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

AMY L. RODA¹, GÖSTA NACHMAN², SCOTT WEIHMANN¹, MARY YONG CONG³, FREDRICK ZIMMERMAN¹

¹USDA APHIS PPQ ²UNIVERSITY OF COPENHAGEN, COPENHAGEN DENMARK, ³FLORIDA DEPT. OF CONSUMER SERVICES, MIAMI, FL
ACKNOWLEDGEMENTS

- Amy Howe
- Arnold Hara
- Bill Tore
- Bryce Donner
- Carmen Pineiro
- Chris Jacobsen
- Cory Penca
- David Buzzi
- Eduardo Varona
- Holly Glenn
- Jesus Castrezana
- Jocelyn Millar
- Julio Rodriguez
- Kathy Wyatt
- Lisa Mosser
- Marcus Jones
- Marcus Ramdwar
- Maria Chong-Qui
- Rory McDonnell
- Rusty Noah
- Shweta Sharma
- Tashma Moss
- Teresa Rosemond
- Teri Allen
- Tracy Wright
- Trevor Smith
- Tim Bond
- Xikui Wei
- GALS Teams
- Dexavior Smith
- Sherry Steel

Photos: Roda USDA
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

Photo: Amy Roda USDA
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
SNAIL REPRODUCTIVE STUDIES - GOALS

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

Photo: Amy Roda USDA
POPULATIONS (CORES) STUDIED

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

Photo: Fred Zimmerman USDA
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

Night survey revealed snails leaving pile and feeding on tomatoes

Snail feeding damage highest near treated pile
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
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.
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 balanced 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
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
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 floats over copper tap but another dies after touching copper sulfate

Snail barrier test in DPI Gainesville quarantine
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 under estimate a snail as a pest
THANK YOU! QUESTIONS?
THANK YOU! QUESTIONS?

What??
Marked snail on cane toad in Trinidad

Giant African snail sampling “helper”
Core 2, Miami, FL