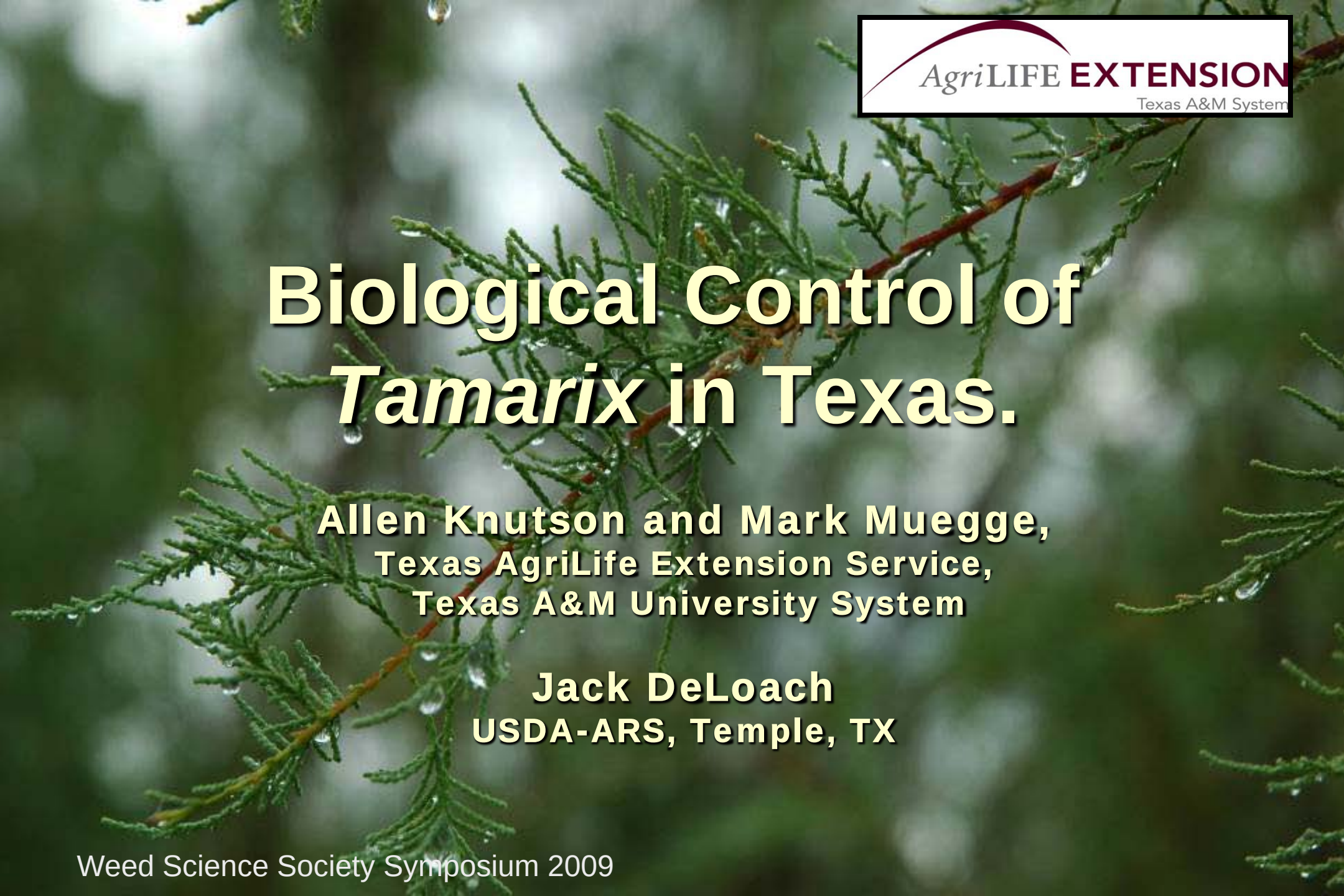


Biological Control of *Tamarix* in Texas.

Allen Knutson and Mark Muegge,
Texas AgriLife Extension Service,
Texas A&M University System

Jack DeLoach
USDA-ARS, Temple, TX

Weed Science Society Symposium 2009

Impacts of *Tamarix* Invasion

- **Reduction in water quantity and quality due to evapo-transpiration**
- **Estimates of 1-2 acre feet of water lost per acre of saltcedar.**
- **Displacement of native plant communities**
- **Adverse effects on wildlife**
- **Alteration to stream hydrology, flooding**
- **Loss of grazing value.**

AgriLIFE EXTENSION
Texas A&M System

Distribution of Saltcedear, *Tamarix* spp,along major rivers and streams.

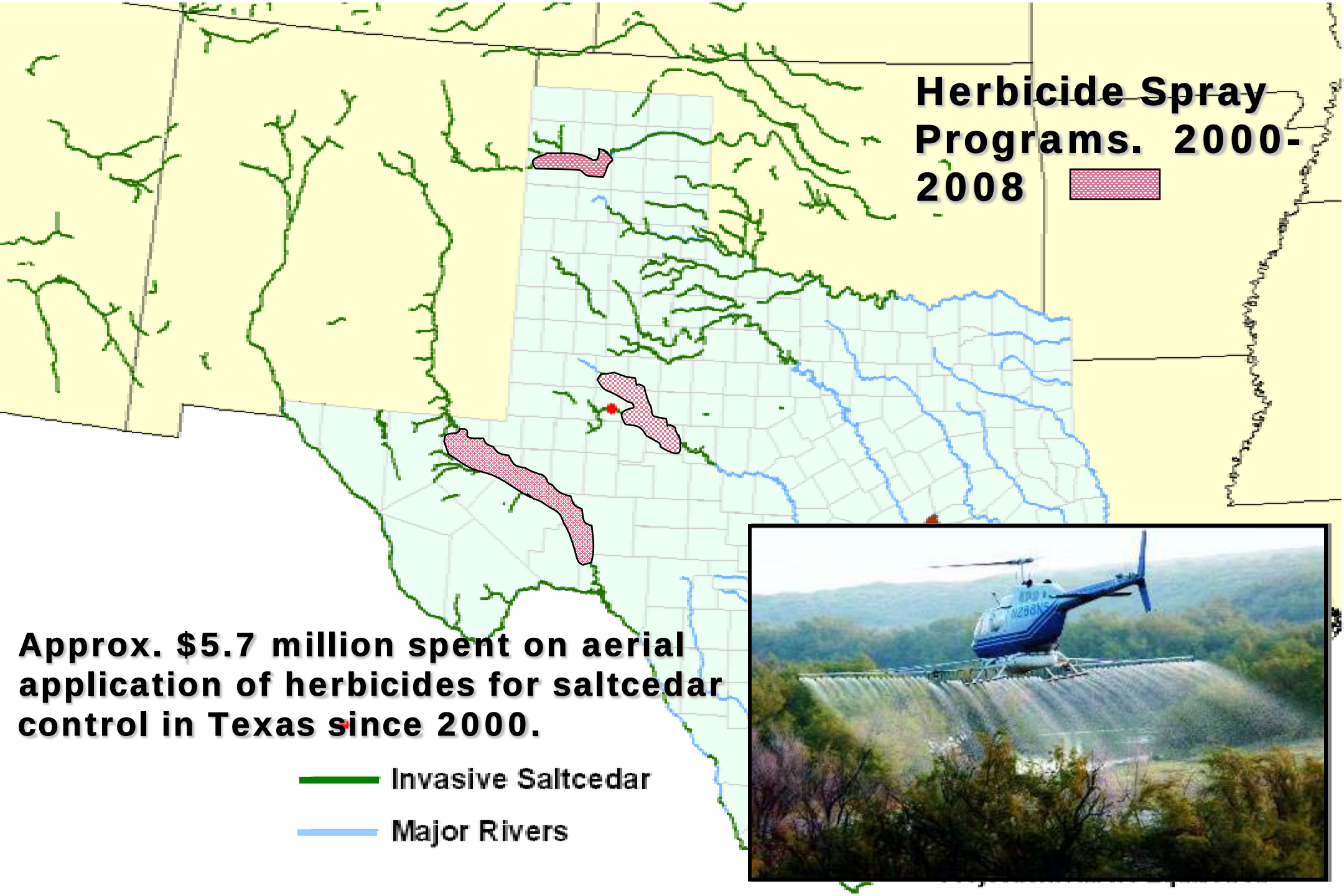
Estimated 500,000 acres of saltcedar in Texas

Invasive Saltcedar

Major Rivers

0 50 100 200 Miles

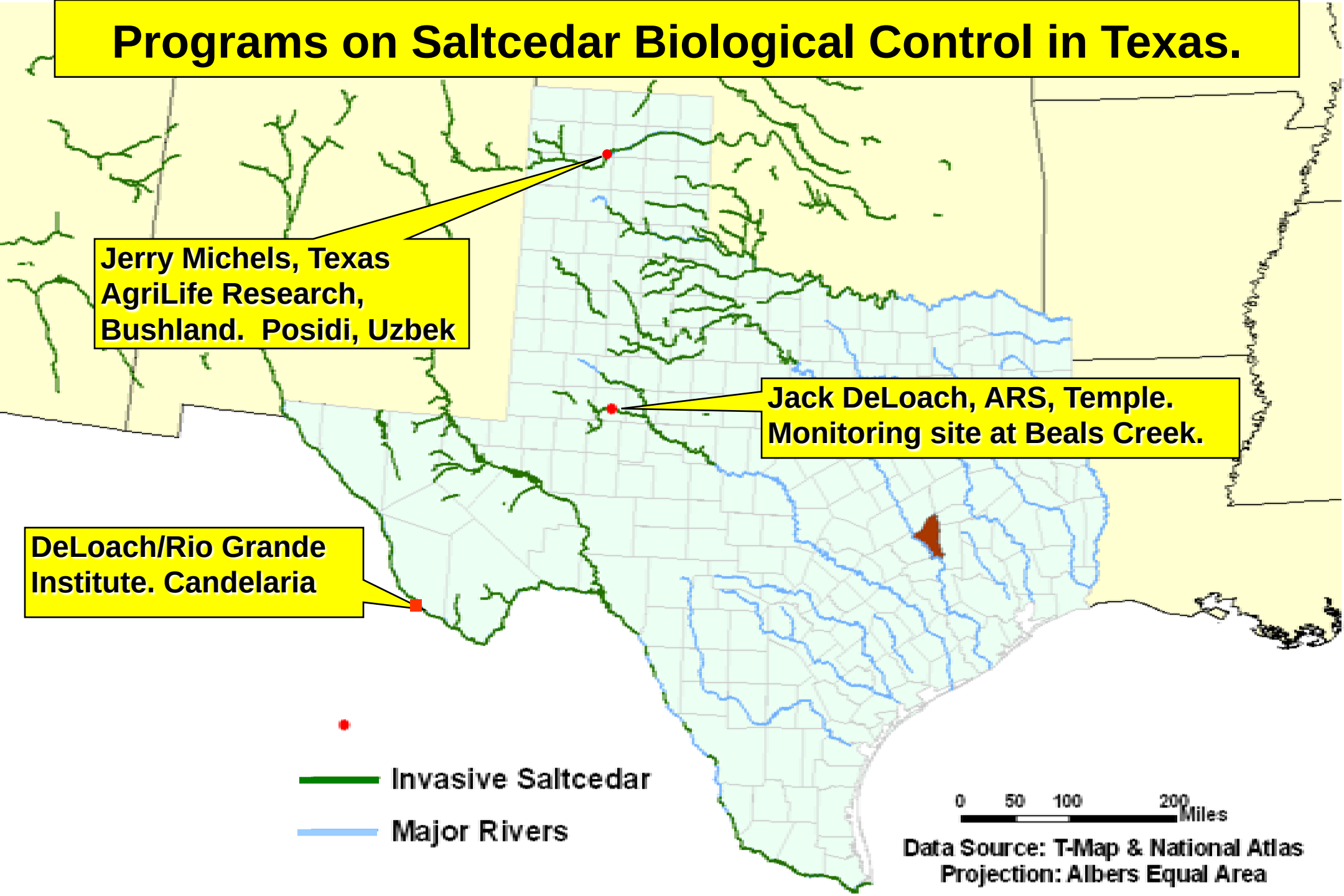
Data Source: T-Map & National Atlas
Projection: Albers Equal Area


Herbicide Spray Programs. 2000-2008
Approx. $5.7 million spent on aerial application of herbicides for saltcedar control in Texas since 2000.
Invasive Saltcedar
Major Rivers

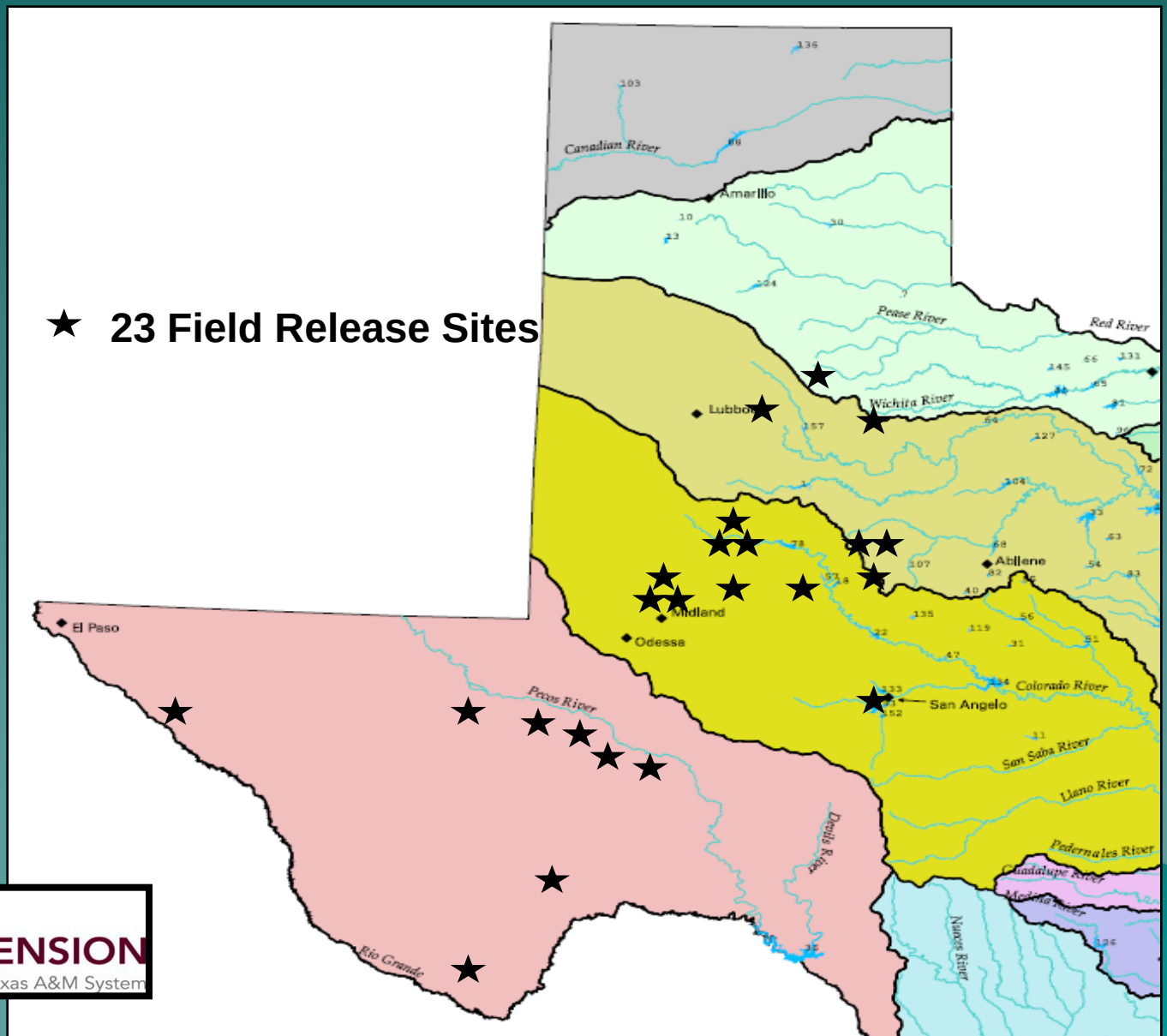
Biological Control: A Brief History.

- 2001. *Diorhabda elongata* from China established in Nevada, Utah, Colorado and Wyoming
- 2008. Extensive defoliation across 100,000 acres.
- APHIS redistribution program
- 2004, “Crete” Beetle released in Texas.

Programs on Saltcedar Biological Control in Texas.



Texas AgriLife Extension Saltcedar Biological Control Implementation Program Release Sites. 2008



AgriLIFE EXTENSION
Texas A&M System

Beals Creek, Big Spring, TX. First Field Release 2004

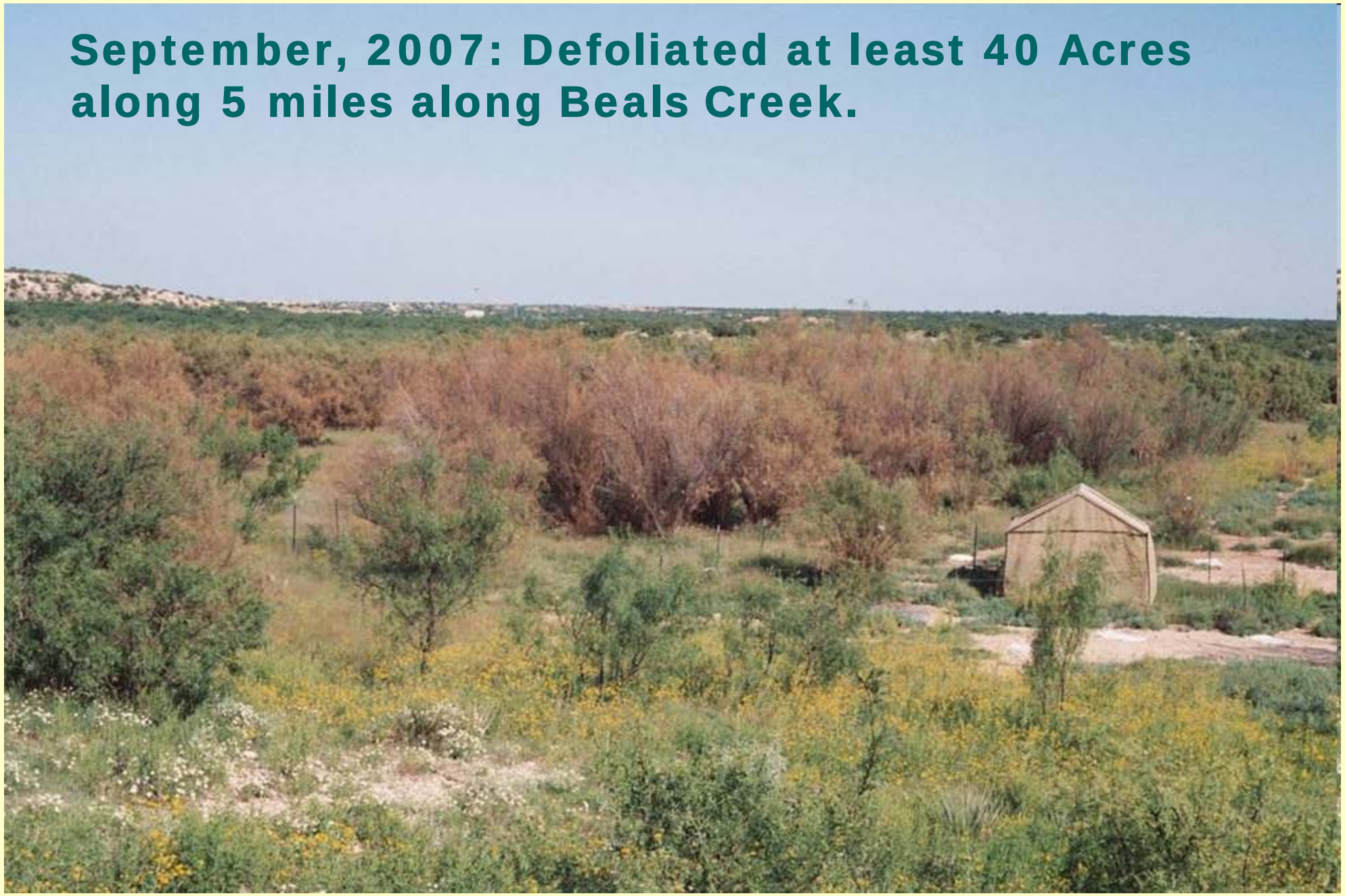
- **Failed to Establish at Lake Thomas and Seymour.**
- **At Big Spring, beetles released April-July 2004.**
- **Larvae and adults defoliated two trees near release site in July, 2004.**
- **First defoliated tree in Texas.**

Big Spring TX: 2006

- Beetles defoliated 19 acres of saltcedar by the end of October.
- Beetle numbers so great that most trees were without green leaves during most of the growing season.
- After 3 seasons, beetles had dispersed up to 1 mile from release site

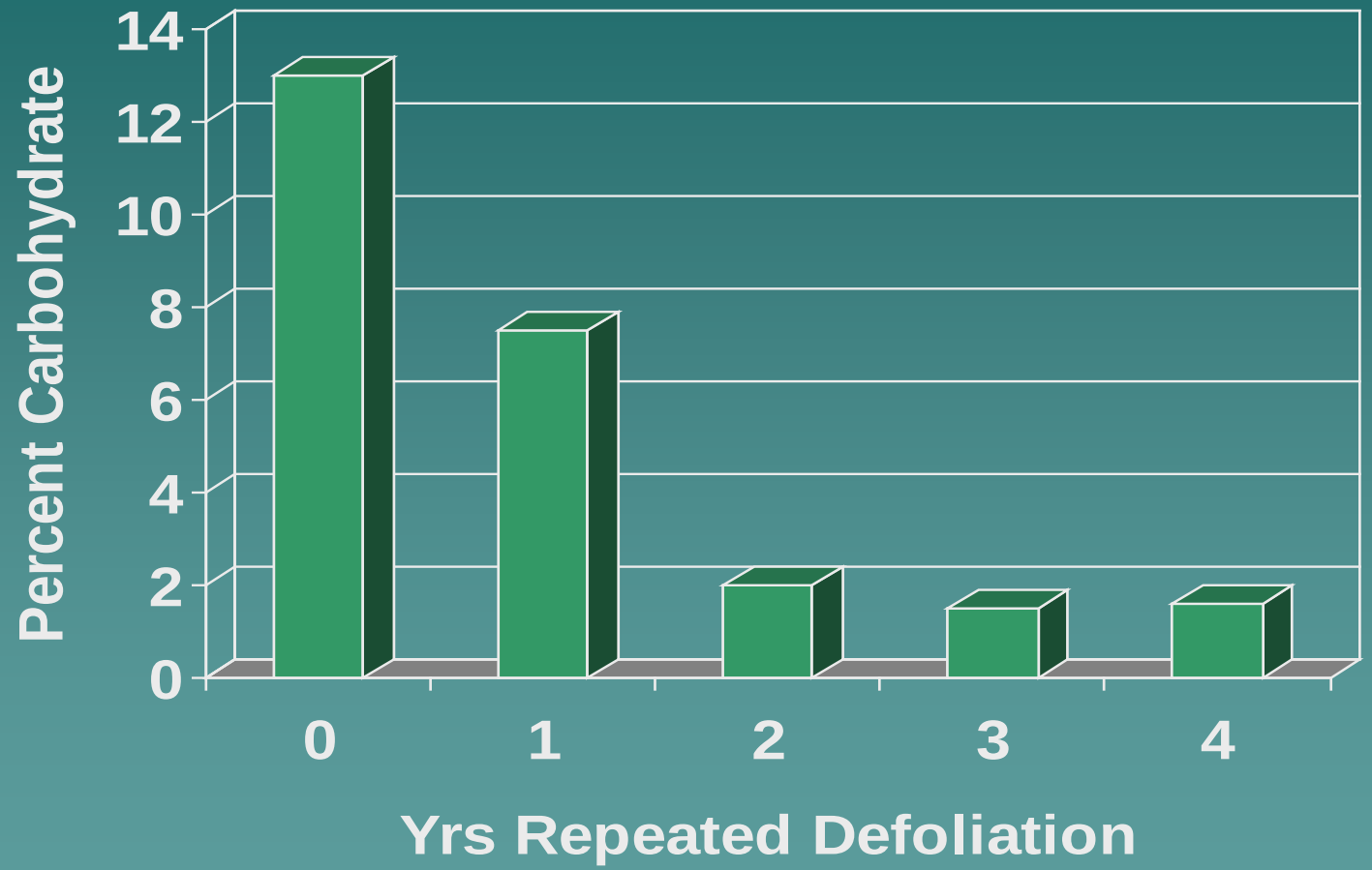
Beals Creek Release Site. Big Spring TX. 2005

September, 2007: Defoliated at least 40 Acres along 5 miles along Beals Creek.



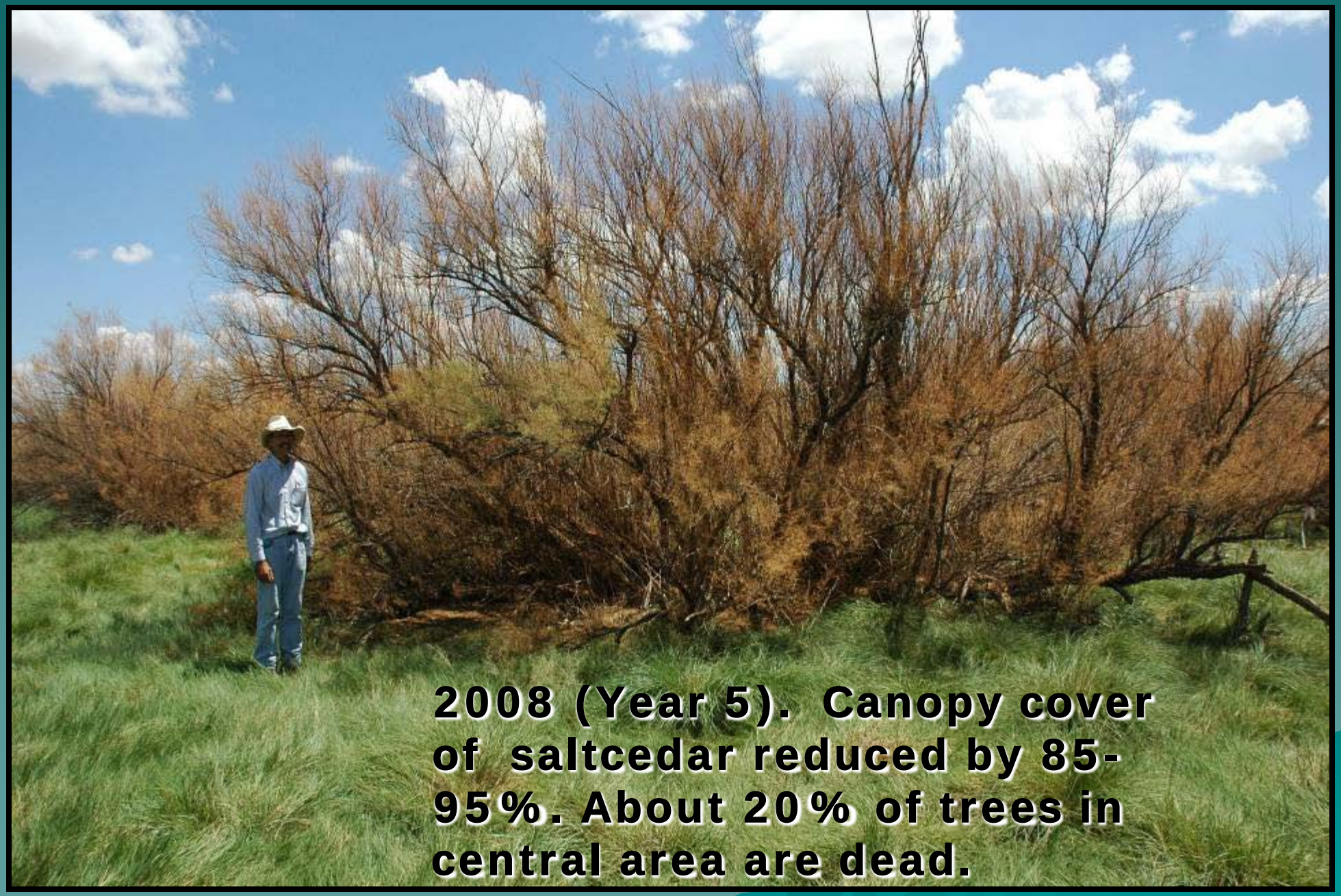
Percent Carbohyrdrate in Root Crown Following Repeated Years of Defoliation by Leaf Beetles, Natural Experiment, Nevada, 2006.

Research by Hudgeons, Knutson, Heinz and DeLoach.



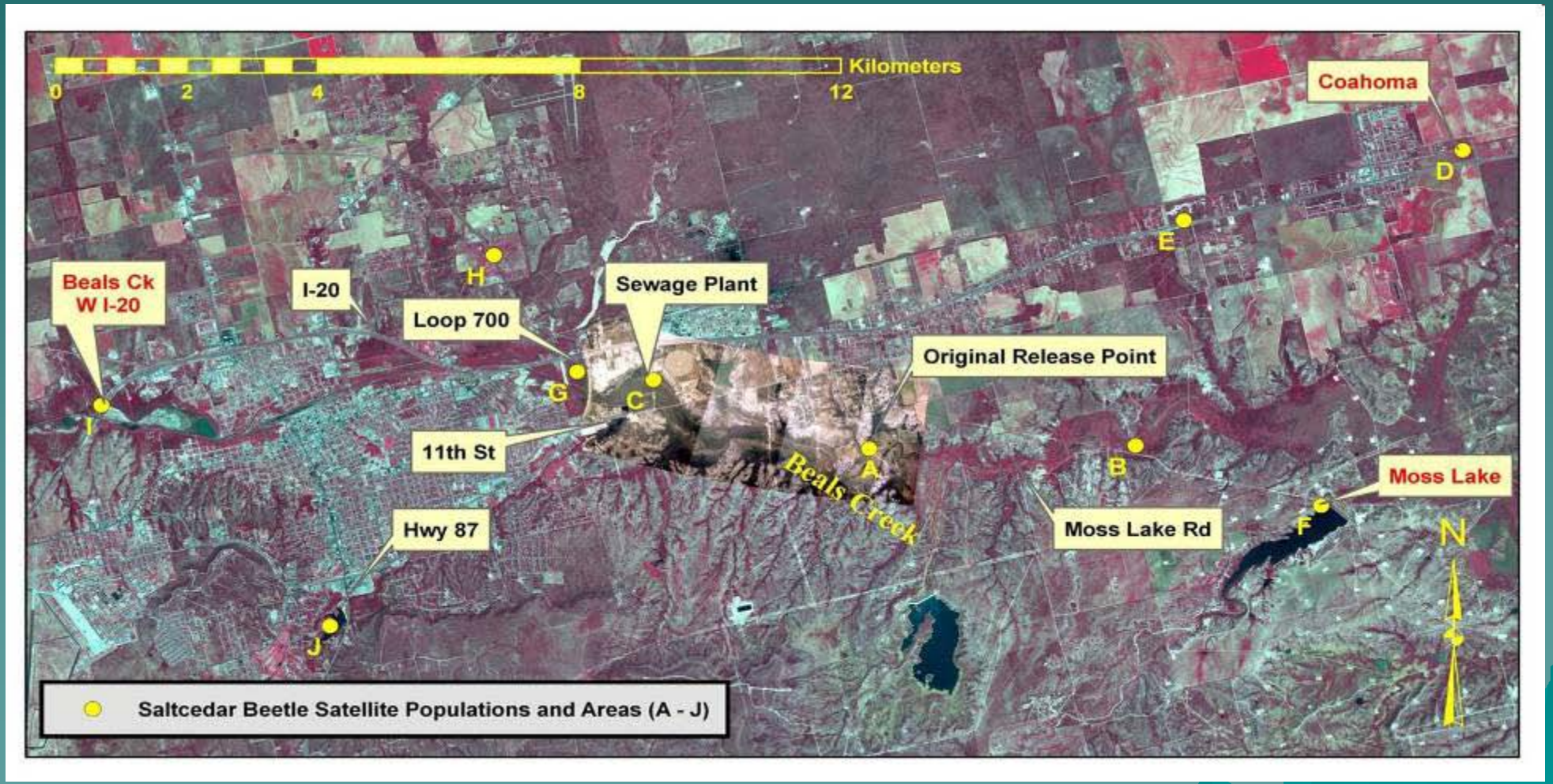
40% of trees defoliated for 4 consecutive years in Nevada failed to produce any foliage and were considered dead (Dudley et al., 2006)

Beetle Defoliation: Beals Creek, TX. September 2006



Big Spring, TX. Year 5: 2008

Ten satellite colonies found over a 14 mile area



2006. Texas AgriLife Extension Service Saltcedar Biological Control Program:

- An educational program conducted by Texas AgriLife Extension in cooperation with USDA-Agricultural Research Service.
- Purpose. To provide educational and technical assistance on biological control of saltcedar to landowners, land and water management agencies, and others interested in controlling saltcedar.

Walk-In Field Cage

50-100 beetles Released in cage in late May. Increased to 700-1000 by early July and released.

Cage Release

- Larval generation developed during June, 700-1,000 adults released on adjacent trees in late June.
- Cage moved to a new tree and process repeated for second release in late July-August.

Open Field Release

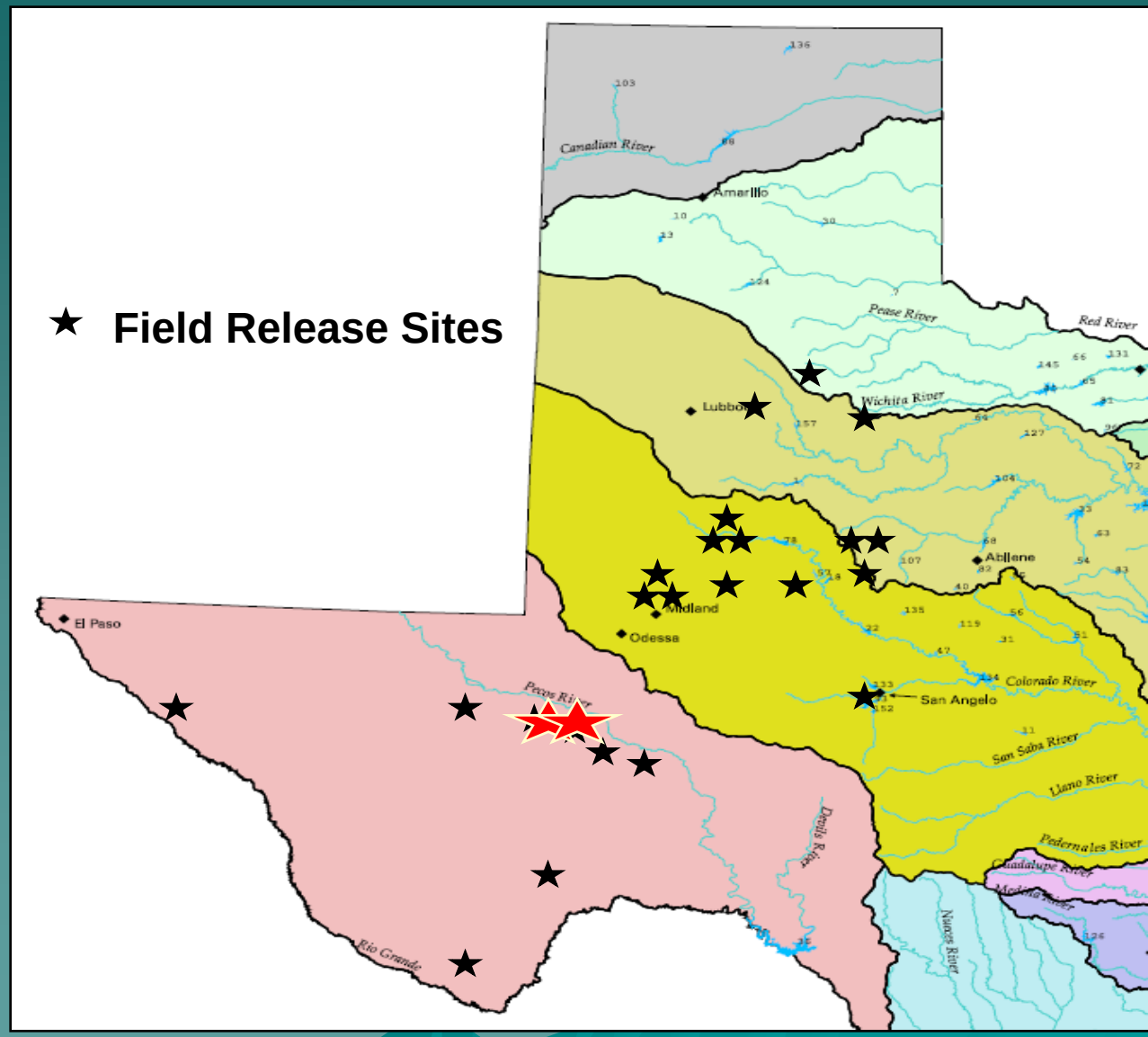
- 2,000-5,000 beetles released open field in late August-September.
- Expected most of these adults to be in diapause.

What does it mean to Establish a Beetle Population.

- Beetles over winter at a site.
- Increase in numbers next summer without additional beetles being released and
- Beetle numbers increase to levels sufficient to defoliate trees.

Texas AgriLife Extension Saltcedar Biological Control Implementation Program Status, 2008

- 2006-7: 23 release sites:
- Beetles established at 2 sites:



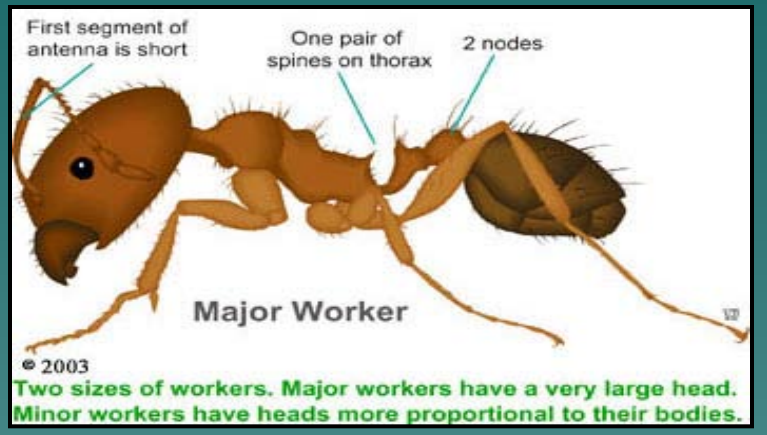
AgriLIFE EXTENSION
Texas A&M System

Why do some populations establish and other do not ?

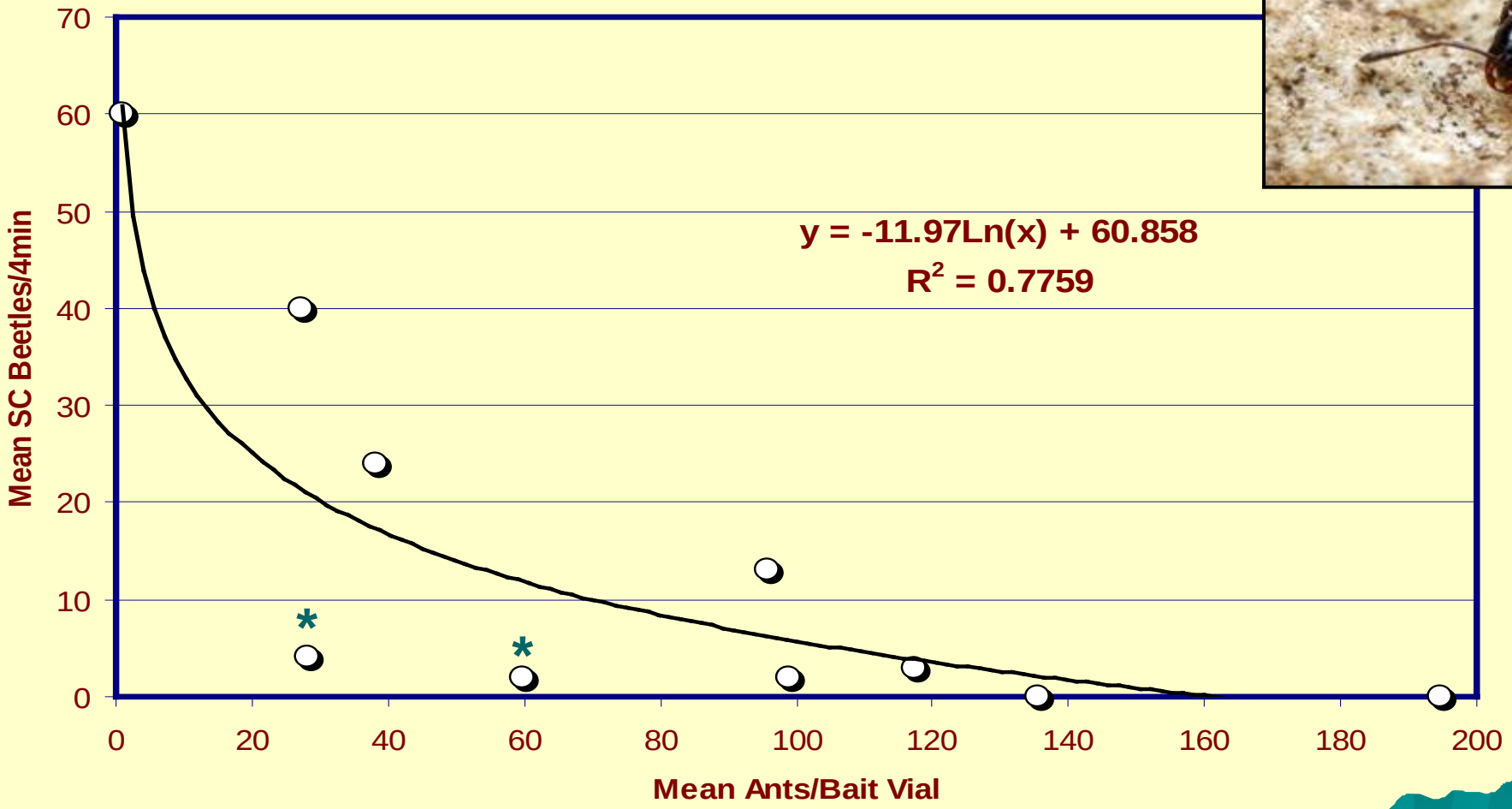
- Do spiders, ants and other predators prey on eggs, larvae & adults on the tree ?
- Do ants and other predators prey on pupae on the soil ?

Ant Abundance at Release Sites.

- Predatory ants: sampled with vials baited with hot dog.
- One vial beneath each of 10 trees
- After 90 minutes, capture and count ants in vial.



Relationship Between Saltcedar Beetle Density and Ants Collected in Bait Vials at 10 Release Sites in Texas. July-August, 2007.

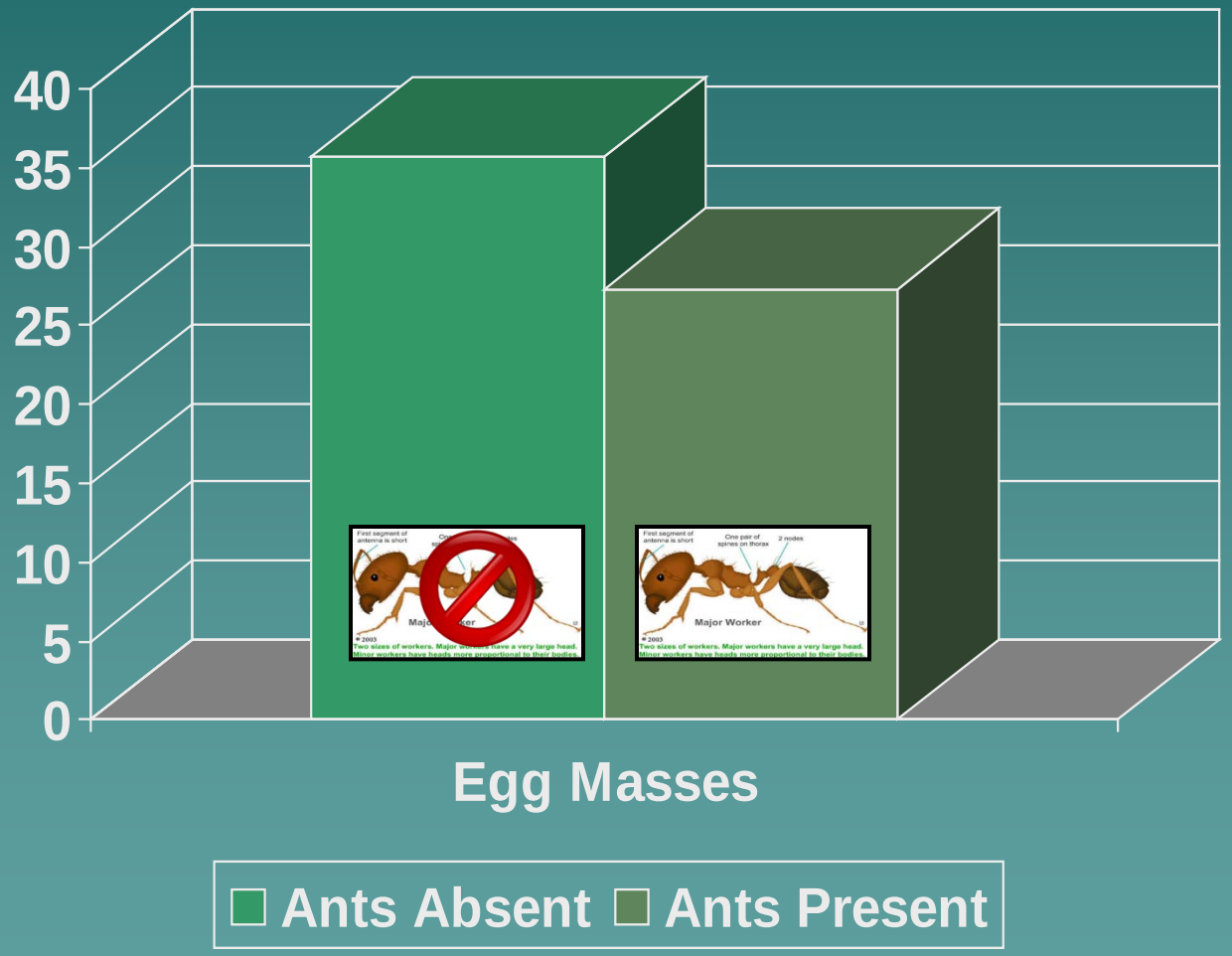


* *Solenopsis invicta* present

2008. Ant Exclusion Study.

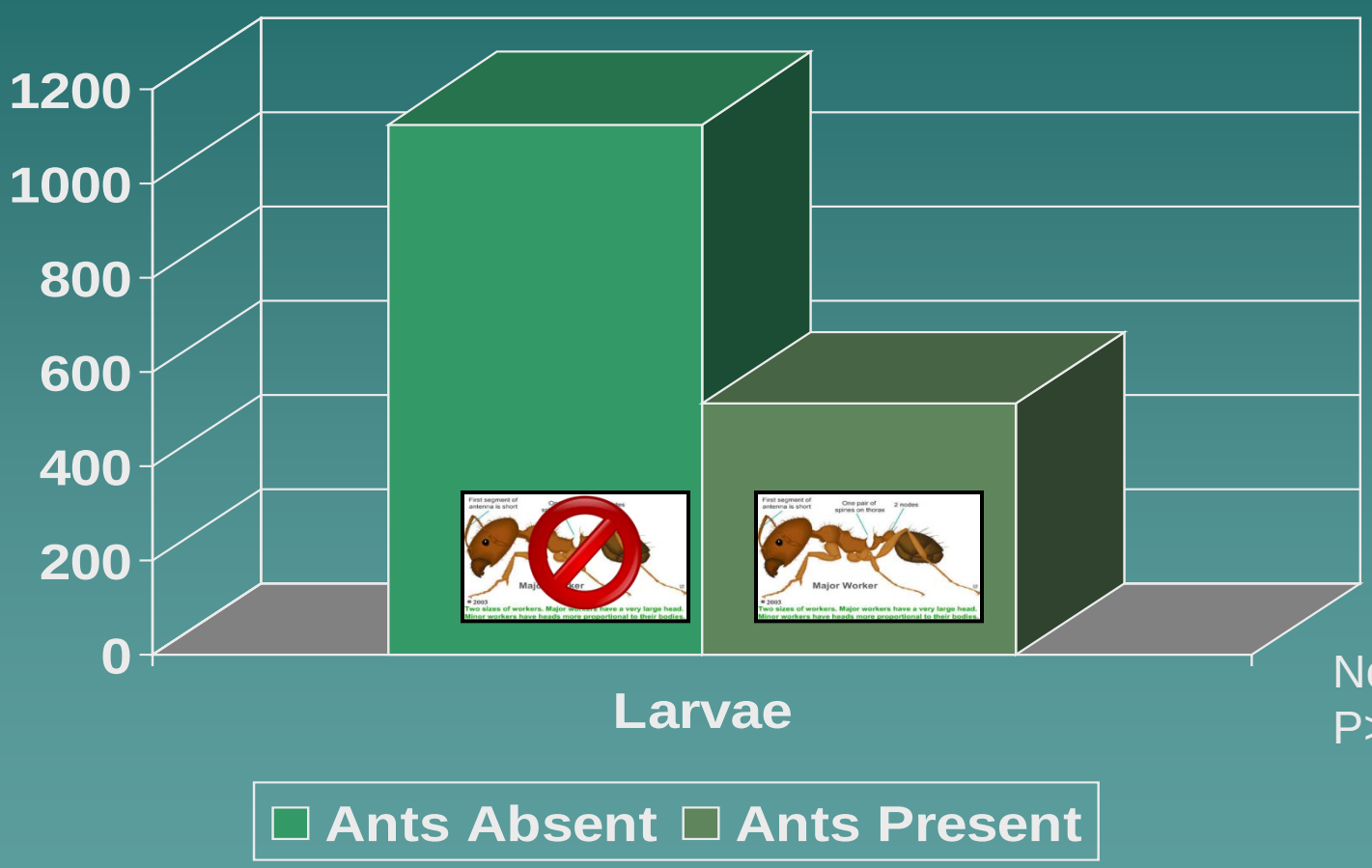
- Location selection
  - Upper Colorado River
  - Ant populations relatively high
- Use large field cages to establish beetles
  - 100 adult beetles/cage
  - 4 reps, 2 treatments
    - Ants present
    - Ants absent
      - Maxforce ant bait
        - Broadcast
        - Bait stations

Results: Mean Total Egg Masses Found Per Cage



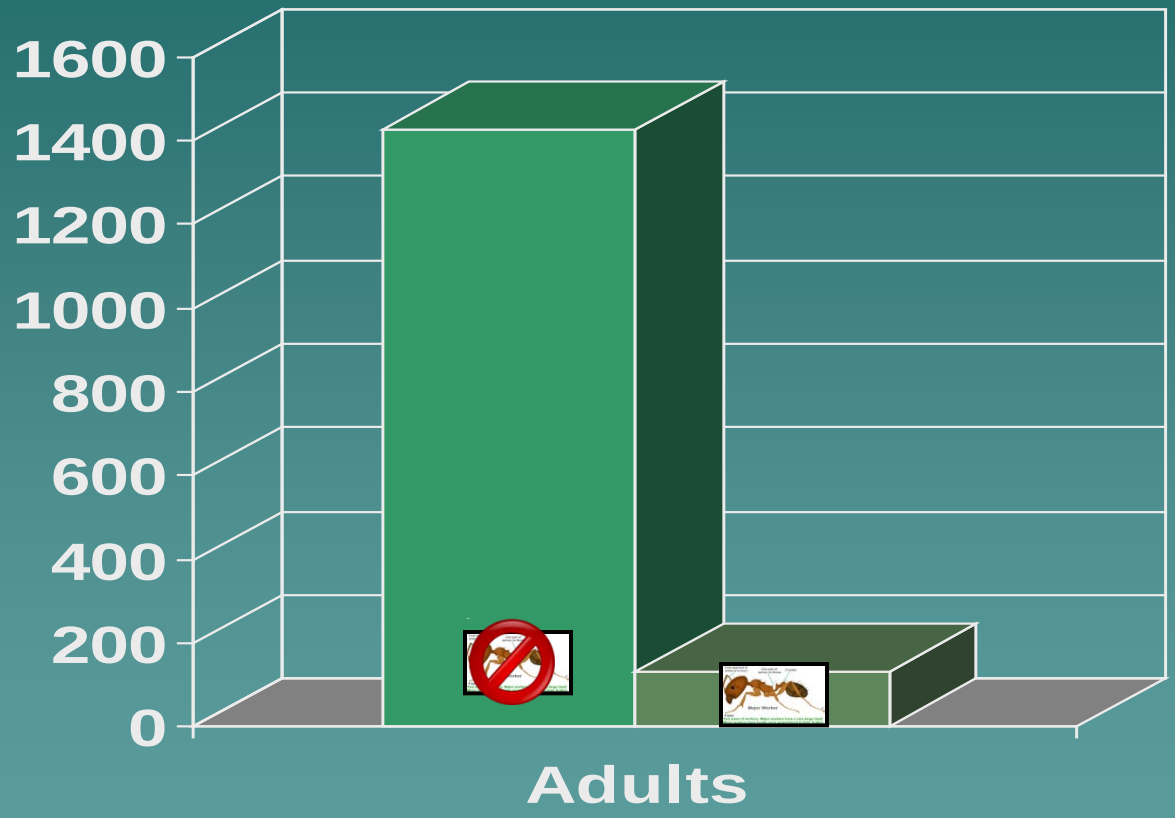
Not Significant: F=2.56
P>0.2506

Results: Mean Total Larvae Found Per Cage



Not Significant: F=6.34
P>F=0.1281

Results: Mean Total Adults Released Per Cage



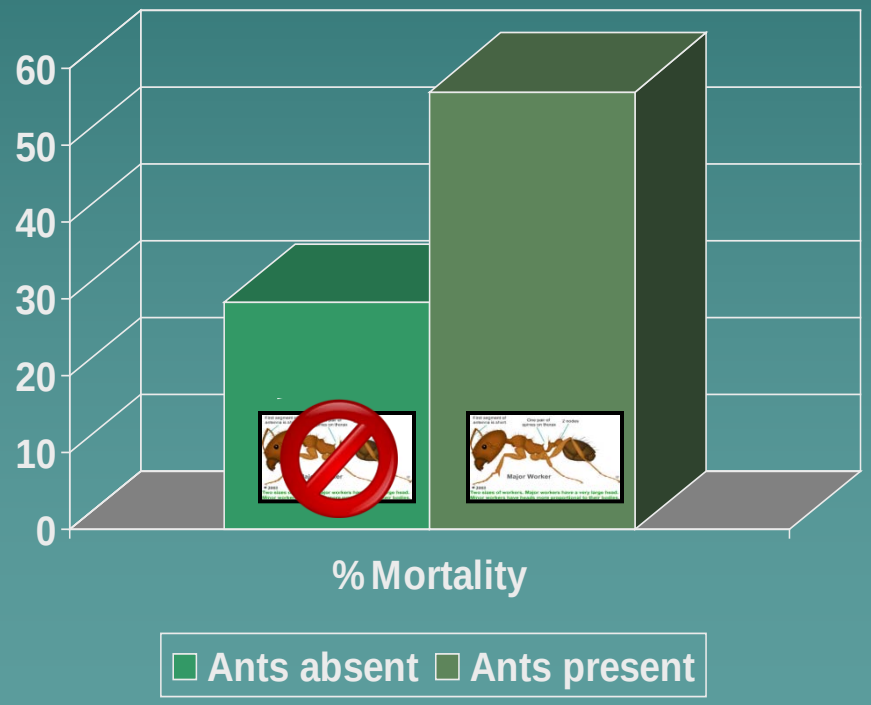
Significant: F=86.38
P>F=0.0026

10X more beetles in Ants Absent Treatment

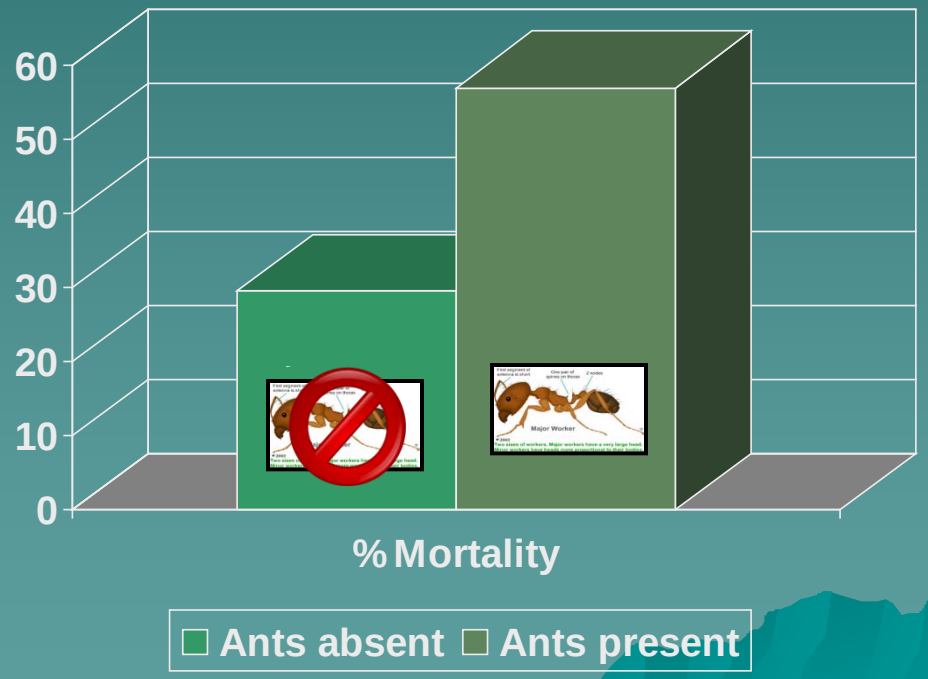
Mortality of Sentinel Pupae:

- Significant treatment effects;

Trial #1

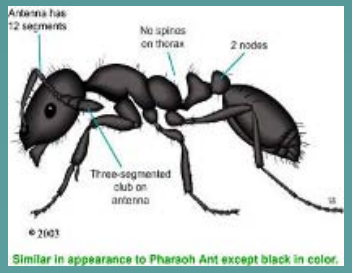


Trial #2

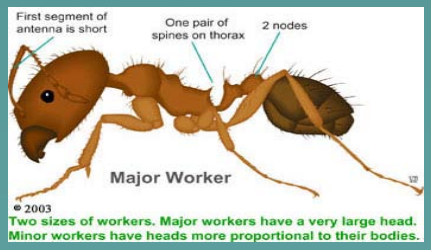


Challenges in Establishing Beetles at New Sites in West Texas.

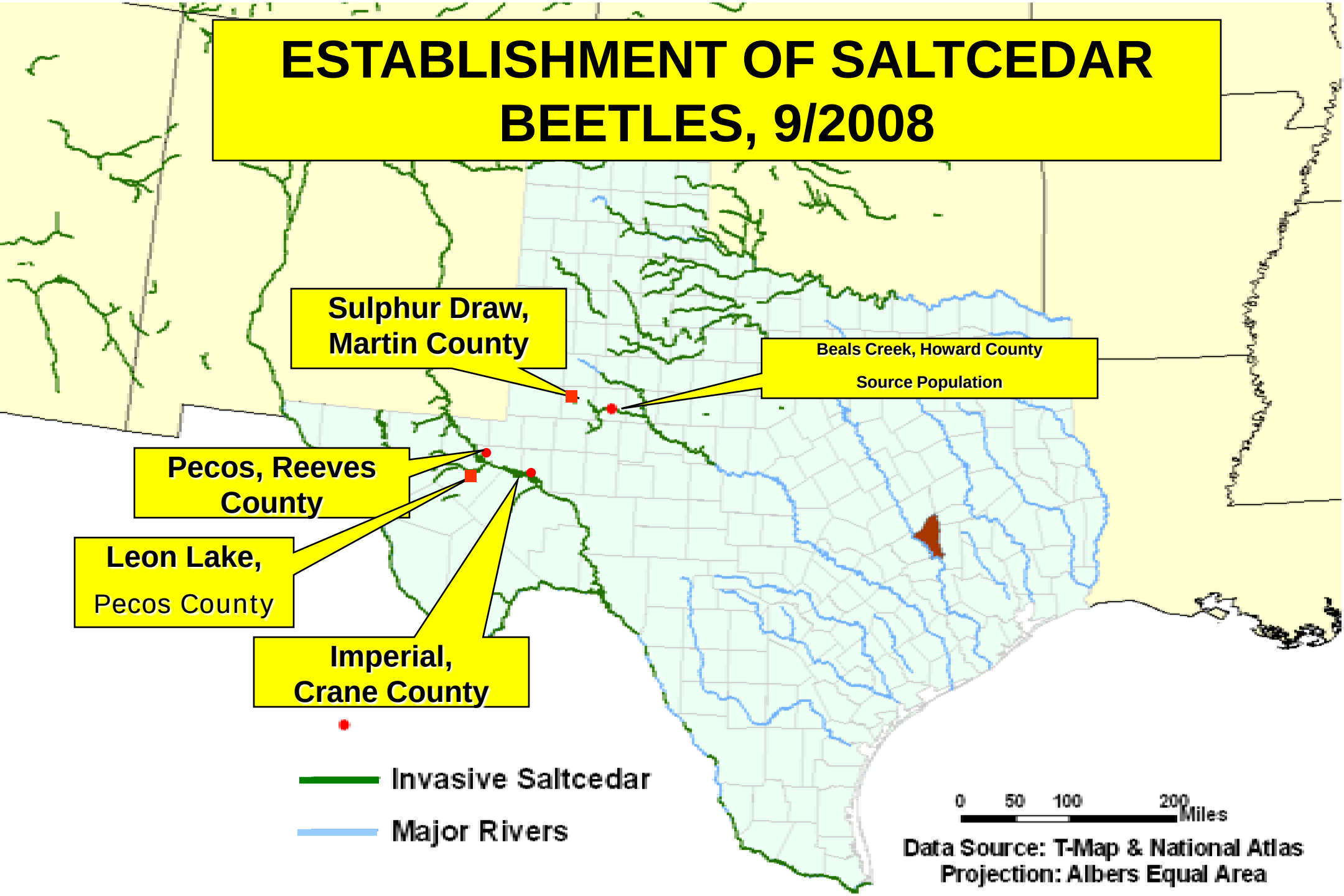
- Predation by native ant species and red imported fire ants.
- Flooding of sites.
- Insufficient numbers of beetles released to establish a population.



Similar in appearance to Pharaoh Ant except black in color.



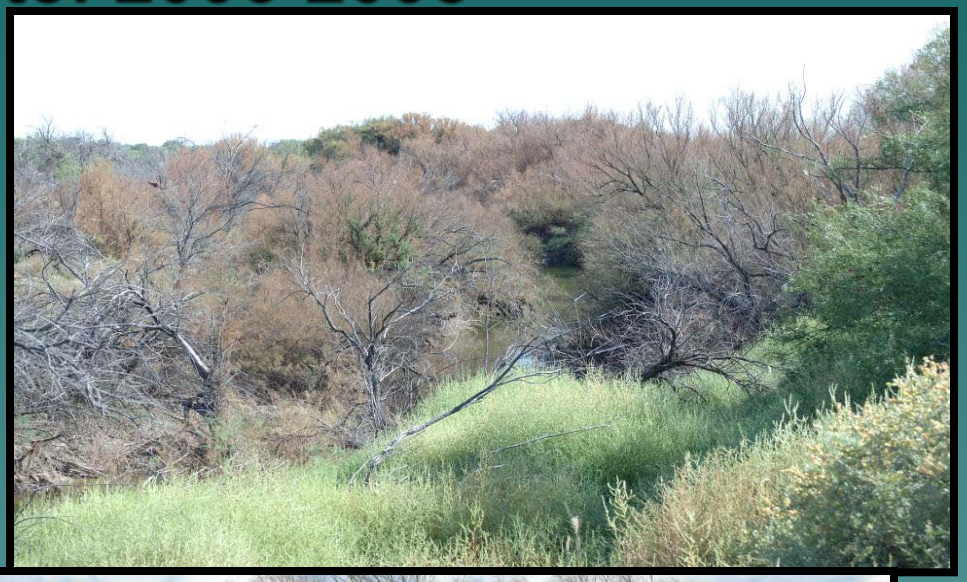
Two sizes of workers. Major workers have a very large head. Minor workers have heads more proportional to their bodies.

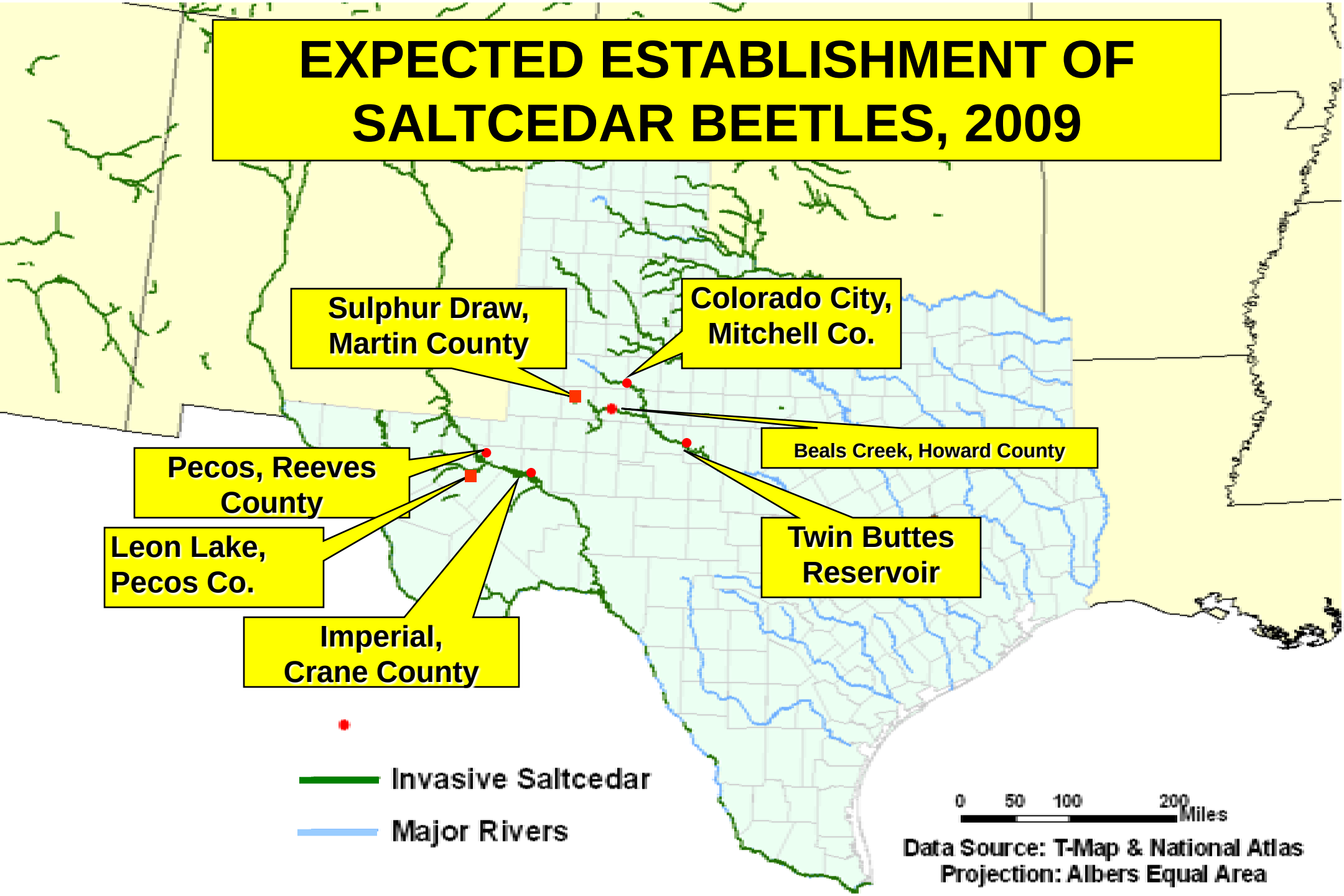

ESTABLISHMENT OF SALTCEDAR BEETLES, 9/2008
Sulphur Draw, Martin County
Beals Creek, Howard County
Source Population
Pecos, Reeves County
Leon Lake,
Pecos County
Imperial, Crane County
Invasive Saltcedar
Major Rivers
0 50 100 200 Miles
Data Source: T-Map & National Atlas
Projection: Albers Equal Area

Success on the Pecos River

Reeves County Site: 2006-2008

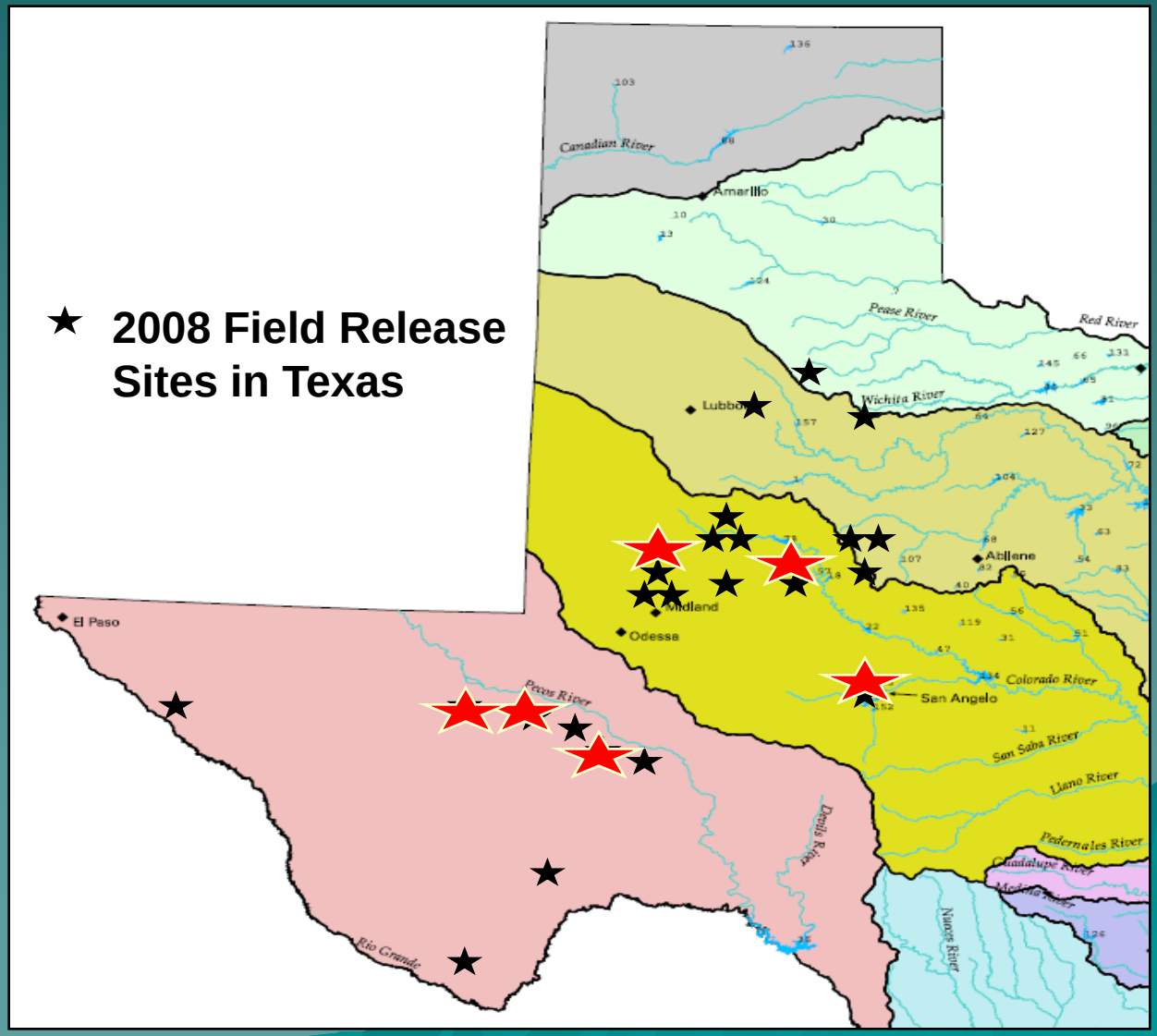
- 2006: Beetles released and defoliated ca. 500 trees across 90 acres.
- 2007, Beetles established and again defoliated 90 acres including large trees along the river.
- 2008. Beetles defoliated original area and in addition all saltcedar trees along 1.75 river miles.




EXPECTED ESTABLISHMENT OF SALTCEDAR BEETLES, 2009
Sulphur Draw, Martin County
Colorado City, Mitchell Co.
Beals Creek, Howard County
Pecos, Reeves County
Leon Lake, Pecos Co.
Twin Buttes Reservoir
Imperial, Crane County
Invasive Saltcedar
Major Rivers
0 50 100 200 Miles
Data Source: T-Map & National Atlas
Projection: Albers Equal Area

Texas AgriLife Extension Saltcedar Biological Control Program: Plans for 2009:

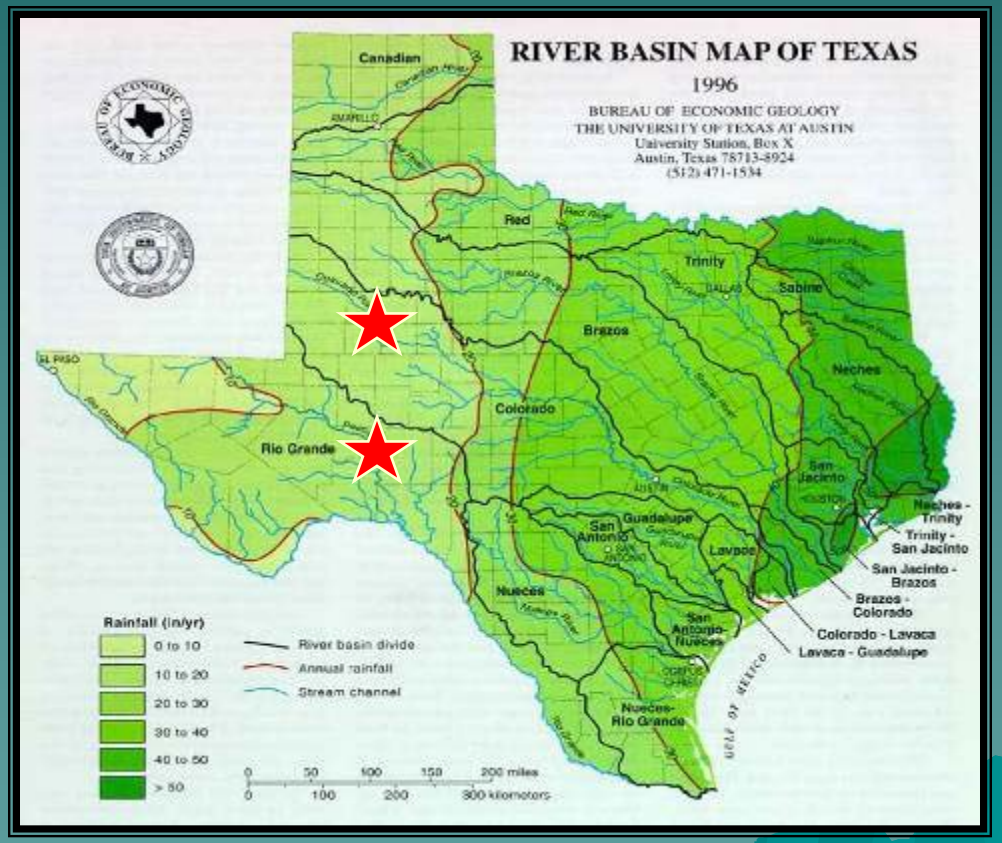
- Release additional beetles to establish populations at 20 current sites.
- Monitor impact on saltcedar and beetle dispersal at 3 (6 ?) new sites where beetles are established.



Texas AgriLife Extension Saltcedar Biological Control Program: Plans for 2009:

Establish beetles at new sites as part of:

1. **the Pecos River Restoration Plan.**
2. **Colorado River Watershed Restoration and Management Plant.**



Texas AgriLife Extension Saltcedar Biological Control Program: Plans for 2009:

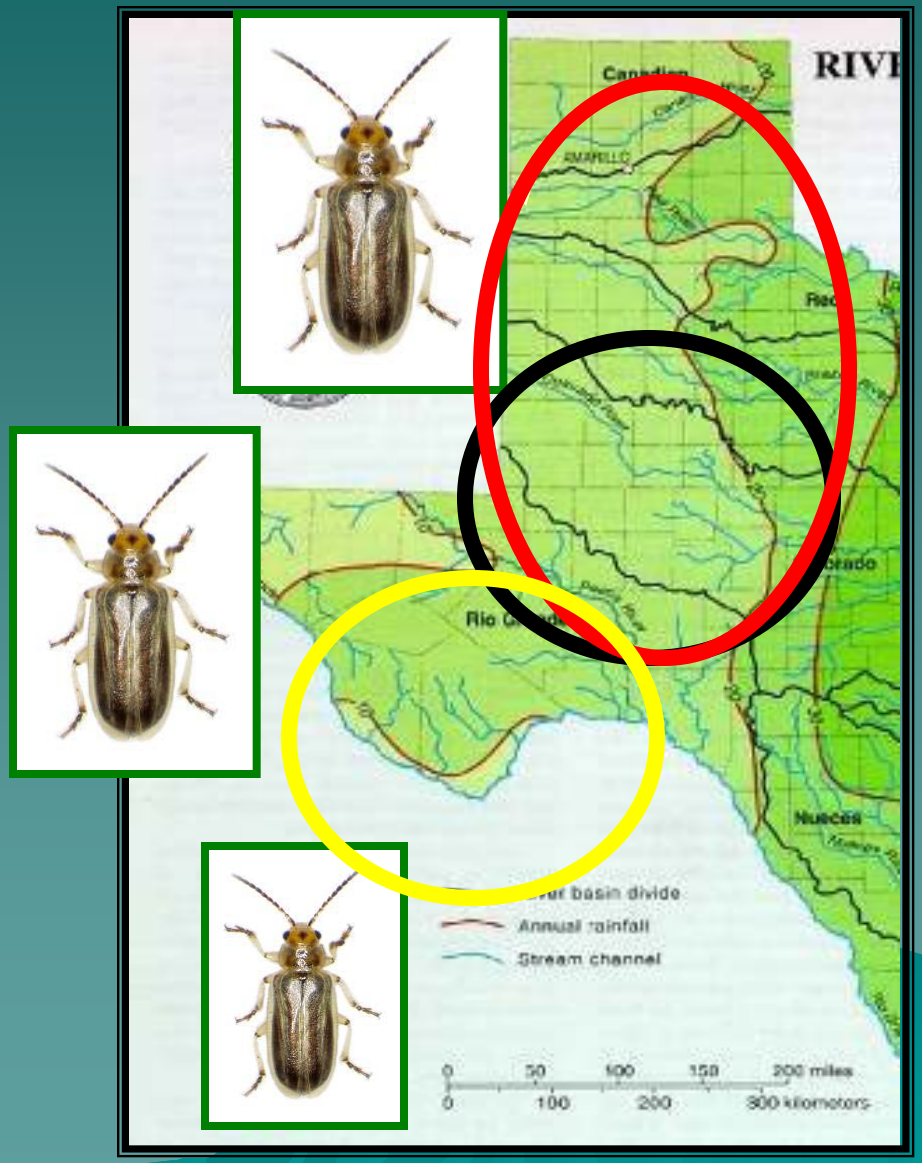
- Assist NPS to establish beetles in Big Bend National Park.
- Work with Texas AgriLife Extension Agents and NRCS to establish at least one nursery site per county to serve as a source of beetles for redistribution to land owners.

NRCS
Natural Resources Conservation Service

AgriLIFE EXTENSION
Texas A&M System

Research Questions

- Uzbek, Crete, Tunisian. Which species where ?
- Risks of releasing multiple species ?
- Can beetles persist outside of ant suppressed area ?



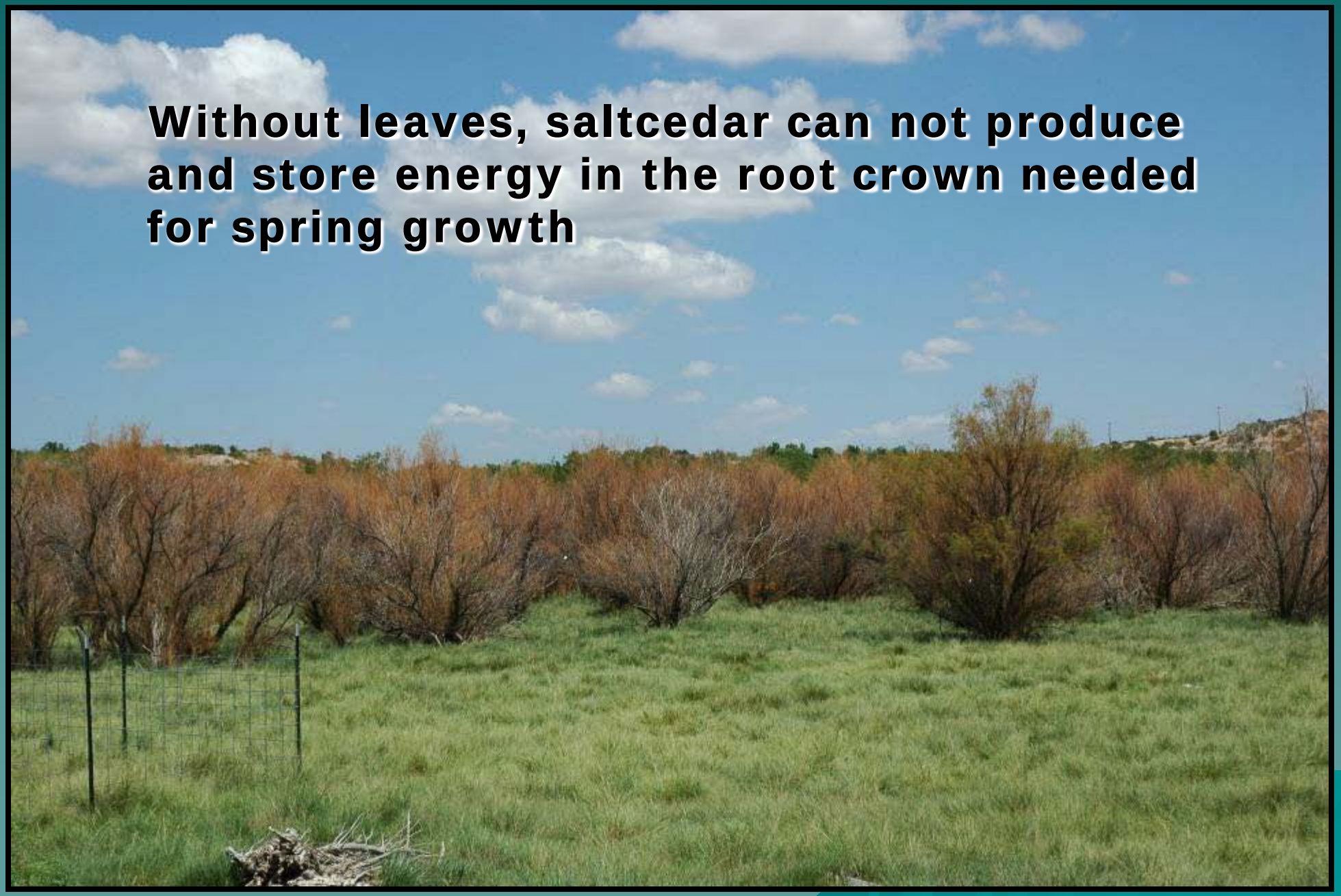
This project funded in part from a grant from the NRCS Conservation Innovation grant program.

- Questions ?

Annual Saltcedar Biological Control Field Day, Big Spring, Tx.

Big Spring, TX. 2008.
Year 5.

Beetle Defoliation: Beals Creek, Tx. September 2006

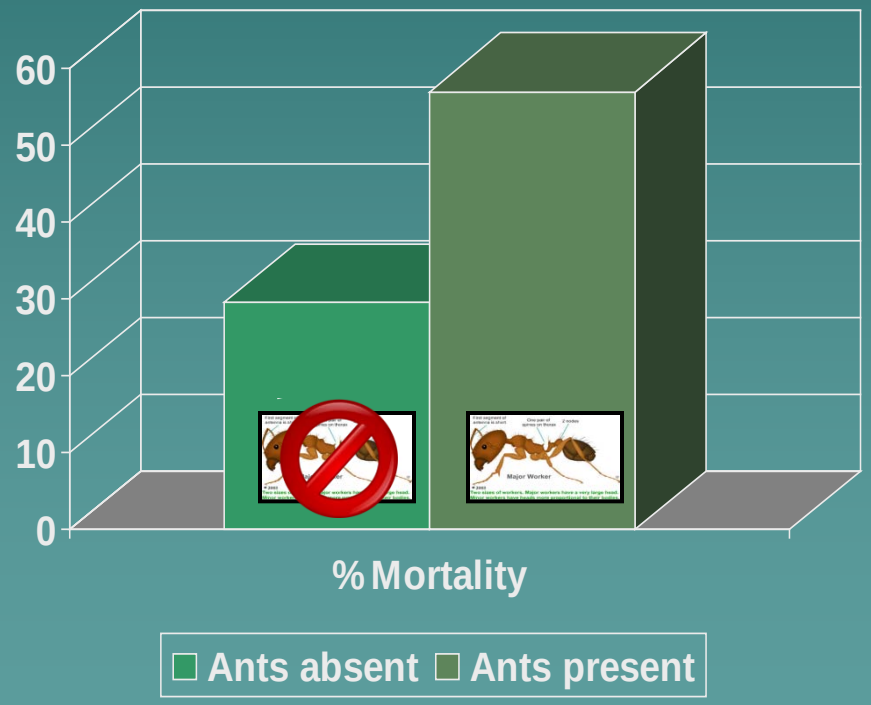


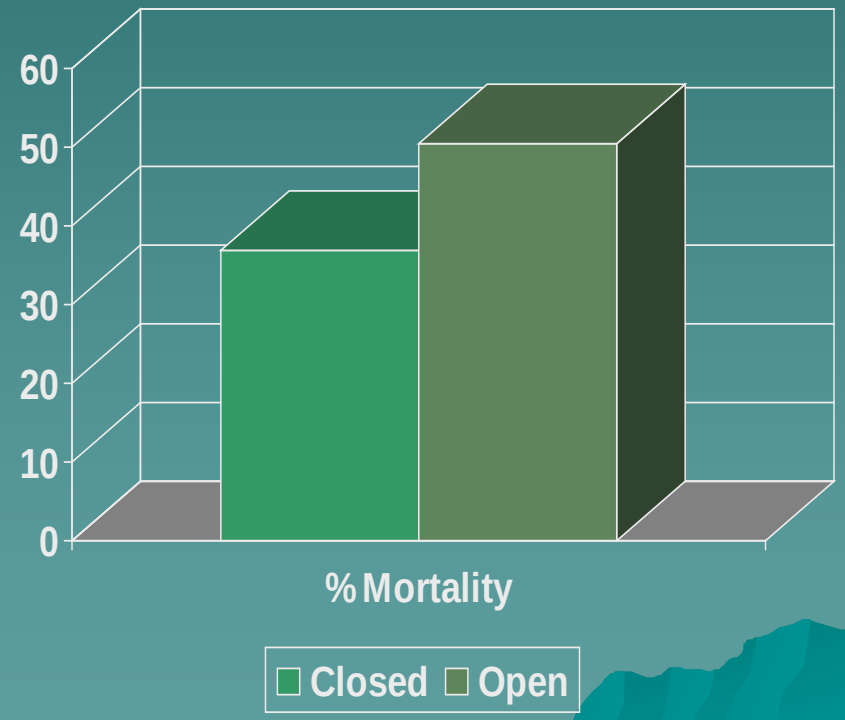
Summary/Conclusions

- Ants can significantly reduce survival of *Diorhabda,* and probably prey on eggs, larvae and pupae
- Using ant bait effectively reduces ant population density and increase beetle survival.
- Other ground dwelling animals prey on *Diorhabda* pupae
- Continue monitoring cage sites to determine if beetles establish and if so, rate of increase.

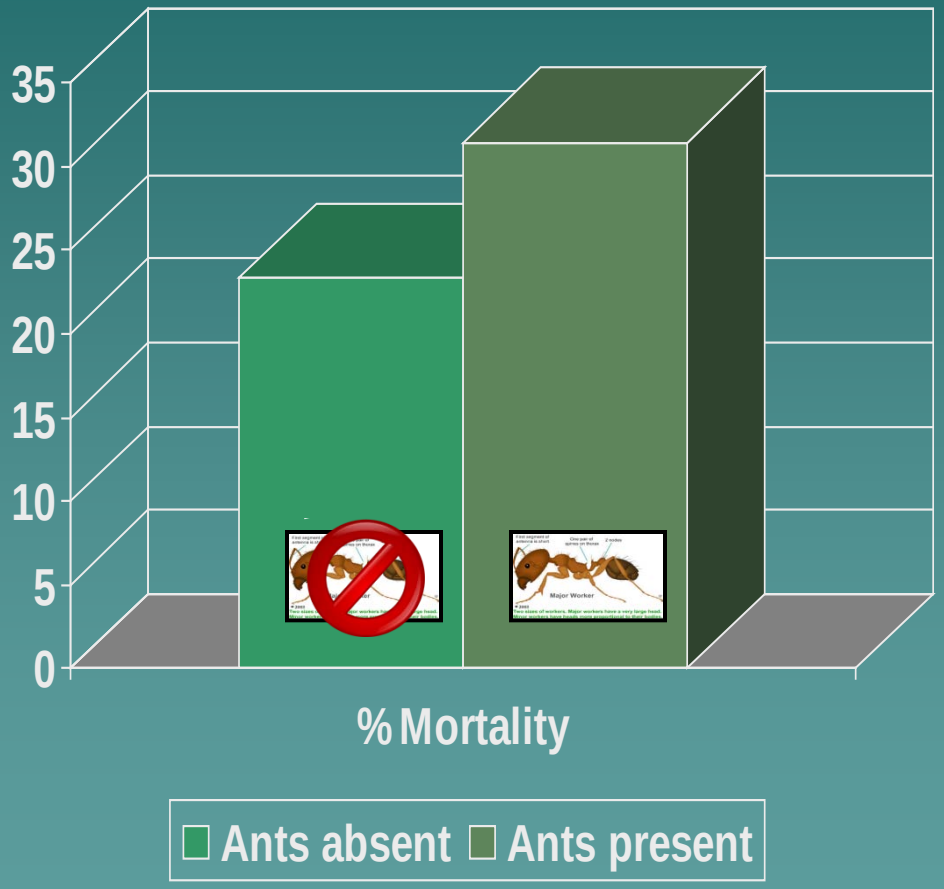
Mortality of Sentinel Pupae: Trial 1

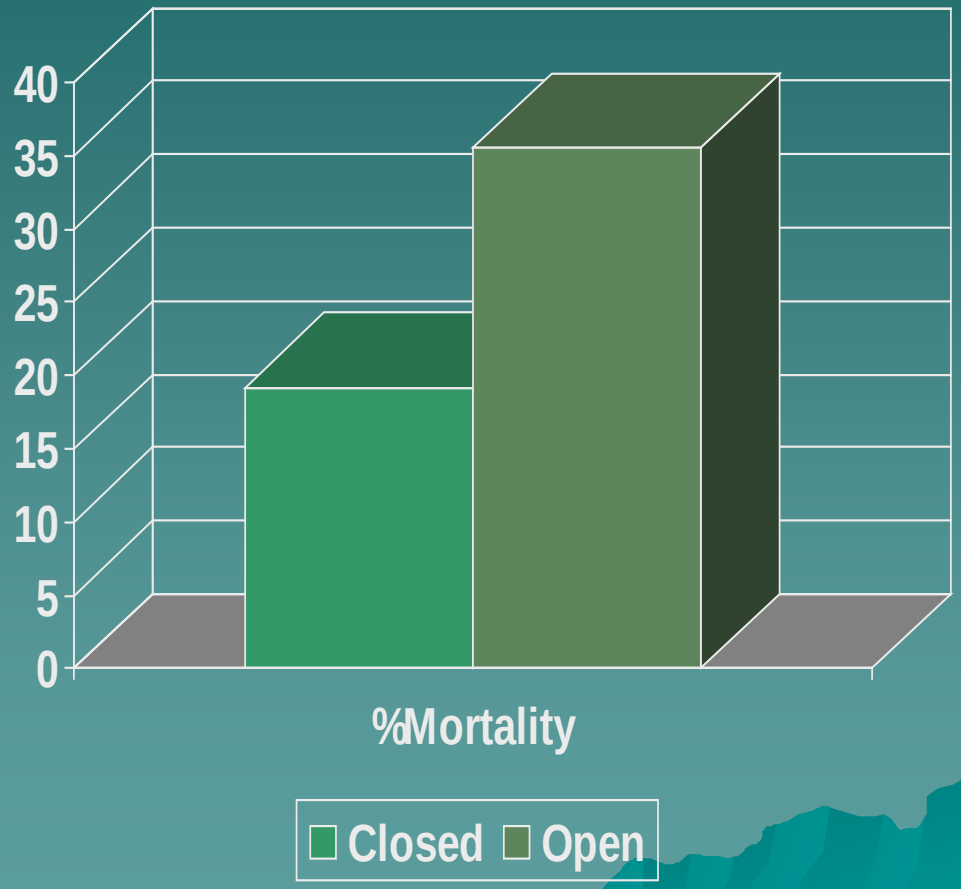
- Significant treatment effects; no significant interactions



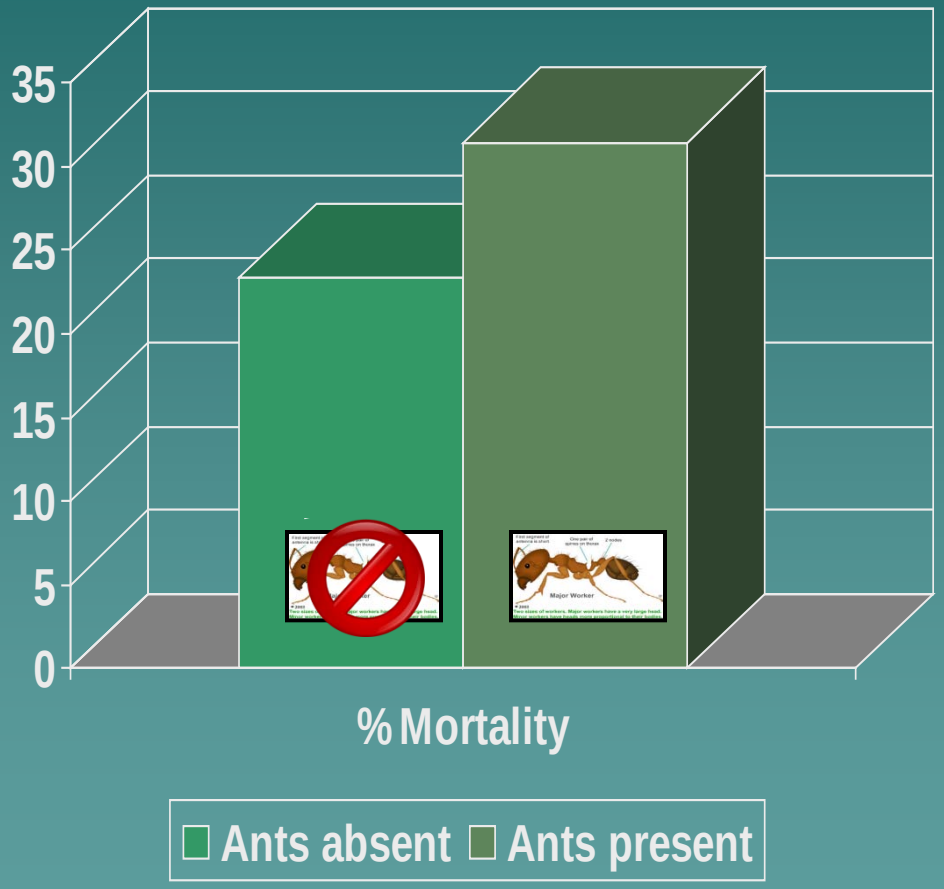


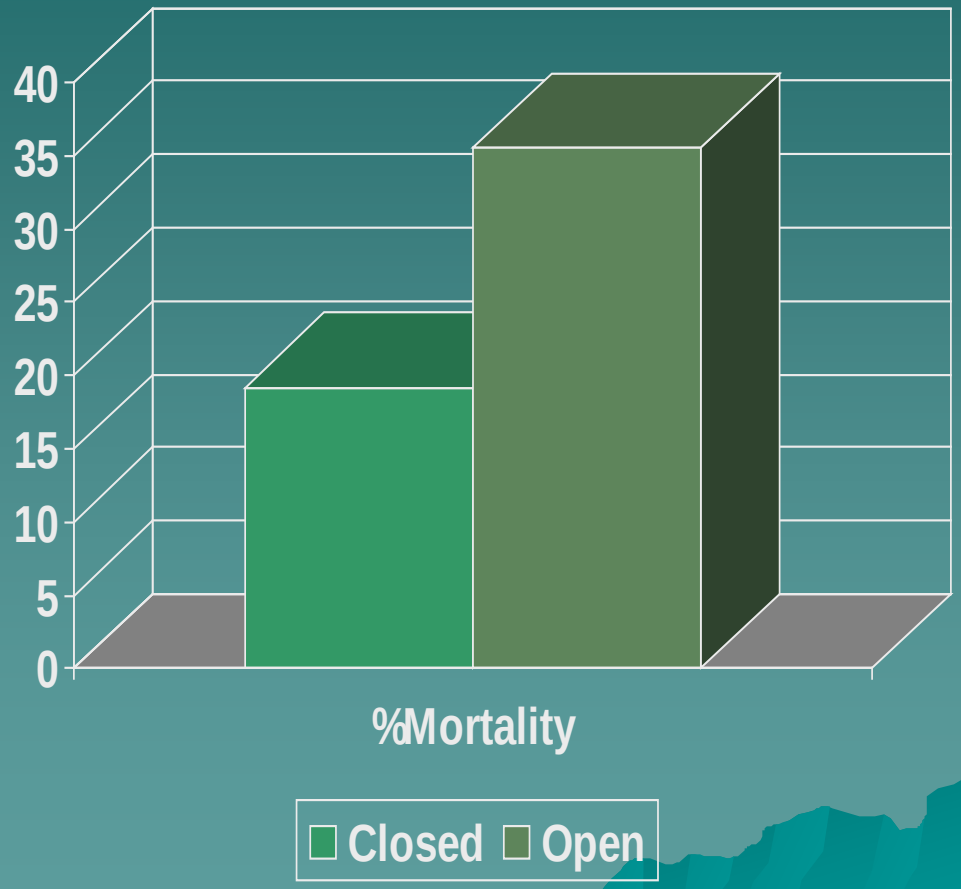
Mortality of Sentinel Pupae: Trial 2





Mortality of Sentinel Pupae: Trial 2





Texas Saltcedar Biological Control Implementation Program: Objectives

- Establish Beetles at New Sites and Increase Impact on Saltcedar.
- Compliment Aerial Herbicide Spray Program on Colorado and Pecos Rivers.
- Establish field nursery sites to serve as a source of beetles for redistribution to land owners.

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Texas A&M System

Pecos River, Reeves and Crane Counties, 2006-7

- Beetles released July, 2006 at three sites.
- Beetles overwintered.
- Numbers increased and by June larvae were defoliating trees.
- July 2007 Survey: 40 beetles observed /4 minute search
- By October, 2007, beetles had defoliated ca. 500 trees across 90 acres.

Big Spring, TX. 2005

- Thousands of larvae defoliated ca. 40 trees in July
- By September, beetles had defoliated 0.4 acre of saltcedar trees

QUESTIONS ?

Annual Saltcedar Biological Control Field Day, Big Spring, Tx.

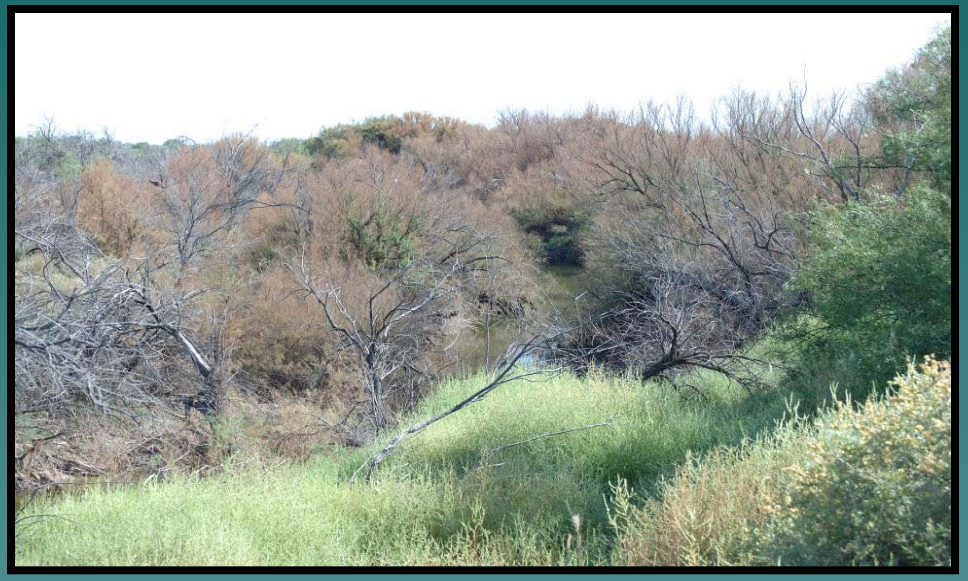
AgriLIFE EXTENSION
Texas A&M System

Defoliation of Saltcedar, Pecos River. October, 2007.

Large Saltcedar Trees Defoliated by Beetles along the Pecos River. Sept, 2007.

Pecos River, Reeves County, 2008

- Beetles increased in July and defoliated ca. 500 trees across 90 acres.
- Beetles moved across the river and defoliated trees that survived herbicide treatment.
- Sept. 2008, beetles found along 1.2 miles of river.



Sulphur Draw, Martin Co. August, 2008.

First establishment of beetles in Colorado River Watershed outside of Beals Creek site.

Beetles released in July, 2007. By mid-Sept, 2008, 21 trees defoliated.

Study 2. Methods & Materials

- Same cages/location as Study 1.
- Experimental Design: Nested RBD
- Ants Present or absent
- Beetle pupae in open or closed petri plates
- 30 petri dishes placed inside each cage.
  - 1 pupa per petri dish
  - 15 dishes with no lids; 15 covered with lids
  - 5mm diameter holes (4/plate) in each lidded plate

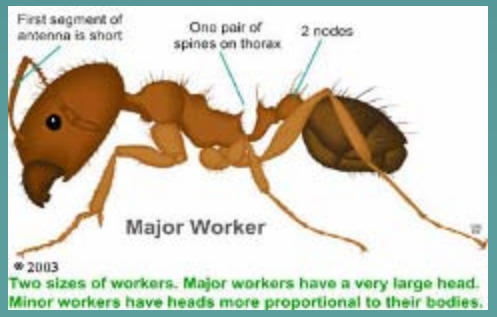
Challenges in Establishing Beetles at New Sites.

- During 2006-2008, Texas AgriLife Extension released beetles at 23 sites in Texas.
- To date, beetles established at only 4 sites.
- Why ?

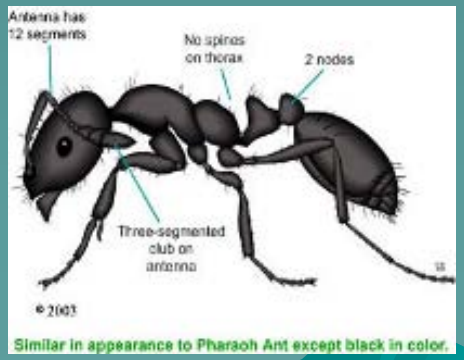
AgriLIFE EXTENSION
Texas A&M System

Challenges in Establishing Beetles at New Sites.

- Some sites were flooded.
- Not enough beetles released to establish a population.
- Too many native and red imported fire ants that feed on larvae and pupae.



Two sizes of workers. Major workers have a very large head. Minor workers have heads more proportional to their bodies.

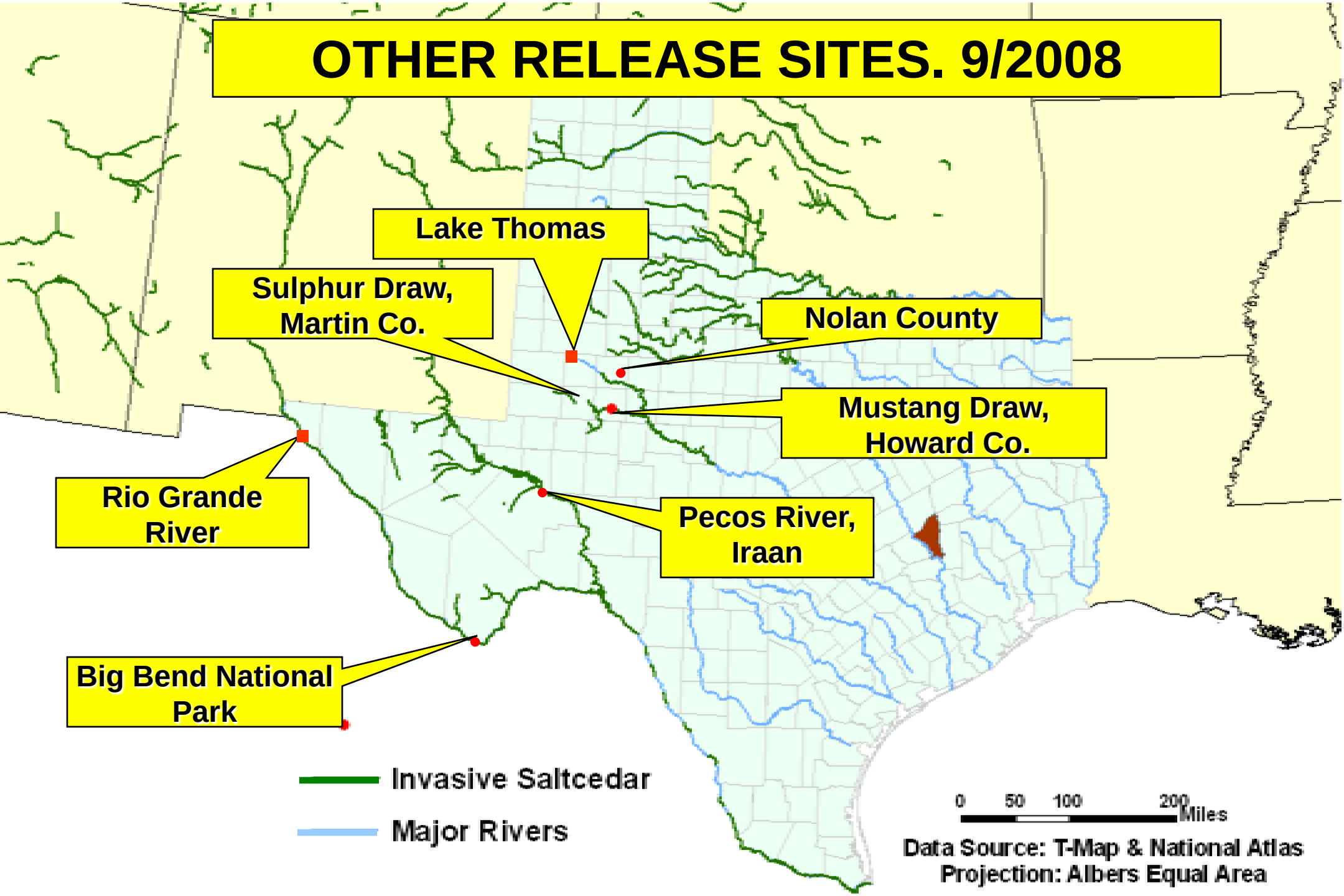


Similar in appearance to Pharaoh Ant except black in color.

Texas AgriLife Extension Service Saltcedar Biological Control Program:

- Texas AgriLife Extension: County Extension Agents and IPM Entomologists
- Natural Resource Conservation Service.
- Regional Water and Irrigation Districts


★ 2008 Field Release Sites in Texas
Canadian River
Amarillo
Pease River
Red River
Wichita River
Lubbock
Abilene
Midland
Odessa
El Paso
Pecos River
Colorado River
San Angelo
San Saba River
Llano River
Pedernales River
Devils River
Rio Grande
Nueces River


OTHER RELEASE SITES. 9/2008
Lake Thomas
Sulphur Draw, Martin Co.
Nolan County
Mustang Draw, Howard Co.
Rio Grande River
Pecos River, Iraan
Big Bend National Park
Invasive Saltcedar
Major Rivers
0 50 100 200 Miles
Data Source: T-Map & National Atlas
Projection: Albers Equal Area

Conclusions

- Beetles established at 4 new sites in 2007-2008.
- Expect beetles to establish in 3-4 additional sites in 2009.
- Expect high success rate on Pecos River.

AgriLIFE EXTENSION
Texas A&M System

Biological Control of Saltcedar:

- Is one option for managing saltcedar.
- Low cost, highly specific to saltcedar.
- Is slow, several years effort may be required to establish beetles.
- Once established, at least 4-5 years of repeated defoliation are needed to kill a tree.
- Implementation Program will continue to establish beetles at new sites.

Texas AgriLife Extension Saltcedar Biological Control Program: Plans for 2009:

- Work with Colorado River Municipal Water District to establish beetles on Upper Colorado.
- Work with Pecos River Restoration Group to establish beetles on Pecos River.

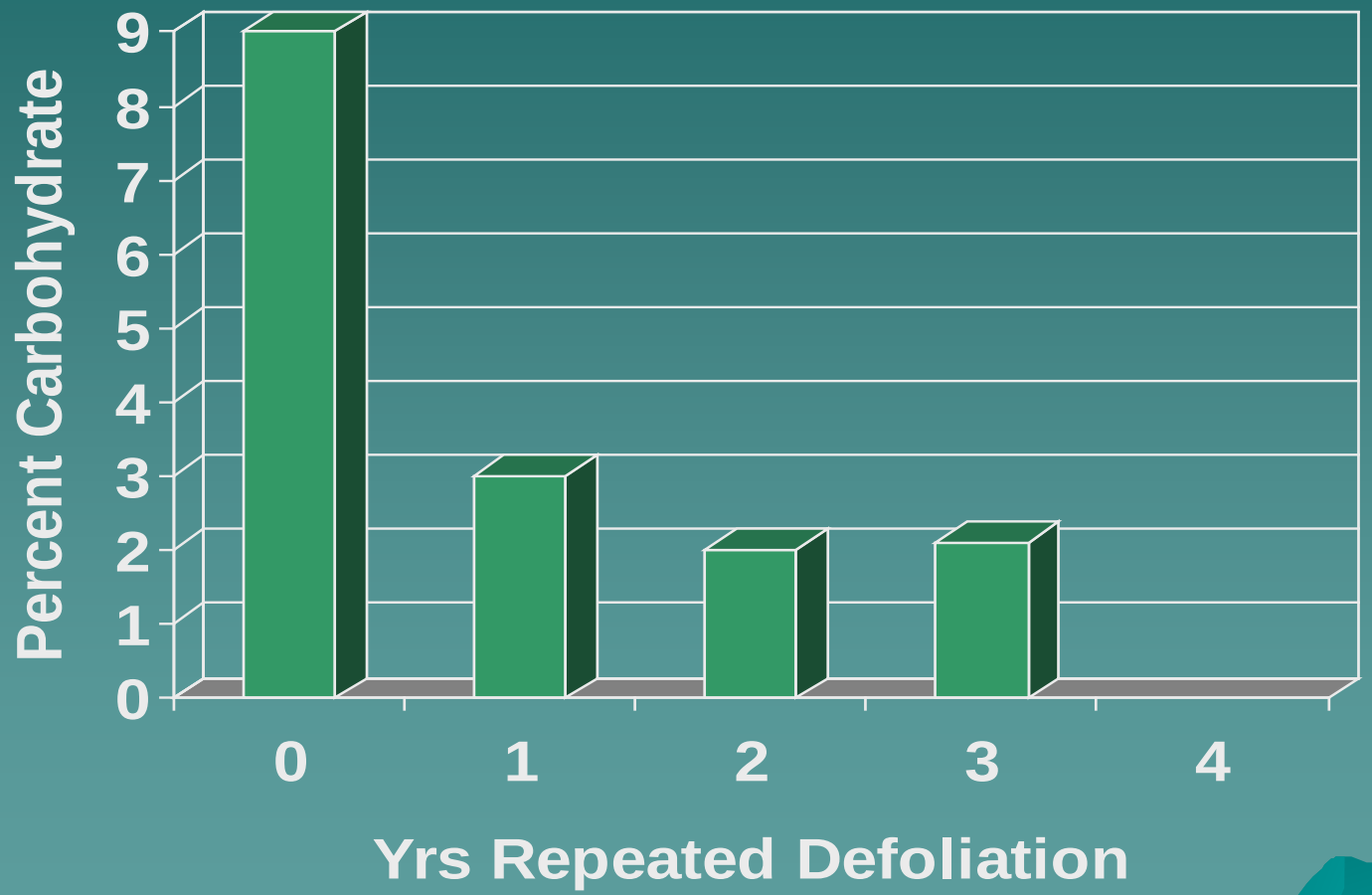
Texas AgriLife Extension Saltcedar Biological Control Program: Plans for 2009:

- Continue to work with Texas AgriLife Extension agents and NRCS to establish beetles at 20 current sites.
- As time and resources allow, establish additional release sites.
- Goal is to establish beetles along major waterways infested with saltcedar in west Texas.

Questions ?

AgriLIFE EXTENSION
Texas A&M System

Percent Carbohyrdates in Root Crown Following Repeated Years of Defoliation by Leaf Beetles, Natural Experiment, Nevada, 2005



Additional Release Sites, 2007-2008

Mustang Draw Release Site, Ed Miller Cooperator.
August, 2008, Howard Co.