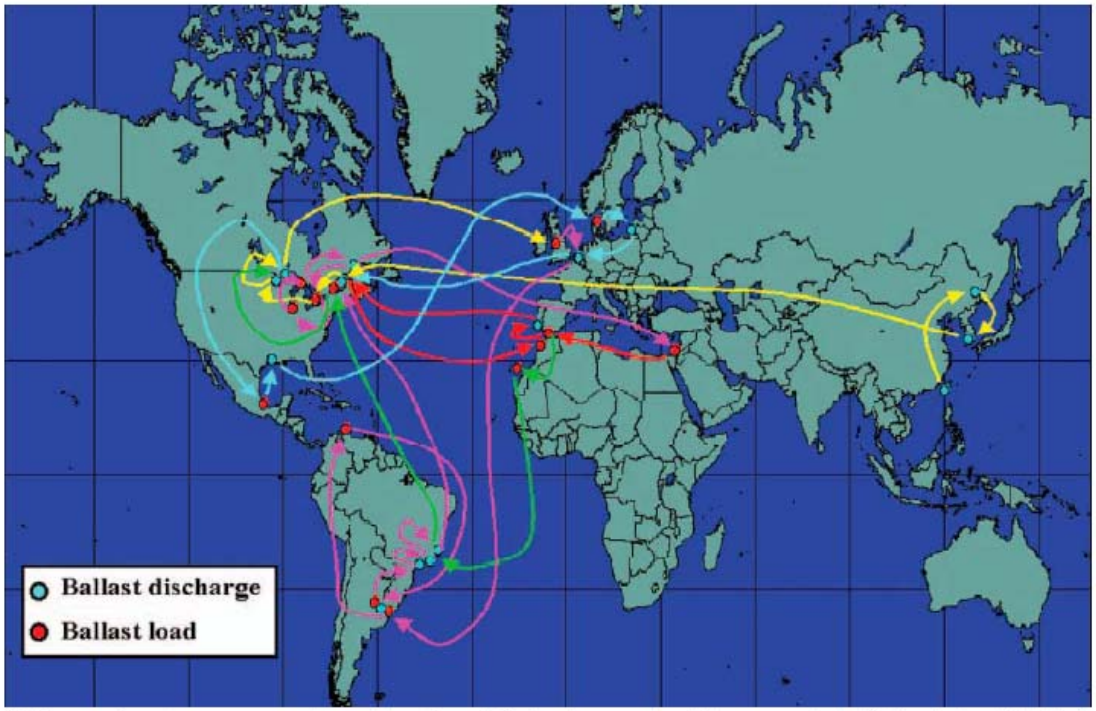
Round 1 (life before mussels)



US was Zebra/Quagga Mussel-free until 1988

- Native to freshwater rivers and lakes in Eastern Europe and Western Asia
- Zebras found in Lake St. Clair in 1988
- Quaggas identified one year later

Entry into the US

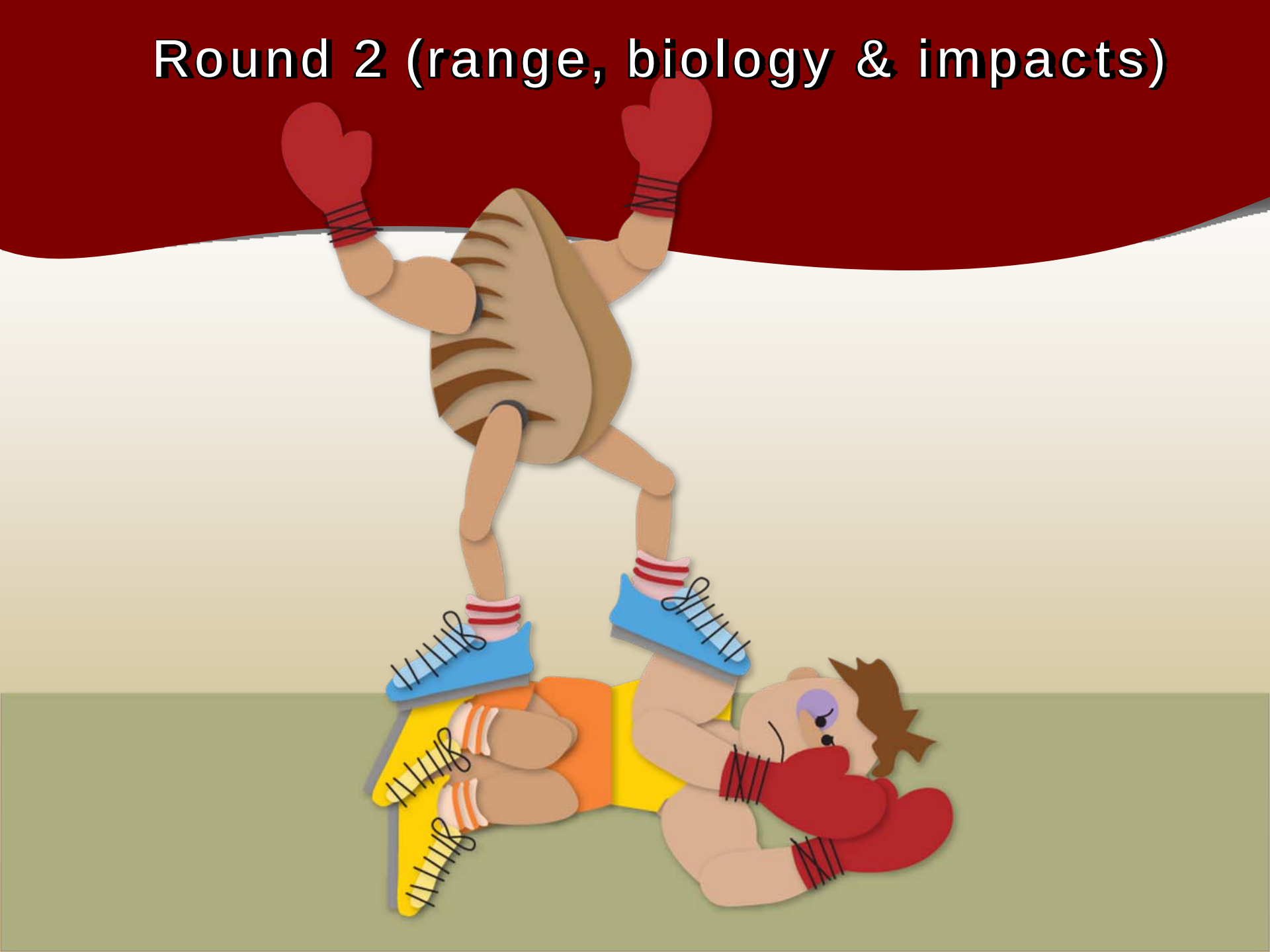


Global activity of a single transoceanic vessel over a 14-month period. Circles indicate sites where ballast water was loaded (red) or discharged (light blue). Colors demonstrate individual voyages. Graphic: BioScience, October 2004 and Hugh J. MacIsaac, et. al.

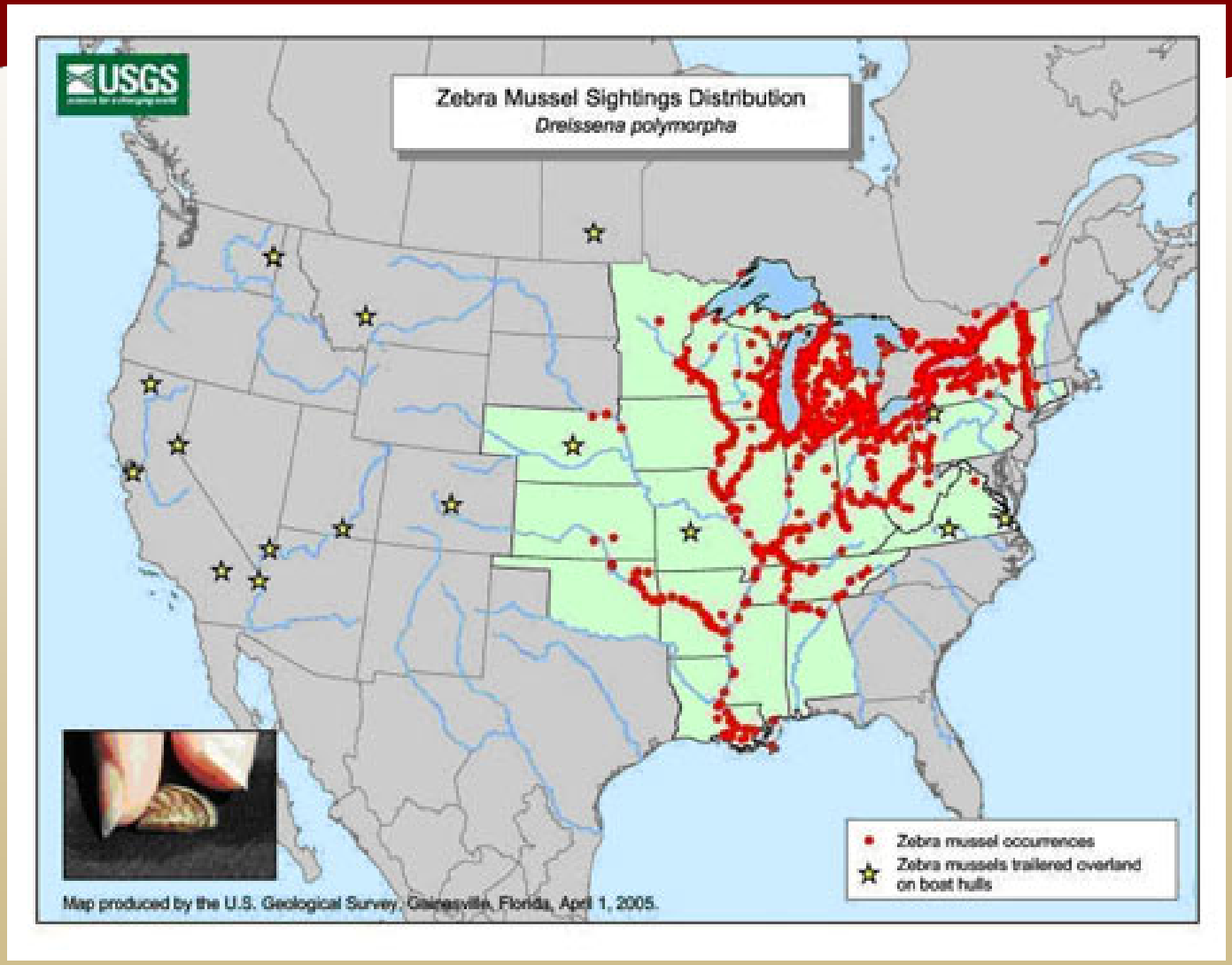
An illustration of water discharge from a maritime vessel. Photo courtesy Marine Invasions Laboratory, Smithsonian Environmental Research Center

Entered the Great Lakes from ballast waters of transoceanic ships

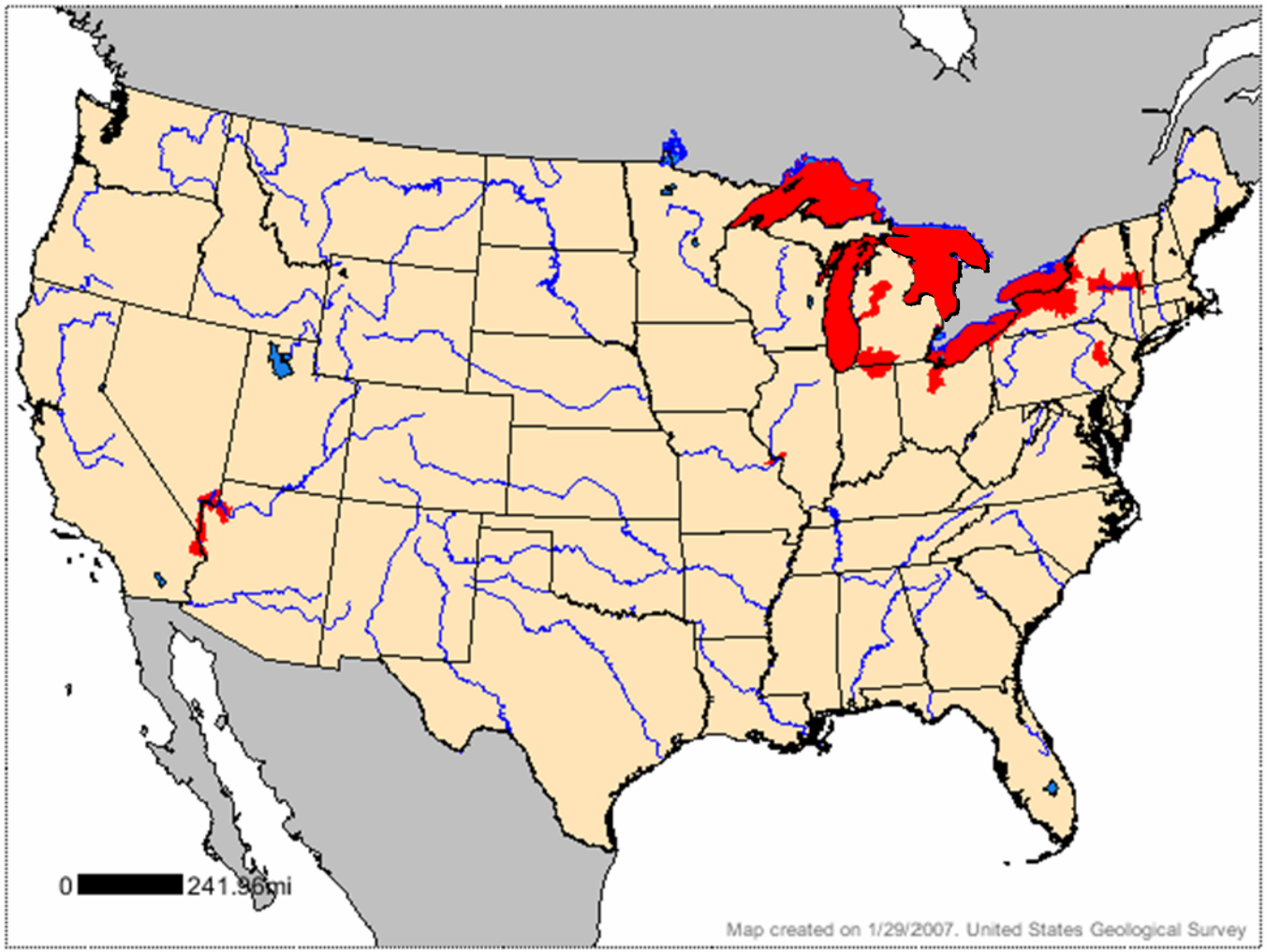
Round 2 (range, biology & impacts)



Zebra Mussel Range in 2006



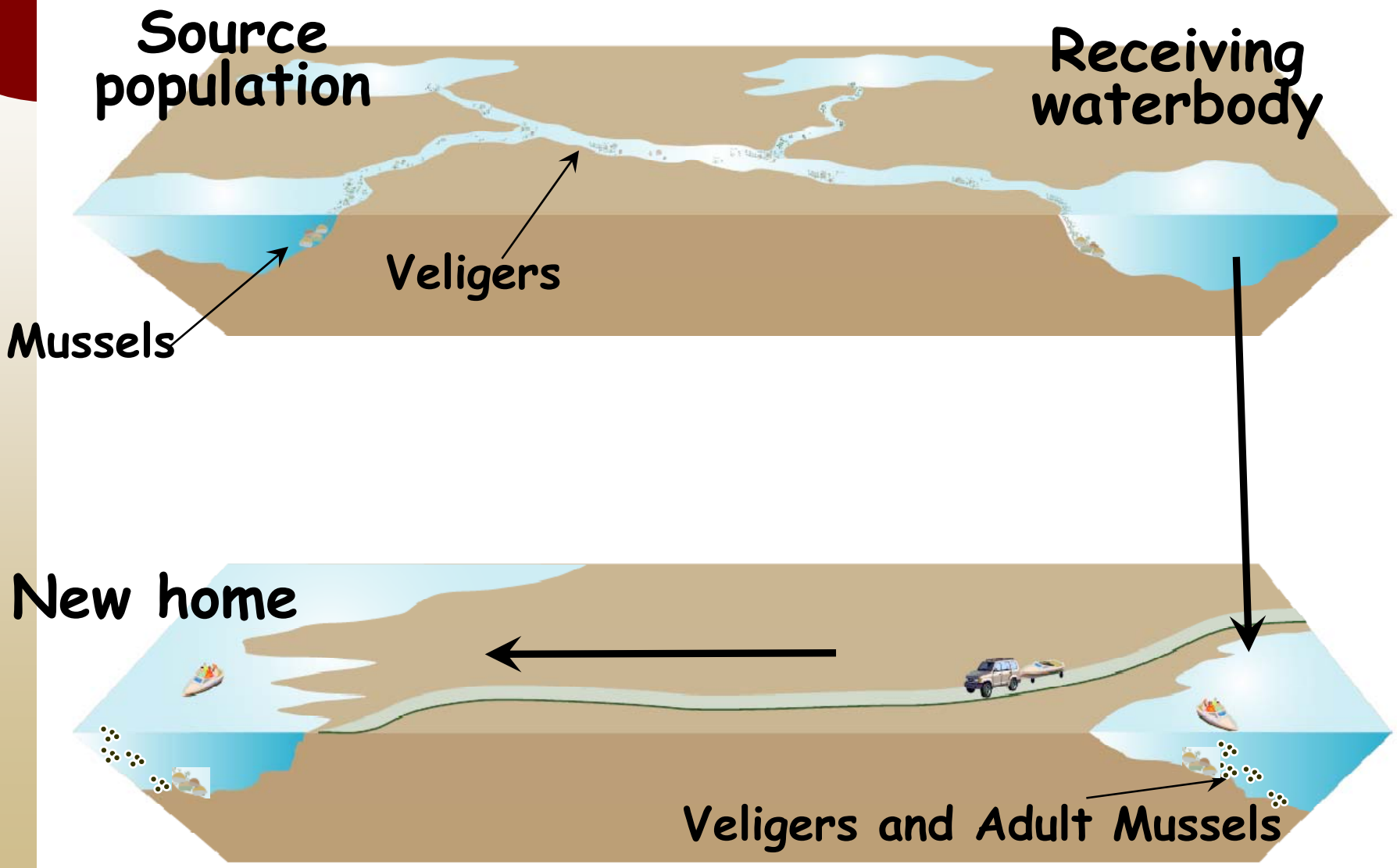
Quagga Mussel Range in 2007



Jan 6 – Lake Mead, Jan 17 – L Havasu

Most recent discovery of Zebra Mussels

Flexing their muscles



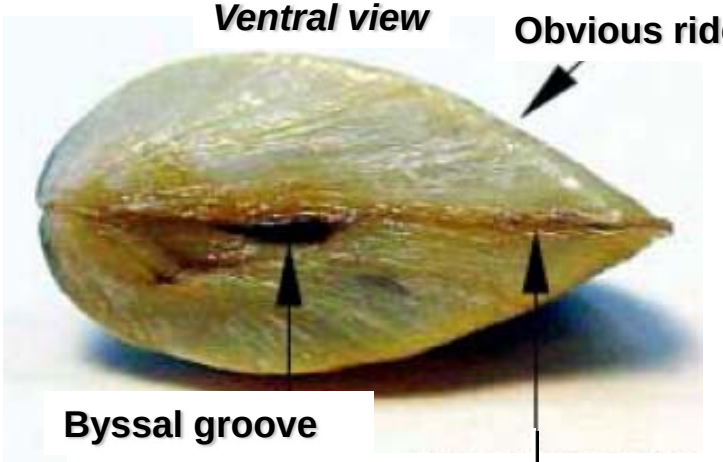
Biology: Zebra vs. Quagga

Zebra Mussel

Quagga Mussel

Ventral view

Obvious ridge

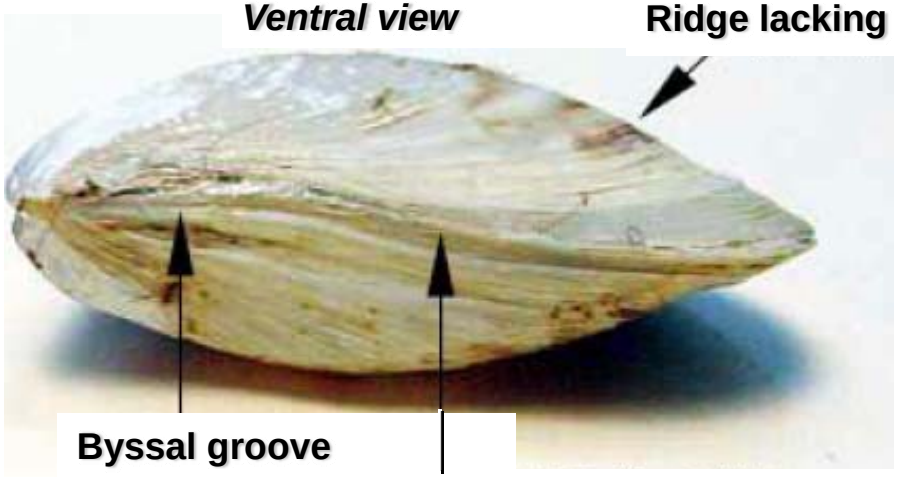


Byssal groove

Bilaterally symmetrical
Join together in midventral line

Ventral view

Ridge lacking



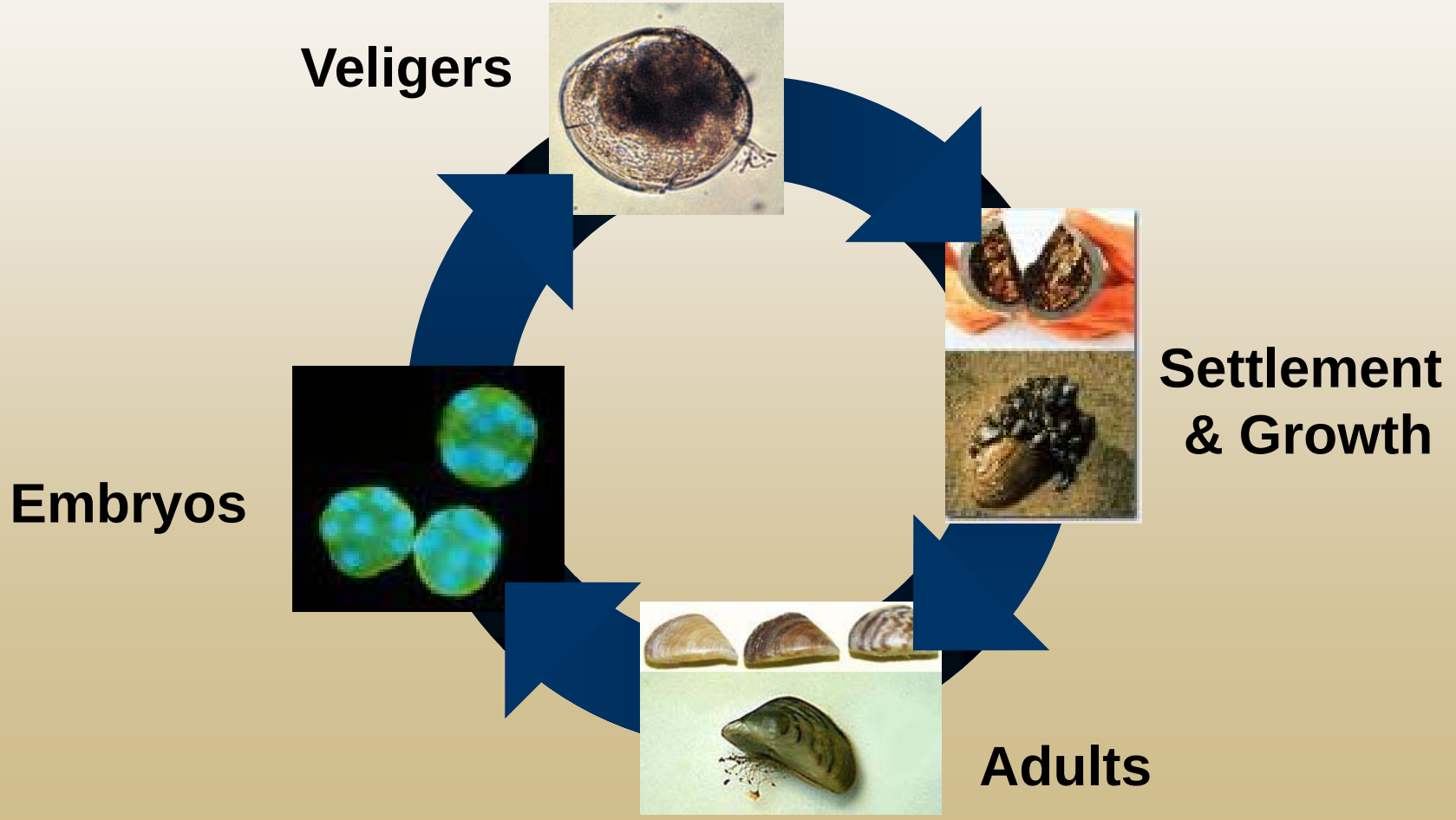
Byssal groove

Asymmetrical; no straight midventral line

Biology: Zebra vs. Quagga

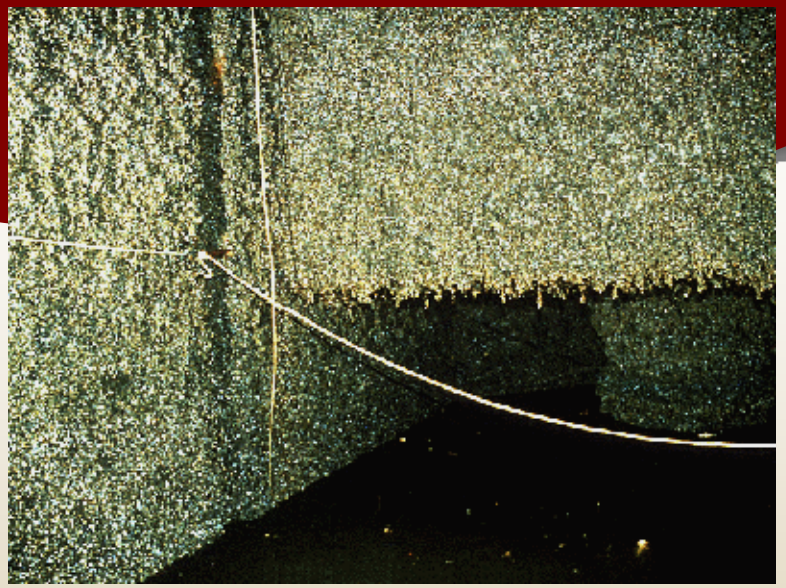
	Zebra Mussel	Quagga Mussel
Substrate	Typically hard	Hard or soft
Depth	3 to 100 ft	3 to 350 ft
Preferred temperature	54° to 68°F	39° to 68°F
Lake Michigan	98.3% in 2000	97.7% in 2005

Biology: Lifecycle



Impacts on Facilities

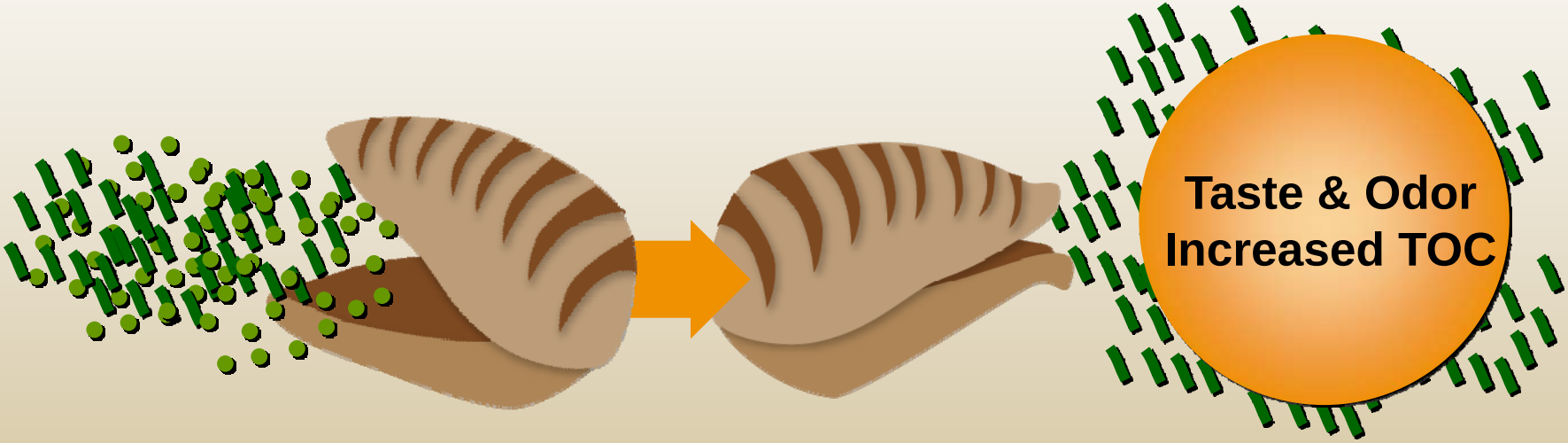
- Water treatment plants
  - Intakes
  - Pump stations
  - Pipes, valves, cables, chains
  - Areas with flow rates < 3 fps
- Hydropower plants
- Dam structures



Source: NY Sea Grant

Recreational Impacts

Impacts on Water Quality



Mussels filter out both types of algae, but…..

Spit live blue-greens out

Removal of competing algae and addition of nutrients by Quagga Mussels creates blue-green algae blooms.

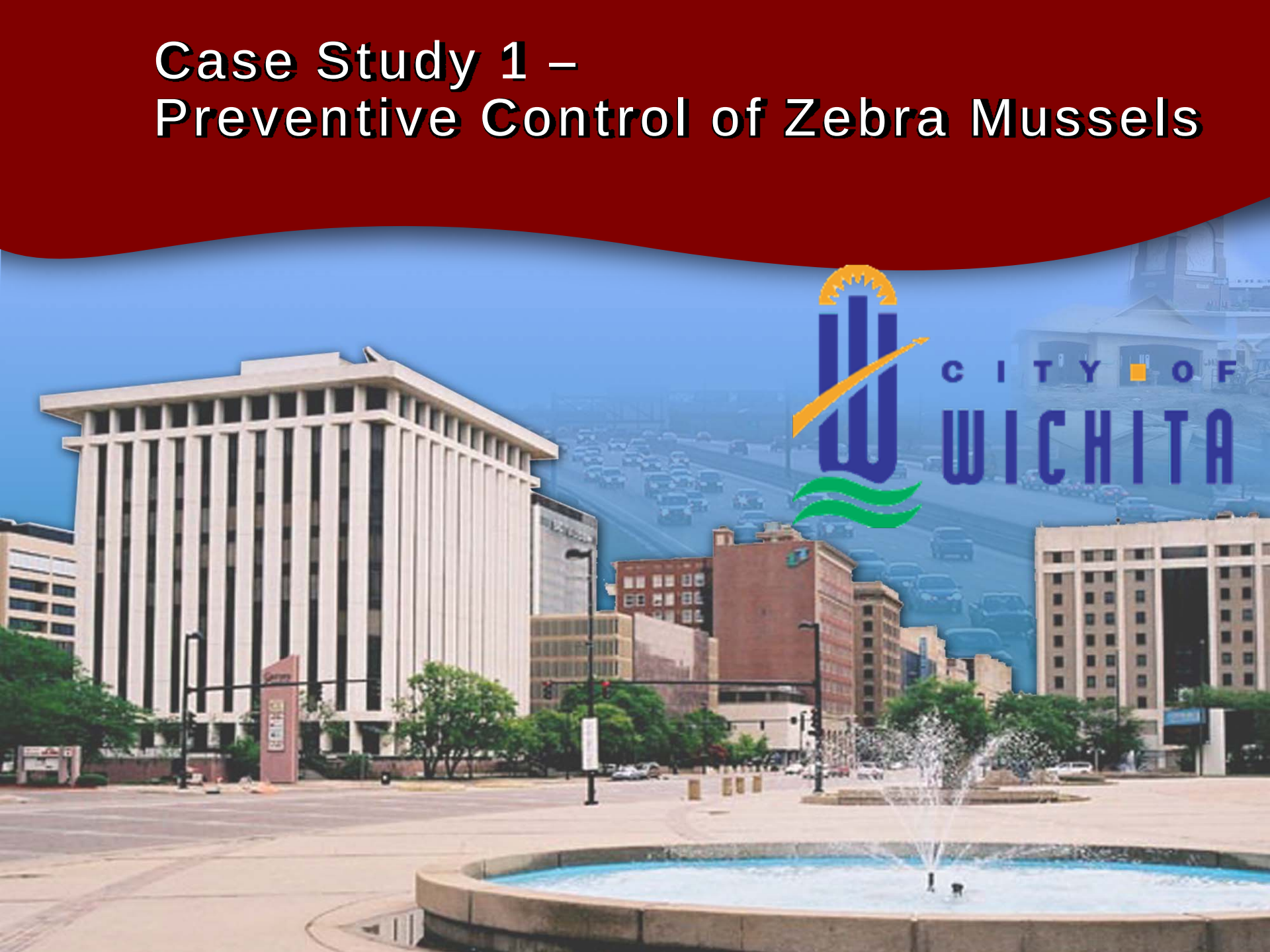
Cost Impacts

- Monitoring
- Capital costs for upgrades
- Operational and maintenance costs
  - Treatment
  - Replacement of damaged equipment
  - Interruption of normal operations

~$100 million per year

Round 3 (taking on the challenge)

Case Study 1 – Preventive Control of Zebra Mussels

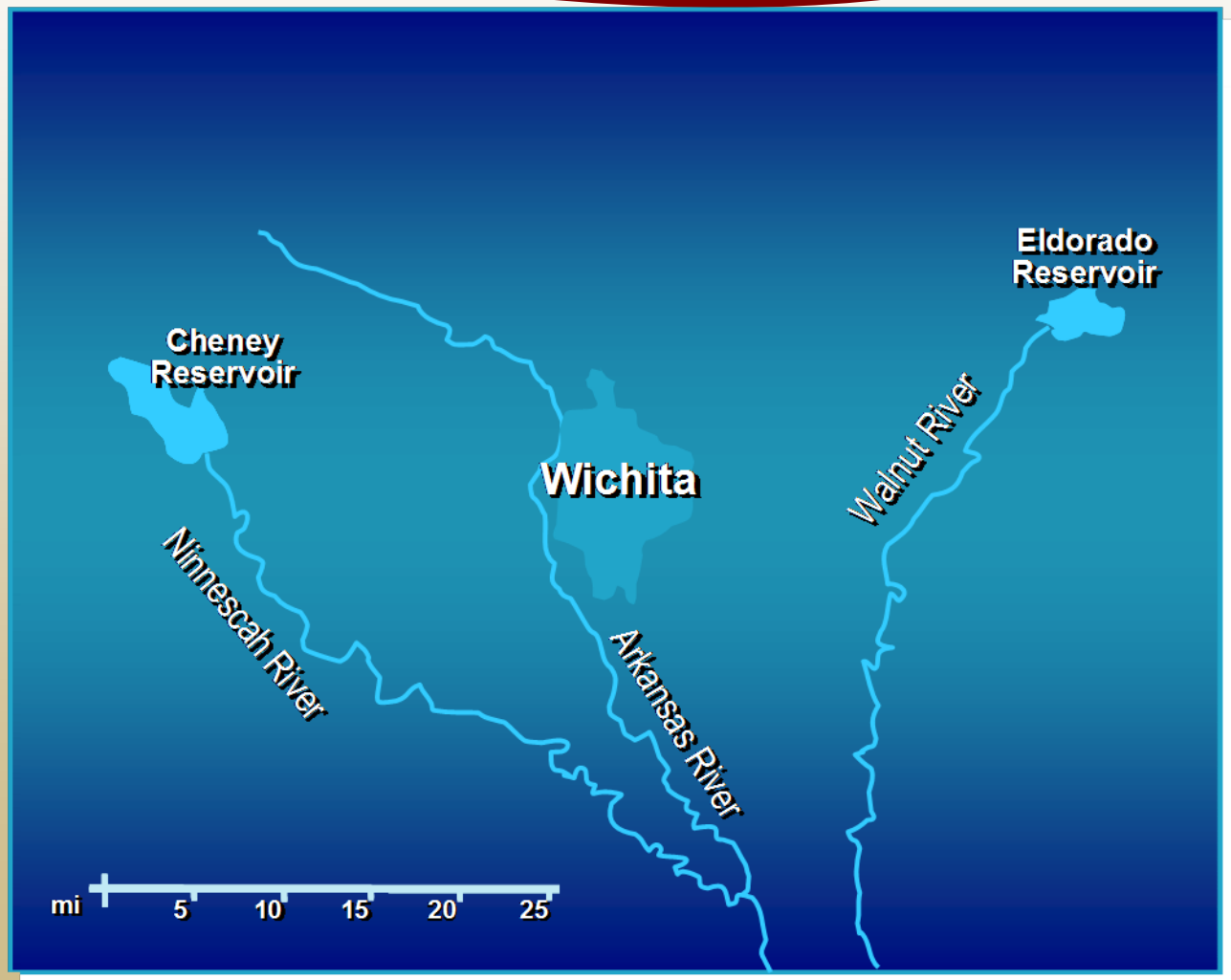


Zebra Mussels Found in El Dorado Reservoir—near city's source

Kansas infestation first discovered in 2003

Wichita's Major Water Source Threatened by El Dorado Infestation

- El Dorado and Cheney Reservoirs are major recreational sites for Wichita residents
- Cheney Reservoir provides 50% of Wichita's drinking water



Wichita Evaluated Several Control Strategies

- Preventive control averts (or delays) arrival of zebra mussels
- Proactive treatment prevents attachment of veligers or translocation of adult organisms
- Reactive treatment controls population of adult organisms at level that can be tolerated by infrastructure

Preventive Measures First Step to Control Zebra Mussels

- Public education
- Stronger state regulations on non-native invasive species
- Seasonal boat inspections
- Decreased access points
- Monitoring program

Preventing Veliger Attachment and Adult Translocation Selected as Second Barrier

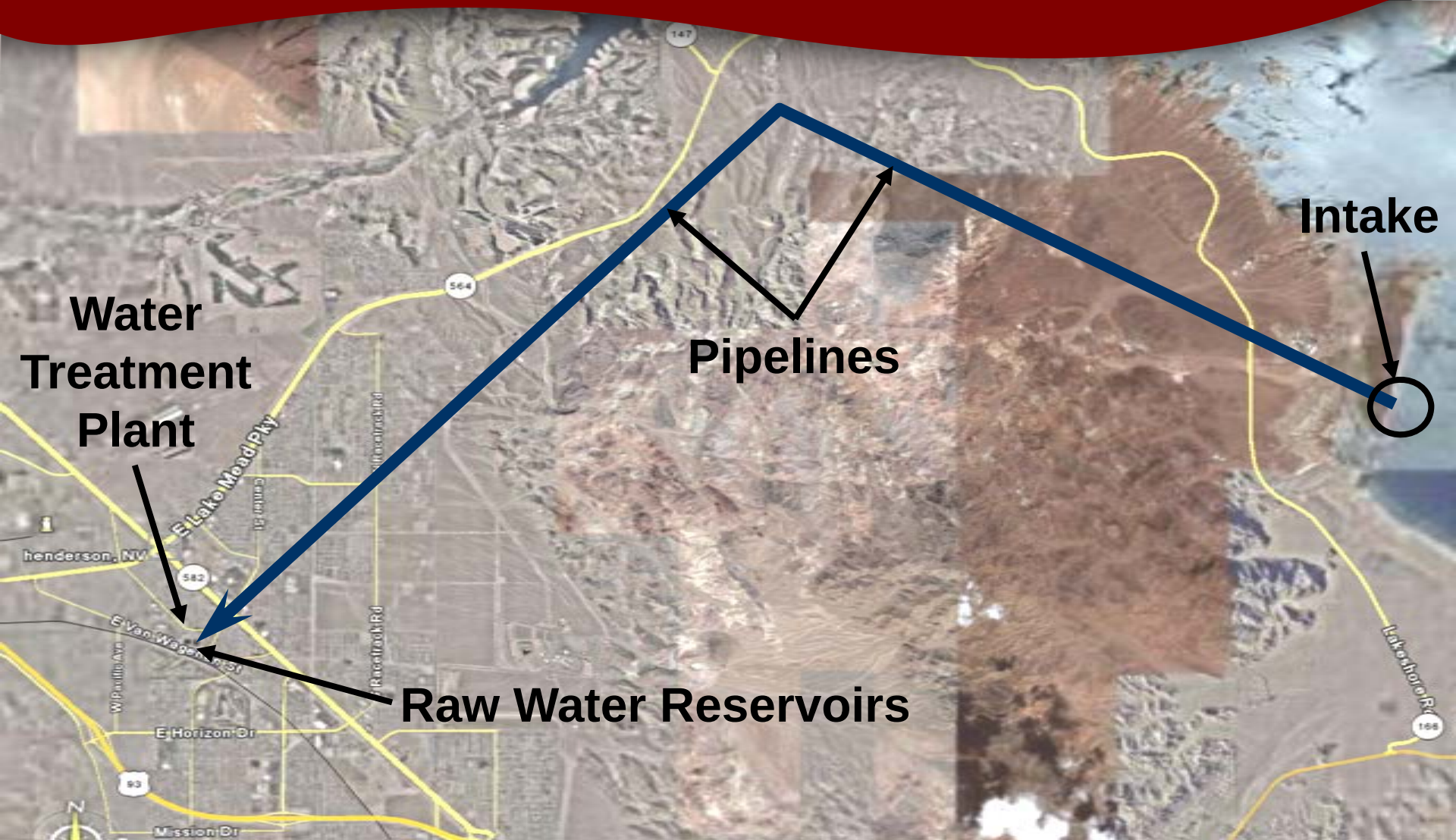
- Physical mechanisms
  - Copper-nickel alloy on screens
  - Bank filtration
  - Manual removal
  - Electric shock waves
  - Accept some loss of capacity
- Chemical systems
  - Oxidizing chemicals (chlorine compounds)
  - Non-oxidizing chemicals (polymers)

Summary of Wichita Approach

- First step is to prevent spread of Zebra Mussels to Cheney Reservoir
- Contingency plan is to install chloramine treatment system at reservoir intake

Case Study 2 – Proactive Control of Quagga Mussels

Henderson's Raw Water System Comprised of Four Key Components



Potential Solutions for Intake and Pump Stations Focused on Adults

- Copper-nickel screen material
- Periodic screen cleaning
- Chemical control for pump stations

Appropriate Approach for Pipelines Depends on Capacity

- 10+ miles of 40-inch Pipelines
  - Annual desiccation and periodic pigging if excess hydraulic capacity exits
  - Chemical control if hydraulic capacity issues or control of adults required

Protection of Raw Water Reservoirs

- Semi-continuous chlorination practiced, but improvements recommended
- Annual cleaning and desiccation

Water Treatment Plant Currently Protected

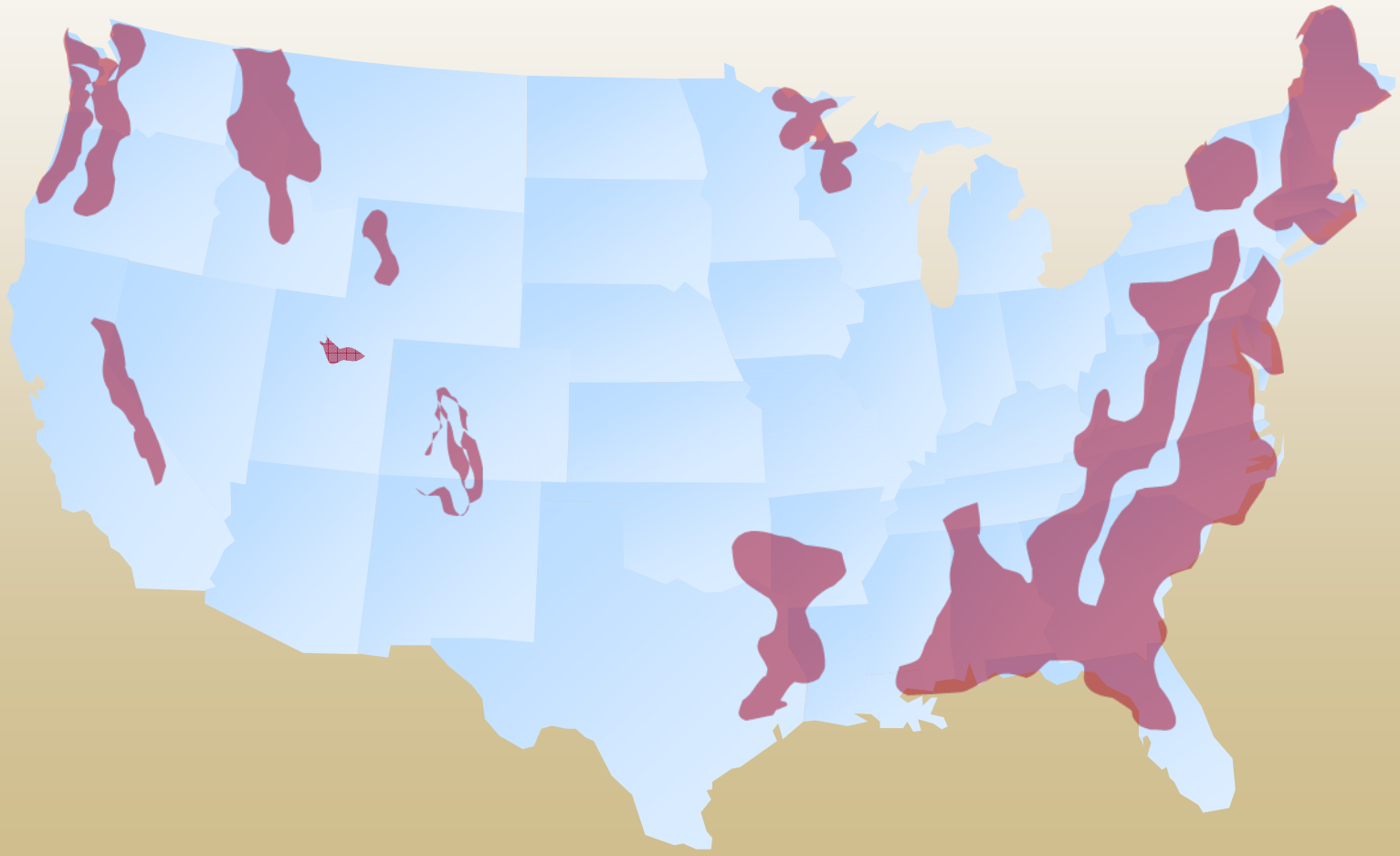
- Continuous prechlorination currently practiced and should be maintained

Summary of Henderson Approach

- Periodic mechanical removal of adults where feasible – intake screens, pipelines, raw water reservoir
- Continuous chemical treatment to kill veligers and prevent translocation of adults – pump stations, water treatment plant

Round 4 (Northwest bound?)

Will low calcium levels protect most of the Northwest?

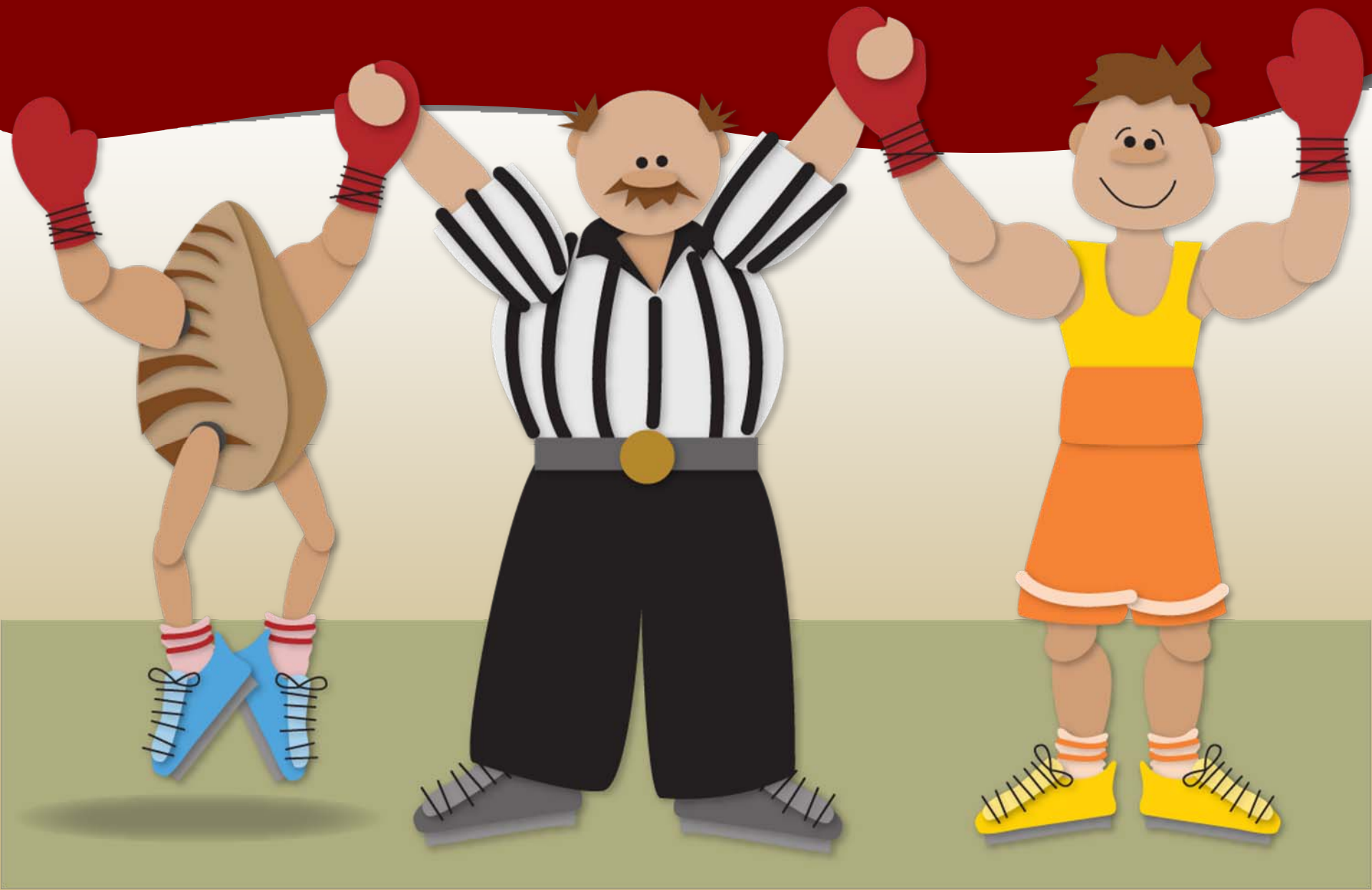


Will low calcium levels protect most of the Northwest?

< 12 mg/L Ca

Highly Adaptable
(adjusted to warmer waters of Mississippi River Delta)

And the winner is ...



Questions