

Nitrate Impacts on Florida Apple
Snail (*Pomacea paludosa*)
Survival and Growth

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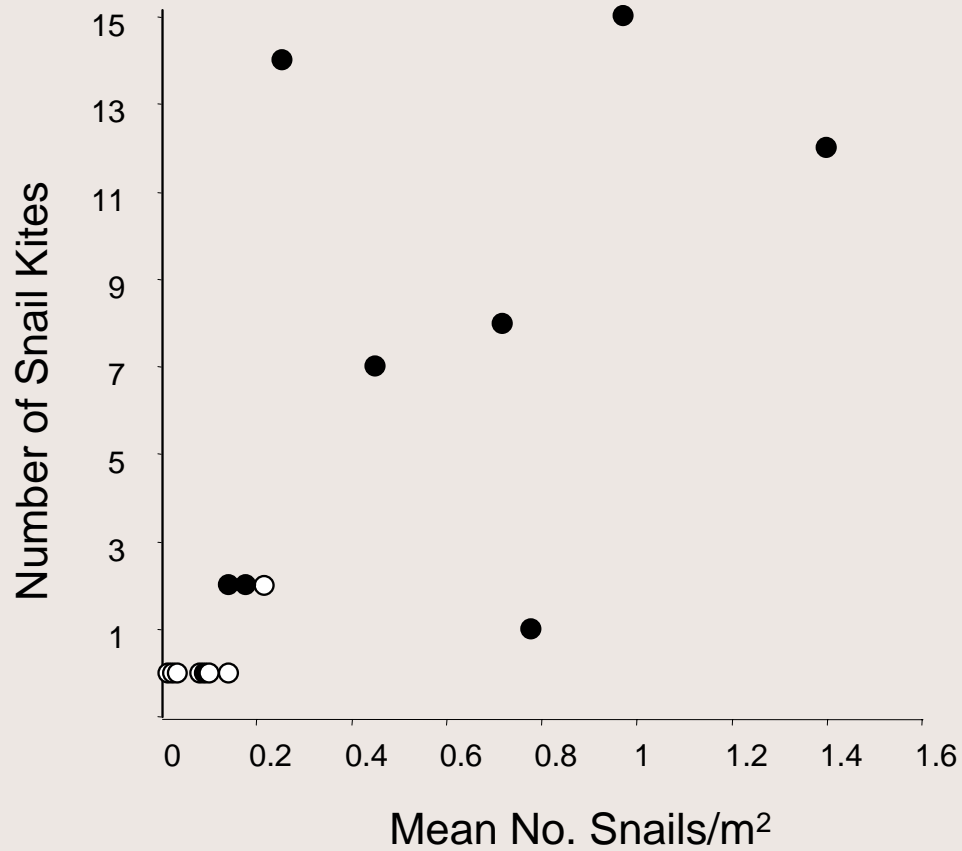
Pensacola, FL

Prompting for Study

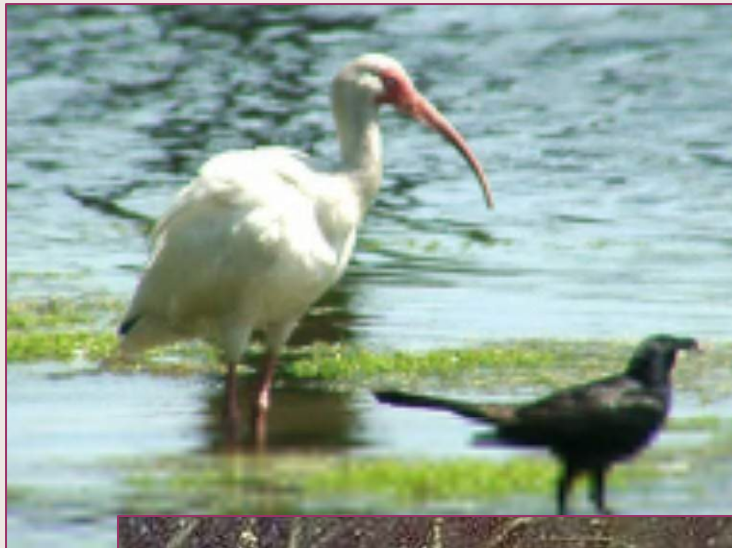
- Decreased limpkin use at Wakulla
- Low snail density?



Predator-Snail Relationship



Other Predators ...



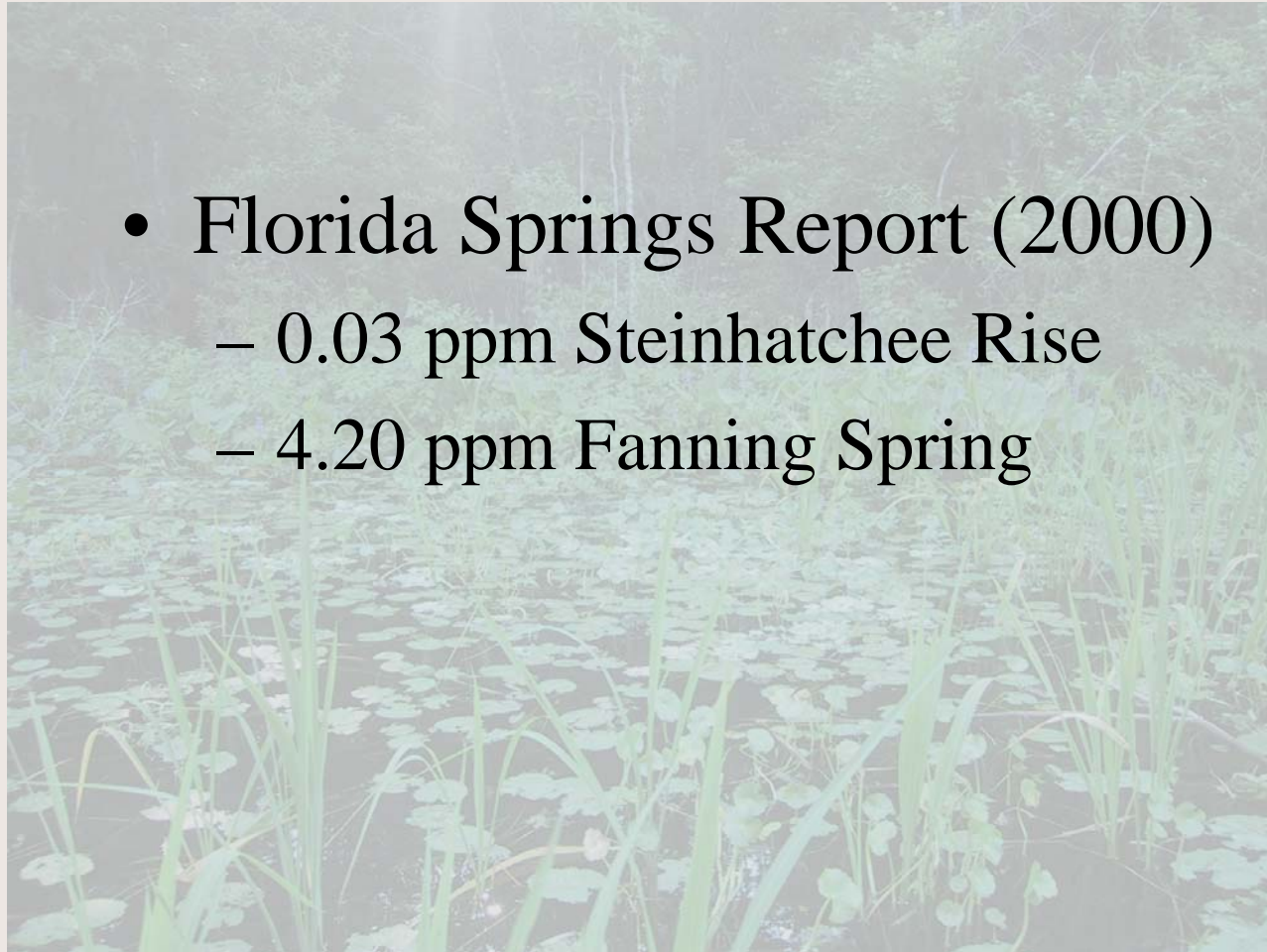
Are Elevated Nitrates Impacting Snails?

- Field component (2002)
- Lab component (2003)



Environmental Levels

- Florida Springs Report (2000)
 - 0.03 ppm Steinhatchee Rise
 - 4.20 ppm Fanning Spring



Nitrate Toxicity

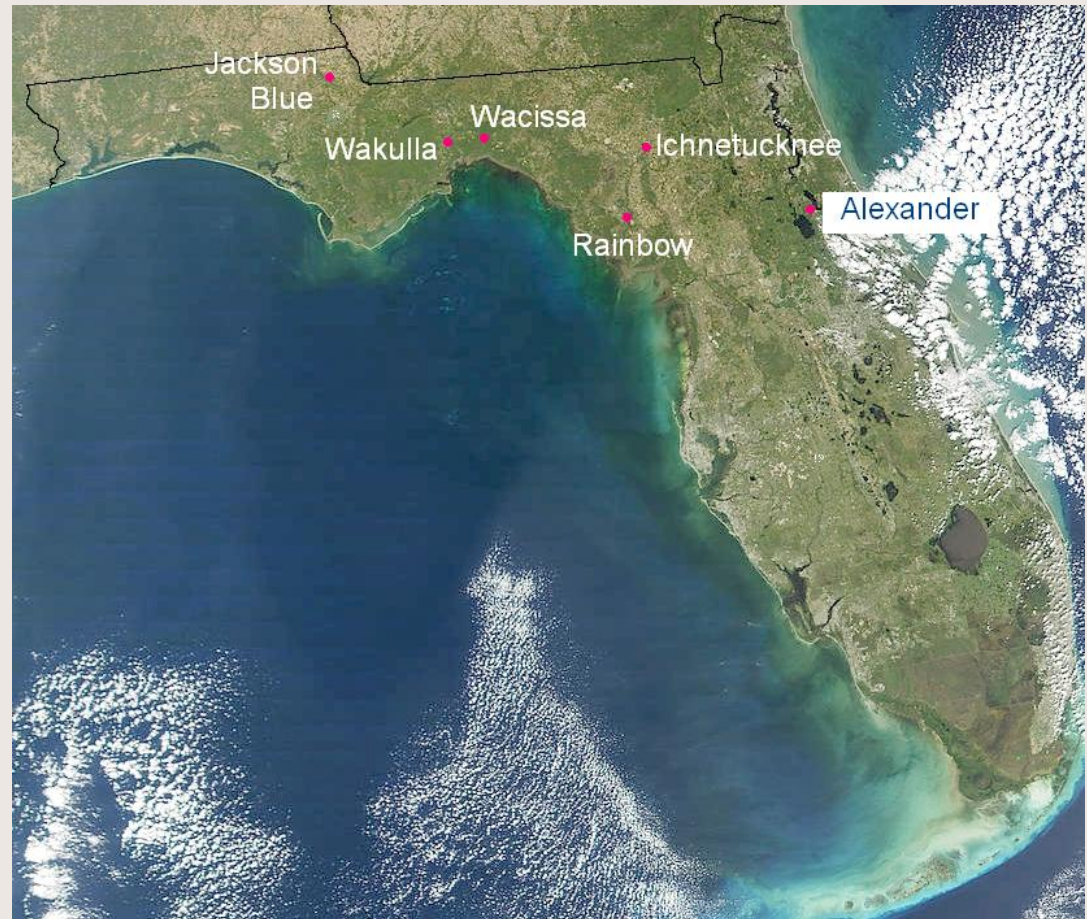
- Little literature available on freshwater snails
 - sodium nitrate v. ammonium nitrate
 - > 2.2 for *Hydropsyche occidentalis* v. 2316 ppm for *Penaeus monodon*
- Often not toxic at environmental levels

Field Study - Hypothesis

- Snail density decreases with elevated nitrate

Field Study - Site Description

- First magnitude springs:
 - Jackson Blue
 - Wakulla
 - Wacissa
 - Rainbow
 - Ichnetucknee
 - Alexander



Field Study - Data Collection

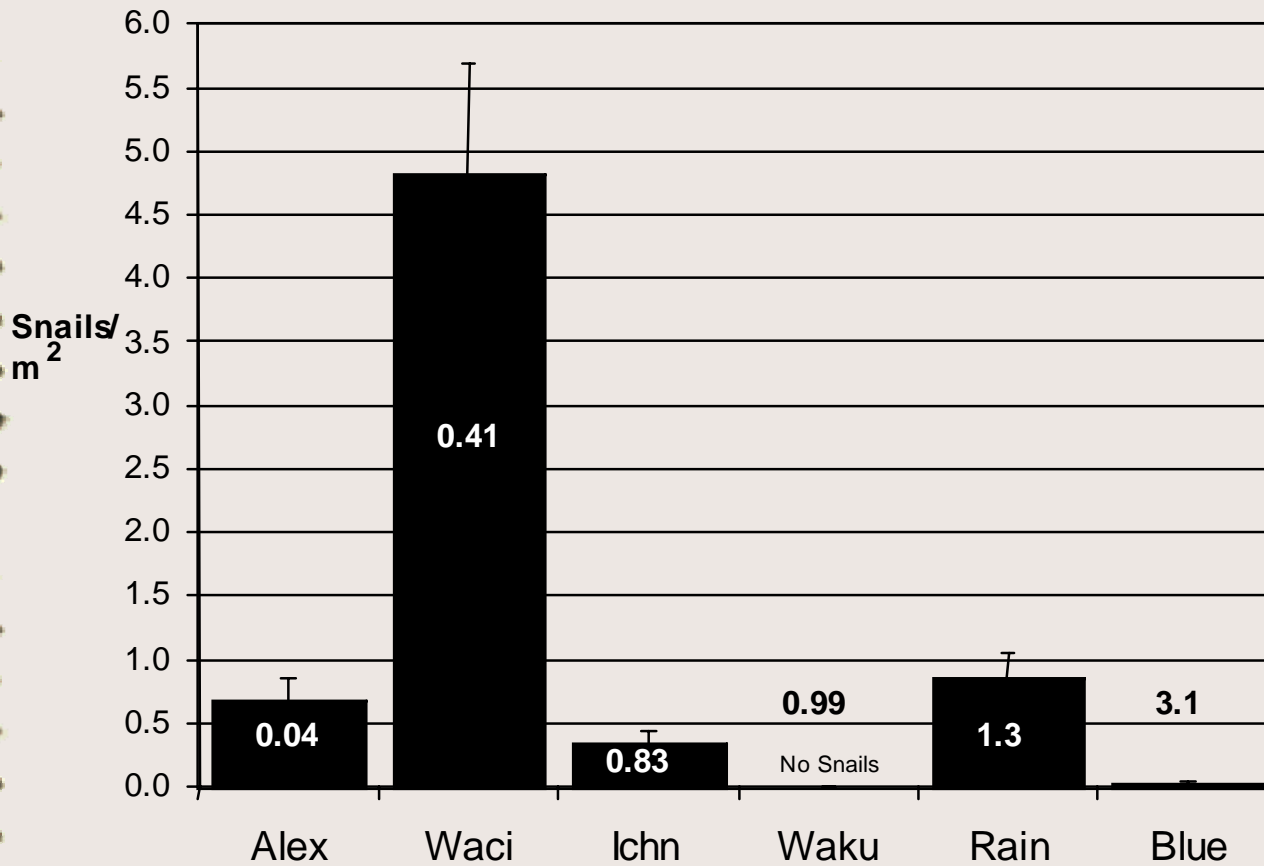
- 1-m² throw trap
- 50 per spring
 - Dip net ...
 - Capture probability ...



Field Study - Statistical Analysis

- Negative binomial
- Generalized Linear Models (GENMOD)
 - Snail density between springs
- Correlation analysis
 - Mean snail density
 - Nitrate levels

Field Survey - Results



$p = -0.4$
Critical value
at $\alpha = 0.05$ is
 -0.81

Lab Hypotheses

- Little effect on survival at ecologically relevant levels (0-25 ppm)
 - adults
 - juveniles
- No suppression of growth at these levels
 - juveniles

Methods - Collection

- Snails and eggs from Wacissa River, Jefferson County

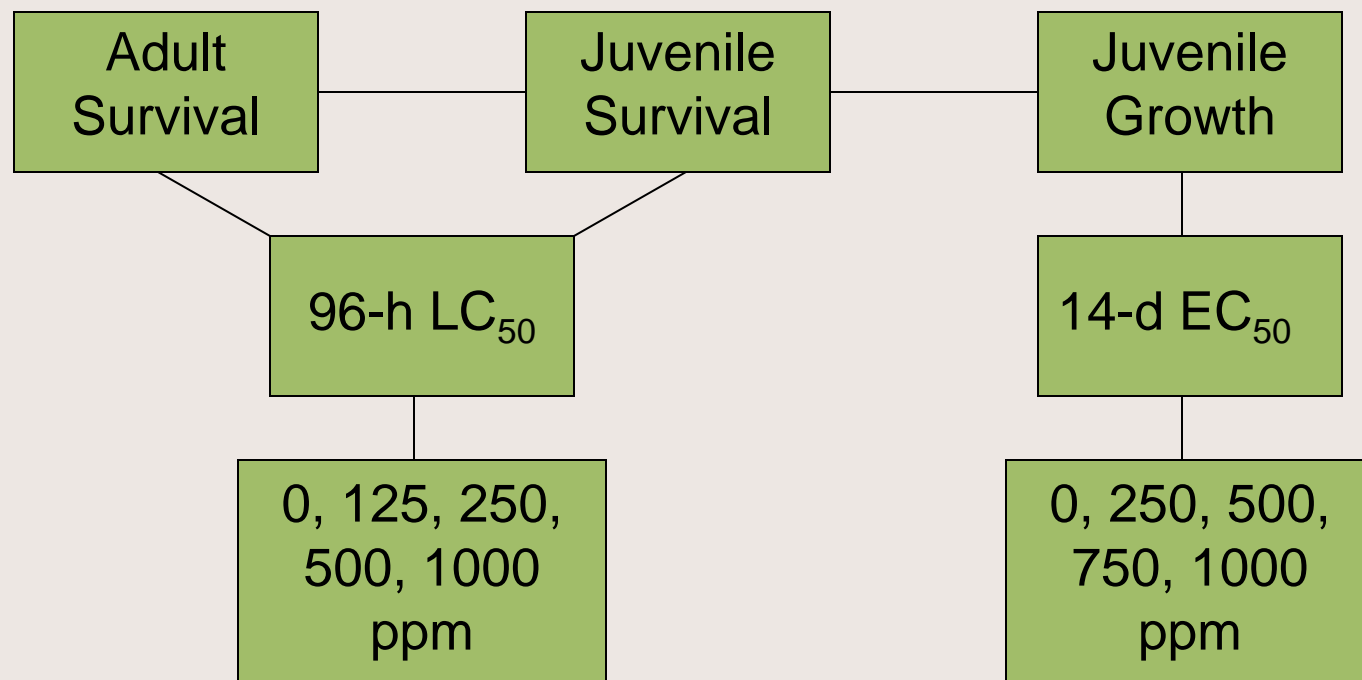


Methods - Holding and Maintenance

- Protocol development
 - Water quality
 - Water temperature
 - Feeding schedule
 - Light conditions
 - Hatching setup



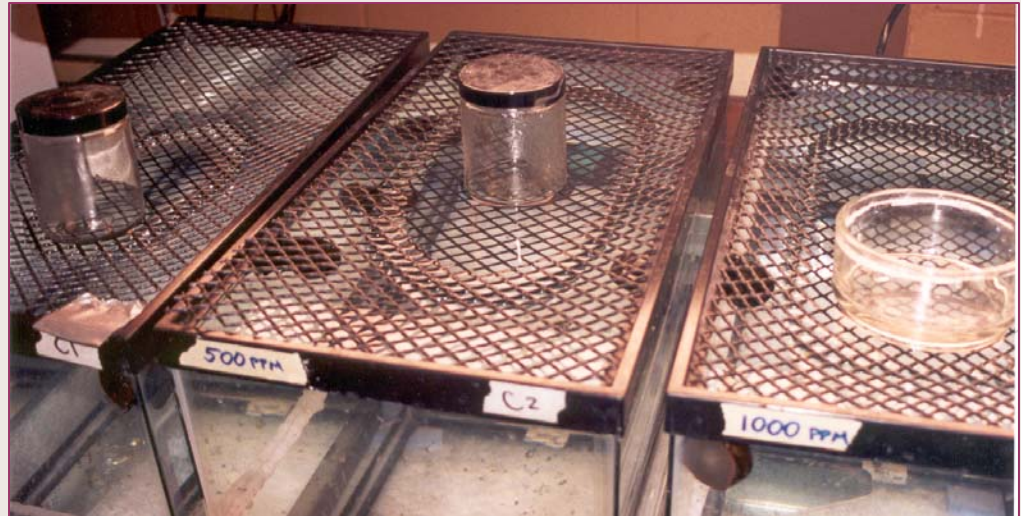
Methods - Experimental Design



* 3 replicates of each;
2 trials of each

Methods - Experimental Design

- Water changes
- Water sampling
 - Nitrate (ion chromatography)
 - Ammonia
 - pH
 - Temperature
 - Dissolved oxygen
 - hardness

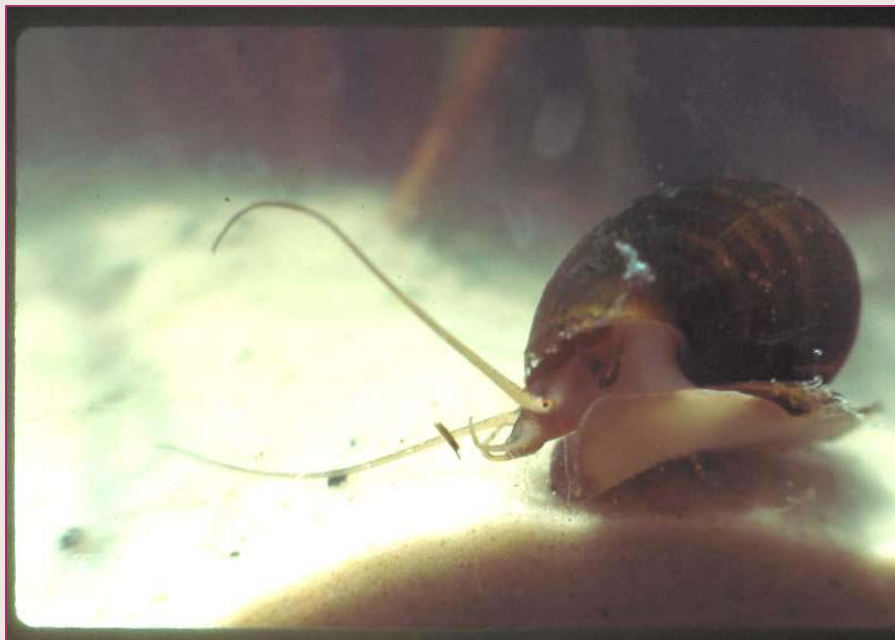


Methods - Statistical Analysis

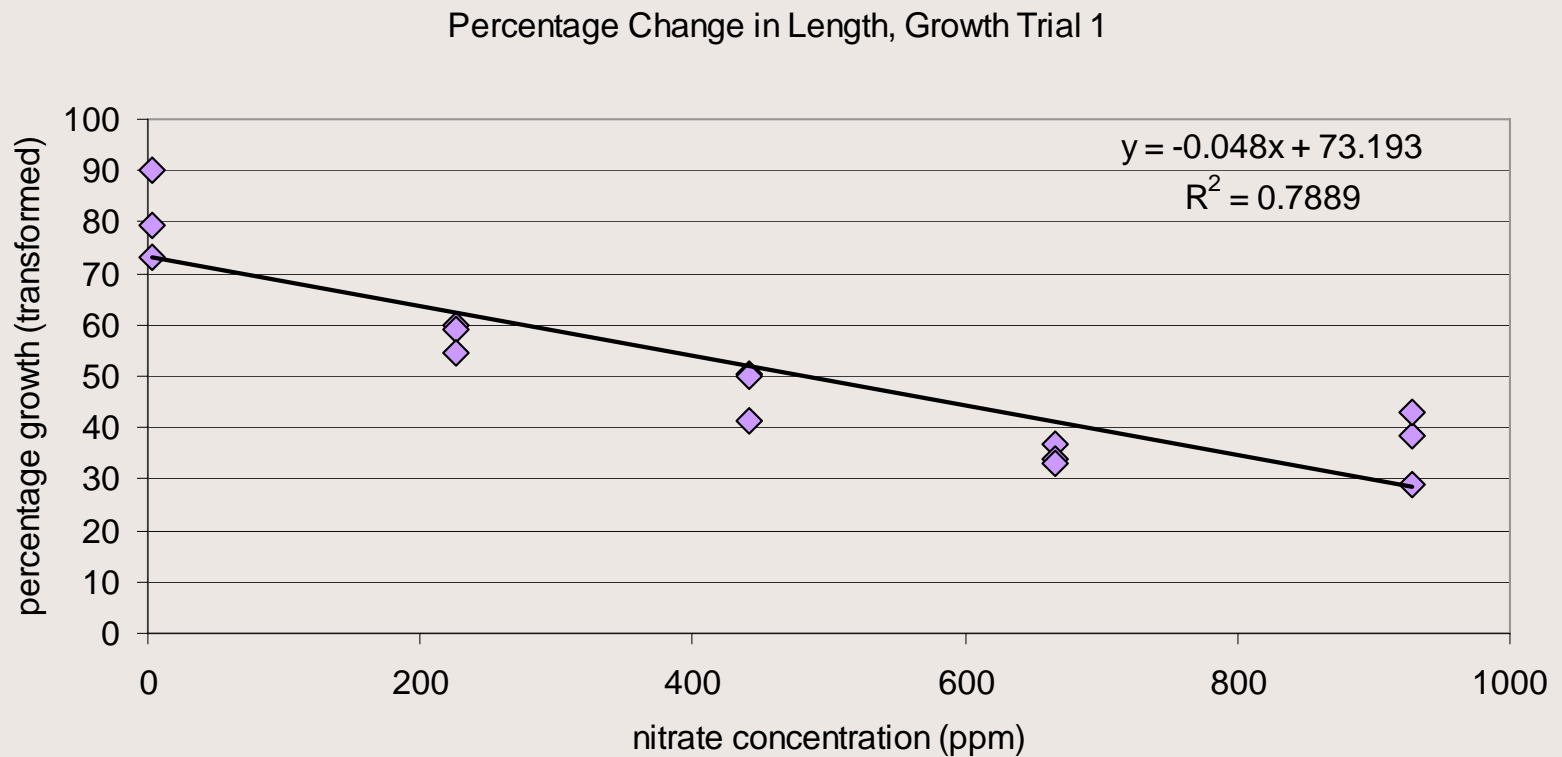
- LC_{50} : regression of percent survival on nitrate concentration
 - target 30-70%
- EC_{50} : regression of percent growth on nitrate concentration

Results - Survival

- Rangefinders: 0-1000 ppm
- High survivorship of both adults and juveniles (77-100%) = no LC_{50}



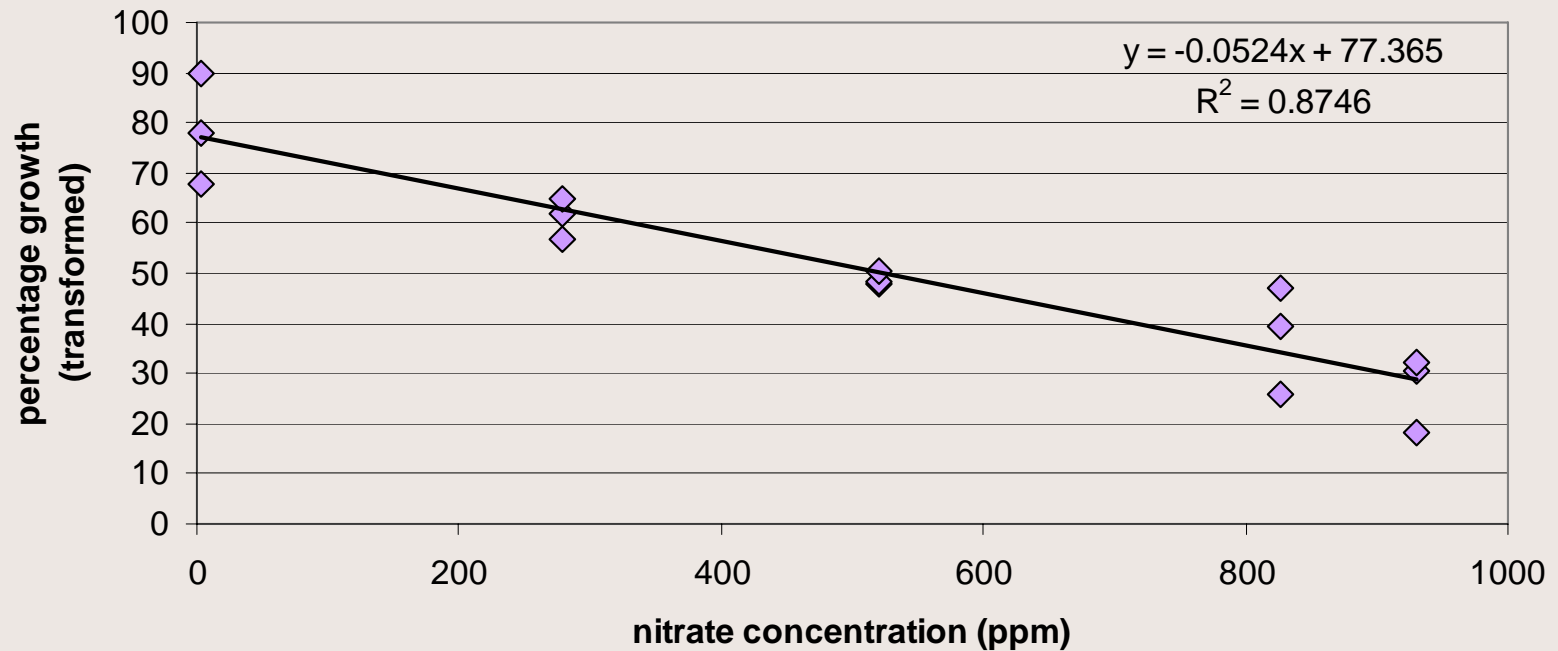
Results - Growth, Trial 1



$$EC_{50} = 587.35 \text{ ppm}$$

Results - Growth, Trial 2

Percentage Change in Length, Growth Trial 2



$$EC_{50} = 617.65 \text{ ppm}$$

Discussion/Conclusions

- No effect on survival in the lab
- Growth affected at environmentally irrelevant levels



... But Snails Have Declined



**Jackson Blue Springs, FL
circa. 1990**

Density in 2002: 0.02 snails/m²

Vegetation Survey - Jackson Blue

- Filamentous algae
- Chemical treatment of hydrilla



Discussion/Conclusions

- If not nitrate toxicity, then ...
- Changes in habitat structure?

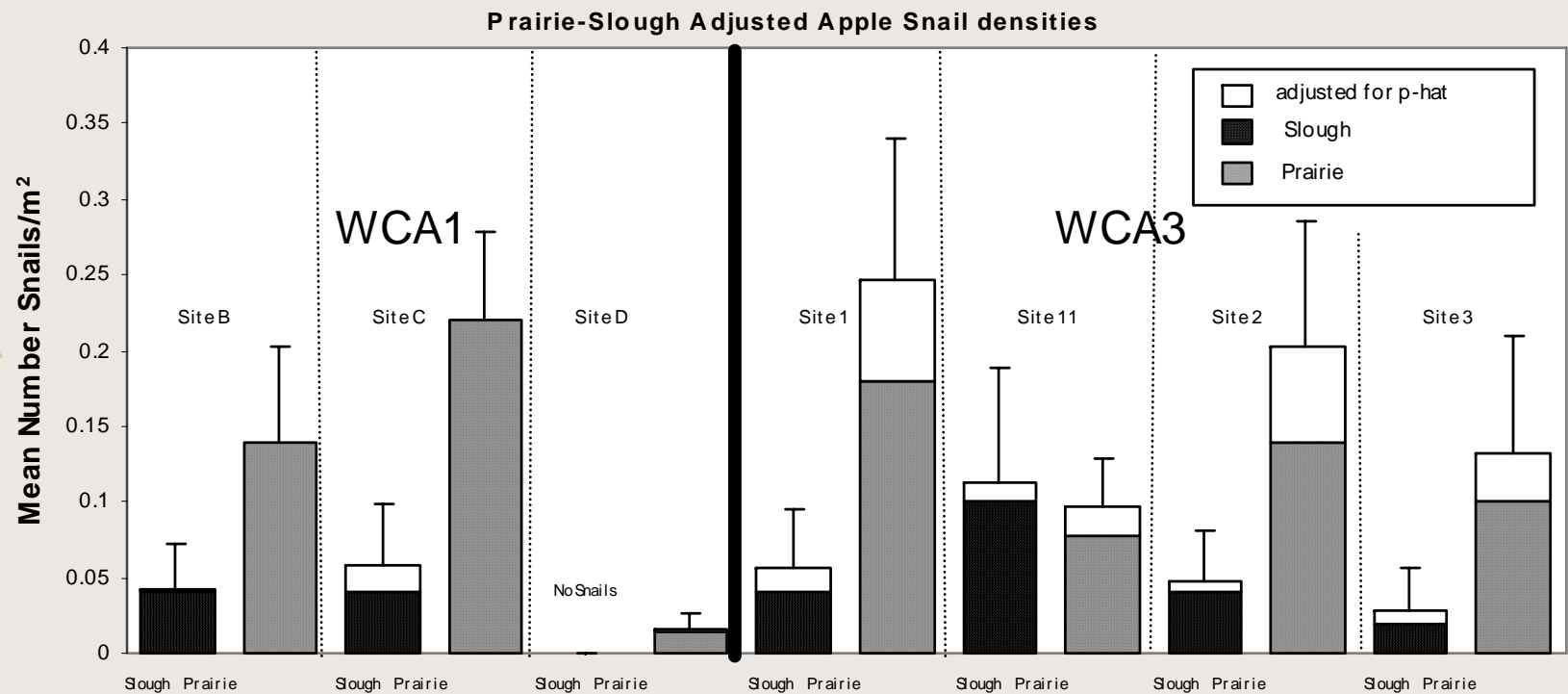
Prairie

v.

slough



Habitat Structure Can Be Critical!



Invasion of the Exotics ...

- Sediment structure?



Hydrilla Displaces Other Plants

- *Vallisneria*
v. *Hydrilla*?
- Forage base?



Treatment of Exotics

- Chemical
 - Acute and/or chronic direct effects?
 - Indirect effects such as ...

Destruction of Emergents



Gee, I hope this
vegetation
doesn't fall over

... And/Or Forage Base



Manual Removal

- Removing vegetation ...
 - snails?
 - cover?



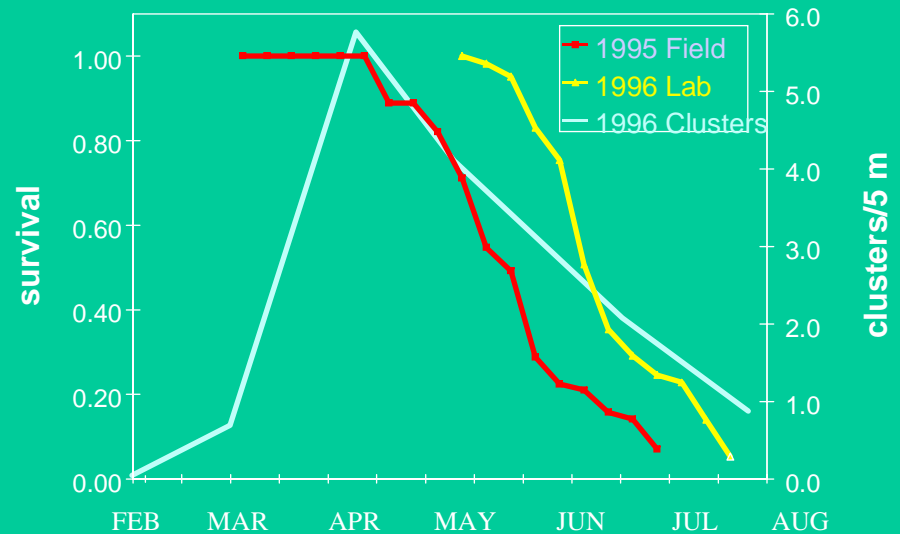
Volunteers remove hydrilla at Wakulla Springs

Repopulation Issues

- Apple snails are an annual species!



Annual Post Reproductive Die Off



Further Investigations?

- Snail habitat preferences in the springs?
- Exotic plant management
 - Direct?
 - Indirect?
- Repopulation potential

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