Investigating Food Quality Effects on the Florida Apple Snail: Water Chemistry Effects on Periphyton Assemblages in the Northern Everglades

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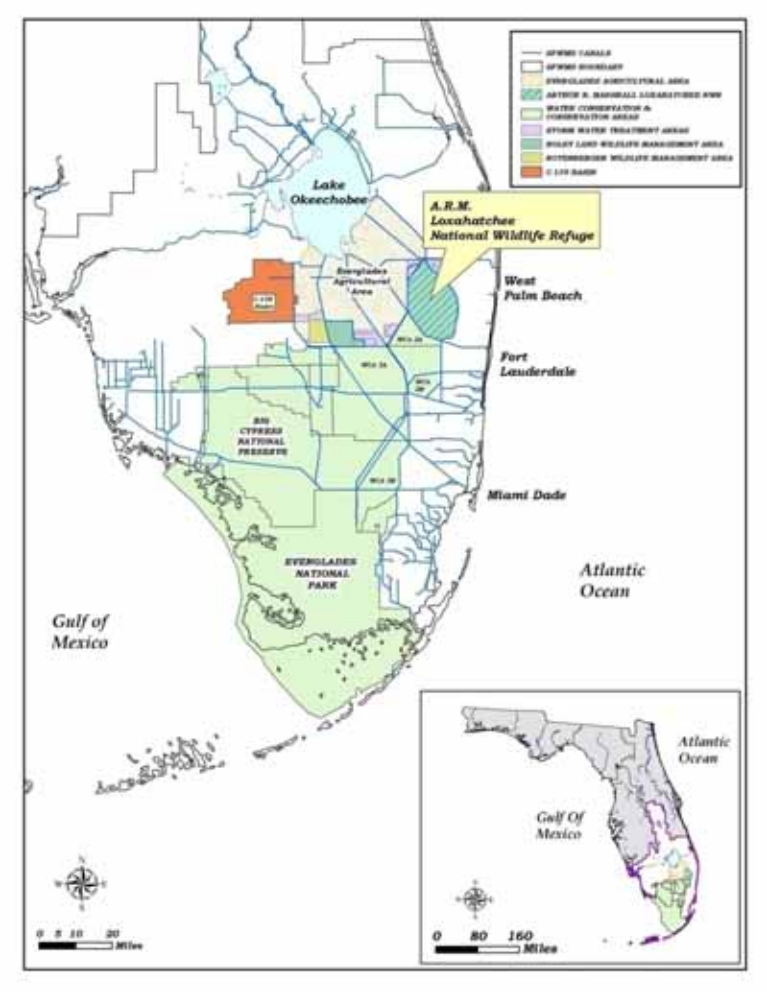


- 147,000 acres
- Canal Levee system
- Water intrusion from perimeter canals to marsh interior
- Water chemistry gradient
- Vegetation alterations (McCormick et al. unpubl data—see poster, GEER 2008)

Introduction to the Apple Snail, *Pomacea paludosa*

- Habitats and food requirements
- Life span and reproduction
- Snail kite dependence; alligators, fish, crayfish, turtles, limpkins

Photo by: www.static.zsl.org

Threats to the Apple Snail

- Declining numbers since 1970s
- Habitat encroachment
- Invasive exotics
- Possible effects of water chemistry changes
- Hydrology alterations
- Copper, Pesticides/ Herbicides Contamination

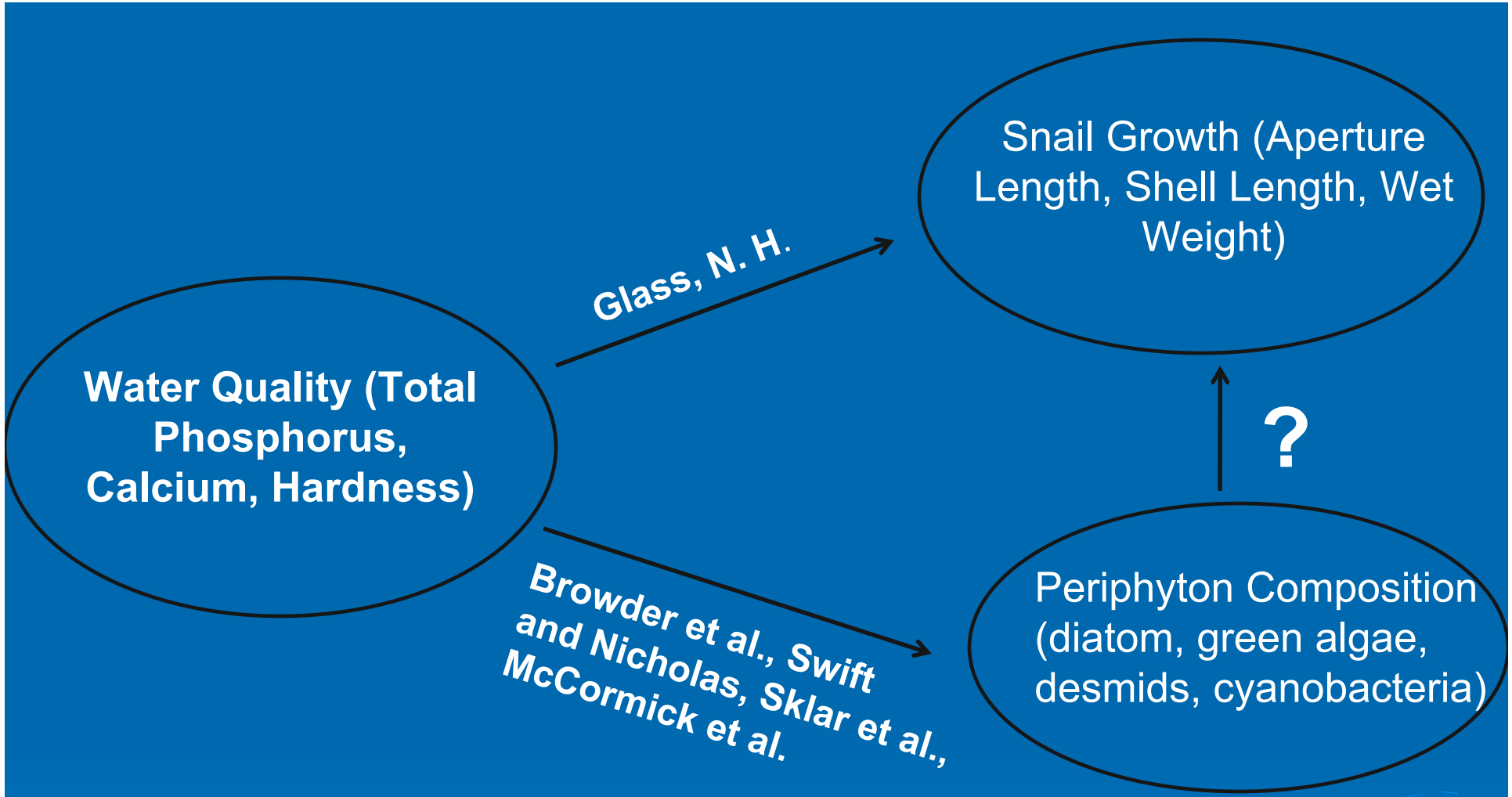
Photo by: Davesgarden.com

Periphyton/Water Chemistry Relations

- Shifts in periphyton assemblages provide early indication of water quality conditions (McCormick et al., 1996)
- Water chemistry determinants such as dissolved minerals, nutrients, pH are very influential on periphyton composition and abundance
- Algal growth and biomass accumulation of periphyton decrease with increasing distance from surrounding nutrient-rich canal waters. (McCormick et al., 1996) Related to lower concentrations of Tphos
- Nutrient rich waters will reduce algal species diversity while overall algal biomass increases (Swift and Nicholas, 1982)

Previous Periphyton Findings

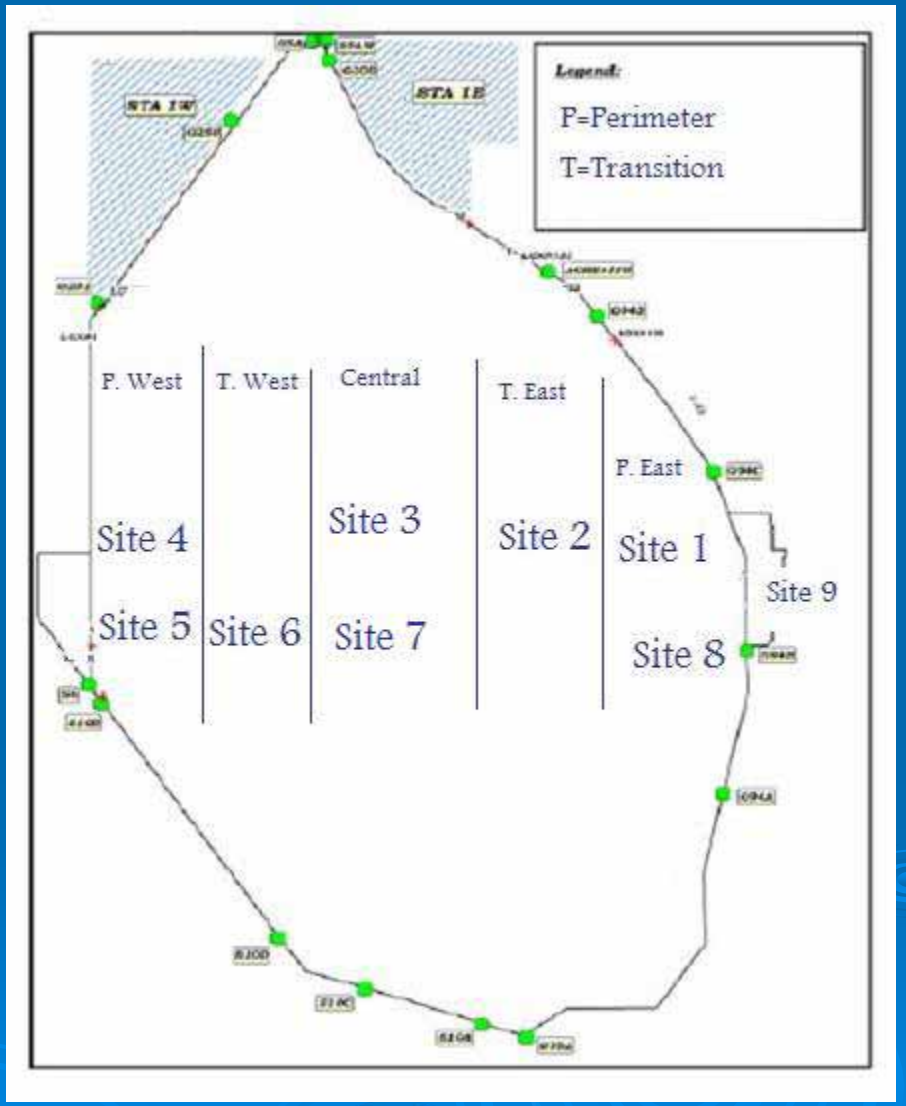
- Edibility gradient of periphyton/selective grazing by snails may be present
  - Carbon isotopic values of snails similar to green algae and diatoms (Williams and Trexler, 2006)
  - Green algae and diatoms have higher food quality (Sklar et al., 2004)
    - Low C:N ratios
    - High lipid content
  - Cyanobacteria not a good food source (Browder et al. 1991 and 1994; Steinman 1996)
    - lower lipid content, secrete unpalatable sheath, chemical defenses
- Cyanobacteria is now the predominant component of periphyton throughout the Refuge (Surratt et al. unpubl data—see poster, GEER 2008)



Hypothesis: Water quality-induced changes in periphyton composition influences Florida apple snail growth/survival

Exposures

- 3 Zones: Interior, Transitional, and Perimeter; 9 sites total (1 impoundment site)
- Lab raised juveniles (5-7 mm); 15 snails/mesocosm
- 6 replicates at each site
- Periphyton Supplied
- 8 Week exposures



Data Collected

Snail Growth and Survival:

- Aperture length (mm)
- Shell length (mm)
- Wet weight (at week 0)

Periphyton Samples Analyzed for:

- Taxonomy
- Nutrition Value: Protein, Carbohydrate content, ash free dry mass, C:N ratios, lipid content

Apple Snails Analyzed for:

- Tissue analysis ash free dry mass

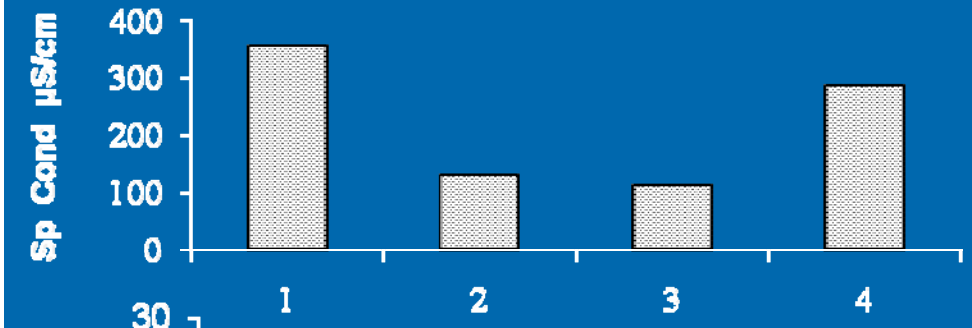
Surface water Samples Analyzed for:

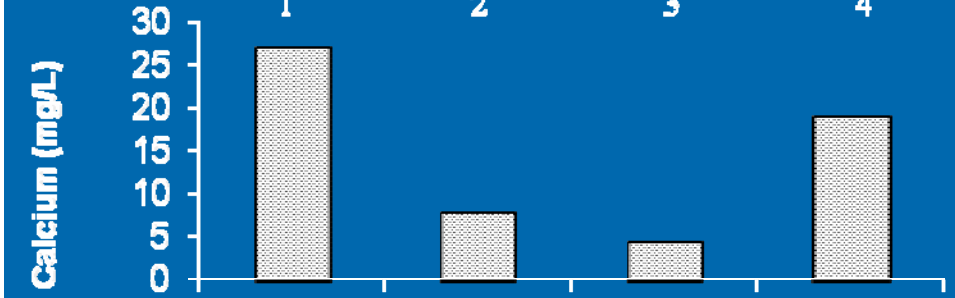
- Ca, SO_4, Tphos

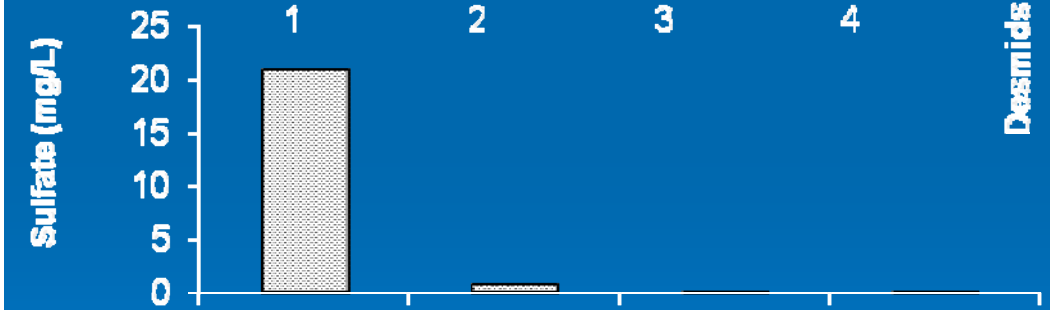
Instantaneous Readings at Each Site Visit:

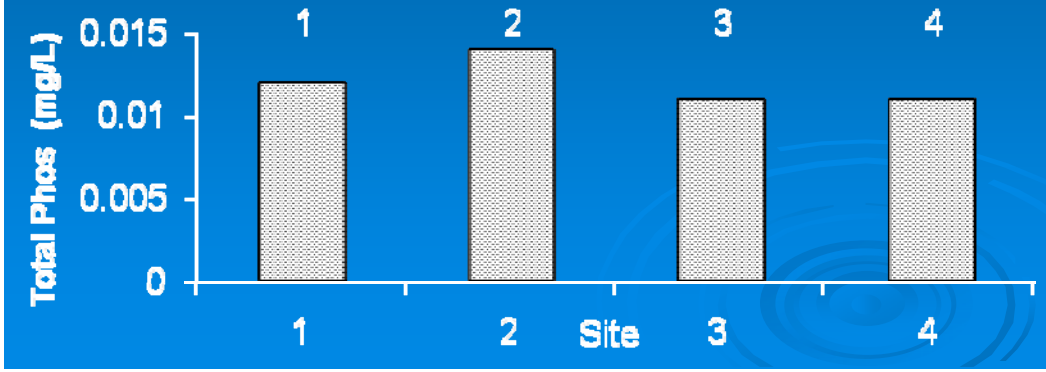
- pH
- Spec Conductivity
- DO
- Temp

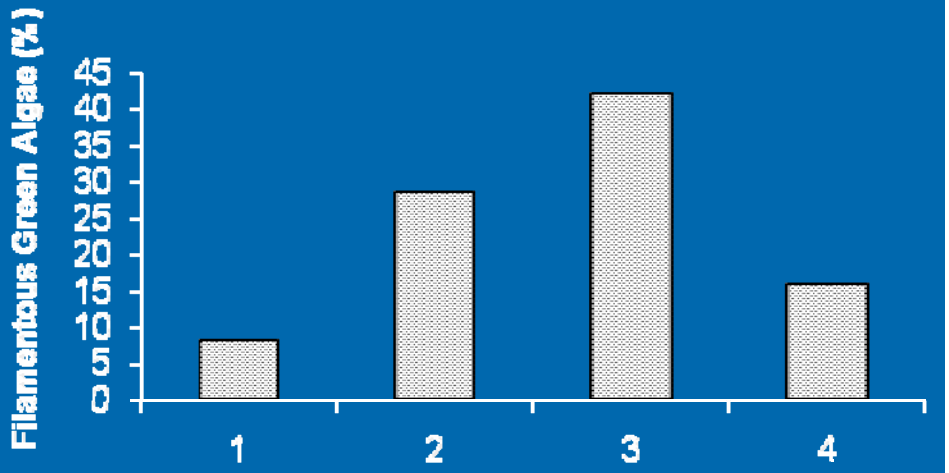
Preliminary Study Results

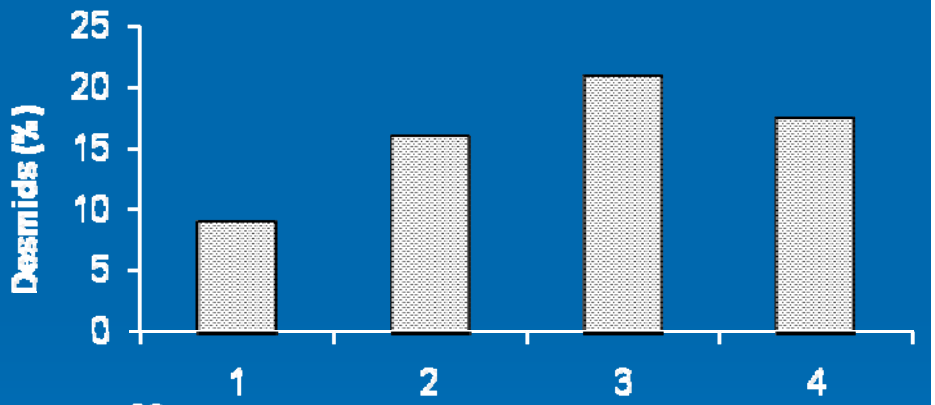


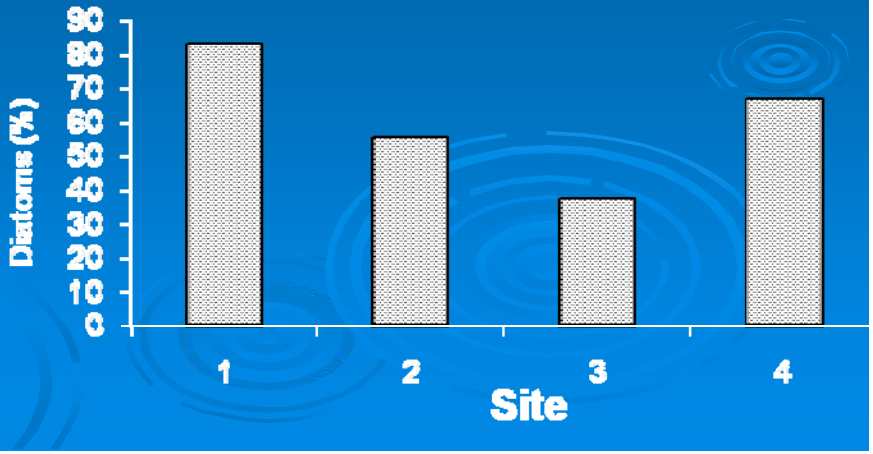












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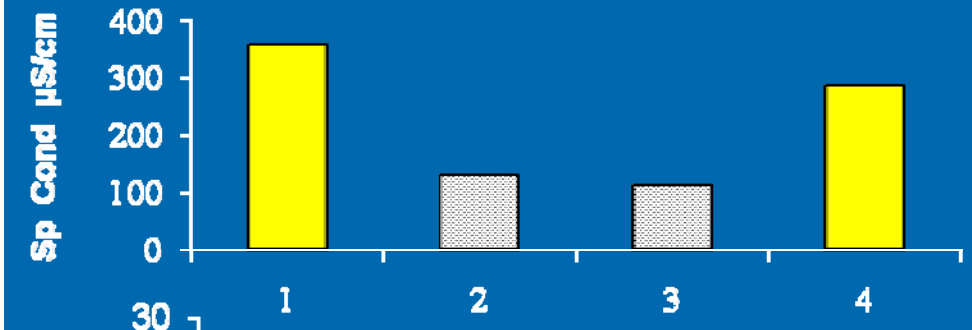

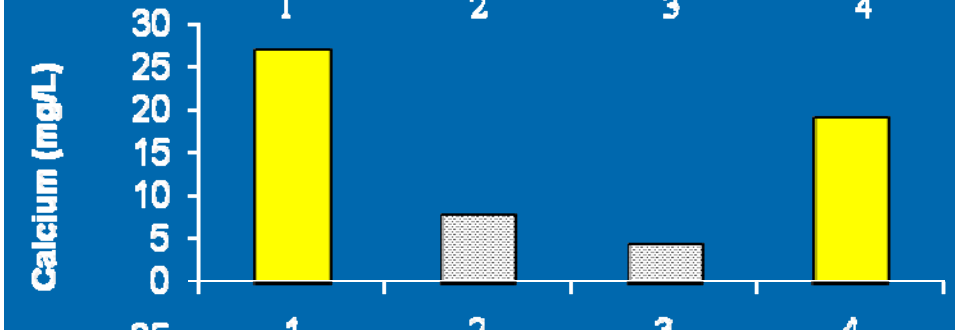

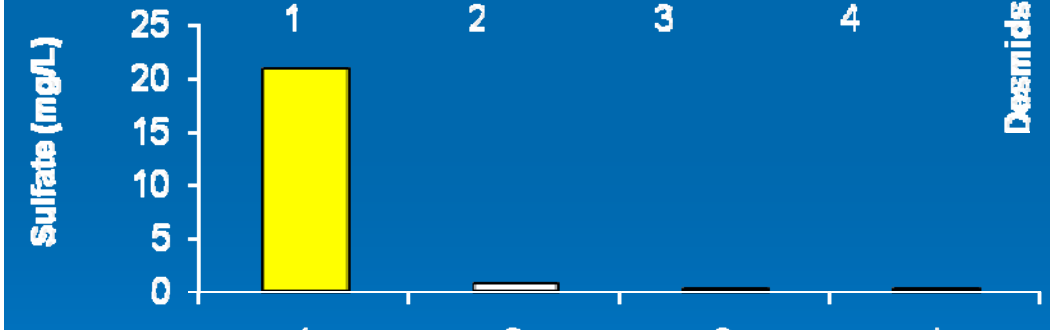

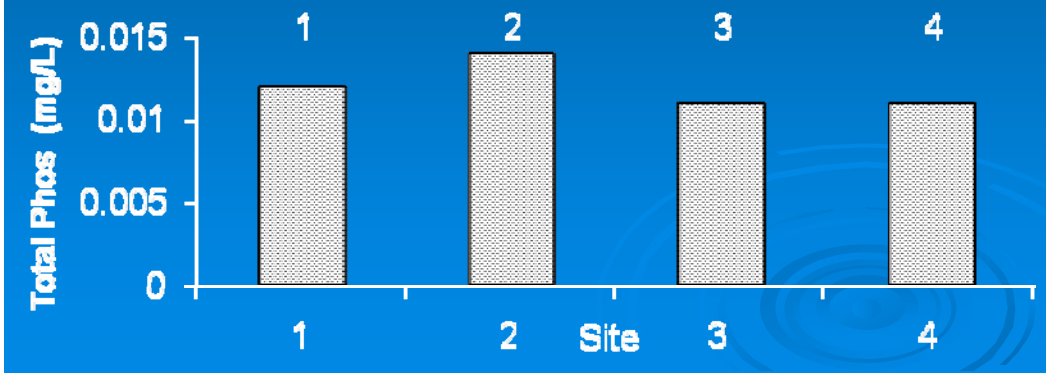

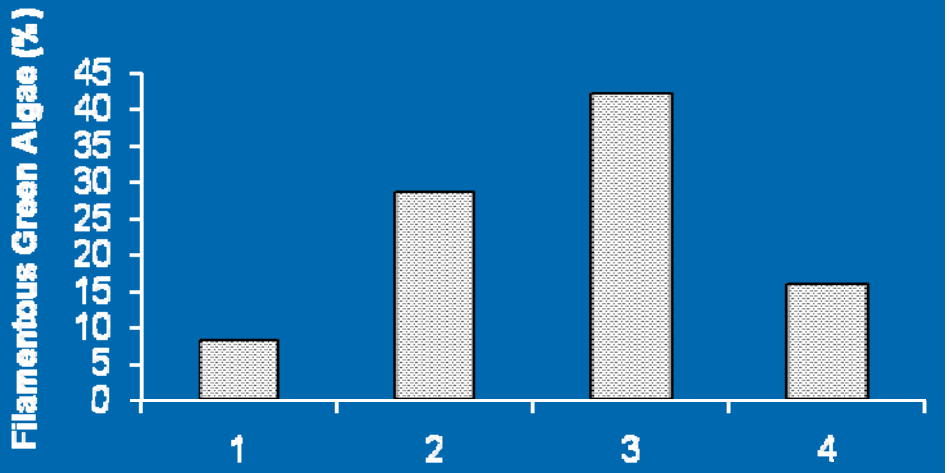

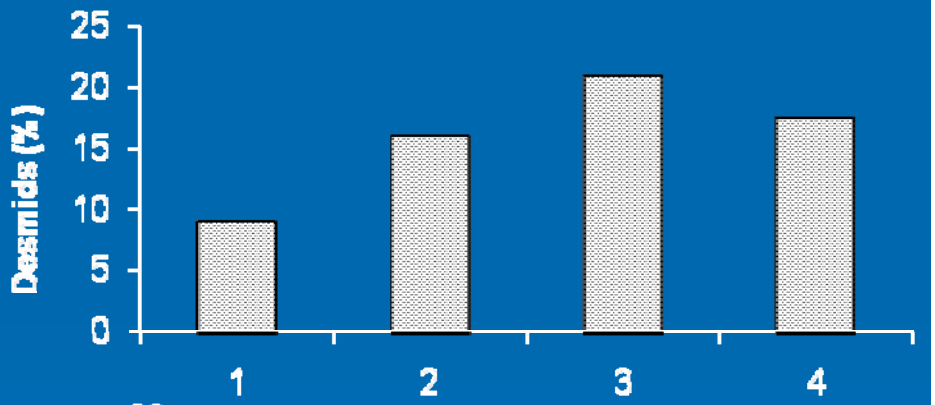

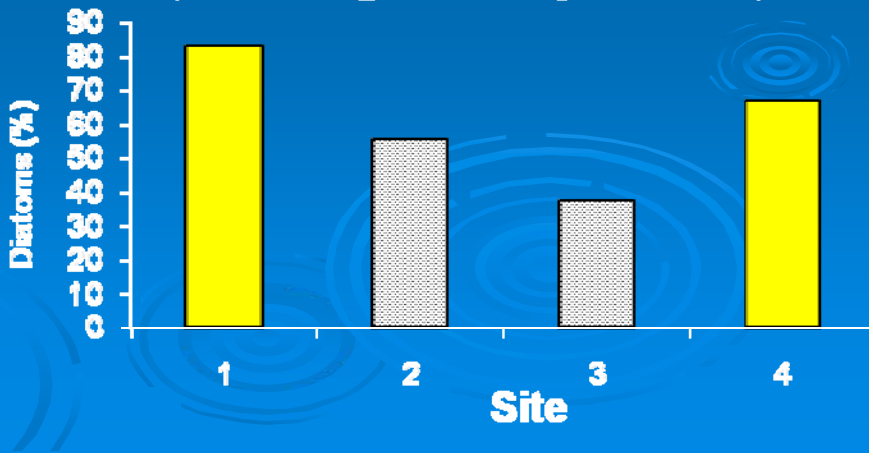

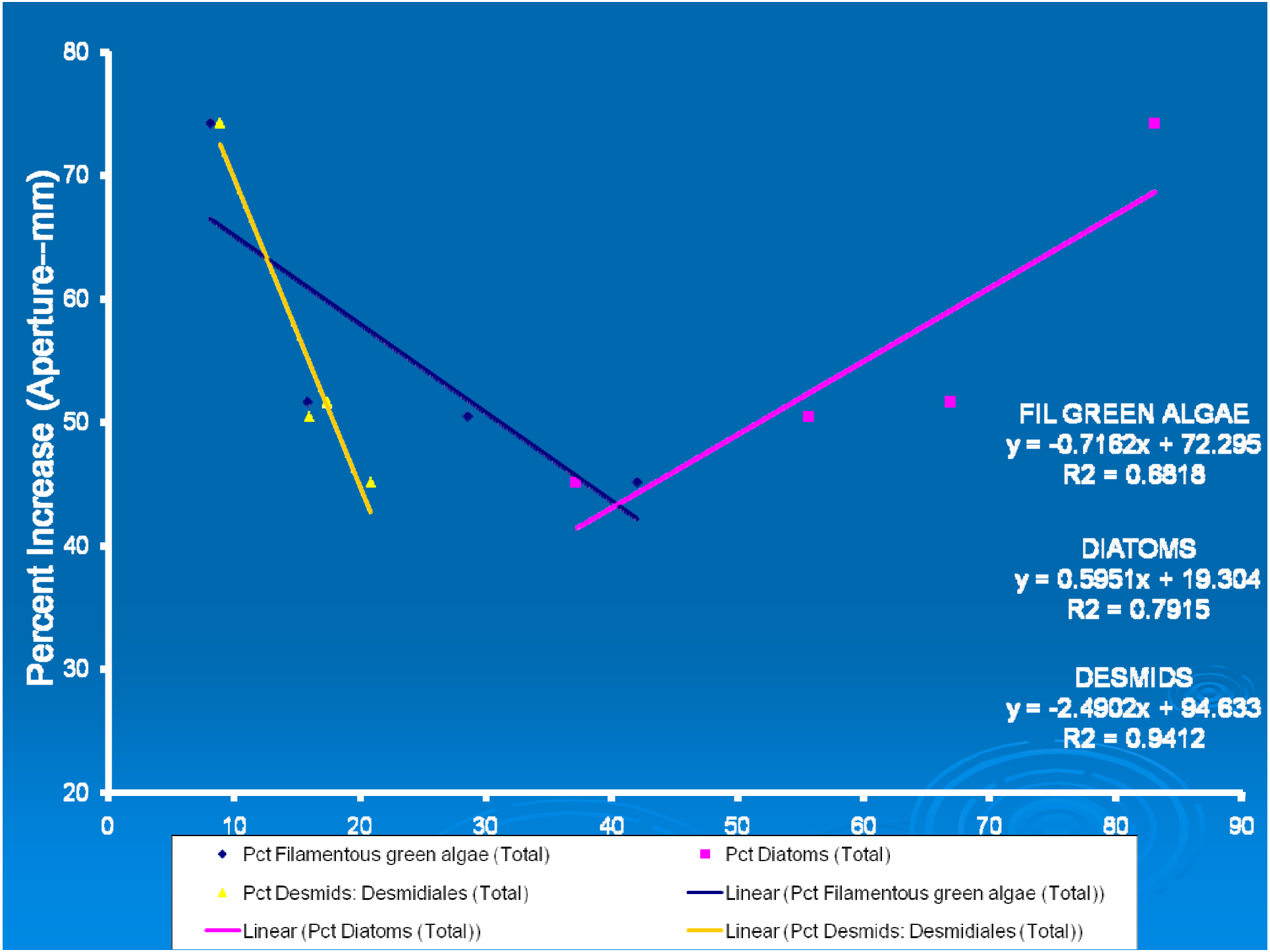
Percent Increase (Aperture--mm)
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
FIL GREEN ALGAE
y = -0.7162x + 72.295
R2 = 0.6818
DIATOMS
y = 0.5951x + 19.304
R2 = 0.7915
DESMIDS
y = -2.4902x + 94.633
R2 = 0.9412
Pct Filamentous green algae (Total)
Pct Diatoms (Total)
Pct Desmids: Desmidiales (Total)
Linear (Pct Filamentous green algae (Total))
Linear (Pct Diatoms (Total))
Linear (Pct Desmids: Desmidiales (Total))

Future Water Chemistry/Apple Snail Studies

Water Chemistry Control Tanks

- Tanks with juvenile snails housed at Refuge headquarters
- Water supplied from 4 sites (2, 3, 4, 9)
- Snails fed uniform diet of romaine lettuce
- Understand direct water chemistry effects on snail growth

Future Water Chemistry/Apple Snail Studies

Egg Cluster Comparison Across Interior sites

- Clusters collected from Interior 8 sites and hatched at Refuge headquarters.
- Clusters measured for egg diameter and egg number
- Snail neonates measured for wet weight at birth
- Separate clusters analyzed for C:N ratios (reported as nutrient content, Baur and Baur, 1997).
- Understand relationships of snail egg clusters reproduced in varying water chemistry environments
- Possible advantages of larger eggs/smaller clusters (larger neonates at birth)?

Clusters from Central Zone **Clusters from Perimeter (West) Zone**

Discussion

- Relationships between apple snail growth and periphyton composition;
- Correlation of periphyton composition and water gradients within the Refuge;
- Nutritional value of water quality-driven periphyton assemblages found along the water quality gradient within the Refuge effect ecologically significant primary consumer.
- Provide insight regarding causes of *Pomacea paludosa* declines in Refuge
- Supports snail kite conservation


Questions?