

Does water chemistry limit the distribution of New Zealand mud snails in Redwood Creek, California?

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Outline

- New Zealand mud snails
- Detection and distribution in Redwood Creek
- Lab experiments evaluating limits to distribution
- Other findings for Redwood Creek



New Zealand mud snails

- Biology
 - Effective colonizers
 - Easily transported
 - Tolerant of a wide range of conditions
 - Parthenogenetic



New Zealand mud snails

- Biology

- Effective colonizers
- Rapid population growth
 - 3-6 months to maturity
 - 20-80+ daughters per brood
 - 2-4 broods per year



New Zealand mud snails

- Biology

- Effective colonizers
- Rapid population growth
- Very high population densities
 - Regularly $>100,000$ per m^2 , records of $800,000$ per m^2
 - Potentially exclude native invertebrates
 - Poor-quality food for most fish



Image: WA Dept. Fish and Wildlife

Detection and distribution in Redwood Creek

- First documented in 2008 at nearby sites, 2009 in Redwood Creek estuary



Image: Breck McAlexander

Detection and distribution in Redwood Creek

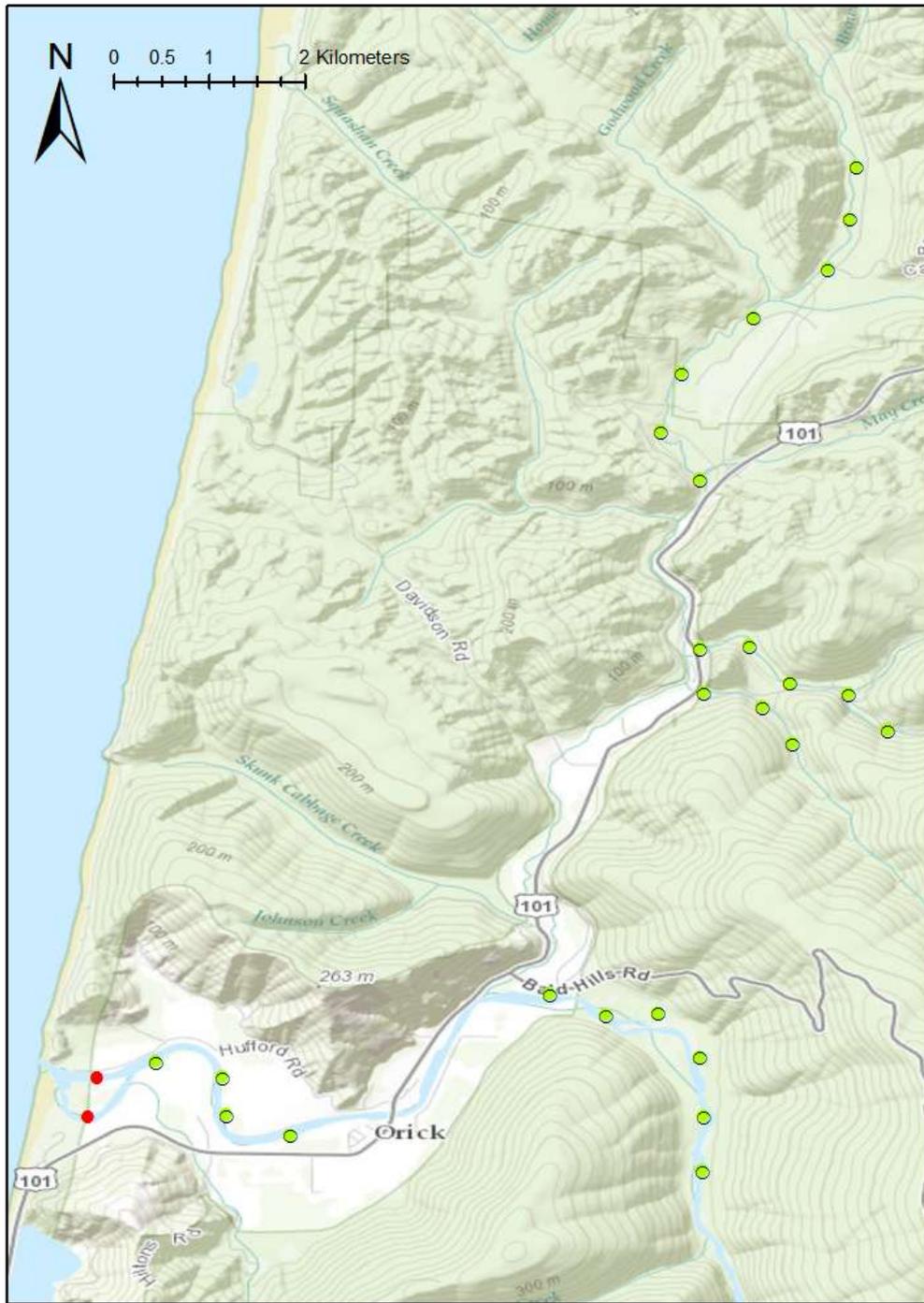
- 2011 and 2012- conducted field surveys to evaluate distribution and habitat associations of mud snails in the Redwood Creek basin

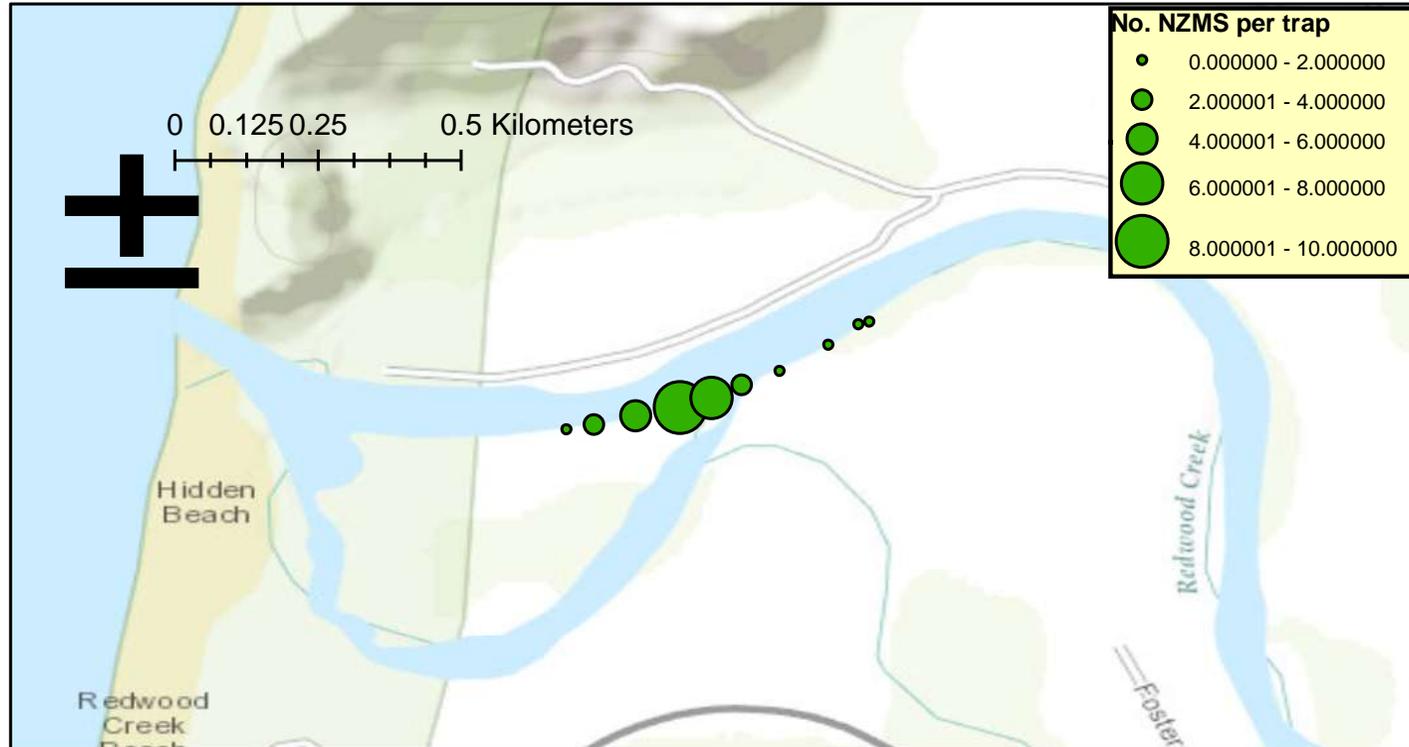


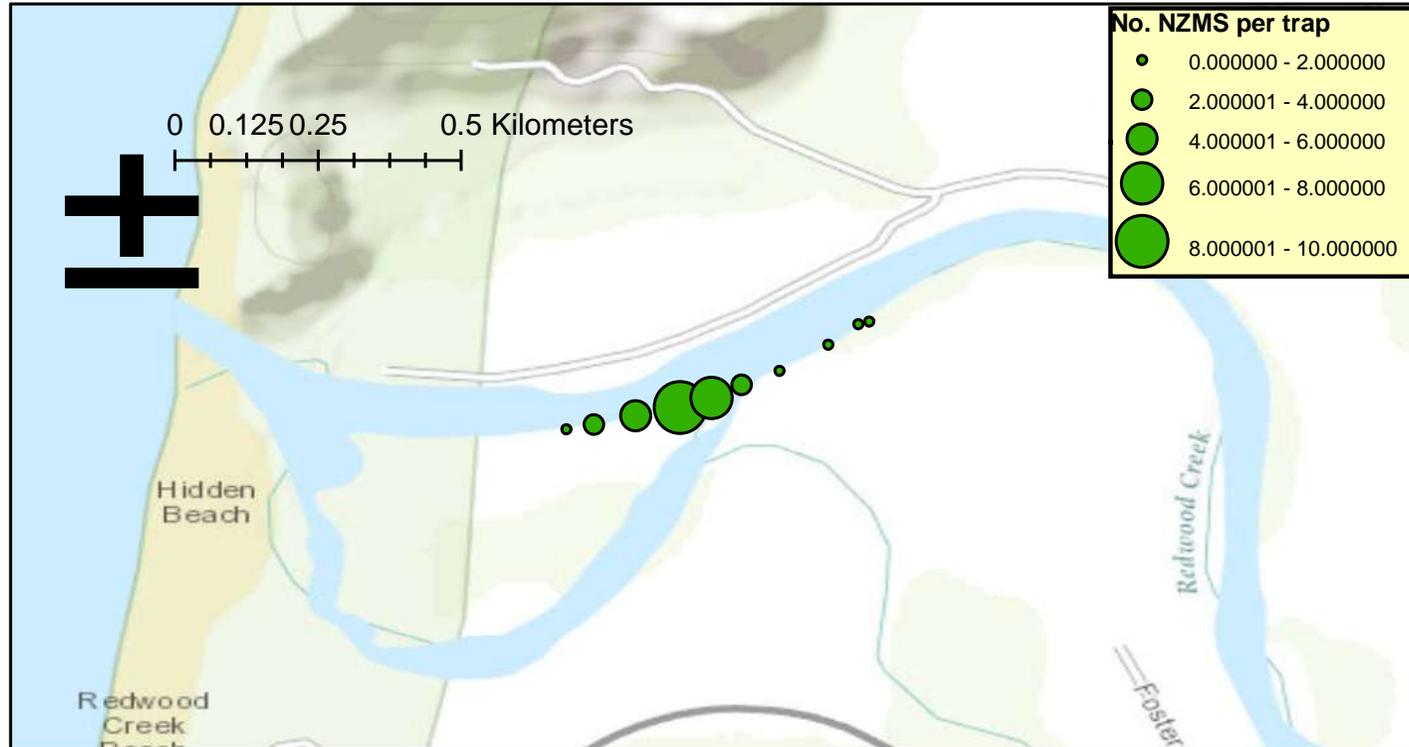
NZMS

Juga









Similar pattern at Maple Creek. What limits mud snail distribution?

Lab experiments evaluating limits to distribution

1. Evaluate snail survival and fecundity when exposed to water from different locations in the Redwood Creek watershed
2. Evaluate effects of water conductivity and calcium concentration with parallel experiments using artificial media



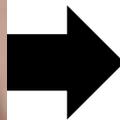
Natural water experiment

- Water from 5 locations
 - Redwood Creek estuary: 150 $\mu\text{S}/\text{cm}$
 - Redwood Creek above Prairie Creek: 140 $\mu\text{S}/\text{cm}$
 - Prairie Creek: 100 $\mu\text{S}/\text{cm}$
 - Lost Man Creek: 75 $\mu\text{S}/\text{cm}$
 - Little Lost Man Creek: 75 $\mu\text{S}/\text{cm}$



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- For each treatment:



X 5

25 total units
125 total snails
Maintained for 120 days

Artificial media experiment

- 6 treatment conditions

Low Ca salt	High Ca salt
20 $\mu\text{S}/\text{cm}$	20 $\mu\text{S}/\text{cm}$
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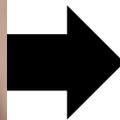
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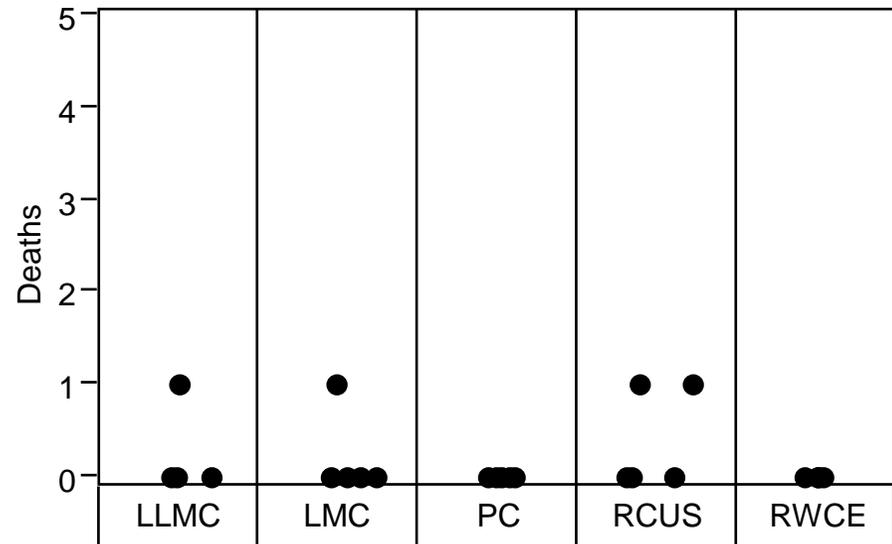


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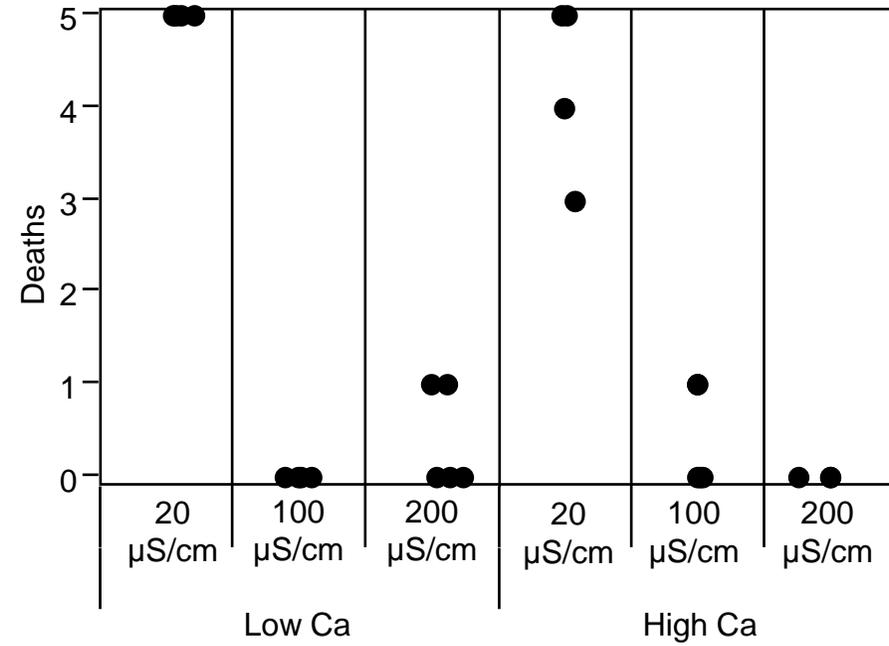
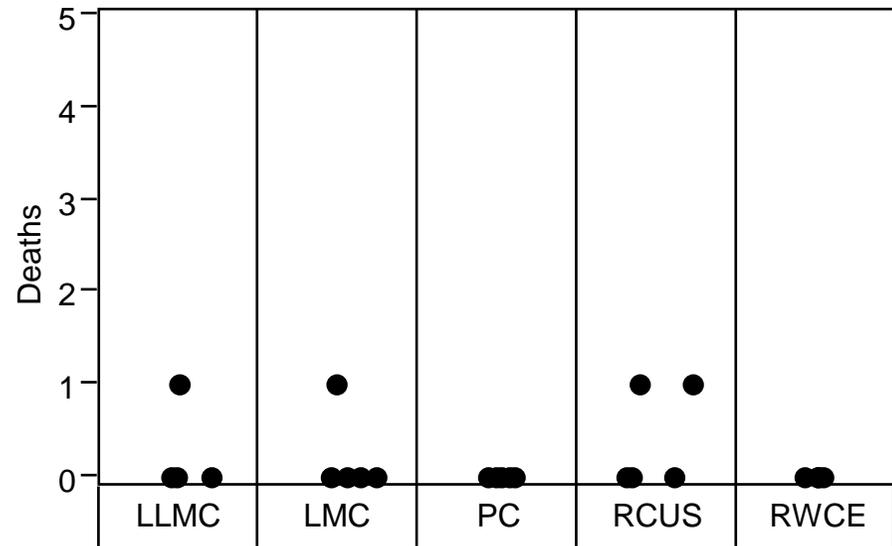
Experimental results

- Deaths



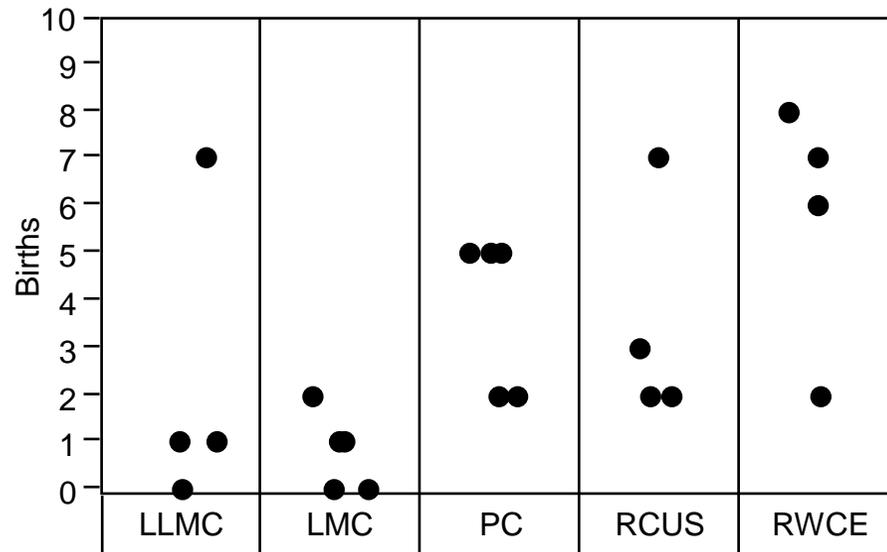
Experimental results

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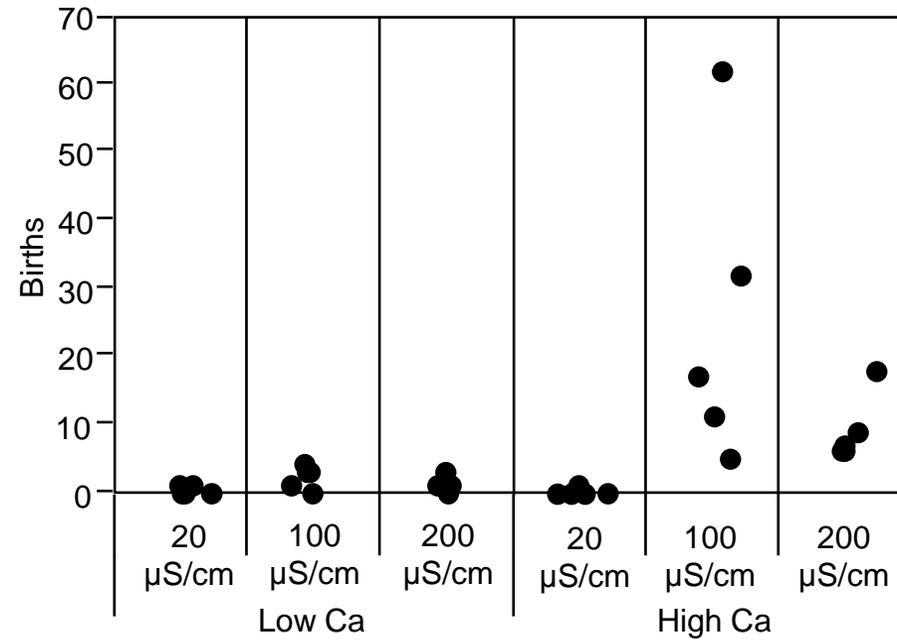
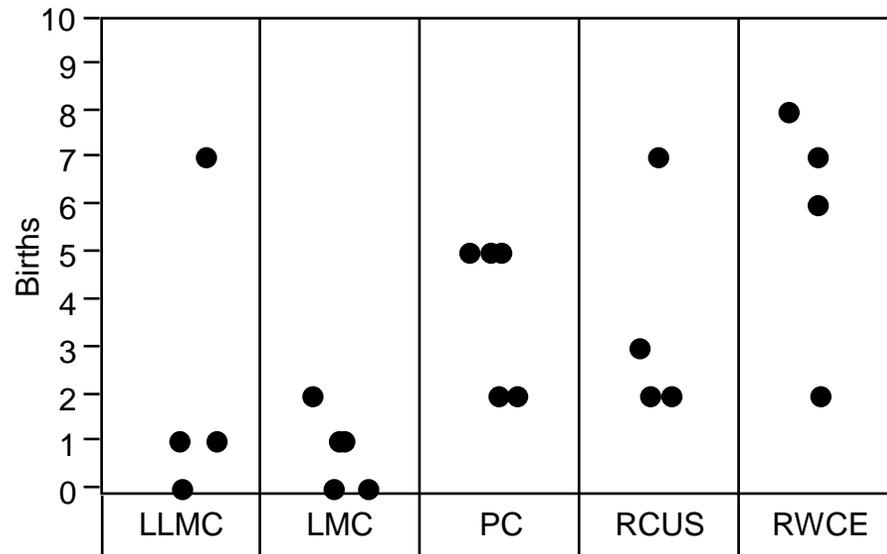
Experimental results

- Births



Experimental results

- Births

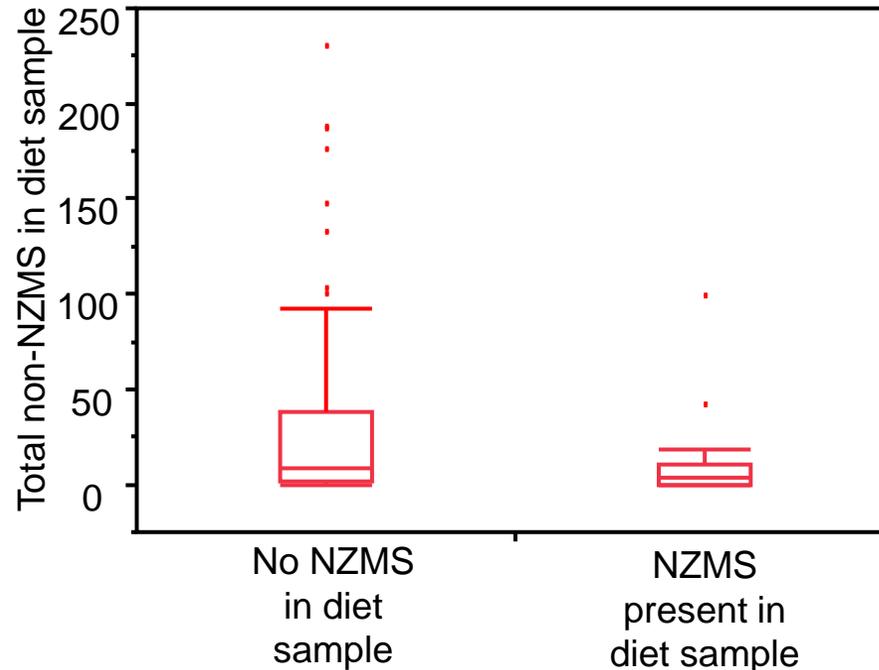


Experimental results

- Snails are hard to kill
 - High survival except at conductivity well below Redwood Creek levels
- Fecundity is low in natural water from Redwood Creek
 - Likely due to Ca limitation
- Water chemistry likely contributes to restricted distribution
 - Interaction with high flows?
 - Temporary?

Other findings in Redwood Creek

- 15% of juvenile steelhead sampled in the Redwood Creek lagoon had mud snails in their stomachs (none in coho or Chinook)
 - Trout that ate snails consumed fewer non-snail prey
 - Most snails recovered from trout guts were still alive



Other findings in Redwood Creek

- Coastal giant salamanders can consume and kill mud snails
 - No preference between Juga and mud snails in lab experiments
 - All mud snails consumed were killed



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