The Sparkling Lake rusty crayfish removal: what have we learned?

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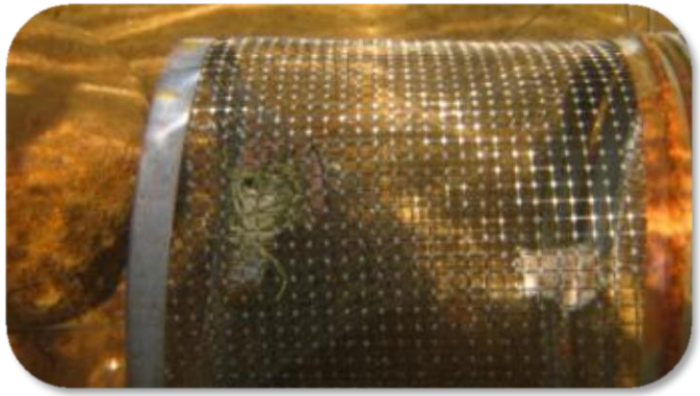
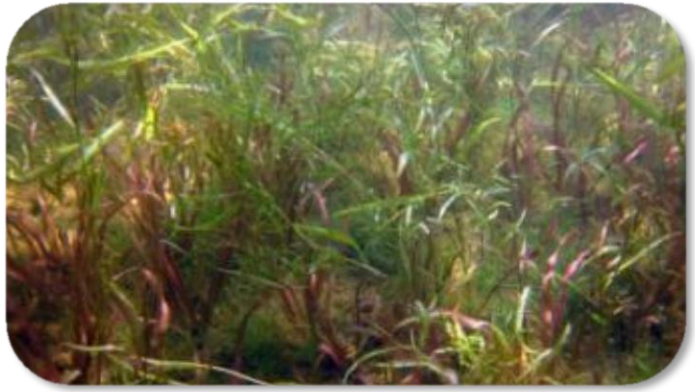




Sparkling Lake

LTER

154 Acres
Max depth 60 ft

Rusty crayfish removal experiment

Removal trapping: 2001-2008
Fishing regulation changes: 2001-2014

C. Hein

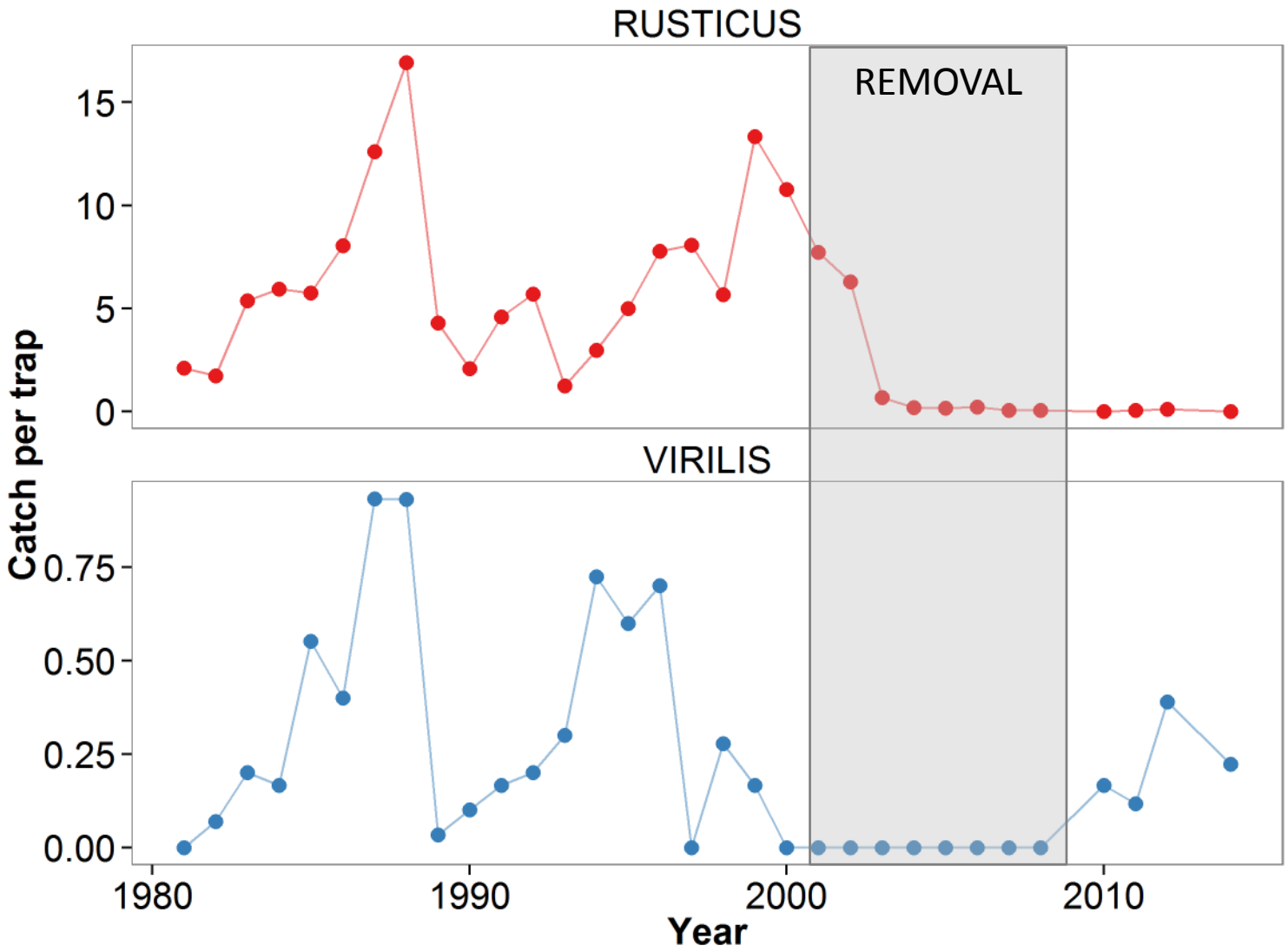
Goals of removal experiment

- Reduce rusty crayfish population
  - Is it possible?
- Observe ecosystem response
  - Are negative effects of rusty crayfish reversible?
- Shift balance between fish and rusty crayfish
  - Can fish control crayfish once we have reduced their population to low levels?

Trapping effort was high

- Intensively trapped June-August, 2001-2008
- 100-300 traps per day
- 1,300-15,000 “trap days” per year
- 91,930 crayfish removed

Rusty crayfish declined by 99%
Native (virilis) crayfish increased 100x



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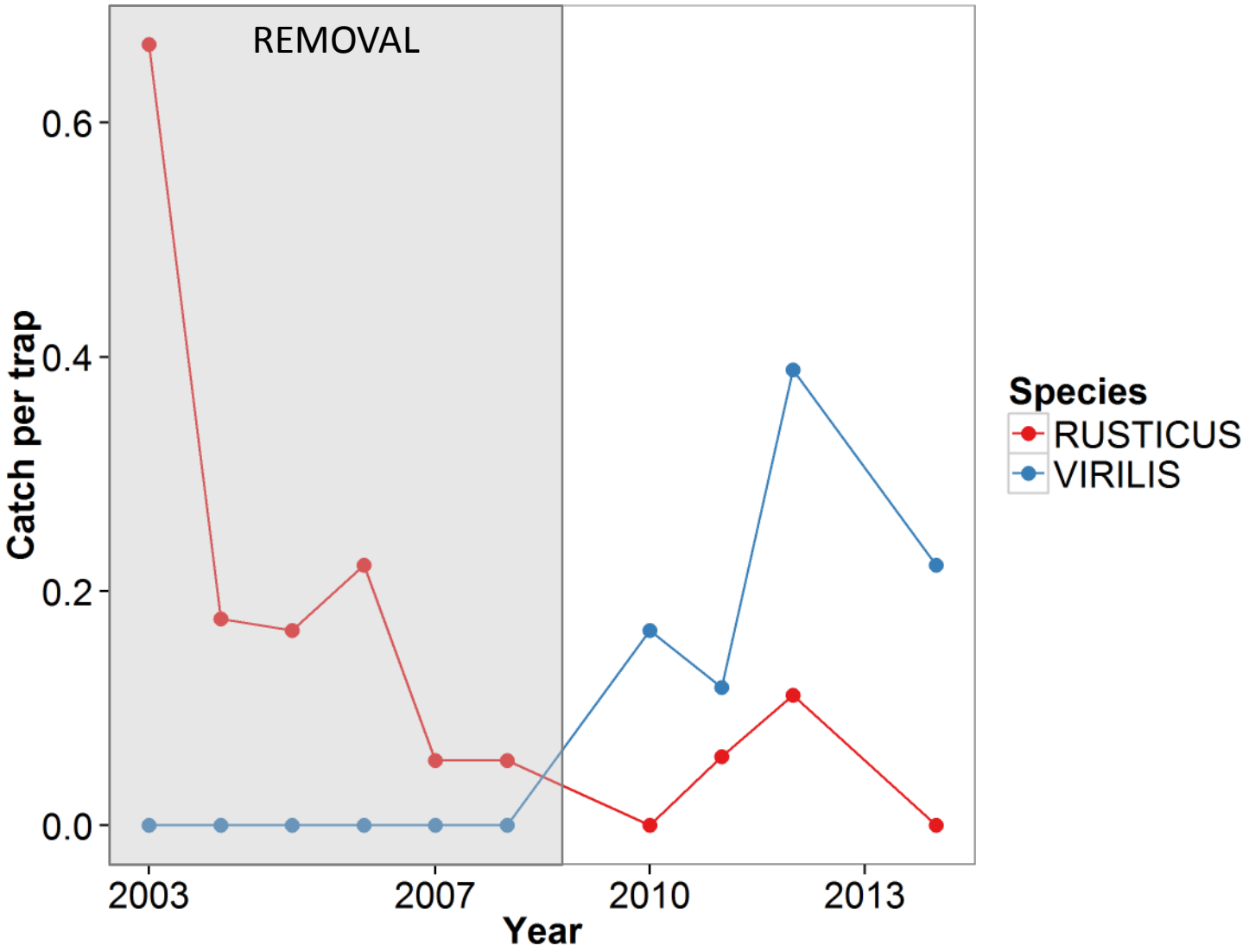
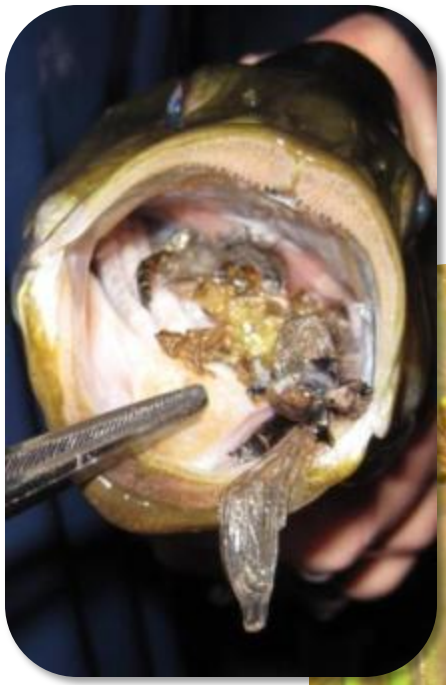


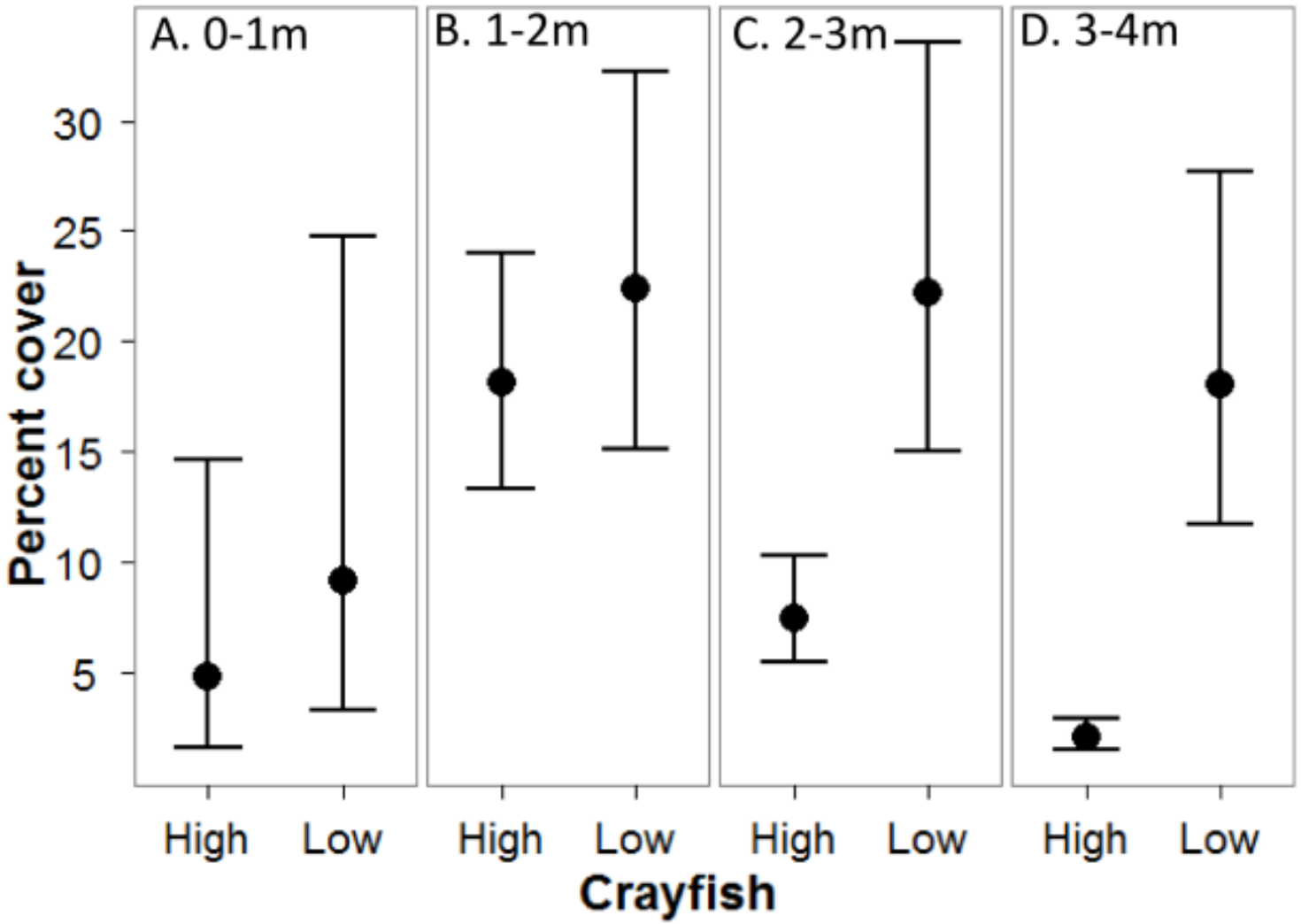
Goals of removal experiment

- Reduce rusty crayfish population
  - Is it possible? **YES (but it requires a lot of effort)**
- Observe ecosystem response
  - Are negative effects of rusty crayfish reversible?
- Shift balance between fish and rusty crayfish
  - Can fish control crayfish once we have reduced their population to low levels?

Sparkling Lake ecosystem response



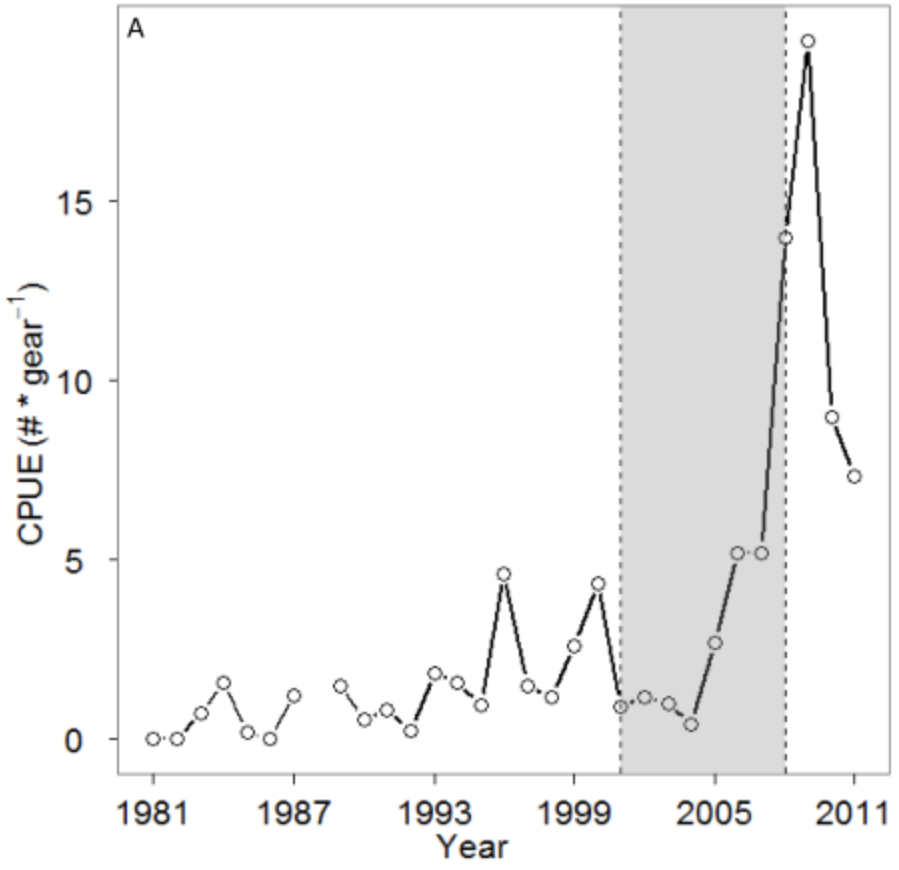
Macrophyte percent cover increased, especially in deeper water



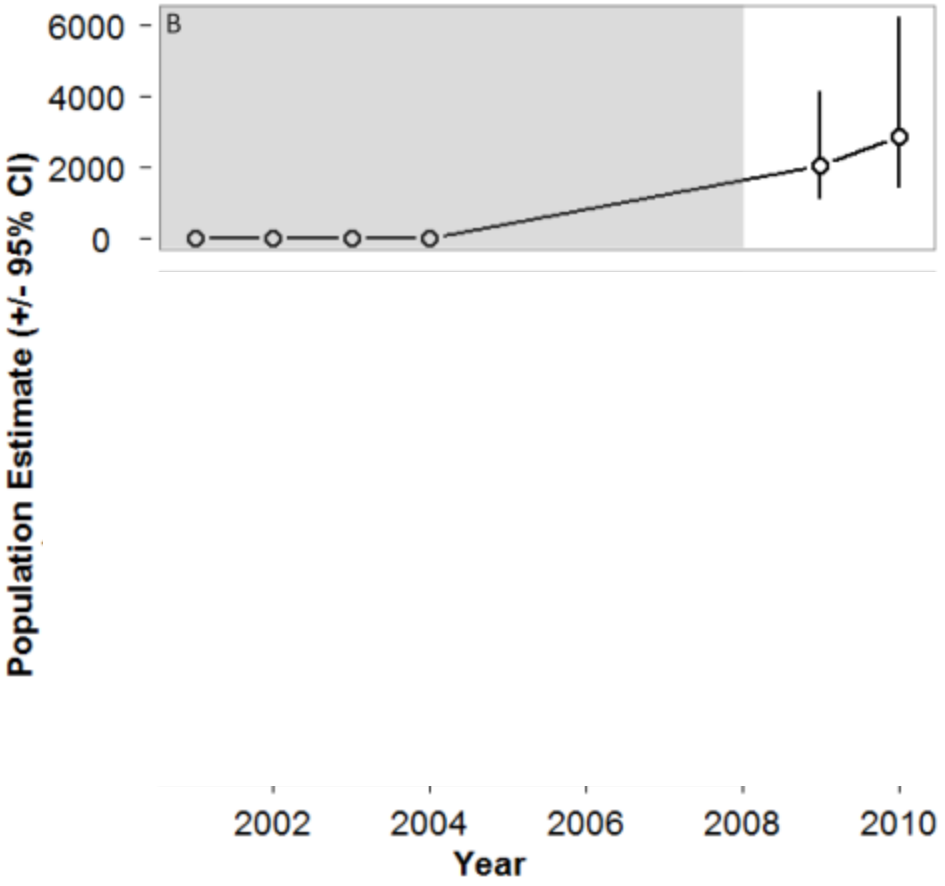
“High crayfish” “Low crayfish”

Lepomis spp. (sunfish) increased

LTER Catch rate

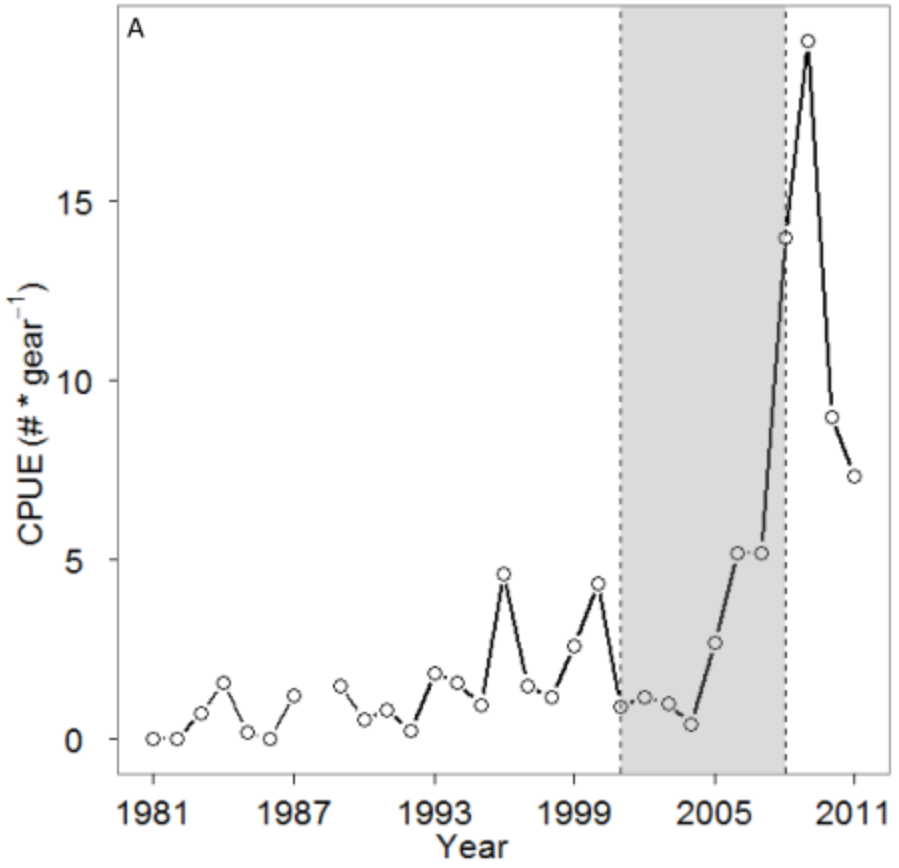


Mark-recapture population estimate

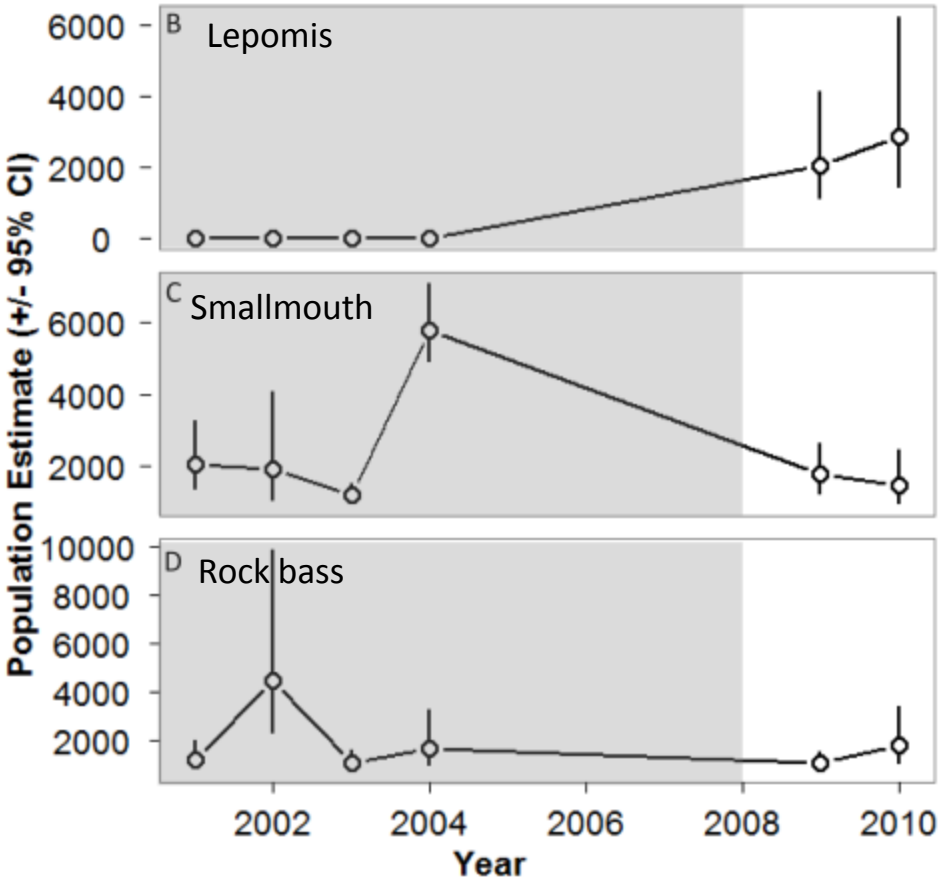


Lepomis spp. increased, others did not change

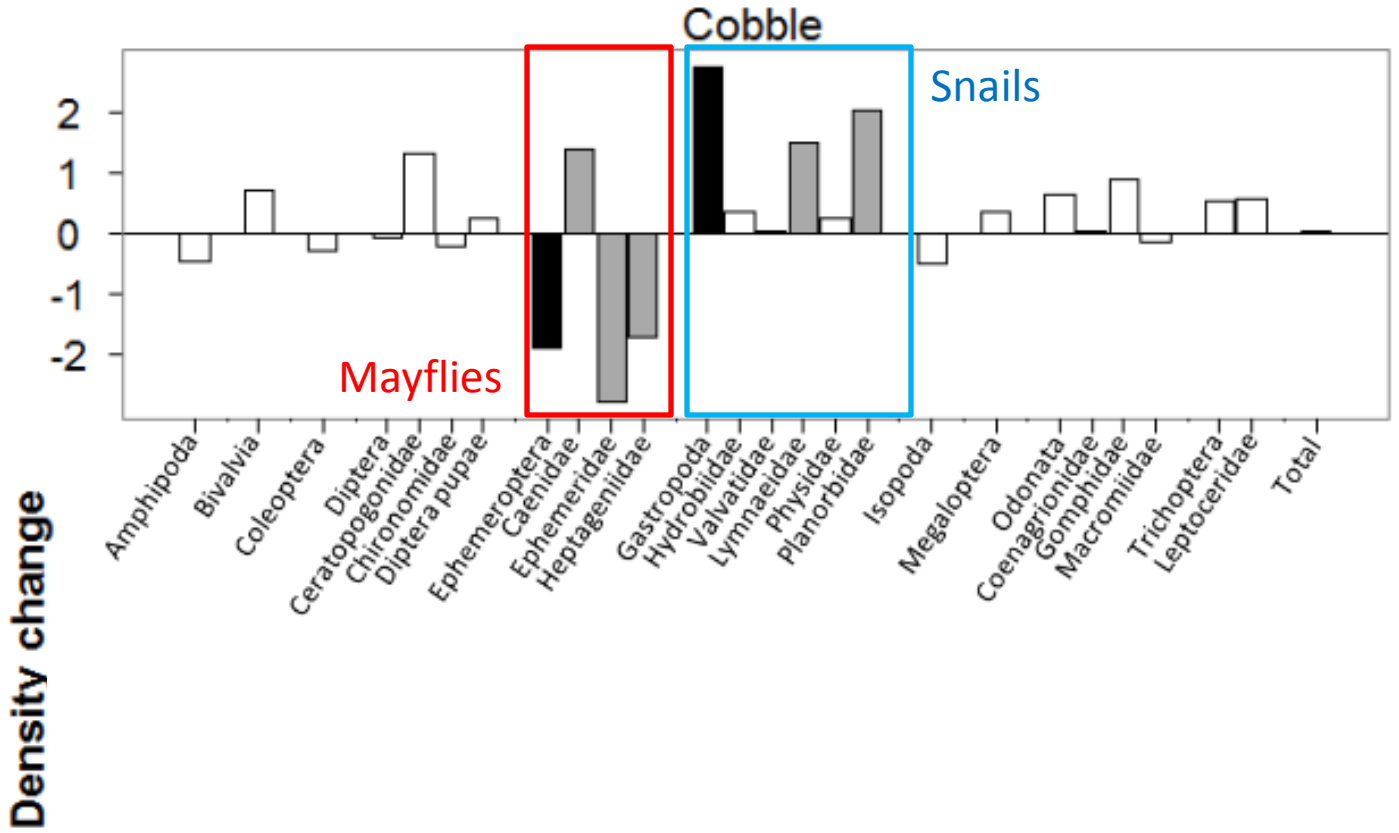
LTER Catch rate



Mark-recapture population estimate



Some invertebrates increased, others decreased



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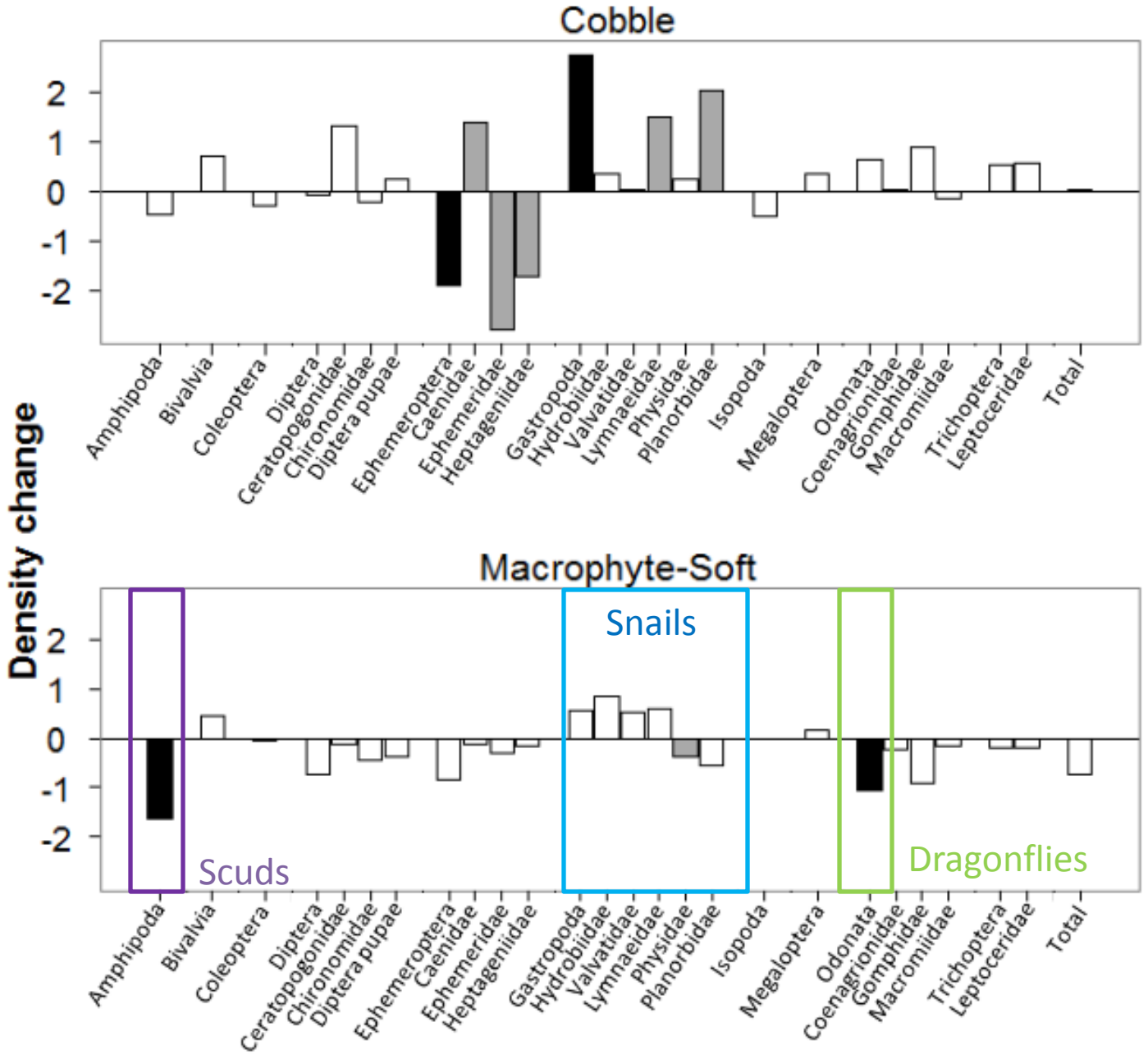
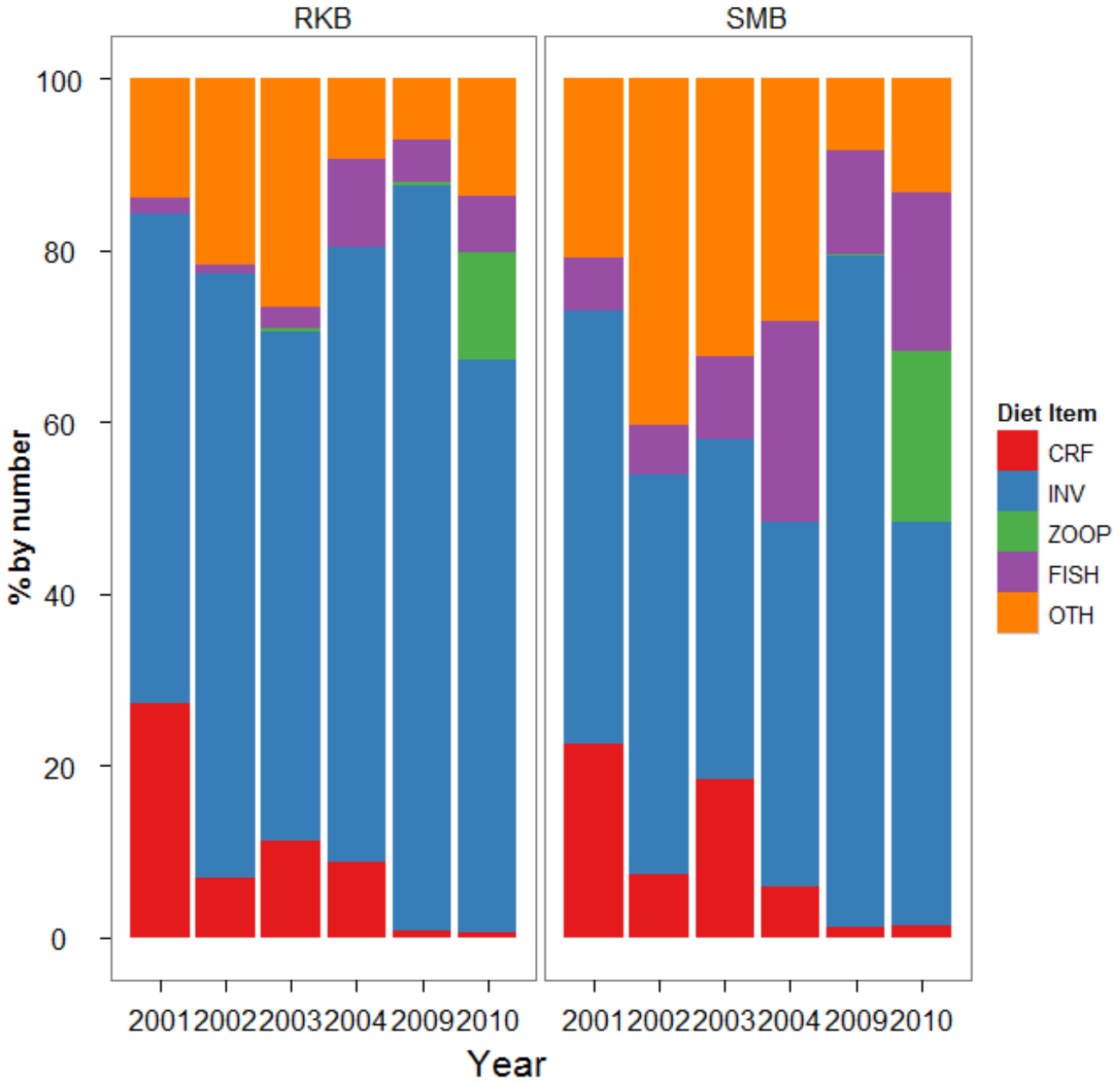


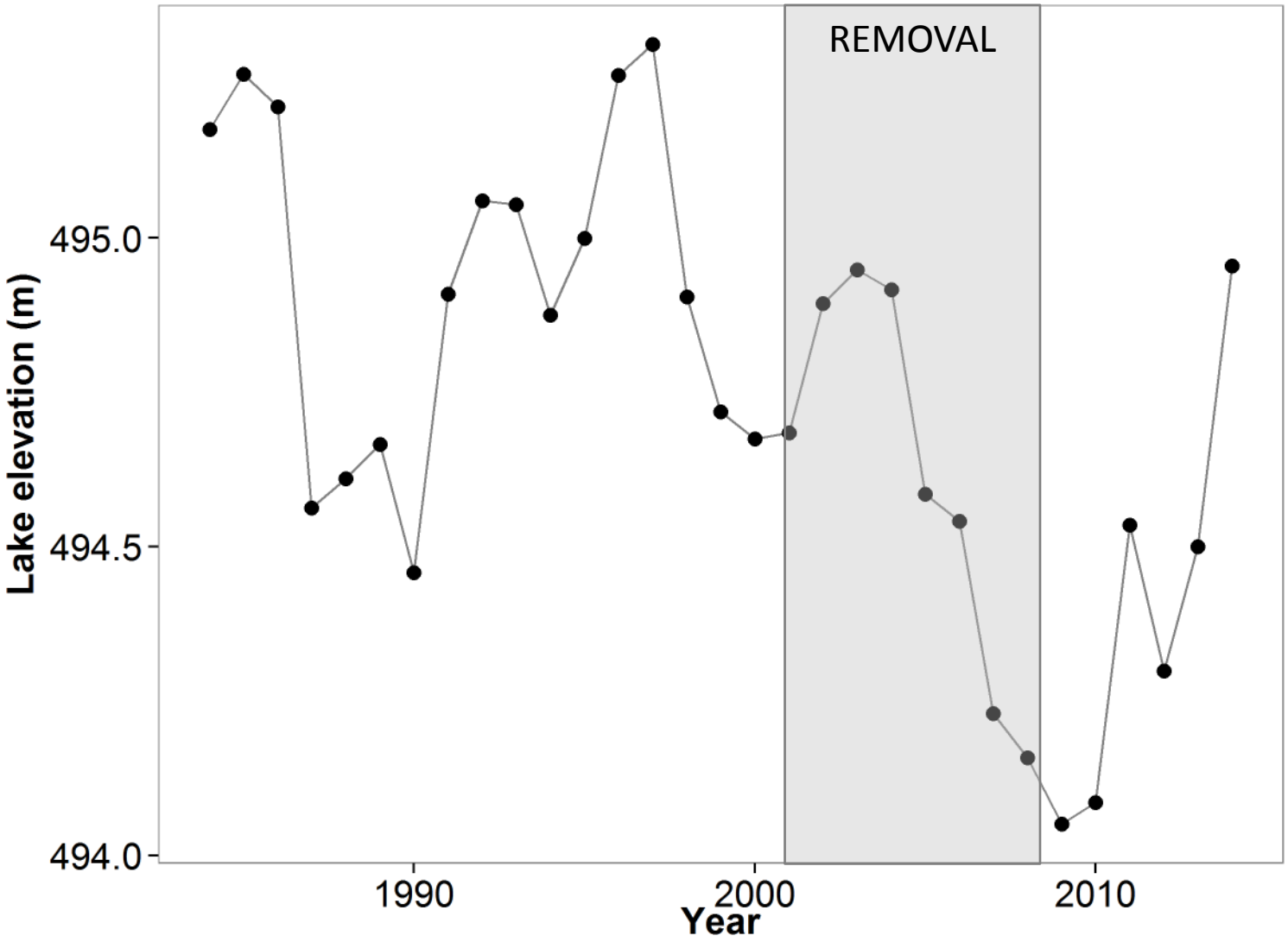
Bass ate more invertebrates



Goals of removal experiment

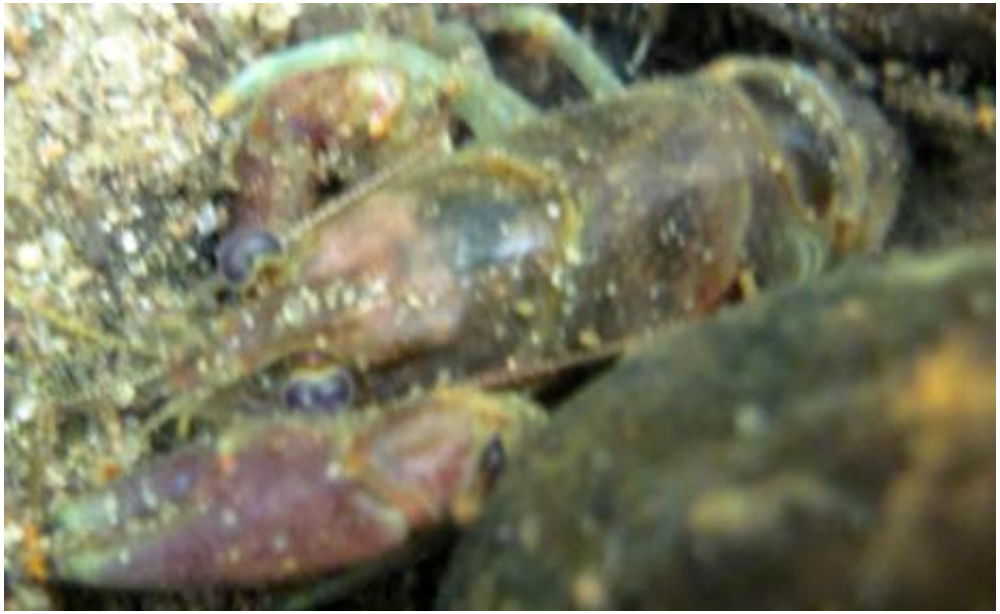
- Reduce rusty crayfish population
  - Is it possible?
- Observe ecosystem response
  - Are negative effects of rusty crayfish reversible?
    YES, WITH SOME UNEXPECTED RESULTS.
- Shift balance between fish and rusty crayfish
  - Can fish control crayfish once we have reduced their population to low levels?

Lake level declined in Sparkling Lake during removal

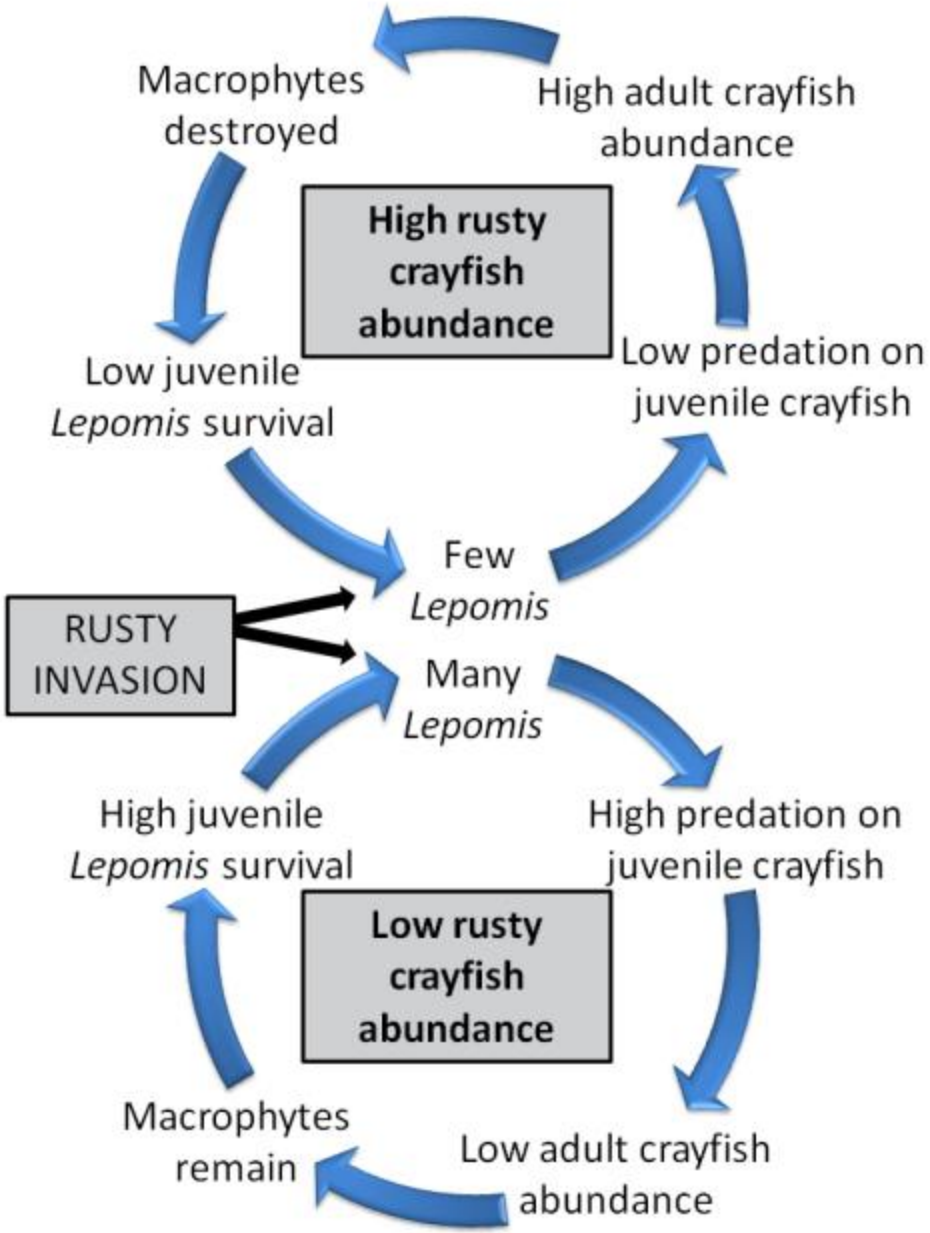


Drought conditions reduce cobble habitat

Rusty crayfish depend on cobble habitat for refuge from predators

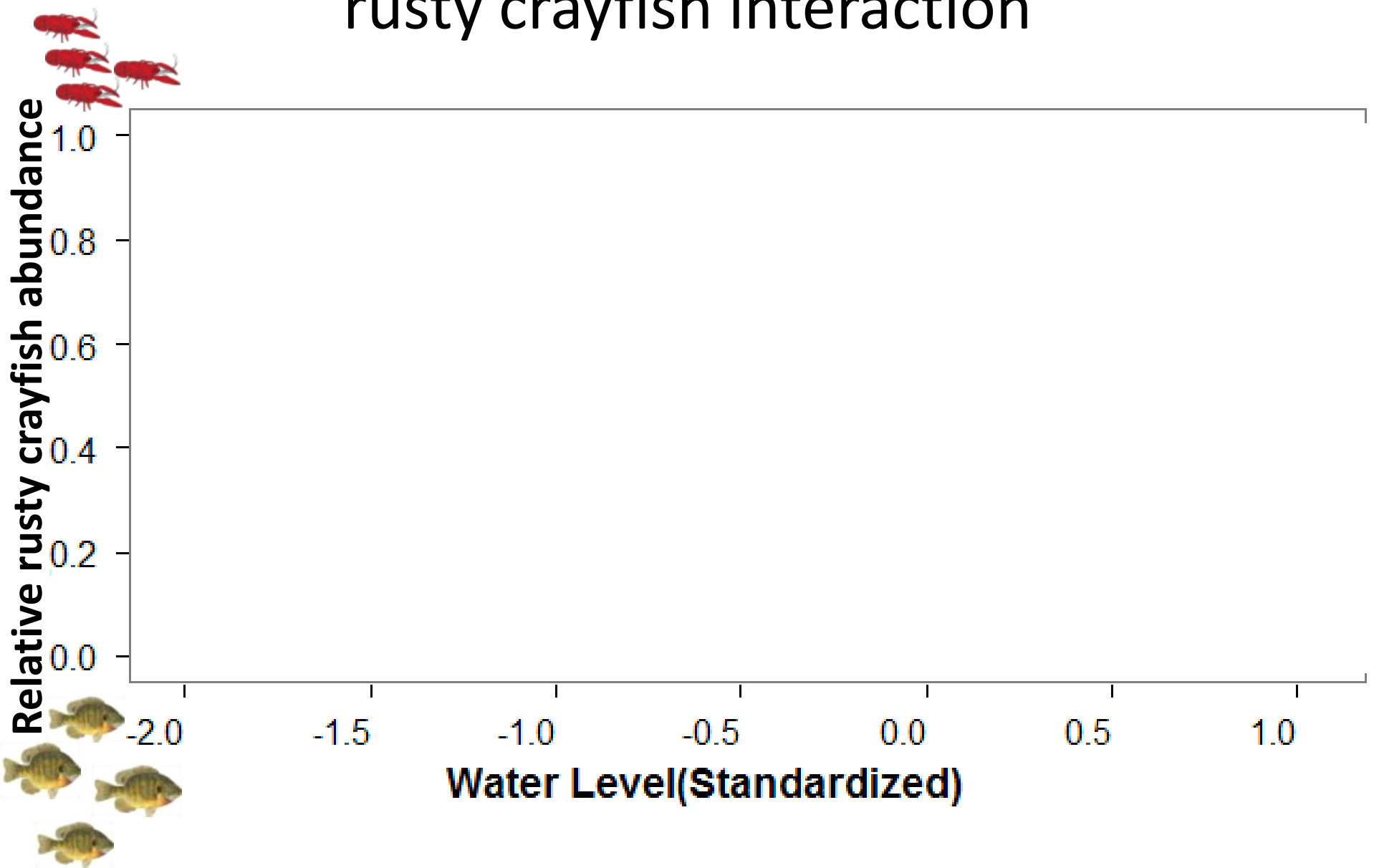


“Alternative stable states” are possible

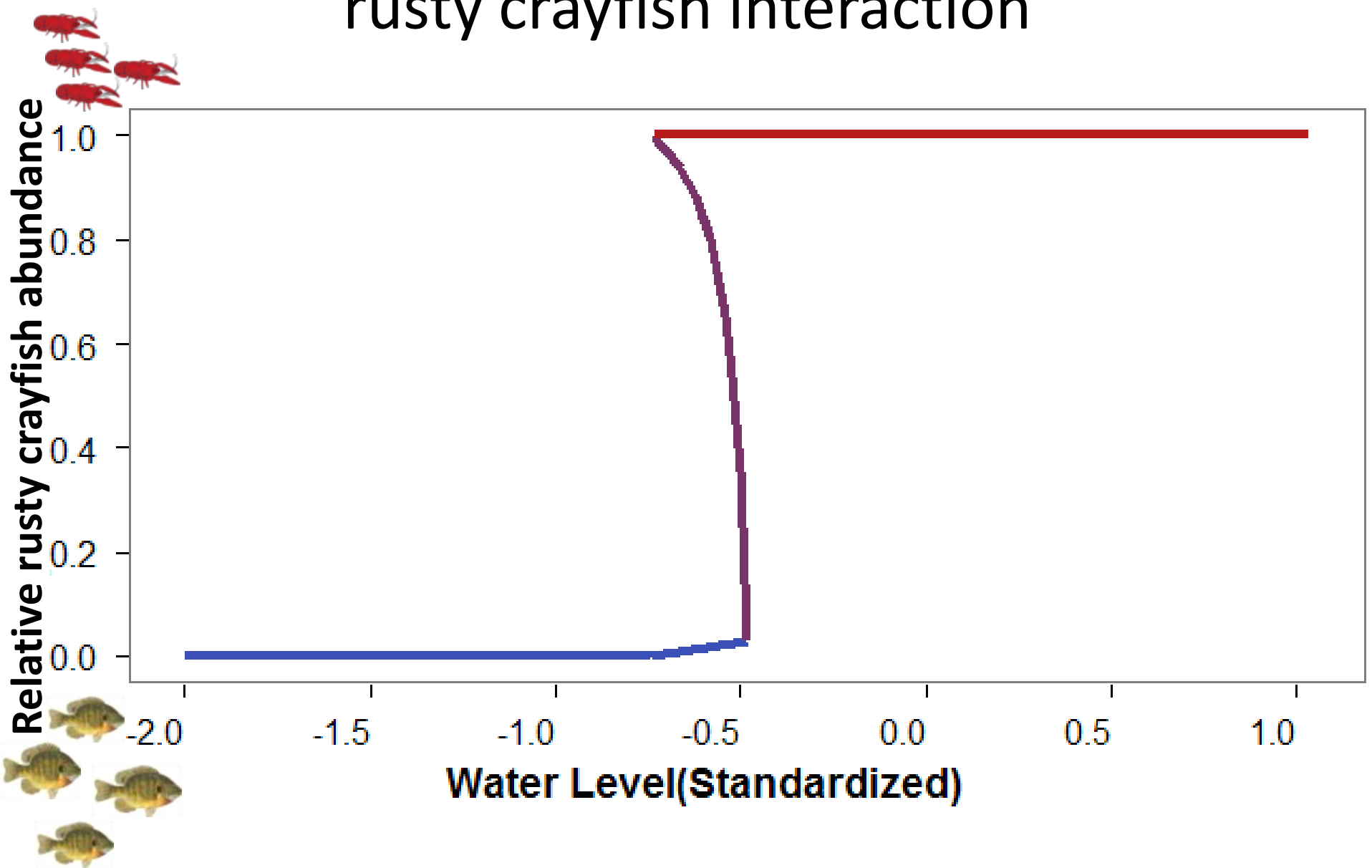


Adapted from Roth et al. 2007

Water level determines outcome of *Lepomis*/ rusty crayfish interaction



Water level determines outcome of Lepomis/ rusty crayfish interaction



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Conclusions and ongoing research

- It is possible to reduce rusty crayfish populations, but high effort is required.
- Many ecosystem components recover following crayfish removal (native crayfish, macrophytes, snails, sunfish)
- We observed some unexpected (and potentially temporary) responses (mayflies and other invertebrates, fish growth).
- Drought may provide opportunities for reducing rusty crayfish in some lakes.
- Future research:
  - Continued monitoring of crayfish and fish populations
  - Quantify relationship between water level and rusty crayfish habitat
  - Identify invaded lakes likely to be affected by water level fluctuations

Questions?

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Hansen et al. 2013. Are rapid transitions between invasive and native species caused by alternative stable states, and does it matter? Ecology 94:2207–2219. http://dx.doi.org/10.1890/13-0093.1

Hansen et al. 2013. Food web consequences of long-term invasive crayfish control. Canadian Journal of Fisheries and Aquatic Sciences. 70: 1109-1122, http://dx.doi.org/10.1139/cjfas-2012-0460