



Zebra and Quagga Mussel Update

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Zebra and Quagga Mussel Update

- Origins and Spread through the U.S. and Canada
- Basic Biology
- Engineering and Ecology

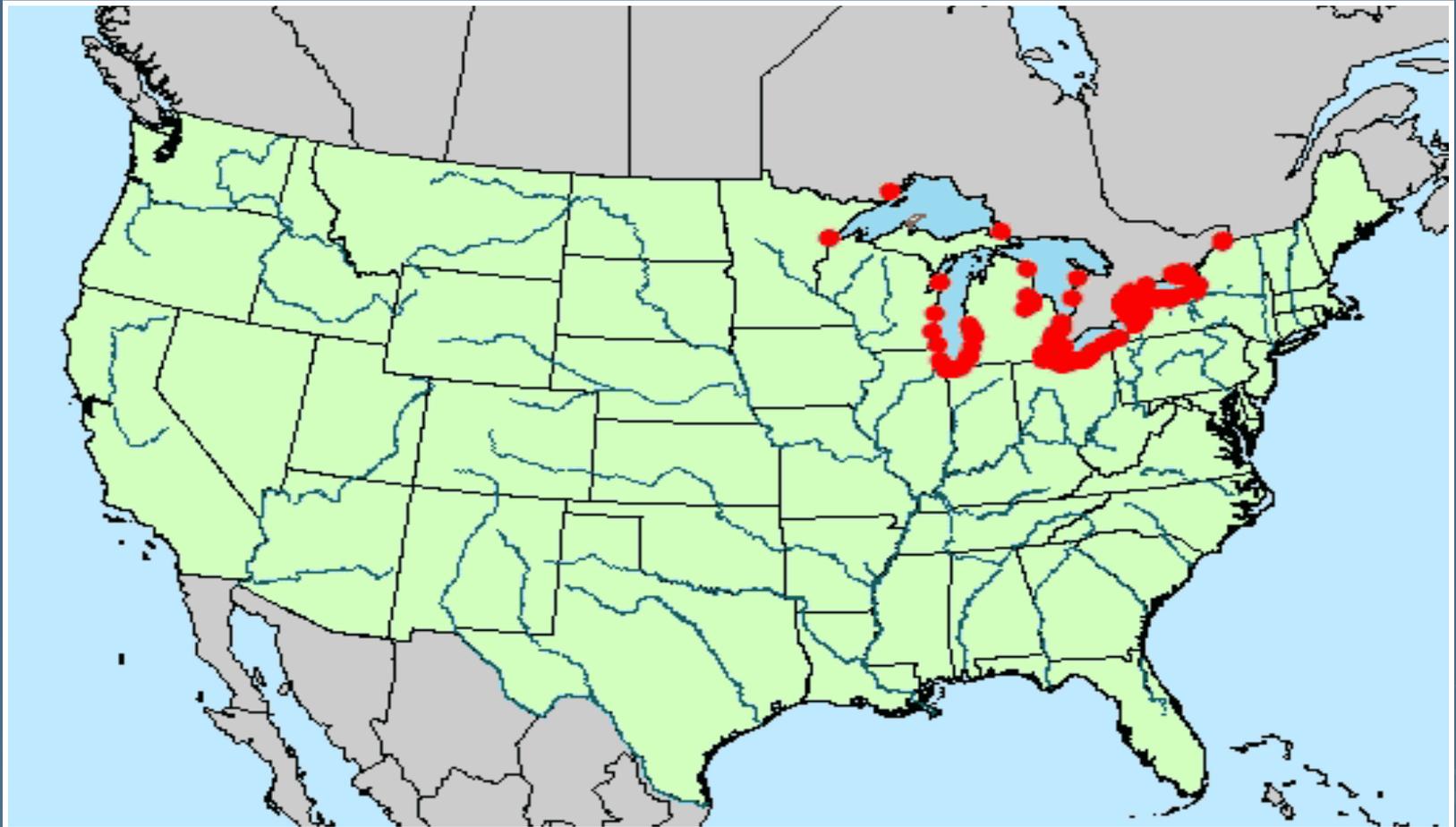
Origins- Lake St. Clair 1988



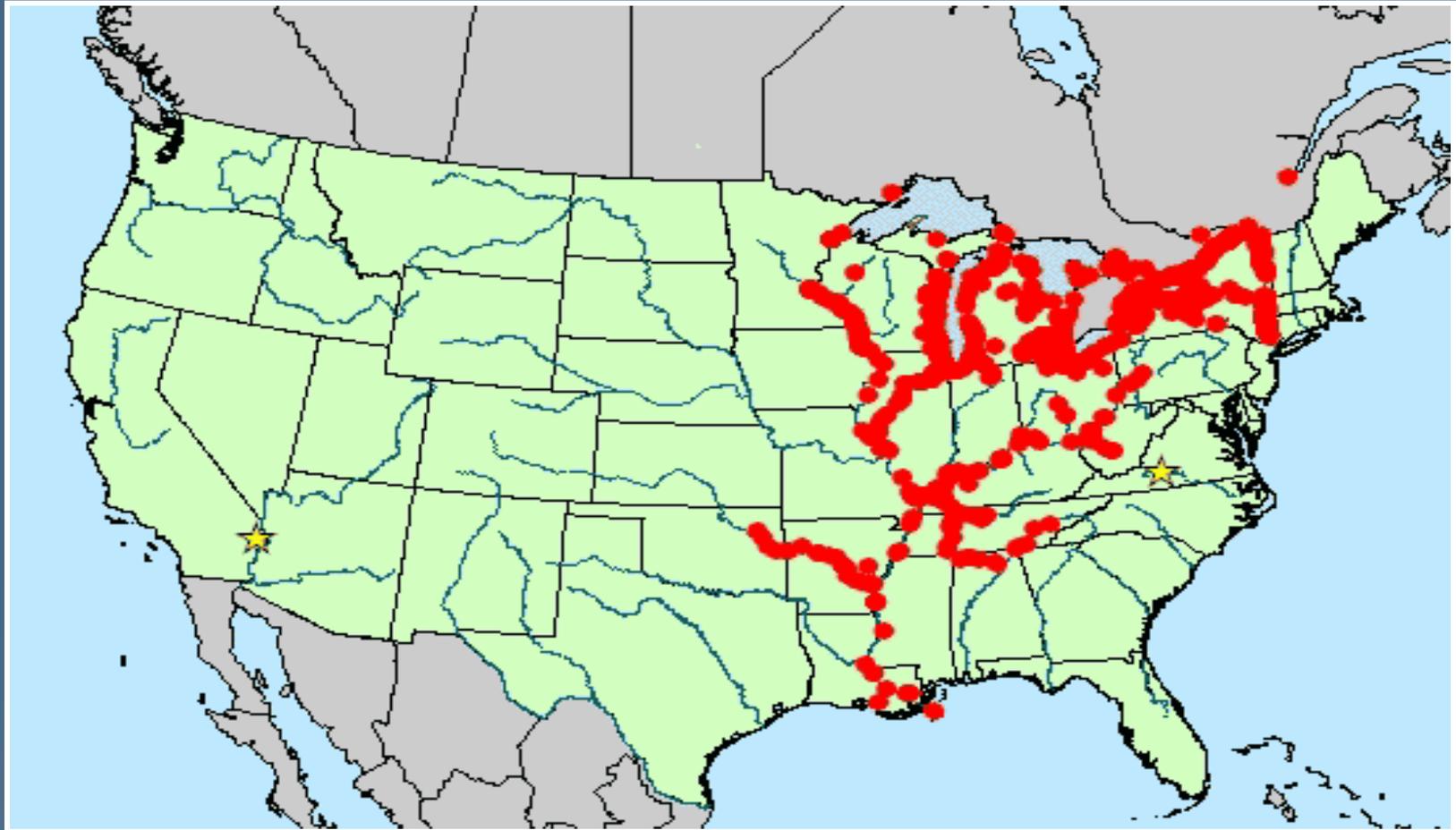
Zebra Mussel Distribution 1988



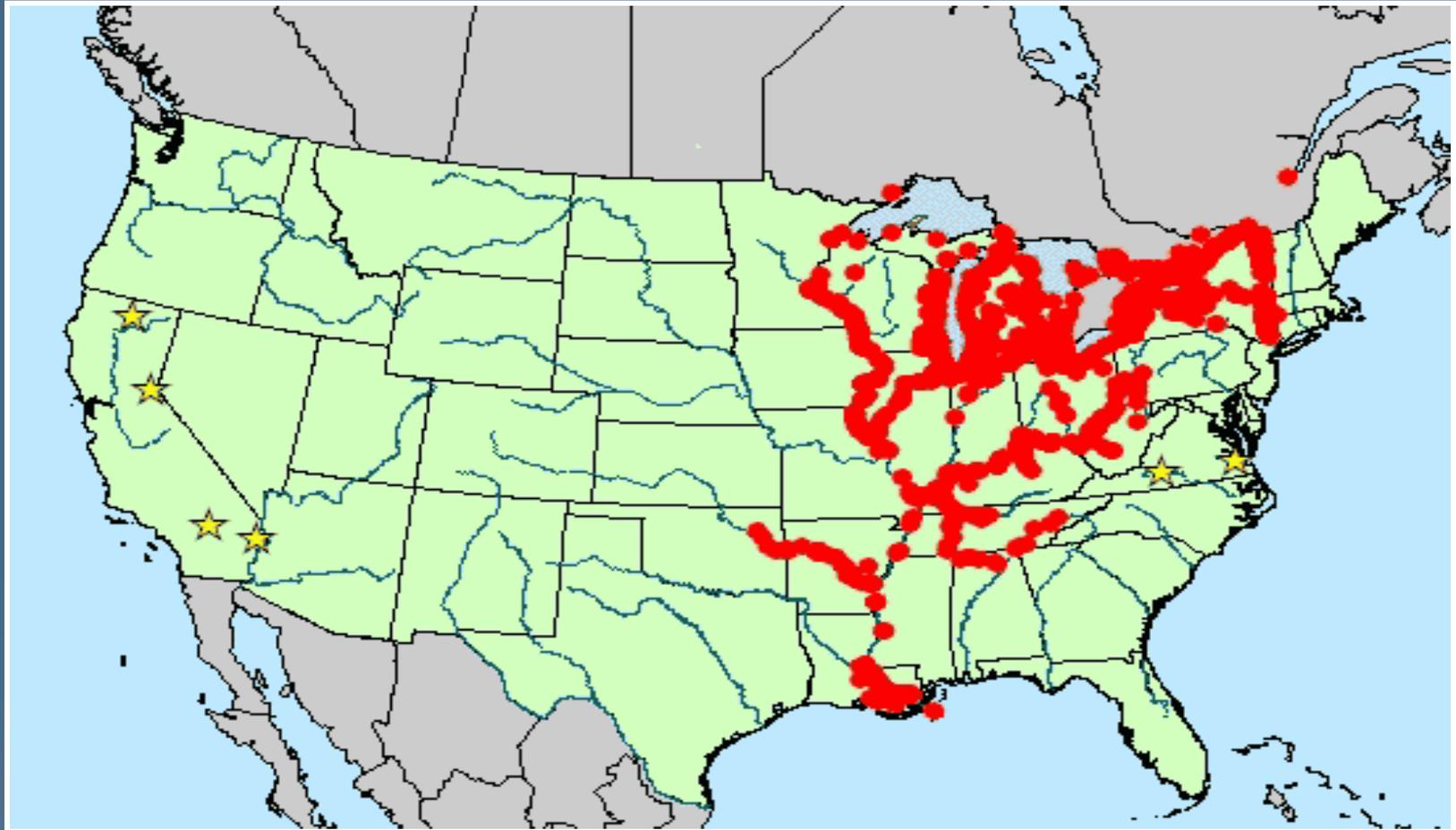
Zebra Mussel Distribution 1990



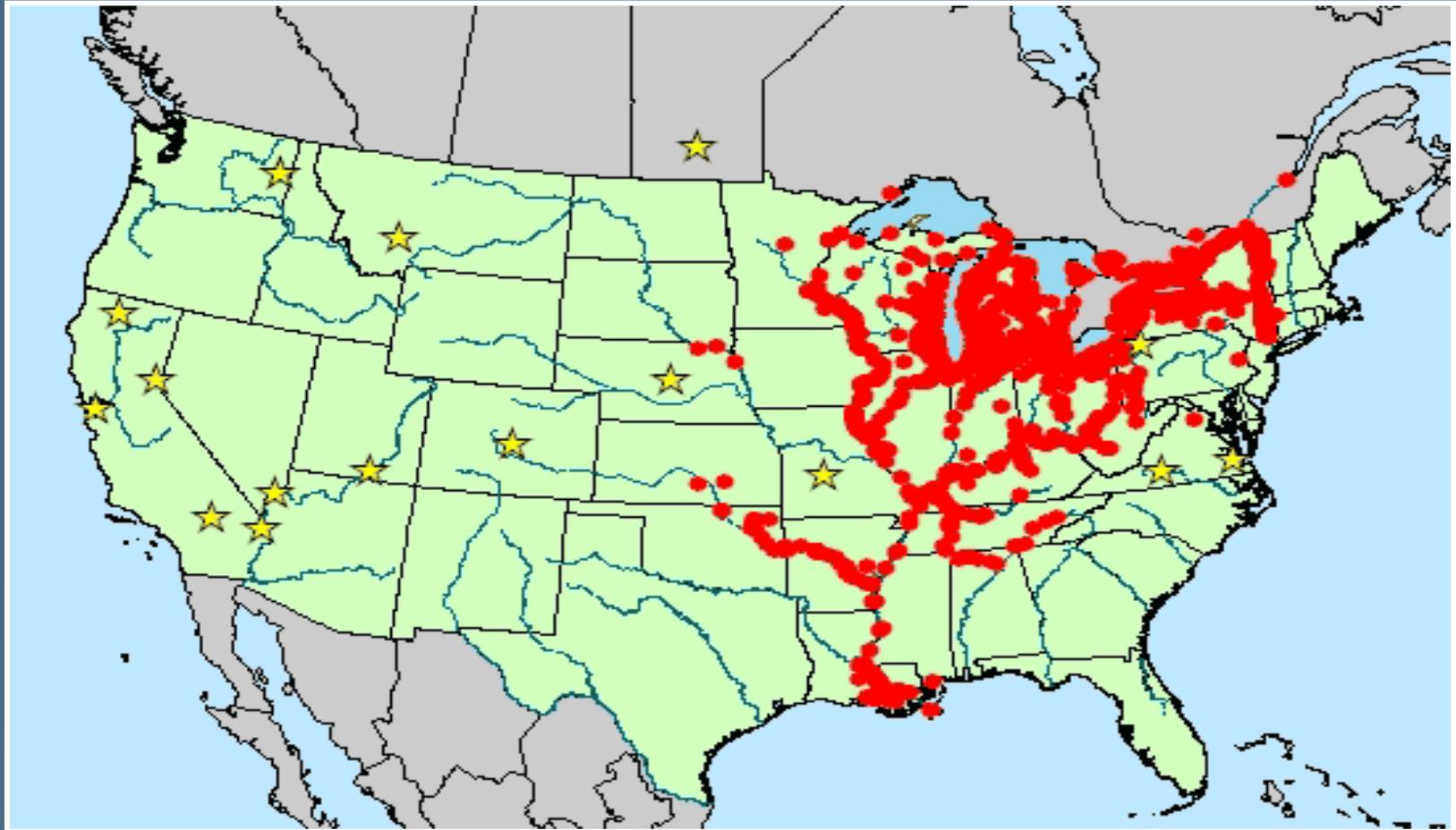
Zebra Mussel Distribution 1994



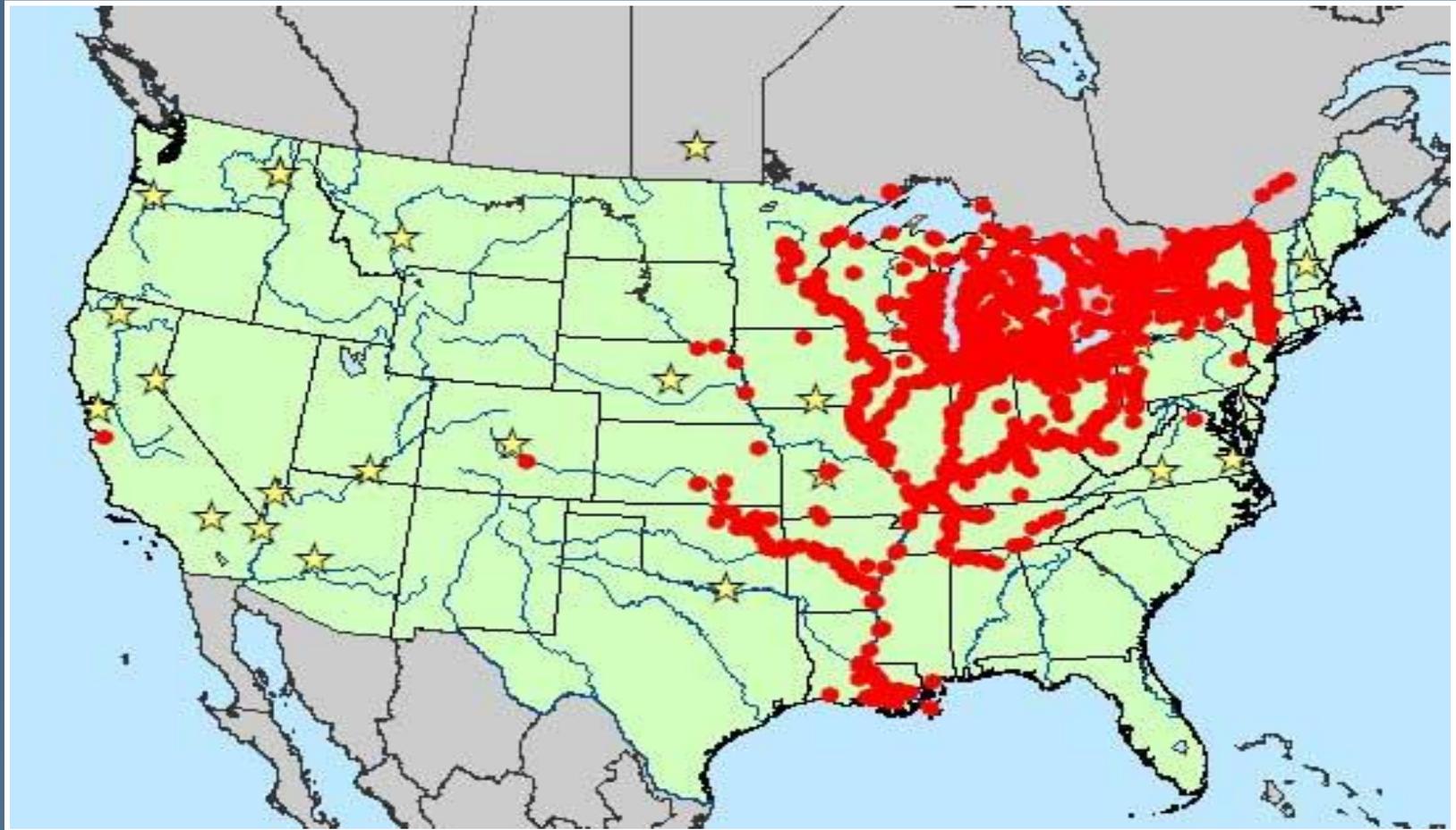
Zebra Mussel Distribution 1998



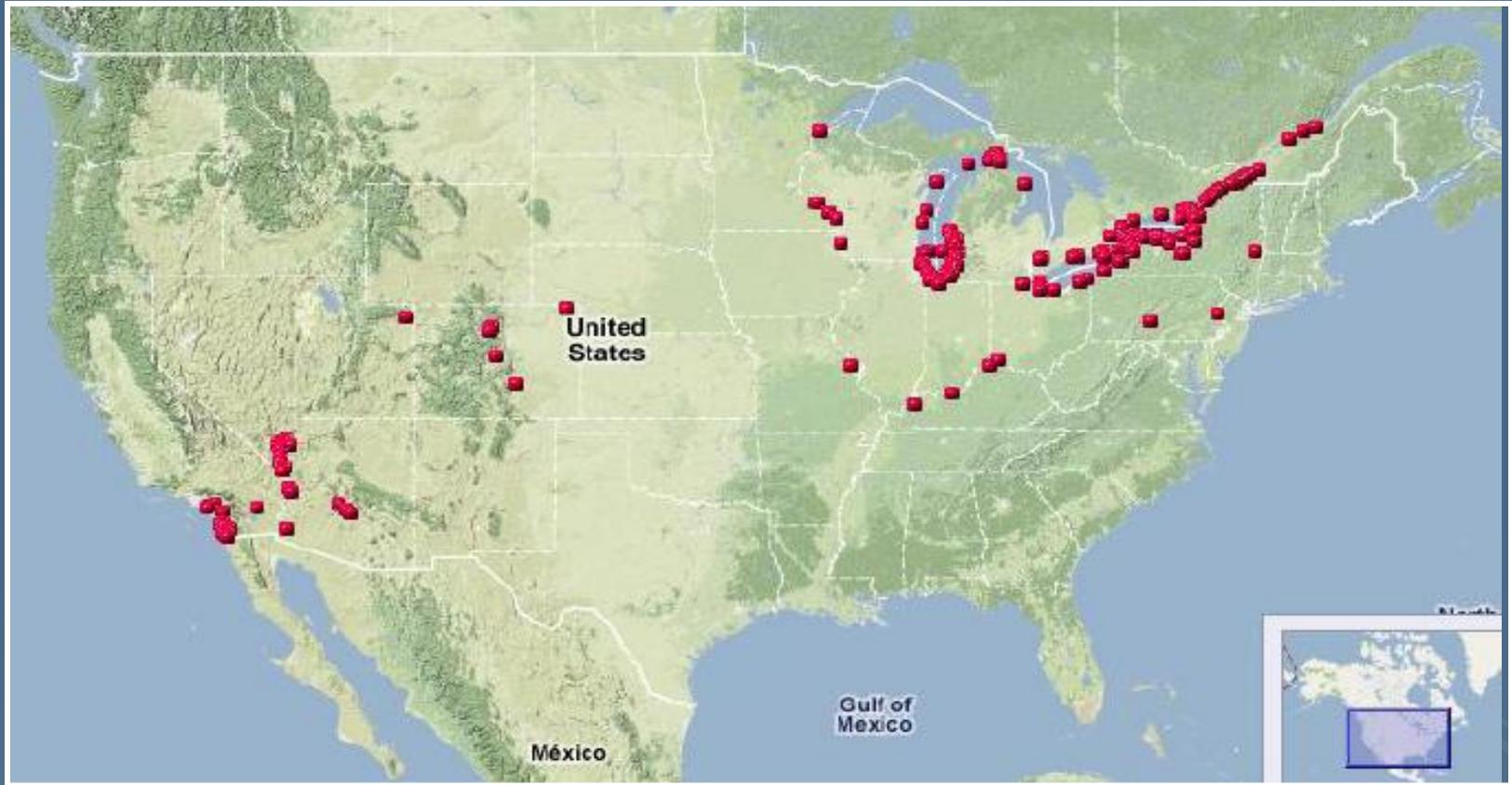
Zebra Mussel Distribution 2004



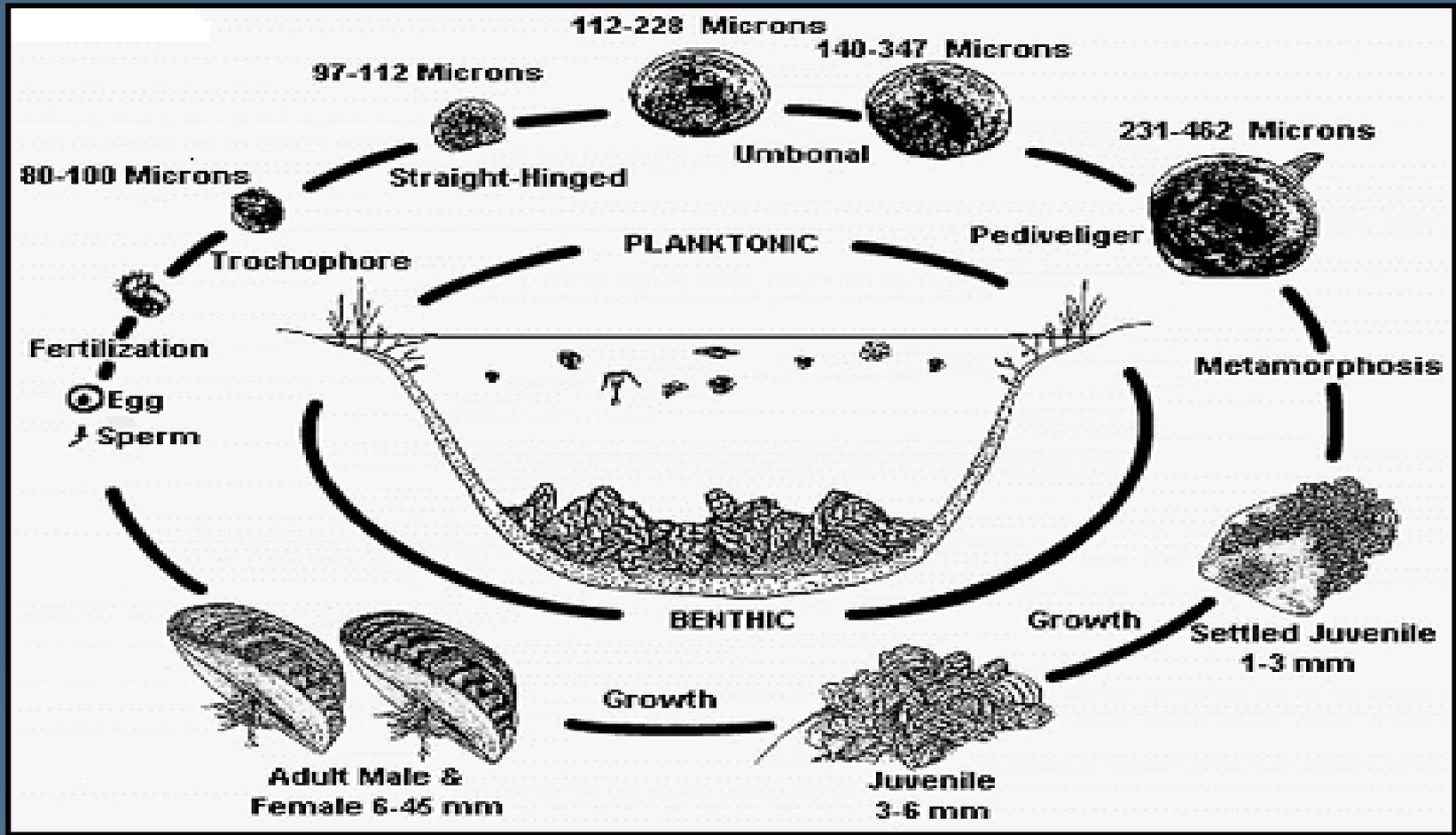
Zebra Mussel Distribution 2008



Quagga Mussel Distribution 2009



Some Basic Biology



Environmental and Nutritional Requirements

- Gametes are released in the spring when water temperatures raise above 12°C.
- Planktonic gamete to settled juvenile takes 8 – 240 days.
- Minimum calcium concentration ~ 20 mg/L but “healthy” growth needs 40mg/L.
- Optimum pH range between 7 and 9.
- A minimum dissolved oxygen of 4.6 mg/L for growth – more is better.

Why do we care?

- Zebra and Quagga mussels grow along and into the intakes and outlets of water system and power generation facilities.
- Significantly altered the Great Lakes ecosystem in the last 20 years.









Control Measures

- Chlorine (Cl_2) 0.5 – 1.0 mg/L
 - ✓ Advantage - Kills the mussels and gives contact time.
 - ✓ Disadvantage – Its chlorine gas, additional disinfection byproduct testing.

Control Measures

- Bleach (NaClO) 0.5 to 1.0 mg/L
 - ✓ Advantages- Kills the mussels, relatively inexpensive and easy.
 - ✓ Disadvantages – Additional disinfection byproduct testing and it will cause feed lines to clog with calcium carbonate when the water is sufficiently alkaline.

Control Measures

- Potassium Permanganate 0.5-0.75 mg/L
 - ✓ Advantages – Kills the mussels
 - ✓ Disadvantage – Its potassium permanganate

Control Measures

- Chlorine Dioxide (ClO₂)
Continuous Dose – 2.0 mg/L
 - ✓ Advantages – Kills the mussels
 - ✓ Synthesized In-situ

Control Measures

- Copper based coatings on intake barriers
 - cribs, screens, etc.
 - ✓ Mussels do not like the coating.
 - ✓ Veligers will float past barriers and reside on interior uncoated surfaces. Not appropriate when salmonid fish species are present.

Other Control Measures

- Electromagnetic fields
- Sonic waves
- Hot water ($> 40^{\circ}\text{C}$)
- Desiccation
- Depletion of D.O. (close to 0 mg/L for effectiveness)
- Reproductive intervention
- Nutrient depletion

Environmental Issues

- Redistribution of nutrients and pollutants in the water and soils of a lake.
- Clarifies water in a lake allowing greater sunlight penetration.
- Increased algae blooms

Environmental Issues Related Pest(s)

■ Round Gobie

- ✓ Came to Lake Erie in the early '90s in ballast water. Native to the Caspian basin – like zebra mussels.

■ Cladophora

- ✓ A green algae that grows to a high density in the clarified lake water then dies and mats on mussel beds.

Environmental Issues Related Pest(s)

■ Clostridium Botulinum

- ✓ An obligate anaerobe that grows in the anoxic cladophora mats on zebra mussel beds. Mussels die in the mats and round gobies eat the mussels.
- ✓ Gobies are infected with the Clostridium and are eaten by the bass. Gobies and bass are eaten by shore birds and they all die.

Geographical Distributions

- Zebra Mussels are found (mostly) in the Great Lakes and Mississippi River system.
- Quagga Mussels are more prevalent in the western states.
- Northwest waters seem to have been spared to date.
- Why?

Summary

- The mussels are here and we will just have to learn to live with them.

- No Magic Bullets

Questions and Discussion

