

# THE RECIPE FOR DESTRUCTION: PESTICIDES ALONE ARE NOT THE ONLY KEY TO GIANT AFRICAN SNAIL (*LISSACHATINA FULICA*) ERADICATION

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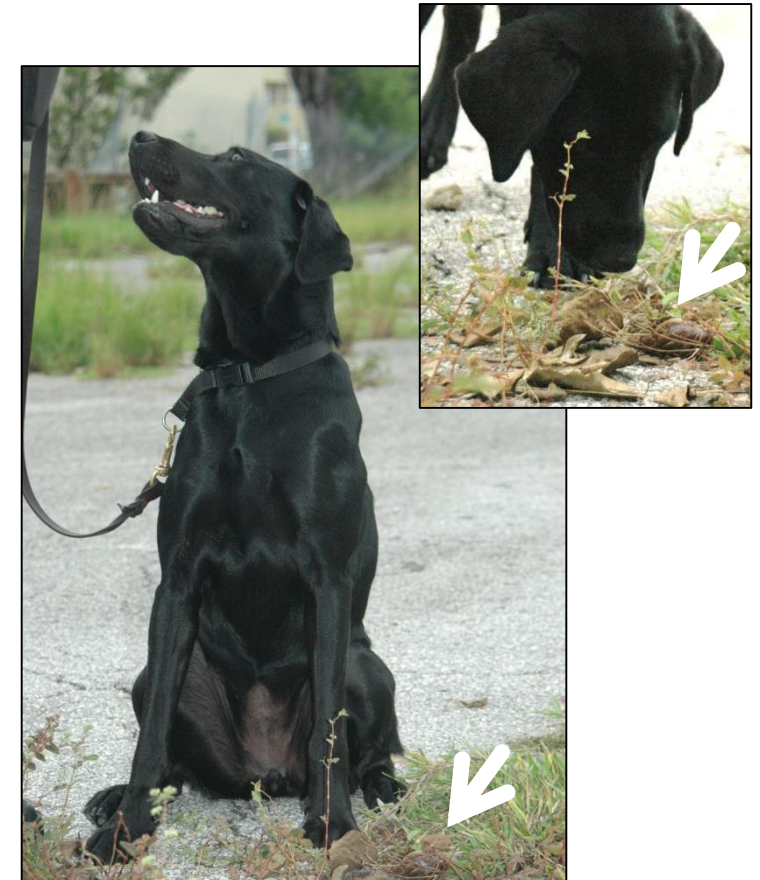
# GIANT AFRICAN SNAIL (*LISSACHATINA FULICA* (BOWDICH))

- One of the most damaging snails in the world
- Consumes at least 500 types of plants
- Can vector plant pathogens
- Threaten human health while functioning as a host in the life cycle of rat lung worm (*Angiostrongylus cantonensis*)
- Detected Oct 2011 in Miami, FL



# FLORIDA'S GAS ERADICATION PROGRAM

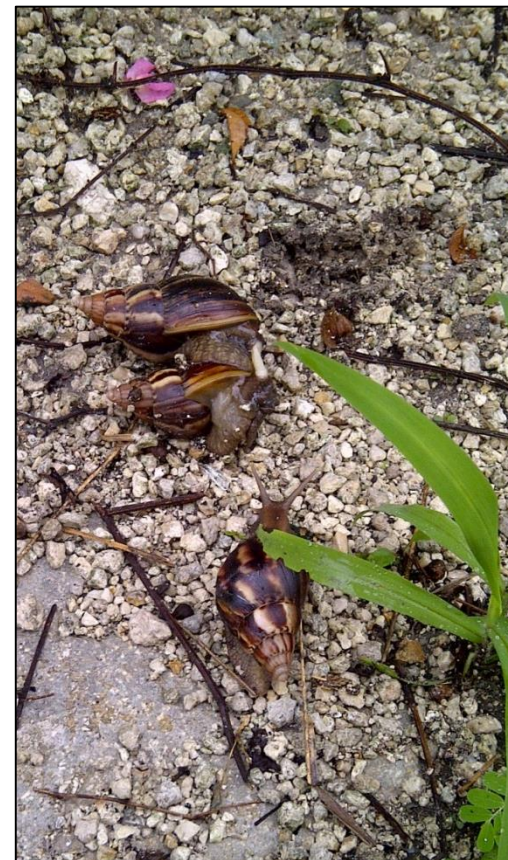
- USDA funded program run by the Florida Dept. of Agriculture and Consumer Service
- Bimonthly visits to infested properties
  - Hand collection
  - Debris removal
  - Pesticide application (Iron Phosphate, Spring 2013 added Metaldehyde)
  - Night Surveys/Collections
  - Detector dogs
- Regulatory Actions
  - Quarantined areas (currently all residential)
  - Compliance agreements with landscapers for controlled movement and disposal of debris
  - Access to properties
- Continuous public outreach
  - Led to finding 98% of new locations



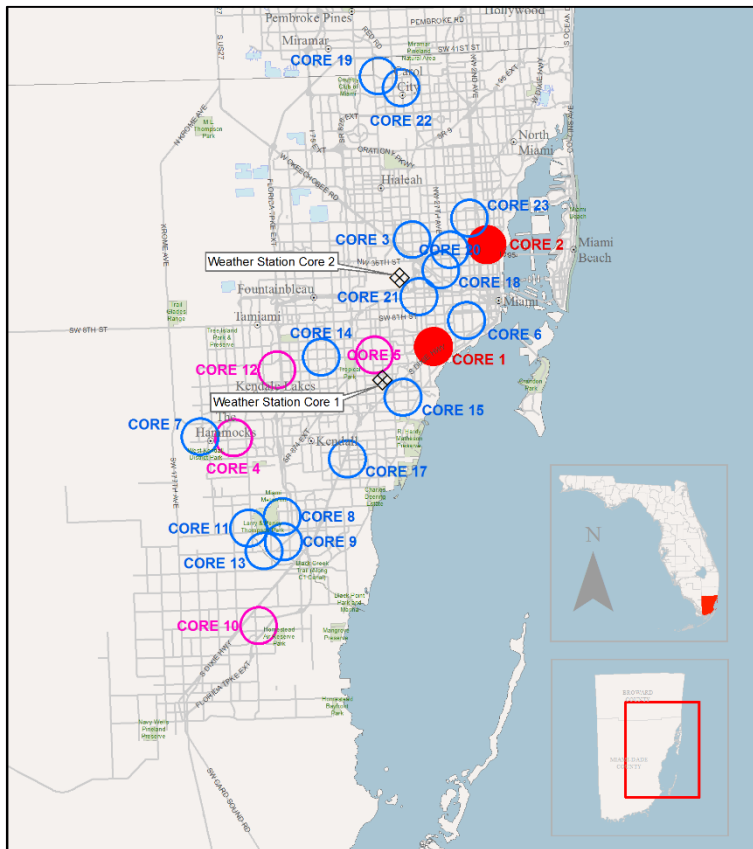
Photos: Bryce Donner, UFL

# SNAIL REPRODUCTIVE STUDIES - GOALS

- Determine the influence of south Florida's seasonal conditions and eradication efforts on the egg producing population



# POPULATIONS (CORES) STUDIED



○ ● ○ Cores Sampled

➤ Up to 100 snails (25 to >100 mm) collected from each core/week



# SNAIL REPRODUCTIVE STUDY-METHODS

- Measured and dissected snails
- Counted number of eggs



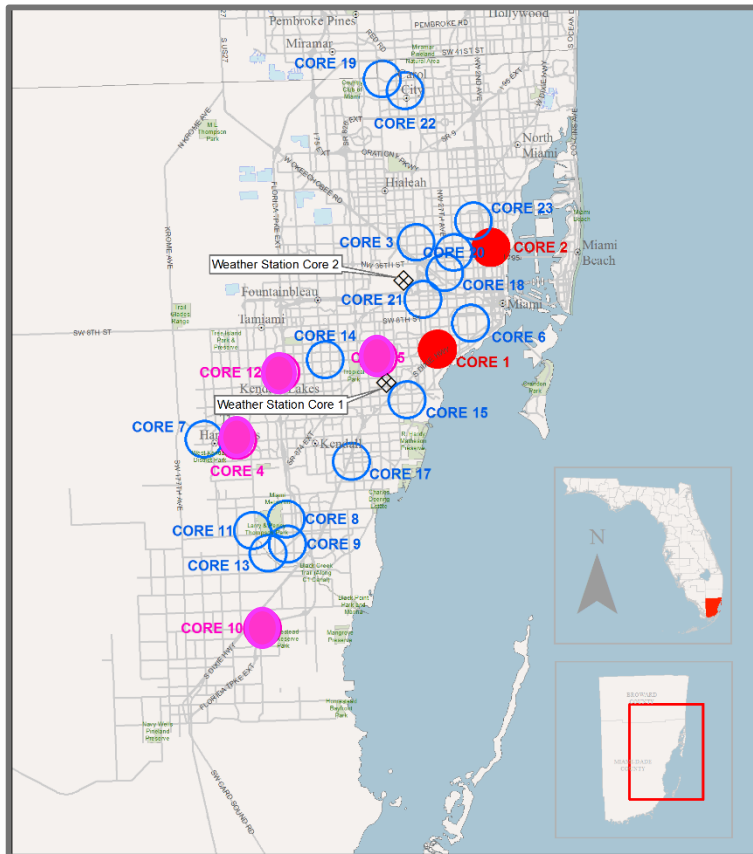
# SNAIL REPRODUCTIVE STUDY-RESULTS

- 2 years of data from 22 Cores
- 23,890 snails dissected
- Size with eggs >47.5 mm
- 5% gravid (2% winter/15% summer)
- Average 113 eggs/snail





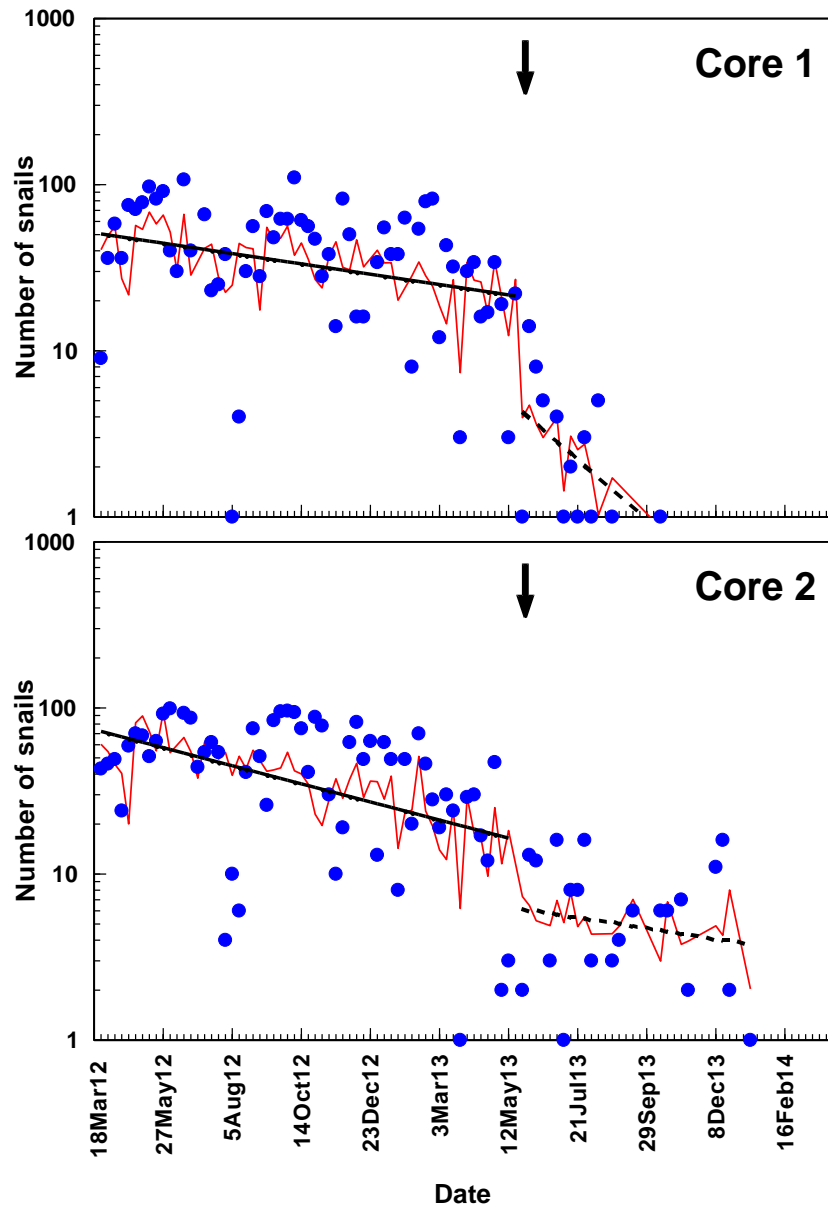
# ERADICATION AND ENVIRONMENTAL EFFECTS MODELED



Selected Cores with highest number of snails collected consistently throughout the study

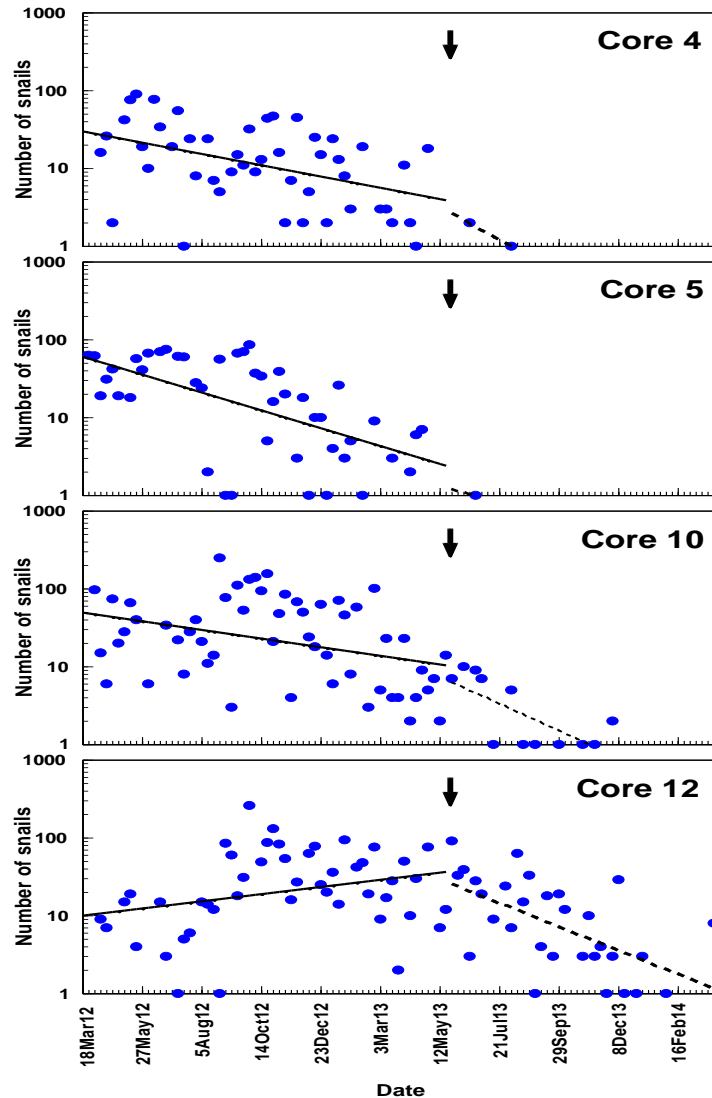
- Cores environmental and eradication effects modeled
- Cores eradication effects modeled

# Factors Affecting Giant African Snail Populations in South Florida



- Addition of metaldehyde dramatically decreased the number of reproductive sized snails (↓)
- Environmental factors made minimal contribution to explaining population changes
  - Only percent relative humidity significant (—)

# Impact of Metaldehyde Dependent on Initial Size of Giant African Snail Populations



- In smaller Cores (4&5) the effect of adding metaldehyde not as dramatic
  - Other control methods working
- Significantly steeper slope in larger Cores
  - Large impact of metaldehyde
- Reproducing sized snails were missing from all Cores by the end of study

## CONCLUSIONS

- By winter 2014 very few or no gravid snails collected from the 22 cores
- Metaldehyde dramatically reduced snail numbers in large cores
- Study showed cultural control methods (hand collection/debris removal) were working



Snail and nest revealed by raking

# GIANT AFRICAN SNAIL IN TRINIDAD AND TOBAGO

- Discovered in Diego Martin, Trinidad in October 2008
- Metaldehyde and thiodicarb used at beginning of program
- The spread to other areas (hitch hikers and flooding)
  - 4 new sites -2014
  - 1 new site – 2015
  - 2 new sites – 2016
  - 15 new sites- 2017
  - 17 new site 2018
- 2018 eradication program switched to management program



Snails seen in and on trash containers in Mt. Lambert, Trinidad

# SNAILS CAUSING ECONOMIC DAMAGE

- Farmers reporting 100% damage/loss of squash
- Feeding of on okra foliage found to reduce the production of pods
- Large cost for pesticides to control snails



Snails feeding on squash and okra Mt. Lambert, Trinidad

# SNAILS PROTECTED IN REFUGES

- Debris left on property
- Small satellite populations undetected
- Populations protected on inaccessible property



Dead snails near metaldehyde treated debris pile



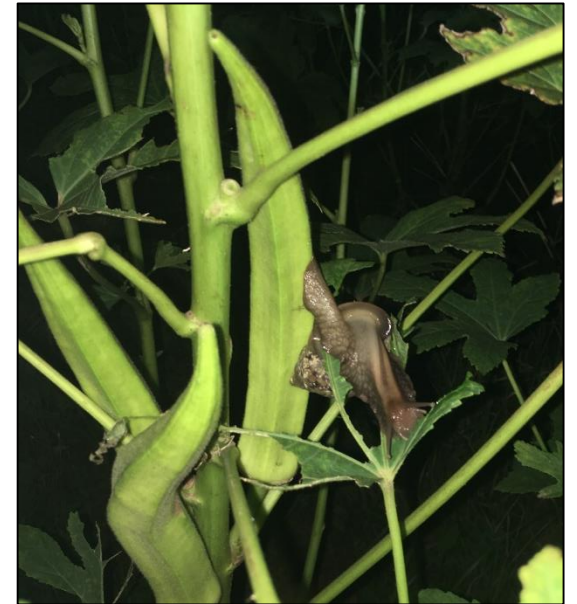
Snail feeding damage highest near treated pile



Night survey revealed snails leaving pile and feeding on tomatoes

# LESSONS FROM FLORIDA'S AND TRINIDAD & TOBAGO'S PROGRAMS

- Metaldehyde an effective pesticide but...
  - Can rapidly reduced snail numbers but may not eliminate all snails
- Debris removal essential
- Populations need to be identified locally (night surveys) and far away (continuous outreach)
- Legal mechanism to access all properties (snails escaped properties 'corralled' with metaldehyde)



Snail feeding in okra canopy avoiding metaldehyde bait



# THE CONNECTION TO HORNTAIL SNAILS AND NURSERIES

- An enemies greatest strength could be their greatest weakness...
  - Can we exploit snail behavior and ecology?
- Their greatest weakness could be their greatest strength...
  - We need to be vigilant and not underestimate the threat.<sup>2</sup>



Horntail snail with limited food choice in Coconut Grove

# SNAILS CAN EAT ALMOST EVERYTHING

## Snail Strength:

- They can survive even when food resources sub-optimal
- Populations could explode once given the optimal food

## Snail Weakness:

- Snails need a balance diet and preferred foods/nutritional needs could lure the snails from hiding

## How could we exploit the behavior for management?

- Draw them away from nursery plants
- Draw them to pesticides and traps



Horntail snail feeding in Coconut Grove



Snail response lure in the laboratory

# SNAILS NEED A HUMID ENVIRONMENT

## Snail Strength:

- Readily find moist environments (like irrigated nursery pots)
- Snails can survive long periods (months!) of unfavorable environmental conditions –'aestivate'
  - Hiding (not eradicated) during extended dry conditions
  - Pesticides may not be as effective (not feeding and may not penetrate the shell or egg shell)
  - Eggs are still developing within the snail

## Snail Weakness:

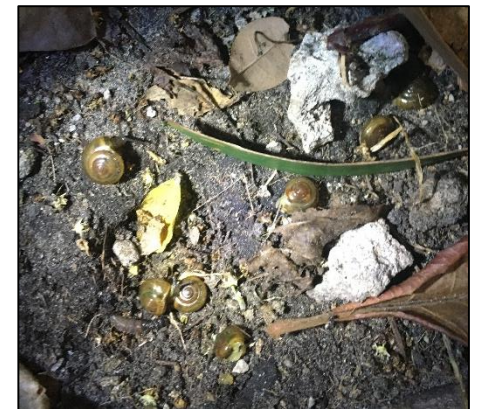
- They return to the moist locations
- They are not reproducing or moving and are very vulnerable
- They are very hungry when the right conditions (a rain after a long dry period) occur

## How could we exploit the behavior for management?

- Remove moist hiding spots near pots
- Remove debris and remove the next generations
- Apply bait when the snails are hungry



Snail forming protective operculum



Patch of horntail snail found in Coconut Grove

# SNAILS DON'T FLY BUT THEY CAN DEFY GRAVITY

## Snail Strengths

- Mucus
  - They can move into the canopy to avoid pesticides
  - They can float over certain barriers
  - They can stick and hang from most surfaces
- Flexible and stretchable bodies
  - They can reach over barriers and out of traps

## Snail Weakness

- They do not have wings
- They do not blow in the wind
- Need us or a big storm event to move far

## How could we exploit the behavior for management?

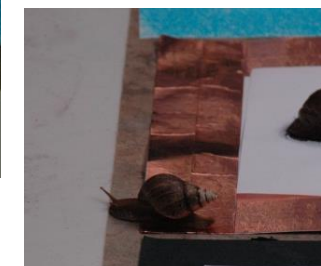
- Make nursery stock unreachable
- Eradicate them for the immediate area



Snail feeding in okra canopy avoiding metaldehyde bait



Snail barrier test in DPI Gainesville quarantine



Snail floats over copper tap but another dies after touching copper sulfate

# CONCLUSIONS

- Because of the giant African snail eradication program we have a better understanding of snail control and have a strategy to eradicate snails
- Metaldehyde is a valuable tool but will not work alone
- We need to understand the unique character of this pest and develop an IPM approach to exploit weaknesses
- We should not underestimate a snail as a pest



THANK YOU! QUESTIONS?



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What??  
Marked snail on cane toad in Trinidad



Giant African snail sampling "helper"  
Core 2, Miami, FL