Not a slow snail:

Rapid rise of environmental awareness and ecological insights regarding invasive island apple snails (*Pomacea insularum*)

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Mollusks invasions neither slow nor without consequence...especially for wetlands

- Come with other invasives
  - Hitchhiking
- Habitat destruction
  - Impede restoration efforts
- Food web alteration
- Potential disease vector
Talk Outline & Model

- Documenting Pace

Predicting Pace

Keeping Up with Pace

Invasive History + Reproductive Habits + Management Actions

Exotic Invasive *P. insularum*

From Rawlings *et al.* 2007

**Applesnails and Giant Ram’s-horn Snails**

All genera and species of the Family Ampullariidae (previously called Pilidae) including *Pomacea* and *Marisa*, except spiketop applesnail (*Pomacea bridgesii*)

Figure 1

Phylogenetic relationships among 46 unique mitochondrial haplotypes from 95 individual apple snails for which complete sequences were generated.

Armand Bayou, Clear Lake, Texas
**P. insularum** clutches in TX equal 8x as large (on average) as **P. canaliculata** clutches from UR

Out of South America: multiple origins of non-native apple snails in Asia


Predicting the Pace

Documenting Pace + Predicting Pace

Invasive History + Reproductive Habits
Oviposition
**Experimental Set-Ups**

- Deterred non-substrate oviposition
- Water temperature: 28°C
- Recorded number of clutches laid on each surface
- Statistics:
  - Chi² Preference Test
Where do they lay clutches?
Do lab experiments reflect field patterns?

Percentage of Oviposition Site Census

<table>
<thead>
<tr>
<th>Clutch Substrate</th>
<th>August 2008</th>
<th>May 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>80%</td>
<td>60%</td>
</tr>
<tr>
<td>Wood</td>
<td>40%</td>
<td>30%</td>
</tr>
<tr>
<td>Metal</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Concrete</td>
<td>0%</td>
<td>10%</td>
</tr>
</tbody>
</table>

N=584

N=180

p<0.05

How do frequency and intensity alter water stress to clutches?

Developmental Stage matters

Clutch Age? On-going

Kruskal-Wallis $\chi^2 = 21.927$ $p < 0.001$

What other ways do snails and plants interact?

Habitat and Herbivory

![Graph showing plant consumption by snails with or without crayfish.](image)

- 0.2 g g⁻¹ d⁻¹
- 50% less
- 80% less

![Bar chart showing number of observations for different plant species.](image)

- Milfoil
- Taro
- Hyacinth

Incubating in the publication process:

- Oviposition trends indicate a reliance on wild taro in the lab and field.
- Snails also utilize exotic plants for food and shelter.
  - Targeting these plant stands may worth increased management action.
- Water exposure damages clutches.
  - Lower hatching rates; premature release
  - Also likely to depend on degree of clutch development
- Eggs likely represent the easiest life history stage to manage to help slow down population growth.
Keeping up with the pace of invasion

Invasive History + Reproductive Habits + Management Actions
Spiral of Invasion

- Native Range
- Arrival in New Environment
- Establishment
- Reproduction
- Spread to New Areas
- Impact

• Fecundity = 2000 eggs/adult
• Lab Hatching Efficiency = 30%
• Juvenile survivorship = 1%

Pace of knowledge gain

http://snailbusters.wordpress.com/about/
Academia meets Consulting: Snail Busters

Jess Van Dyke
- Retired from Florida DEP
- Regional Biologist
- Colleague: Dr. Sean McGlynn

Started work with stormwater pond south of Tallahassee, FL

Discovered hand-removal to be impossible
- Started trapping
- Has removed 4 tons from 15-acre system

Started blog b/c discouraged on the lack of information about these snails in the primary literature
Snails make the news yesterday!

- Apple snails in Mobile, AL
- Spread into Mobile-Tensaw delta
- Dramatic changes in just 1 year
- Successfully overwintered

Photo and Story Credit to Ben Raimes
Hot off the blog:

- Jess’s research
  - Test of SePRO’s chelated copper products
  - Solicited by professional colleague
  - Describes challenges of working with snails and exposure to chemicals
  - Provides cautious preliminary results
Hot off the blog: Battle Snail versus Other EIS

Red imported fire ants attacking a clutch of **Solenopsis invicta**

**Procamburus clarkii**, Red Swamp or Louisiana crayfish
Hot off the blog: Distribution of *Pomacea insularum* in South Florida

- Threat to native *Pomacea paludosa*
- Multi-faceted impacts on endangered kite
- Huge challenge to control spread
Syncing Up the Pace

- Action regarding apple snails & wetlands needs to be taken quickly.
- Understanding basic fecundity remains central to applied management.
- Scientific blogging of apple snail invasion serves as to foster communication & research in “real time.”
- Helps everyone keep up the pace with new insights.
Thank you!
Any Questions?

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