
A.R.M. Loxahatchee National Wildlife Refuge
Accelerated Exotics Control Plan
May 22, 2007

Background

- **WCA 1: ~147,000 acre tree island-marsh matrix**
  - **Peat-mound and peat-ridge bayheads**
  - **Sawgrass marsh, slough, wet prairie**
- **Refuge established in 1951 under a 50-year agreement. New agreement executed in 2002**
- **Lease agreement establishes exotic plant control as primary goal of management effort.**

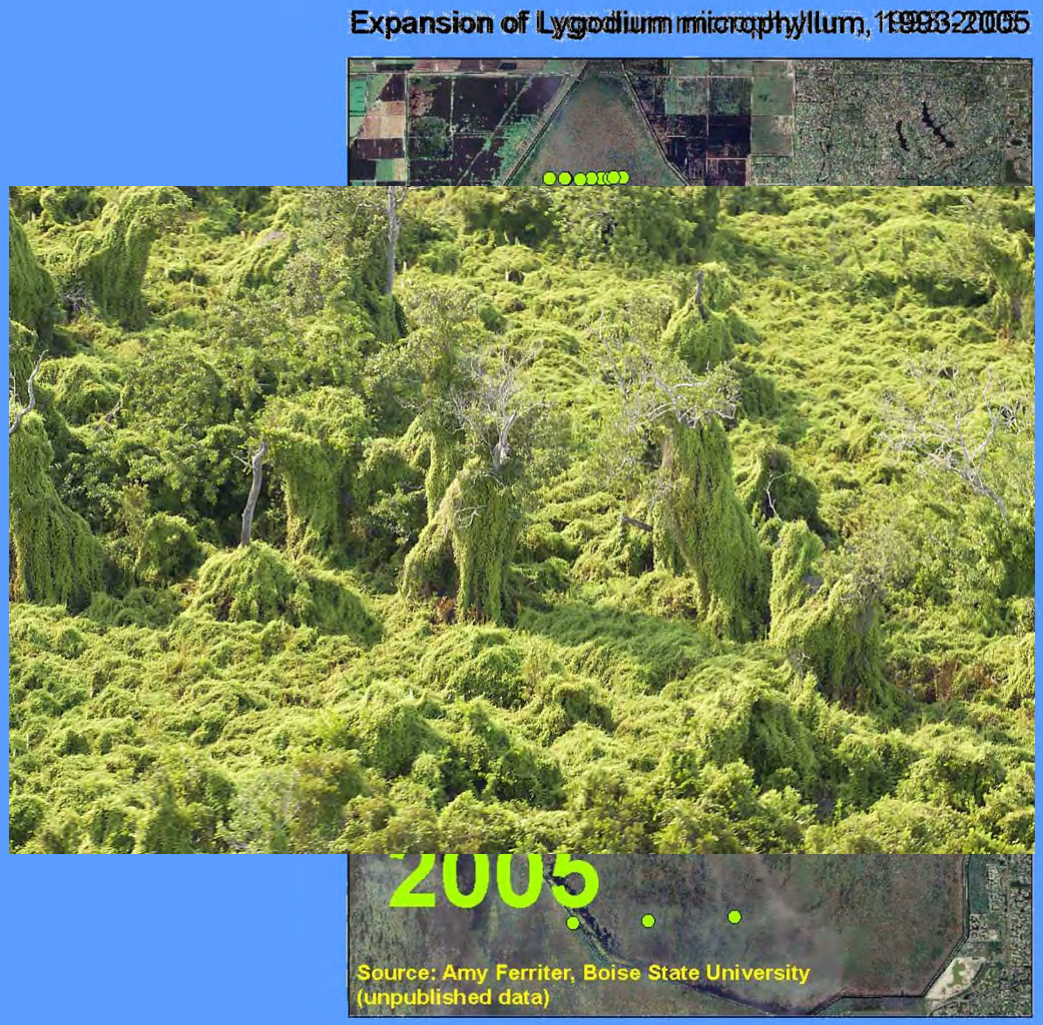
Class I Invasive Plants at Refuge

- ***Old World climbing fern (*Lygodium microphyllum*)**
- ***melaleuca (*Melaleuca quinquenervia*)**
- ***Brazilian pepper (*Schinus terebinthifolius*)**
- **Australian pine (*Casuarina equisetifolia*)**
- **shoe-button ardisia (*Ardisia elliptica*)**
- **torpedograss (*Panicum repens*)**
- **guava (*Psidium guajava*)**
- **earleaf acacia (*Acacia auriculiformis*)**
- **rosary pea (*Abrus precatorius*)**
- **Nephthytis (*Syngonium podophyllum*)**
- **Java plum (*Syzygium cumini*)**

***major pest in Refuge**

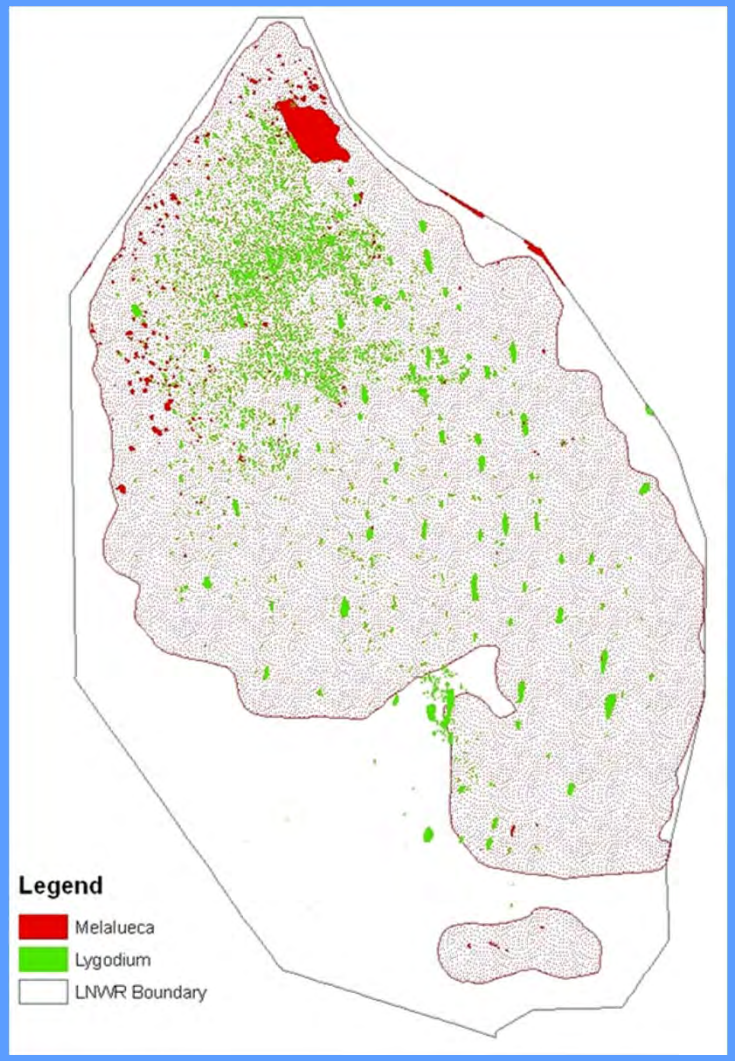
A biological catastrophe....

- **1989: *Lygodium microphyllum* (“the perfect weed”) confirmed in Refuge**
- **1993-2005: Spread monitored via systematic reconnaissance flights**
- **2005 aerial assessments estimated that roughly 70% of Refuge was infested with Old World climbing fern and/or melaleuca.**



Aerial Sketch Mapping

- **Base map, September 2005**
- **On-the-fly digitizing**
- **Cover classes based on treatment method (aerial versus ground)**
- **~95,000 acres impacted by invasive plants**
- **Old World climbing fern present in most tree islands**



Principles of Invasive Plant Control

Strategy

Eliminate existing stands

- mechanical removal
- treat with herbicides

Halt expansion

Seed/sapling mortality

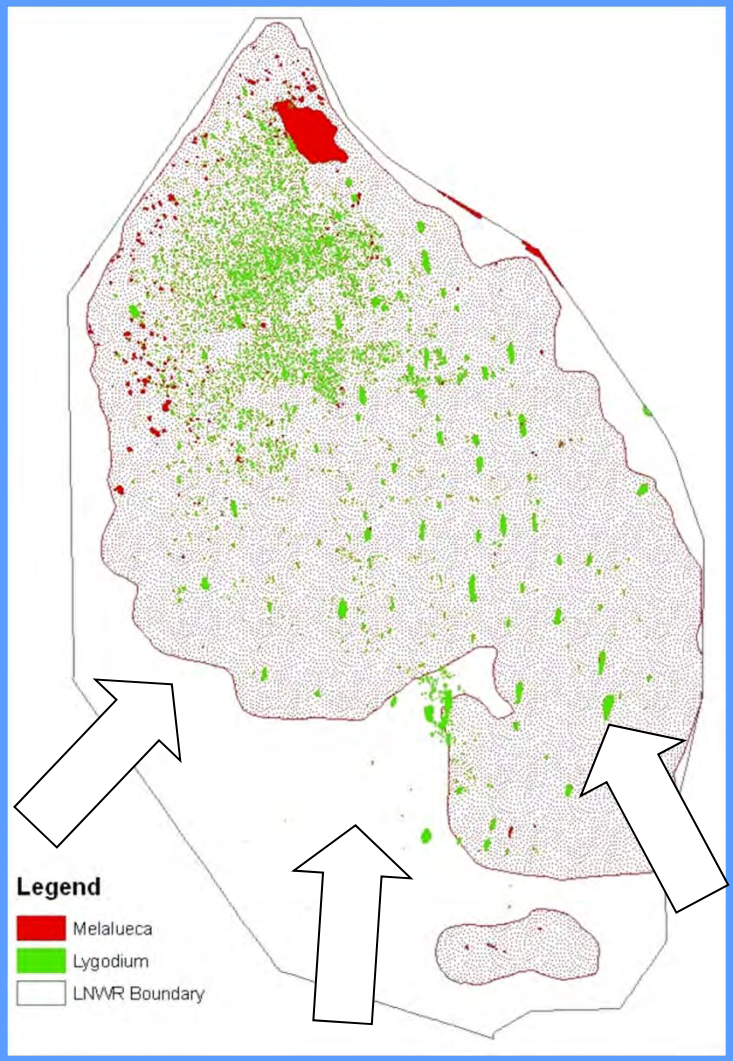
- hand-pull saplings
- treat with herbicides
- damage by biocontrol insects

Reduce seed production

- damage by biocontrol insects

Control Strategy

- **Contain spread, then follow with methodical treatment of quarantined area.**
- **Primary focus on southern end at encroaching edge of melaleuca**
- **Containment not fast enough: north end of Refuge heavily infested**
- **Old World climbing fern adds new dimension to problem**

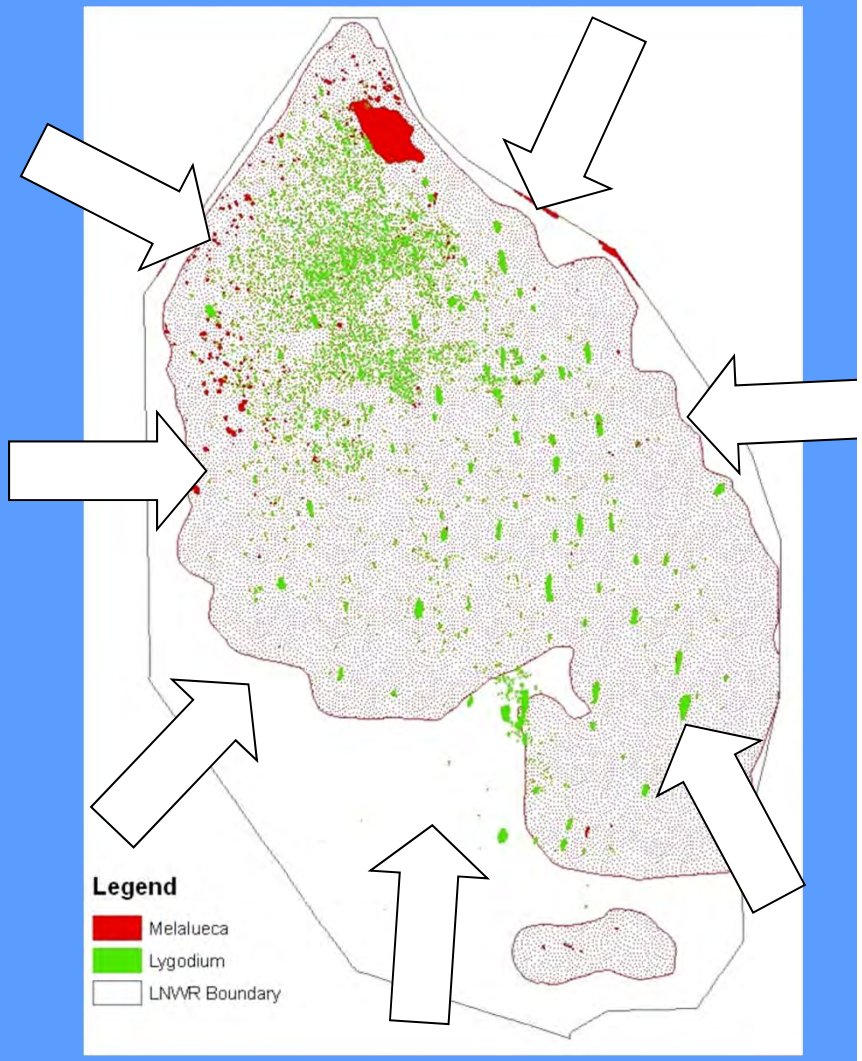


"The Surge"

- **FDEP, SFWMD, and USFWS partner to implement accelerated vegetation management plan**
  - **Goal: Complete "first pass" treatments of exotics for entire Refuge by September 2008**
  - **Work began March 2007**
- **FDEP resource commitments;**
  - **FY07: $3 million**
  - **FY08: $4 million**
- **District personnel involved in contracting, project management, logistic, and field support;**
- **USFWS personnel involved in project management, logistical efforts and field support;**

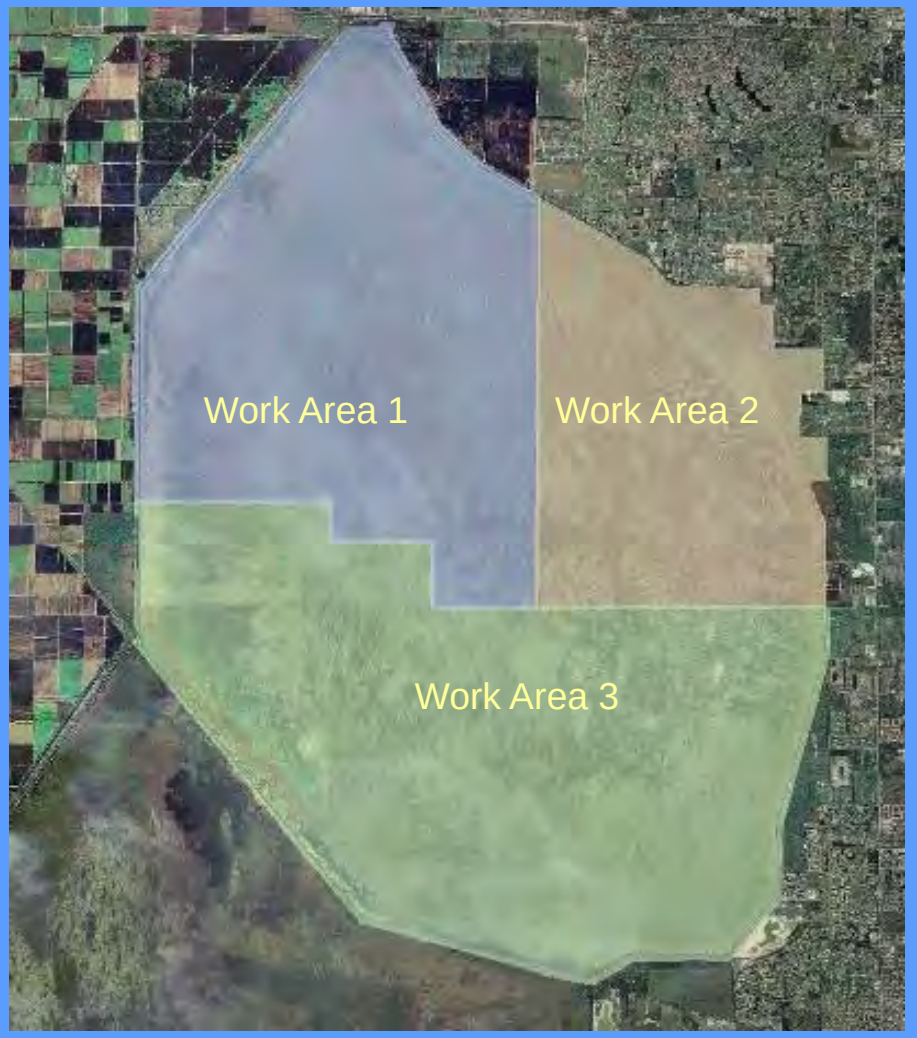
Control Strategy

- **Updated strategy: Complete first pass treatments (aerial and ground) by Sept. 2008**
  - **Set back seed and spore source**
  - **Save remaining tree island plant communities**
- **Establish aggressive follow-up strategy of ground-based treatments to hold gained ground**



Project Management

- **Refuge divided into three Work Areas**
  - **District's aerial contractor to treat the entire Refuge**
  - **District's ground contractors cover Work Areas 1 and 2**
  - **Existing Refuge's ground contractor to continue treatment in Work Area 3**
  - **Roughly 100 applicators mobilized each day**
- **Estimated 100,000 acres of exotic-impacted natural area to be treated**



Vegetation Control Options

- **Herbicides**
  - **Aerial applications to dense cover (>75%) in areas >0.25 acre**
  - **Ground applications to sparse cover**
    - **Foliar (Lygodium patches)**
    - **Stump treatments (melaleuca and other woody species)**
- **Mechanical and Cultural Controls**
  - **Hand pulling saplings**
  - **Prescribed fire**
- **Biological control releases since 2002:**
  - **melaleuca weevil and melaleuca psyllids now established**
  - **lygodium moths released but not established to date**

Glyphosate

$C_3H_8NO_5P$

- **Broad-spectrum, non-selective, systemic herbicide**
- **Mode of Action:**
  - **Inhibits enzyme activity associated with amino acid synthesis. The affected pathway exists in higher plants and microorganisms, but not in animals.**
- **Low soil activity (Strongly adsorbed to soil particles)**
- **Average half life**
  - **Soil = 47 days**
  - **Water = 41 days**

Wildlife Toxicity Category

Risk Category	Mammals	Birds	Fish or Aquatic Insects
	Acute Oral or Dermal LD_{50} (mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute LC_{50} (mg/L)
Practically nontoxic	>2,000	>2,000	>100
Slightly toxic	501-2,000	501-2,000	>10-100
Moderately toxic	51-500	51-500	>1-10
Highly toxic	10-50	10-50	0.1-1
Very highly toxic	<10	<10	<0.1

Highlighted categories specify the range for glyphosate use cited in this fact sheet.

Imazapyr

$C_{13}H_{15}N_3O_3$

- **Broad-spectrum, non-selective, systemic herbicide**
- **Mode of action:**
  - **Absorbed into foliar tissue; can be absorbed by roots**
  - **Inhibits enzyme activity associated with amino acid synthesis**
  - **Highly phloem mobile (root grafting concerns)**
- **Soil activity moderate:**
  - **low soil adsorption**
  - **Half life 69-125 days**

Wildlife Toxicity Category

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[1]Highlighted categories specify the range for imazapyr cited in this fact sheet. The toxicity of imazapyr to wildlife receptors varies by species.

Metsulfuron Methyl $C_{14}H_{15}N_5O_6S$

- **Selective systemic herbicide**
  - **Dahoon holly, swamp bay, most graminoids resistant**
  - **Fern species and red maple, cypress (if foliated) susceptible**
- **Mode of action:**
  - **Absorbed into foliar tissue; can be absorbed by roots**
  - **Associated with amino acid synthesis; Inhibits enzyme activity**
- **Soil activity low to moderate**
- **Average half life**
  - **Soil = 97 days**
  - **Water = 30 days**

Wildlife Toxicity Category

Risk Category	Mammals	Birds	Fish or Aquatic Insects
	Acute Oral or Dermal LD_{50} (mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute LC_{50} (mg/L)
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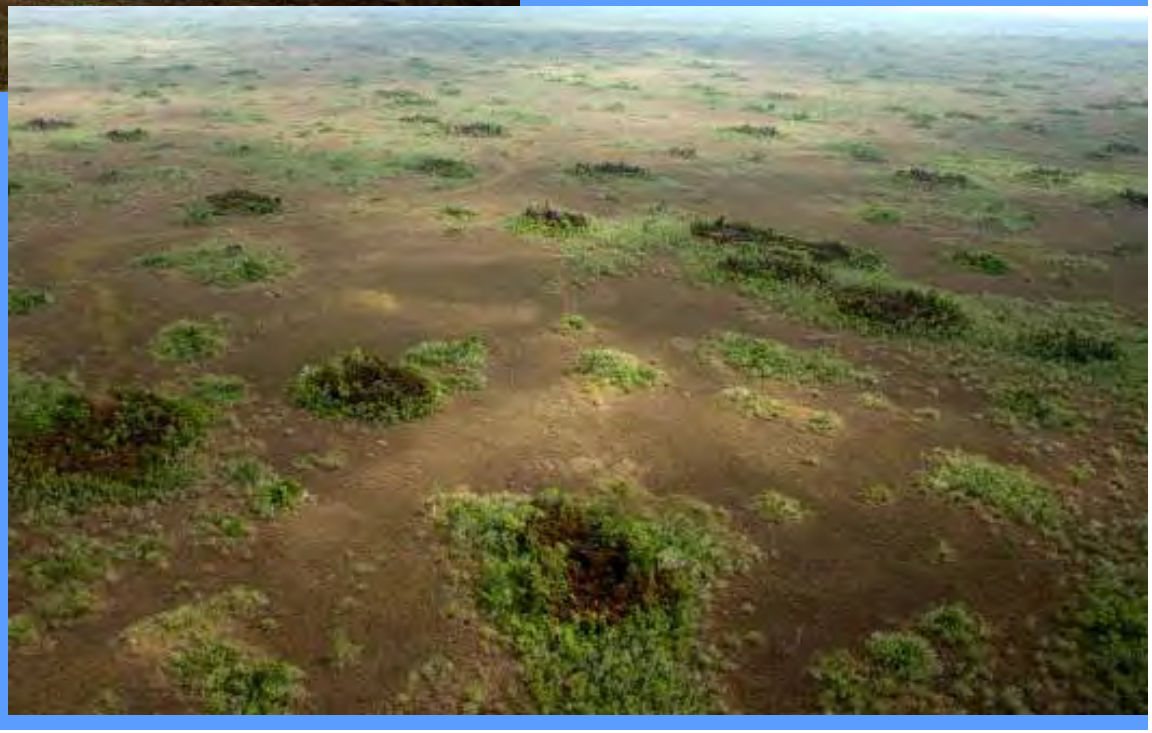
Highlighted categories specify the range for metsulfuron-methyl use cited in this fact sheet.

Aerial Treatments

- **Melaleuca (per acre)**
  - **3 qt. imazapyr + 3 qts. glyphosate + 4 qts. SunWet + 4 oz. NuFilm @ 20 GPA**
- **Old World climbing fern (per acre)**
  - **2 oz. @ 20 GPA**
- **Rate of progress: ~200 acres/day**
- **$300/treated acre (melaleuca)**
- **$75/treated acre (lygodium)**
- **Pros**
  - **Cost effective**
  - **No ground disturbance**
  - **Rapid progress**
- **Cons**
  - **Only used for dense cover**

Lygodium-infested tree islands



Aerial Melaleuca Treatments

Experienced applicators are critical to success!

Proper treatment procedure

Inappropriate treatment procedure with non target damage

Ground Treatments

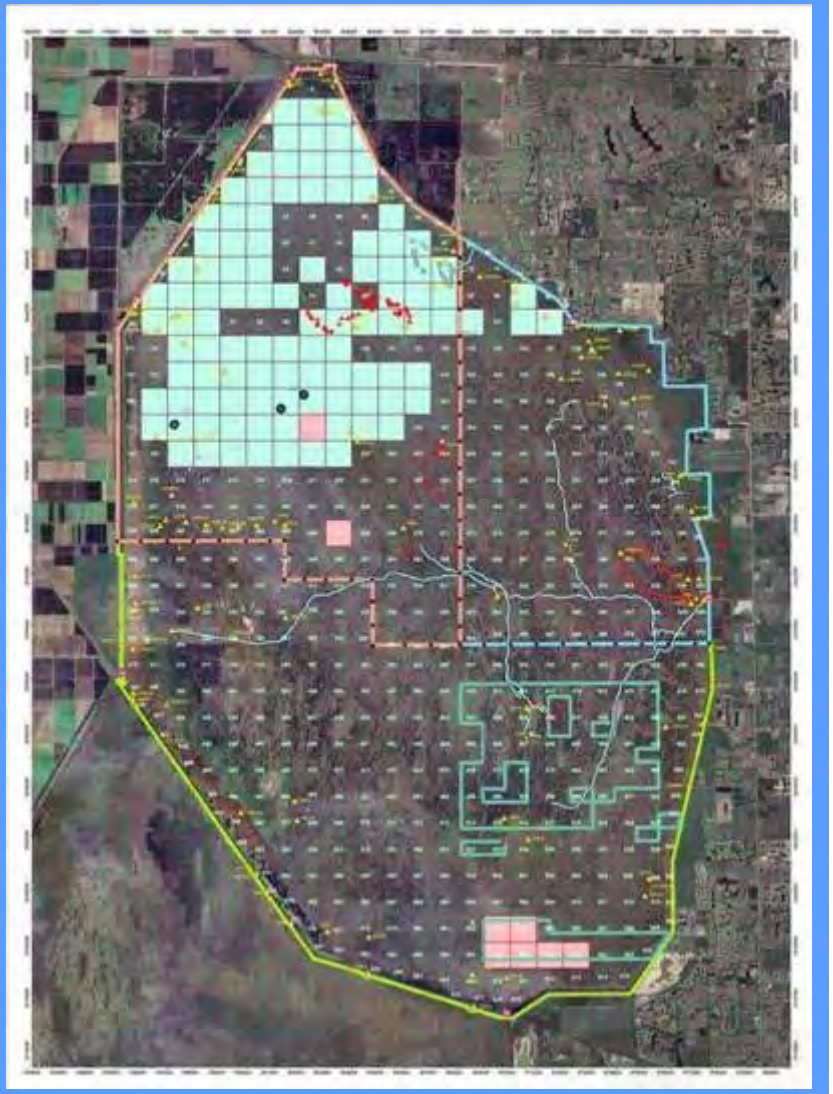
- **Melaleuca**
  - **Cut stump: Mixture of 40% glyphosate, 10% imazapyr, 50% water**
  - **Foliar: Mixture of 3% glyphosate, 1% imazapyr, 96% water**
- **Lygodium**
  - **Foliar: 2 oz. per 100 gallon mix metsulfuron methyl**
- **$200/acre (melaleuca)**
- **$360/acre (lygodium)**
- **~10 acres/day (crew of six)**
- **Pros**
  - **Less non-target damage**
- **Cons**
  - **Expensive and slow**
  - **Labor intensive**
  - **Some ground disturbance**

Melaleuca Cut Stump Treatments

Lygodium Ground Treatments

Status to Date

- **Aerial and ground crews began work in early March**
- **New baseline map**
- **Three new boat ramps installed by District field station**
- **1-km grid system used to track progress within each work area**
- **Aerial Treatments**
  - **~8000 acres treated**
- **Ground Treatments**
  - **2500 acres *canvassed***
  - **All ground treatments suspended due to low water levels**



Some Cause For Hope...

- **Native vegetation resprouting in 2006 aerial treatment areas**
  - **Dahoon holly, swamp bay, and graminoid release**
- **New *Lygodium* biological control (eriophyid mite, *Floracarus perrepae*) approved for release**
- **Recent aerial assessments show progress with melaleuca on south end**

What's next?

- **Revise 5-year management plan**
- **Aggressively seek funding for Phase 2 (follow-up) controls**
- **Strategic implementation of prescribed fire**
- **Vegetation recovery assessments**

Questions?