If You Cut It, Will They Come?

Pollinator Response to Chinese Privet Removal

Scott Horn, Jim Hanula, Jacob Hudson, Mike Ulyshen, and Yanzhuo Zhang

How do a bunch of Entomologists get involved with Chinese Privet?

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Southern Research Station

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"Yellow star thistle: Volunteers tackle a thorny problem "

Napa Valley Register.com

"Garlic mustard is a threat to several tree species"

Providence Journal

"How to stop honeysuckle invasion"

Dayton Daily News

Kudzu That Ate U.S. South Heads North as Climate Changes

Bloomberg Business

Available online at www.sciencedirect.com
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ECOLOGICAL ECONOMICS
Ecological Economics 52 (2005) 273–288
www.elsevier.com/locate/ecolecon

Update on the environmental and economic costs associated with alien-invasive species in the United States

David Pimentel*, Rodolfo Zuniga, Doug Morrison

College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14850-0901, United States

Available online 29 December 2004

Abstract

OPEN ACCESS Freely available online
PLOS BIOLOGY

Invasive Plant Suppresses the Growth of Native Tree Seedlings by Disrupting Belowground Mutualisms

Kristina A. Stinson[1], Stuart A. Campbell[2], Jeff R. Powell[2], Benjamin E. Wolfe[2], Ragan M. Callaway[3], Giles C. Thelen[3], Steven G. Hallett[4], Daniel Prati[5], John N. Klironomos[2*]

1 Harvard Forest, Harvard University, Petersham, Massachusetts, United States of America, 2 Department of Integrative Biology, University of Guelph, Guelph, Ontario, Canada, 3 Division of Biological Sciences, University of Montana, Missoula, Montana, United States of America, 4 Department of Botany and Plant Pathology, Purdue University, West Lafayette, Indiana, United States of America, 5 Department of Community Ecology, UFZ Centre for Environmental Research, Halle, Germany

The impact of exotic species on native organisms is widely acknowledged, but poorly understood. Very few studies have empirically investigated how invading plants may alter delicate ecological interactions among resident species in the invaded range. We present novel evidence that antifungal phytochemistry of the invasive plant, *Alliaria petiolata*, a European invader of North American forests, suppresses native plant growth by disrupting mutualistic associations between native canopy tree seedlings and belowground arbuscular mycorrhizal fungi. Our results elucidate an indirect mechanism by which invasive plants can impact native flora, and may help explain how this plant successfully invades relatively undisturbed forest habitat.

Citation: Stinson KA, Campbell SA, Powell JR, Wolfe BE, Callaway RM, et al. (2006) Invasive plant suppresses the growth of native tree seedlings by disrupting belowground mutualisms. PLoS Biol 4(5): e140. DOI: 10.1371/journal.pbio.0040140

Introduction

Widespread anthropogenic dispersal of exotic organisms has raised growing concern over their devastating ecological

plants, can be negatively affected by AMF [14–16]. Naturalized exotic plants have been found to be poorer hosts and depend less on native AMF than native plants [17]. They often colonize areas that have been disturbed [2], and disturbances

Oecologia (2006) 150:272–281
DOI 10.1007/s00442-006-0512-2

ECOSYSTEMS ECOLOGY

The effect of Chinese tallow tree (*Sapium sebiferum*) ecotype on soil–plant system carbon and nitrogen processes

Jianwen Zou · William E. Rogers · Saara J. DeWalt · Evan Siemann

Received: 18 October 2005 / Accepted: 6 July 2006 / Published online: 18 August 2006

Abstract The EICA hypothesis predicts that shifts in allocation of invasive plants give rise to higher growth rates and lower herbivore defense levels in their introduced range than conspecifics in their native range. These changes in traits of invasive plants may also affect ecosystem processes. We conducted an outdoor pot experiment with Chinese tallow tree (*Sapium sebiferum*, Euphorbiaceae) seedlings from its native (Jiangsu, China, native ecotype) and introduced ranges (Texas, USA, invasive ecotype) to compare their relative performances in its native range and to examine ecotype effects on soil processes with and without fer-

than for the native ecotype. Soil respiration rates and N_2O emission increases from fertilization were also greater for the invasive ecotype than for the native ecotype, while shoot-specific respiration rates (g CO_2–C g^{-1} C day^{-1}) did not differ between ecotypes. Further, soil inorganic N (ammonium and nitrate) was higher, but soil total N was lower for soils with the invasive ecotype than soils with the native ecotype. Compared with native ecotypes, therefore, invasive ecotypes may have developed a competition advantage in accelerating soil processes and promoting more nitrogen uptake through soil–plant direct interaction.

forest ecology

Woody Invaders and the Challenges They Pose to Forest Ecosystems in the Eastern United States

Christopher R. Webster, Michael A. Jenkins, and Shibu Jose

ABSTRACT

Invasive exotic species pose significant challenges for natural resource managers charged with the maintenance of biological diversity and the sustainable production of forest resources. In this article, we review what is known about the biology and control of some of the most serious woody invaders of eastern forests. Based on the parallels between these invasions, we propose a working framework for integrating invasive control into forestry practices. In general, early detection and rapid response to invasions are essential. However, given that consistently effective control strategies that are broadly applicable simply do not exist for many species, adaptive management strategies will be necessary.

species, high reproductive output and/or propensity for vegetative reproduction, animal dispersed seeds, and the ability to form a seed bank. However, often, it is difficult to predict with certainty which introduced species actually will become invasive. Worse yet, changes in extrinsic factors, such as land use or disturbance regime, may facilitate invasive behavior in previously noninvasive

- Invasive species are considered one the top threats to forest ecosystems in North America.
- 42% of the decline in native species now listed as endangered or threatened in the US is a result of non-native invasive plants, animals or microbes (Pimentel 2002).
- **GA-EPPC** "Category 1" (20 listed plants)
  - *Exotic plant that is a serious problem in Georgia by extensively invading and displacing native species.*
- Chinese privet……one of the worst!

Chinese Privet, *Ligustrum sinense*

- Used in traditional medicine in China
  - Hard to find in natural areas
  - 8 recognized subspecies
- Introduced into the US in 1852
- Widely used for hedges and borders

Chinese Privet:

"remarkable ornamental?"

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Sunshine Ligustrum will grow up to 4 feet in height with an equal spread. It's a multi-stemmed shrub with an upright, spreading nature. It's fast-growing and long lived (under optimal conditions reaching up to 30 years or more). Deer tend to pass Sunshine Ligustrum by, as do other common pests. Its dense nature is terrific for topiary, so if you feel a creative urge to prune it into a unique shape, it will certainly be amenable.

Your Sunshine Ligustrum is the type of shrub gardeners love to rave about! It will adapt to many spots in your landscape, you can choose to prune it or leave it natural, pests don't bother it and its color lasts all year round. There is no downside to this remarkable, ornamental shrub so plant one today and begin to reap its rich rewards.

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* Adaptive to a variety of soil conditions

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Southern Living PLANT COLLECTION

Playing “Between the Hedges”

The Augusta Chronicle

$30 plus shipping and handling, Dawgs fans can order plants and get their own piece of the hedges in a pot. The product is officially licensed by the school through the Collegiate Licensing Corp.

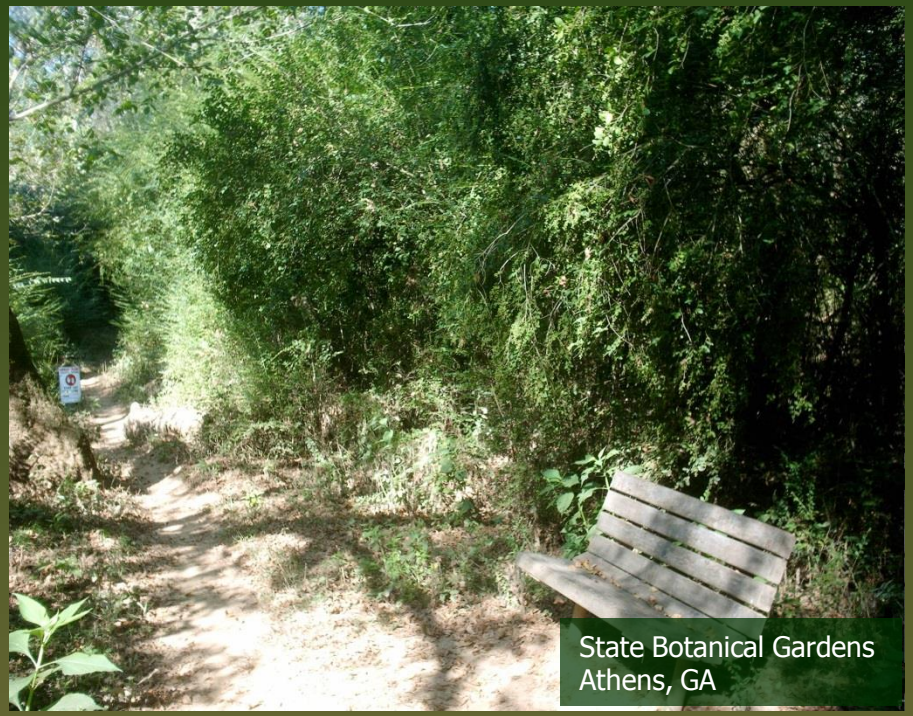
“If you’re an Auburn fan, it’s just a privet,” said Garrison,63, (owner) “But if you’re a Georgia fan, it’s something special.”

Chinese Privet, *Ligustrum sinense*

- Well established in the Southeast by the 1930's
  - Prolific seed producer--seeds dispersed by birds, small mammals, and flooding
  - No native natural enemies

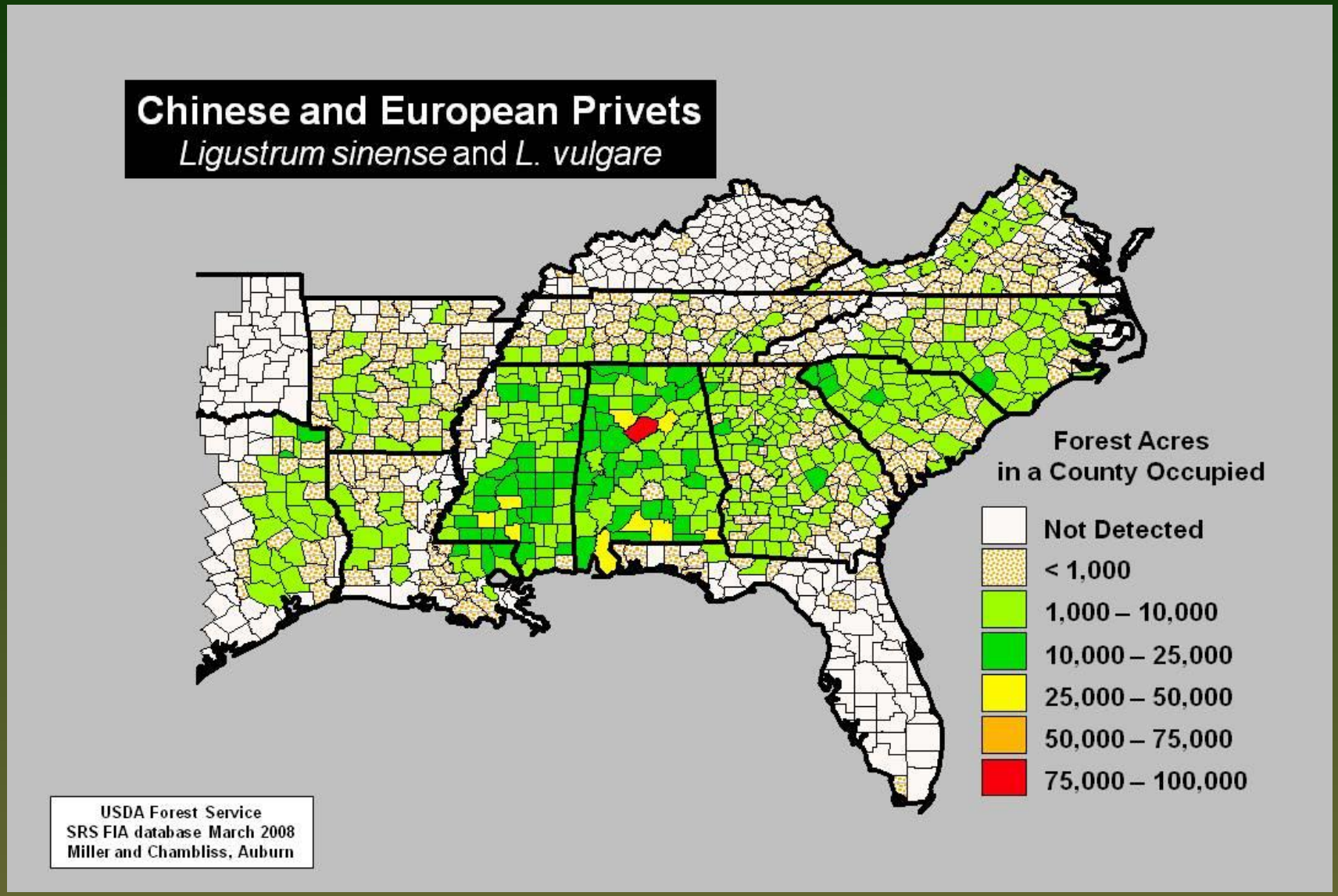
- 59% of Oconee river floodplain infested (Ward 2002)


Sandy Creek Nature Center
Athens, GA



Privet in the forest is an ecological nightmare.

It covers 1-3 million acres of forest land in the Southeast (and growing!!!)



Broad Goals

1. Increase public awareness
2. Lay groundwork for biological control project
3. Understand impacts of privet invasion and its control on forest plant and animal communities ★

Specific Questions

- Which method (manual felling vs mulching) of Privet control is most effective?
- How does the local plant community respond when Privet is removed?
  - Plant cover=floral resources=pollinators
- How do pollinators respond once privet is removed and native plants return?
- How do pollinators in privet cleared areas compare to communities in areas that have never had privet ("desired plots")?
- How do cleared areas change over time?

Why study pollinators?

- They provide important ecosystem services (pollination)
- Leading to estimated economic value in the U.S. (2003) of between 18-27 billion dollars
- Natural areas near agricultural fields can serve as a refuge and possibly increase crop pollination……so healthy forests might contribute to higher yields
- Declining worldwide

The White House
Office of the Press Secretary

For Immediate Release June

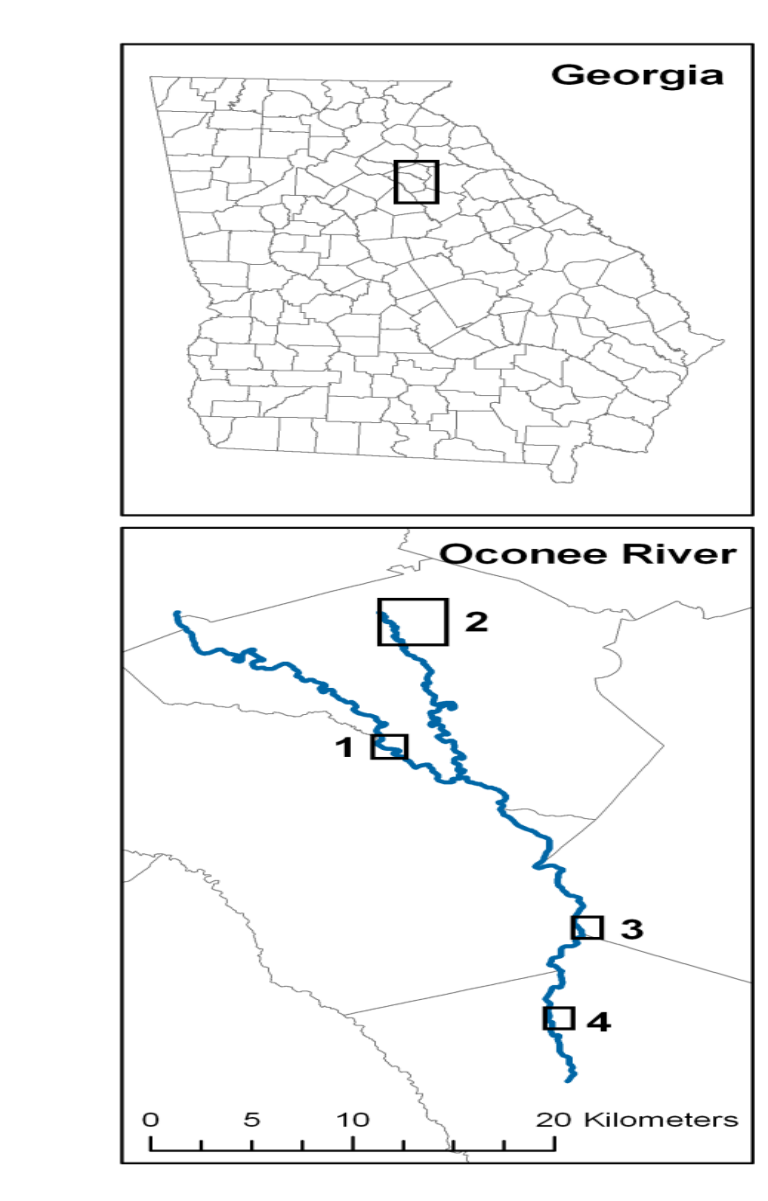
Presidential Memorandum -- Creating a Federal Strategy to Promote the Health of Honey Be and Other Pollinators

MEMORANDUM FOR HEADS OF EXECUTIVE DEPARTMENTS AN AGENCIES

Why Bees and Butterflies?

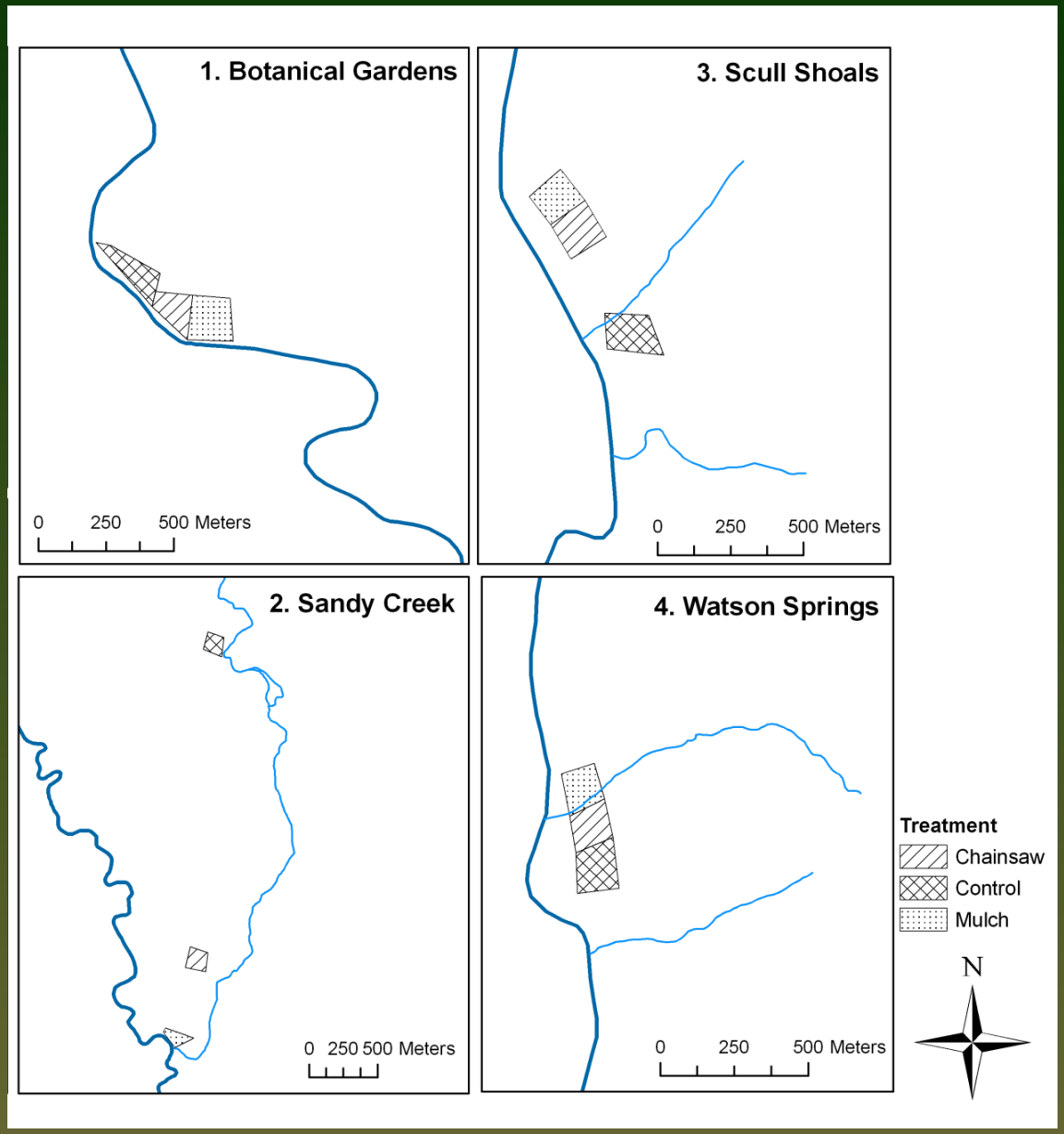
- Bees are the real pollination powerhouses—considered the most efficient (repeatedly visit a plant species on a given foraging trip, ensuring pollination)
- Butterflies (larvae) important part of the food chain serving as prey for other species and probably the most important insect "ambassador" (think monarch).
- Disturbance creates winners and losers in forests
  - Question we always get: How does "X" affect insects??
- Useful bio-indicators for forest and ecosystem health
- We feel that forest management (i.e. privet removal) activities should not be detrimental to pollinators

Where did we work?



59% of Oconee River Floodplain infested with privet

What did we do?



- Four Treatment Locations (BG, SC, SS, WS)
- Three, 5-acre plots at each location
  - Mulch
  - Felling
  - Control
- Three "desired" plots

Treatment #1
Felling + stump treatment

Advantages: Lower cost, lower environmental impact, easier to treat stumps

Treatment #2
Mulching + stump treatment

Advantage: removes ALL debris, cleaner “look”


Gyrotrac Mulcher


Gyrotrac Mulcher

Treatment #3
Control

Treatment #4
Desired Plots

Follow-up Treatments

- Initial treatments (Fall 2005) alone didn't kill all the privet
- Foliar application of 2% glyphosate in late fall or early winter of 2006
- Maximum impact on privet with minimum impact on native vegetation

Foliar Application

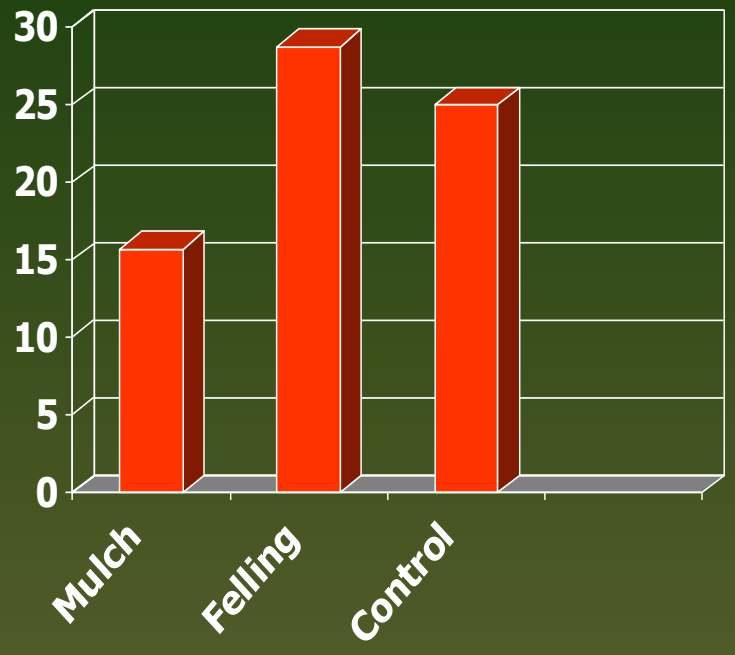
Before – November, 2006

After – January, 2007

Foliar application worked!

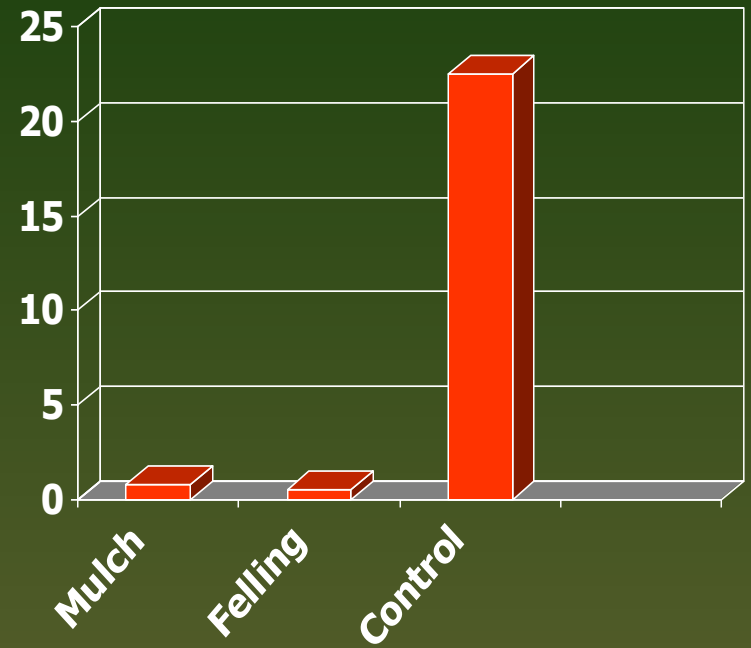
% Privet in Herbaceous Layer

10 months after initial treatment



Summer 2006

22 months after initial treatment



Summer 2007

"Hit the reset button"…… 99% reduction in privet

Biomass and Nutrient Measurements

- Established random transects on felling plots and measured amount of residue per square meter to estimate biomass
  - 19.9 tons (dry wt.) of privet per acre
  - Equal to ~ 28 whole pine trees 12 inch DBH
- Process subsamples for nutrient content analysis to estimate nutrients tied up by privet
  - Privet contains 250 lbs N per acre
  - Equal to 2500 lbs of 10-0-0 fertilizer

Plant sampling methods

- Plants sampled at beginning of project and then again 5 years post-treatment
- Established 3 transects across each of the 15 plots
- Line intercept method used
  - Presence/absence
  - Plant species
  - Plant height
  - Shrub cover

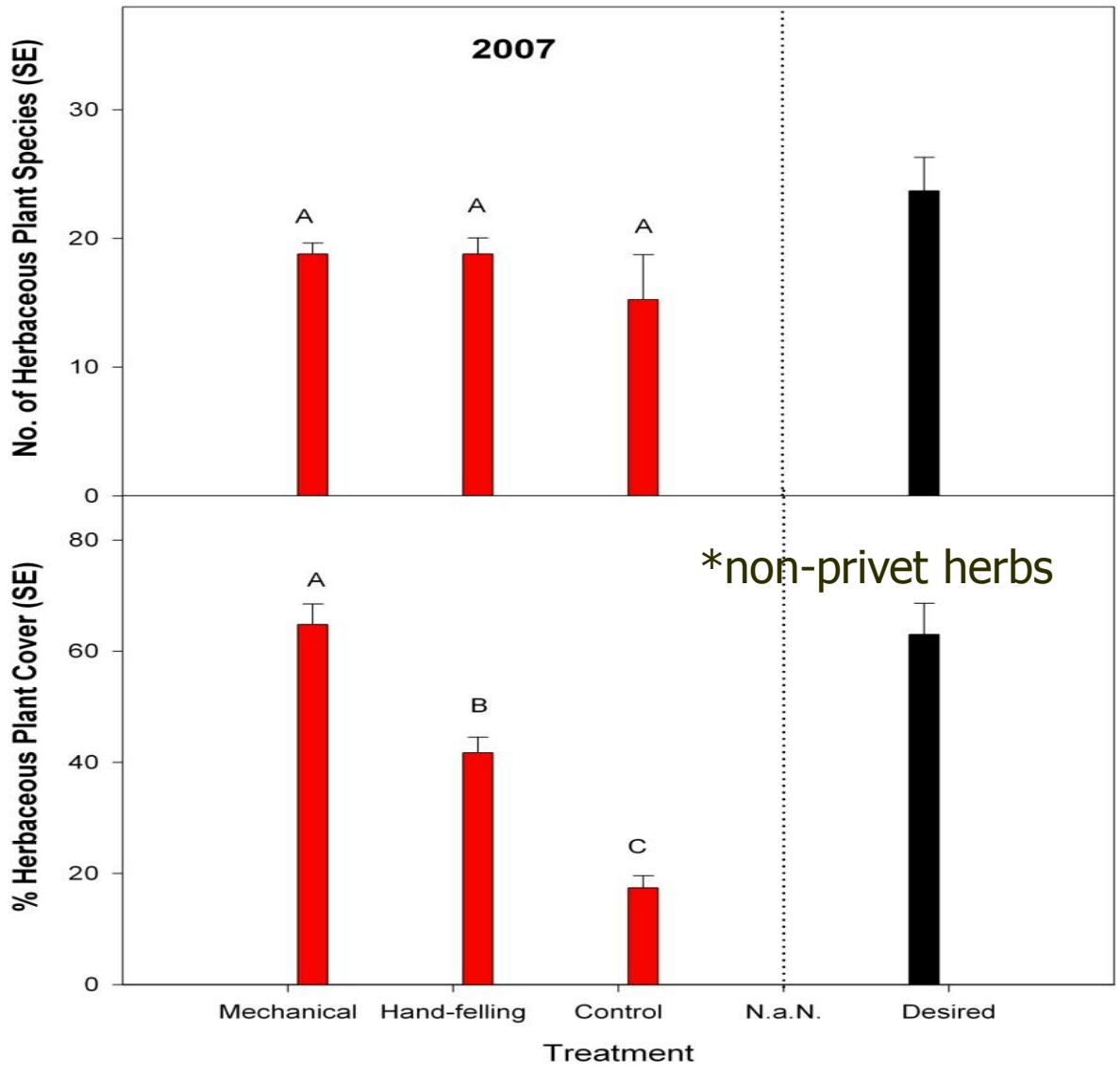
Pollinator sampling methods

- Pollinators sampled at beginning of project and then again 5 years post-treatment
- Sampled for one week in each month from March-September (7 sampling periods)
- Five subplots were established and equally distributed in each of the 15 plots
- Each subplot had 2 pan traps (blue, yellow)

Pan trapping

- Widely accepted collection technique
- Simple and inexpensive
- More time efficient and less biased than sweep netting
- Collects pollinators during all activity times
- Major downside = Might not attract all pollinators equally

Results—Immediate Plant Response



Plant diversity increased, but not significantly

Percent of herbaceous plant cover significantly increased

<20% control
>40% felling
>60% mulch

Mulch plot herb cover similar to "Desired" plots (good news!)

Early colonizers

Results—Immediate Plant Response

Results—Immediate Plant Response

Results—Immediate Plant Response

Plants that showed up Post-removal

- Herbs/vines
  - Pokeweed
  - Fireweed
  - Winged stem
  - Nettle
  - Violets
  - Aster spp.
  - Greenbrier
  - Muscadine
  - Elderberry
  - Sedges
  - Poison Ivy
  - J. Stiltgrass

- Trees/shrubs
  - Boxelder
  - Sweetgum
  - Red maple
  - Sycamore
  - Redbud
  - Red mulberry
  - Loblolly
  - Hophornbeam
  - Ironwood
  - Slippery elm

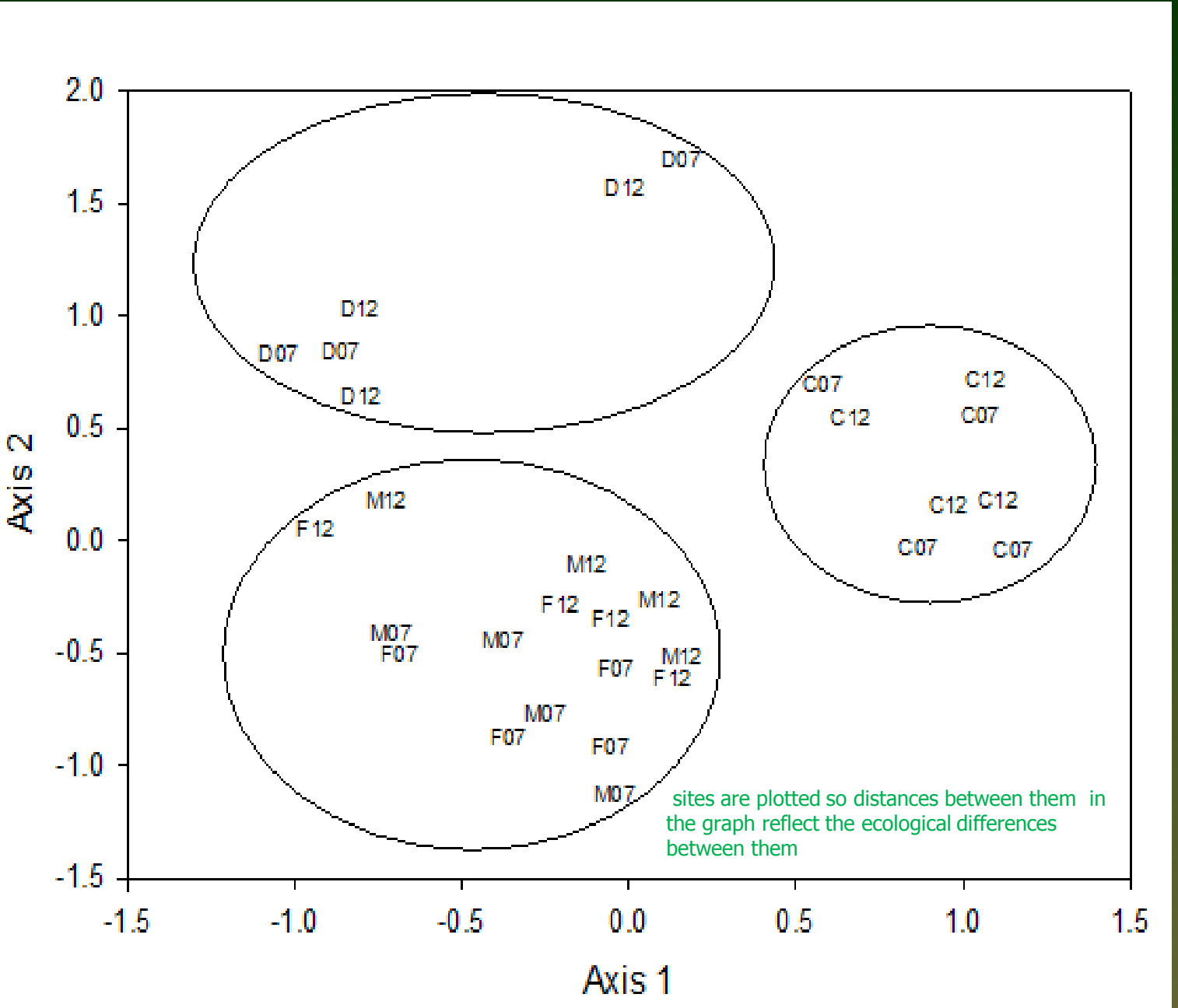
Results—5 yr. Plant Response

January 2012

- Very little privet has returned
- Boxelder has moved in

Results—5 yr. Plant Response

NMS Ordination for Herbaceous Plants 2007 and 2012



Mulch and Felling plots from both 2007 and 2012 are ecologically similar

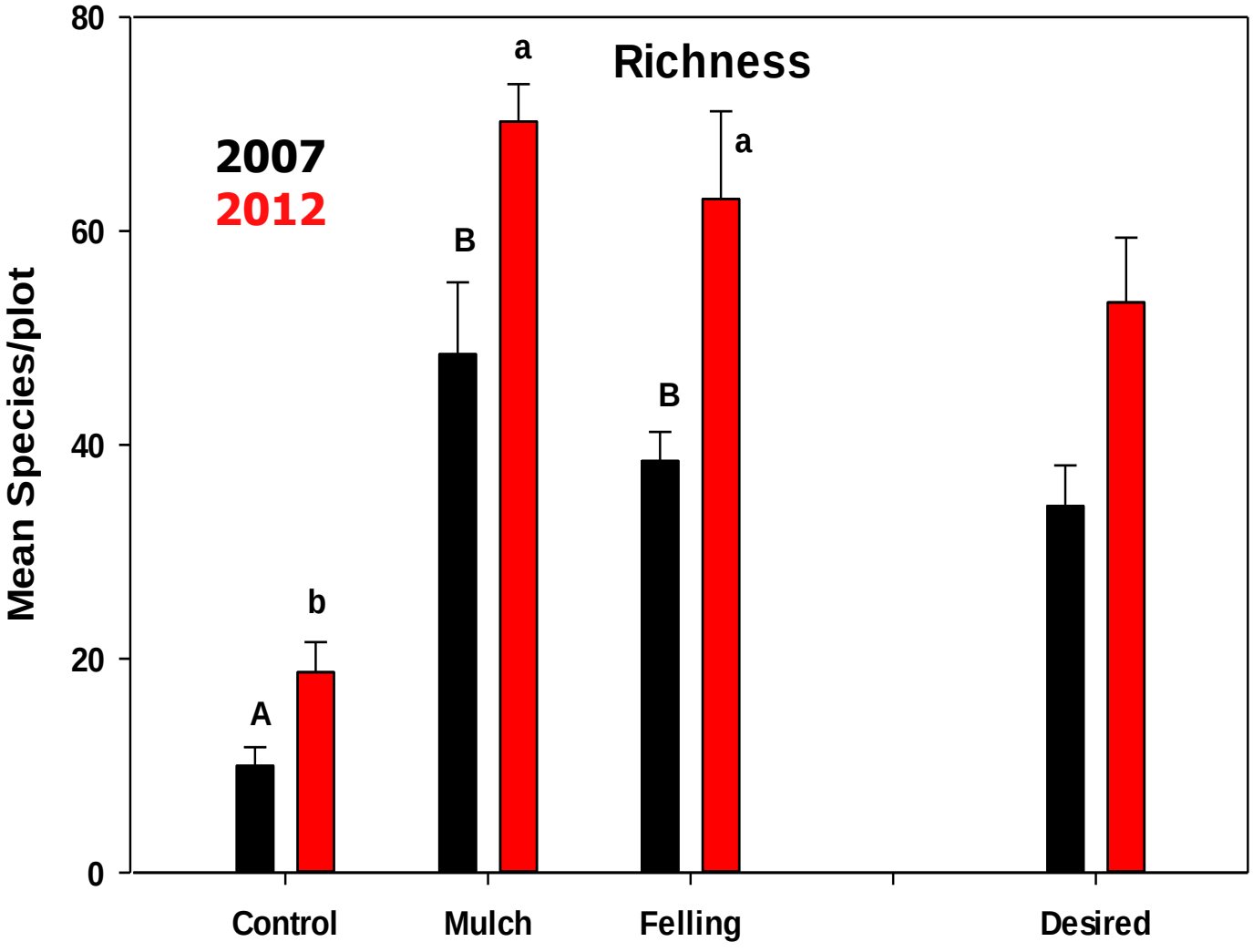
Removal technique had little effect on plant community between the two

Both treatment plots moving towards the "desired" plots

Unexpected Outcome

A rare plant, yellow fumewort (*Corydalis flavula*), was discovered on one of our removal plots at the State Botanical Gardens. This plant occurs in only 4 counties in Georgia.

Results-Bee Richness

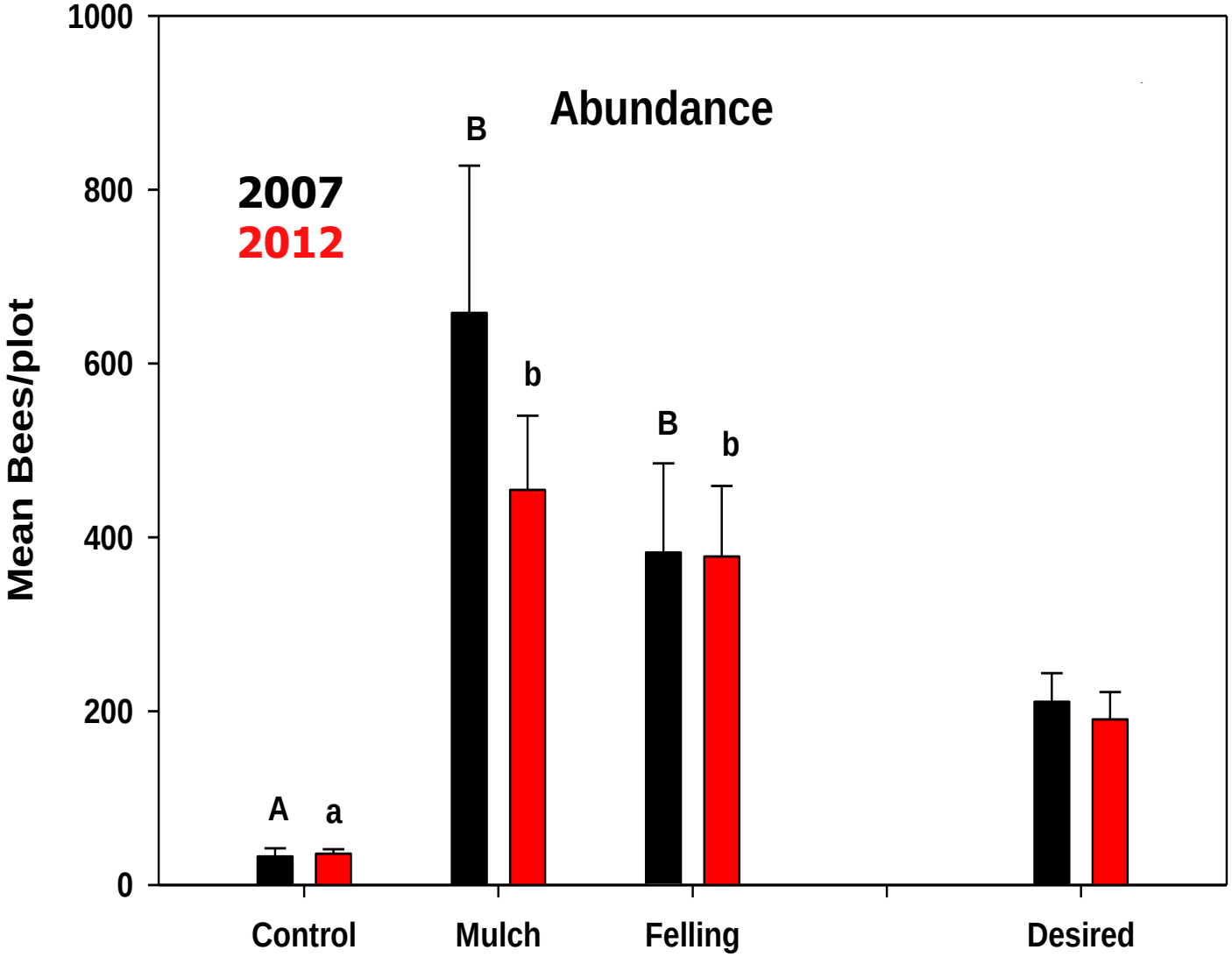


2007
Bee diversity went up almost 5x on mulch and 4x on felling plots

Even surpassed Desired plots—extra sunlight?

2012
Trend continued for 5 year assessment—mulch and felling plots significantly more diverse than control

Results-Bee Abundance



2007

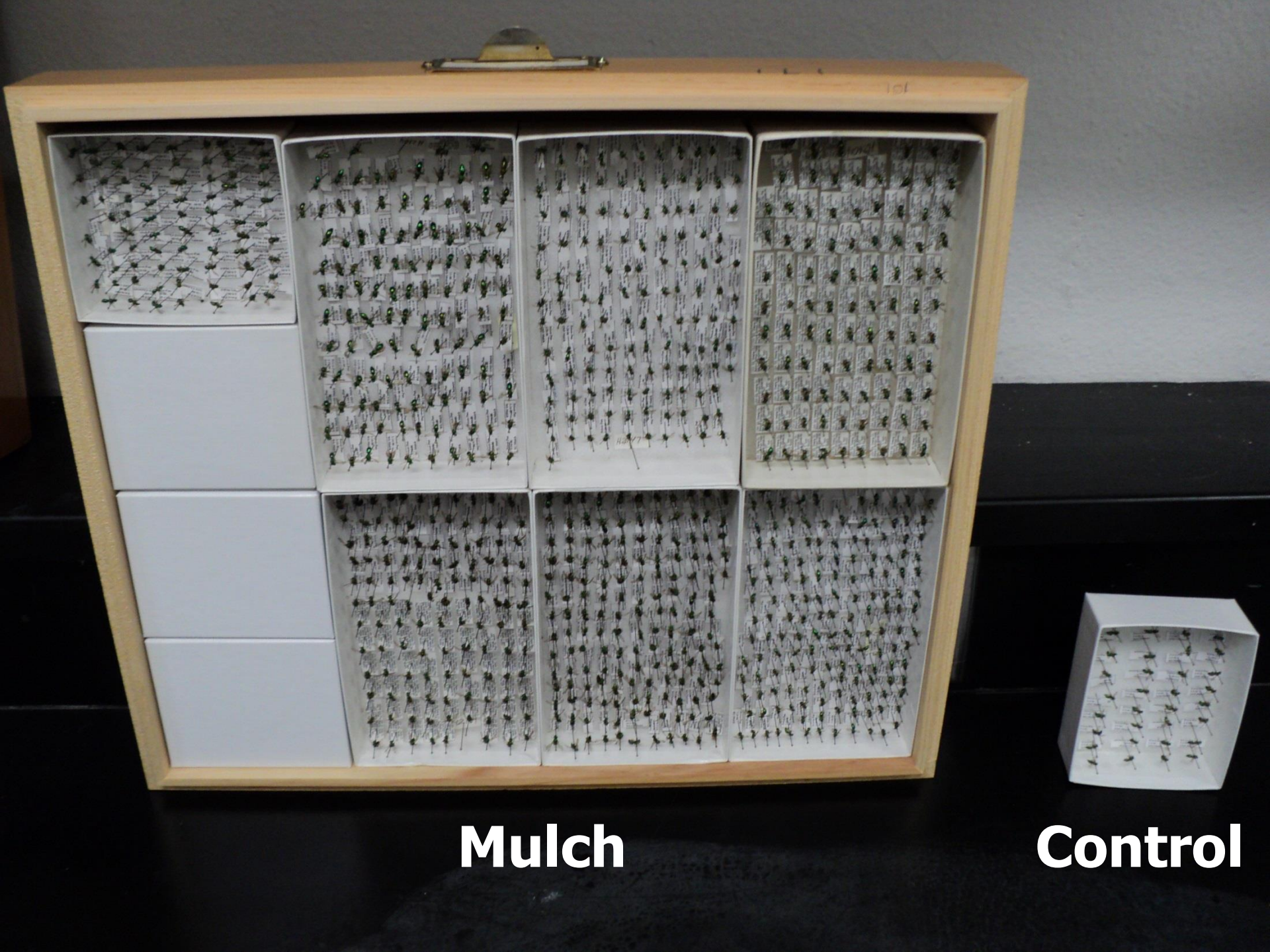
Control 33/plot
Felling 383/plot
Mulch 658/plot

Dramatic results!

2012

After 5 years bee numbers remained significantly higher on privet removal plots

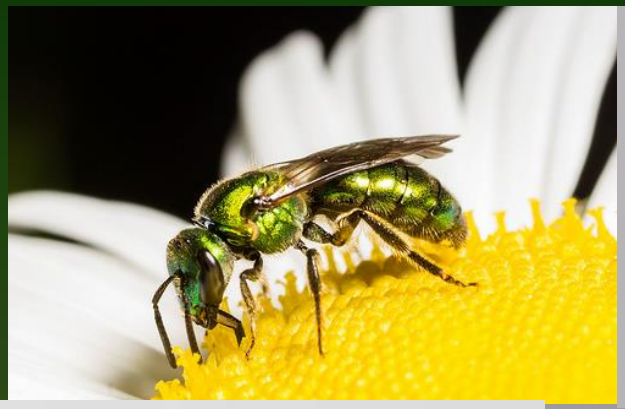
Change in plant cover led to a sustained change in the bee community


Mulch
Control

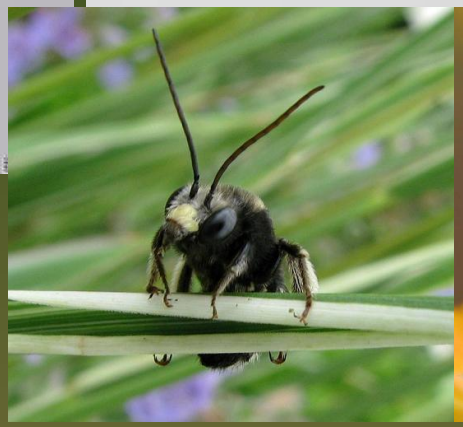
Common bees collected

- *Augochlora pura*
- *Augochorella aurata*
- *Lasioglossum* spp.
- *Ceratina calcarata*
- *Bombus* spp.
- *Osmia* spp.
- *Andrena* spp.
- *Melissodes* spp.
- *Nomada* spp.

10,000 bees
120 species

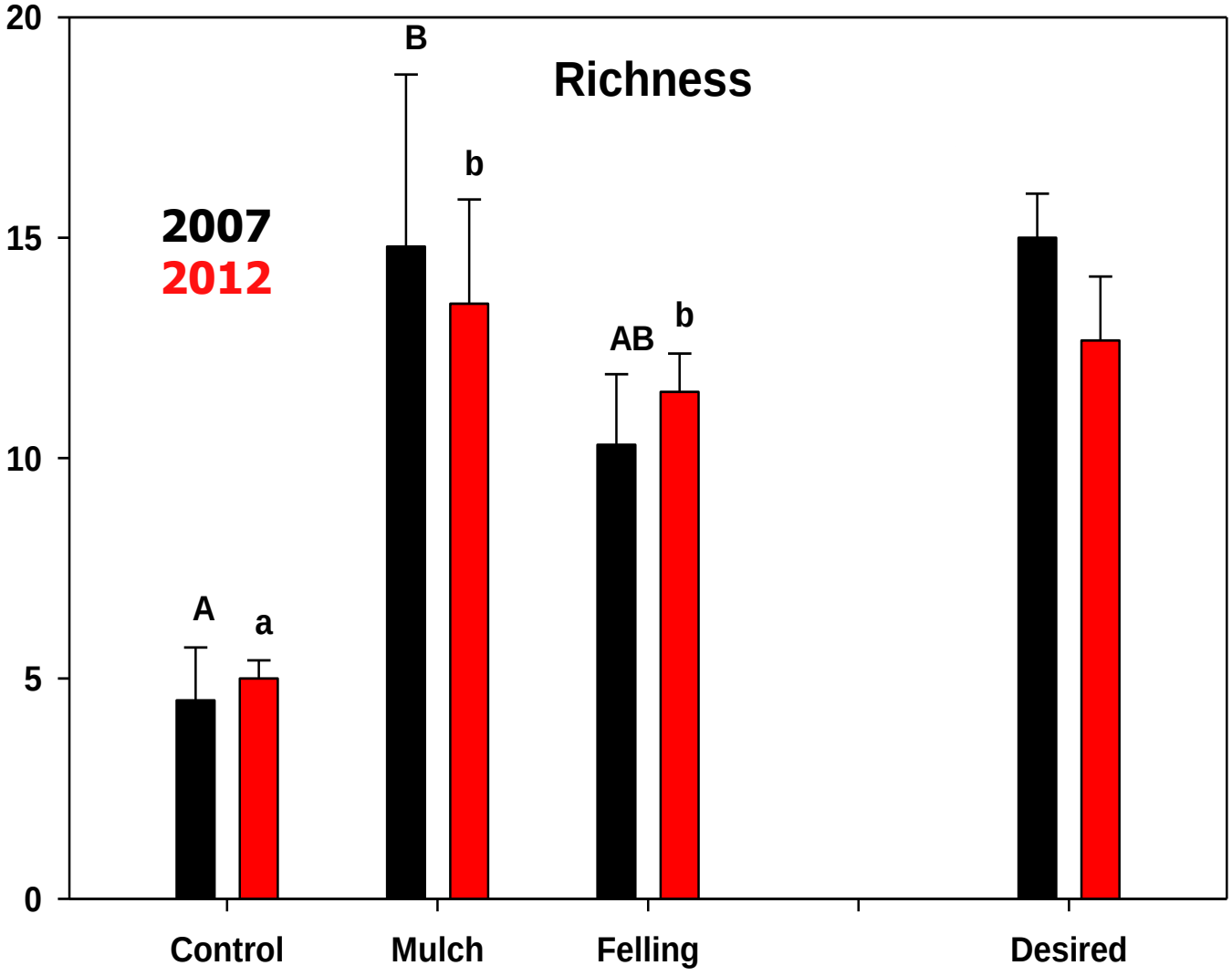






Results-Butterflies



2007

Richness went up more than 2x on felling plots and almost 4x on mulch plots

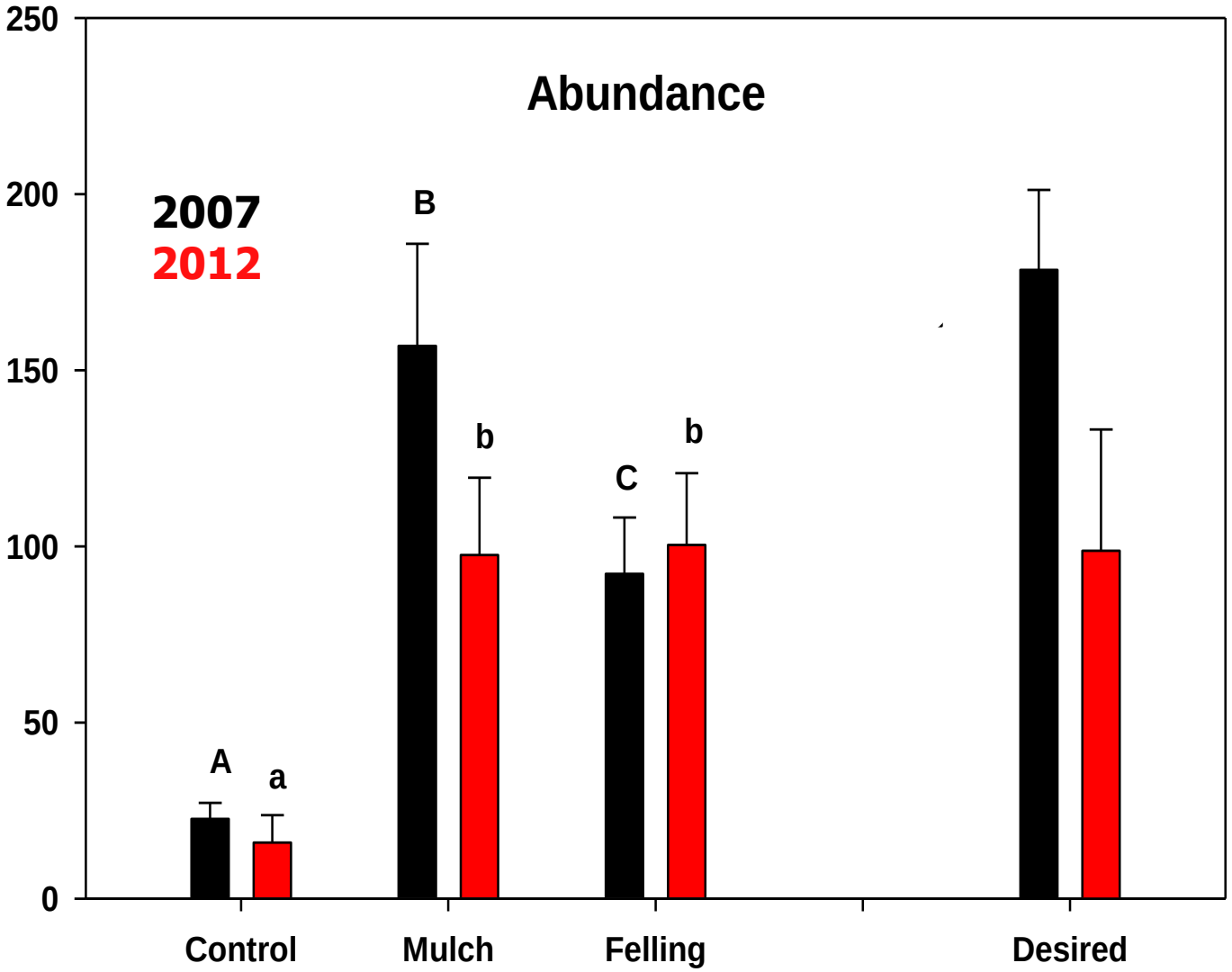
Richness on mulch plots same as desired plots

2012

Similar to bees- Butterfly communities strongly responded to plant restoration over the long term

Larval host plants?

Results-Butterflies



2007

Control 22/plot
Felling 92/plot
Mulch 157/plot

Mulch plot again was very similar to desired plots in the number of butterflies caught

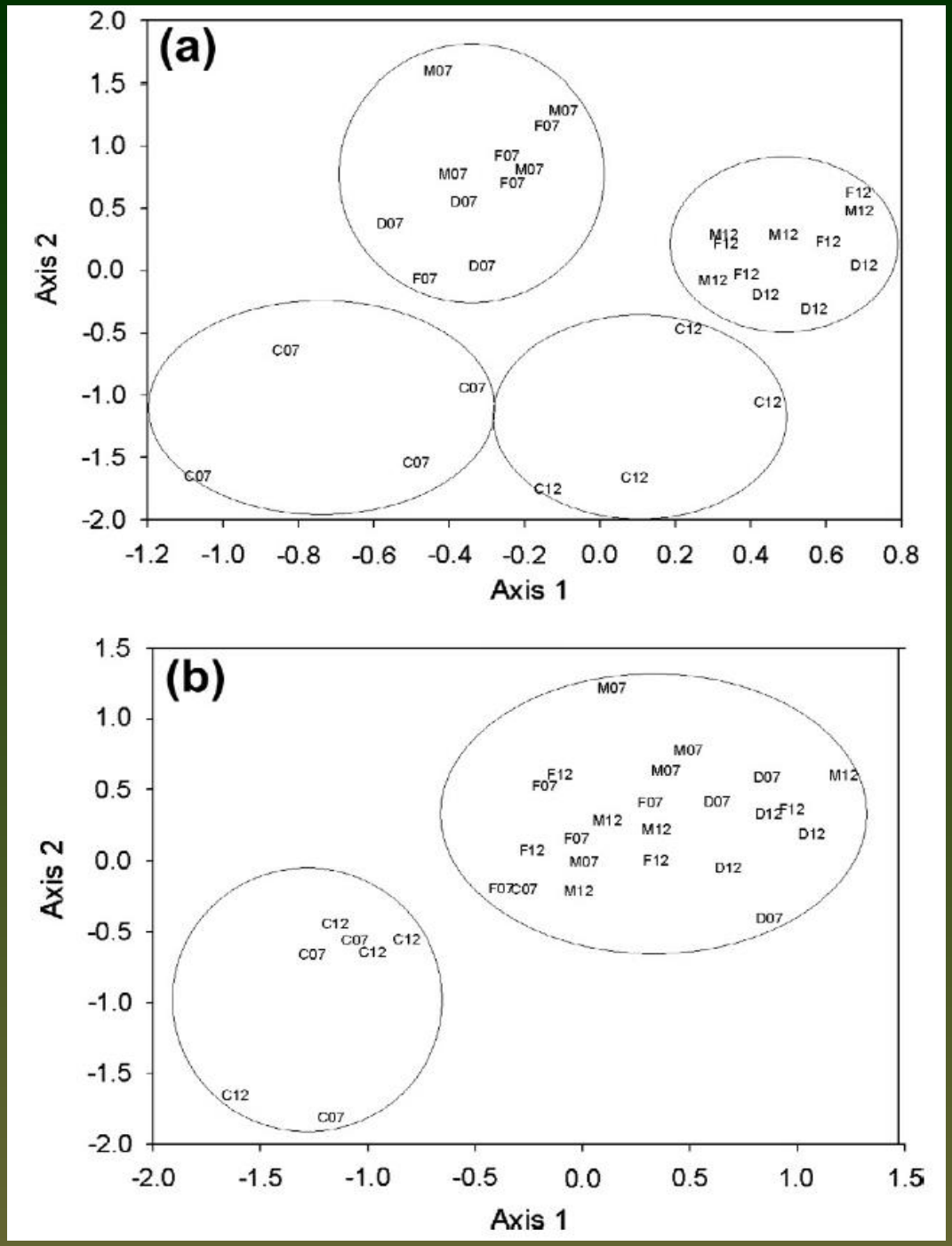
2012

The trend continued demonstrating a positive response to privet removal and to the return of native plants.

Common butterflies collected

- Clouded skipper
- Zabulon skipper
- Silvery checkerspot
- Tiger swallowtail
- Carolina satyr
- Pearl crescent

NMS Ordination for Bees and Butterflies 2007 and 2012



Summary

Chinese Privet…..

- Reduces the number of native trees
- Reduces the number of native shrubs
- Reduces herbaceous plant species and number
- **Reduces bee diversity and abundance**
- **Reduces butterfly diversity and abundance**

  - It has been 10 years since we first cleared our treatment plots and privet re-invasion is still limited

Is There Light at the End of the Privet Tunnel?

Long-term options- Biological Control?

- 3 million acres in the Southeast
- Eradication with mechanical and herbicide treatments not practical (physically or economically) on such a large scale
- Biological control offers the best long-term option
- No native *Ligustrum* species in U.S.
- Lilac closest relative in the Oleaceae (not native)

Exploration in China

Lacebug

Leptophya hospita

Testing completed and petition submitted to APHIS

"Native Americans ran the continent as they saw fit……

If there is a lesson it is to think like the original inhabitants of these lands and we should not set our sights on rebuilding an environment from the past but concentrate on shaping a world to live in for the future."

From:

1491: New Revelations of the Americas Before Columbus

By Charles C. Mann

Thanks