ERDC
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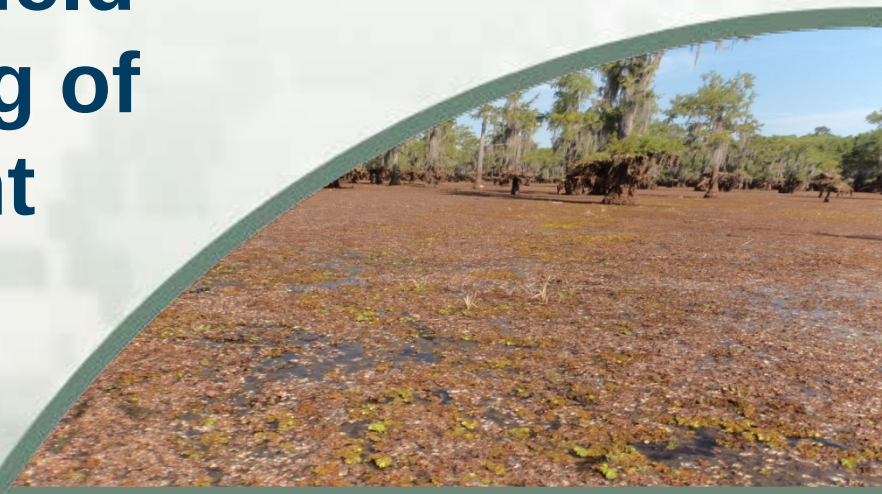
Preliminary Results of Field Sampling and Monitoring of Herbicide Managed Giant Salvinia



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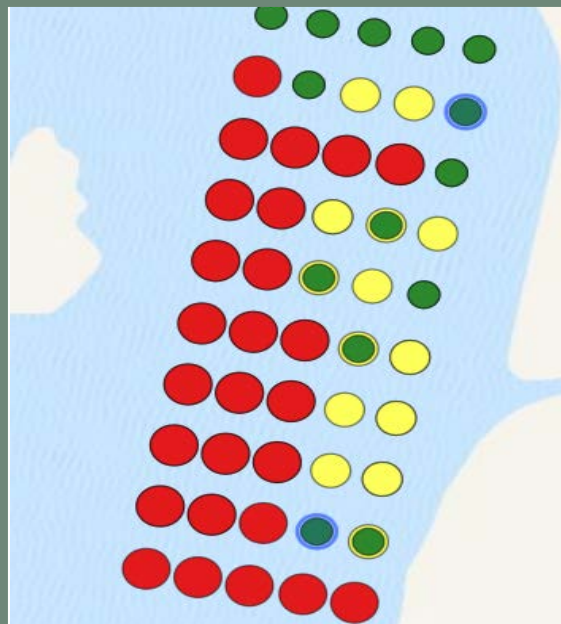
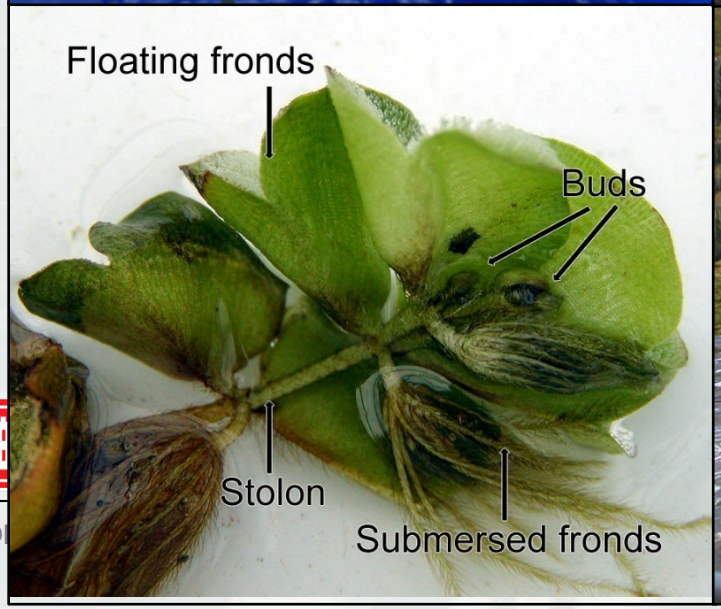


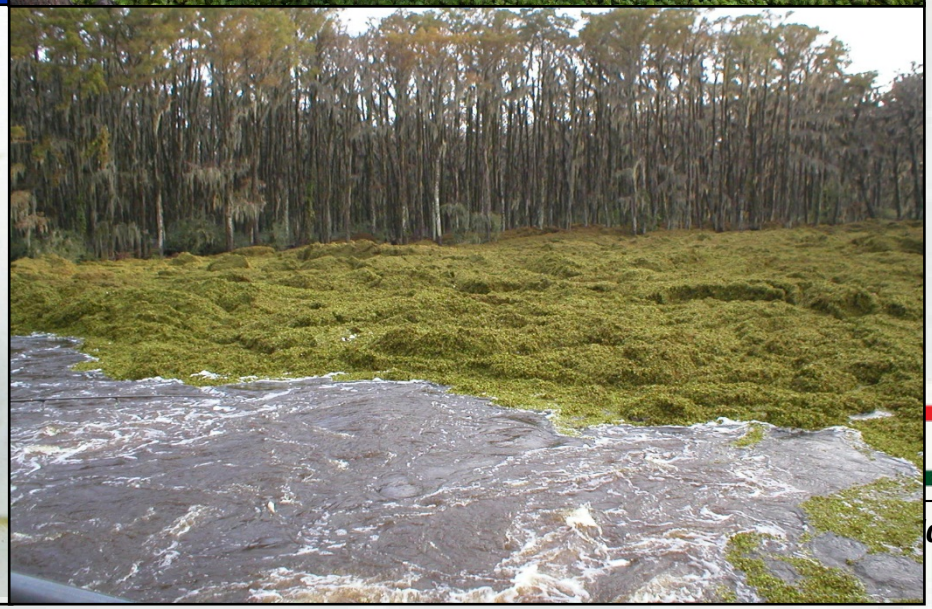
US Army Corps of Engineers®

Giant Salvinia (*Salvinia molesta*)

- Sterile, free-floating invasive fern native to Brazil
- Ornamental plant in water gardens that is spread through the nursery trade
- Federal noxious weed list
- Plant anatomy:
  - Emergent fronds
  - Submersed fronds (no roots)
  - Prominent midrib covered with stiff white leaf hairs
  - Trichomes (Cage or egg beater-like hairs) on frond surface

Giant Salvinia





Why is Giant Salvinia a Problem?

- Plants impede/disrupt navigation, irrigation, transportation, and recreational activities
- Displace wildlife and native plant species
- Alters water quality – O_2, nutrients, organic matter
- 2nd most invasive species in the world
  - ► Environmental, economic, and human health problems
- Rapid colonizer (vertical and horizontal)
  - ► Plants double in coverage every 36 to 53 hr
  - ► Multiple layers thick (>1 ft. in U.S.; 3 ft. in S. America)

Plant Growth Stages

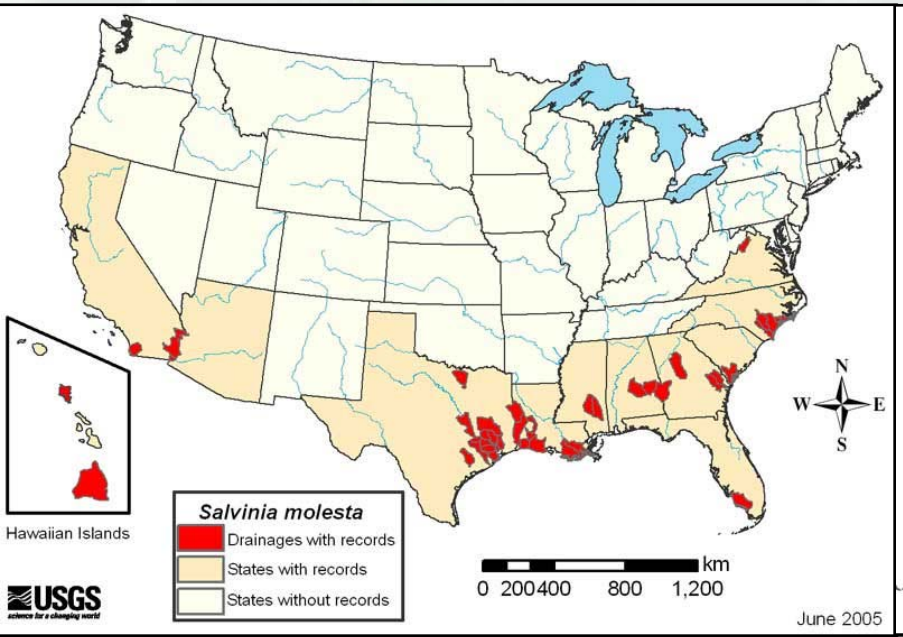
Primary

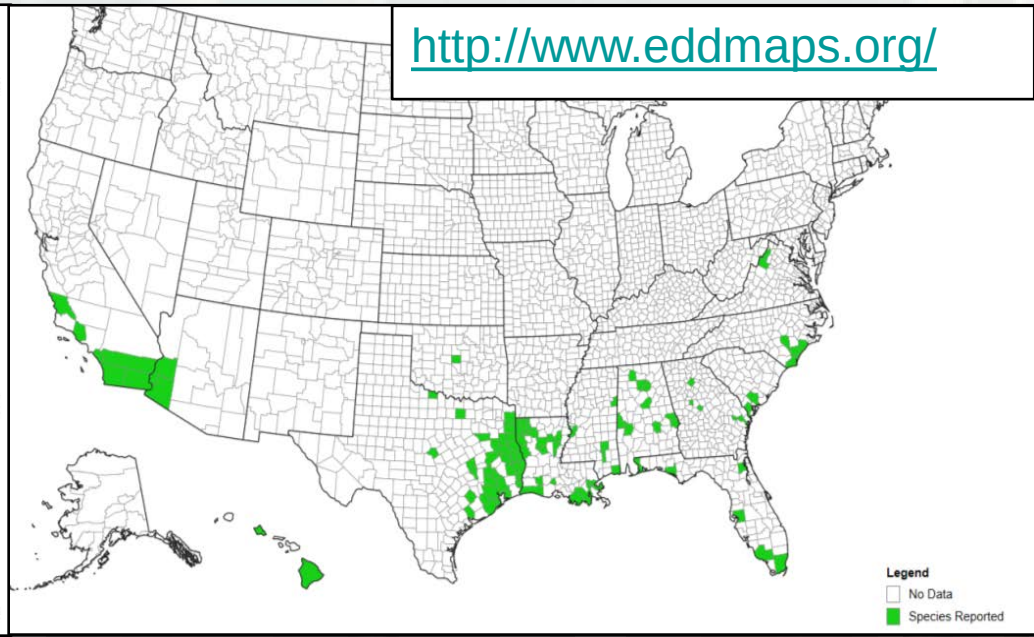
Secondary

Tertiary

Distribution

- Introduced into U.S. in 1995 (SC)
- Discovered in Toledo Bend (LA/TX) in 1998
- 12 states have or had populations
- Most infestations are located in LA and TX





Notable Infestations

- USACE Districts impacted: New Orleans, Fort Worth, Vicksburg
  - ► Potential spread: Galveston, Mobile, Jacksonville
  - ► Others?
- Key Infestations: Toledo Bend Reservoir, Sam Rayburn Reservoir, Steinhagen Reservoir, Caddo Lake, Turkey Creek Lake, Lake Bistineau, Lake Conroe, Red River, LA coastal marshes

Giant Salvinia Management

- Technologies:
  - Aquatic herbicides
  - Giant salvinia weevils
  - Drawdowns
  - Mechanical harvesters
  - Integrated
  - Cold winters

Budgets/Acreage of Giant Salvinia Managed

- LA Dept. of Wildlife and Fisheries
  - ▶ $7.8M budget
  - ▶ 52,000 acres
  - ▶ Manages acres – 19,000 (2014), 18,000 (2015)
- Ft Worth District
  - ▶ $400K
  - ▶ 2,500 acres in Sam Rayburn & Steinhagen
- New Orleans District (RAG)
  - ▶ $0K/0

Giant Salvinia Weevil (*Cyrtobagous salviniae*)

- Since 1999, weevils have been reared and released in Louisiana and Texas
  - Lewisville Aquatic Ecosystem Research Facility (ERDC)
  - LSU AgCenter
  - Texas Park and Wildlife
  - Red River Waterway Commission

Giant Salvinia Weevil Research

- Field site release monitoring (LAERF)
  - ► Nitrogen analysis for weevil establishment
  - ► Manipulation of nitrogen at sites for improved establishment
  - ► Compare common vs giant salvinia weevils for giant salvinia establishment
- Search for cold tolerant weevil strain (LSU/Red River Waterway)
- IPM of weevils + herbicides (Red River/LSU)

Herbicides with Giant Salvinia Activity

- Glyphosate
- Diquat
- Flumioxazin
- Penoxsulam
- Fluridone
- Carfentrazone
- Copper
- Bispyribac
- Endothall
- Topramezone

Efficacious Aquatic Herbicides

Herbicide	Timing	Application	Use	Rate/concentration
Glyphosate	Sp, Su, F	Foliar	Alone/Combo	96 to 120 oz/A
Diquat	Winter Sp, Su, F	Foliar	Alone Combo (Gly)	64 to 96 oz/A 12 to 32 oz/A
Penoxsulam	Sp, Su	Foliar/Sub	Alone	4-5.6 oz/A 5-40 ppb
Flumioxazin	Sp, Su, F	Foliar/Sub	Alone Combo (Gly/Endo)	6-12 oz/A, 200-400 ppb 1-4 oz/A
Carfentrazone	Sp, Su, F	Foliar	Combo (Gly)	2-4 oz/A
Fluridone	Sp, Su	Subsurface	Alone	5-40 ppb
Bispyribac*	Sp, Su	Foliar/Sub	Alone	2 oz/A 45 ppb
Endothall*	Sp, Su	Foliar	Combo (Flumi)	16 oz/A
Topramezone*	Sp, Su	Foliar/Sub	Alone	16 oz/A

* = Minimal commercial use of product

Sp = spring, Su = summer, and F = fall

2008 to 2015 Giant Salvinia Chemical Control Research

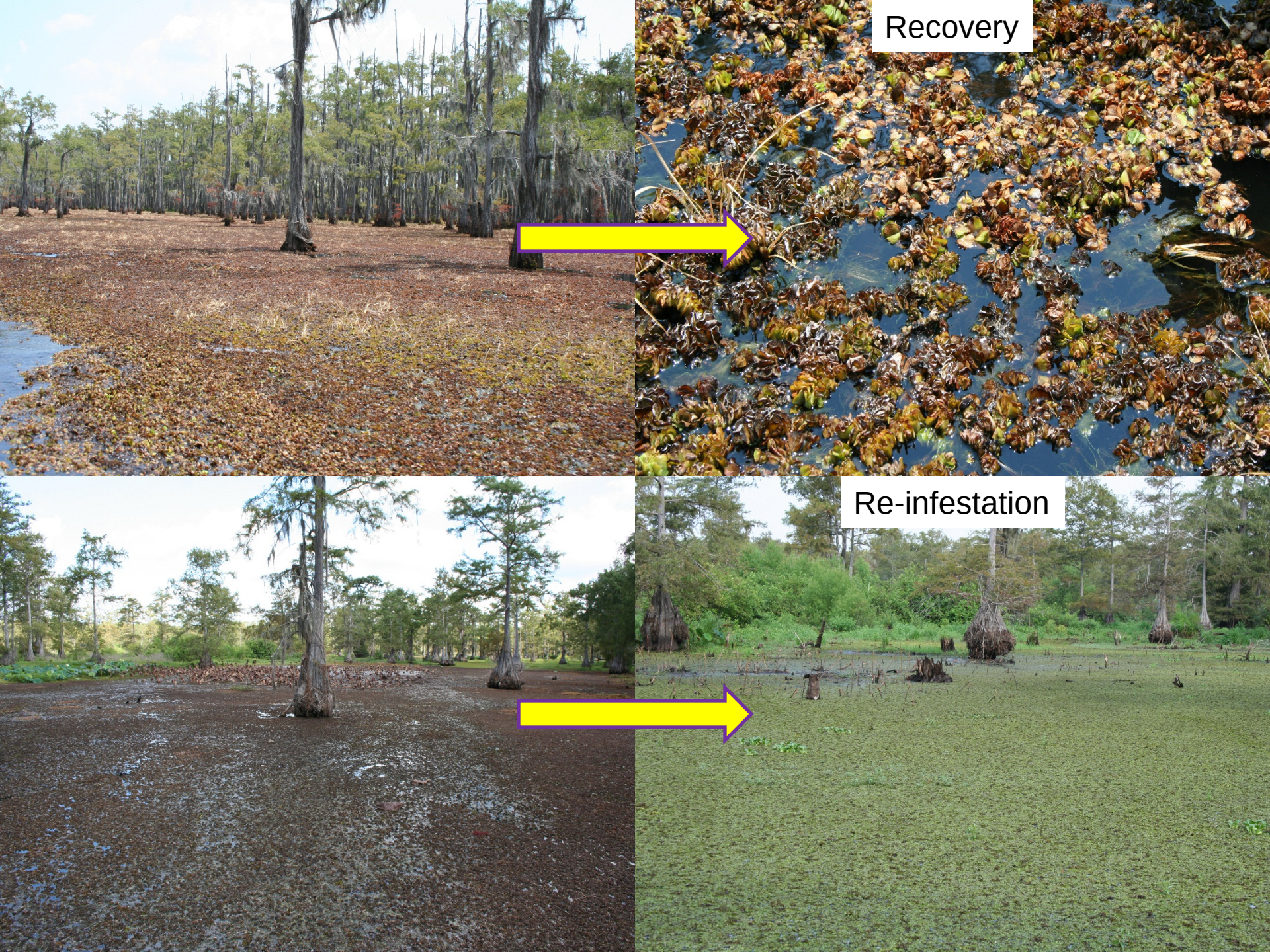
- Screen new and experimental herbicides
- Evaluation of new use patterns
- Evaluate herbicide combinations and surfactants
- Evaluate IPM of herbicides + weevils
- Determine optimal timing and seasonality differences
- Sampling and monitoring of operational treatments

Need For Research and Demonstration

- Herbicides can provide fast acting and effective manage of giant salvinia
- Diminished operational budgets, limited field personnel, and widespread acreage – hinder accurate plant surveys
- Need a reliable, fast, efficient, and low cost technology to assist with monitoring giant salvinia infestations and management techniques

Importance of Field Monitoring

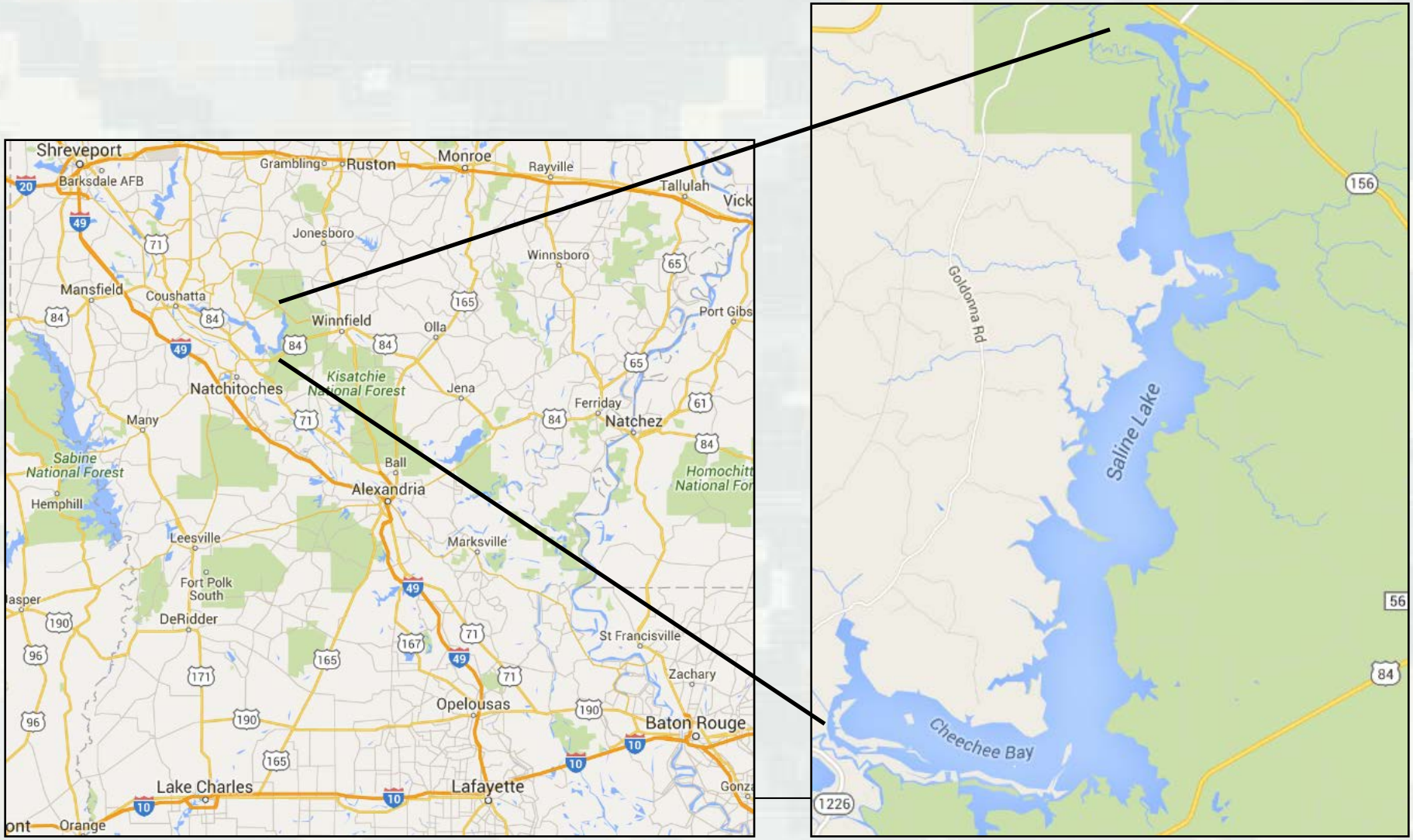
- 1000's of acres of giant salvinia are managed yearly
- Limited efforts have been made to assess efficacy of herbicides, use patterns, and long-term control
  - ► Control efforts and success are difficult to measure (quantitatively and qualitatively)
- Plant decay, storms, water flow, and tides move plants in and out of treatment zones
- Are post-treatment plants the result of recovery or re-infestation?


Recovery
Re-infestation

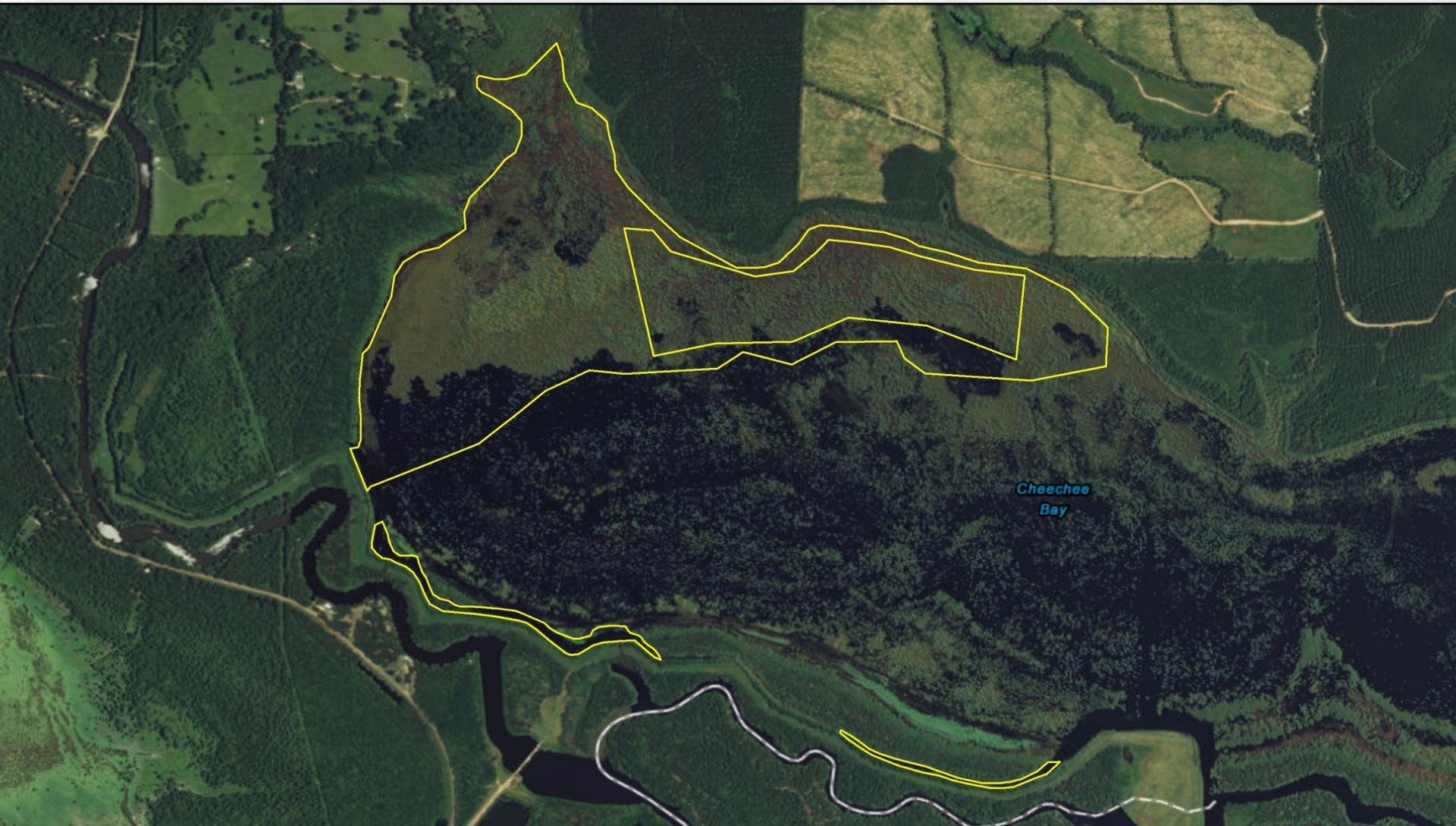
APCRP Giant Salvinia Work Unit

- FY15-16 Field Monitoring/Sampling
- Evaluate field monitoring methods to quantitatively assess treatment efficacy
- Adapting software using ground truth data
- Provide guidance to field managers

Field Monitoring and Sampling Investigation Saline Lake, LA



Treatment Site within Saline Lake, LA

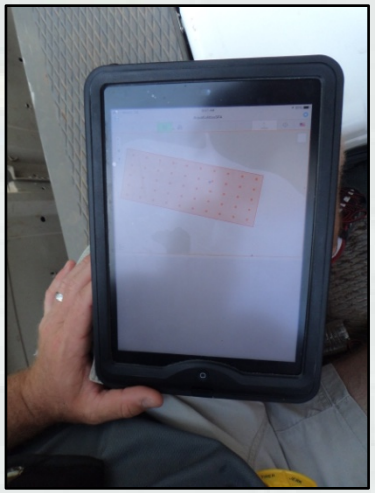


Project & Site Description

- Continuous surface mat of giant salvinia
- 250 acres treated with glyphosate + diquat + 2 surfactants (most common treatment)
- 50 acre monitoring block (25 treated/25 untreated) within the larger treatment area
- Monitoring period: July to Sep 2015
  - ► PRE, 2, 4, 7, and 9 weeks after treatment (WAT)
- 50 meter sampling grid

Equipment

- Hardware/software:
  - iPad with cellular/GPS capability
  - App: File Maker GO
- Mudboat



Data Collected

- Qualitative
  - Visual % plant coverage
  - Visual % plant injury
  - Visual % plant recovery

- Quantitative
  - Plants collected at 10 random locations PRE and 2 WAT
  - Placed in mesocosm tanks for growth recovery
  - Number of plant layers thick

Treatment Site Over Time

Pre-treatment

2 WAT

2 WAT

4 WAT

4 WAT

4 WAT

Plant Layers – 7 WAT

Plant Density – 7 WAT

Findings and Lessons Learned

- Qualitative field monitoring quick and equipment user friendly
- Recovery and re-infestation easy to distinguish
- Quantitative sampling verifies and documents qualitative assessments
- Challenge of providing complete herbicide coverage

FY16 Research

- Continued giant salvinia field monitoring and sampling in LA
- Find new field sites in TX
  - Cooperation with USACE Fort Worth District (Sam Rayburn) and Lower Netches Valley Authority
- Fine tune and increase data collection
- Investigate other hardware/software

Benefits of Work

- Determine if current herbicides and application methods are effective
- Determine if ground truth/monitoring technology is reliable and applicable to natural resource managers
  - If yes, provide information and guidance on applicability and ease of use of technology USACE Districts, state agencies, and water management districts to better manage giant salvinia

Giant Salvinia Cooperators

- Aquatic Plant Control Research Program (ERDC)
- Louisiana Dept. of Wildlife and Fisheries
- LSU AgCenter
- University of Florida
- Red River Waterway Commission
- Gator Creek Technologies


Questions?