

# City of Austin Parks:

Assessing impacts of invasive plants on native plant species diversity using a Bayesian approach

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# Austin Invasive Management

2010

- City Council Resolution to develop Invasive Species Management Plan

2013

- City staff and 150 volunteers trained to collect baseline data on invasive species in parks and greenbelts

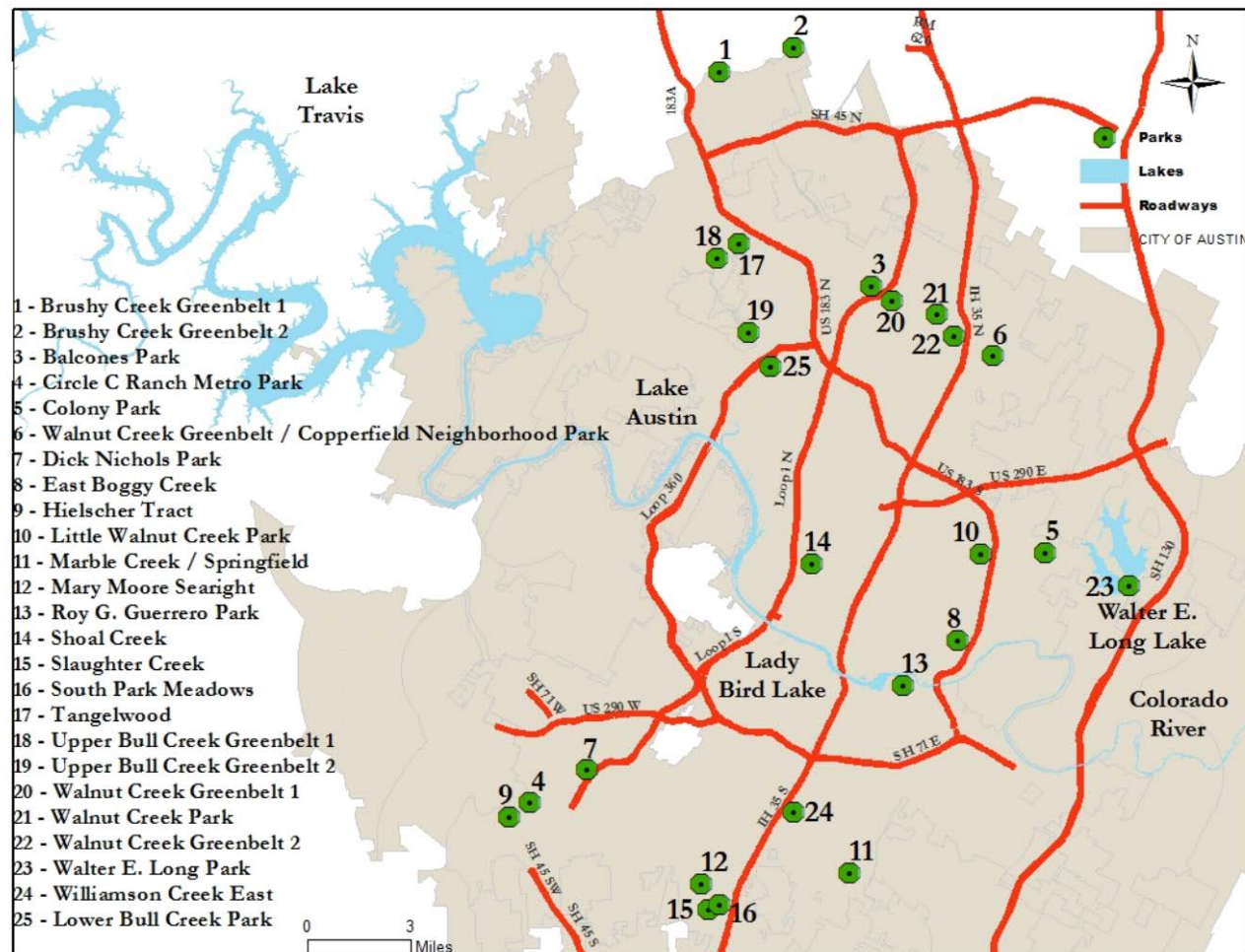
*...non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.  
National Invasive Species Council*

## Question:

- Is native species diversity affected by the presence of invasive species?



# Study sites

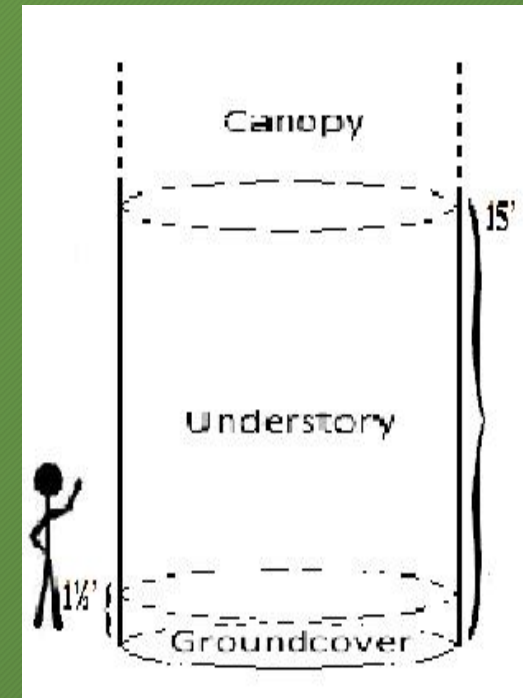


- 25 parks sampled
- cover a total of 1800 acres
- >2200 plots surveyed



# Study design

- Plots are circular with 5 meter radius
- Plots are randomly distributed in target areas
- Target plot number per park was 1.5 plots per acre
- Plots were classified as wooded, open or edge
- Within each plot, native species count and invasive species cover were assessed in three strata: Canopy, Understory & Groundcover



# Invasive Species Found

## 2013 Top 24 in Central Texas

### Trees

- Tree of Heaven
- Paper Mulberry
- Chinese Parasol Tree
- Large Leaf Privets
- Chinaberry
- Chinese Pistache
- Chinese Tallow

### Shrubs

- Heavenly Bamboo
- Scarlet Firethorn
- Salt Cedar

### Vines

- Japanese Honeysuckle
- Catclaw Vine
- Kudzu

### Herbs

- Malta Star Thistle
- Elephant Ear
- Japanese Hollyfern
- Bastard Cabbage

### Grasses

- Giant Cane
- King Ranch Bluestem
- Bermudagrass
- Golden Bamboo
- Johnsongrass

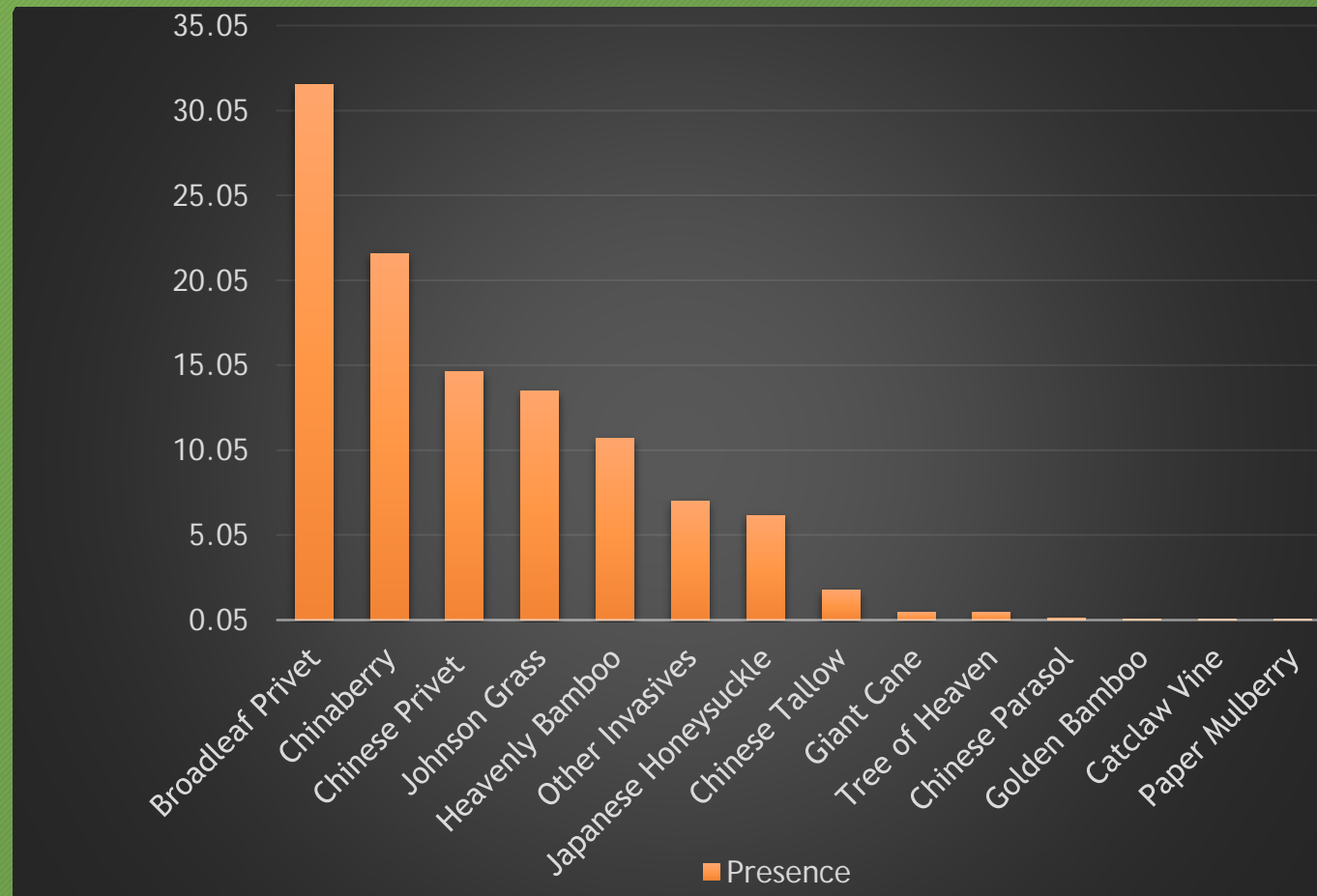
### Aquatic

- Common Water Hyacinth
- Hydrilla

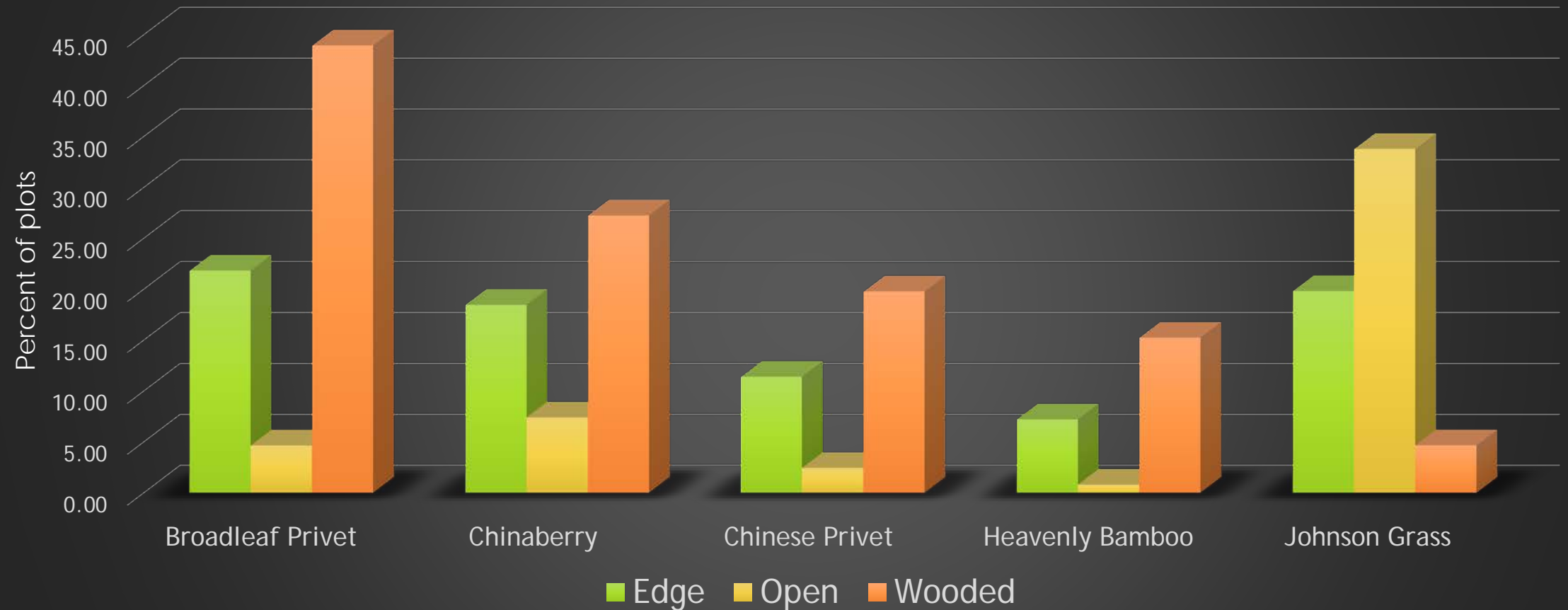


# Overall Invasive Species plot presence

Percent of all plots containing the species

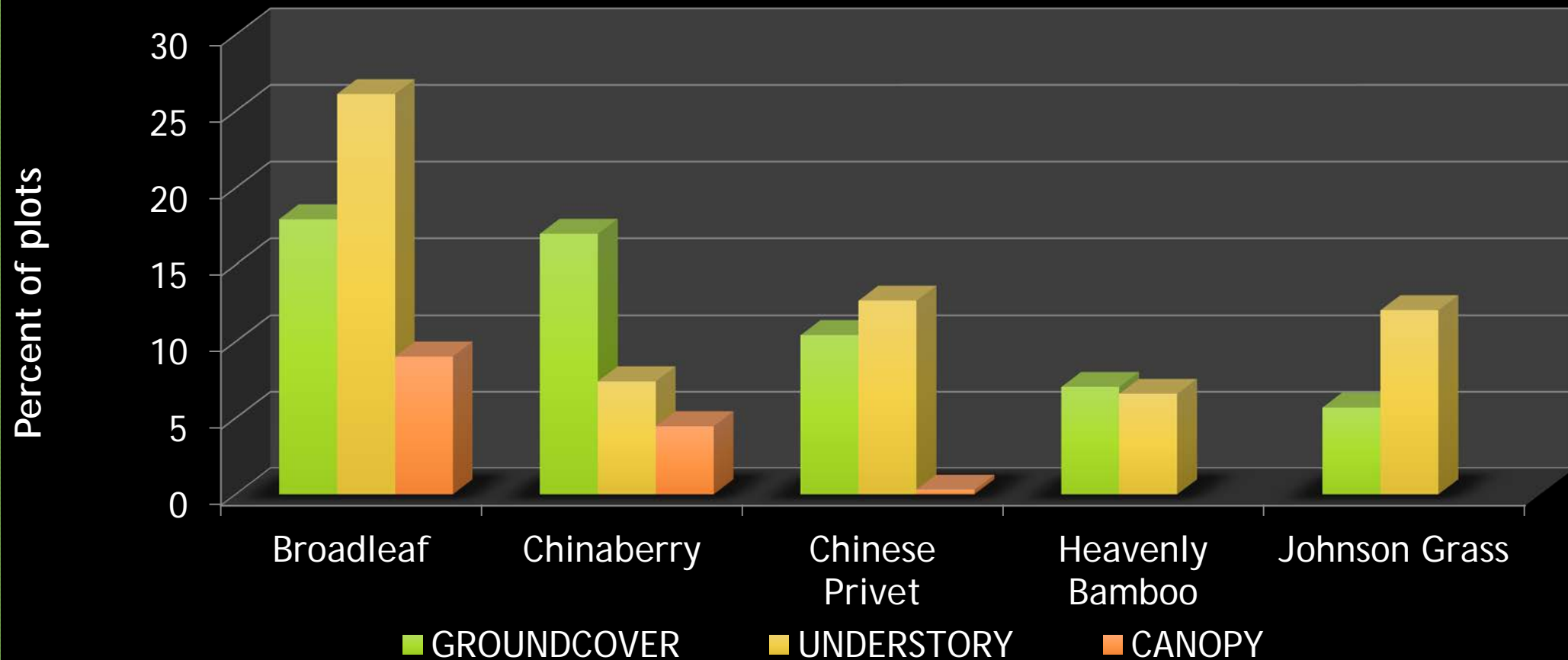


# Presence by habitats





# Presence by strata



# Why Bayesian Statistics?

- A more appropriate theoretical foundation for ecological sampling
  - “Statistical Analysis and the Illusion of Objectivity” by James Berger and Donald Berry in *American Scientist* (1988)
- Less uncertainty (esp. with smaller sample sizes)
  - Bayesian Credible Intervals are generally smaller than Frequentists Confidence Intervals
- Flexibility in models used
  - Non-Linear Models (which seem prevalent in ecology) present problems in frequentist statistics (existence and uniqueness of solution). However, these models can easily be run with Bayesian computer programs (i.e. OpenBUGS)



# Is native species diversity affected by the presence of invasive species?

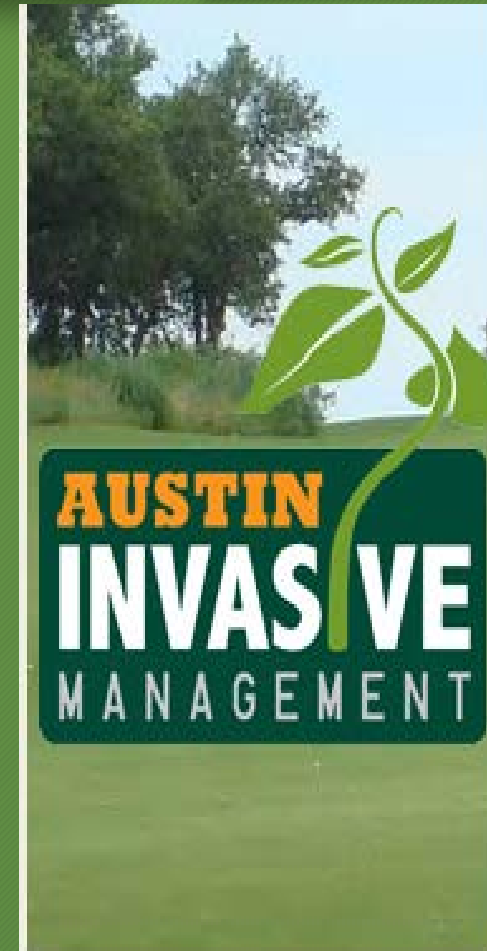
Focus on wooded habitats and below canopy level

The goal was to estimate a Poisson mean and the distribution for the number of native species that would be found per park

A Bayesian modeling framework was used to generate the distribution of the mean

Model 1:

- Obtain a mean and a 95% credible interval for the mean count of native species per park in the understory
- Obtain a mean and a 95% credible interval for the mean count of native species per park in the groundcover





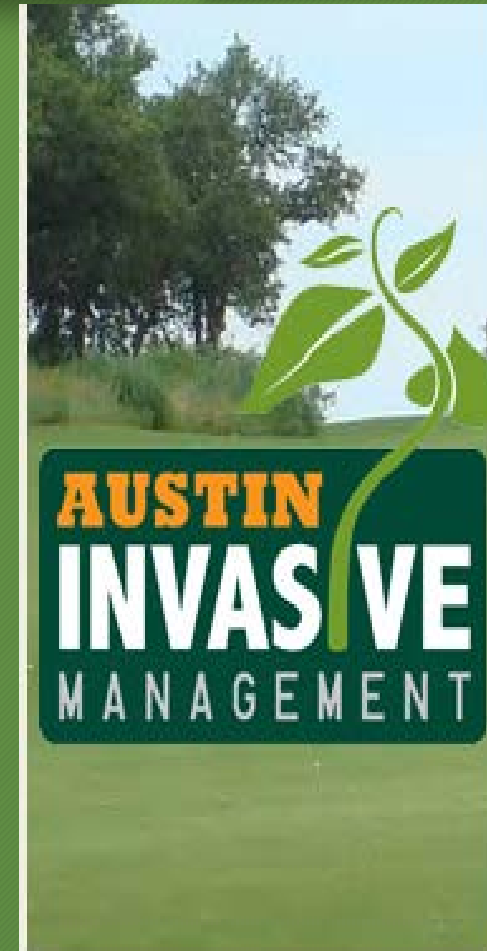
# Bayesian Analysis :Wooded Habitats

## Model 2:

- Estimate the effect of percent cover of invasive species in the understory on the mean count of natives in the understory
- Estimate the effect of percent cover of invasive species in the groundcover on the mean count of natives in the groundcover

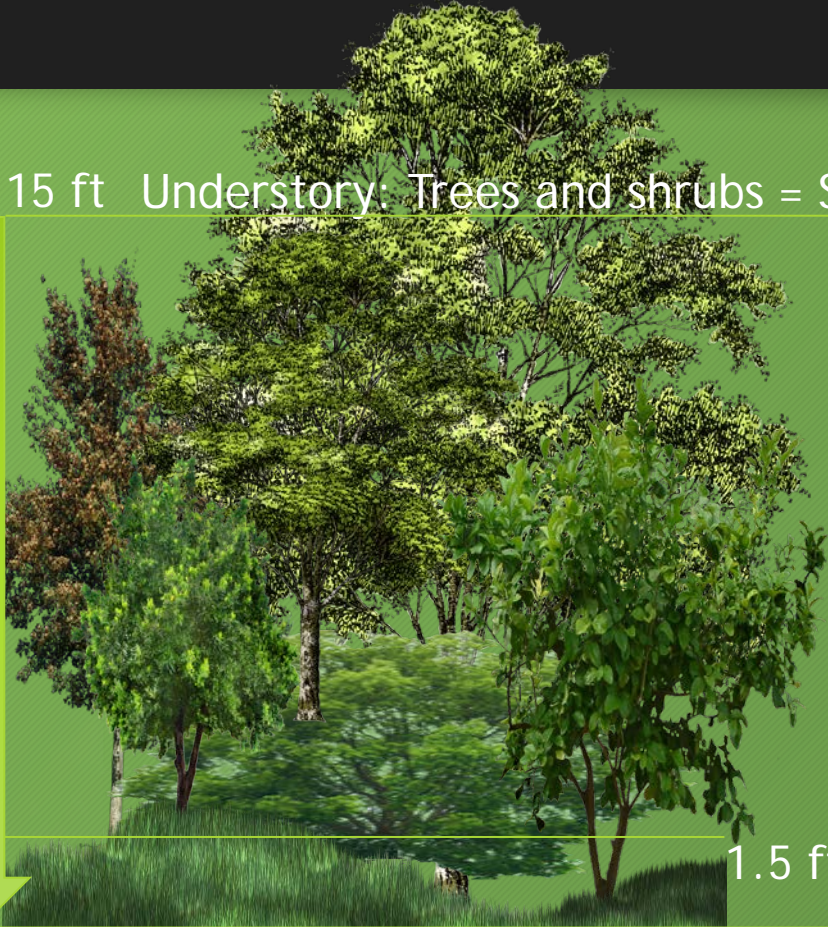
## Model 3:

- Estimate the effect of percent cover of invasive species in the understory on the mean count of natives in the groundcover



# Vertical Plant Community

15 ft Understory: Trees and shrubs = Saplings



1.5 ft

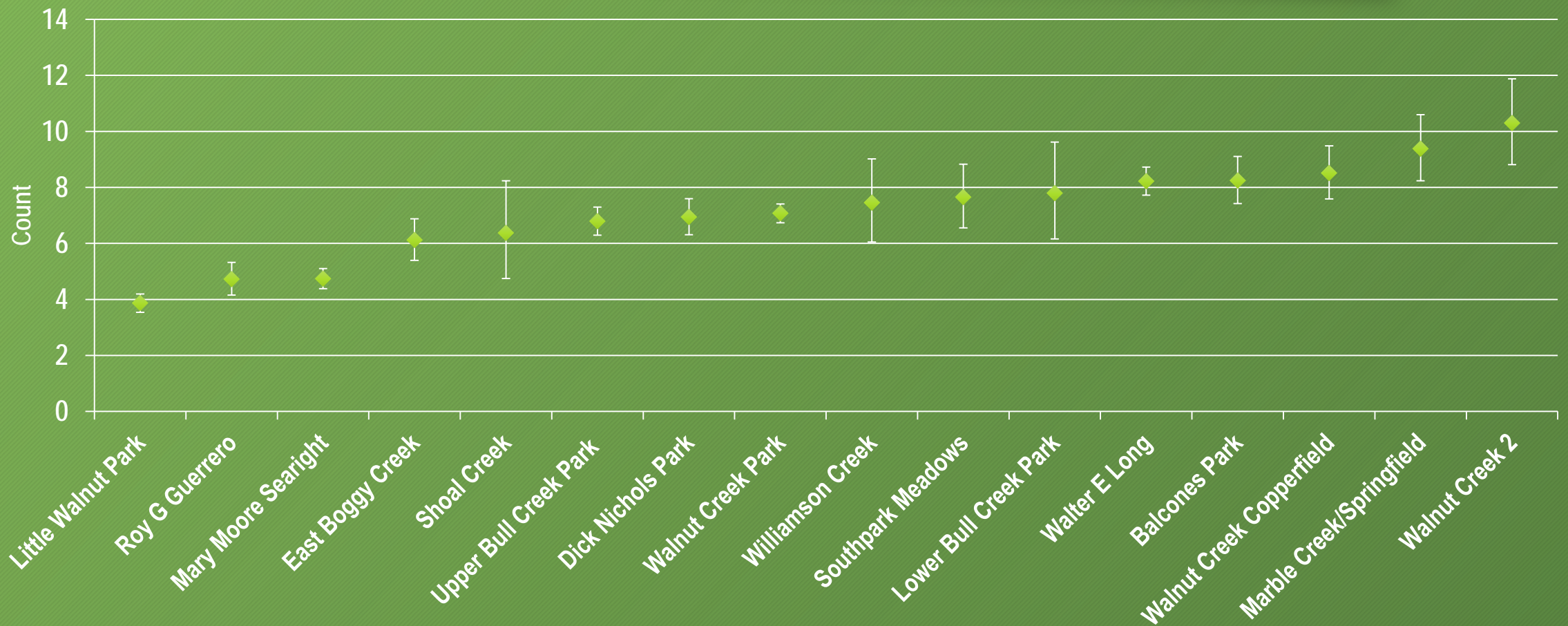
Groundcover: Herbaceous grasses, shrubs, vines, flowers = Seedlings

1.5 ft



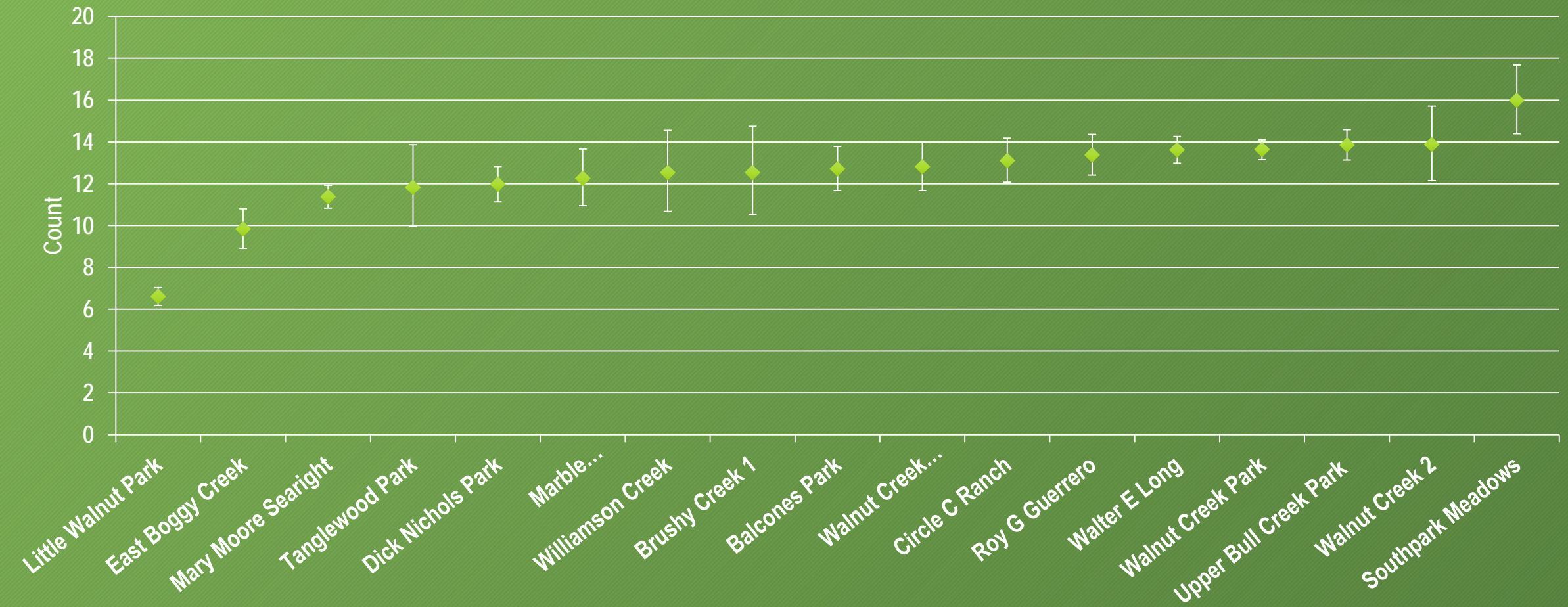


# Model 1: Estimated Mean Count of Native Species/Plot in Understory by Park

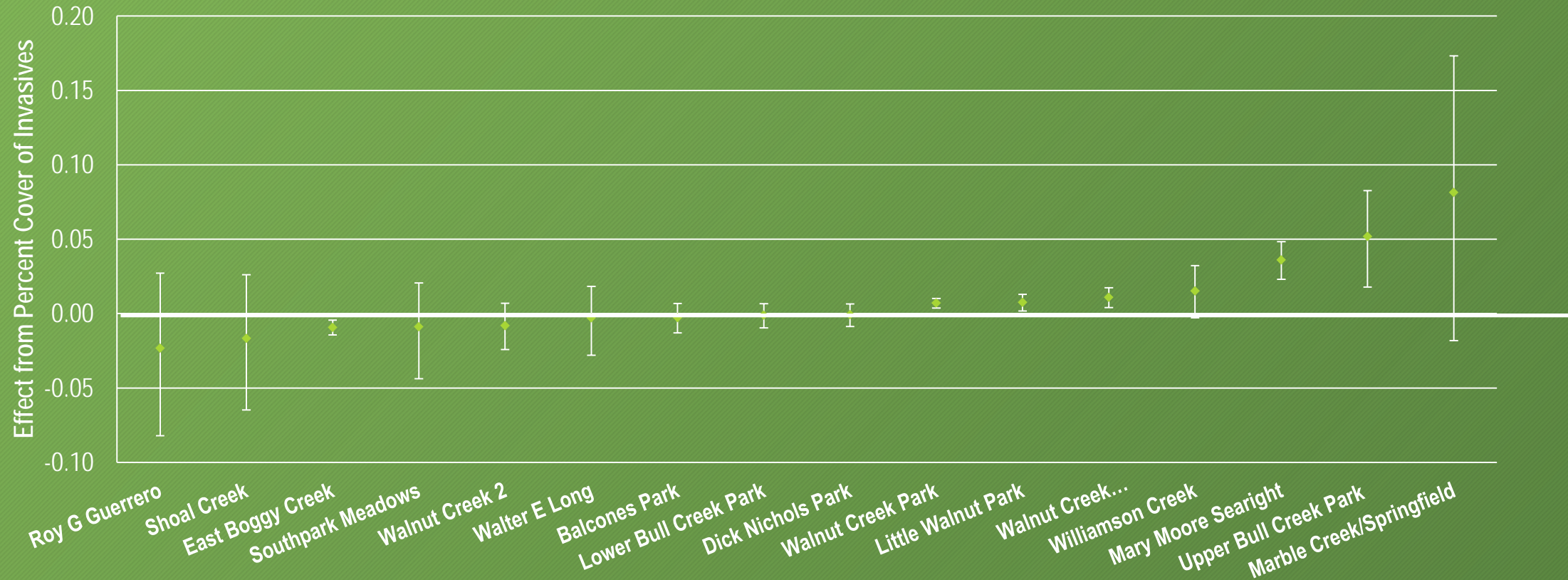




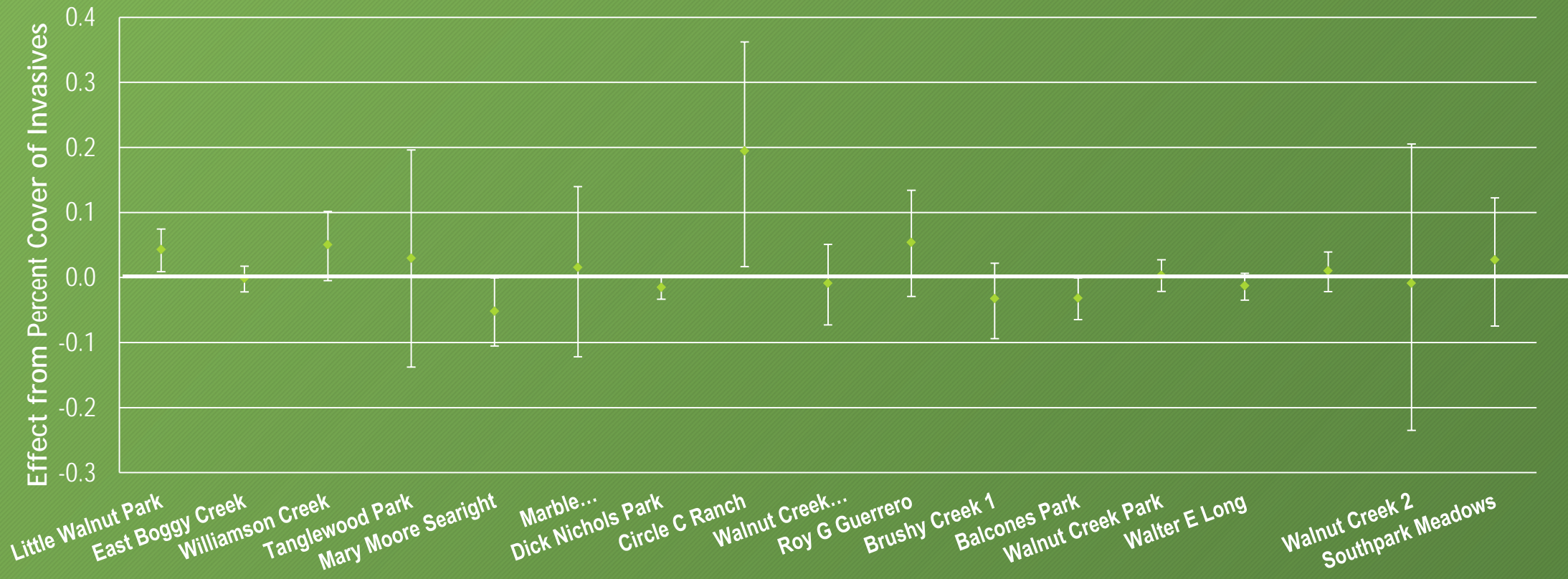
# Model 1: Estimated Mean Count of Native Species/Plot in Groundcover by Park



## Model 2: The estimated impact of percent cover of Understory Invasive Species on Native Species in the Understory

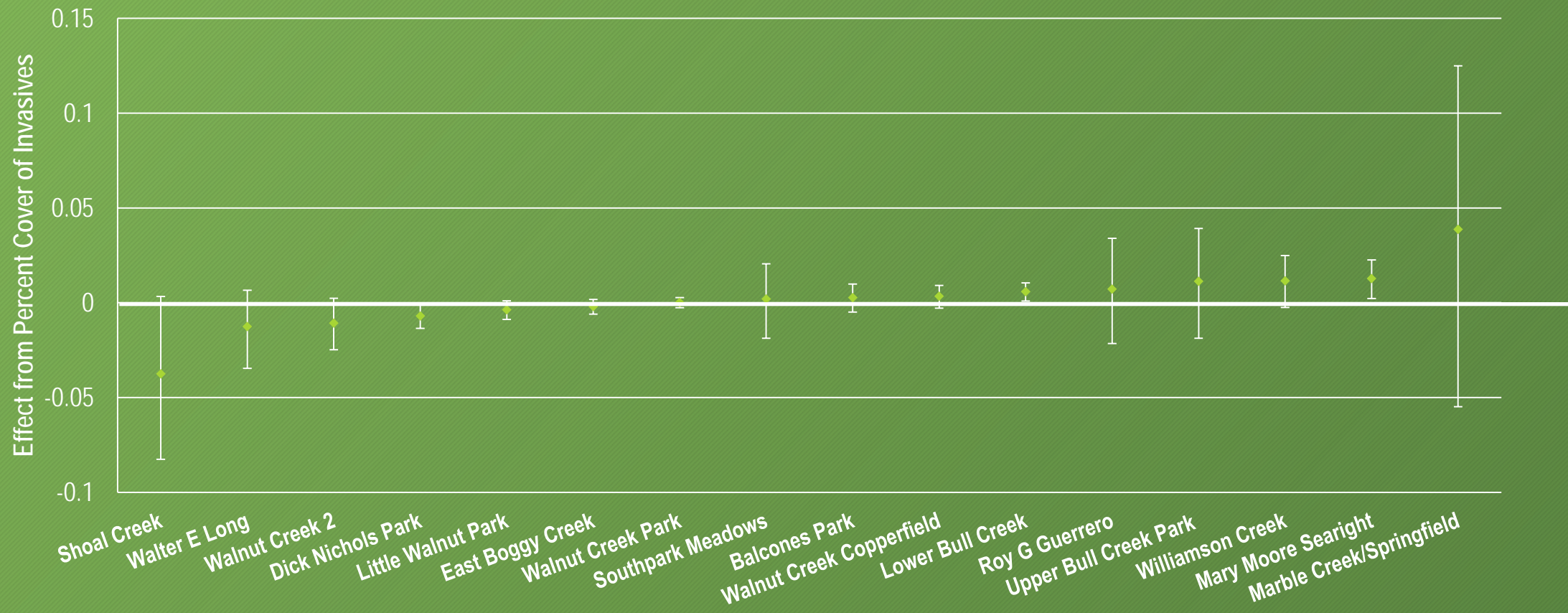


## Model 2: The estimated impact of percent cover of Groundcover Invasive species on Native Species in the Groundcover





# Model 3: The estimated impact of percent cover of Understory Invasive Species on Native Species in the Groundcover



# Summary

The top 5 invasive species found were: Broadleaf privet, chinaberry, Chinese privet, heavenly bamboo and Johnson grass. Broadleaf privet is the main invasive species detected.

Two parks have lower native species diversity compared to other parks, Little Walnut Park and East Boggy Creek. Walnut Creek Greenbelt 2 and Southpark Meadows highest native species diversity.

Only East Boggy Creek has evidence for a negative impact on natives from percent cover of invasive species.

However the study design did not lend itself to the detection of impacts potentially because of the diversity of the parks and different habitat types.

Future studies should focus on only broadleaf privet in parks with a high percent cover to understand the impacts to native species.



# Questions?

