

Secondary succession, community assembly and restoration in grasslands and savannas

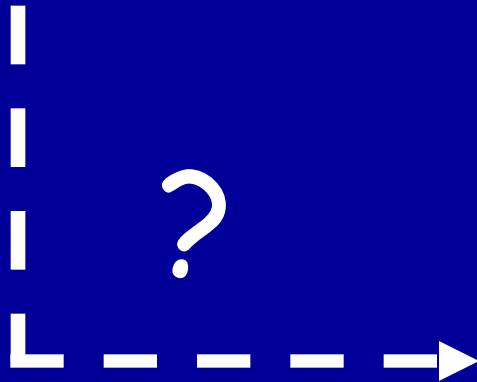
Final Report

Bryan L. Foster and Todd Aschenbach





Longleaf pine savanna Restoration at SRS





R



High Tree Density
Light limitation
Belowground competition

Altered disturbance regime
(Fire Suppression)

Dispersal Limitation

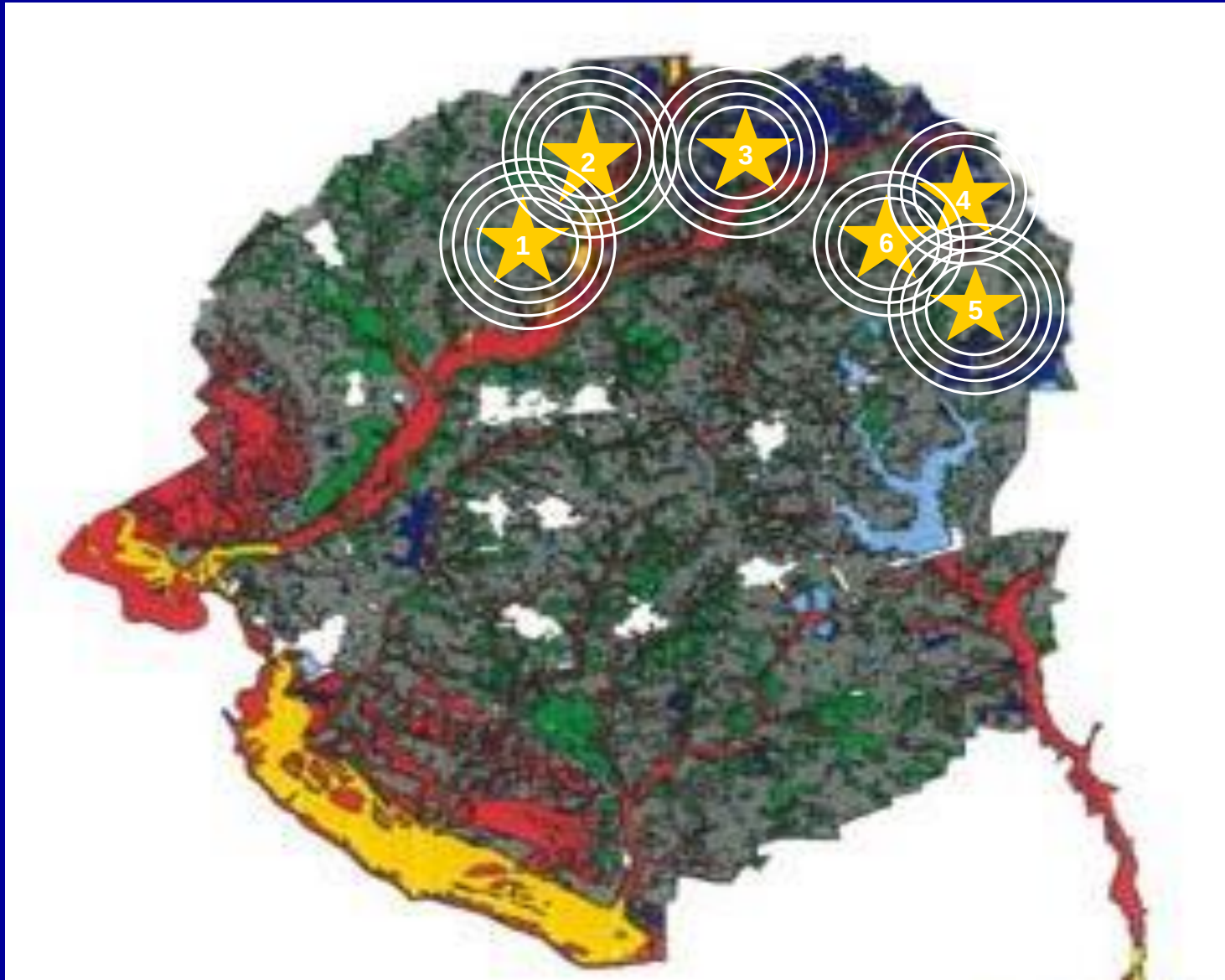


Habitat Destruction
Habitat Fragmentation
Regional Species Loss

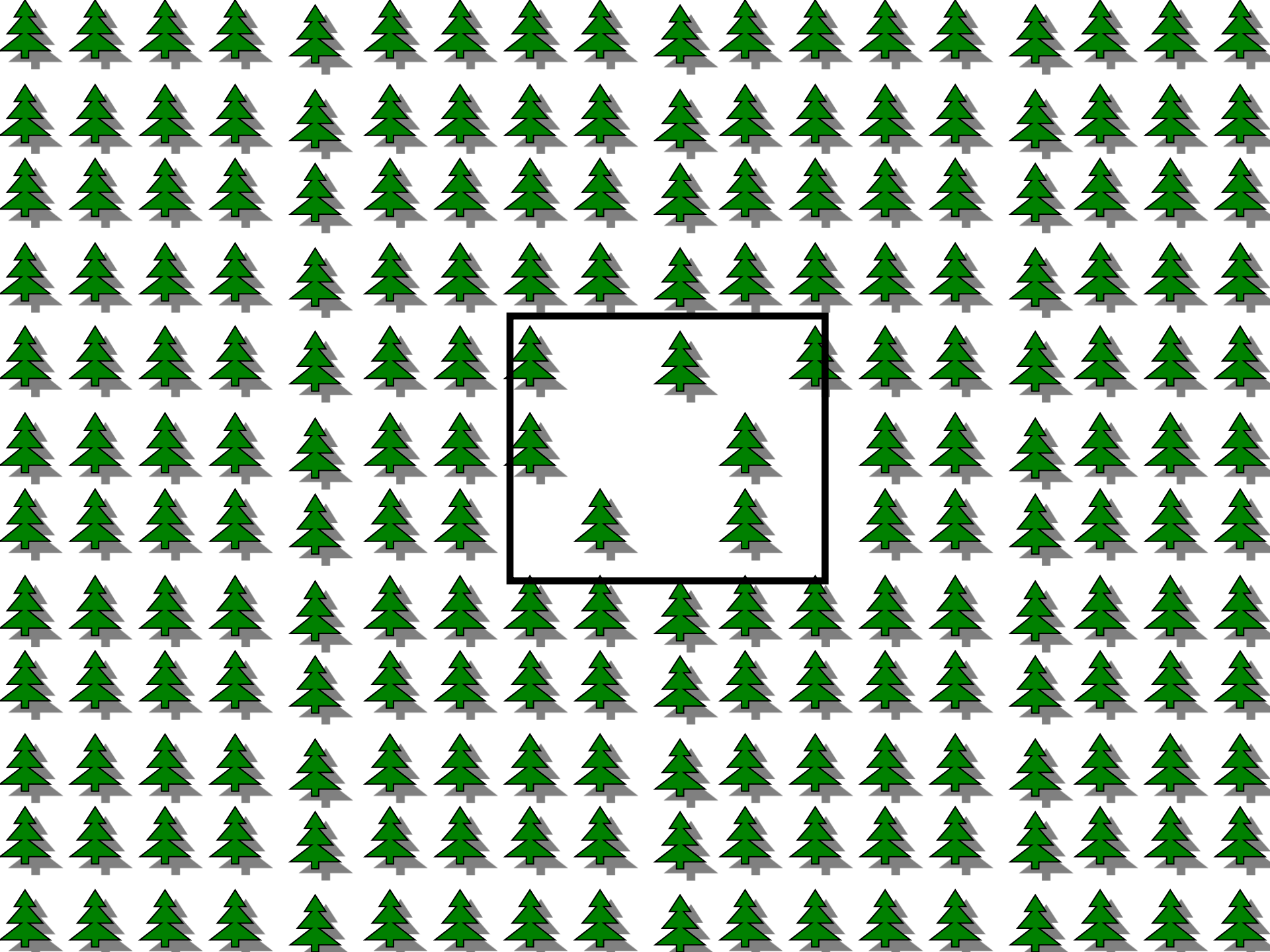
Abiotic
Resistance

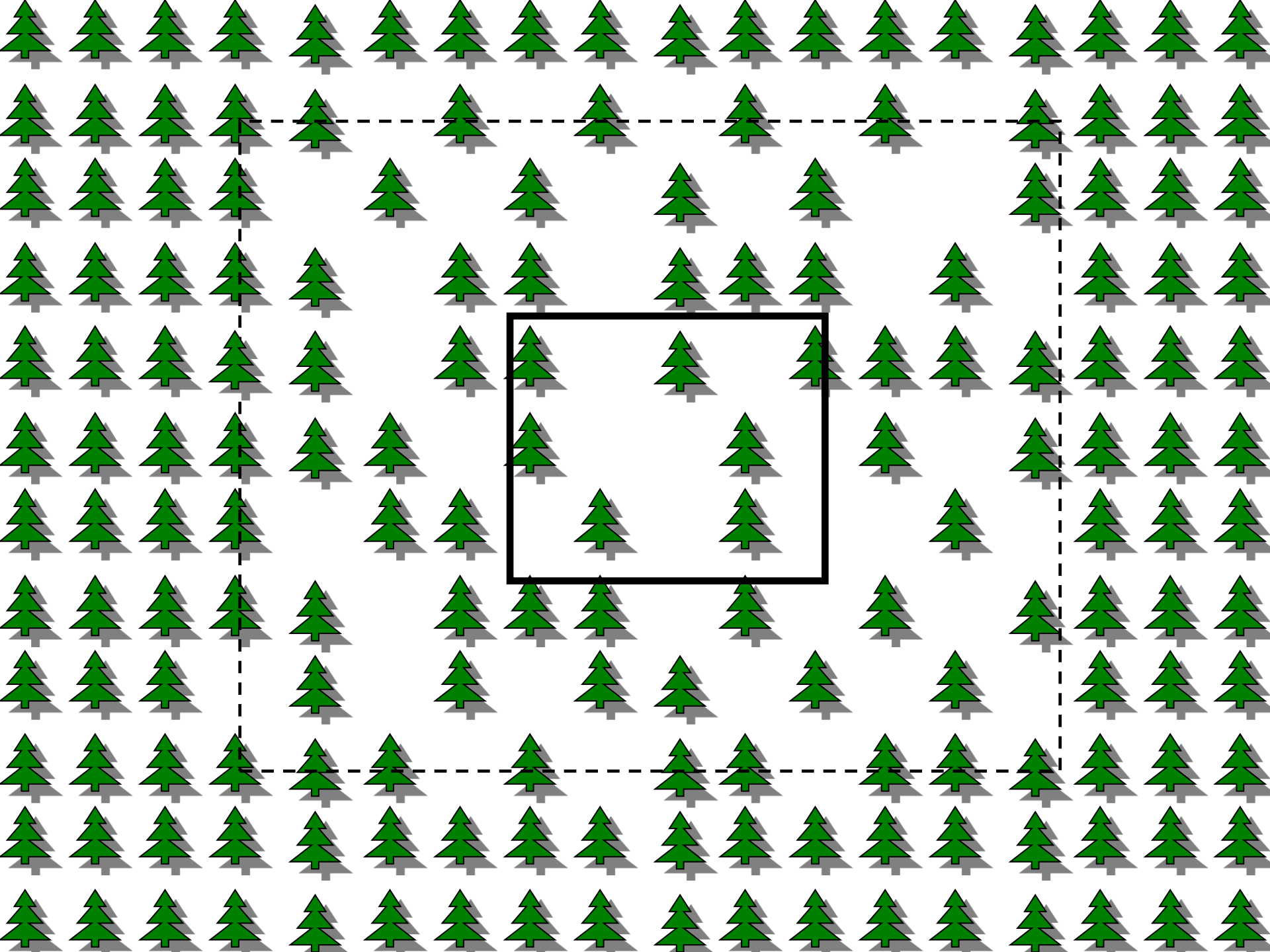


Altered Soils



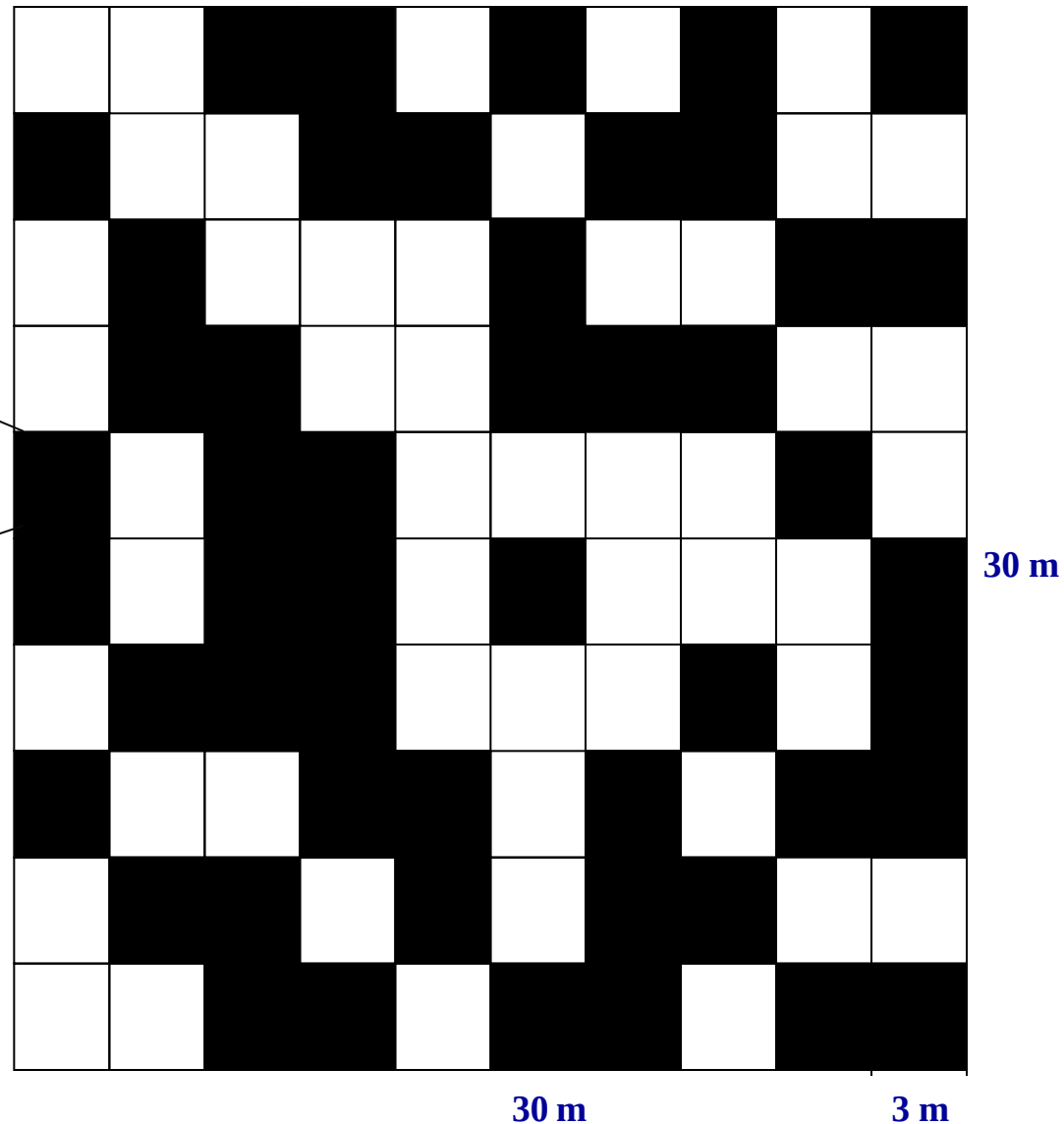






- 31 species planted as transplants
 - 6 Grasses
 - 7 Legumes
 - 18 Non-leguminous Forbs
- Local seed source
- Greenhouse propagation
- Planted in 2002 and 2003
- Irrigated (summer 2002 and 2003)

Basic Experimental Design

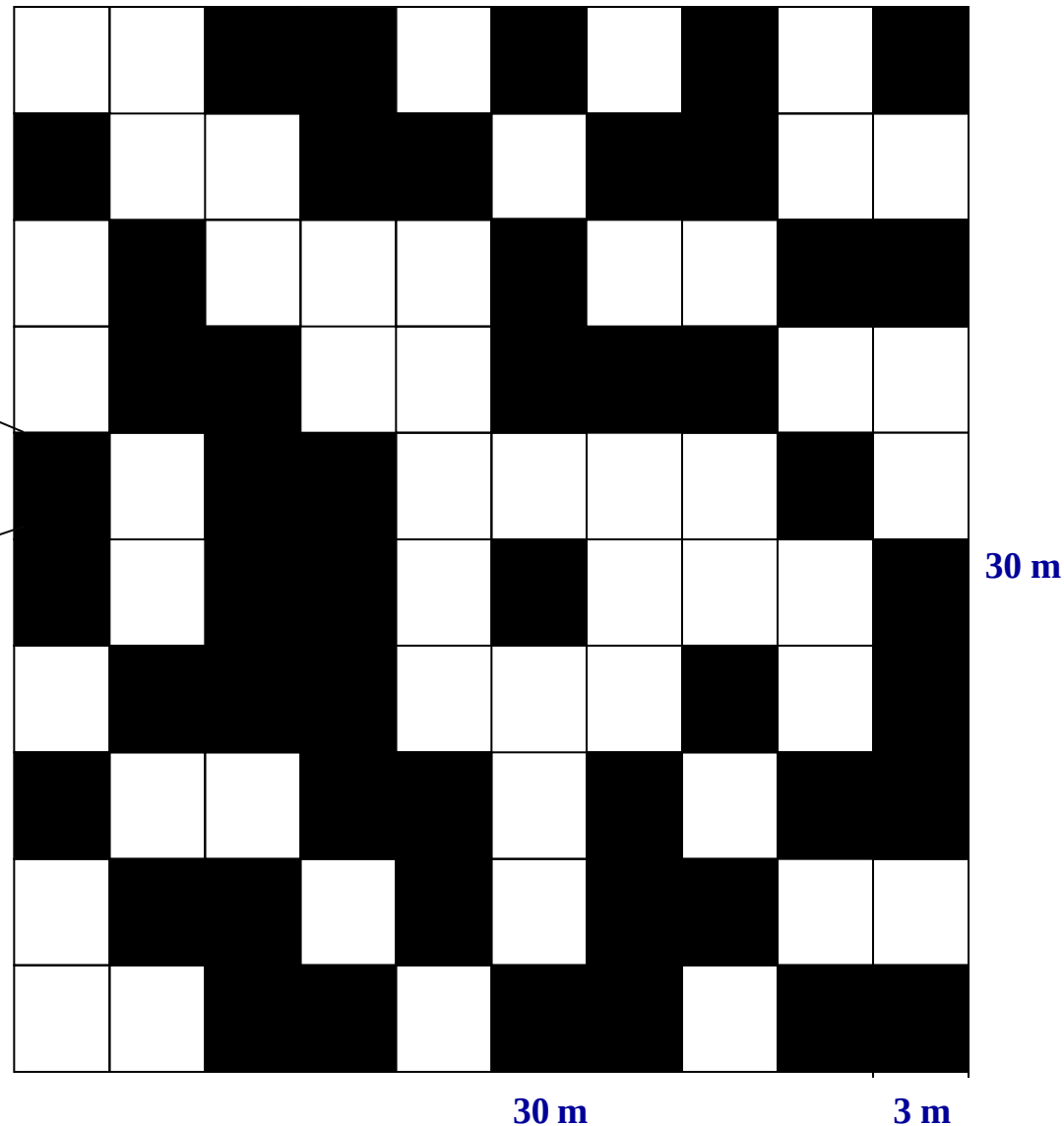


- 50 Plots per treatment
- Replicated at 6 sites
- ($\Sigma=600$ 3 x 3m plots)

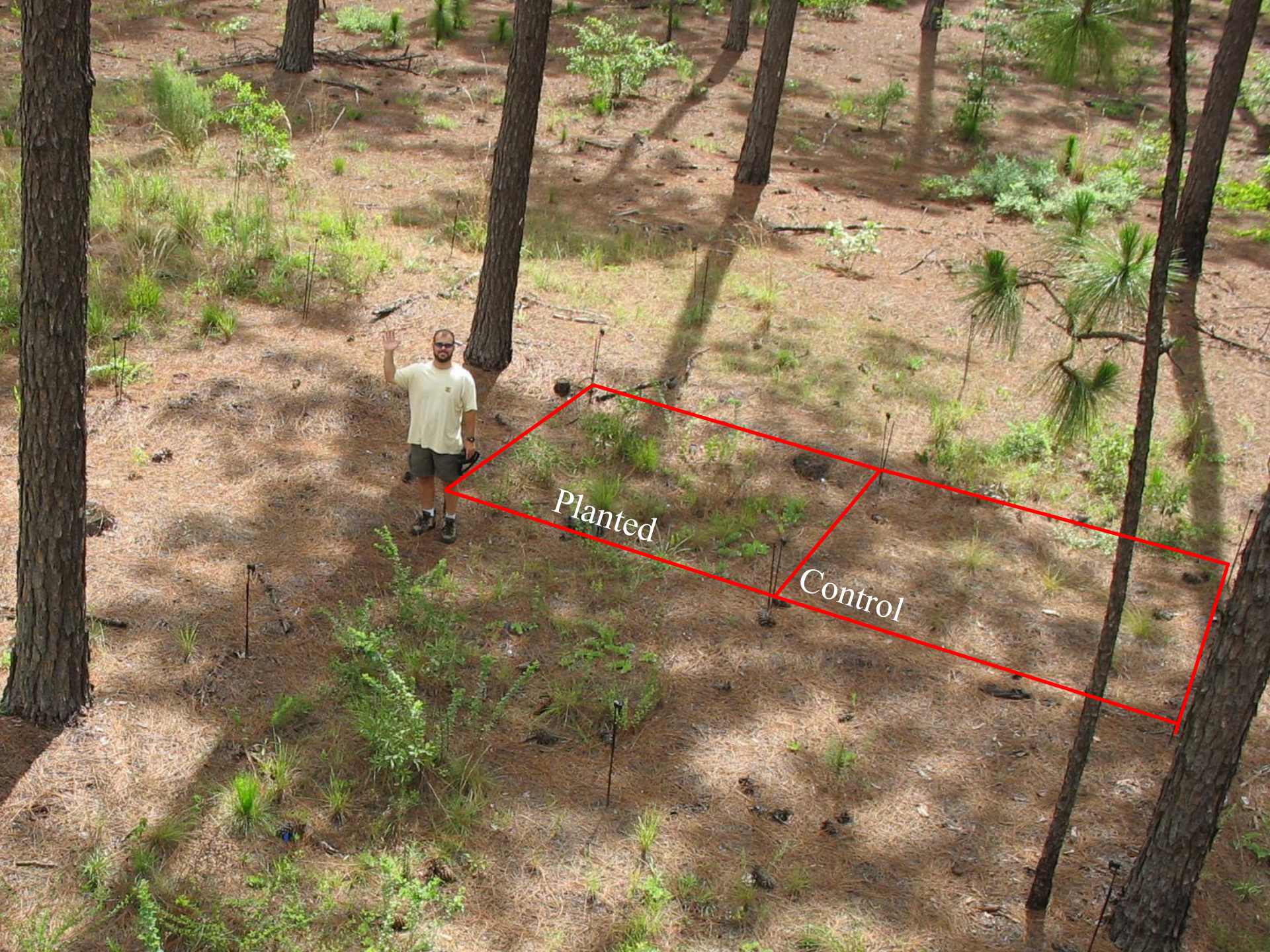
Basic Experimental Design



31 species
planted



- 50 Plots per treatment
- Replicated at 6 sites
- ($\Sigma=600$ 3 x 3m plots)

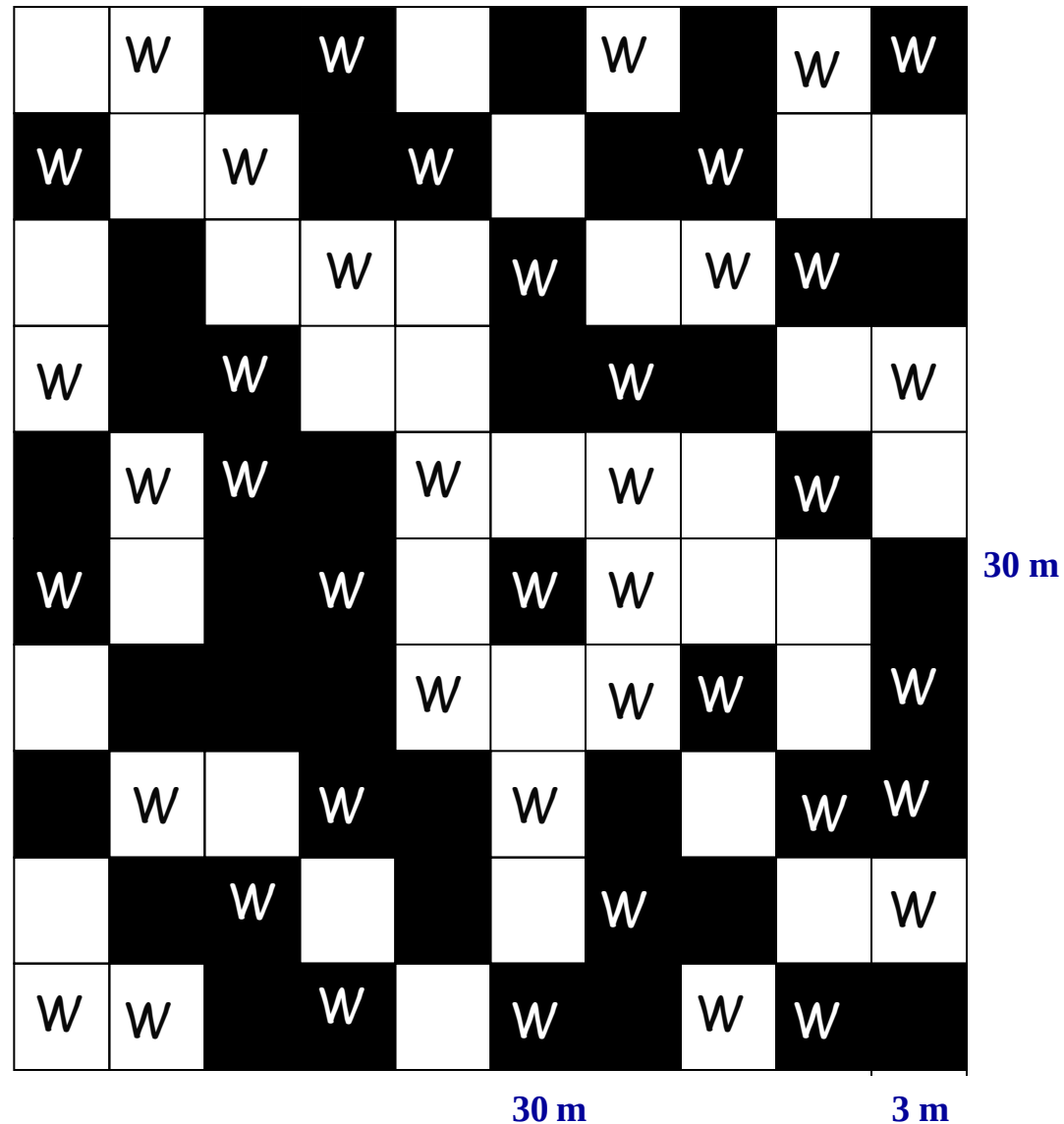


Planted

Control

Full Experimental Design

		Wiregrass	
		-	+
31 species	-	-Wiregrass -31 species	+Wiregrass -31 species
	+	-Wiregrass +31 species	+Wiregrass +31 species



Objectives

Short-term

- Restore understory communities at six sites using intensive site-preparation and out-planting techniques
- Evaluate the influence of restoration efforts on added species establishment, survival and capacity for proliferation
- Evaluate the influence of restoration efforts on community properties: diversity, native / exotic species abundance; and Ecosystem properties: vegetative cover, light interception; plant production
- Evaluate restoration effectiveness across sites that differ in soil type (soil moisture, soil fertility, soil clay content: xeric-mesic gradient)

Objectives

Long-term

- Evaluate long-term persistence of planted species
- Evaluate the dependence of community assembly on the initial presence of wiregrass
- Evaluate the capacity of intensively-restored focal communities to facilitate natural dispersal and spread of the savanna understory community to larger areas

Objectives

Long-term

- Evaluate long-term persistence of planted species
- Evaluate the dependence of community assembly on the initial presence of wiregrass
- Evaluate the capacity of intensively-restored focal communities to facilitate natural dispersal and spread of the savanna understory community to larger areas

What is the role of wiregrass in the community? (Is wiregrass a keystone species?)

+

Maintains system-level
integrity
by facilitating fire

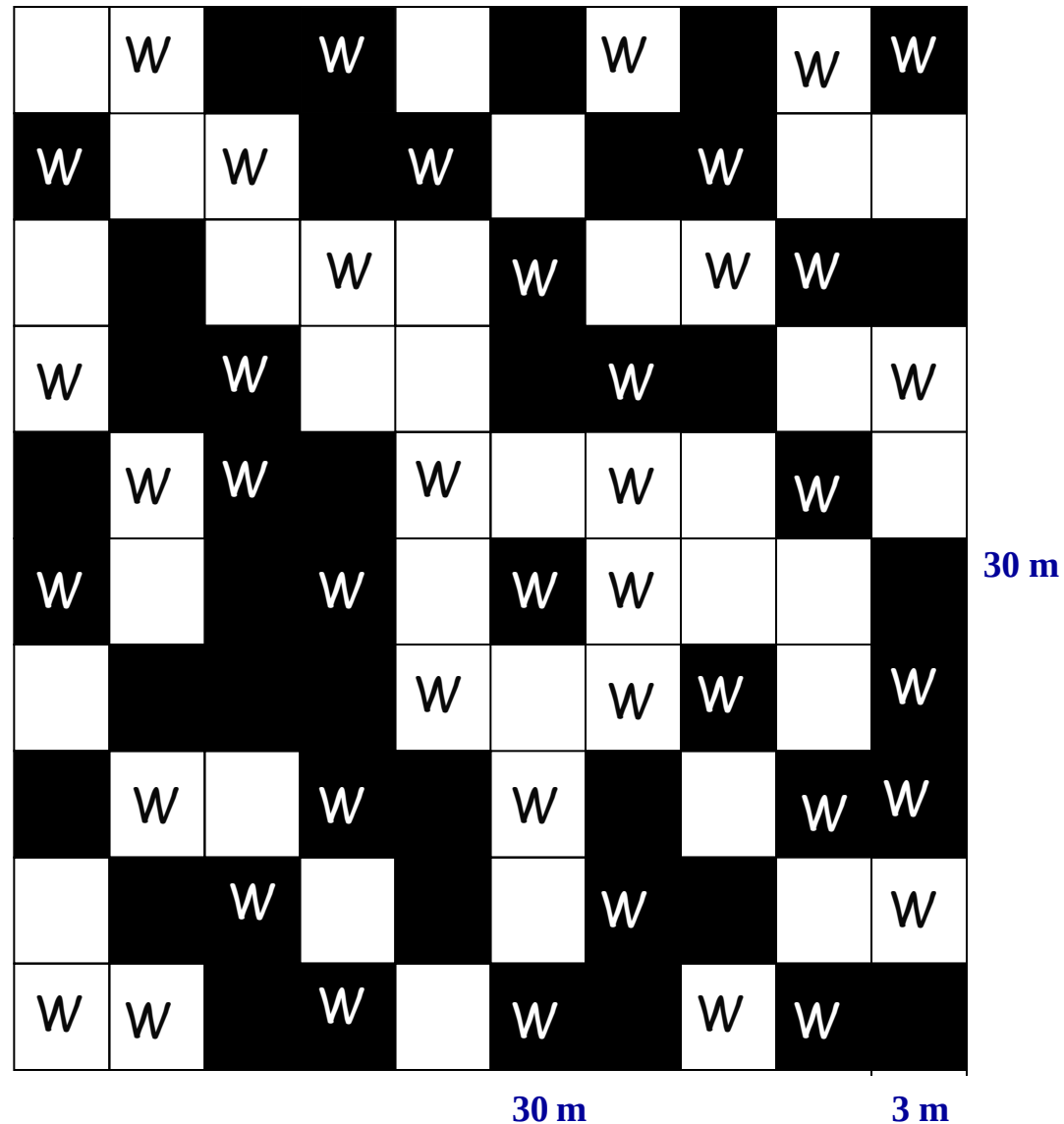


-

Constrains
local diversity
via competitive exclusion

Full Experimental Design

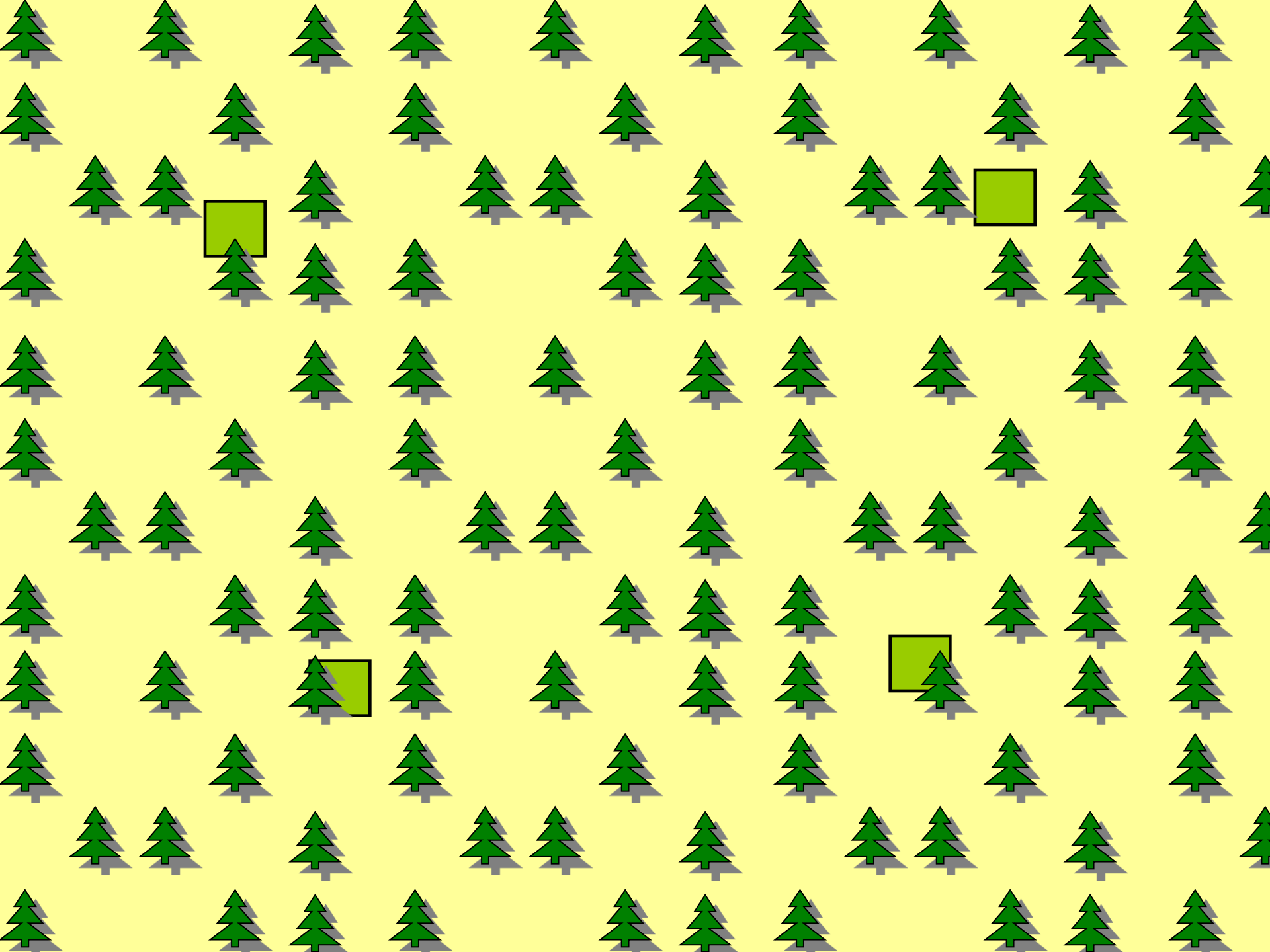
		Wiregrass	
		-	+
31 species	-	-Wiregrass -31 species	+Wiregrass -31 species
	+	-Wiregrass +31 species	+Wiregrass +31 species

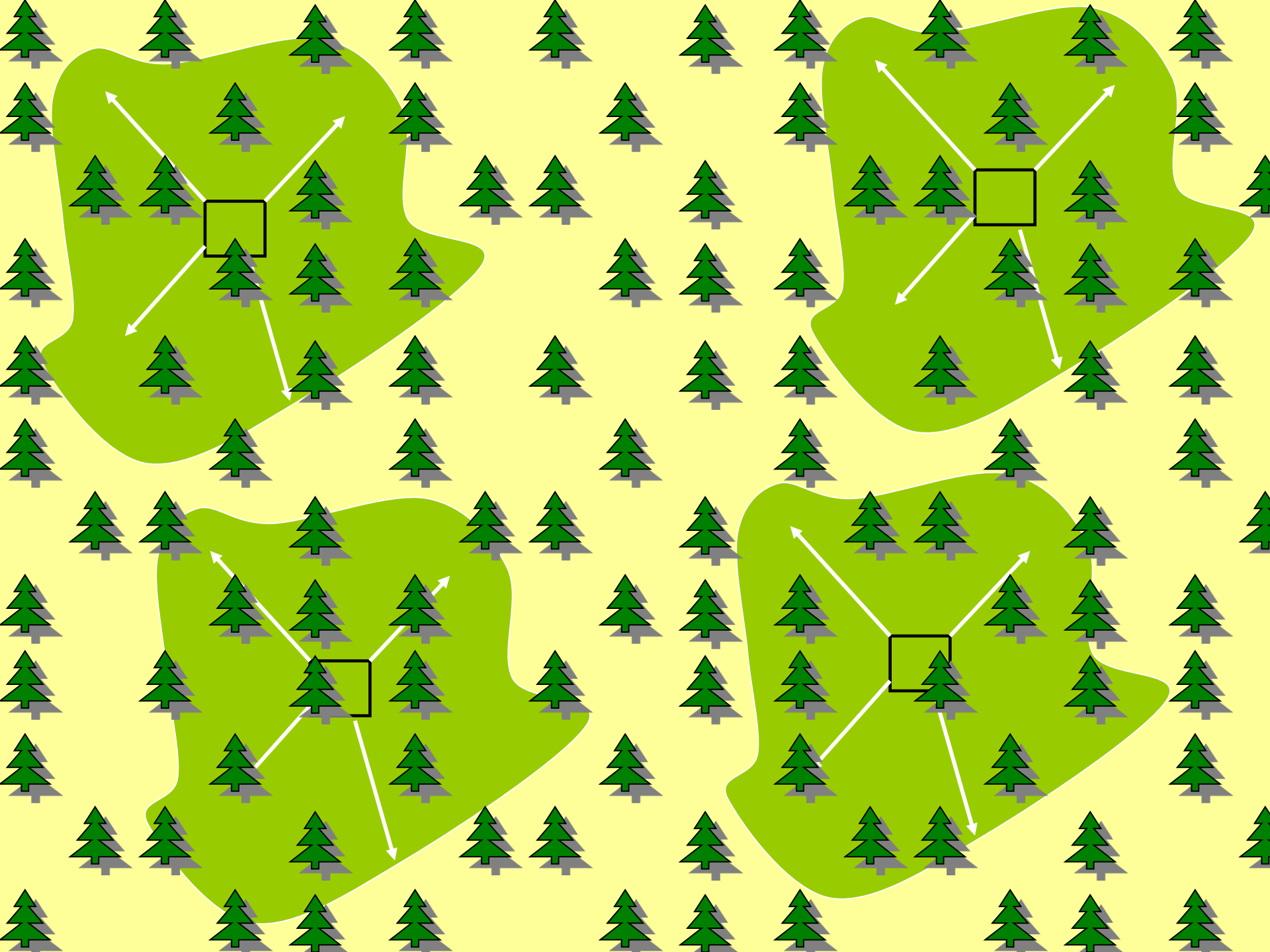


Objectives

Long-term

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Pre-Planting Conditions 2002



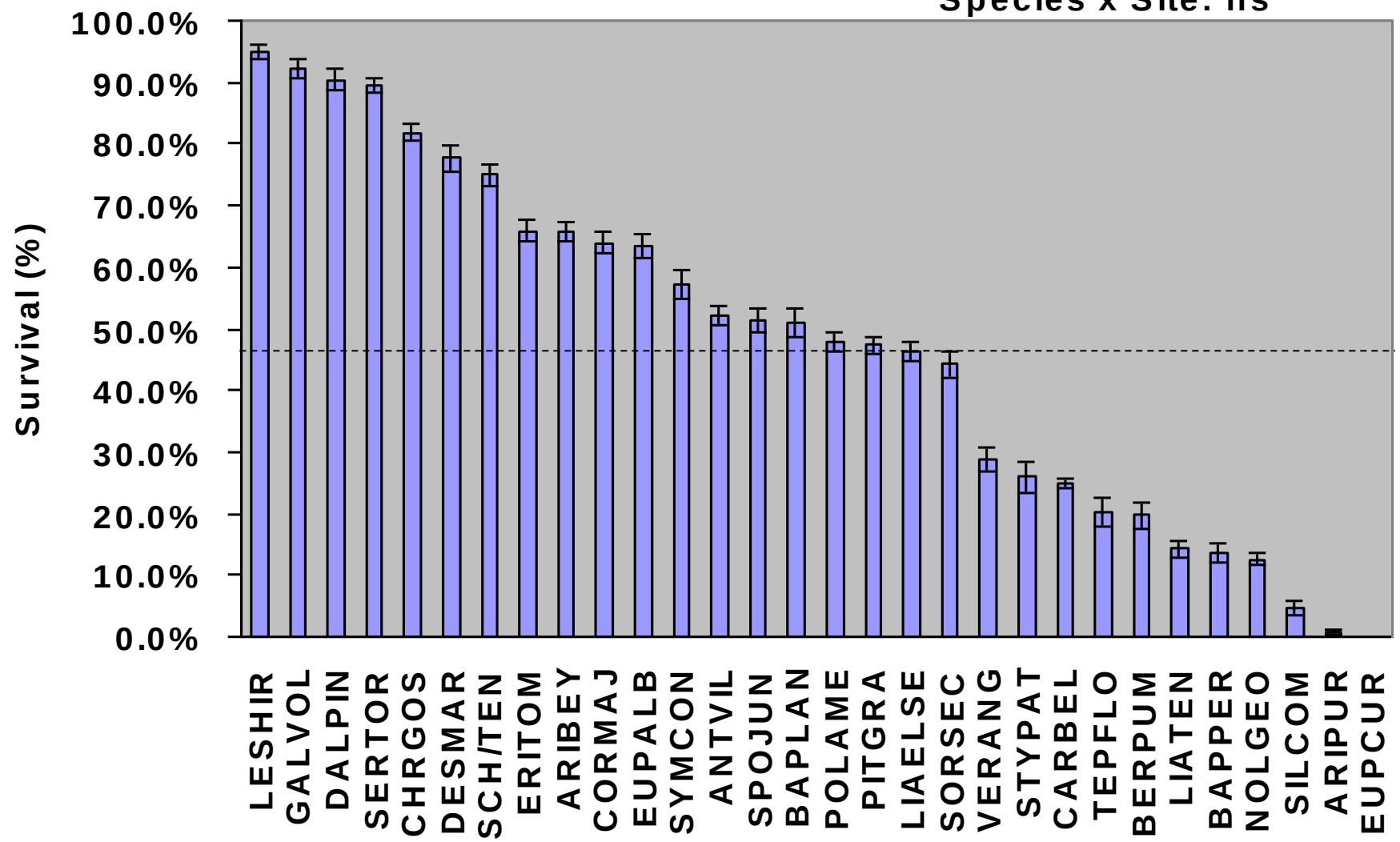


A photograph of a forest floor with various plants and trees. In the foreground, there are several tall, thin grasses and some small, purple-flowered plants. The ground is covered with a layer of brown pine needles and leaves. In the background, there are many tall, thin trees with green foliage. A black rectangular box with white text is overlaid on the center of the image.

Initial Transplant Survival

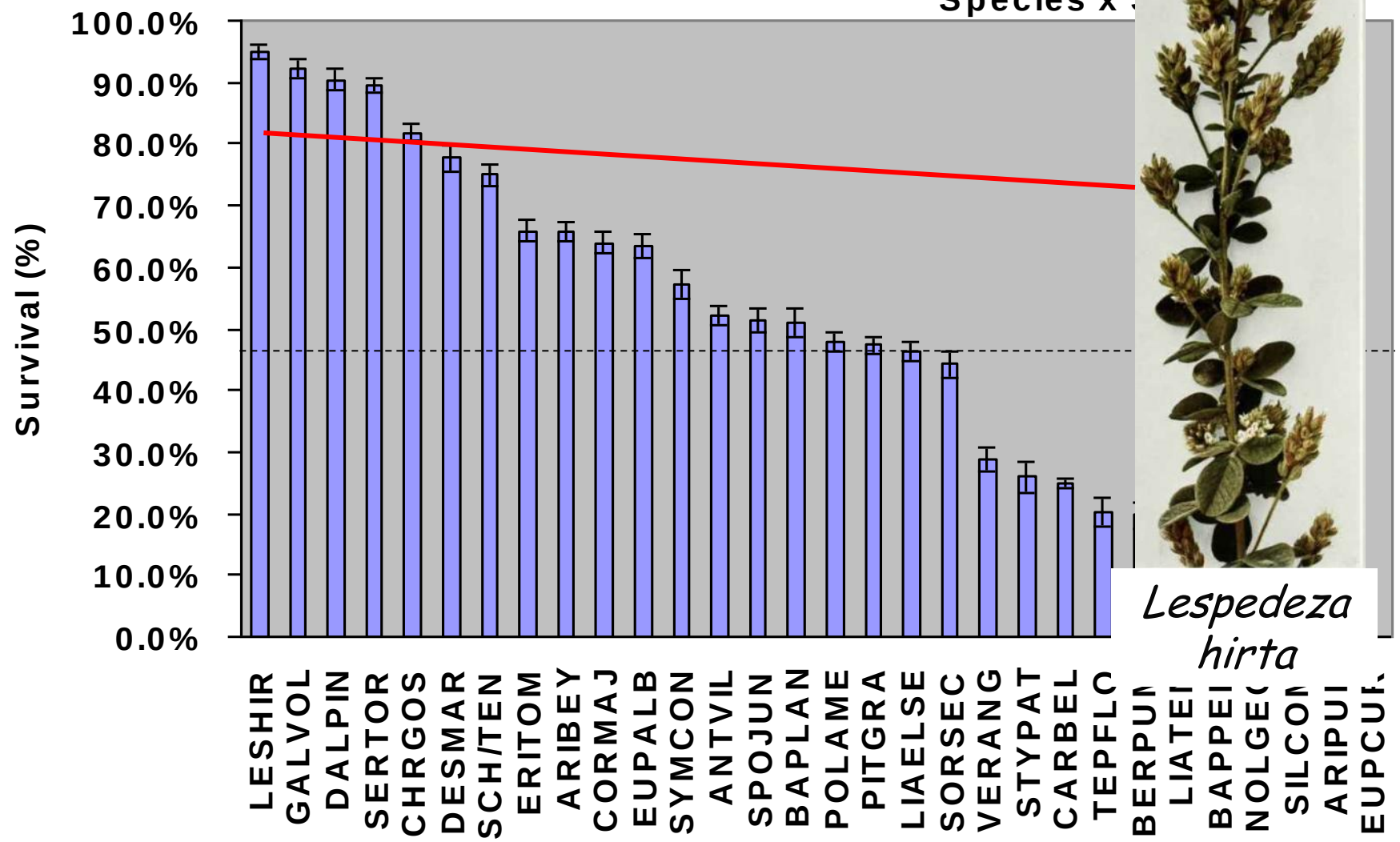
Survival of transplanted species to 2004

Species: $p < 0.001$
Site: $p < 0.001$
Species x Site: ns



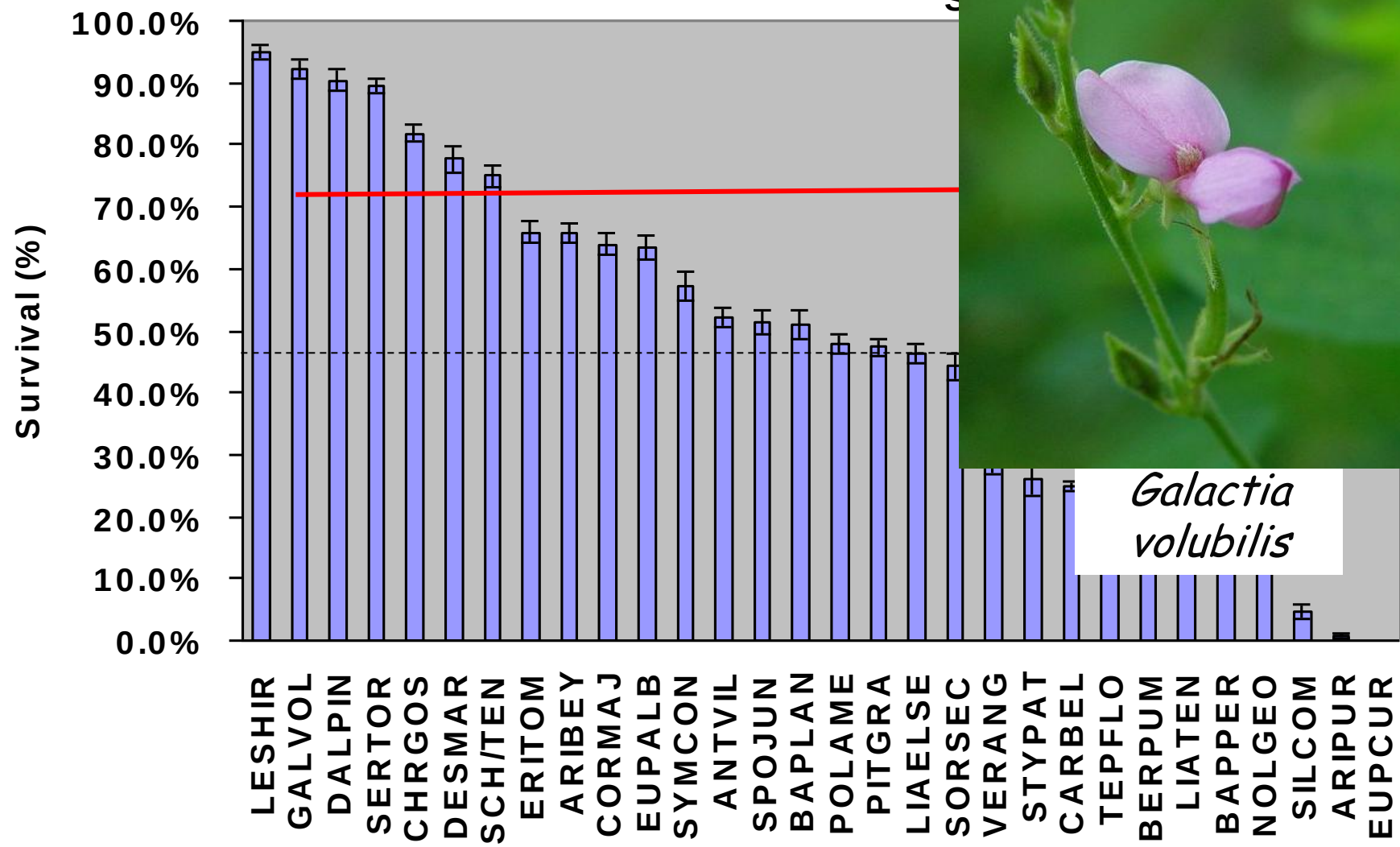
Survival of transplanted species to 2004

Species: p<0.001
Site: p<0.001
Species x Site: p<0.001



Survival of transplanted species to 2004

Species: $p < 0.001$

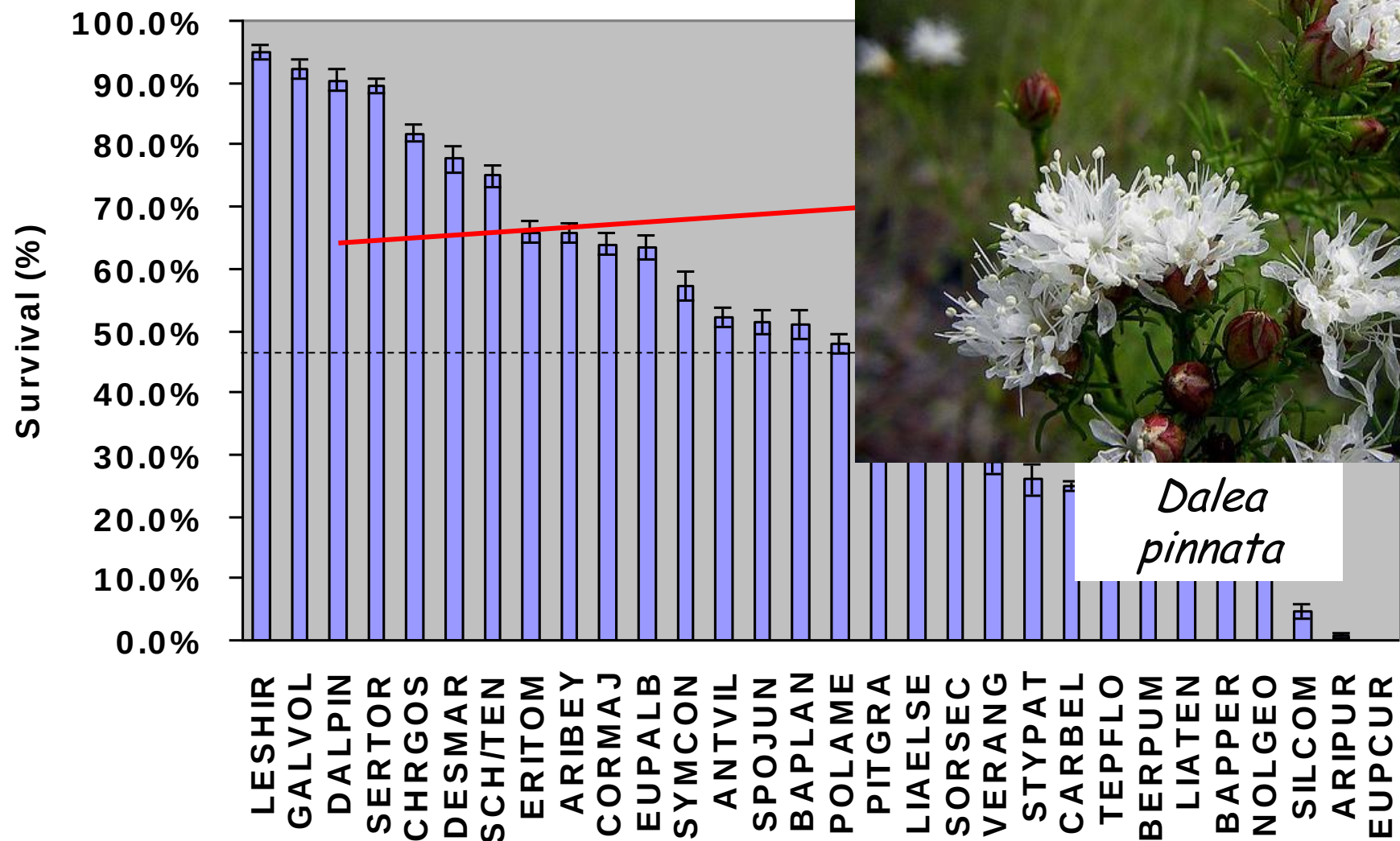


Galactia volubilis

Survival of transplanted species to 2004

Species: $p < 0.001$

Site: $p < 0.001$



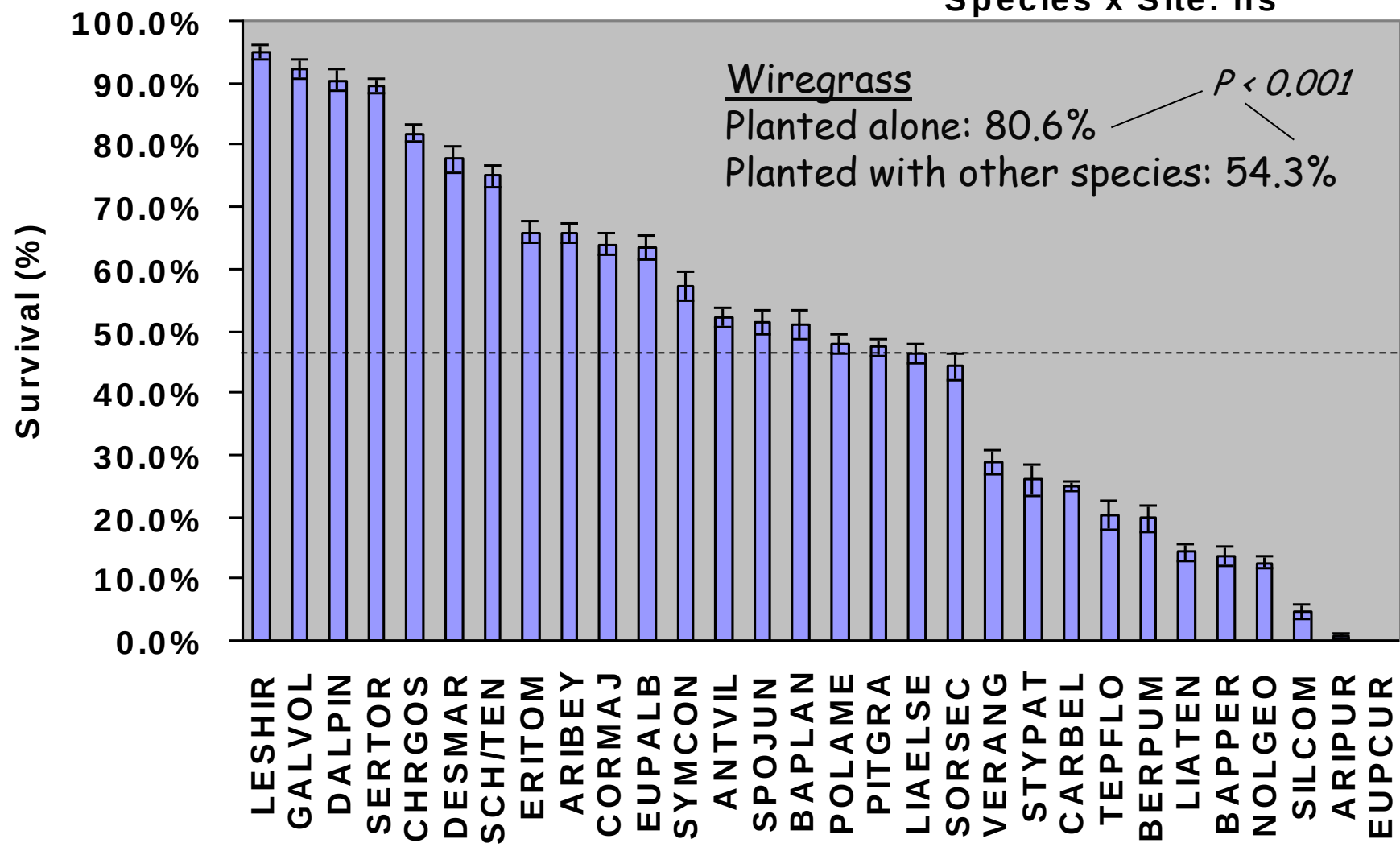
Dalea pinnata

Survival of transplanted species to 2004

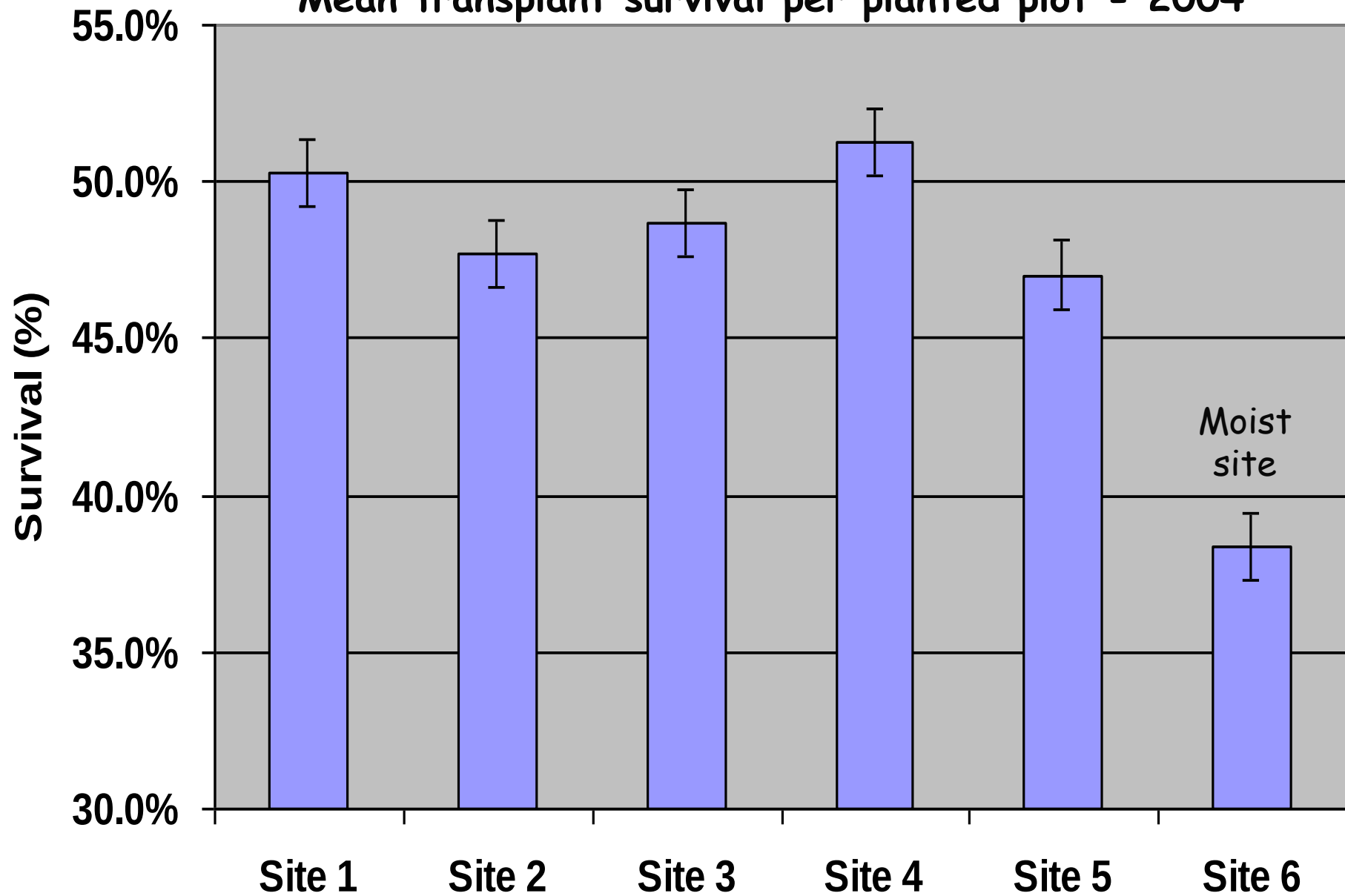
Species: $p < 0.001$

Site: $p < 0.001$

Species x Site: ns



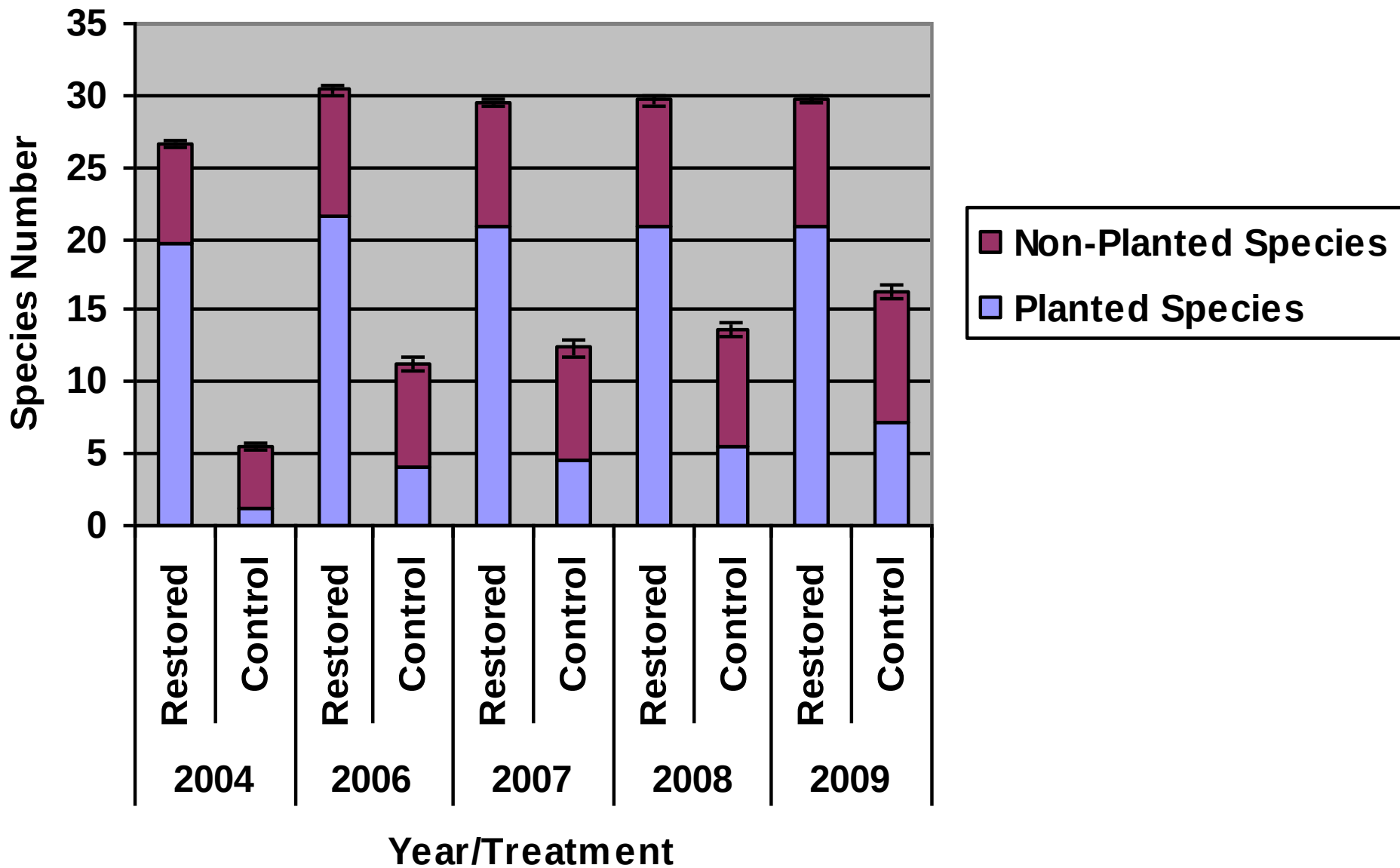
Mean transplant survival per planted plot - 2004



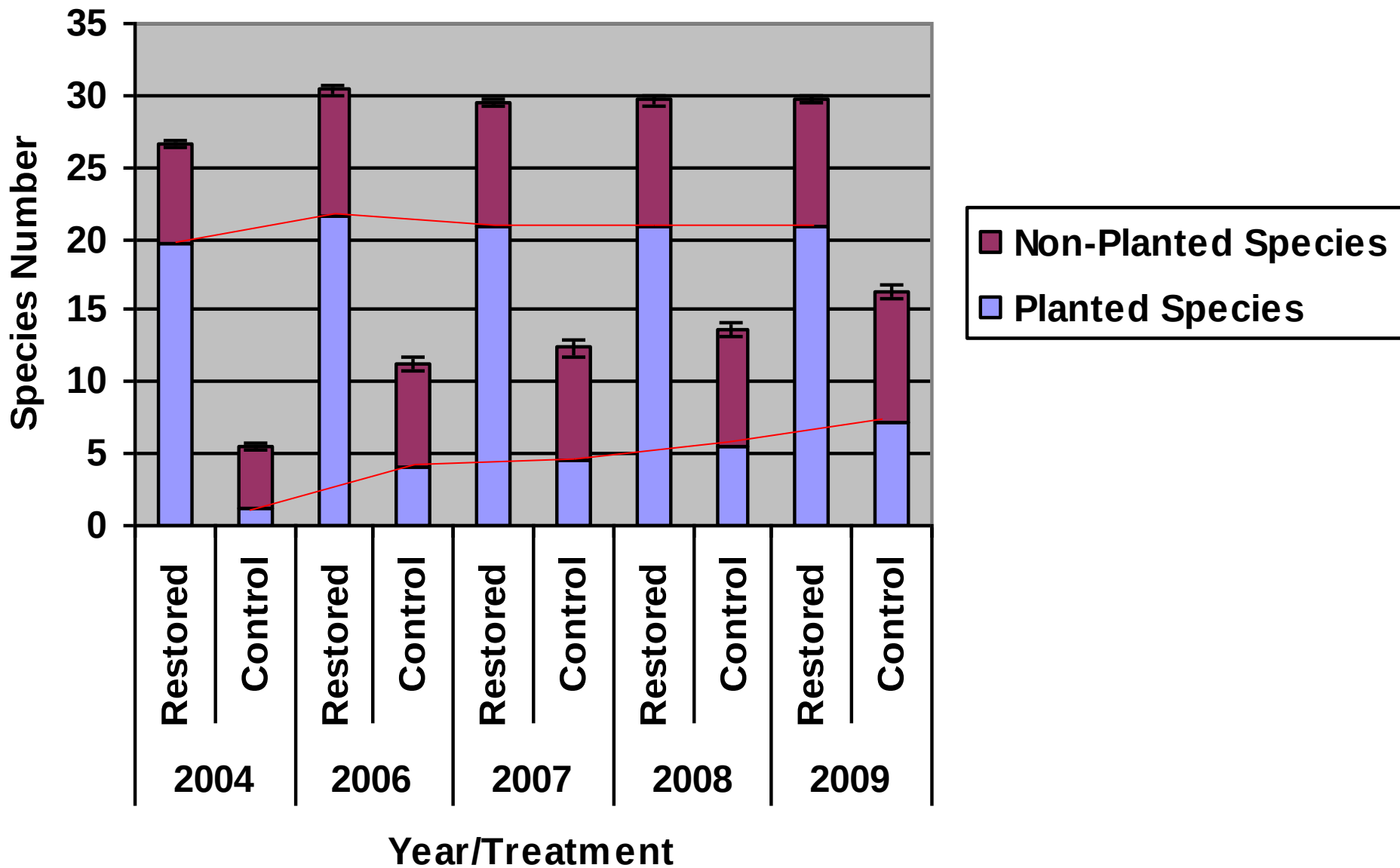
A photograph of a forest floor with a variety of plants, including tall grasses, purple flowers, and green shrubs, with a dense forest of tall trees in the background.

Species Richness

Species Richness 2004 - 2009



Species Richness 2004 - 2009



A photograph of a forest floor covered in dense, low-growing vegetation. The plants include various grasses, small shrubs, and flowering stalks, some with purple and yellow blossoms. The ground is partially covered with dry pine needles and small stones. In the background, a dense stand of tall, thin trees with green foliage is visible. A black rectangular box with white text is overlaid on the middle of the image.

Plant Cover and Community Biomass

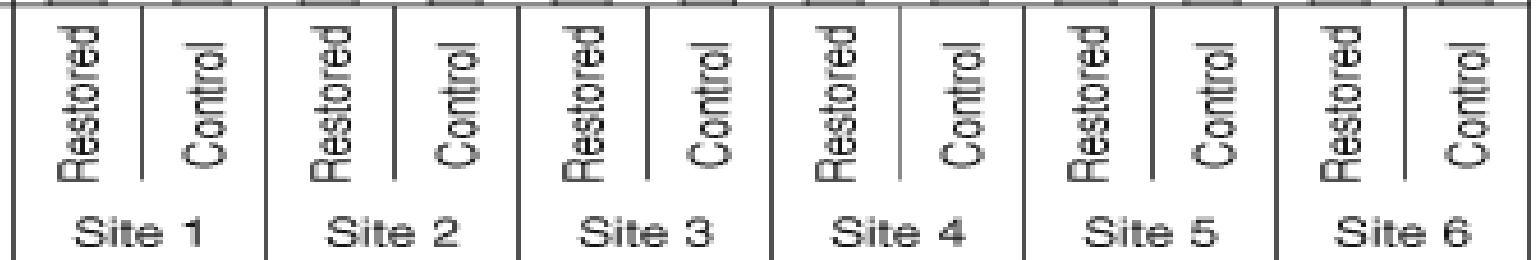
2006

Aschenbach et al. 2009

Cover (%)

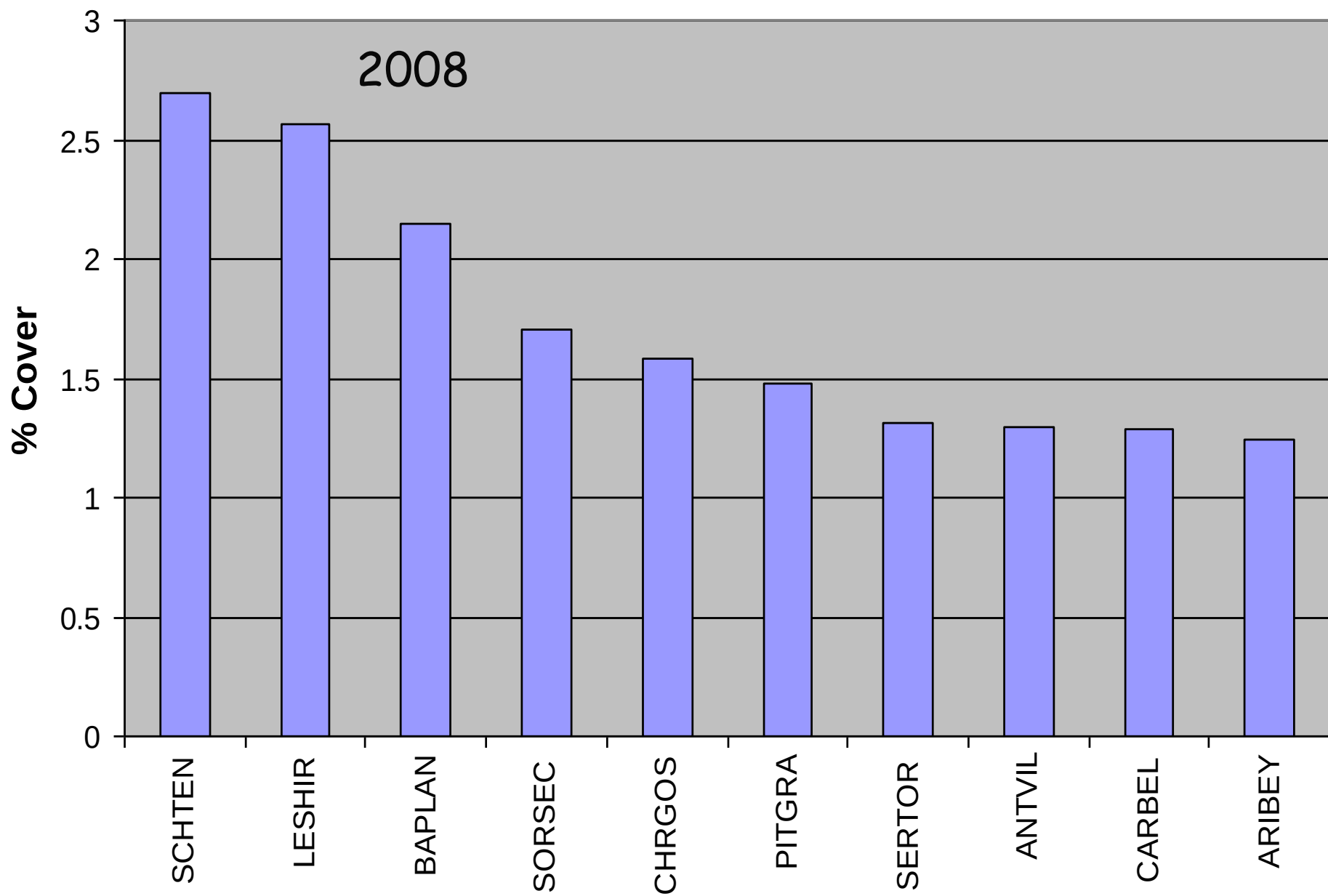
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%

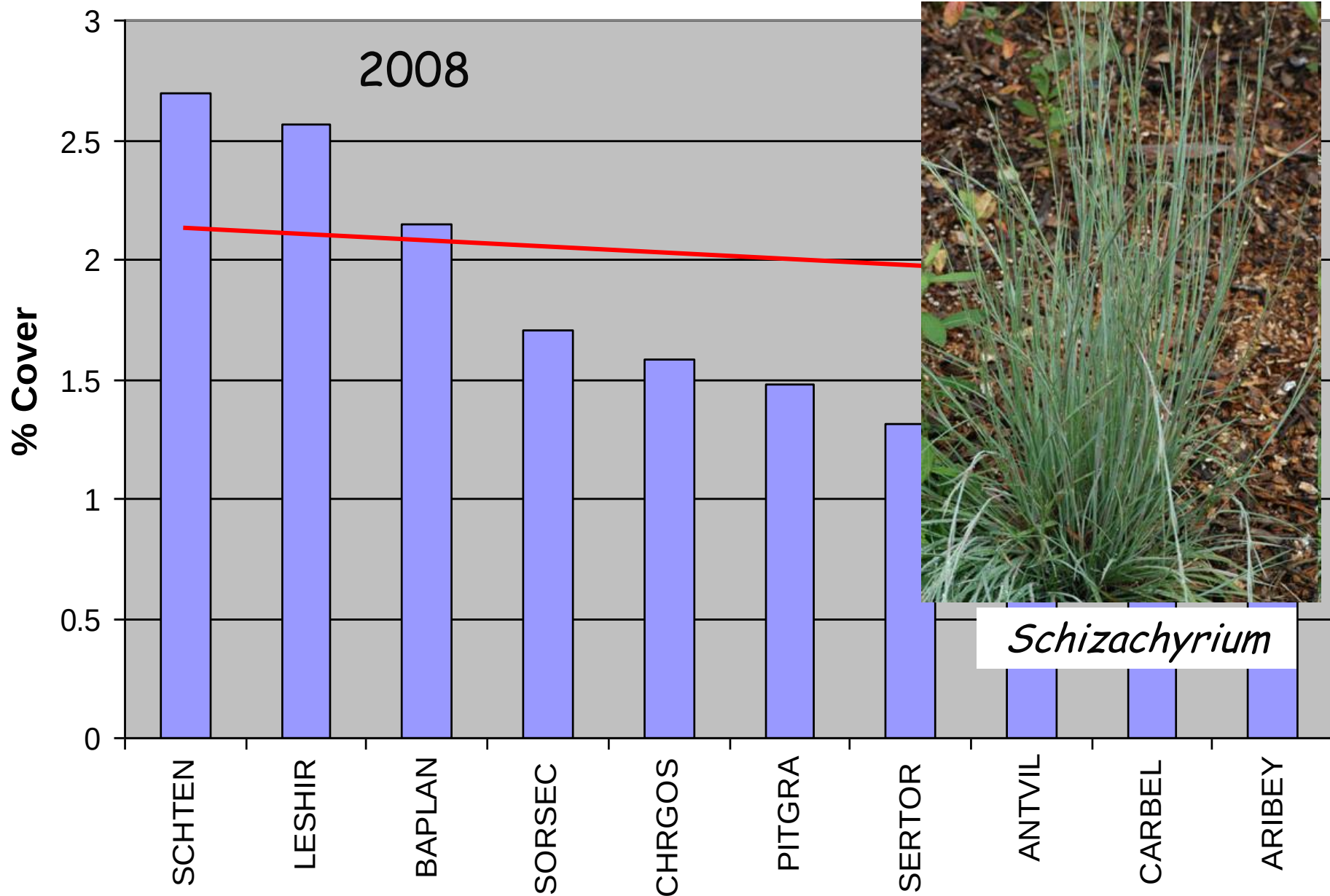
Moist
site

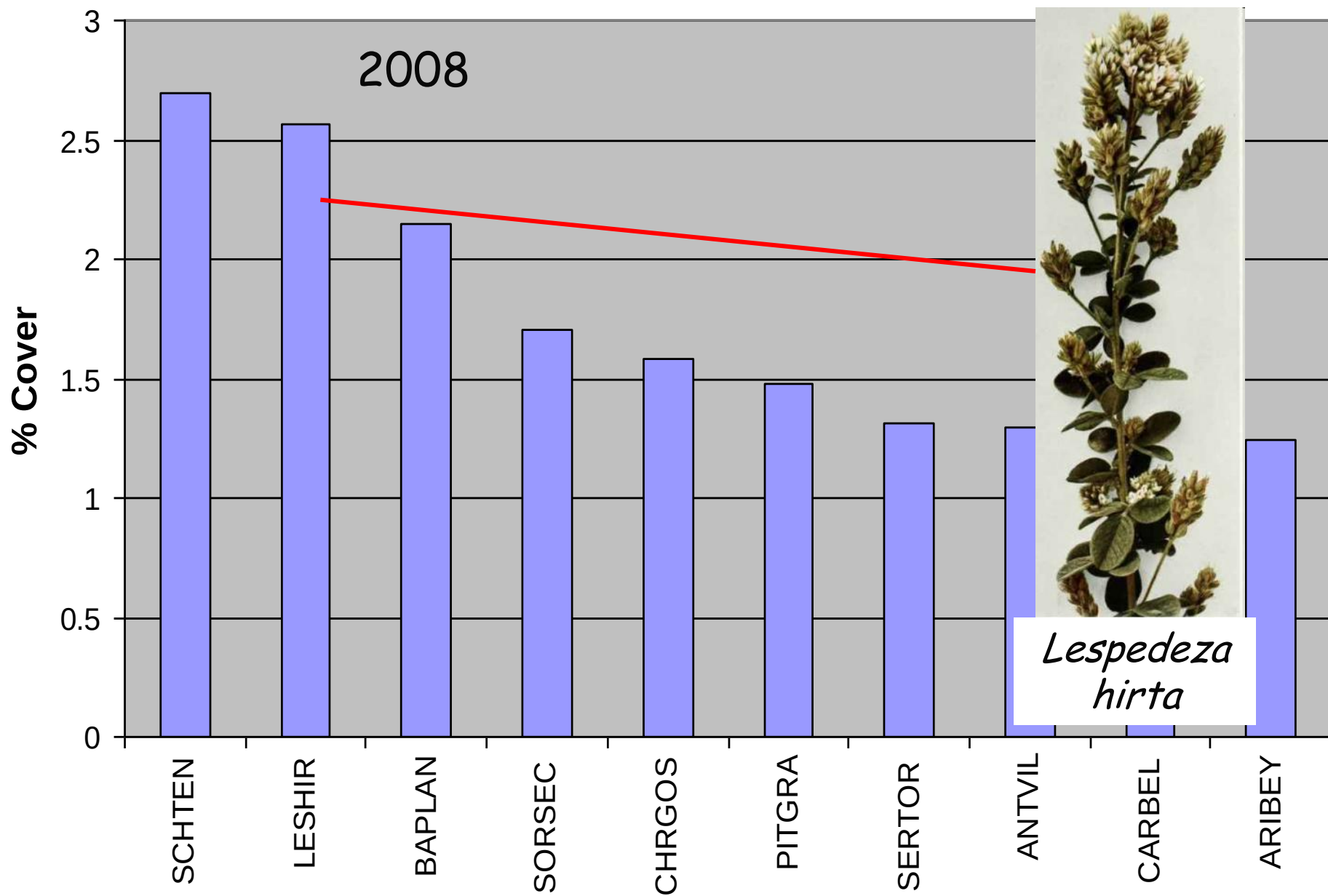


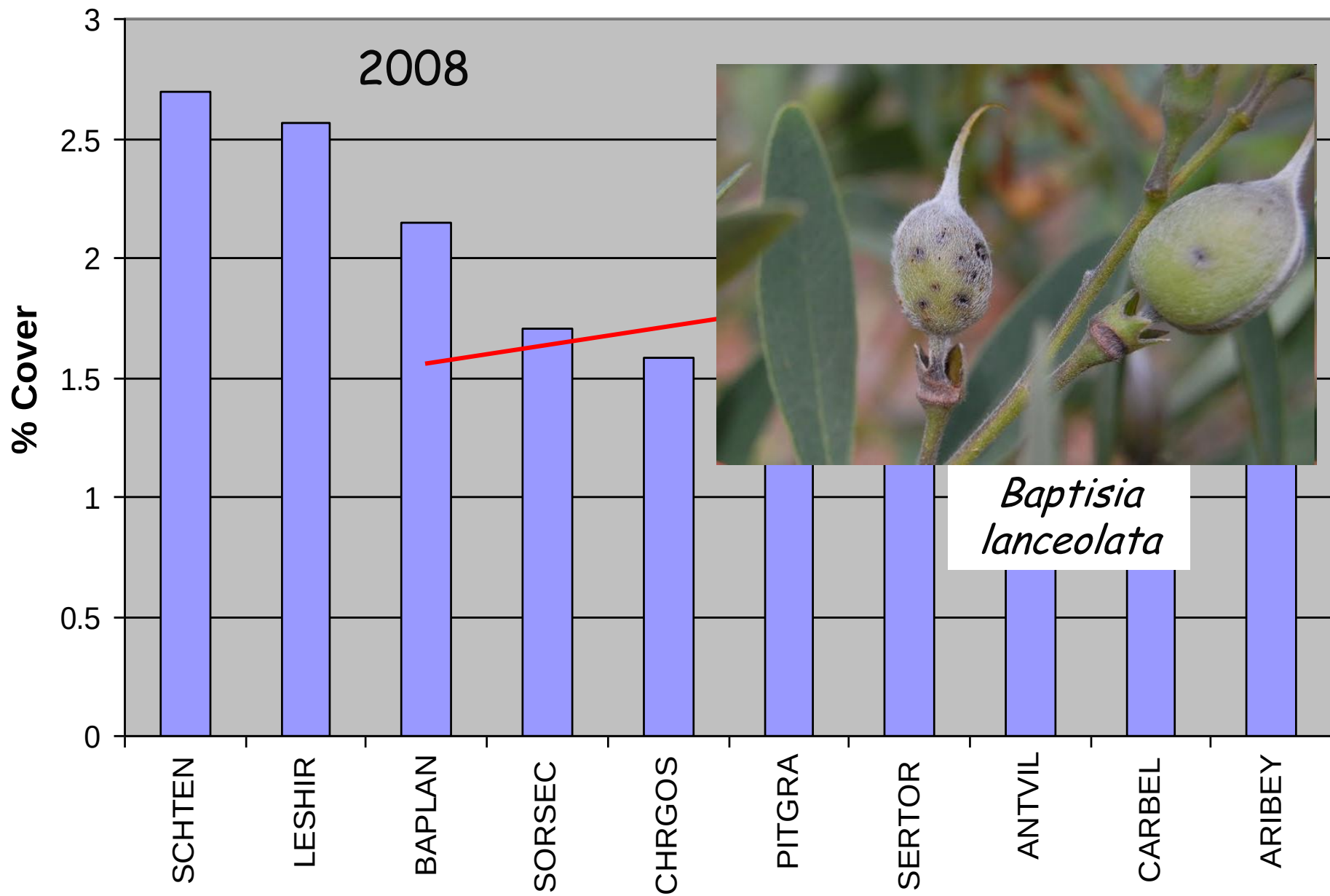
■ Non-planted Species

■ Planted Species

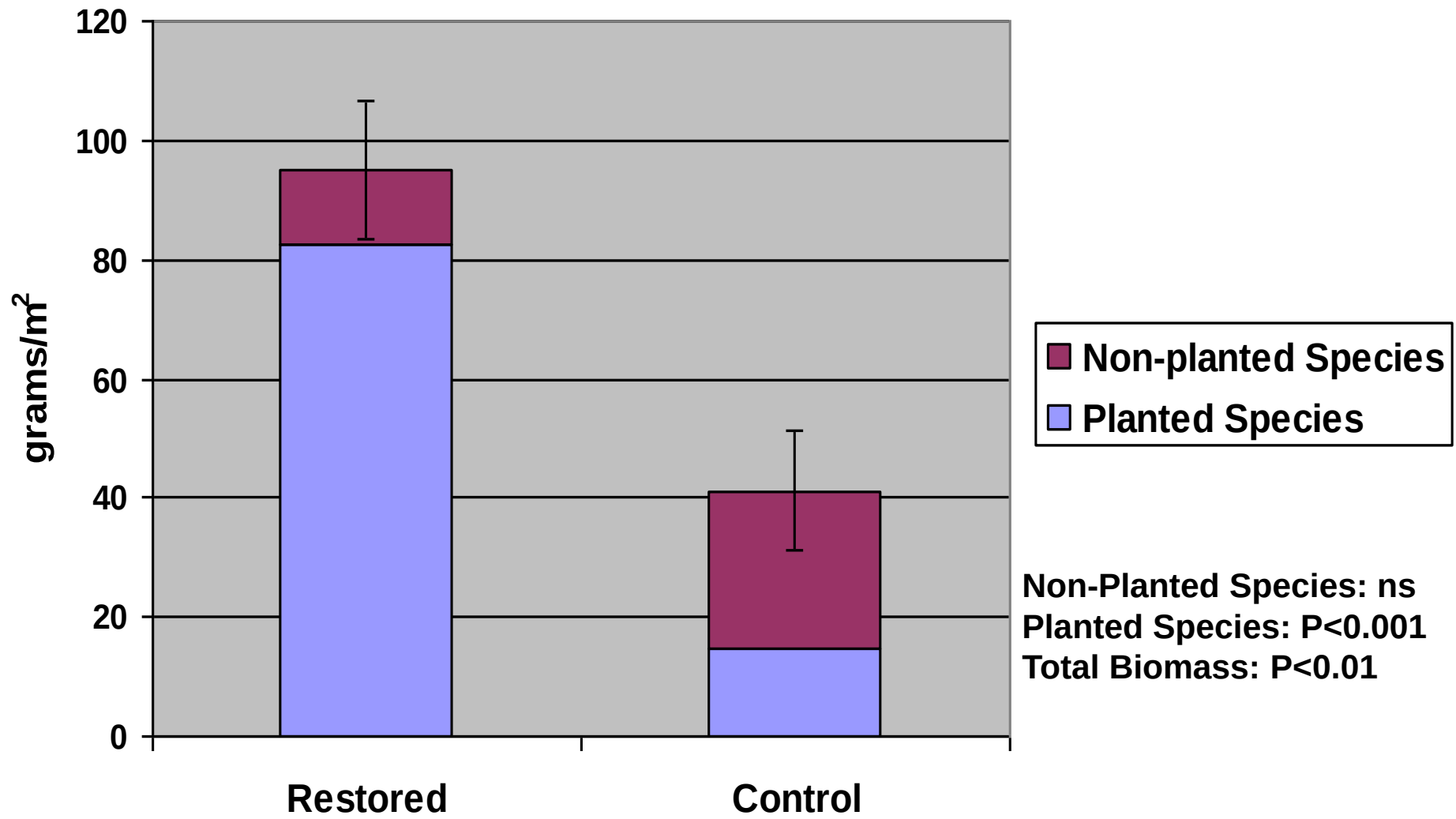






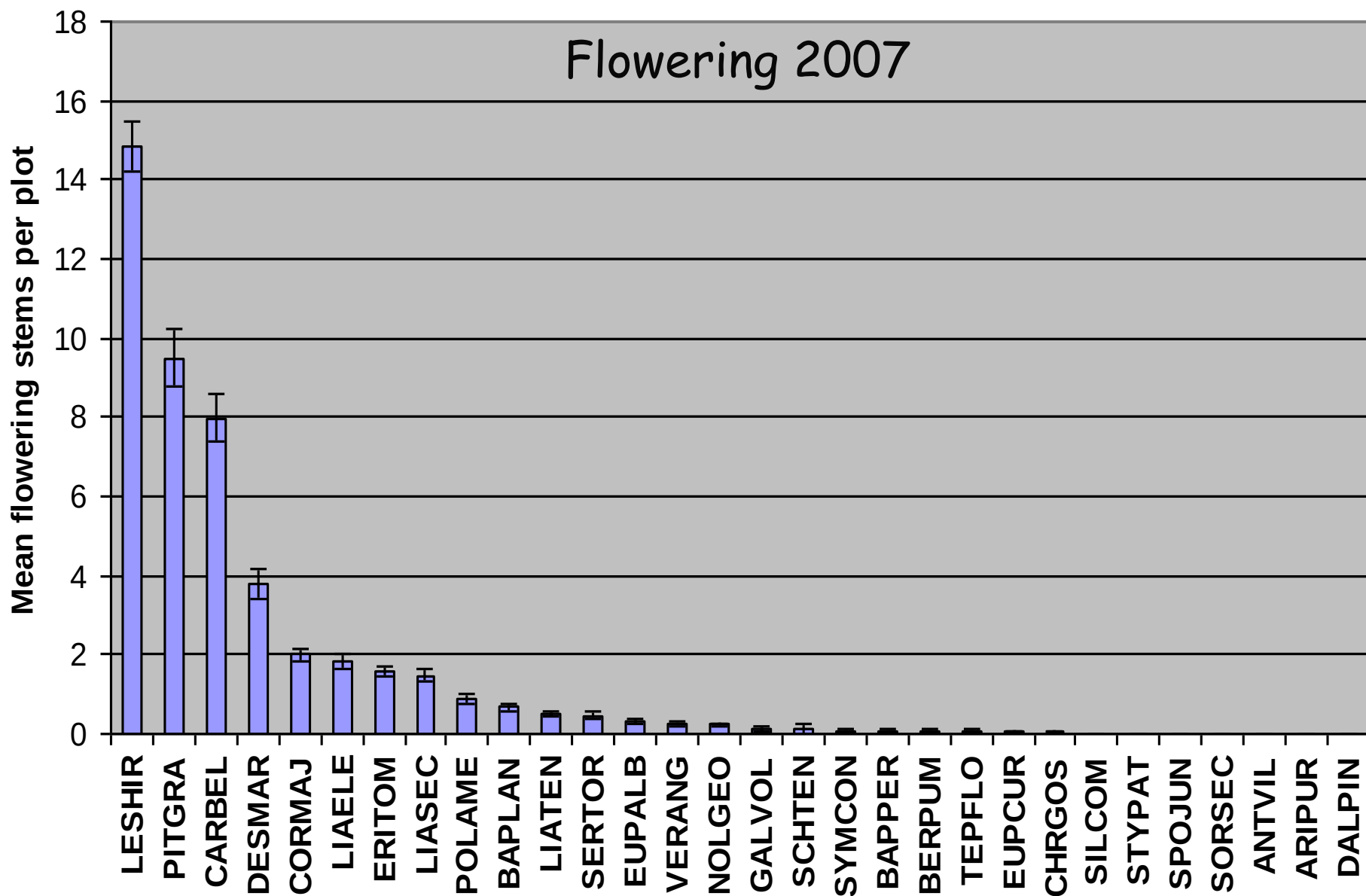


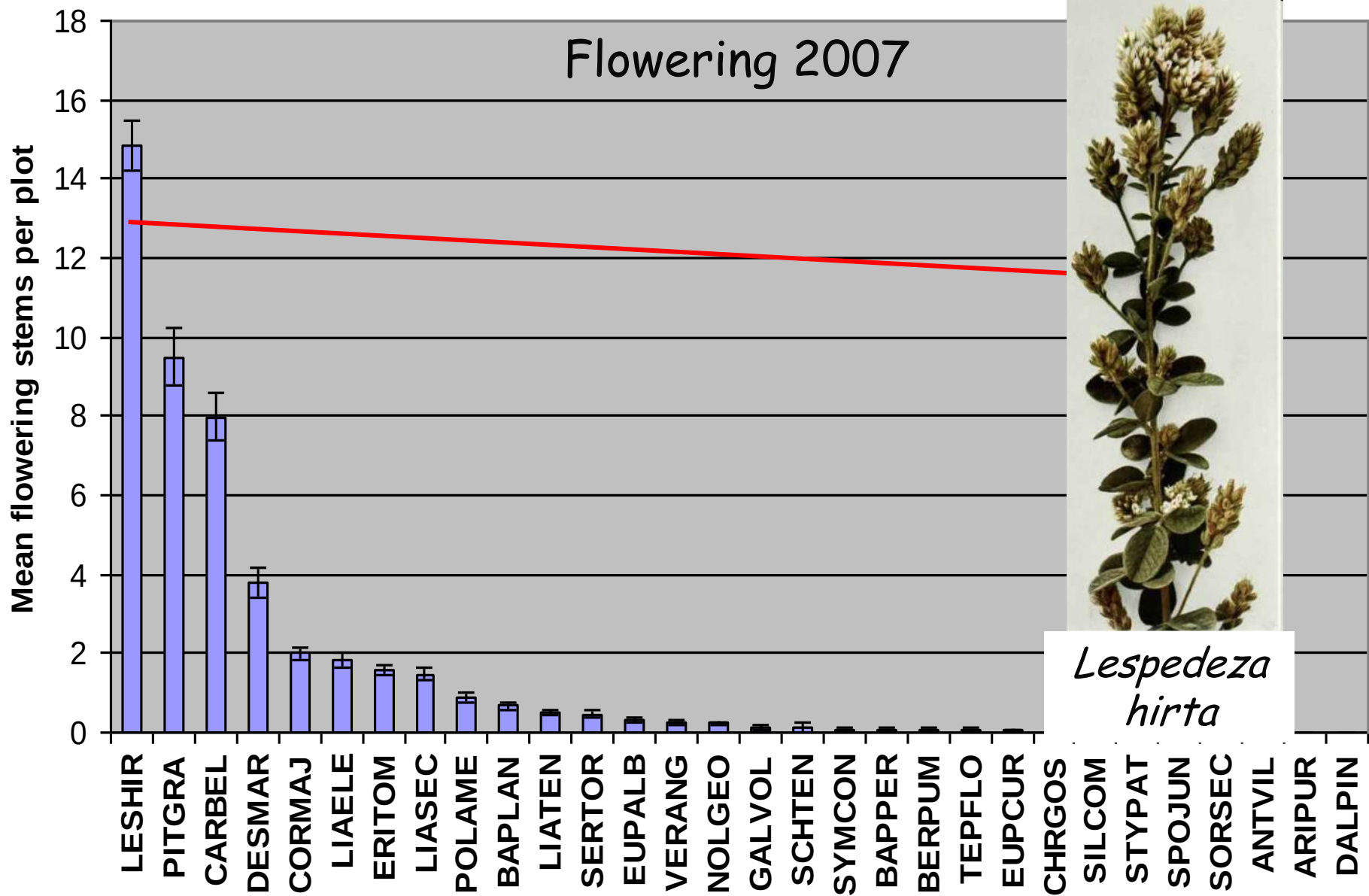
Biomass 2008

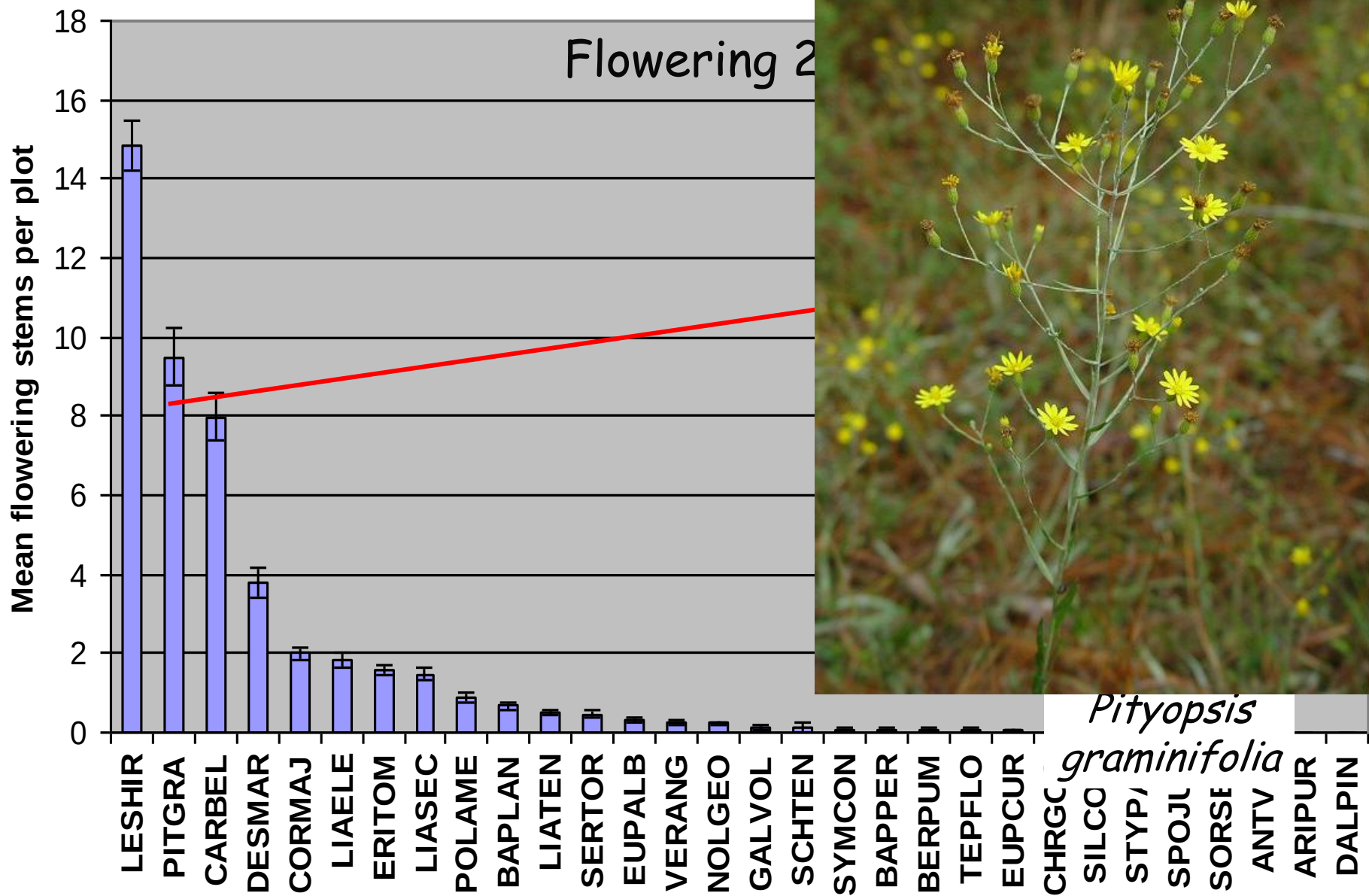


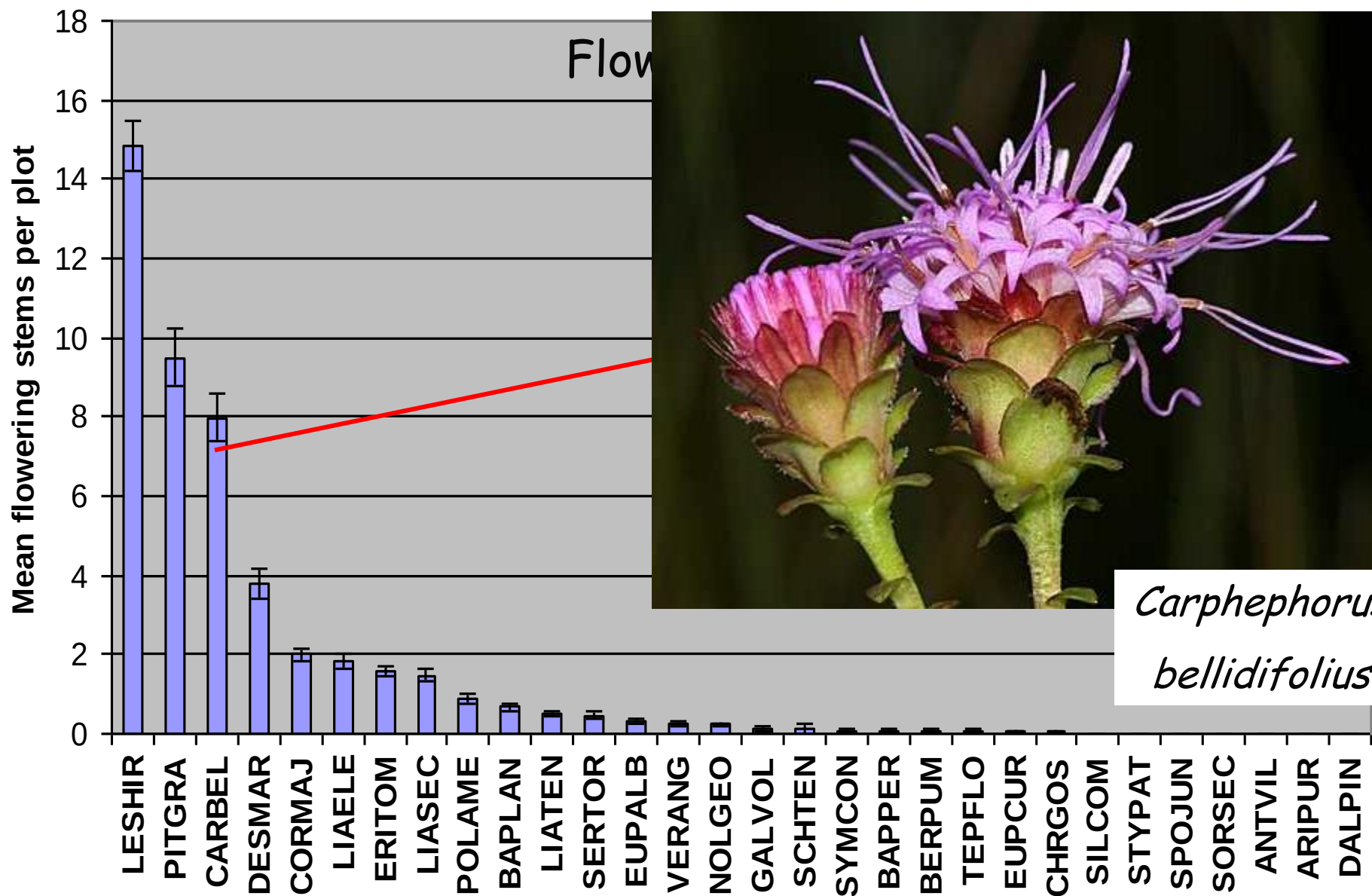
A photograph of a forest floor. The ground is covered with a dense layer of tall, thin grasses and various wildflowers. Some flowers are purple, some are white, and some are yellow. The background is filled with tall, dark tree trunks, suggesting a forest setting. The lighting is bright, indicating daytime. A black rectangular box with the word "Flowering" in white text is overlaid on the center of the image.

Flowering

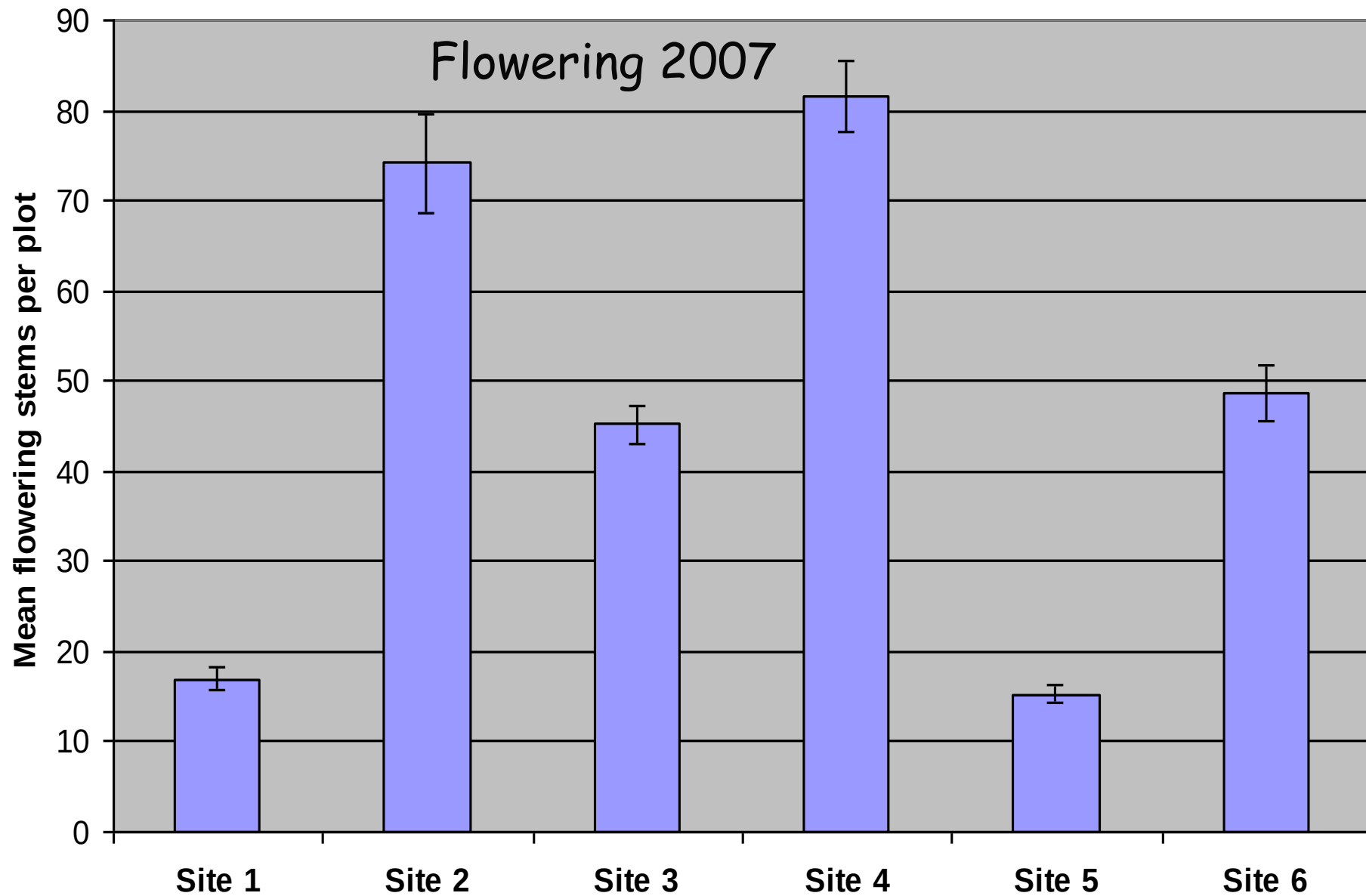








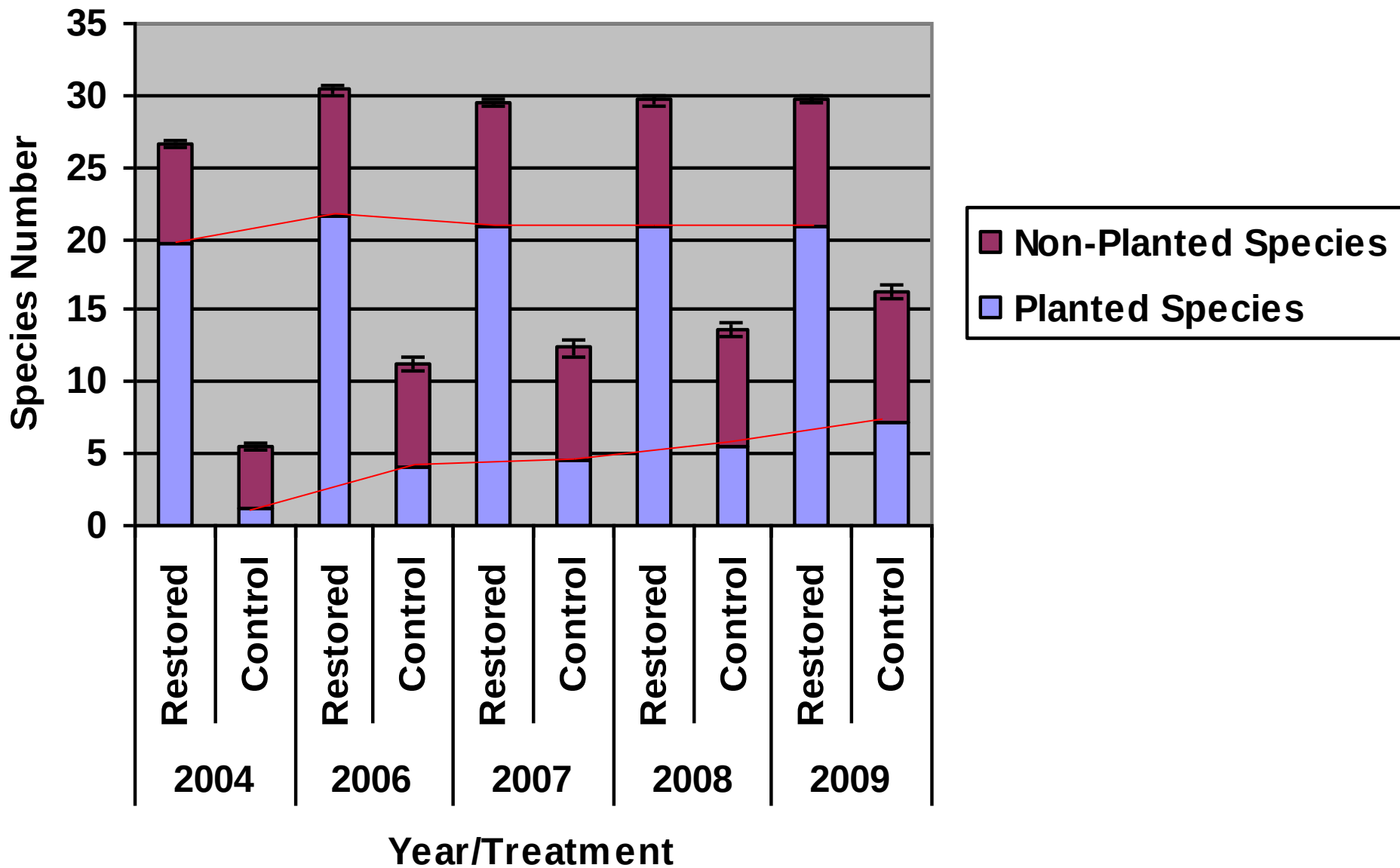
Flowering 2007



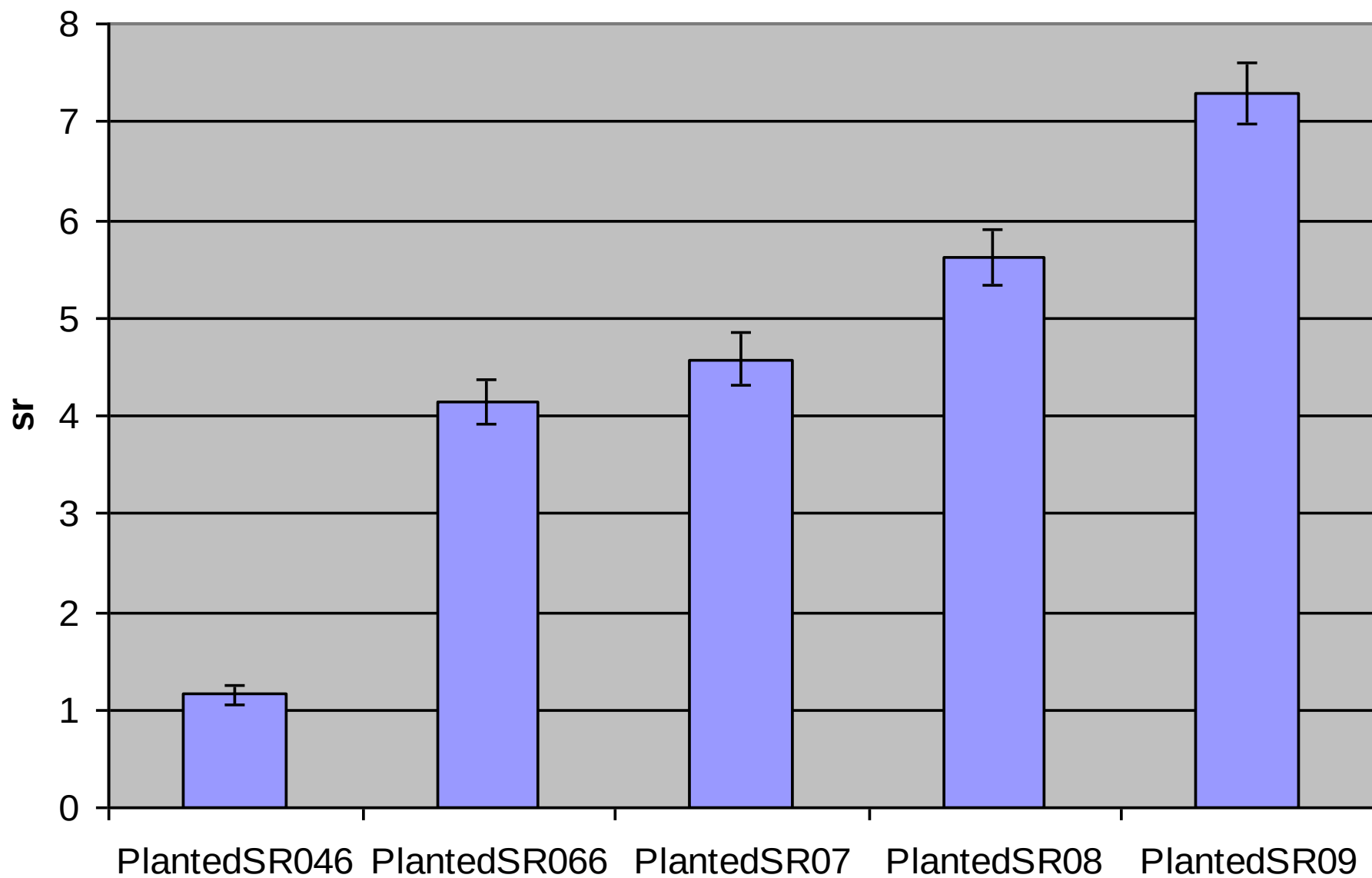
A photograph of a forest floor. In the foreground, there are several tall, thin grasses with feathery seed heads, some green and some brown. Interspersed among the grasses are various small plants, including some with purple flowers and others with white flowers. The ground is covered with a layer of brown pine needles and leaves. In the background, there are many tall, thin tree trunks, likely pines, standing closely together. The lighting is bright, suggesting a sunny day.

Species movement

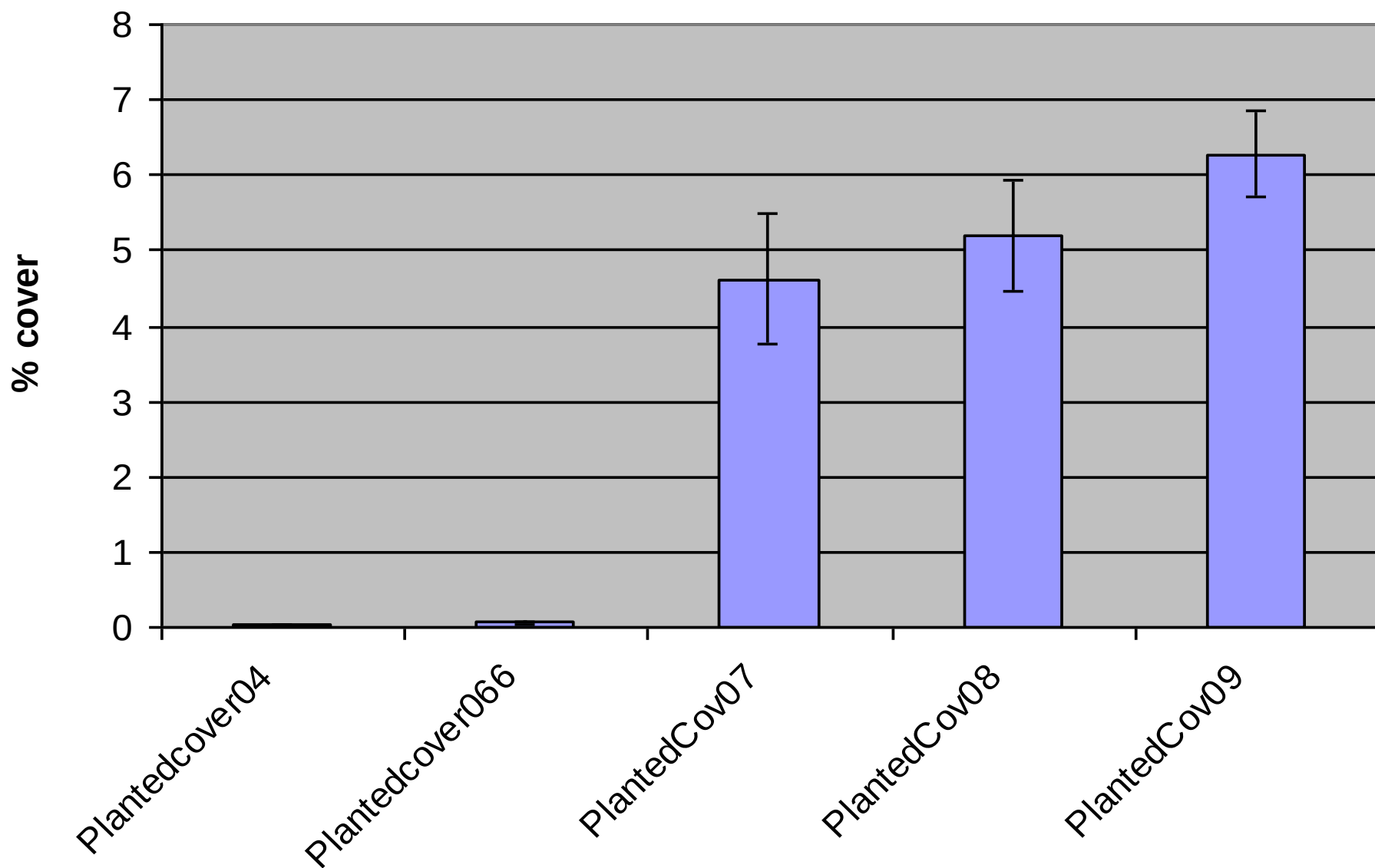
Species Richness 2004 - 2009

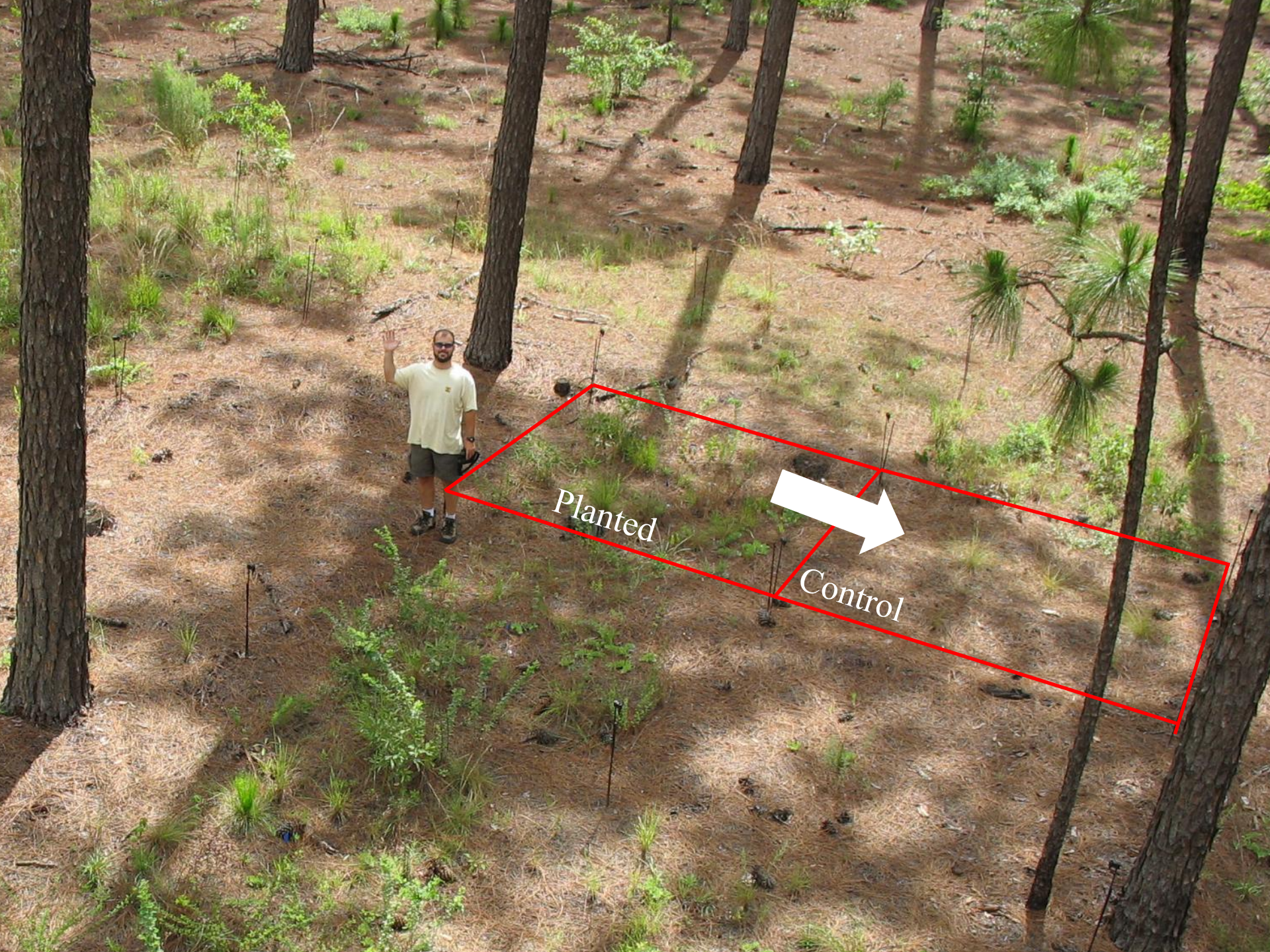


Mean Planted SR in Control +/- 1se: all sites combined



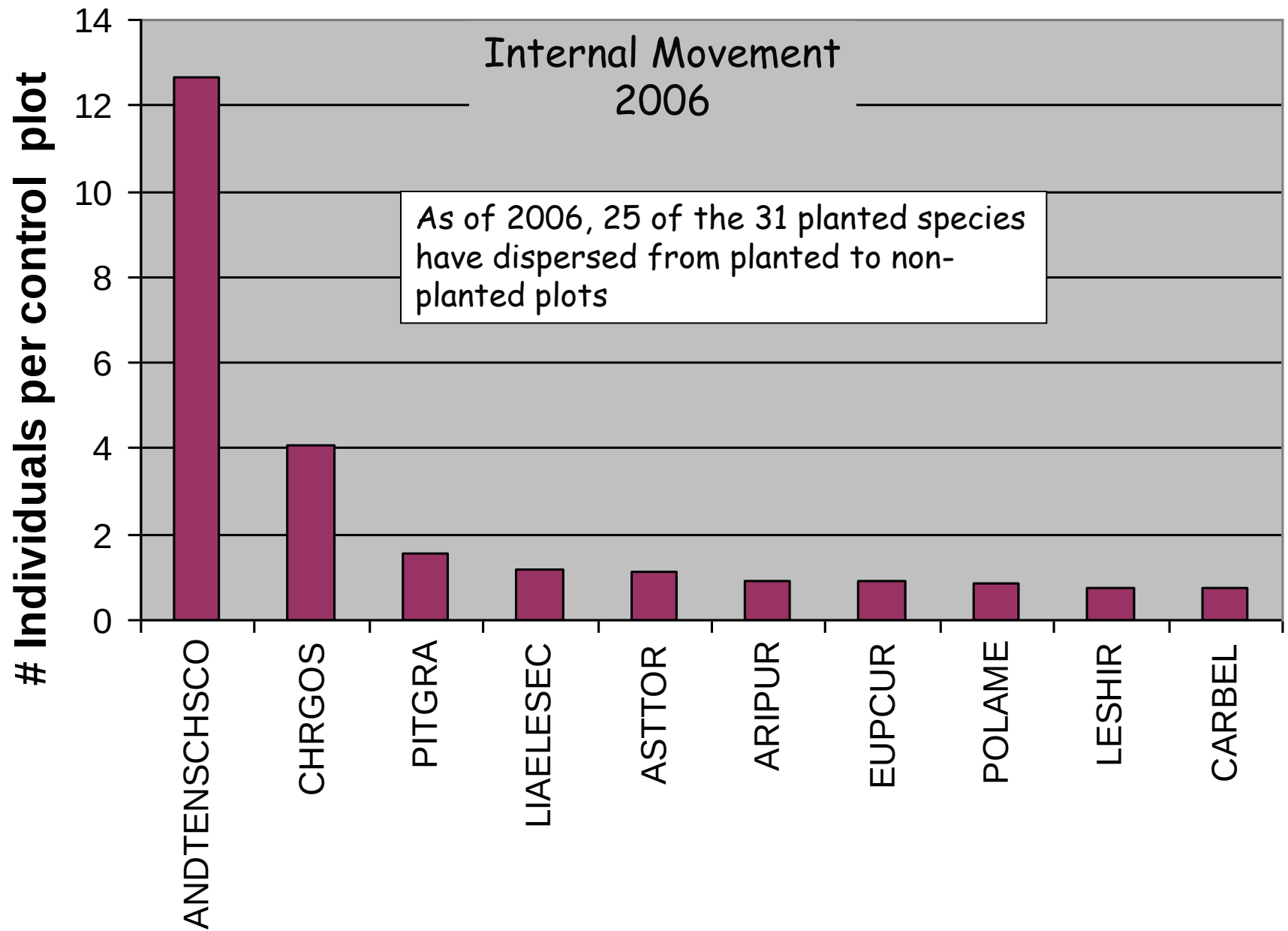
Mean Planted Cover $\pm$ 1 se in control plots: all sites combined





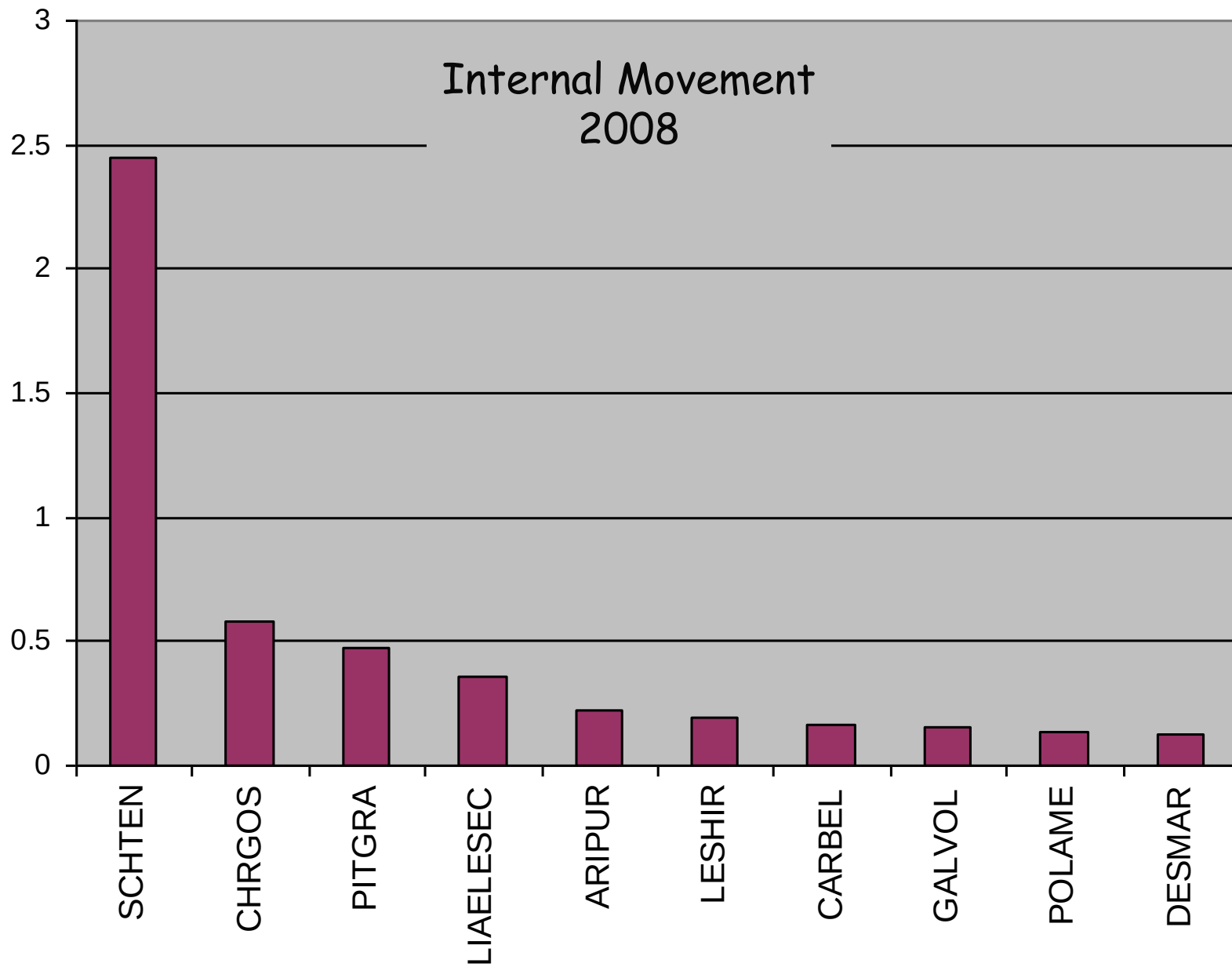
Planted

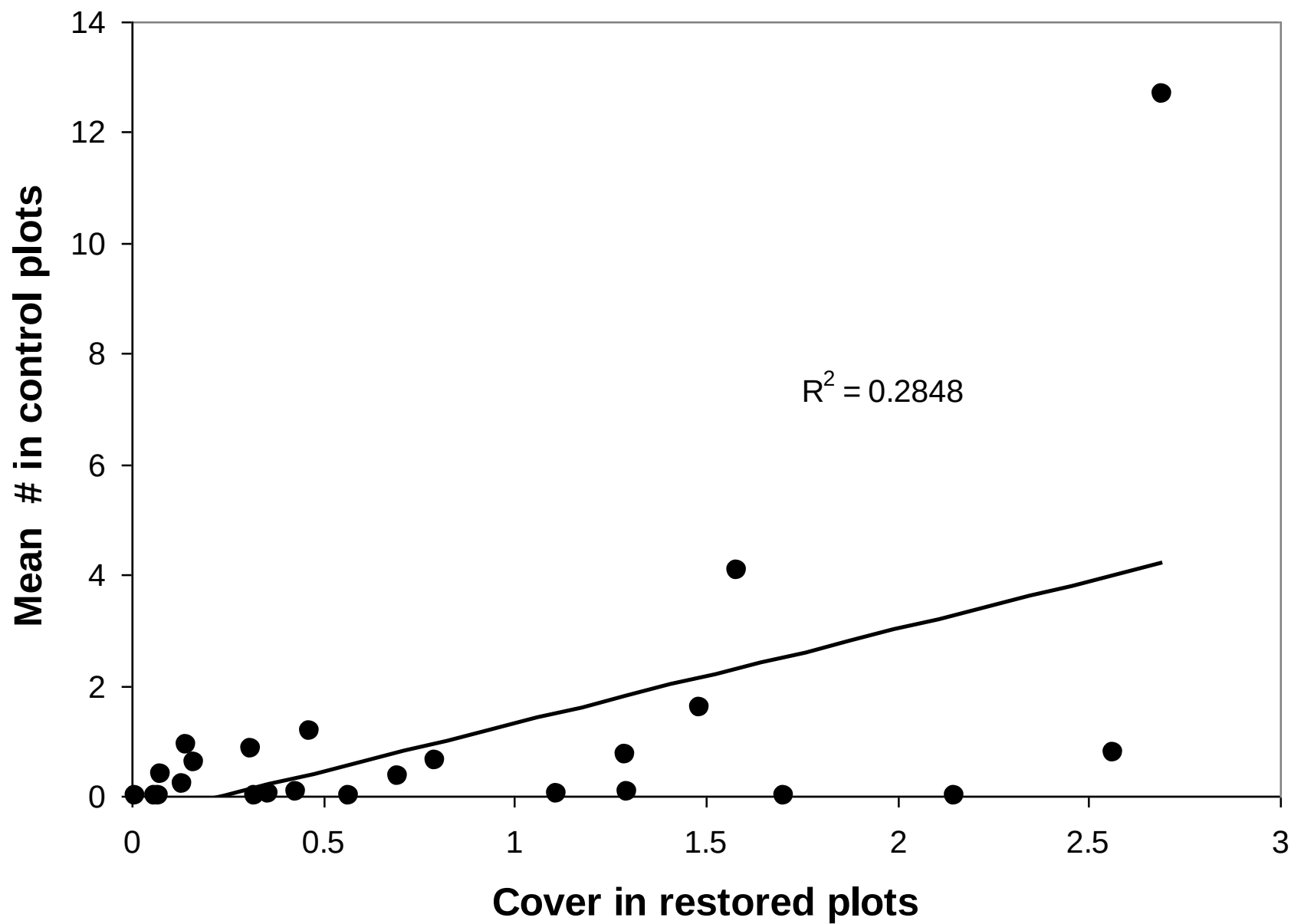
Control

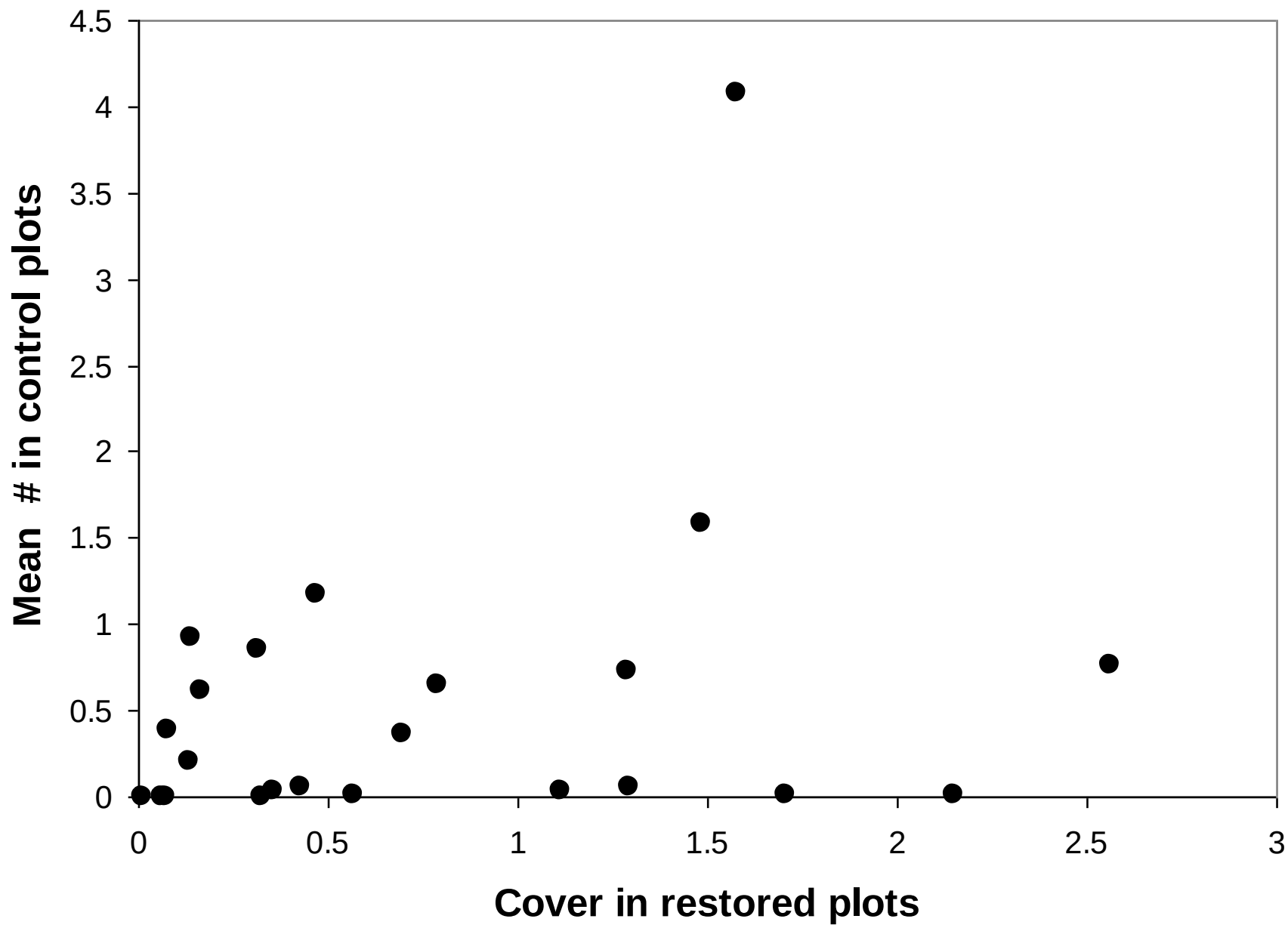


Internal Movement 2008

% Cover in control plots

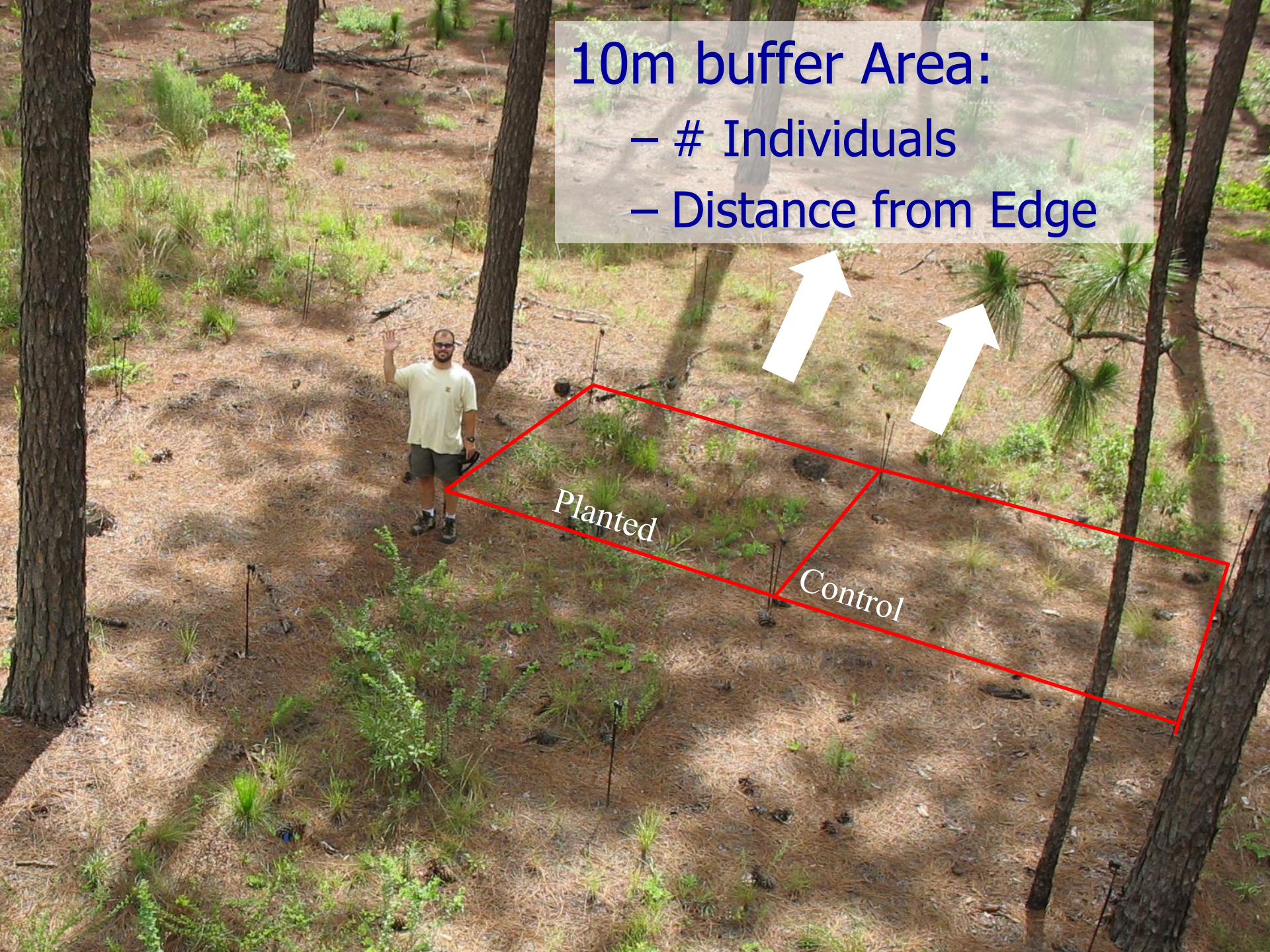


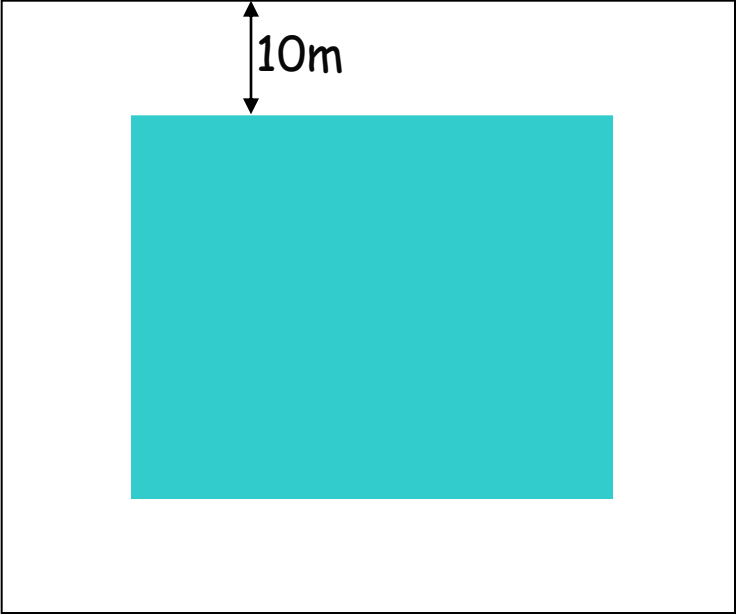




10m buffer Area:

- # Individuals
- Distance from Edge





External Movement 2008

of Individuals in buffer

Total number of individuals dispersed
into buffer = **763**

PITGRA

GALVOL

CARBEL

LIAELESEC

CHRGOS

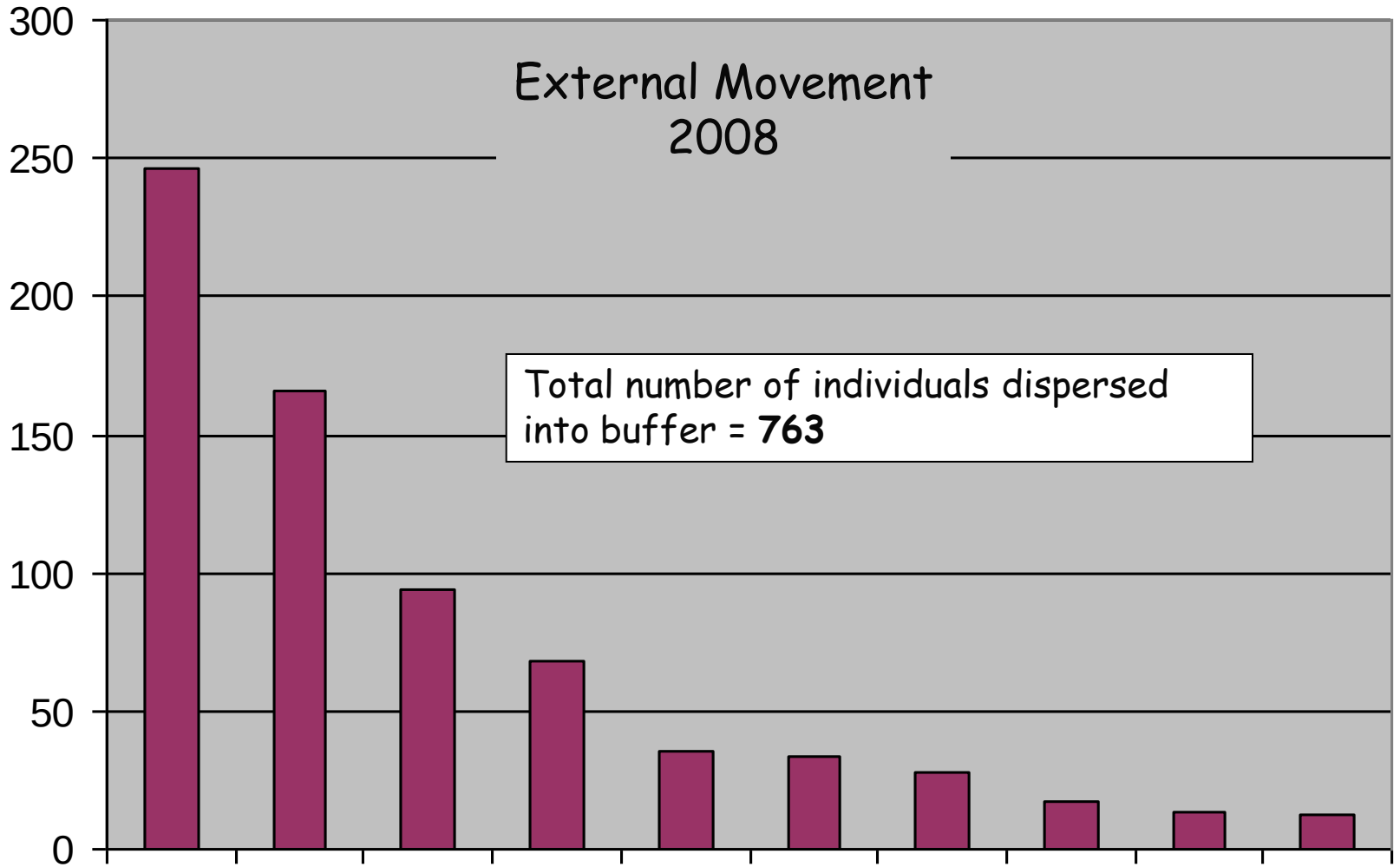
EUPCUR

LIATEN

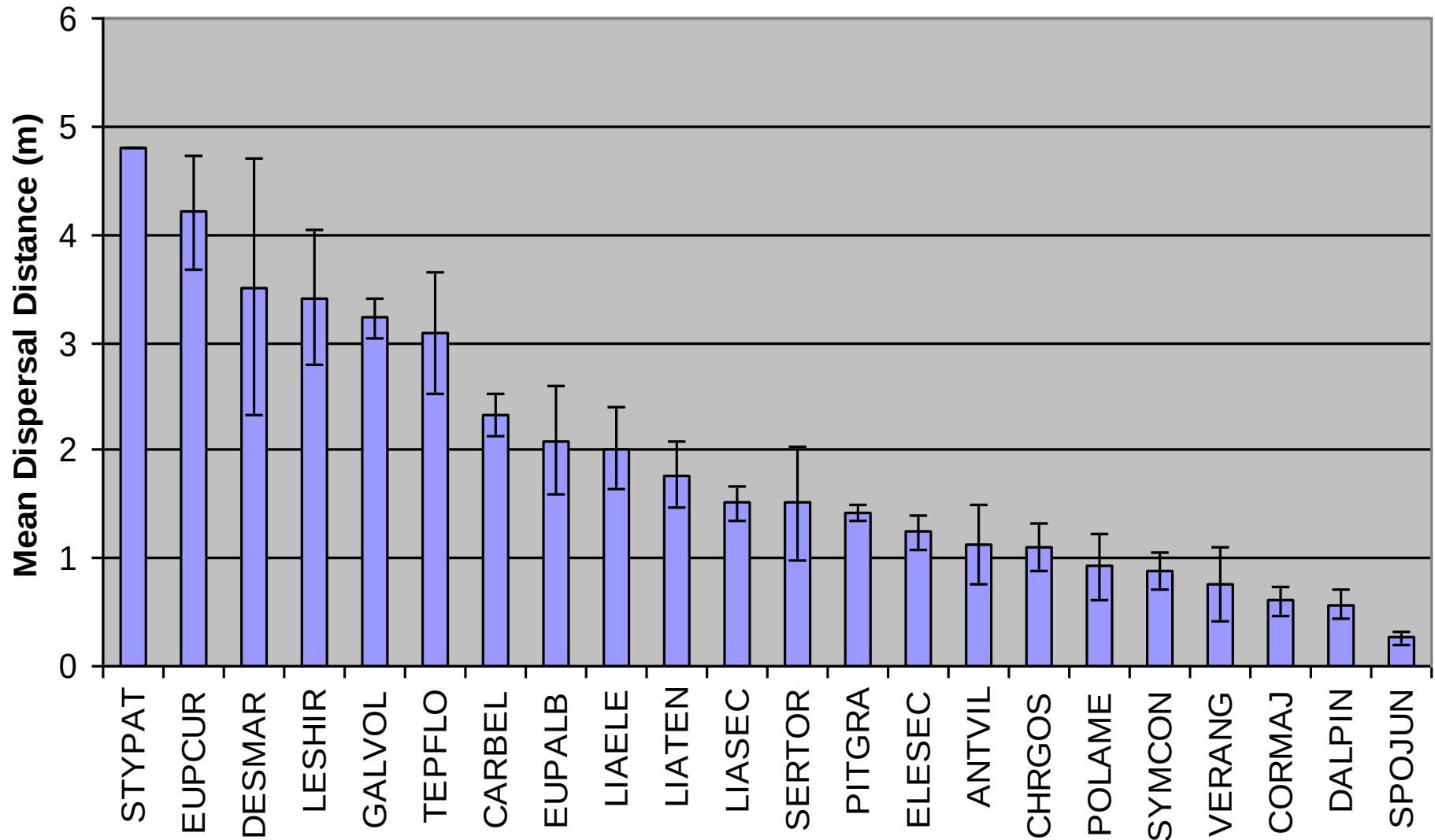
LESHIR

POLAME

CORMAJ

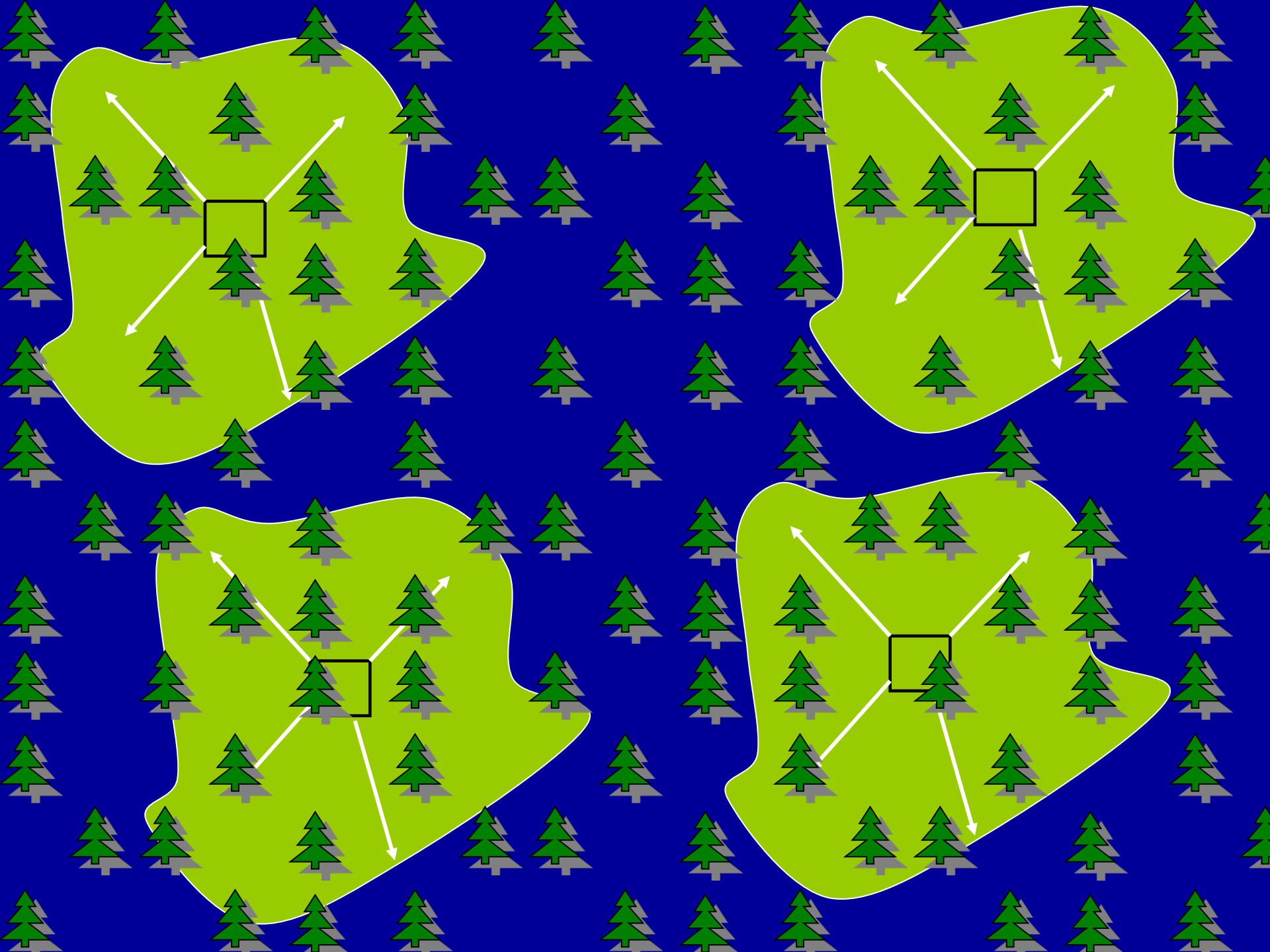


Mean External Dispersal Distance (2008) +/- SE



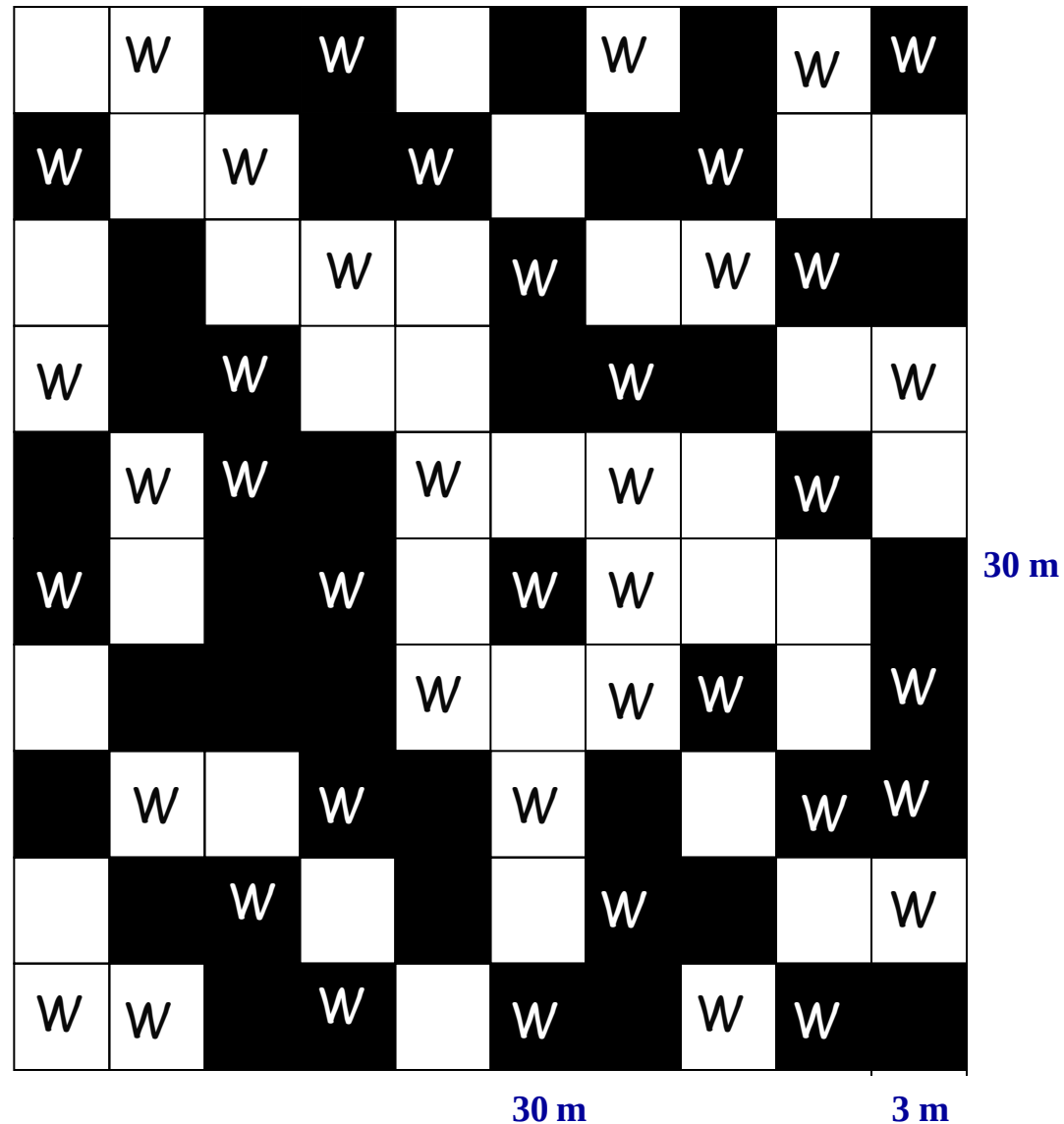
A photograph of a forest floor. In the foreground, a young plant with green leaves is growing, supported by a black stake. The ground is covered with dry pine needles and various green plants and grasses. In the background, a dense forest of tall, thin trees is visible. A black rectangular box with white text is overlaid on the image.

Where to go from here?



Full Experimental Design

		Wiregrass	
		-	+
31 species	-	-Wiregrass -31 species	+Wiregrass -31 species
	+	-Wiregrass +31 species	+Wiregrass +31 species



Acknowledgements

- US Forest Service - Savannah River
- University of Kansas
- Grand Valley State University
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