

Changes in Insect Pollinator Phenology Across an Urban Gradient in Florida

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Table of Contents

Background

Methods

Preliminary Results

Conclusions

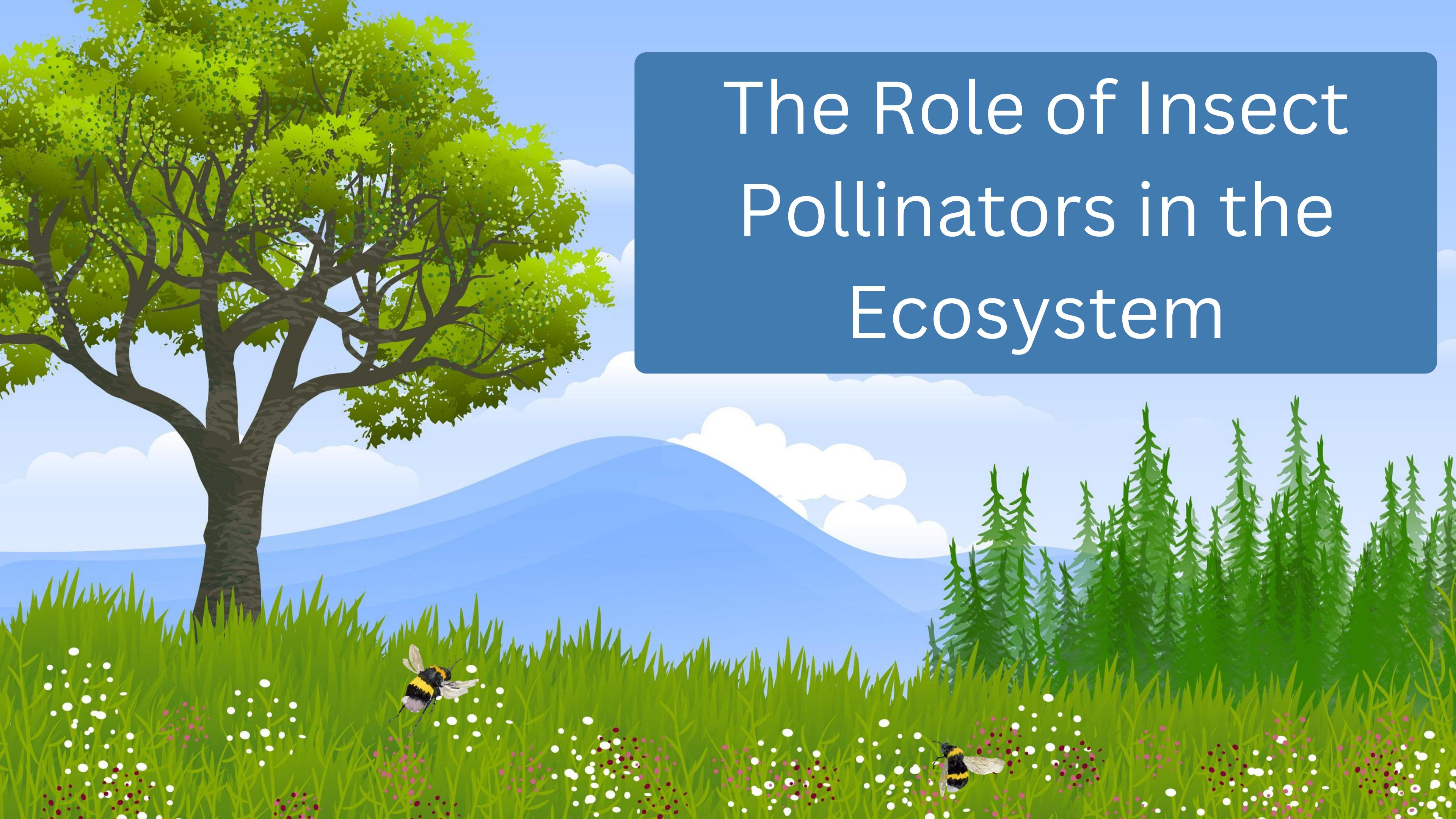
Table of Contents

Background

Methods

Preliminary Results

Conclusions



The Role of Insect Pollinators in the Ecosystem



Tilling and Aerating Soil



A close-up photograph of a dark-colored dung beetle, likely a Dung Beetle, rolling a large, dark, spherical ball of dung across a sandy, gravelly surface. The beetle is positioned on the left side of the frame, facing towards the right. The background consists of small, light-colored pebbles and sand. A solid brown rectangular overlay covers the upper right portion of the image, containing white text.

Aiding in
Decomposition

A close-up photograph of a bird, likely a sunbird, feeding its chick. The adult bird is on the left, captured in mid-flight with its wings spread wide. It has a vibrant orange-red cap and a greyish body. Its long, thin beak is extended towards the right, where a young chick is perched on a branch. The chick has a light brown head and a yellowish beak, which is open as if it's being fed. A small green fly is caught in the adult bird's beak, just above the chick's head. The background is a soft-focus green, suggesting a natural, outdoor setting.

Abundant Food Source

Pollination





Food and Agriculture Organization of the United Nations



“About two thirds of the crop plants that feed the world, plus many plant-derived medicines in our pharmacies, rely on pollination by insects or other animals to produce healthy fruits and seeds. Of the slightly more than 100 crop species that provide 90 percent of national per capita food supplies for 146 countries, 71 species are bee-pollinated (but relatively few by honeybees), and several others are pollinated by thrips, wasps, flies, beetles, moths and other insects.”

– FAO. (2004). Conservation and management of pollinators for sustainable agriculture—The international response.

Urban Factors Have Been Linked to Insect Pollinator Declines

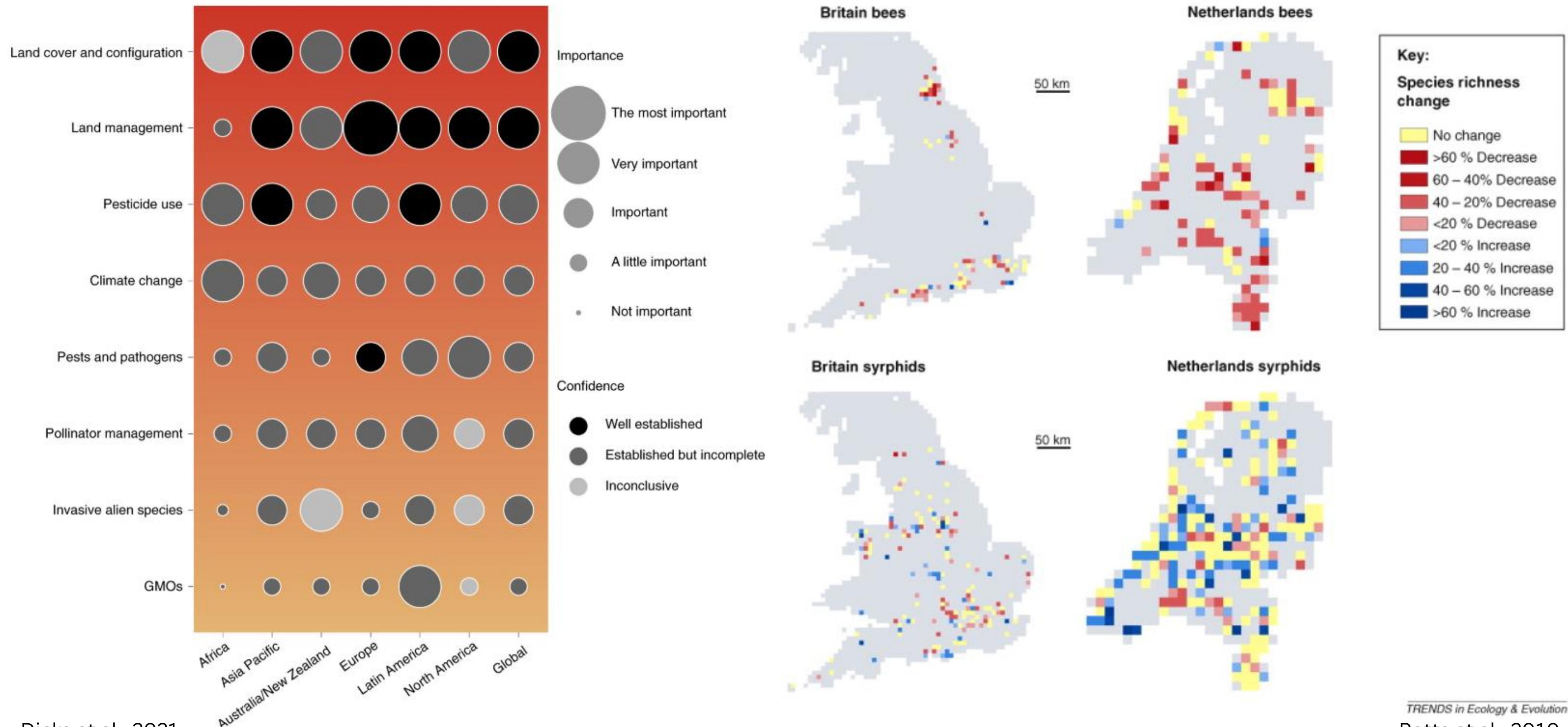
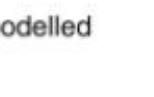


Fig. 3: Environmental drivers of insect OTU richness in rural and urban ecosystems.



Urbanization can have negative, positive, neutral, or mixed effects on pollination (Silva et al., 2023)

Insect taxa	Ecosystem	Spatial scale of response to habitat	Environmental drivers	Directionality of effect
Diptera	Rural		Local flower richness	↑
	Urban		Edge density Residential cover	↑ ↑
Lepidoptera	Rural		Local flower richness	↑
	Urban		Not modelled	
Coleoptera	Rural		Local flower richness Habitat diversity	↑ ↑
	Urban		Habitat diversity	↑
Hymenoptera	Rural		Edge density Proportion of arable land	↑ ↓
	Urban		Edge density	↑
Bees (Anthophila)	Rural		Edge density Proportion of arable land	↑ ↓
	Urban		Edge density	↑

While the richness and abundance of Hymenopterans and generalist pollinators increases in cities, the opposite is true for Dipterans, Lepidopterans, and specialist pollinators (Theodorou et al., 2020)





Fig. 3: Environmental drivers of insect OTU richness in rural and urban ecosystems.

Insect taxa	Ecosystem	Spatial scale of response to habitat	Environmental drivers	Directionality of effect
Diptera	Rural	250 m	Local flower richness	↑
	Urban	250 m	Edge density Residential cover	↑ ↑
Lepidoptera	Rural	250 m	Local flower richness	↑
	Urban	Not modelled	Not modelled	
Coleoptera	Rural	1000 m	Local flower richness Habitat diversity	↑ ↑
	Urban	1000 m	Habitat diversity	↑
Hymenoptera	Rural	1000 m	Edge density Proportion of arable land	↑ ↓
	Urban	1000 m	Edge density	↑
Bees (Anthophila)	Rural	1000 m	Edge density Proportion of arable land	↑ ↓
	Urban	1000 m	Edge density	↑

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Most urban pollinator studies are conducted in temperate cities of Europe and North America (Silva et al., 2021)





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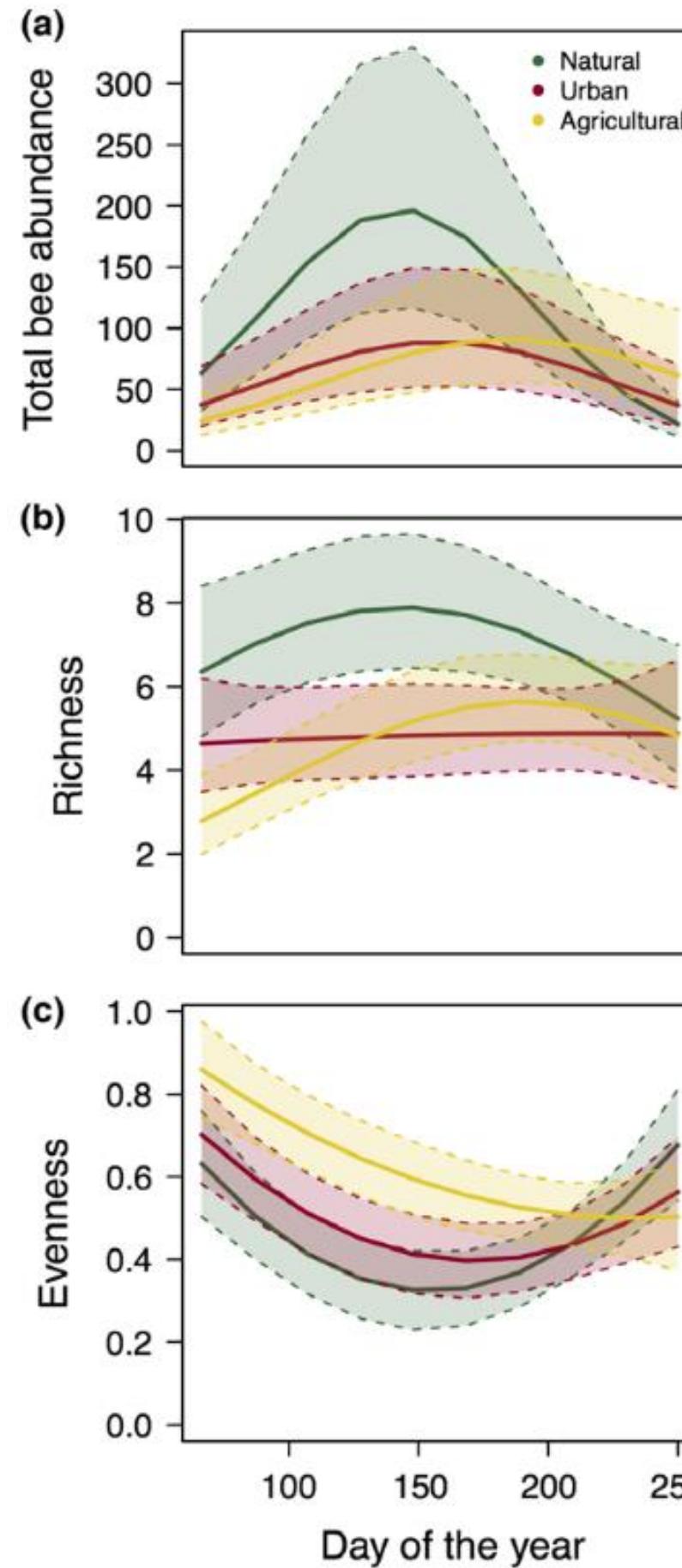
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While the richness and abundance of Hymenopterans and generalist pollinators increases in cities, the opposite is true for Dipterans, Lepidopterans, and specialist pollinators (Theodorou et al., 2020)

By 2050, more than two-thirds of the world's population is expected to live in cities (Gerten et al., 2019)

Most urban pollinator studies are conducted in temperate cities of Europe and North America (Silva et al., 2021)





Leong et al., 2016

Some studies suggest that urbanization can shift pollinator phenology – in this case, flight period. These studies, however, are mostly focused on bees and small in spatial scale.

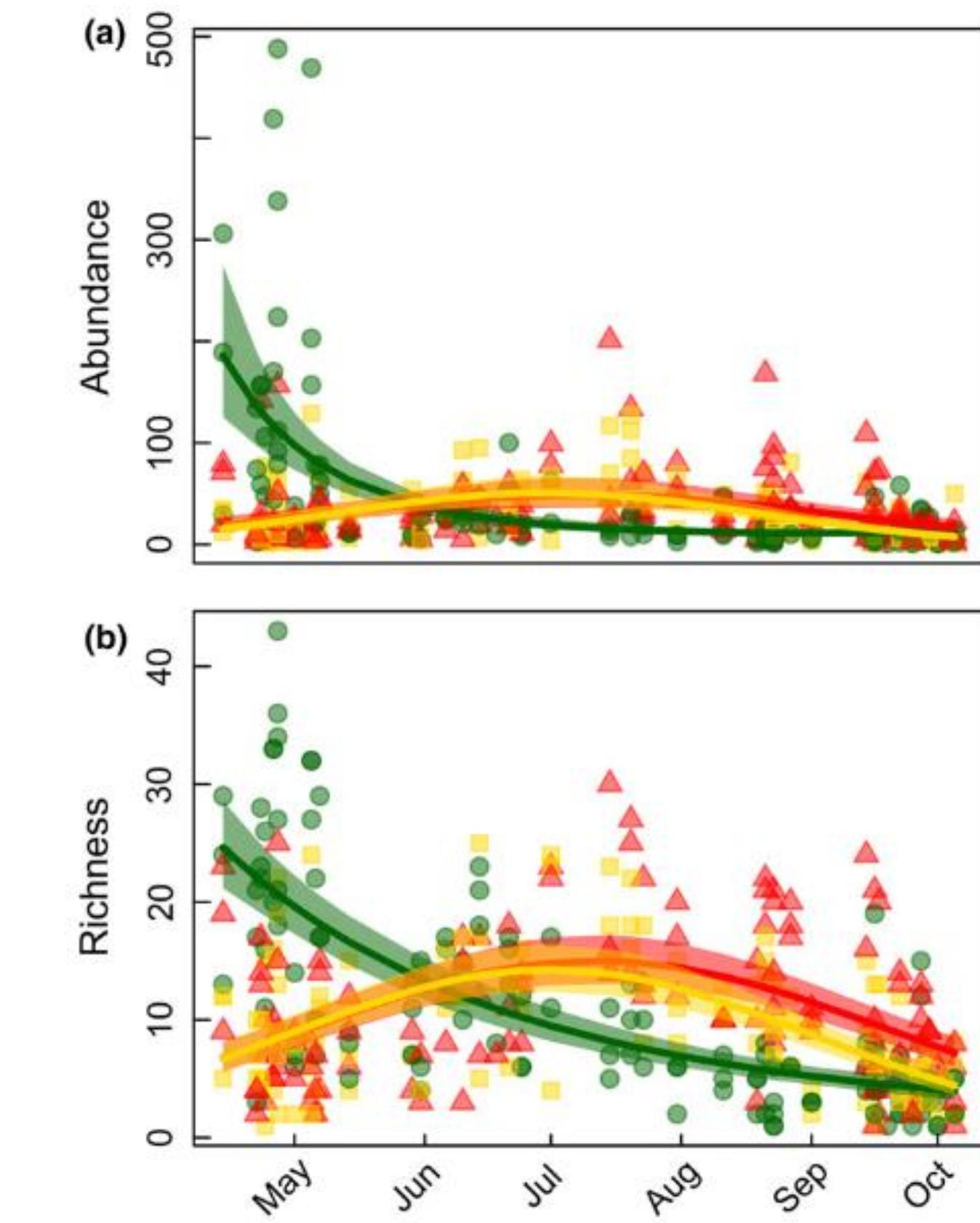
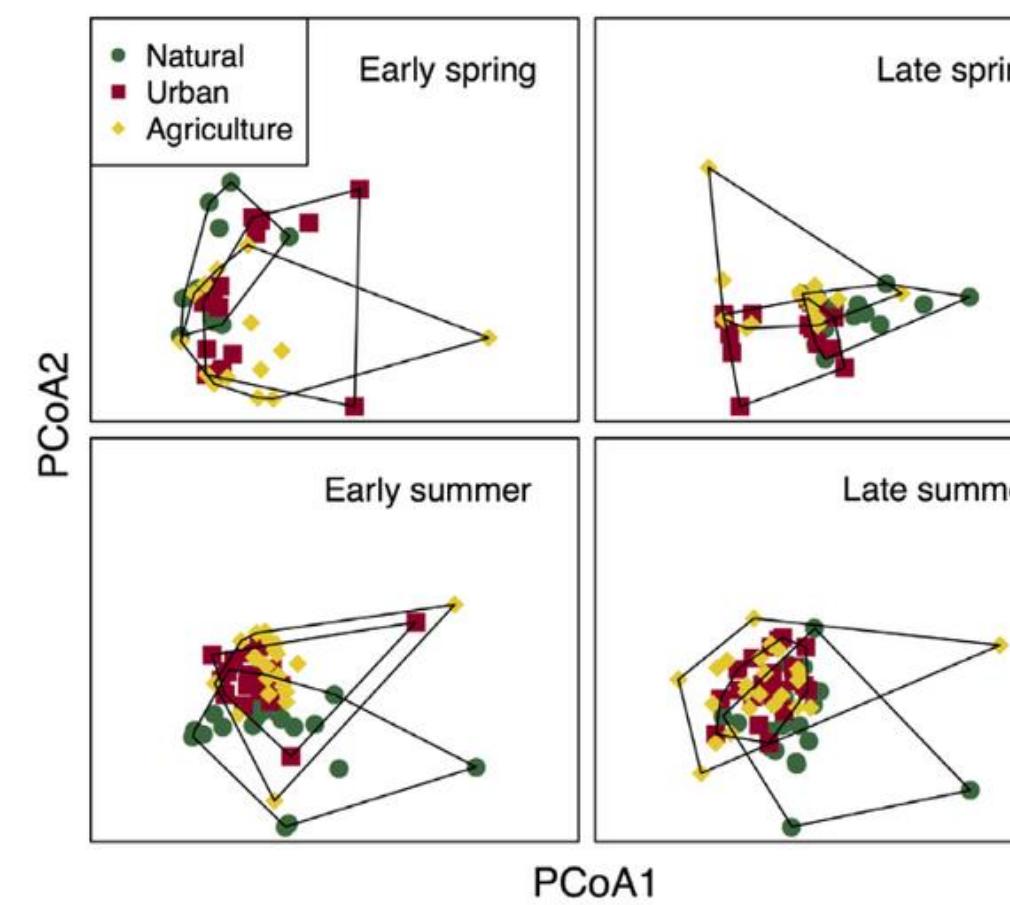
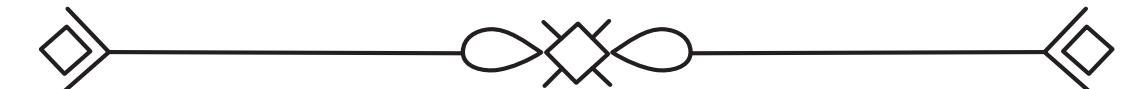


FIGURE 1 Abundance (a) and species richness (b) of bees change throughout the season differently within forest sites (green circles) vs. within agriculture and urban sites (yellow squares and red triangles). Each point represents one site visit ($N = 36$ sites visited 11 times). Fitted model curves are surrounded by calculated 95% CI

Harrison et al., 2018

Missing from the Studies:



- An overview of the phenology of many insect pollinator species in urban and non-urban areas-- not just bees-- using a large data set
- Use of citizen science data to assess flight period
- Assessment of how these patterns may change not just in urban areas, but along latitudinal/longitudinal scales

What We Would Like to Know:



- Will these same patterns emerge over a larger geographic scale and with a larger dataset?
- Will there be variation by taxonomic groups?
- Will there be variation along latitudinal and longitudinal gradients?

Table of Contents

Background

Methods

Preliminary Results

Conclusions

Research Objective:



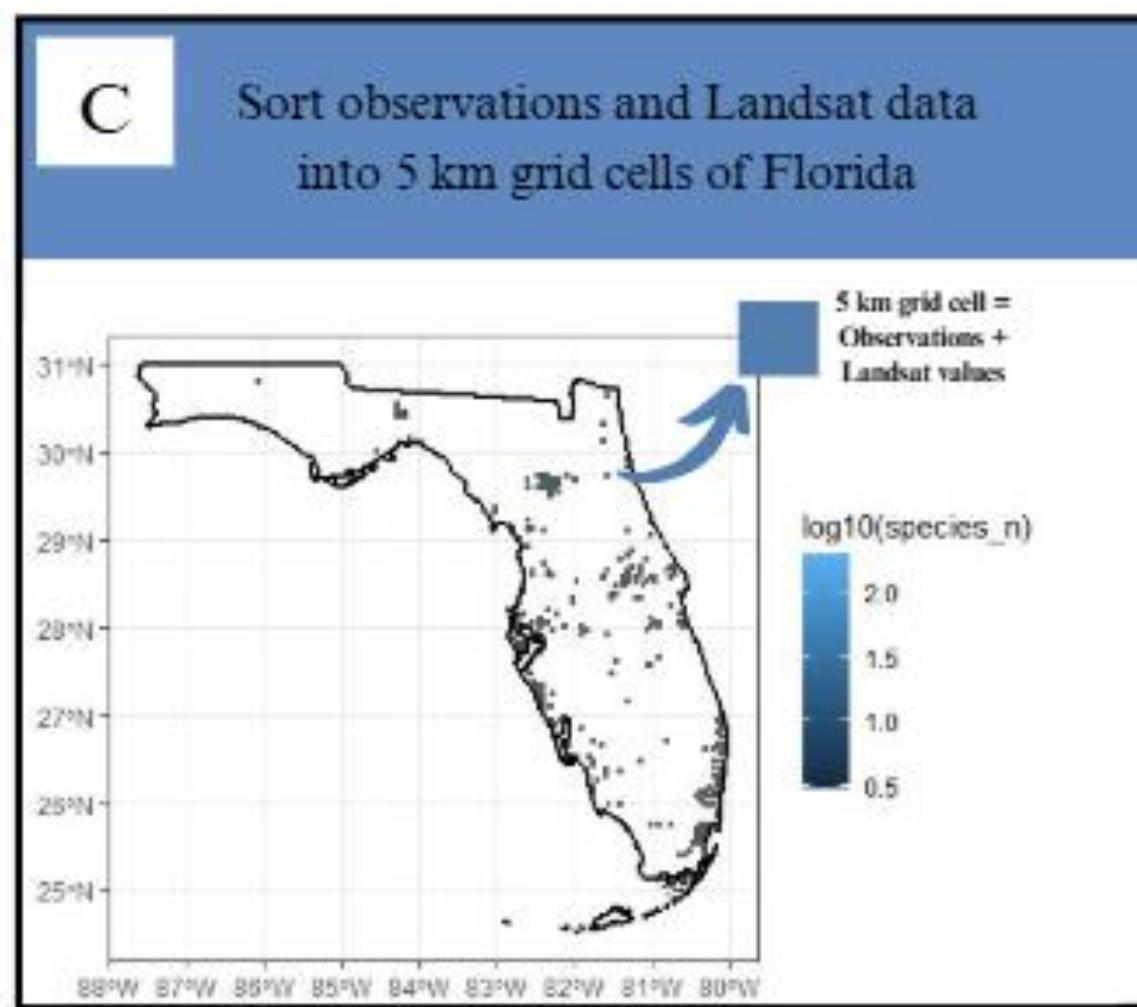
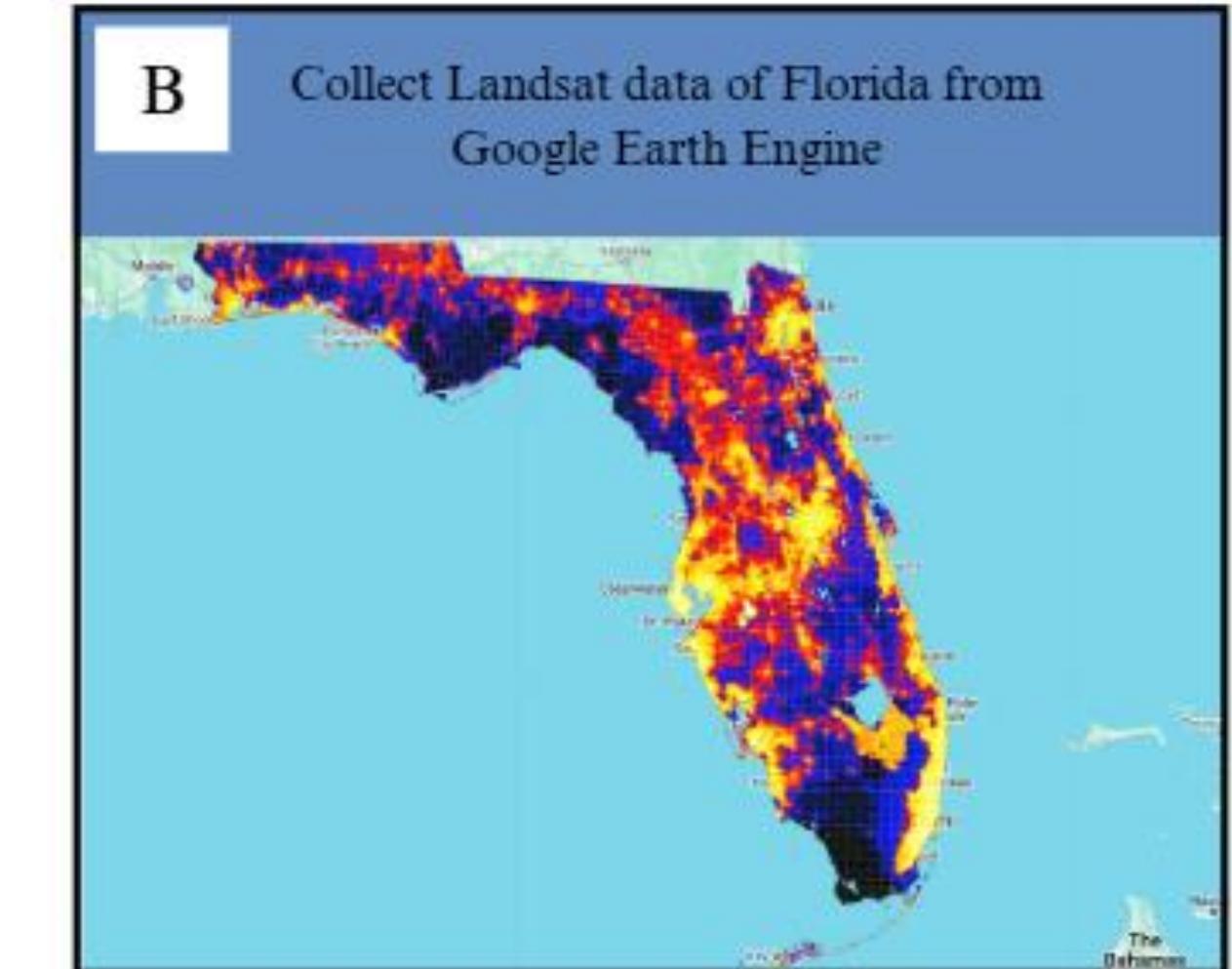
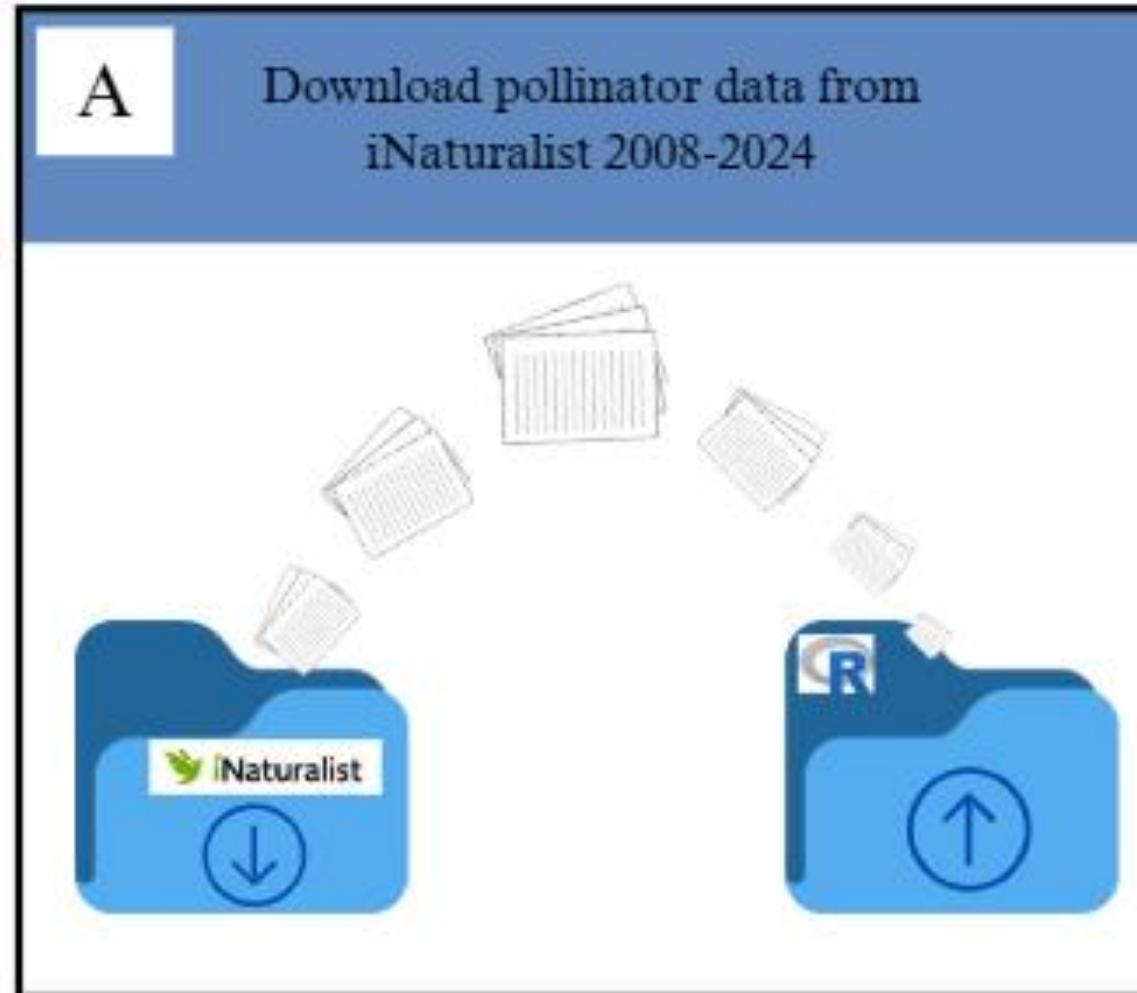
To assess pollinator phenology as a function of urbanization across spatial and taxonomic scales.

Hypotheses:



- A) Urbanization will be a significant predictor of pollinator phenology.
- B) The pollinator phenological response to urbanization will vary by taxonomic group, functional group, and along latitudinal/longitudinal gradients.

Methodology Work Flow

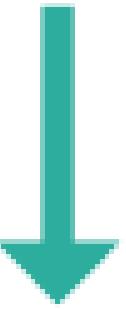


- D Filter Data
- ✓ Research Grade
 - 10 observations per grid
 - 3 species per grid

E

Utilize the phenesse R package to obtain phenological estimates

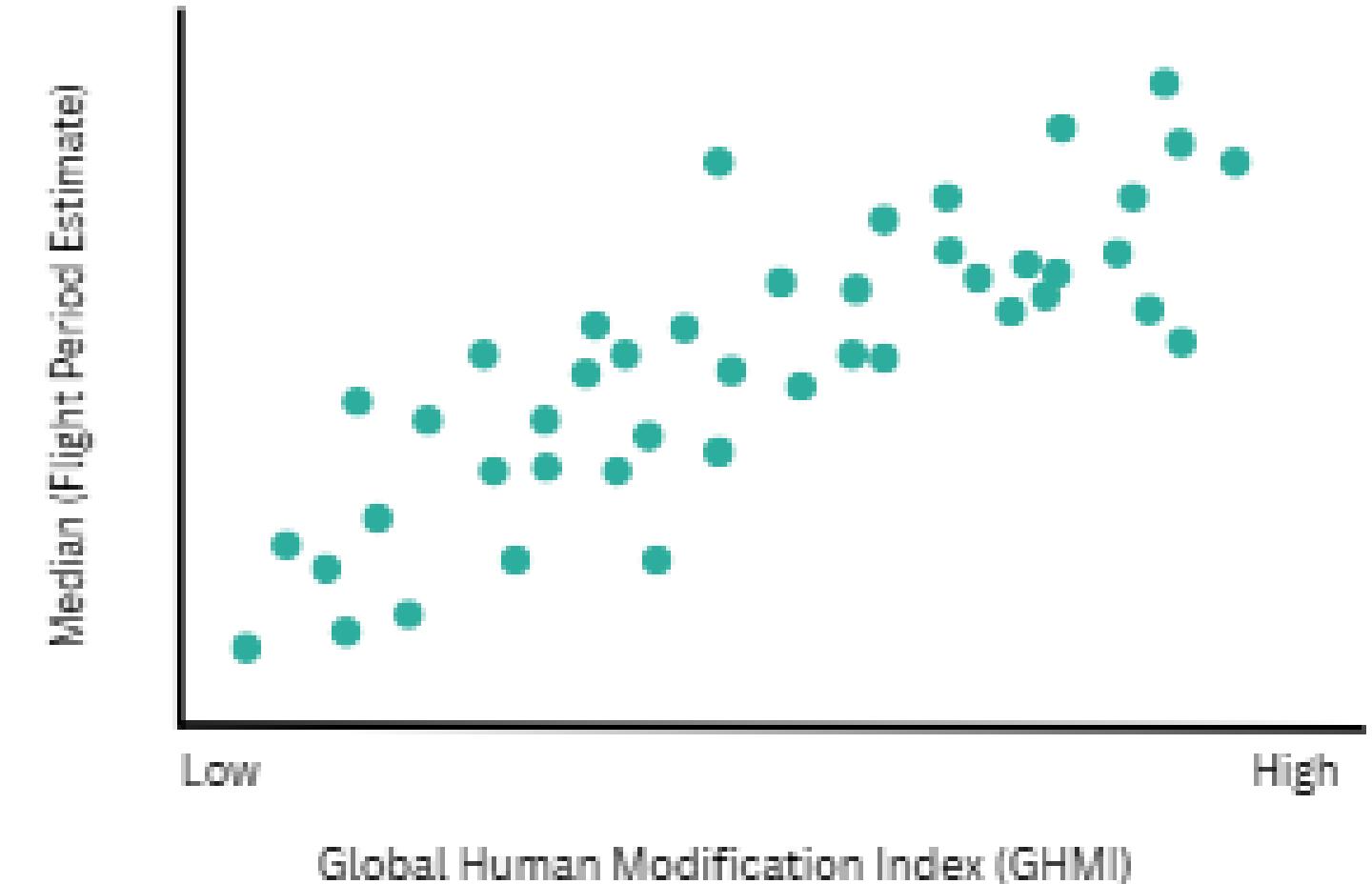
Flight Period



Onset Median Offset Total Duration

F

Utilize statistical analyses to assess phenology across urban/geographic gradients



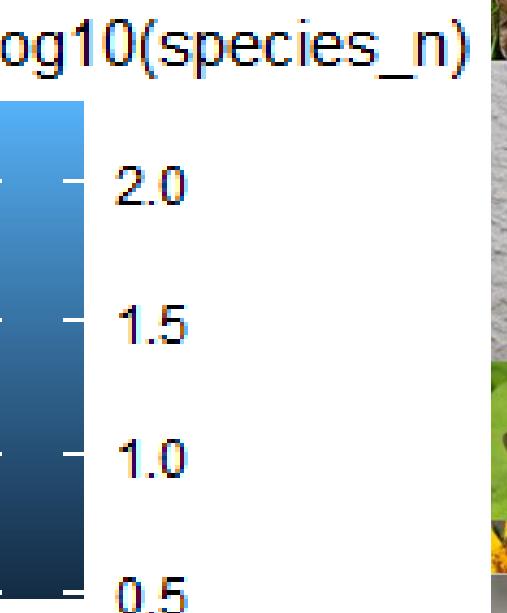
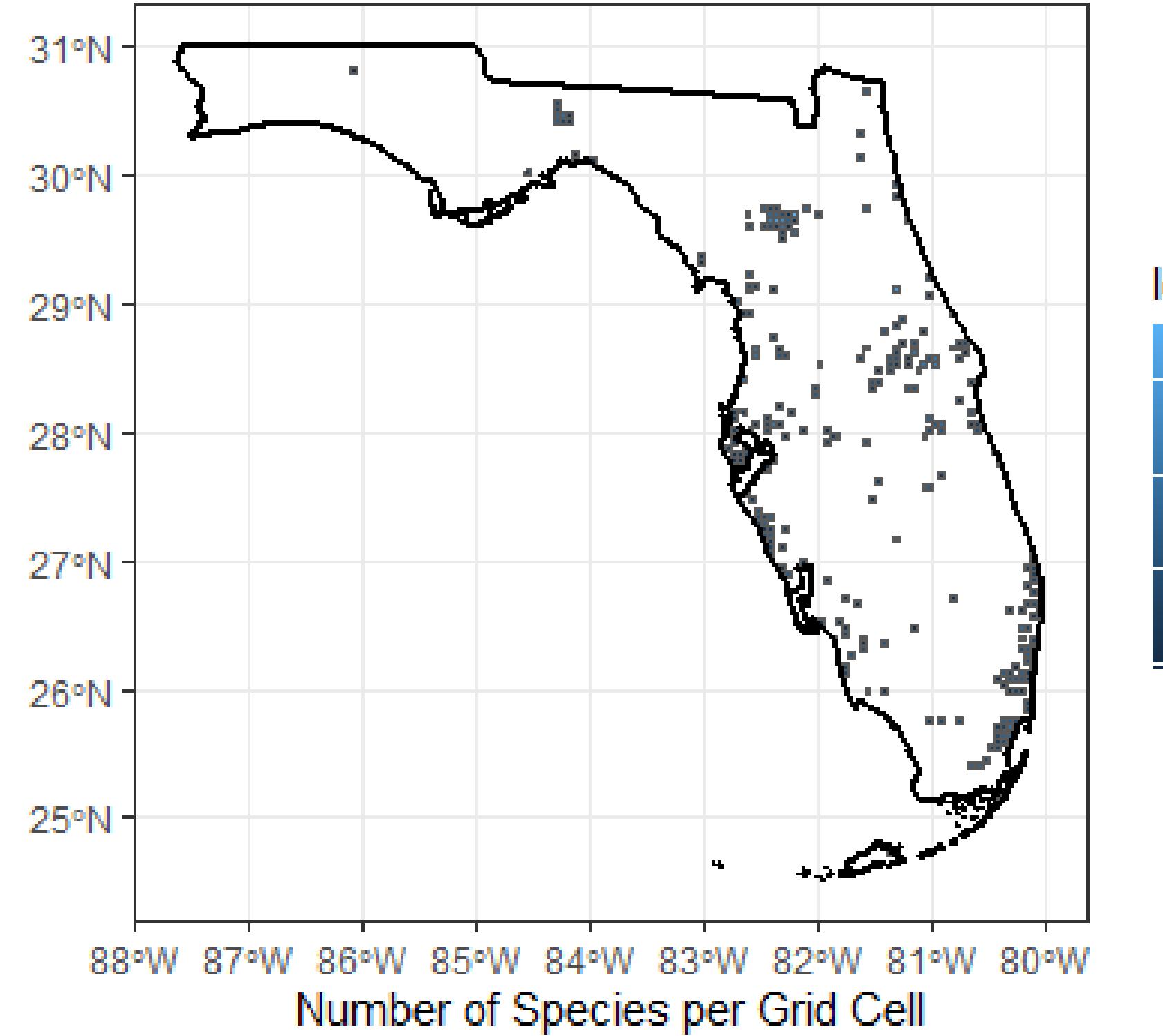


Table of Contents

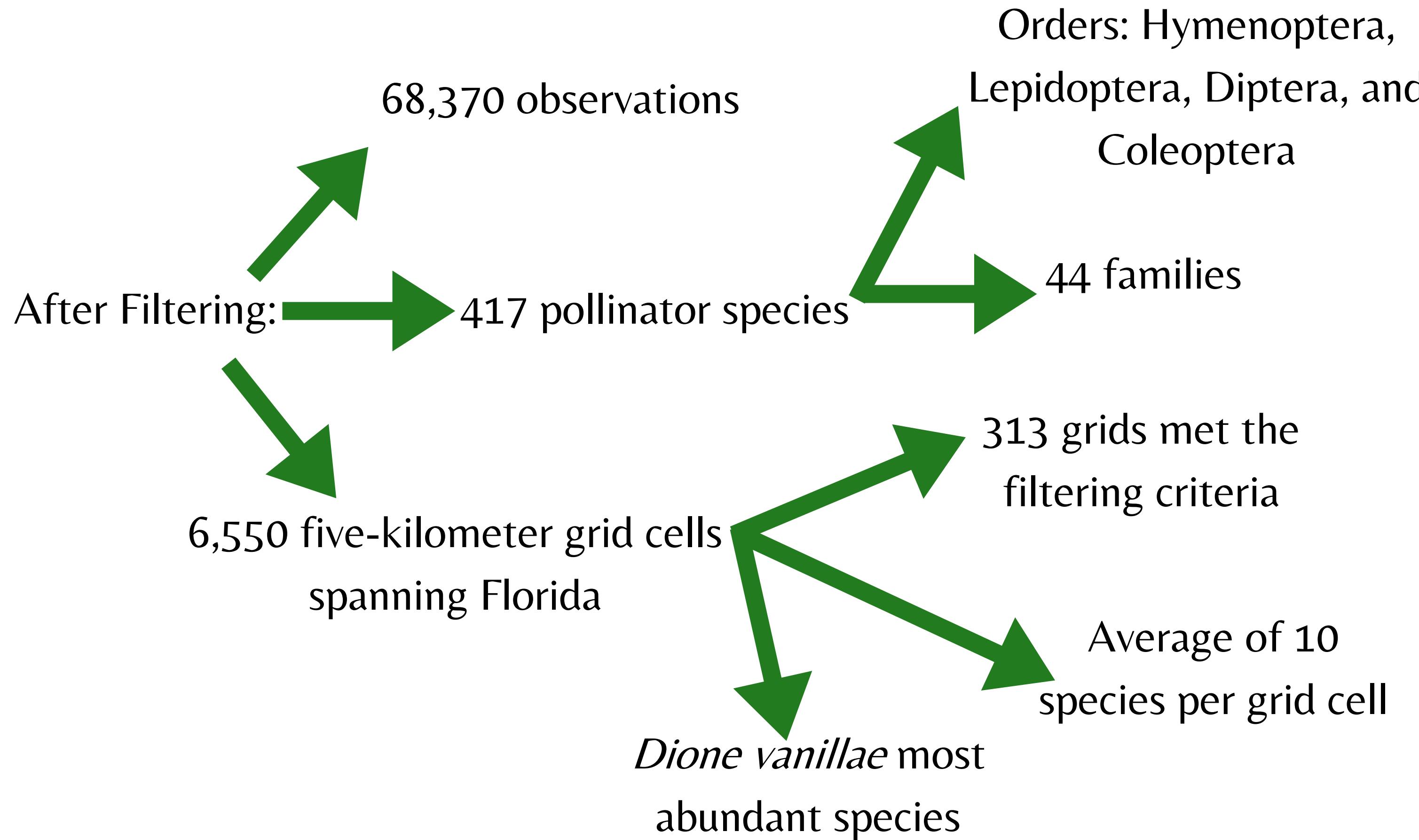
Background

Methods

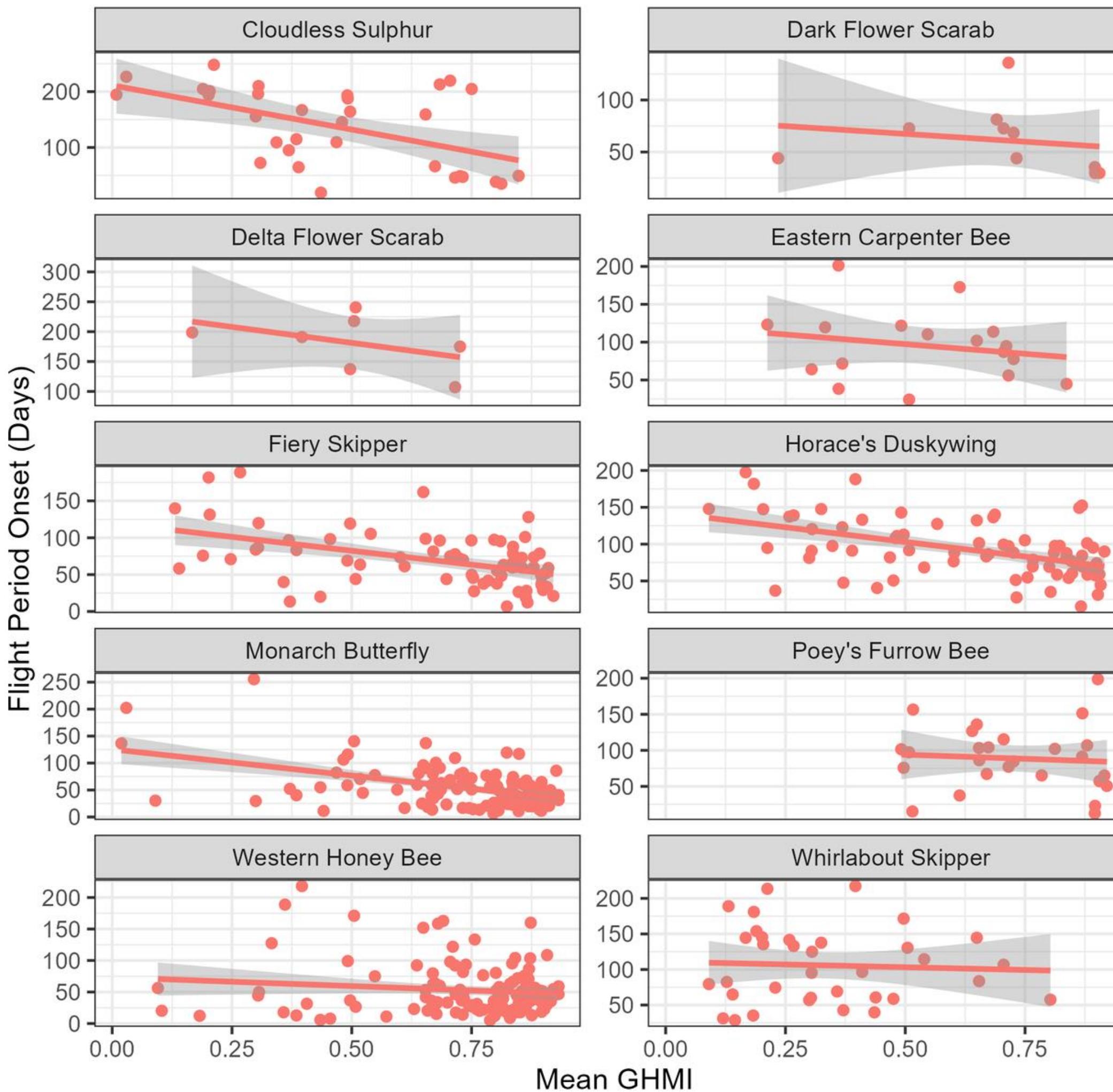
Preliminary Results

Conclusions

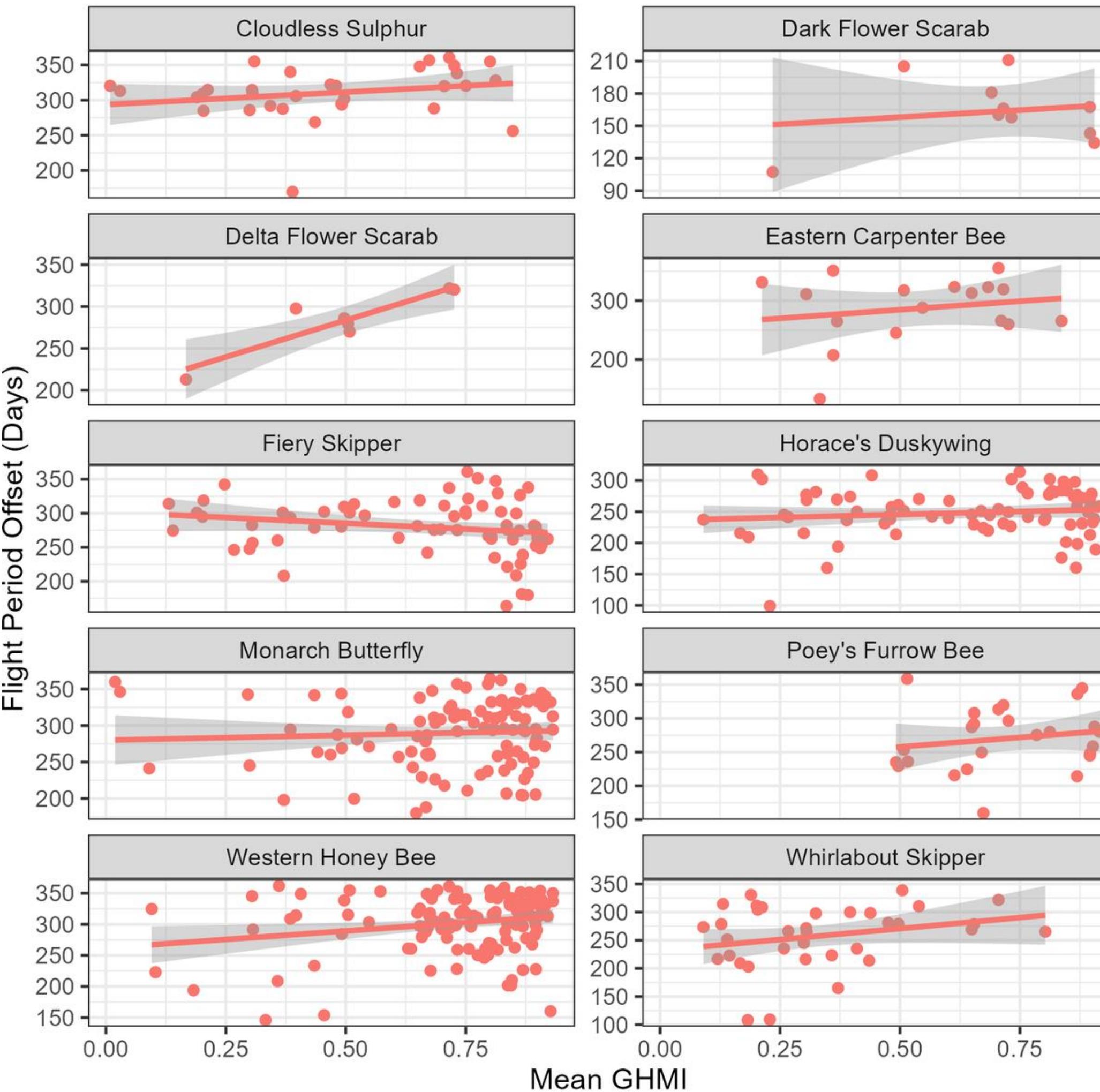
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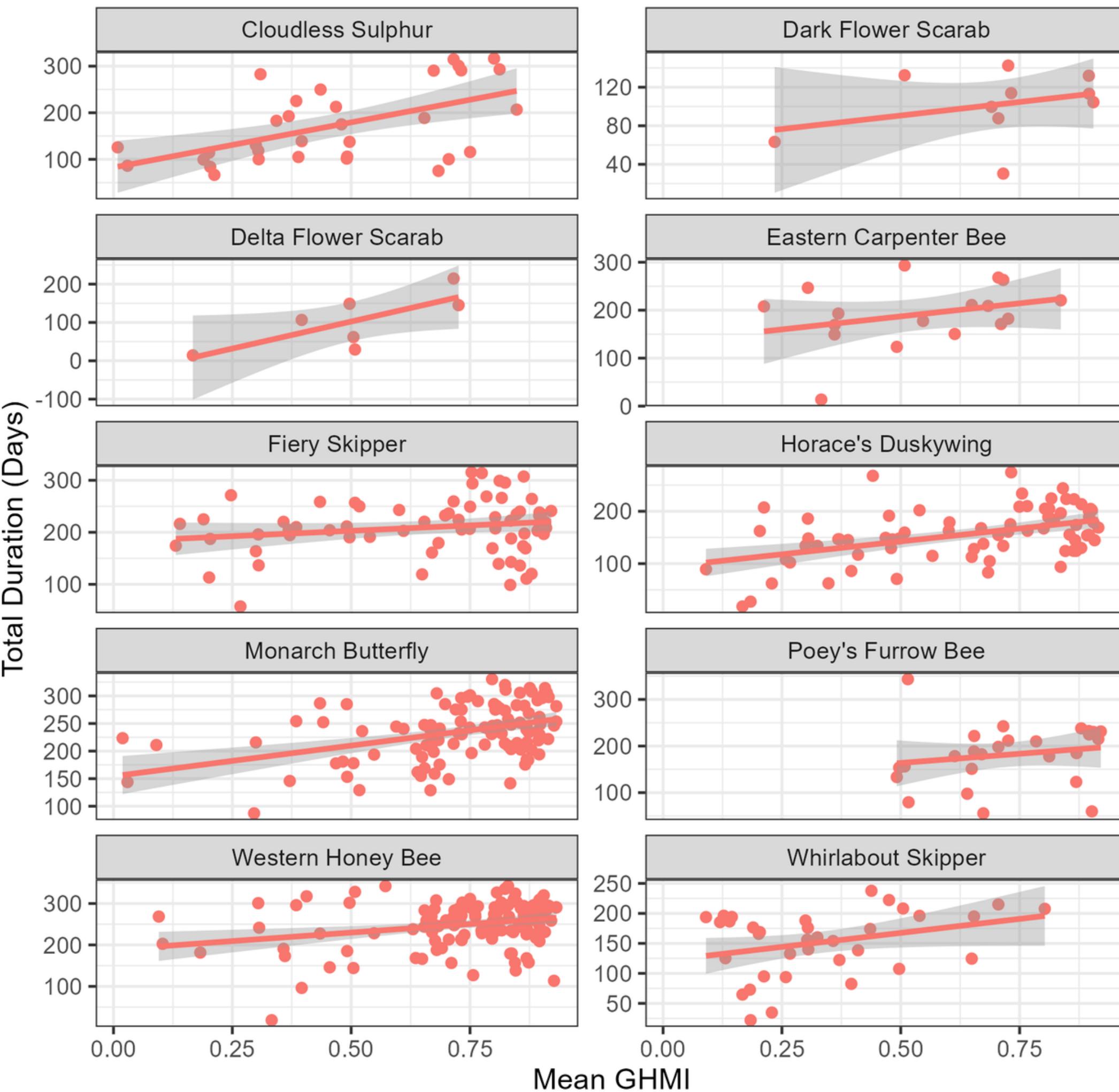
Onset of Flight Period of 10 Species in Low Versus High GHMI Areas



Offset of Flight Period of 10 Species in Low Versus High GHMI Areas



Total Duration of Flight Period of 10 Species in Low Versus High GHMI Areas



Total Flight Duration Across a Range of GHMI (Urbanization) Values for All Species

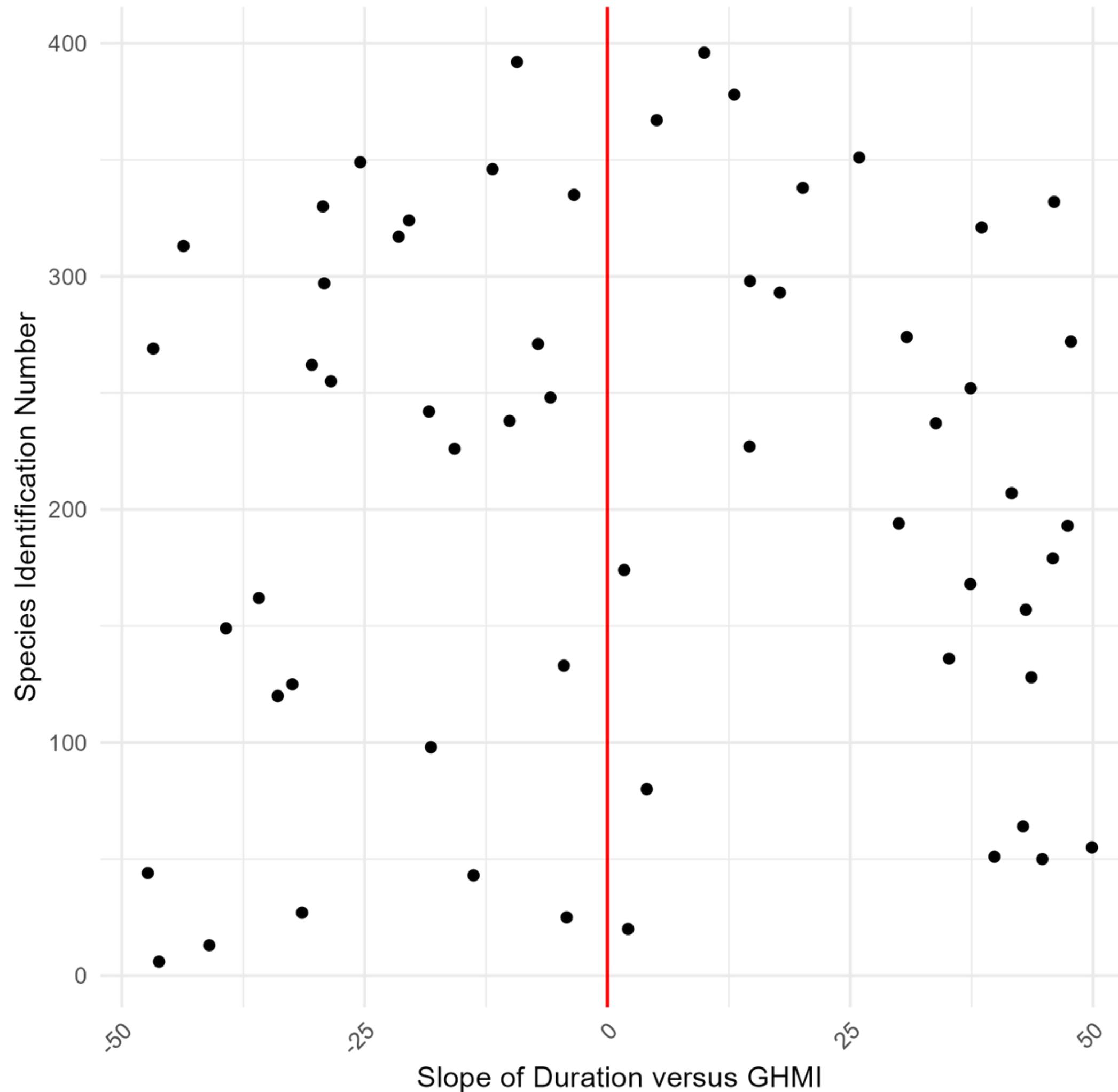


Table of Contents

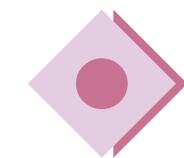
Background

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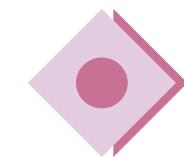
Preliminary Results

Conclusions

Preliminary Conclusions, Next Steps



Some insect pollinator species show variation in phenological estimates across the urban gradient



Phenological response to urbanization varies by taxa



Future investigations: how this varies by latitudinal and longitudinal gradient, how this varies by functional group (specialist versus generalist)



Questions?

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