

# Comparative sensitivity of glochidia and juvenile mussels to ammonia, metals, and chlorine

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# Overview

- Endpoints measured in laboratory toxicity tests with freshwater mussels
- Comparison of glochidia and juvenile mussel toxicity data for ammonia, copper, chlorine, zinc, lead, and cadmium
- Recommendations for future studies

# Endpoints

## ➤ Glochidia:

- 24- and 48-h survival
- Valve closure with addition of NaCl

## ➤ Newly-released juvenile mussels:

- 48- and 96-h survival (foot movement)
- 96-h growth (shell length)
- 10-d survival and growth (with or w/o feeding)

# Endpoints (cont)

- 2-month-old juvenile mussels:
  - 48- and 96-h survival (valve closure?)
  - 10- to 28-d survival and growth (feeding)
- Adult mussels:
  - Acute (4-d) or chronic (up to several months)
  - Survival, growth, bioaccumulation
  - Biomarkers
    - Exposure (metallothionein and metals)
    - Effects (glycogen as a measure of energy reserves)

# Ecological relevance of toxicity tests conducted with glochidia

- A1.2.2 “For most species, the duration of a toxicity test conducted with glochidia should be up to 24 h with survival measured at 6 and 24 h. Control survival is typically >90% at the end of 24-h toxicity tests conducted with glochidia. Longer duration toxicity tests with glochidia (e.g., 48 h) can be conducted as long as control survival >90% is achieved. However, toxicity tests conducted for >24 h with glochidia may not be as ecologically relevant.”

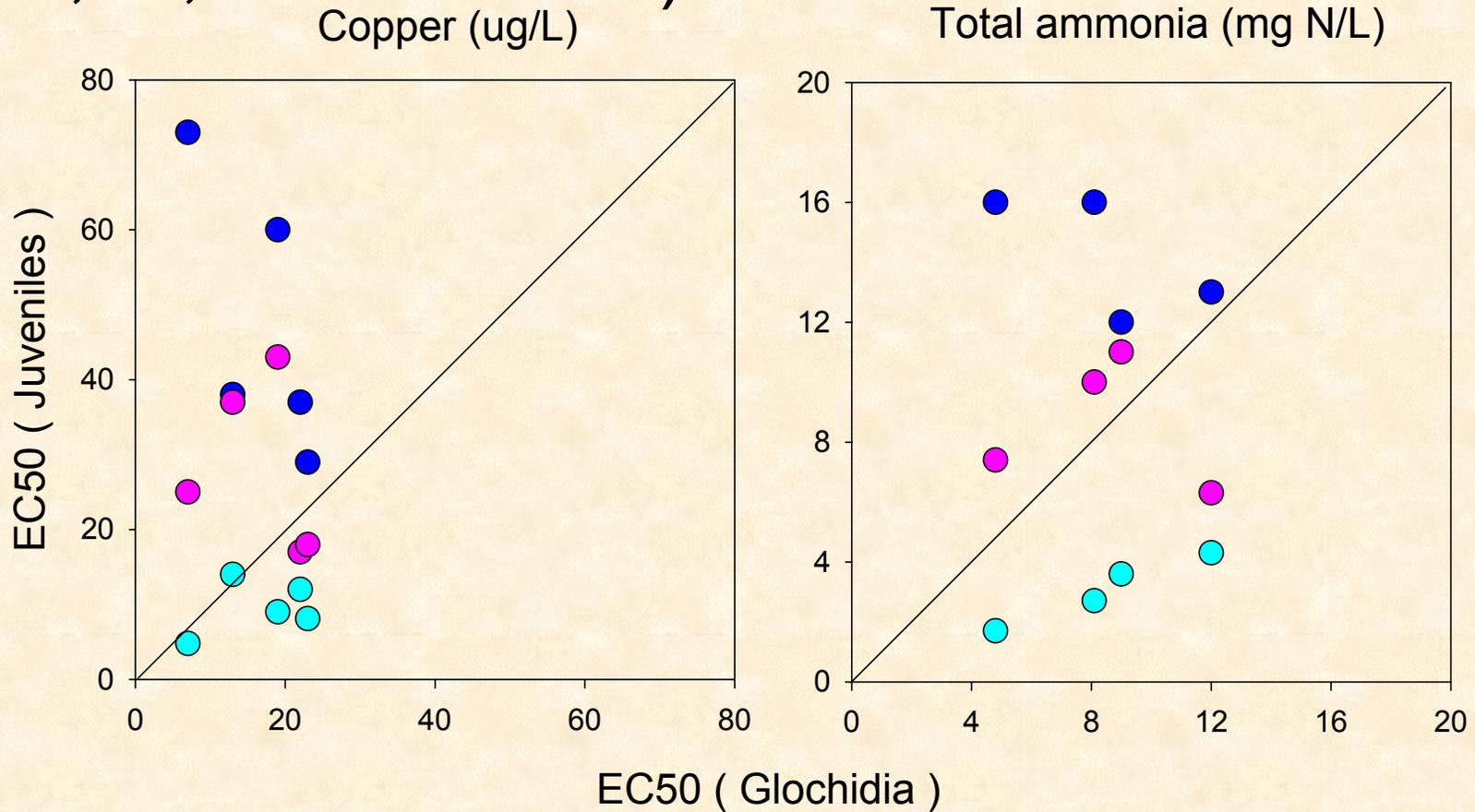
# Ecological relevance of toxicity tests conducted with glochidia (cont)

- A1.2.5 “The relatively short duration of toxicity tests with glochidia is based on the relatively short duration between release of glochidia into the water column and encystment on the host and is based on the relatively short survival time of glochidia after isolation from the female mussel (Table A1.2). If the life history of the glochidia for a particular species is not known (e.g., the host required for encystment or how long glochidia released from a female mussel can remain in the water column before encysting on a host), it might be appropriate to conduct toxicity tests with glochidia for longer than 24 h as long as 90% control survival can be achieved at the end of the test.”

# Use of glochidia toxicity data

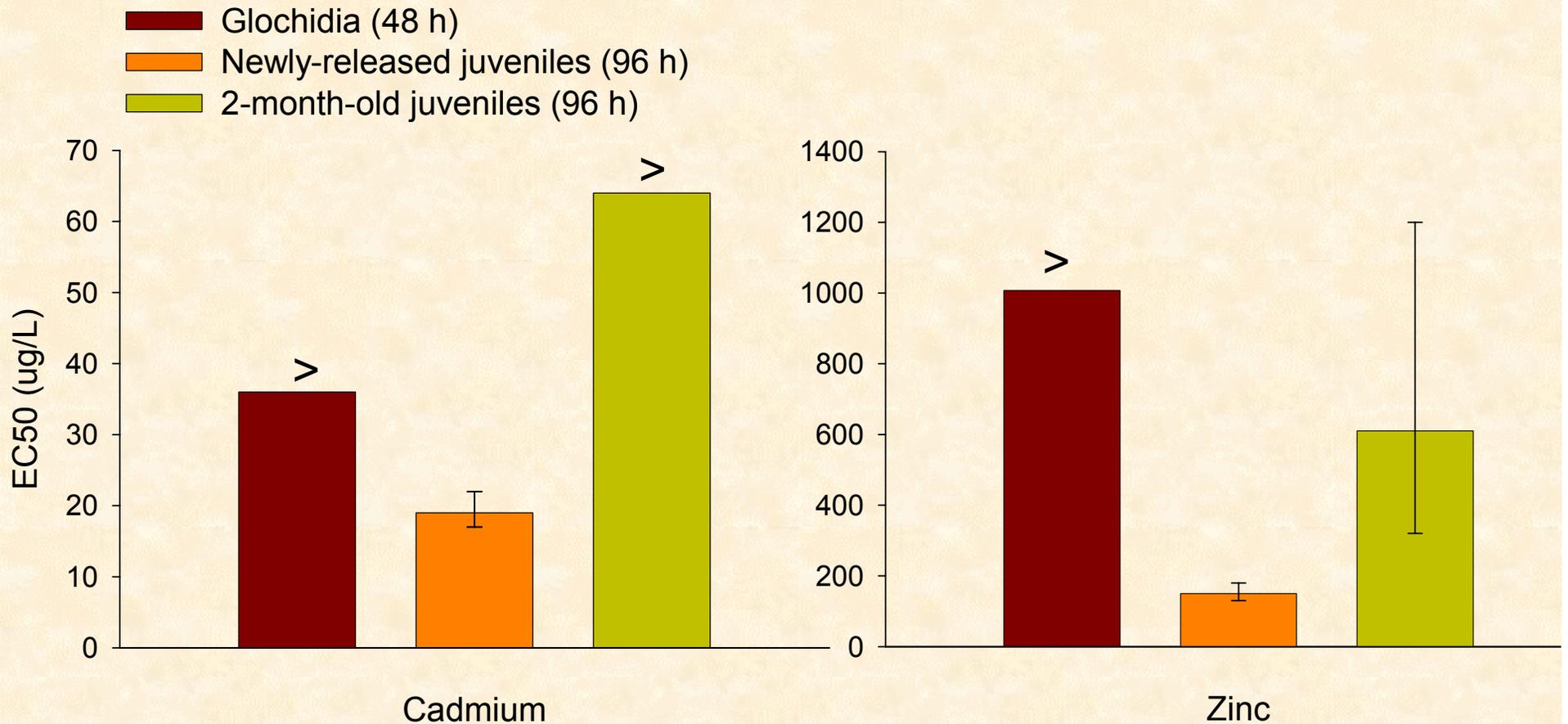
- Evaluate sensitivity of a critical life stage in the life history of a mussel
- Predict toxicity in other life stages that may be more difficult to test
  - Methods for transforming juveniles unknown for many mussel species

# Copper and ammonia EC50s for glochidia (2-d tests) vs. newly-released juveniles (2-, 4-, or 10-d tests)

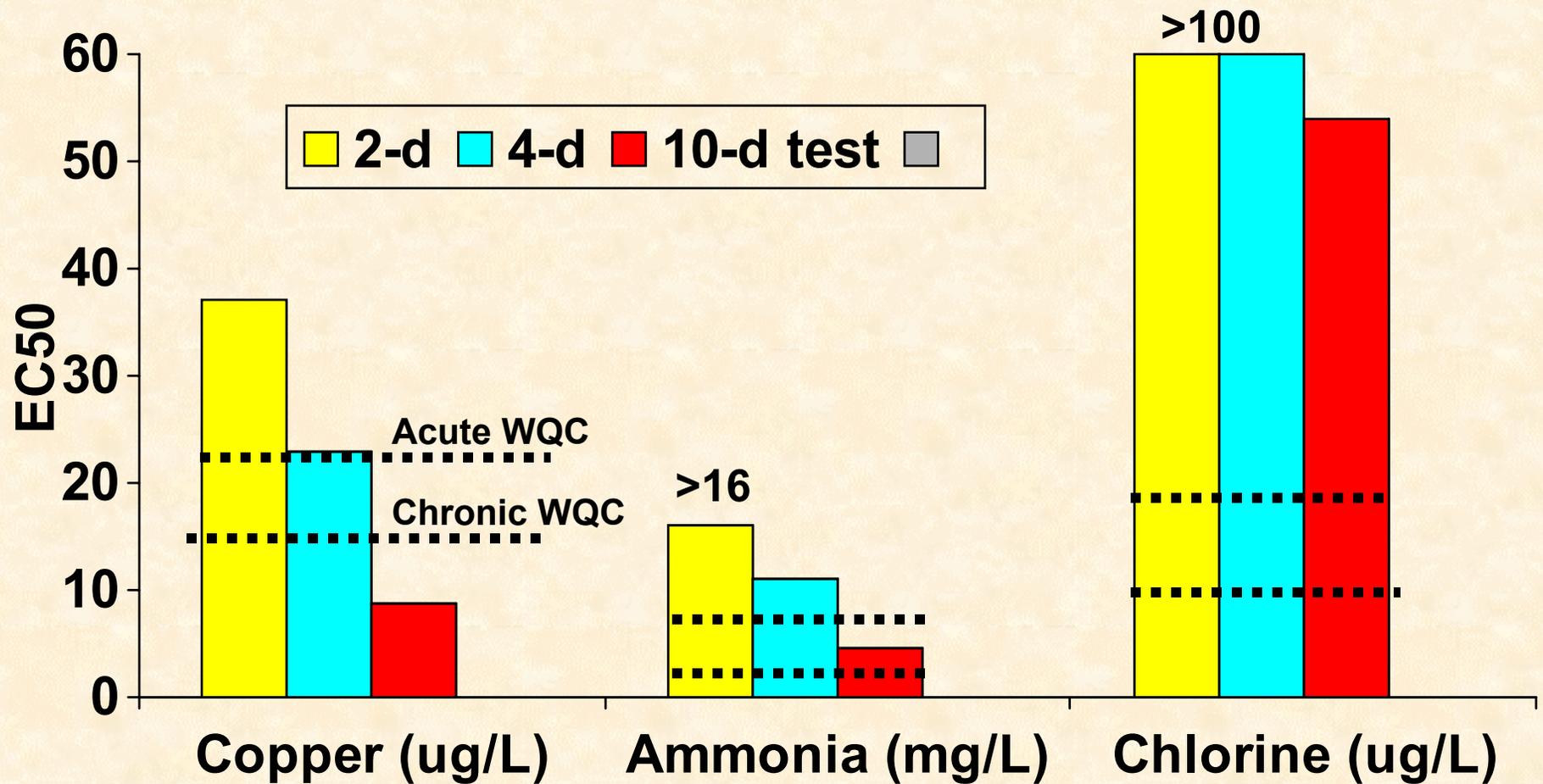


- Juvenile 2-d tests
- Juvenile 4-d tests
- Juvenile 10-d tests

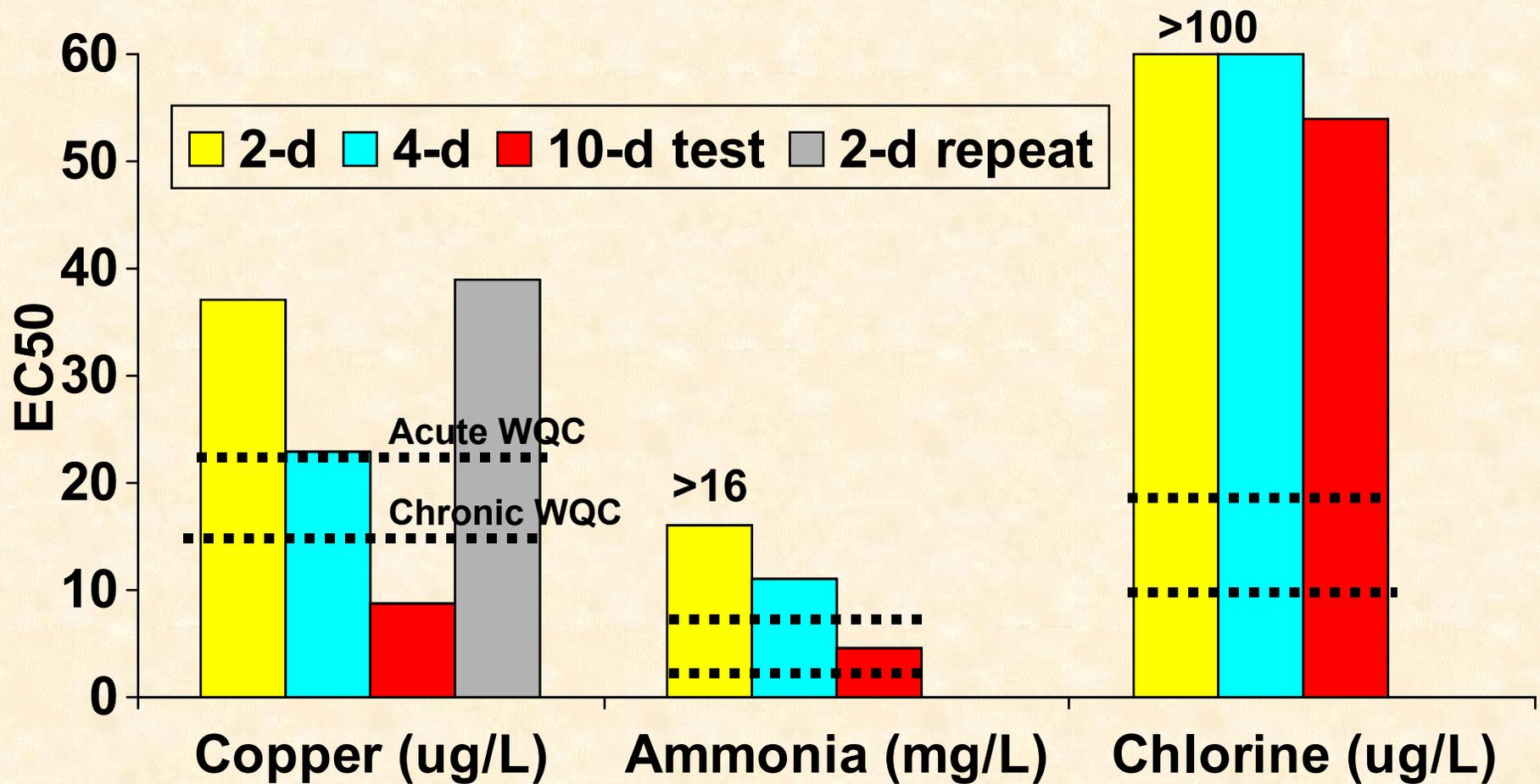
# Cadmium and zinc EC50s for glochidia (2-d tests) vs. juveniles (4-d tests)



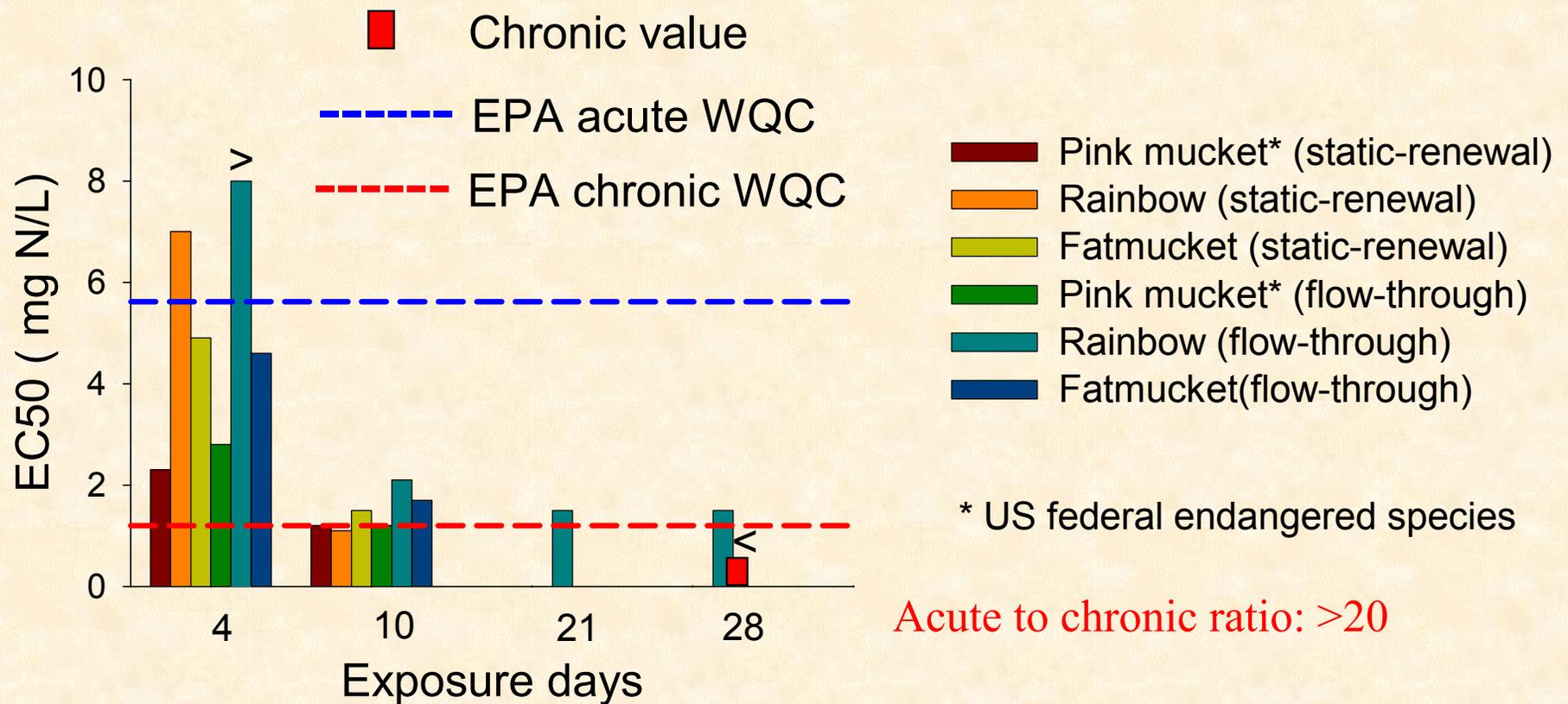
# Juvenile: Neosho mucket



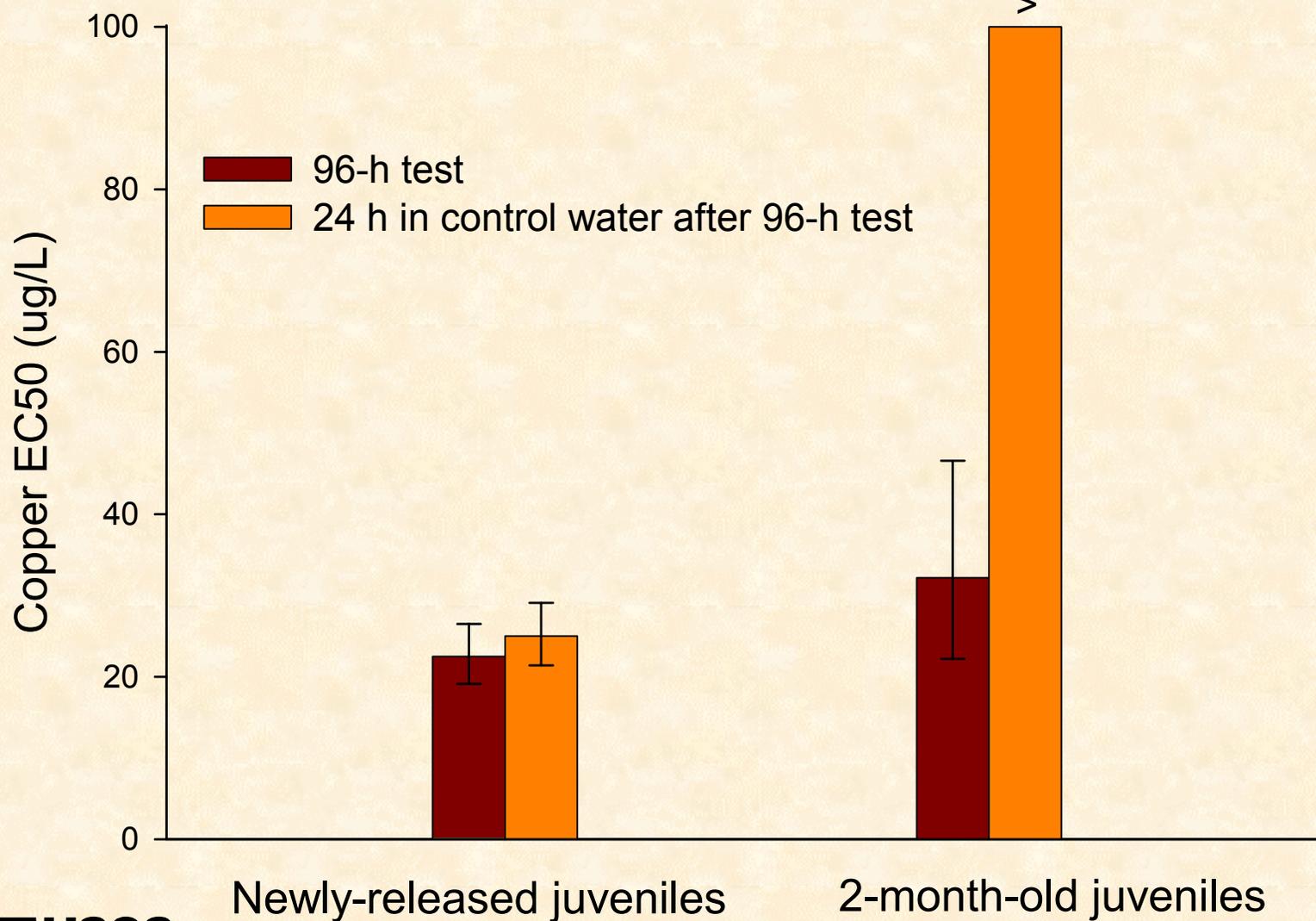
# Juvenile: Neosho mucket



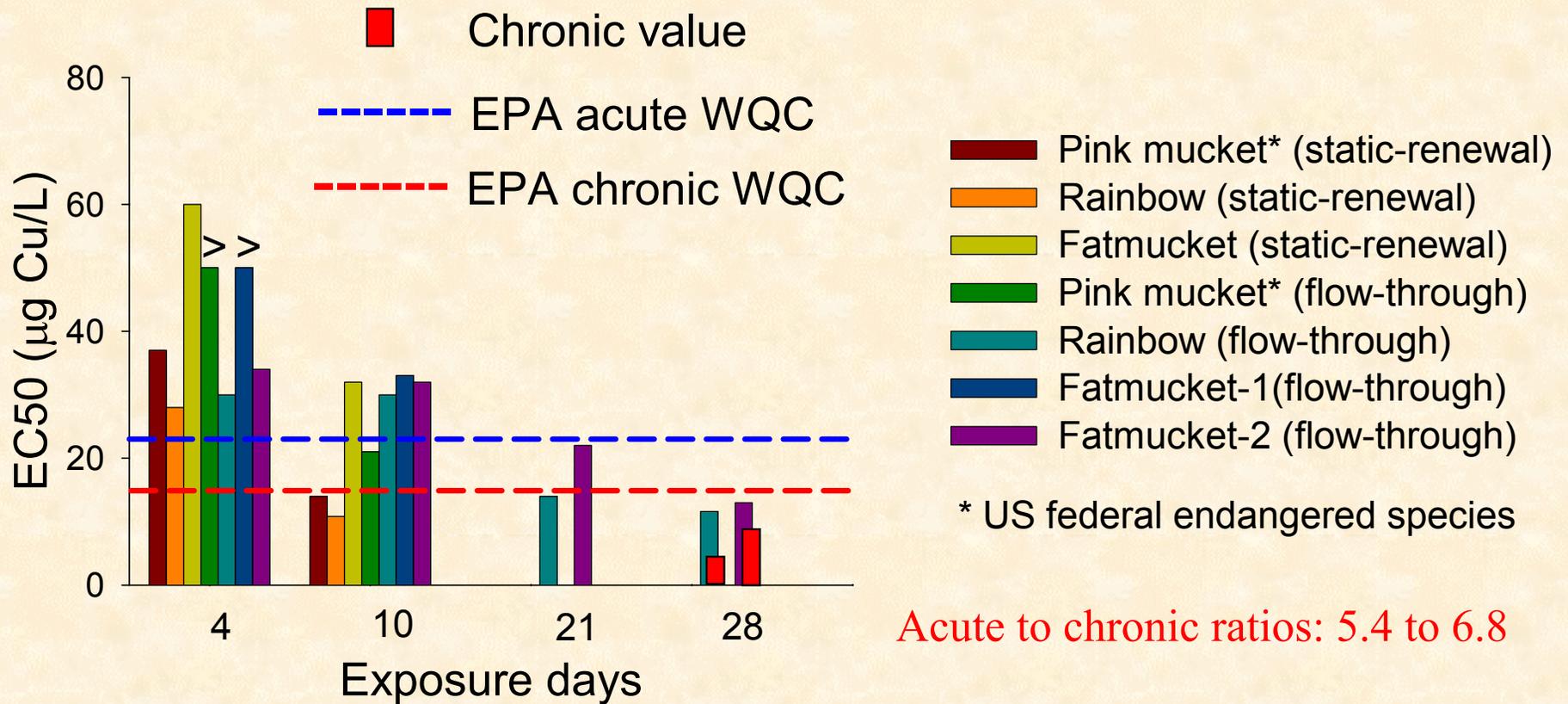
# Total ammonia EC50s and chronic values for 2-month-old juvenile mussels



# Acute copper toxicity to newly-released juveniles and 2-month-old juvenile fatmucket



# Copper EC50s and chronic values for 2-month-old juvenile mussels



# Conclusions

- Copper, ammonia, chlorine:
  - 48-h glochidia toxicity data predictive of 96-h juvenile mussel responses
- Lead, zinc, cadmium:
  - 48-h glochidia toxicity data not predictive of 96-h juvenile mussel responses
- 2-month-old juveniles:
  - Slightly less sensitive compared to newly-released juveniles to copper
  - Able to avoid 96-h copper exposure ( $EC_{50} < LC_{50}$ )

# Conclusions

- Additional research needed evaluating relative endpoint sensitivity in acute or chronic toxicity tests with:
  - Brooding females
  - Glochidia
  - Newly-released juveniles and older juveniles
  - Adult mussels
  - Quality and quantity of hosts
- Endpoints measured in these exposures should include:
  - Glochidia survival and ability to transform on a host fish
  - Survival, growth and behavior of juvenile mussels
  - Survival, growth, behavior, bioaccumulation, and reproduction of adult mussels