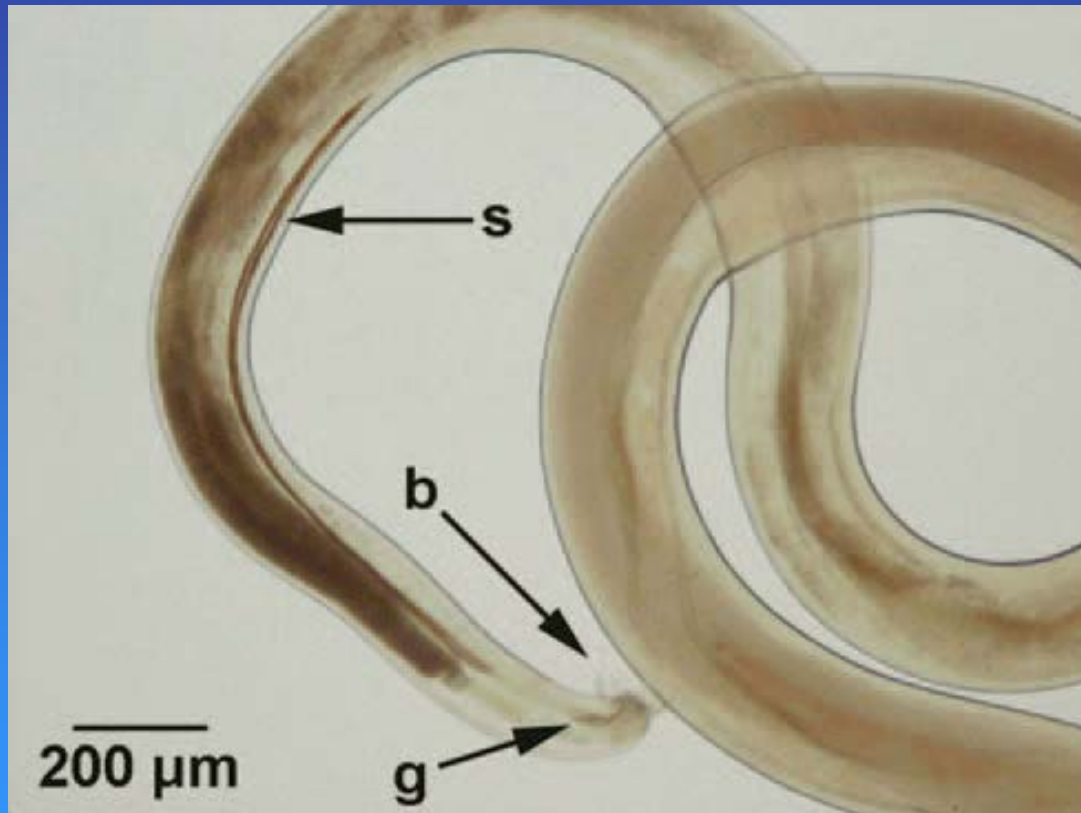# Human Health Risks Associated with Channeled Apple Snails in the GSARP Region

John Teem, Division of Aquaculture, Florida Department of Agriculture
Juan B. Gutierrez, Biomedical Mathematics, Florida State University

Angiostrongylus cantonesis

The Life Cycle of *A. cantonesis* Requires Infection of a Rat Host in Addition to a Snail Host

Paratenic hosts- an animal acting as a substitute intermediate host of a parasite, usually having acquired the parasite by ingestion of the original host; no development of the parasite takes place but the phenomenon aids in the transmission of infection. Called also transfer or transport host.

**Humans   Birds
Monkeys   Shrimp
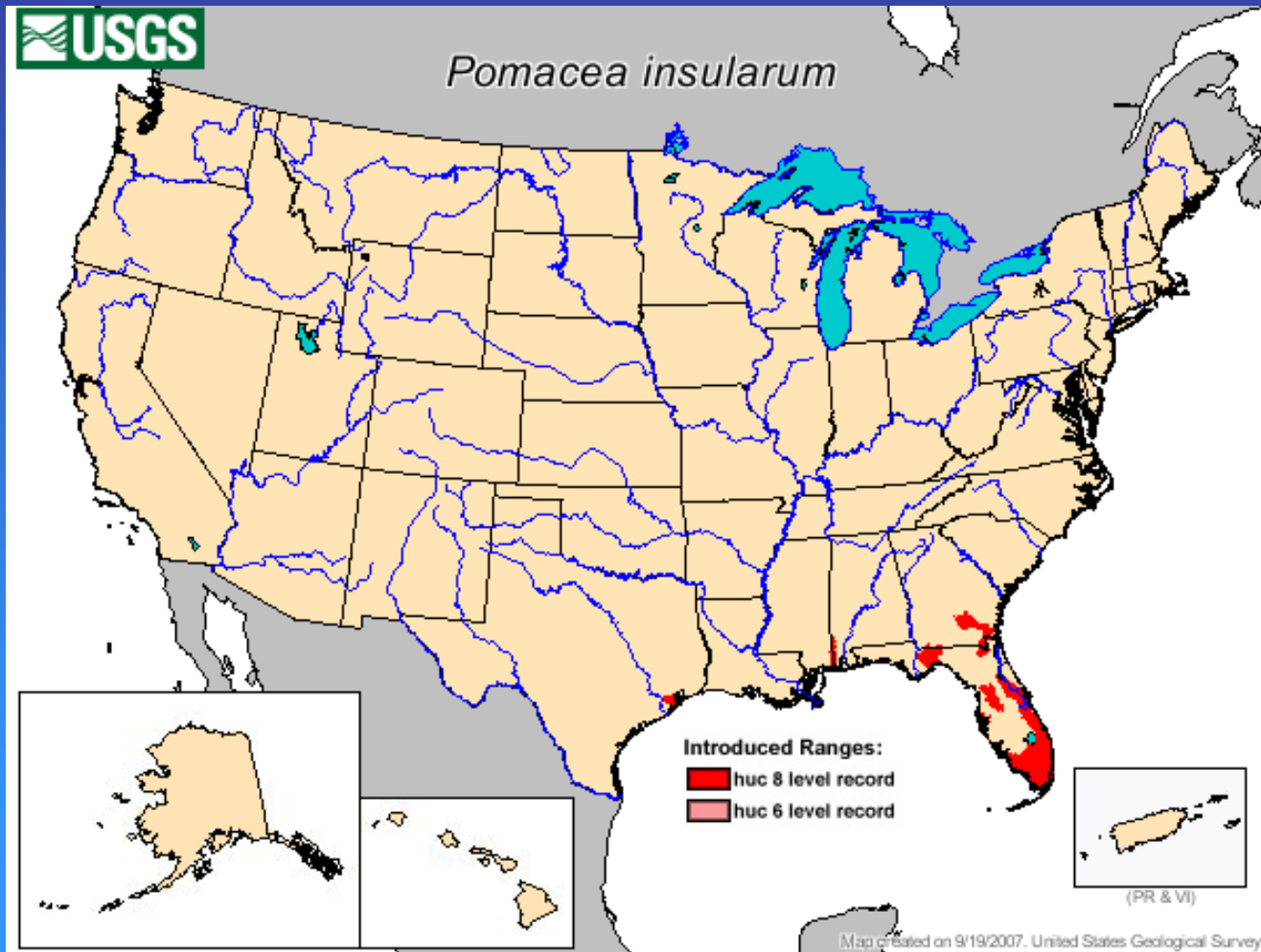Horses   Land Crabs
Pigs
Frogs
Snakes**
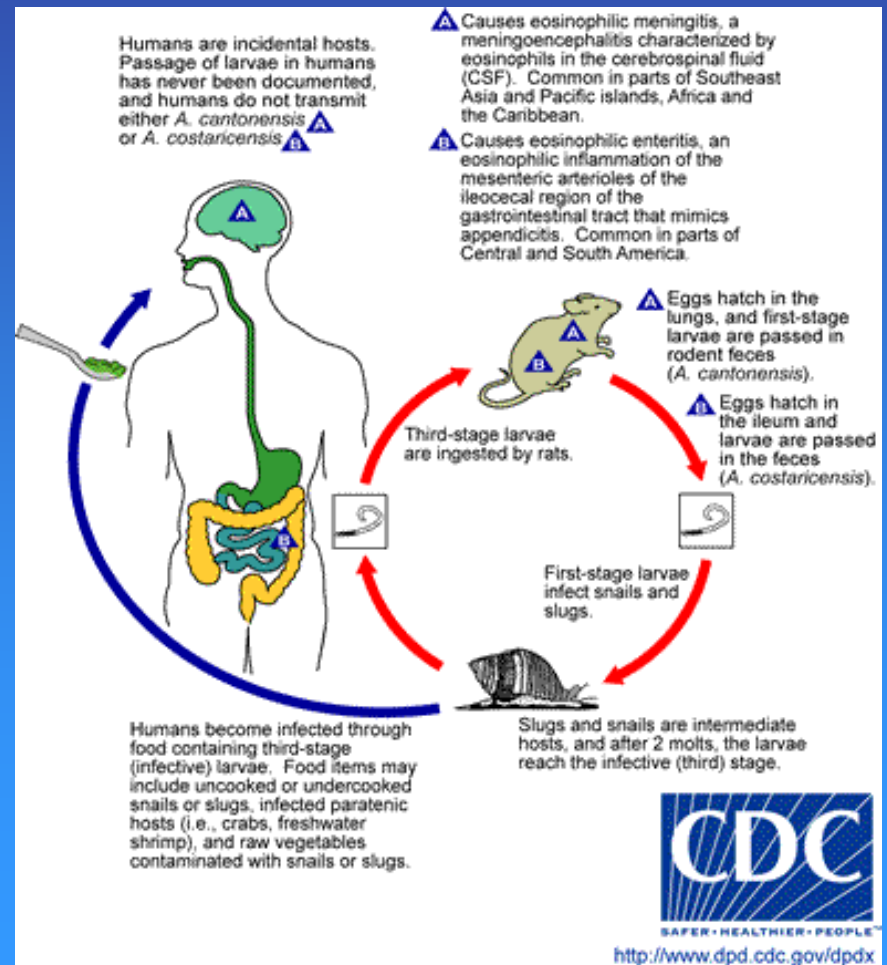
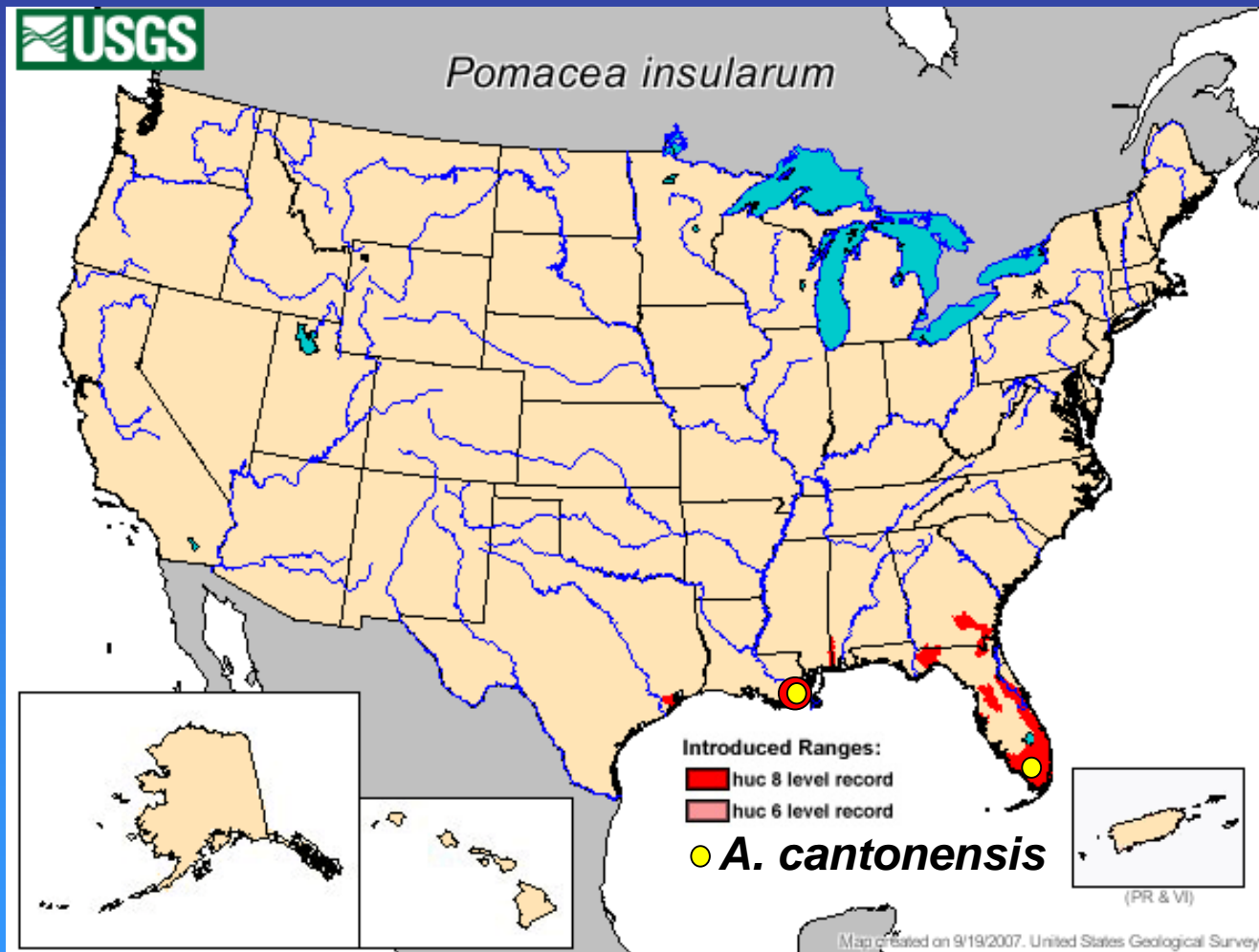# The Predominate Nonindigenous Apple Snail in the GSARP Region is *Pomacea insularum*

Pomacea insularum

Pomacea insularum

Pomacea insularum

USGS

Introduced Ranges:
- huc 8 level record
- huc 6 level record

○ *A. cantonensis*

(PR & VI)

Map created on 9/19/2007. United States Geological Survey

Assessing the Health Risks Associated with Channeled Apple Snails in the GSARP Region

Collect apple snails from New Orleans and Miami, send samples to the CDC in Atlanta to assay for the presence of the rat lung worm using DNA-based detection assays (PCR)

Develop an in-house capacity to detect the rat lung worm using PCR. Test channeled apple snails from a third location (to be determined).

Develop a mathematical model to predict the spread of channeled apple snails.

# PCR Detection of Rat Lung Worm In Infected Snails
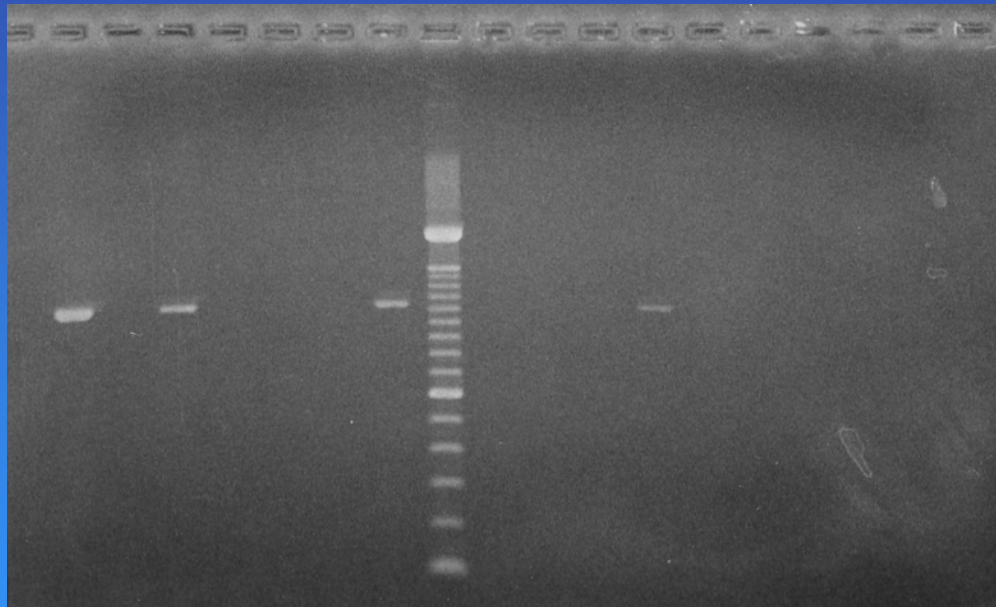
Miami: 60 analyzed, all negative
**New Orleans: 31 analyzed, 5 positives**

DNA-based detection of rat lung worm in channeled apple snails in the GSARP region

Location	Samples assayed	Species	Positive for A. cantonensis
New Orleans, LA	31/60	Pomacea insularum	5
Miami, FL (Miami Metro Zoo)	60/60	Marisa cornuarietus	0
Picayune, MS	43/43	Pomacea insularum	0
Houston, TX	60/60	Pomacea insularum	0
Everglades National Park, FL	52/52	Pomacea insularum	0

A. cantonesis was only found in New Orleans Snails
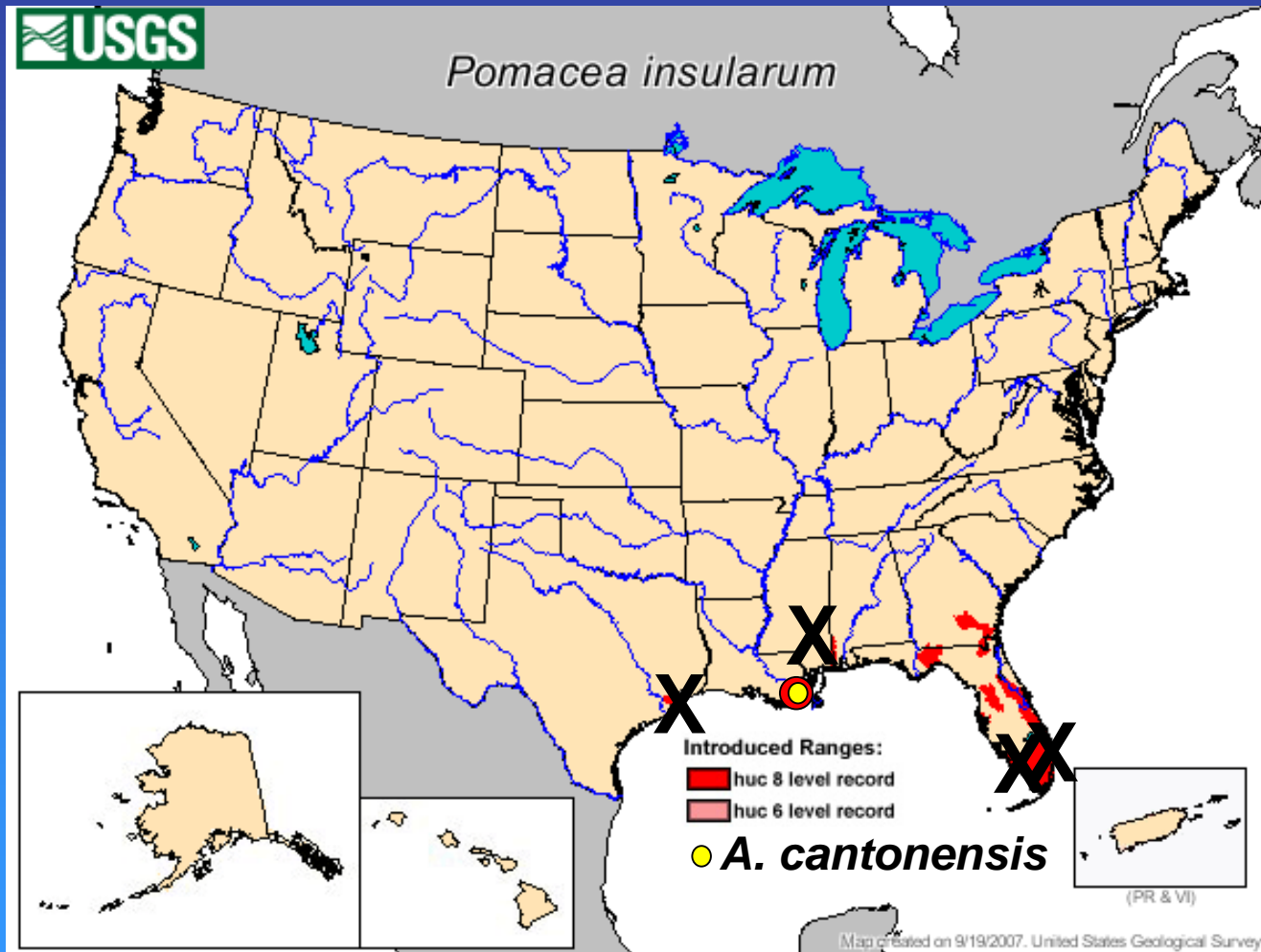
Transfer of Detection Technology to FDACS/Division of Aquaculture
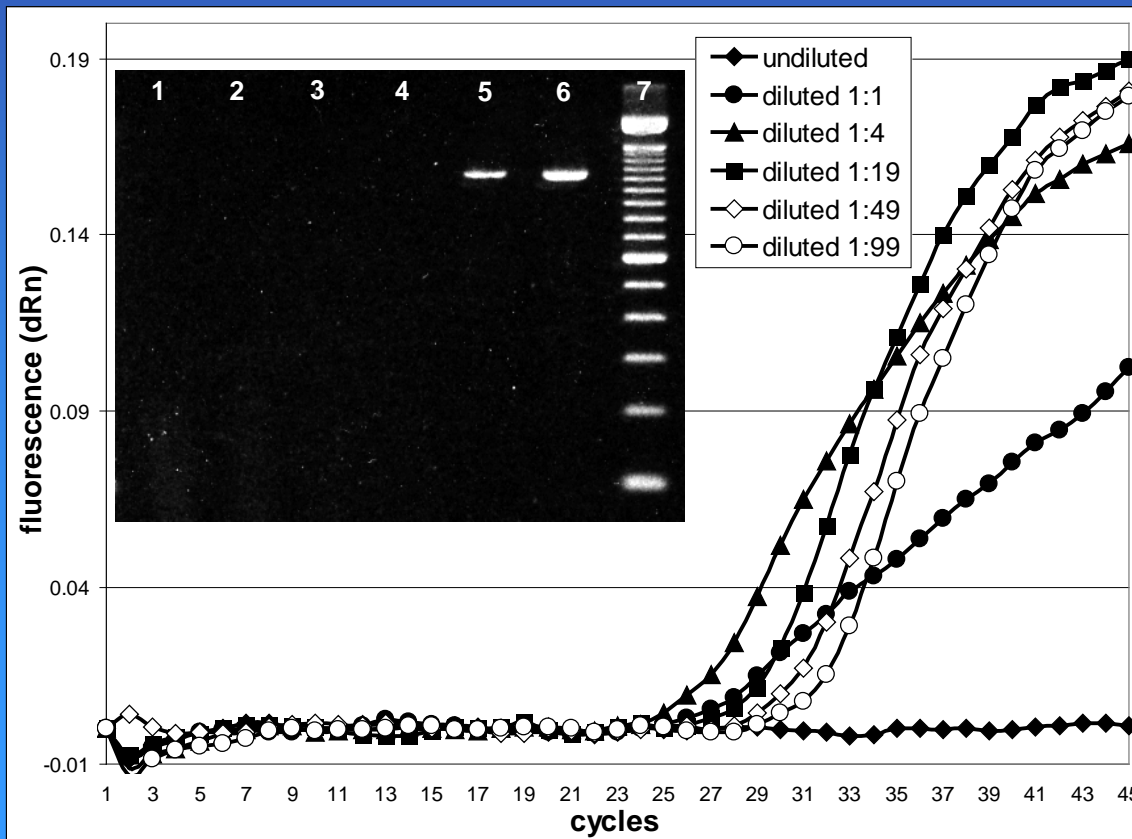
Some problems:

1. PCR inhibitors
2. FDACS limited in DNA purification equipment

Solution:

TaqMan real-time PCR assay developed at CDC.

Used successfully at FDACS to detect *A. cantonesis* positive samples from New Orleans

Mathematical Model Objectives

Create partial differential equations that model the diffusion of a species over time through a spatial domain.

Create a grid of polygons representing the spatial domain, in which each polygon represents a geographic area with specific properties related to the diffusion of the species.

Model the diffusion of the species through the grid, calibrating the diffusion rate with experimental data.

Generate new grids using existing GIS data maps.

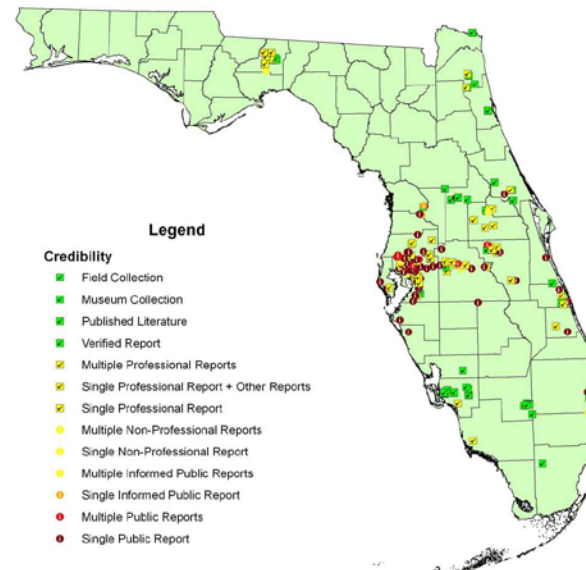Model the effects of biocontrol efforts on spread.

Invasion Modeled Within a Spatial Domain

Create partial differential equations (PDEs) that model the diffusion of a species over time through a spatial domain.

Ideally, the spatial domain will be represented in the format of geographic map which will show the spread of the species from points of introduction over time.

Florida Fish and Wildlife Conservation Commission
Exotic Applesnail Locations
15 November 2006

Legend
Credibility
- Field Collection
- Museum Collection
- Published Literature
- Verified Report
- Multiple Professional Reports
- Single Professional Report + Other Reports
- Single Professional Report
- Multiple Non-Professional Reports
- Single Non-Professional Report
- Multiple Informed Public Reports
- Single Informed Public Report
- Multiple Public Reports
- Single Public Report

Modeling the Channeled Apple Snail Invasion at Lake Munsen (Tallahassee, FL)

Conclusions

Five snails from New Orleans were found to be positive for rat lung worm.

No samples were positive for the parasite in snails taken from Miami, FL, or Picayune, MS. However, both sites had previously had cases of infected paratenic hosts (a gibbon and a horse, respectively).

No samples were positive for the parasite in snails taken from Houston, TX or Everglades National Park, FL.

Results suggest that rat lung worm infections of channeled apple snails are not widespread throughout the GSARP region.

Conclusions

DNA-based detection assays for the rat lungworm were transferred from the CDC to the Florida Department of Agriculture and Consumer Services.

Additional testing can be performed in the future to better define the geographic distribution of the parasite in the GSARP region.

Conclusions

A mathematical model was devised for modeling the spread of an invasive species through a spatial domain.

A software product was produced allowing a user to generate an invasive species diffusion model video for a geographic area.

http://www.math.fsu.edu/~jgutierr/jbg_personal/scilab_en.html

Recently an outbreak of the rat lungworm occurred in Hawaii

Parmarion martensi

Two people are in a coma since December 2008.

Infected people ingested raw produce from their gardens that may have had a small infected slug.

*Parmarion martensi, a nonnative* slug from Asia may be the cause of the recent oubreak.

Slugs like *P. martensi* may pose a greater risk than apple snails for transmitting *A. cantonesis* to humans in the GSARP area.
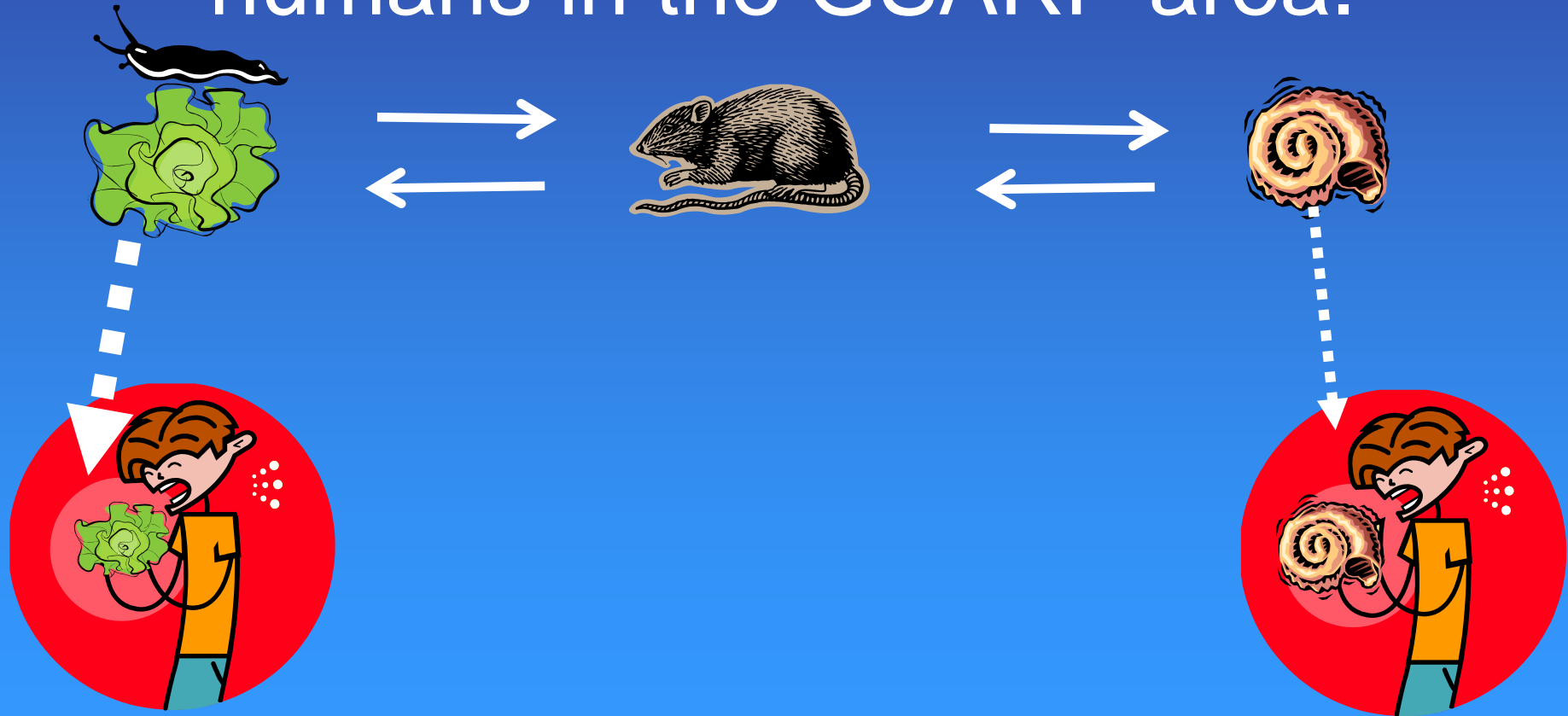
Future Directions

1. Continue testing samples in other GSARP areas to refine the map.

2. Identify other mollusk species that are infected in the GSARP region.

3. Survey plants imported from Asia or Hawaii for *P. martensi*

Invasive Snails and an Emerging Infectious Disease: Results from the First National Survey on Angiostrongylus cantonensis in China (Zhou et al., 2008)
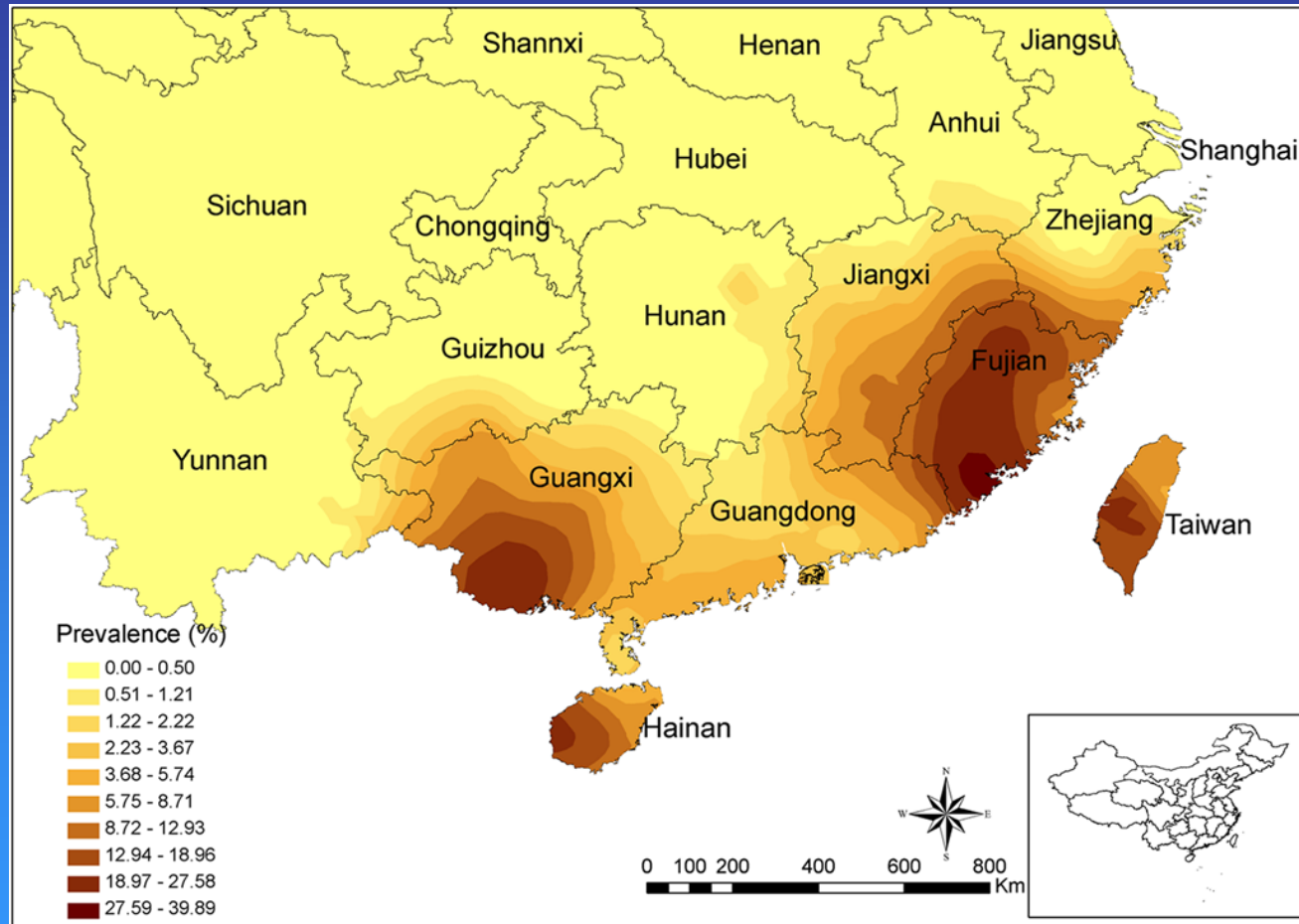
A better understanding of the spread of *A. cantonesis* in the GSARP region will require a finer resolution map involving tests on multiple mollusk species.