

The Effects of Invasive Goatgrass Removal on Serpentine Wildflowers and Pollinators



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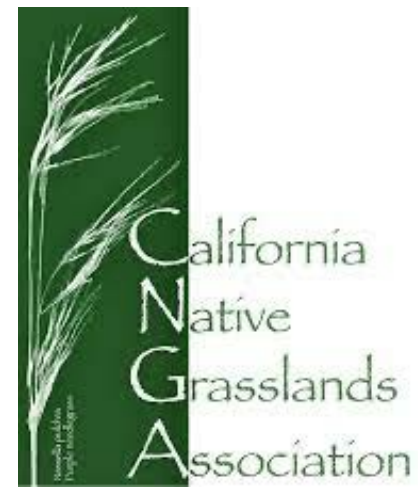
Advisors: Susan Harrison
& Fernanda Valdovinos

Acknowledgements

For thousands of years, the land where this study took place has been the home of Patwin and Miwok peoples.

Thank you to Prof. Susan Harrison, Prof. Fernanda Valdovinos, Marina LaForgia, Cathy Koehler, Paul Aigner, Ben Amann and the McLaughlin Reserve for their support. Thank to Bitu Rostami, Alexis Grana, Isabel Mendoza, Nat Walts, Rebekah Shane, and Kyle Bianchi for assistance in the field. Thank you to Paul Havemann for providing aerial images. **Collaborators on this work include Paul Aigner, Sabine Dritz, and Fernanda Valdovinos.**

Photos taken by Becca Nelson unless otherwise noted.



Natural Reserve System
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The PHI BETA KAPPA *Society*

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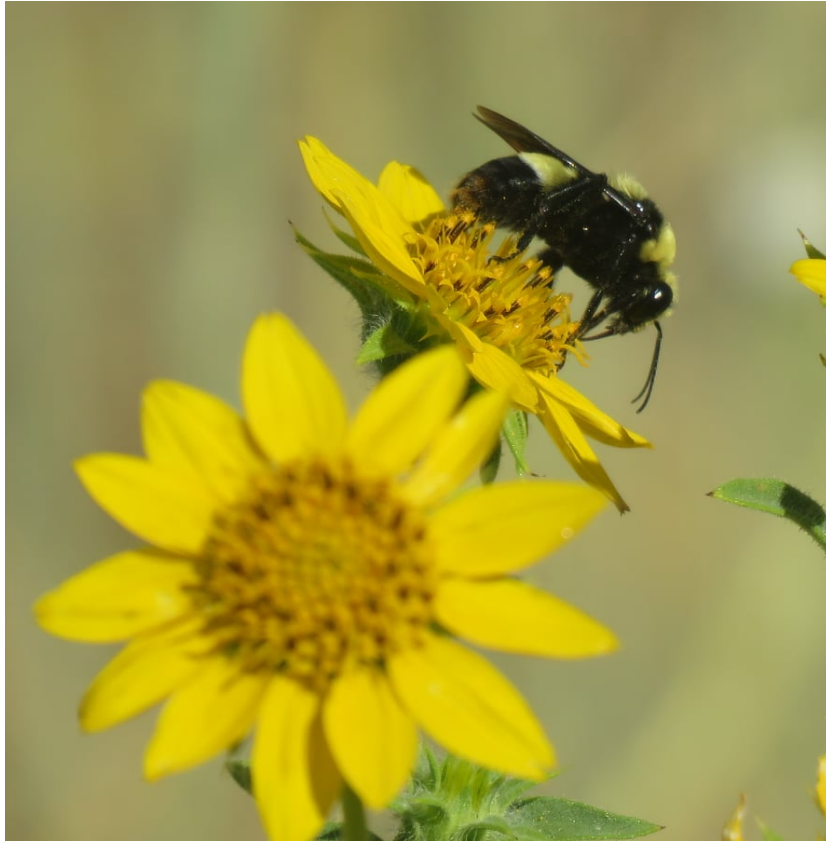
— Founded December 5, 1776 —



An aerial photograph of a coastal landscape. The foreground and middle ground are dominated by a mix of green and yellow vegetation, possibly a wetland or marsh. A dark, irregular line separates this vegetated area from a greyish-brown, sandy or silty area on the right side, which appears to be a beach or a tidal flat. The overall scene is captured from a high angle, looking down.

Research Overview

Serpentine Grasslands are Refugia



Goatgrass: a Serpentine-tolerant Invader



Barbed Goatgrass
(*Aegilops triuncialis*)

- **Winter annual
invasive grass**
- Can tolerate
serpentine soils

An aerial photograph of a serpentine landscape. The terrain is characterized by a mix of dark grey, brown, and green patches, indicating different soil types and vegetation. A prominent feature is a large, irregularly shaped area of bright yellow-green, which likely represents a specific plant species or a particular soil condition. The overall scene is a complex mosaic of colors and textures, typical of a serpentine ecosystem.

**How does removing an invasive grass affect
serpentine plant-pollinator interactions?**

Hypotheses



Restoration

Hypotheses



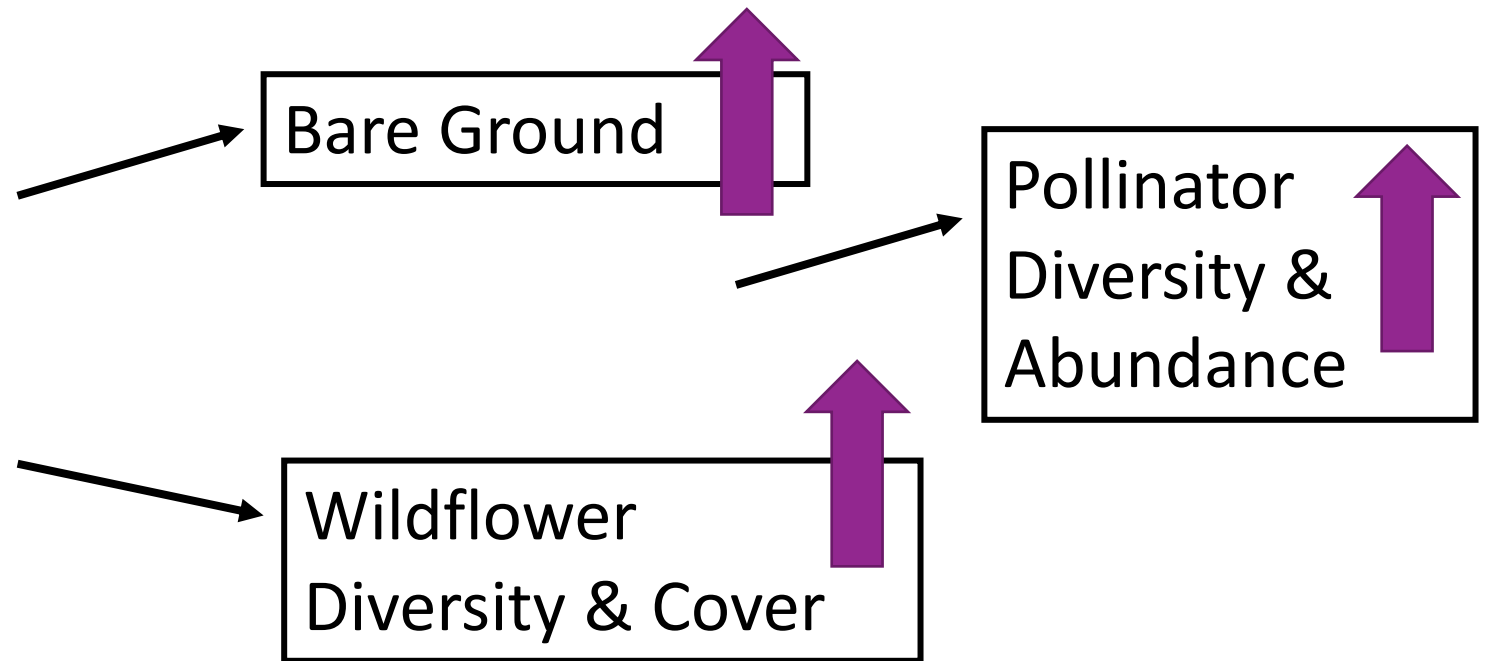
Restoration



Hypotheses



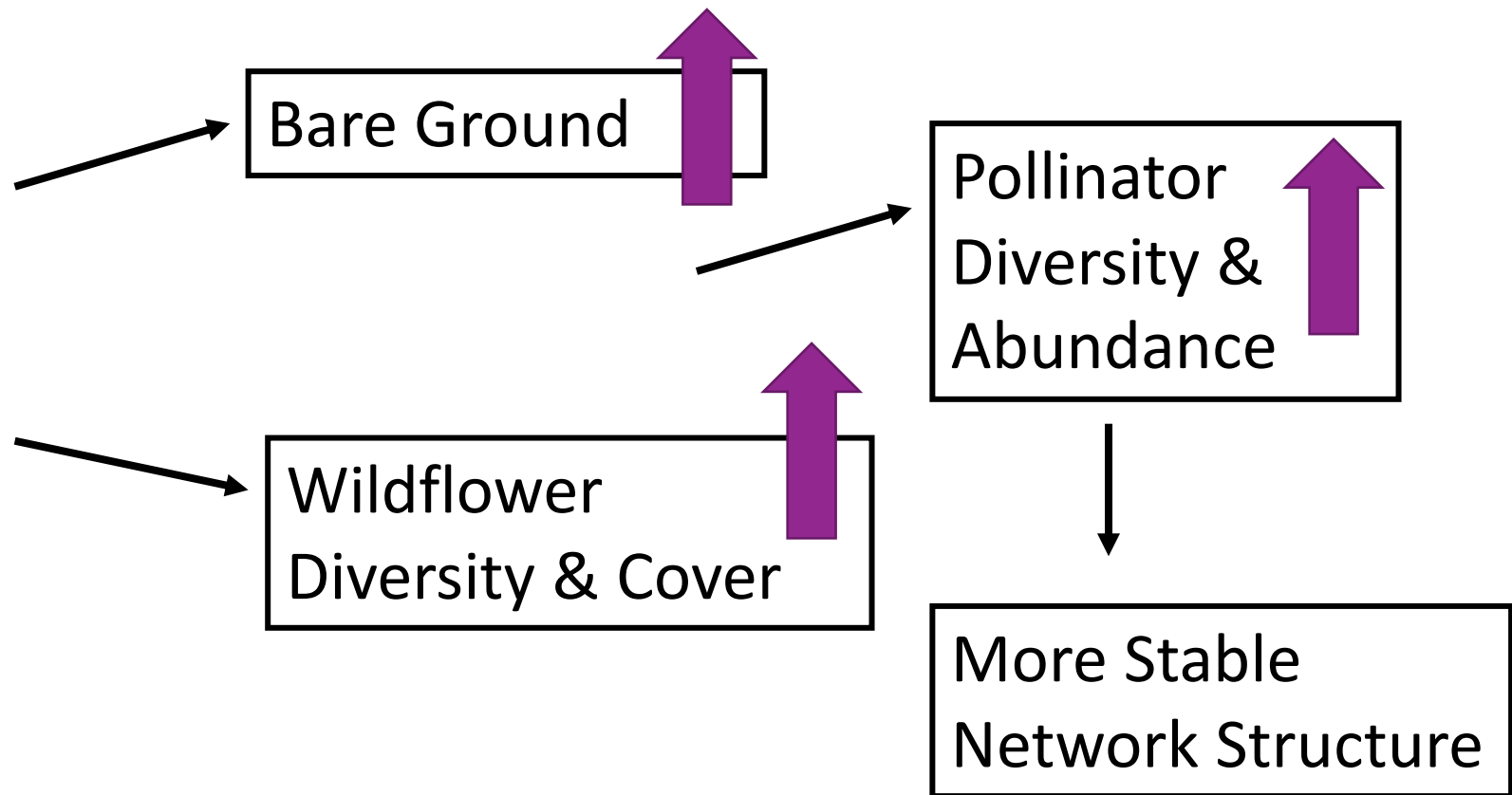
Restoration



Hypotheses

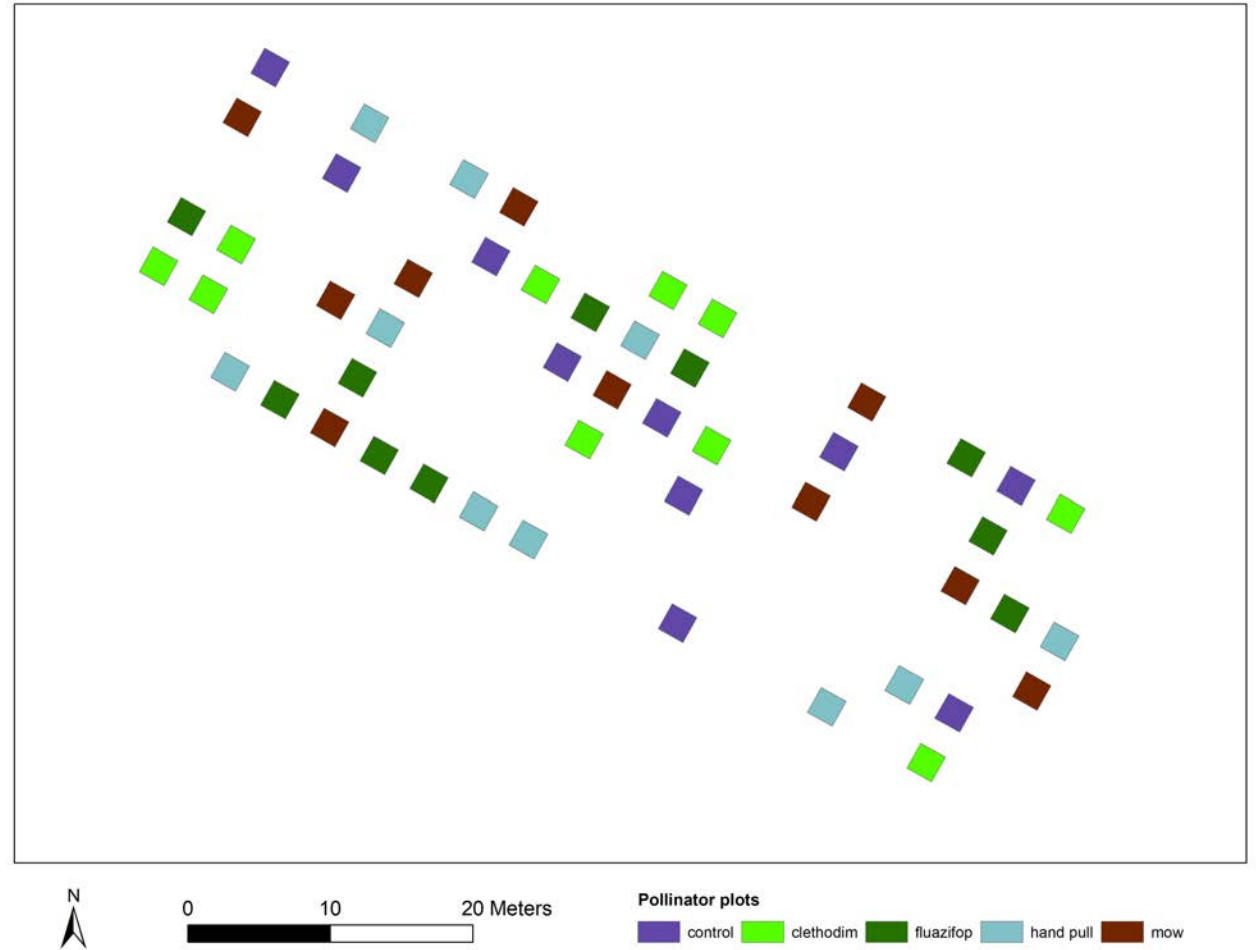


Restoration



Methods: Empirical Data

- Goatgrass Removal treatments compared to control plots at UC McLaughlin Reserve
- Removal Details: clethodim (0.73g/L), glyphosate (9.83g/L), and fluazifop-P (1.40g/L). Mechanical removal methods included both hand-pulling and mowing
- 3 years of pollinator observations for 10 plots of each of the treatments during spring and summer for 2011-2013

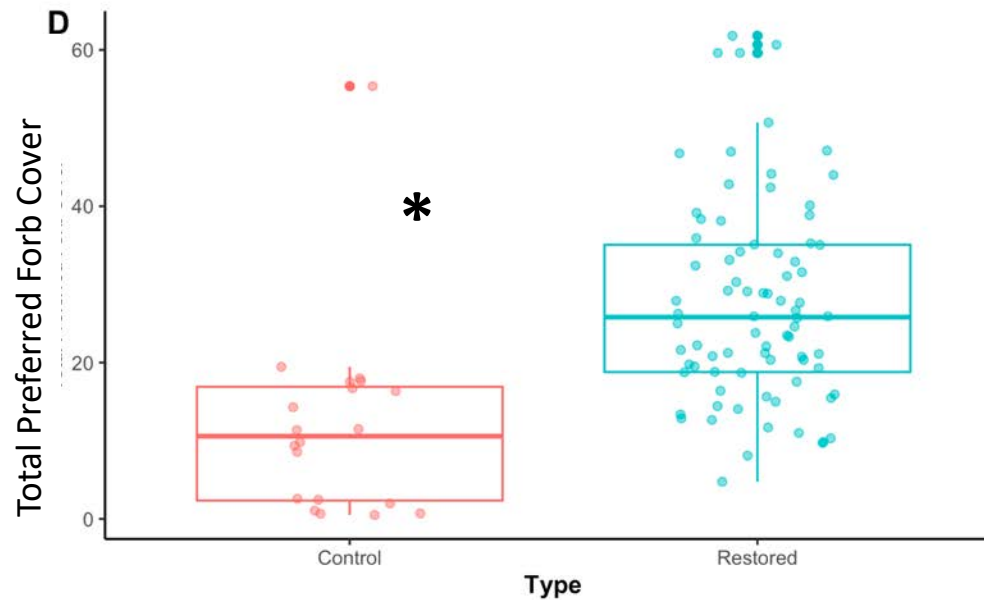
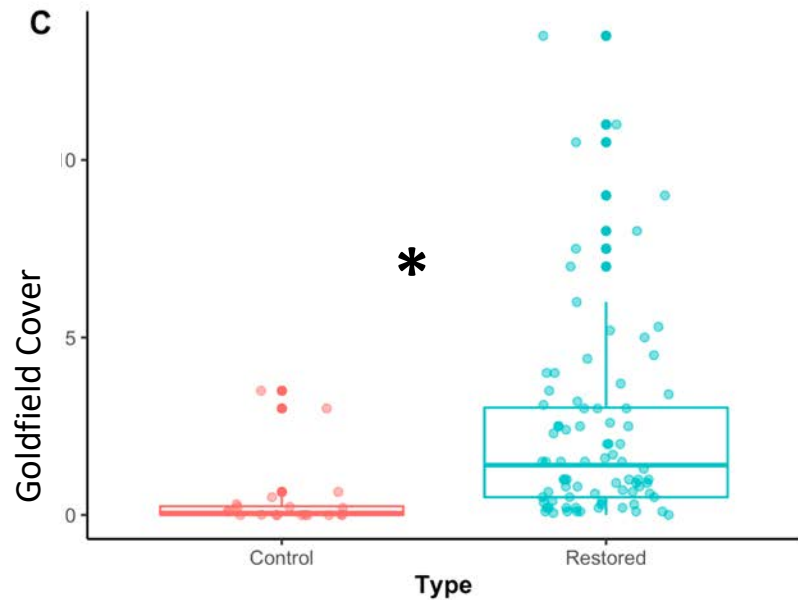
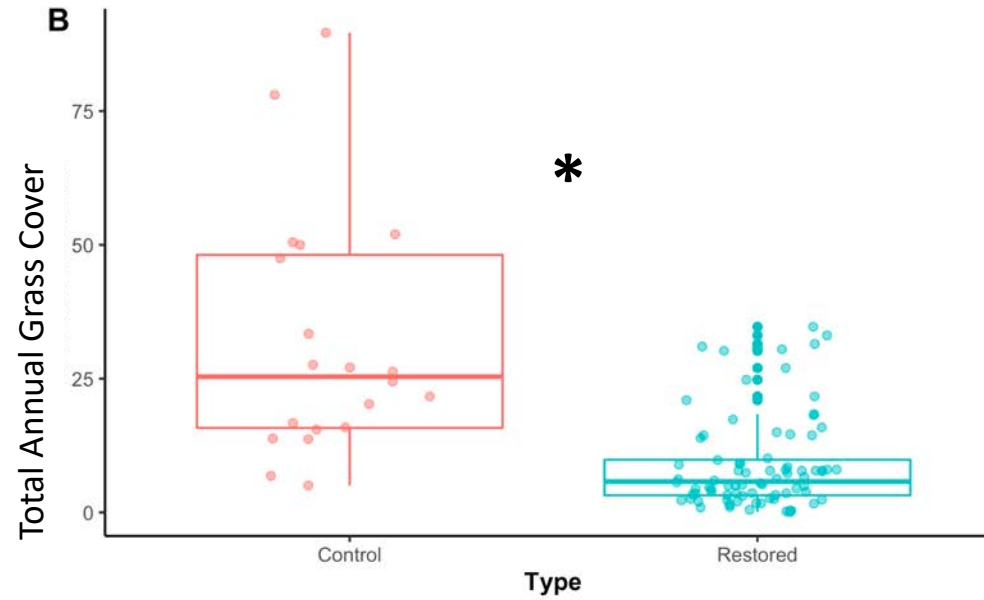
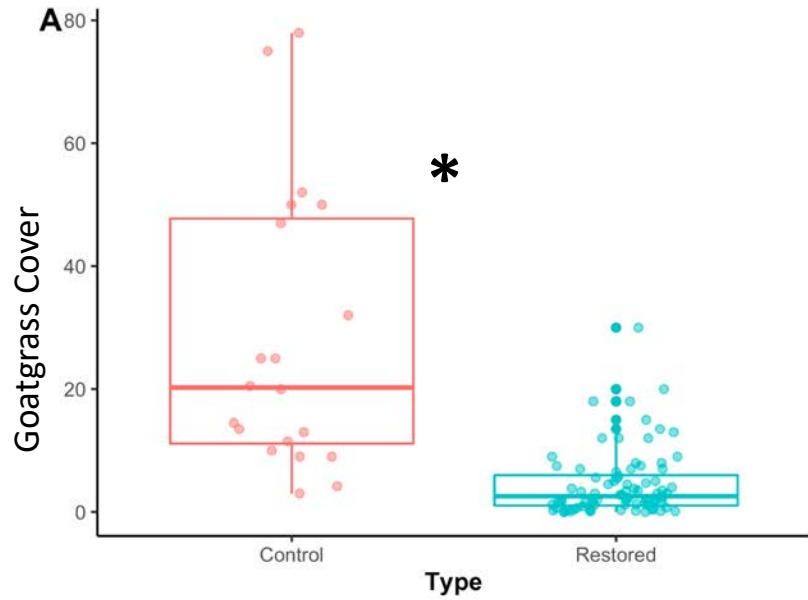


Aigner and Woerly 2011, *Invasive Plant Science and Management*
Valdovinos et al. 2013



Plant Community Response

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& Valdovinos *in prep*

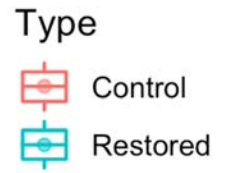
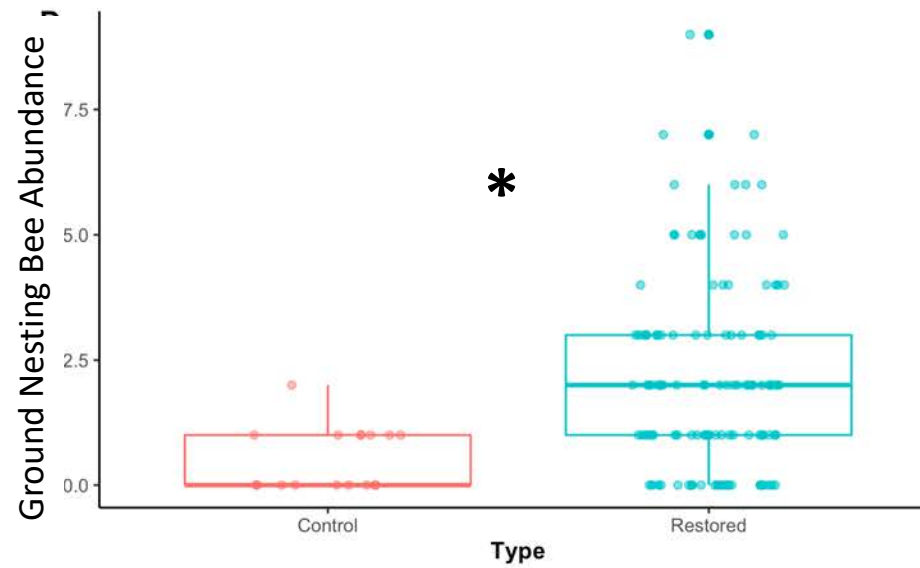
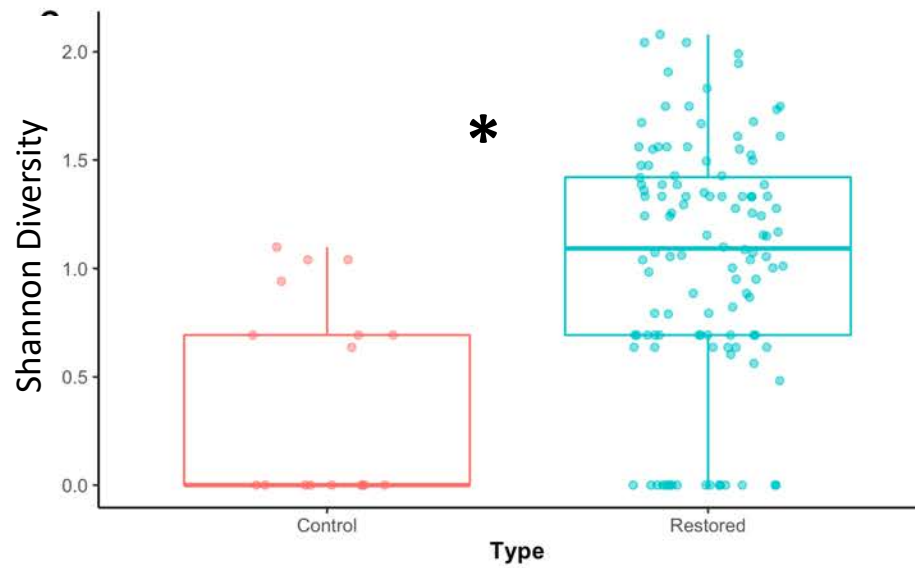
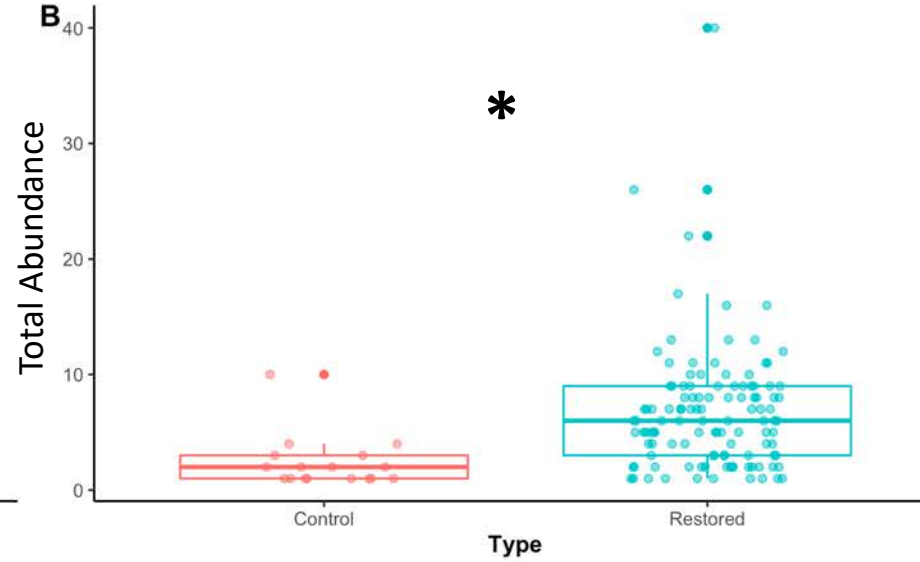
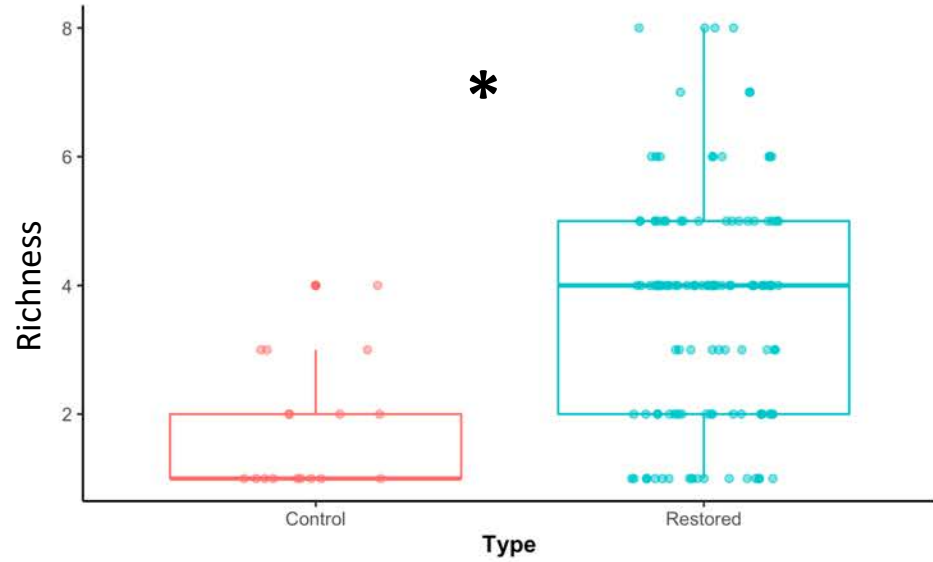


Type

- Control
- Restored

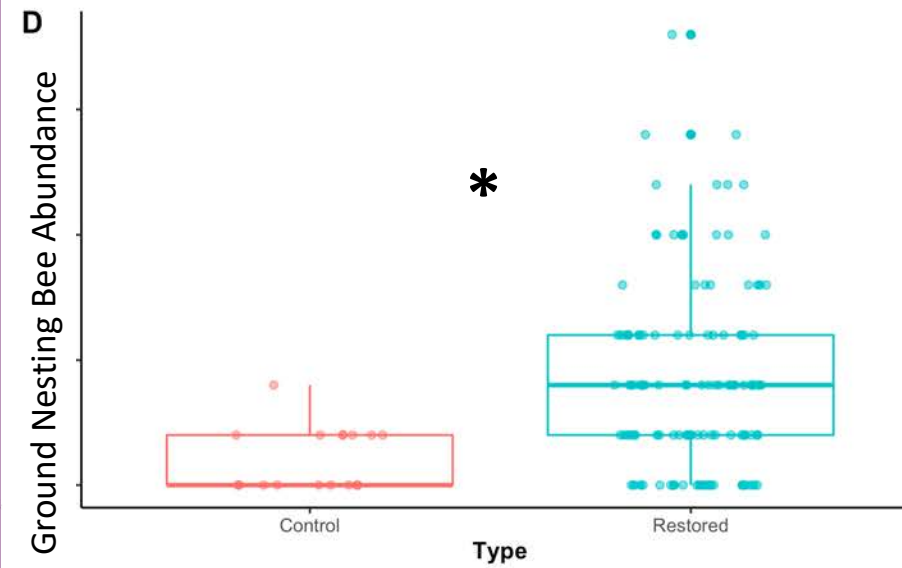
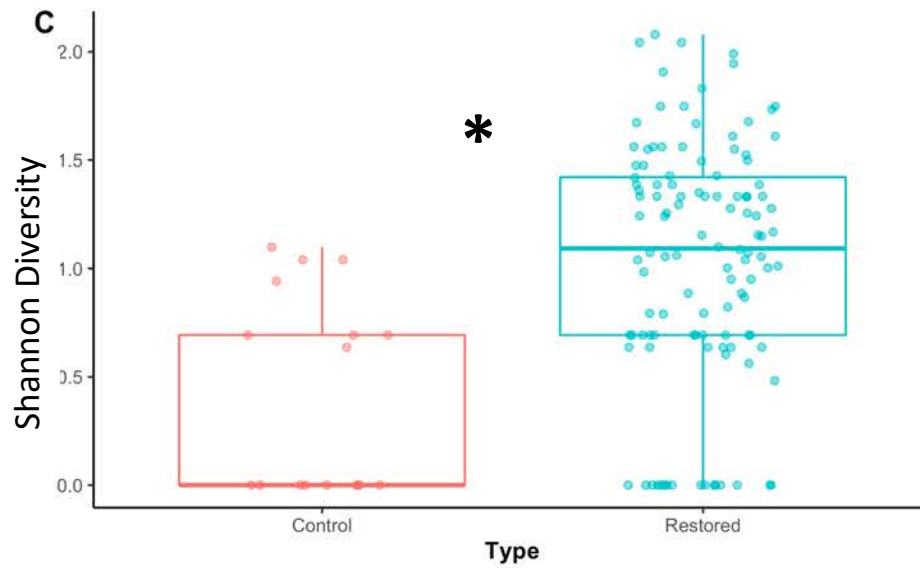
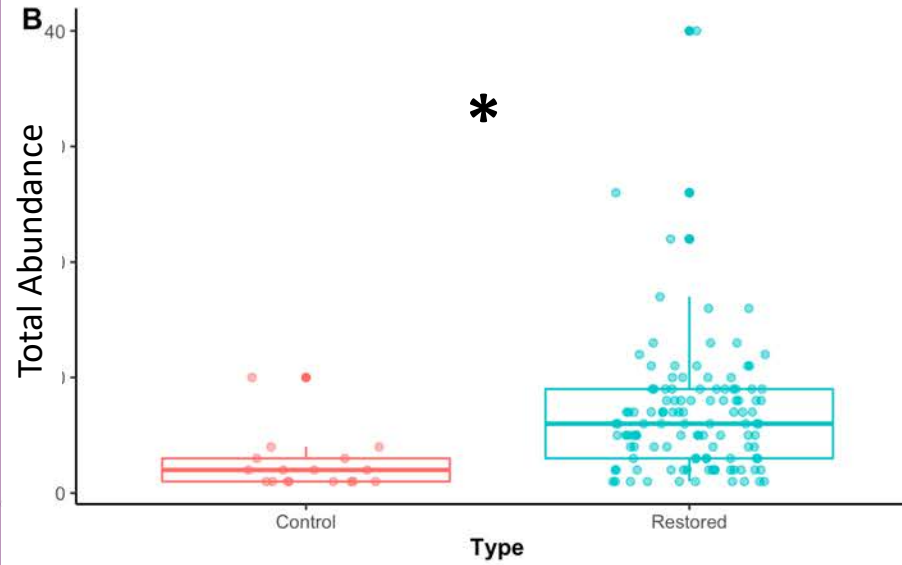
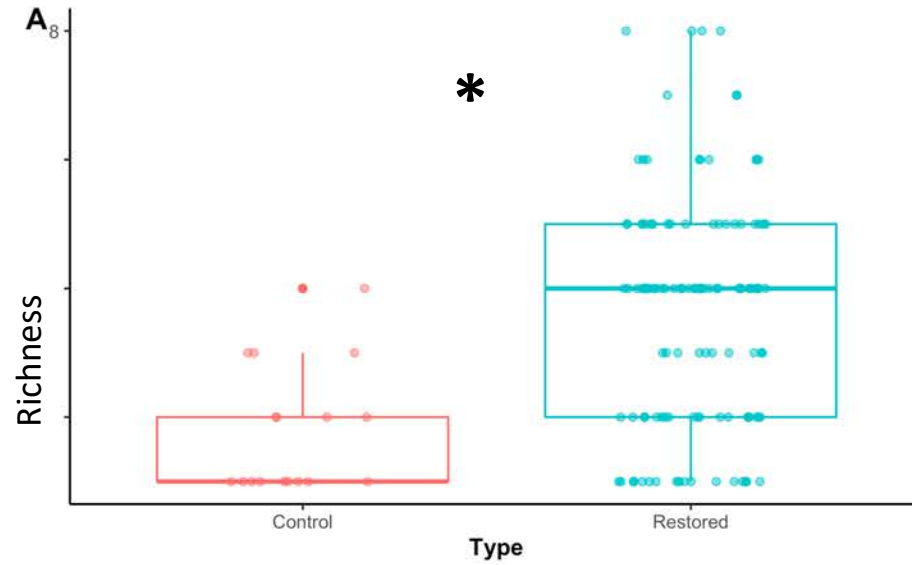
Pollinator Community Response

Nelson, Dritz, Aigner
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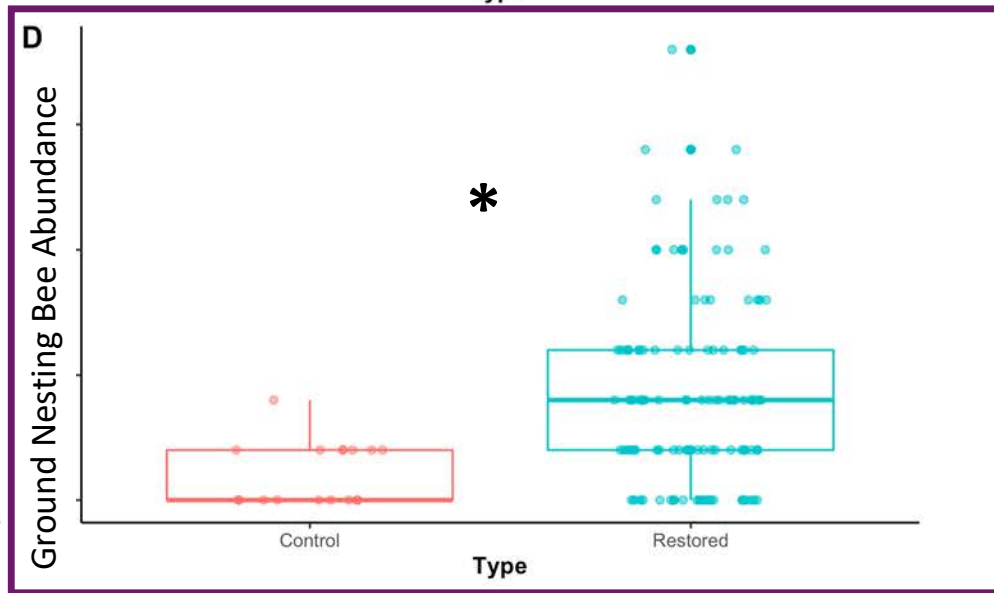
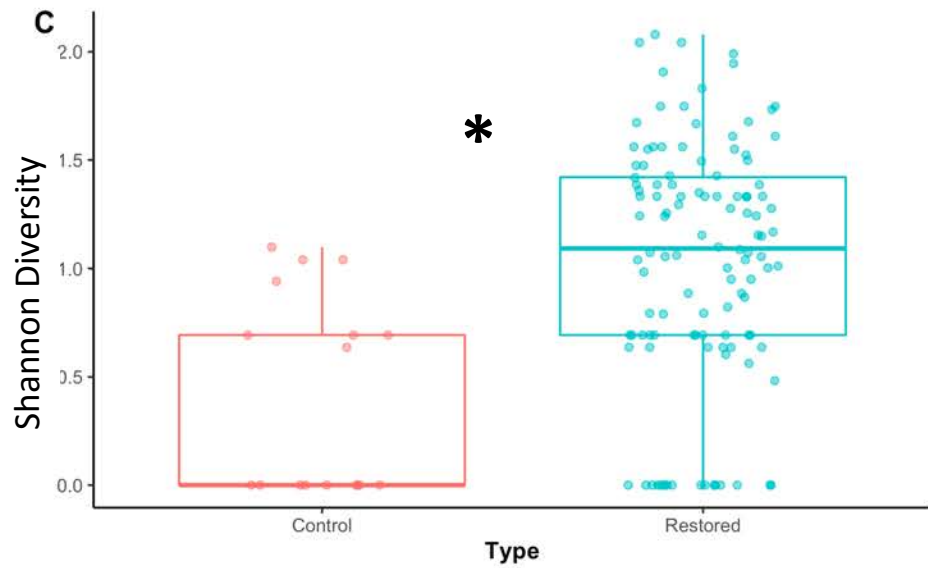
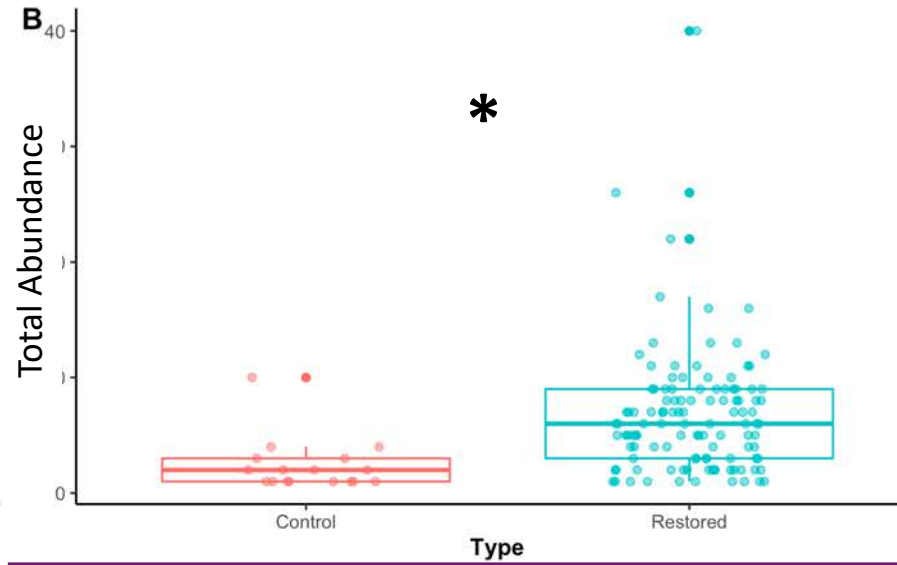
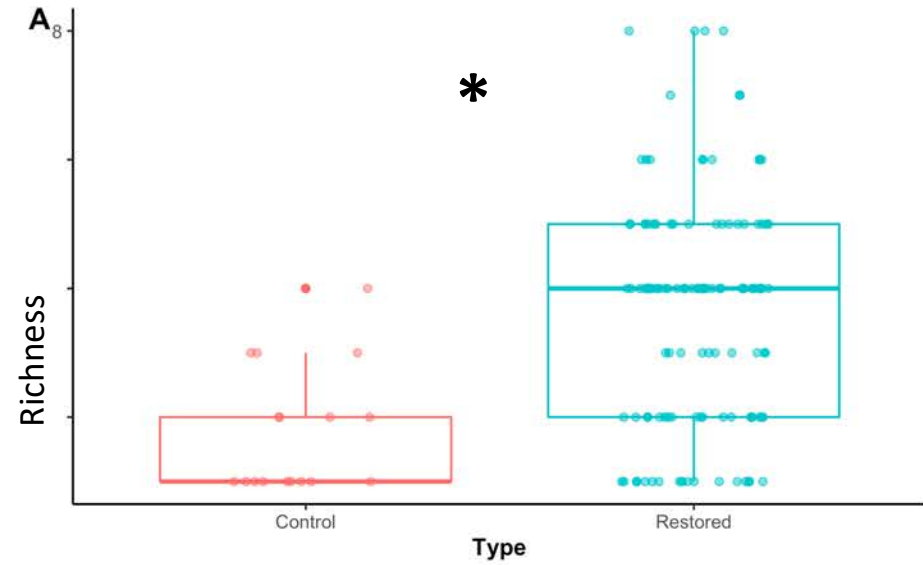


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Pollinator Community Response

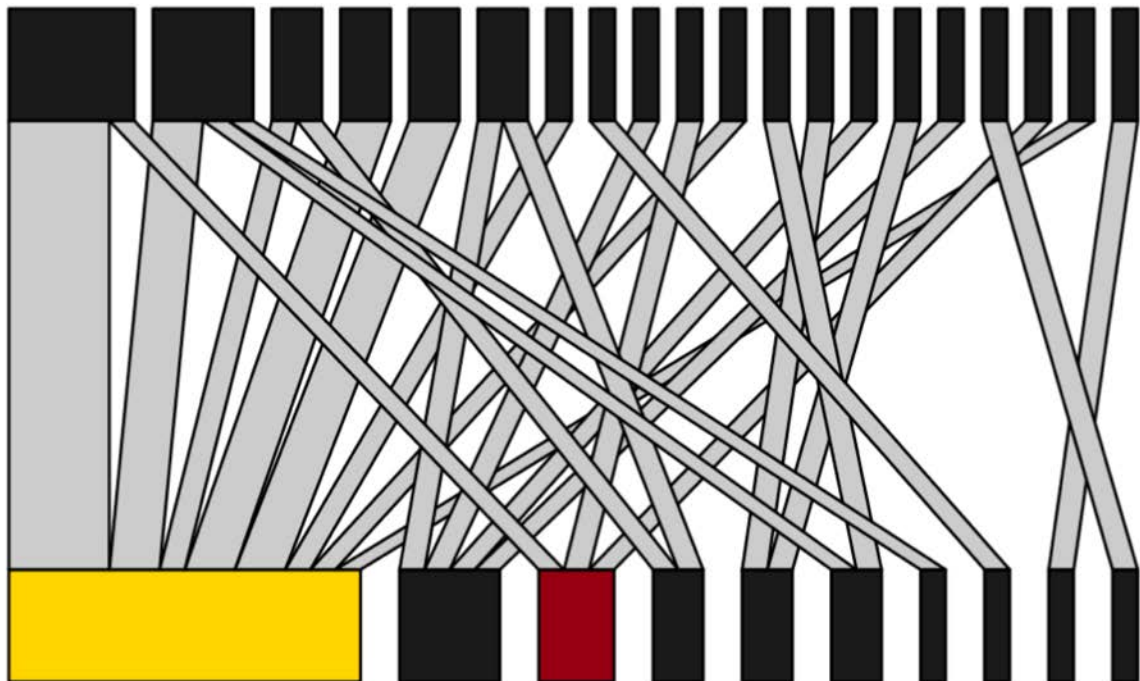
Nelson, Dritz, Valdovinos & Aigner
in prep



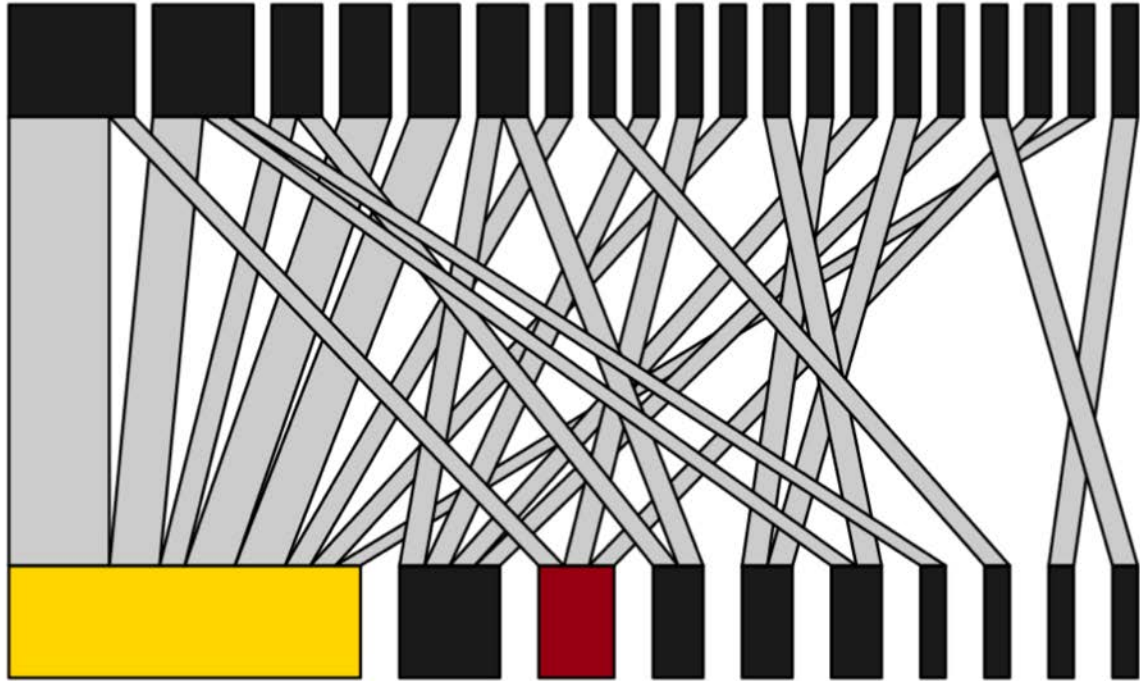
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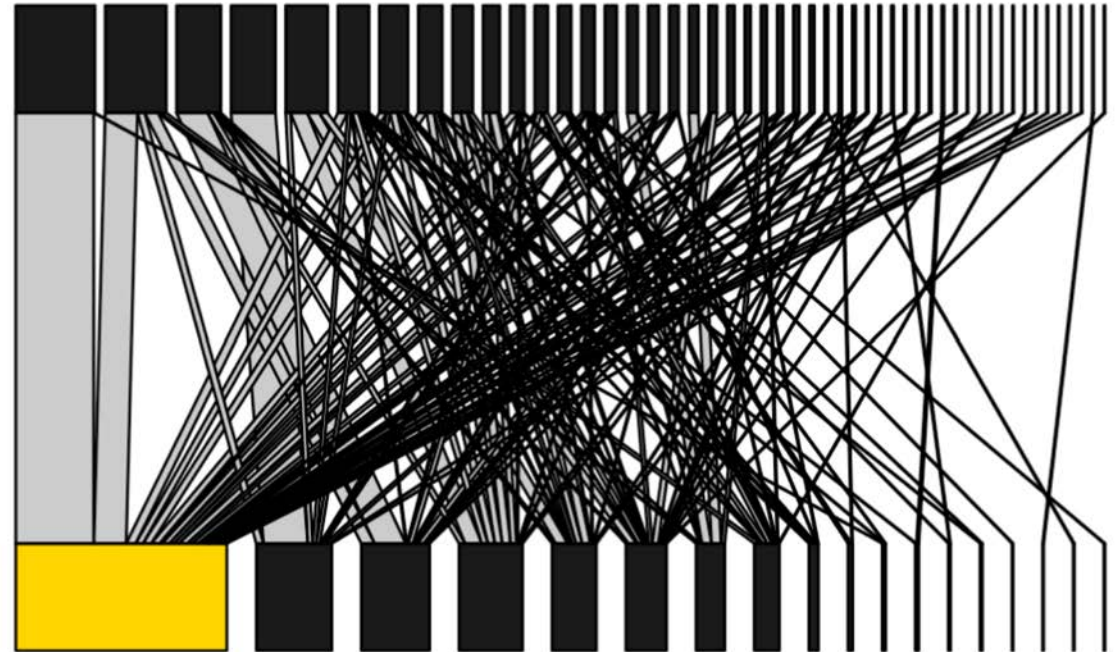
Control



Control



Restored



Goldfields: a Core Generalist Wildflower

- Most abundant wildflower
- Goldfields act as a key hub for pollinators
- Most strongly contributed to network nestedness
- Restoration enhanced the role of goldfields



California Goldfields (*Lasthenia californica*)

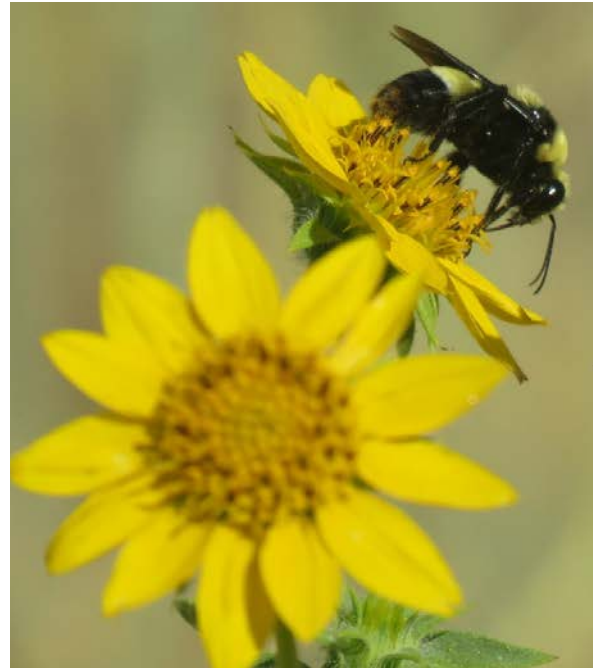


Goatgrass removal restored plant-pollinator mutualisms.

Adaptive Management Recommendations



**Repeated
Goatgrass
Removal**



**Diverse Floral
Resources across
Season**



Pollinator Nesting

10 Years Later...

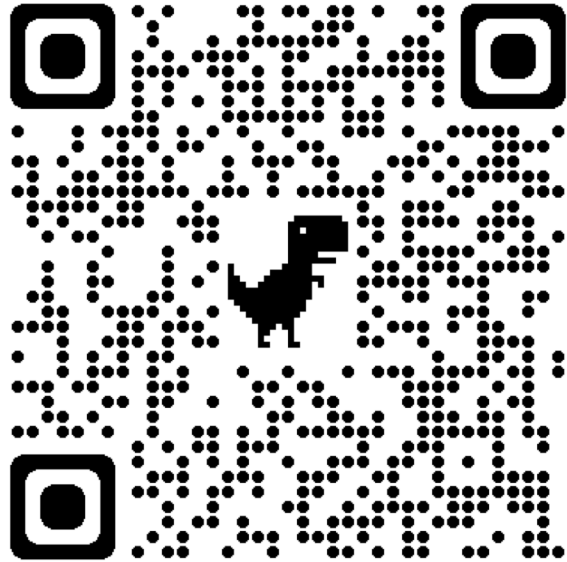


Thank you!



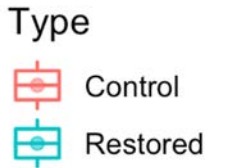
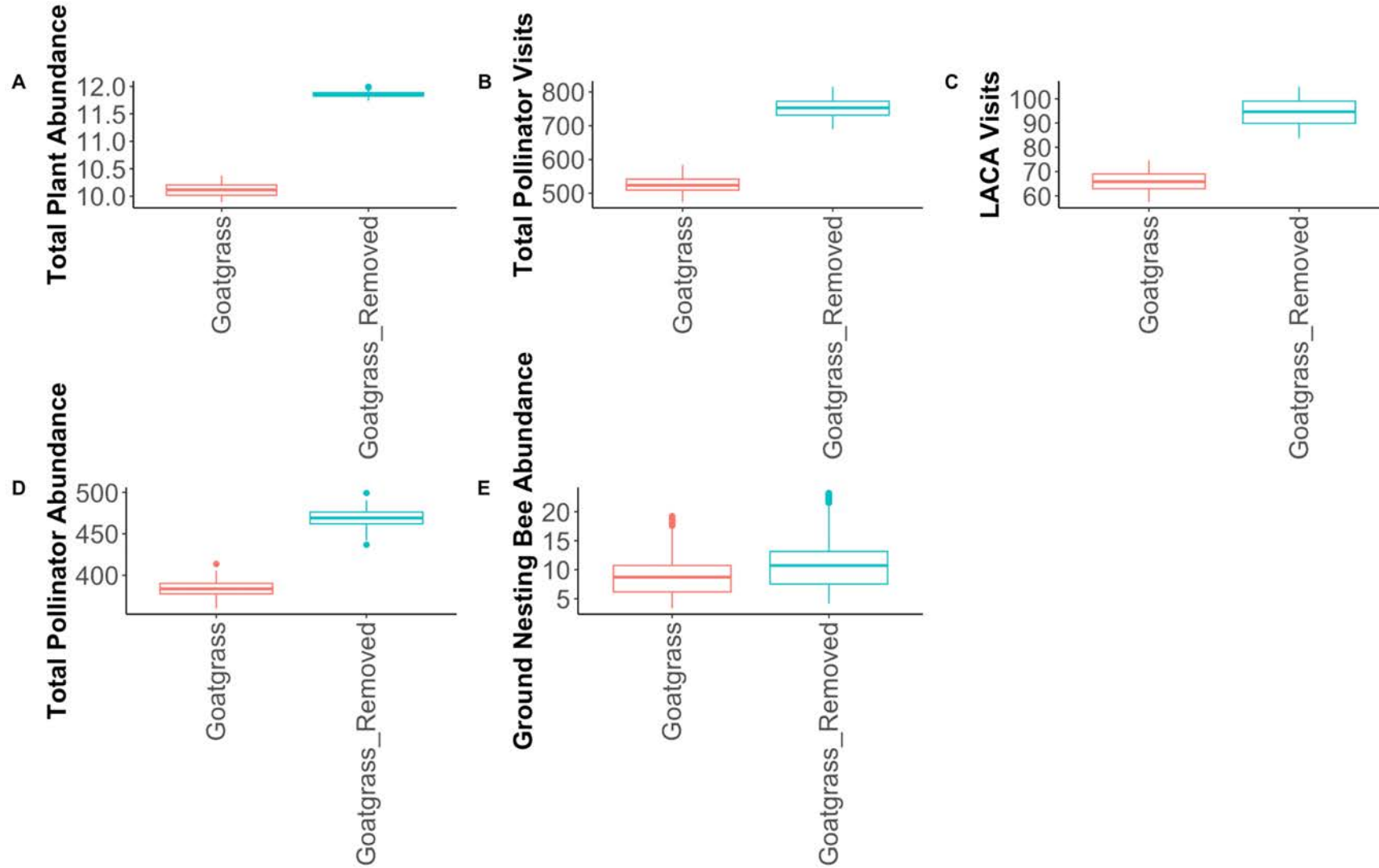
Questions? Contact ranelson@ucdavis.edu

Website &
SciComm



Simulation Results

Nelson, Dritz, Aigner
& Valdovinos *in prep*



Methods: Consumer-Resource Models



$$\frac{dp_i}{dt} = \gamma_i \sum_{j \in A_i} e_{ij} \theta_{ij} V_{ij} - \mu_i^P p_i$$



$$\frac{da_j}{dt} = \sum_{i \in P_j} c_{ij} V_{ij} b_{ij} \frac{R_i}{p_i} - \mu_j^A a_j$$

Methods: Consumer-Resource Models



$$\frac{dp_i}{dt} = \gamma_i \sum_{j \in A_i} e_{ij} \theta_{ij} V_{ij} - \mu_i^P p_i$$

Recruitment

Plant
Population
Dynamics



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Recruitment

Visit Quality, Quantity,
& Seed Production

**Plant
Population
Dynamics**



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Plant Mortality

**Plant
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Floral Reward
Consumption

**Pollinator
Population
Dynamics**

Methods: Consumer-Resource Models



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Recruitment

Visit Quality, Quantity,
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Plant Mortality

**Plant
Population
Dynamics**



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Floral Reward
Consumption

Pollinator Mortality

**Pollinator
Population
Dynamics**