



# THE EFFECTS OF LAND MANAGEMENT ON BEE DIVERSITY IN NATURAL LANDSCAPES

PRAIRIE STATE CONSERVATION COALITION



ILLINOIS

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~20,000 species of bees globally and >4000 in the US.  
We know very little about them which makes conservation difficult.

On May 19, 2015 the  
“National Strategy to  
promote the health of  
honey bees and other  
pollinators” and  
“Pollinator Friendly best  
management practices”



NATIONAL STRATEGY TO  
PROMOTE THE HEALTH  
OF HONEY BEES AND  
OTHER POLLINATORS

Pollinator Health Task Force

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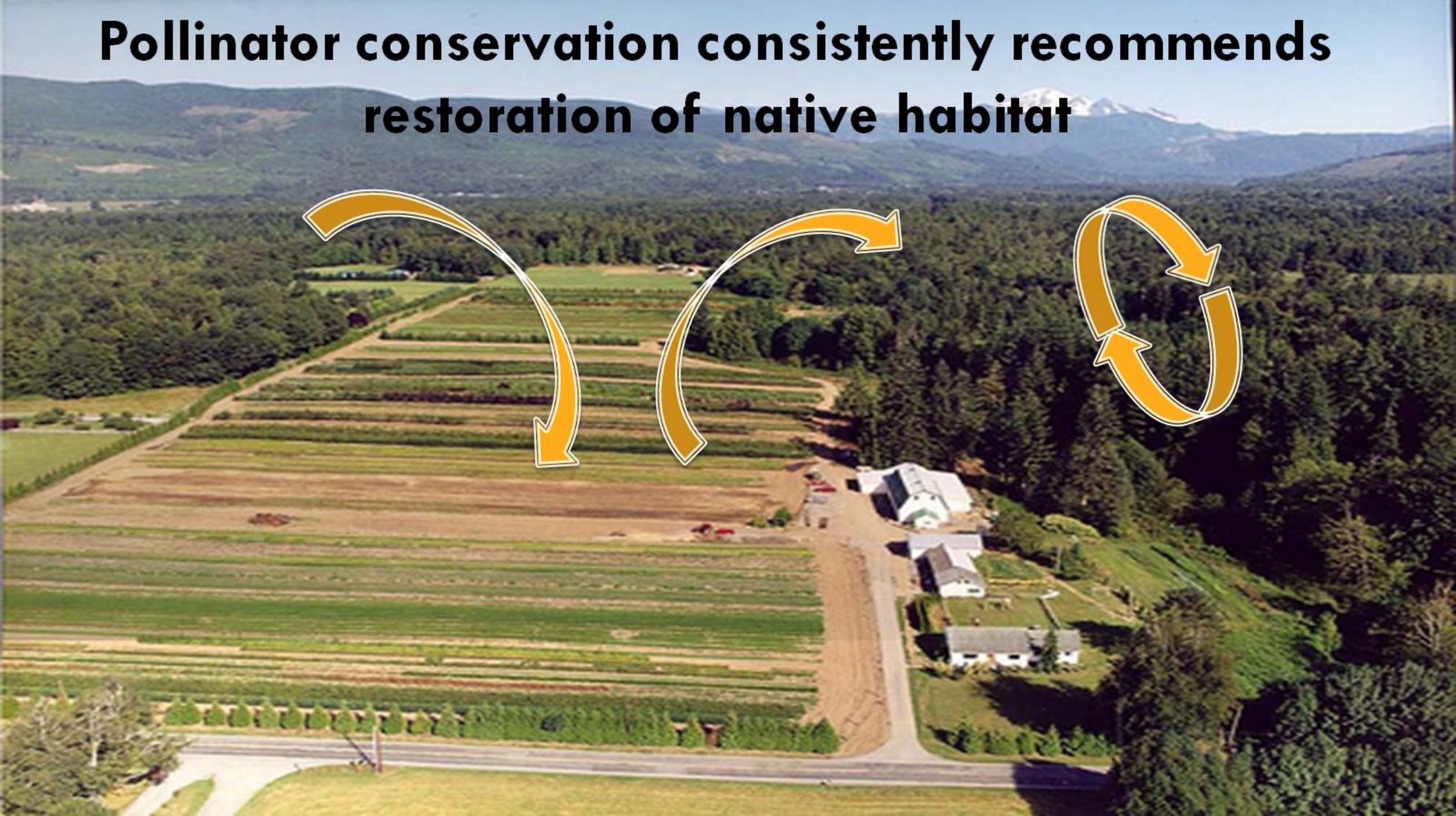
Restore or enhance 7 million acres of land for  
pollinators over the next 5 years through Federal  
actions and public/private partnerships



## NATIONAL STRATEGY TO PROMOTE THE HEALTH OF HONEY BEES AND OTHER POLLINATORS

Health Task Force

# Pollinator conservation consistently recommends restoration of native habitat





**Most restored communities must have some management to persist.**

**What are the common methods used to manage habitat?**

**How do these methods affect bee diversity?**



**In 2013, 28 land managers of TGP responded to survey questions on site characteristics, site establishment, site management and site monitoring.**

# Site Characteristics

- **Most sites were between 101 and 1000 acres and established in the 1990s**
  - ▣ Site size in other areas of the country is expected to be strongly correlated with bee diversity but this has not been observed in TGP habitat- Hopwood 2009 and Hendrix et. al 2010.
  - ▣ Often as sites age, plant diversity decreases which could adversely affect bee diversity- (Sluis 2002; McLachlan and Knispel 2005; Carter and Blair 2012; Hansen and Gibson 2014). No work has examined bees with respect to site age directly.

# Site Establishment

- Historically most of the land was former farmland (pasture or crop) so most sites were cleared by harvesting crops but other methods like tilling, burning or spraying with herbicides were also used.
- ▣ Tillage of habitat is considered to negatively affect bees but the evidence is weak at best- (Winfree et al 2009 and Williams et al 2010) shallow tilling may not effect bees much. Tillage may also effect soil characteristics but we don't have much data on this.
- ▣ Agrochemicals, even inert ones or herbicides, may have lasting effects on bees . Neonicotinoids can persist in soils for long time periods (Goulson 2013) and could affect ground nesting bees and newly planted sites. Glyphosate can affect navigation and beta carotene in honey bees (Helmer et al. 2014; Balbuena et al. 2015)
  - **Do agrochemicals in the soil affect bee survival or behavior?**

80% of bee families are predominantly ground nesting (O'toole and Raw 1991) and in 1 year they spend 85-95% of their time underground



pupa



adult



larva



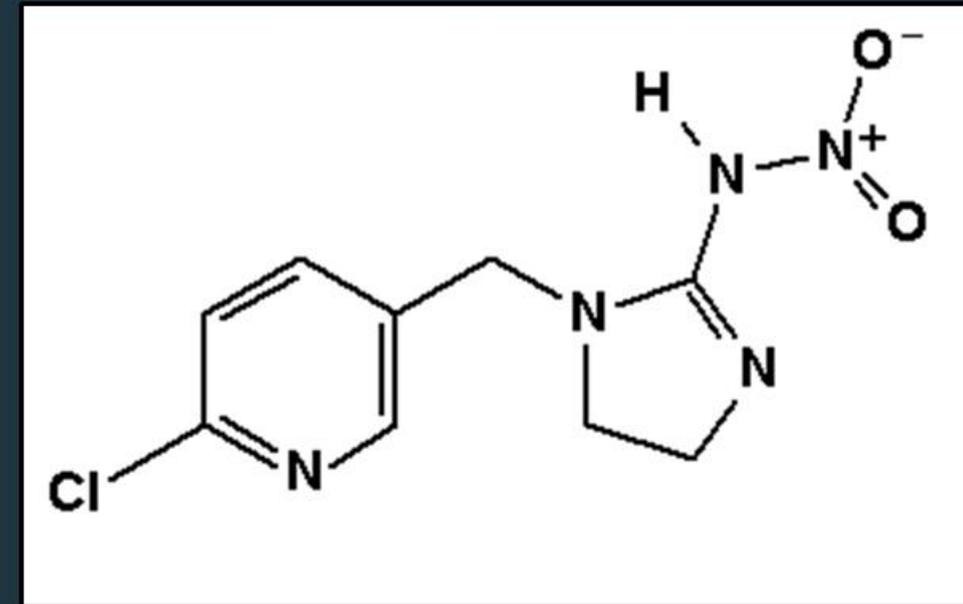
egg



Neonicotinoids, a class of pesticides, have raised significant concern about the effects they may have on bees

11

Imidacloprid has a photolysis half-life of **39 days** at the soil surface, with a range of 26.5–229 days when incorporated into the soil. Persistence in soil allows for continual availability for uptake by plant roots. -CADPR



# Newly restored habitats may create “ecological traps” for bees

- The Conservation Reserve Program is a leasing program for agricultural land to help encourage farmers to set aside land for soil and wildlife conservation
- CP-42 is specifically for pollinator habitat and is populated with plants believed to help pollinators



Nicholas Anderson  
MS Student

# Ongoing projects: Effects of soil contaminants

13

- Preliminary data suggests slower development and higher mortality of bees exposed to soil realistic concentrations of imidacloprid.
- Sub-lethal effects on foraging and nesting will be tracked next year.



# Site Establishment

- **Plant diversity was established most often by broadcasting seeds with most taken from nearby sites.**
  - Using only local seed sources could limit the inclusion of more rare species and create homogenous landscapes.
  - Broadcasting seeds can also limit establishment of certain plants depending on the season they are cast (Yurkonis et al. 2010; Larson et al. 2011) with better forb establishment if broadcast in the winter.
  - More effort to identify and establish plants known to be good for bee diversity is necessary.
    - **Do seed mixes effectively increase bee diversity and can we improve them?**

# Plant seed mixes for restoring habitat

15

- Range significantly in price and plant species diversity
- Diversity is limited by growers ability to economically produce
  - Seed viability
  - Demand
- Using data on seven Iowa prairies and over 40 seed mixes designed for Iowa we evaluated whether they would increase bee diversity to levels found in remnant sites.
- We identified “bee plants” that had higher associated bee richness than other plants

# Mixes can be improved with small additions

- While bees accumulated for mixes do fall within the range of remnant prairies they still have significantly fewer plant species and are not predicted to support as many bees as remnants
- Mixes that included the 4 bee plants always perform better and adding bee plants even to small mixes make a significant difference

*Amorpha canescens*



*Dalea purpurea*



*Ratibida pinnata*



*Zizia aurea*



# Site Management

- **Burning was most often used to manage land with most managers burning every few years.**
  - Significant increases in forb diversity, suppression of invasive species and grasses are very beneficial for bees.
  - Most bees will not be directly affected by burning because 80% nest underground but those that nest in twigs are likely to be significantly affected (Cane and Neff 2011).
  - Timing of fire might make a huge difference in plant and bee communities with growing season burns helping increase forb diversity and possibly preserving more cavity nesting species (Collins 1992; Bowles and Jones 2013).
  - Burning regimes that help maintain habitat heterogeneity are likely very important for bees.

# Site Management

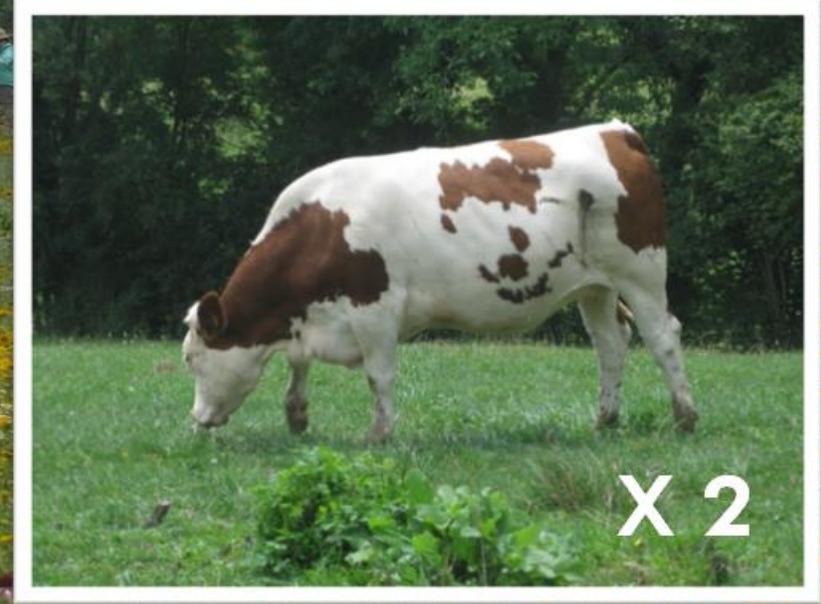
18

- **Mowing, Haying and Grazing were also used but with less frequency.**
  - ▣ Haying can improve bee diversity in some landscapes likely by increasing nesting resources, habitat heterogeneity and reducing invasive species cover. (Gibson et al. 2011, Campbell et al. 2007).
  - ▣ Haying could also negatively affect plant diversity by removing flowering heads before the seeds scatter and also cavity nesting bees that are above ground.
  - ▣ Grazing in particular is believed to be benign as it mimics a “natural” process but many question how closely and whether this effects bees.
  - ▣ **Do haying and grazing affect the bee community?**

# Does management affect resources available to bees and the bee community?

19

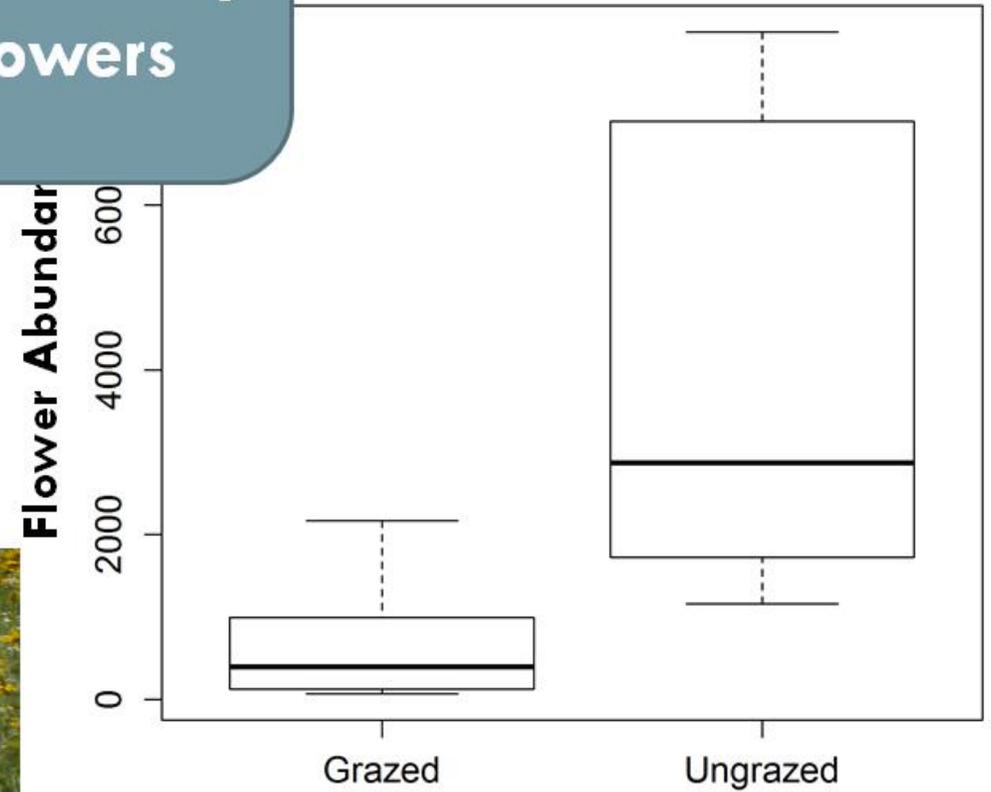
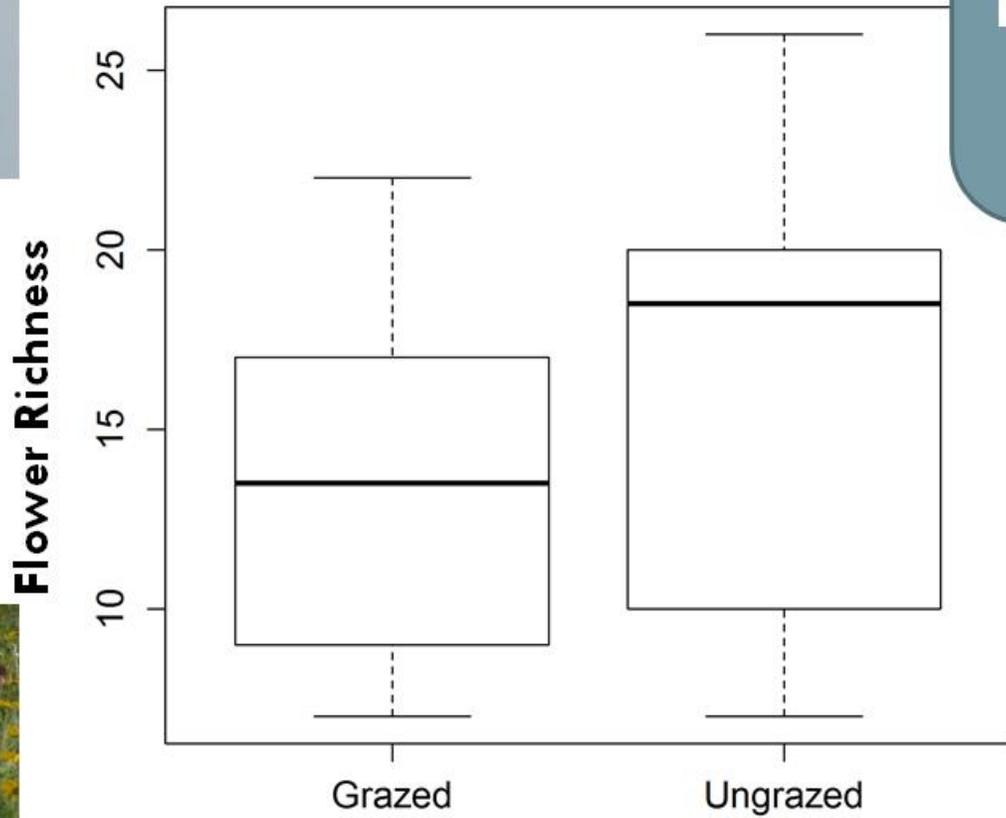
Floral and Nesting Resources were measured



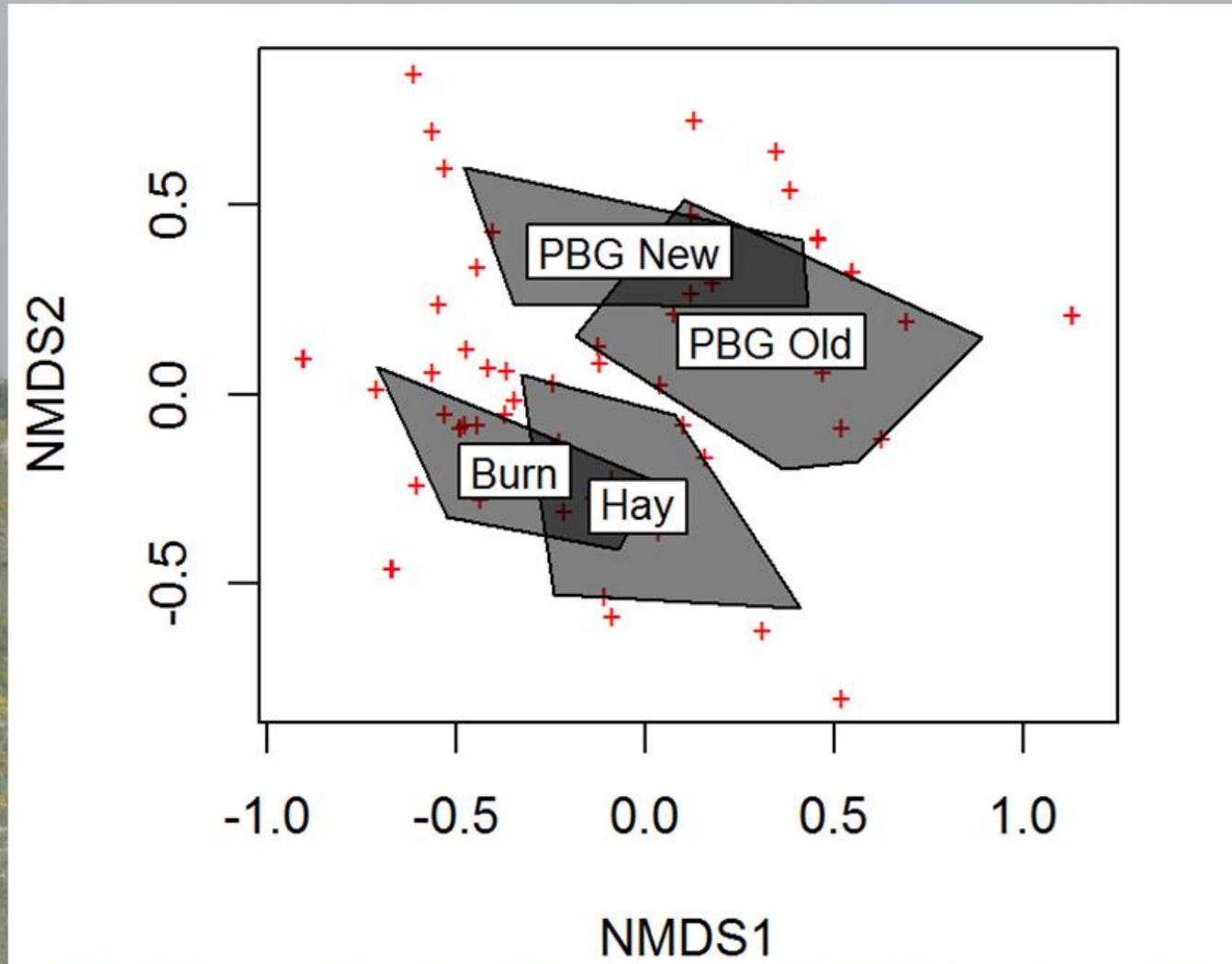
# Floral Resources

20

Ungrazed sites  
have significantly  
more flowers



# Flower communities are significantly different in composition



# Does management affect resources available to bees and the bee community?

22

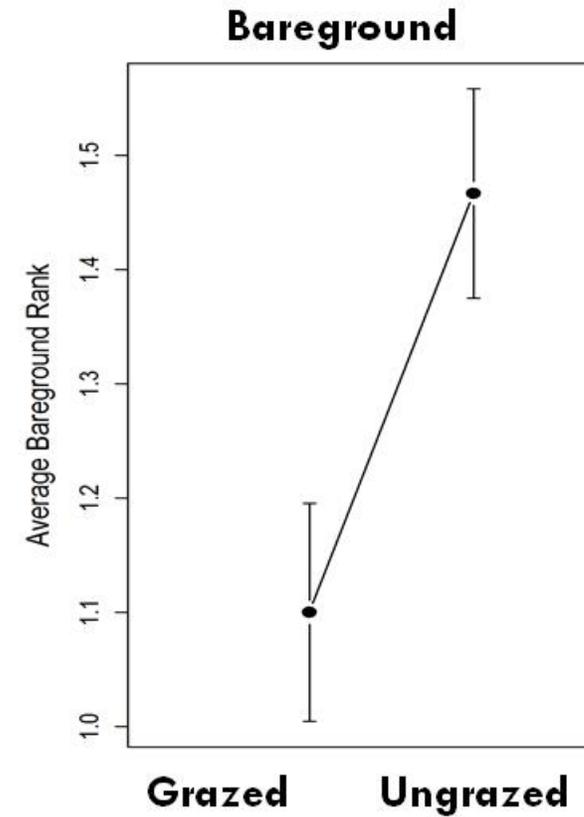
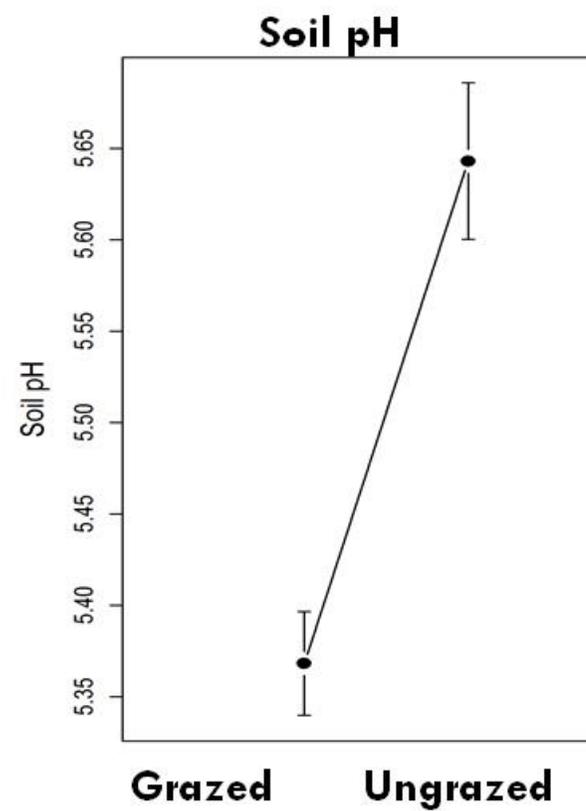
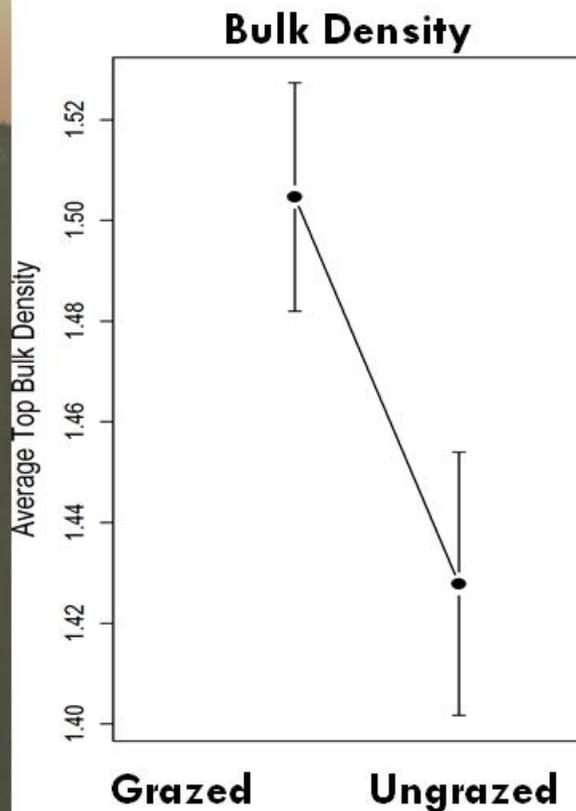
Floral and Nesting Resources were measured

80% of native bees nest in the soil



# Soil characteristics varied significantly between grazed and ungrazed patches

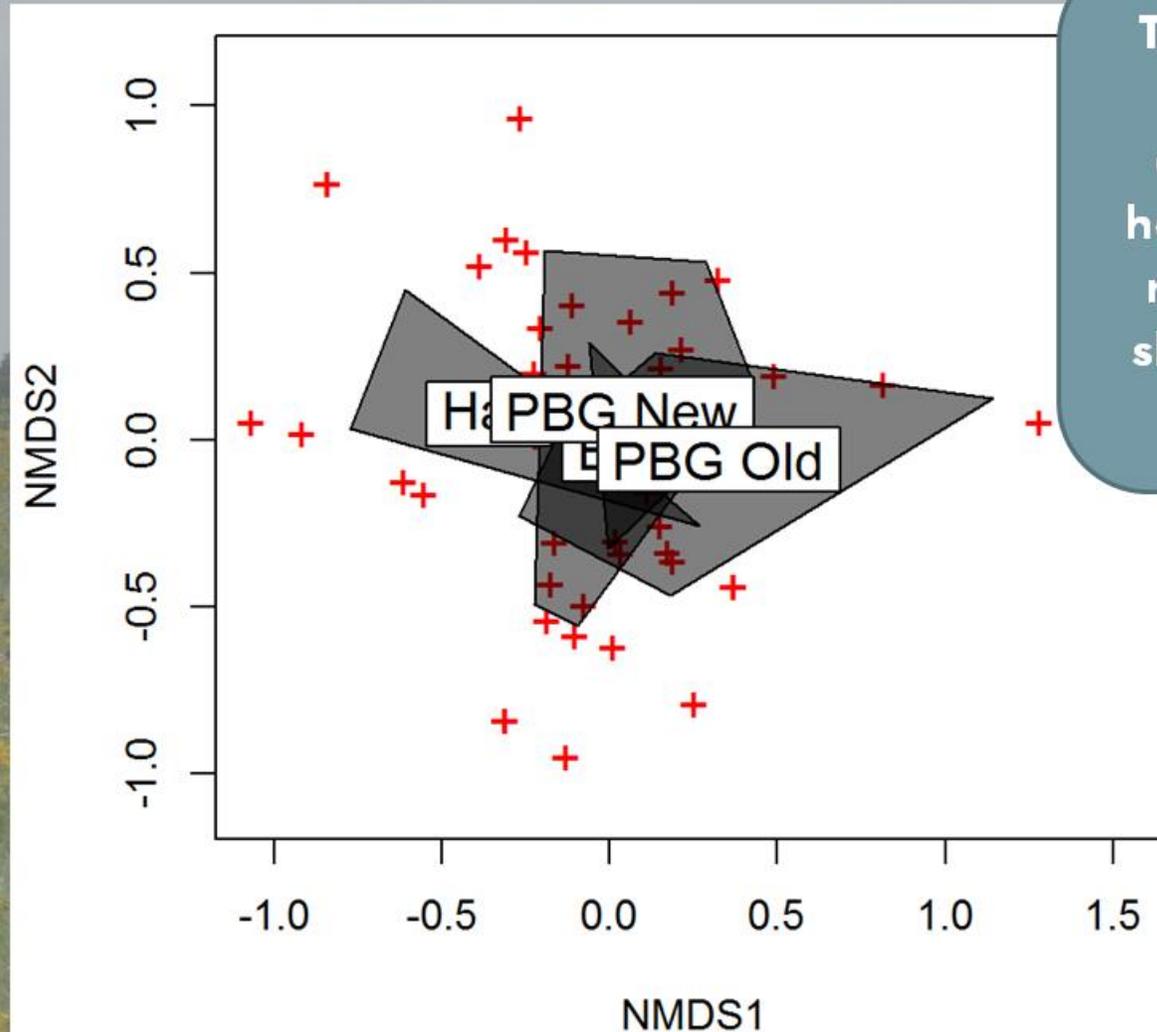
**Soil was more dense, the pH was lower and less bareground was available in grazed sites**







# Bee communities are not different between management sites



This could suggest the communities have already been largely homogenized so we do not see the effects we should see in sites that are so different

# Site Monitoring

- **Most managers want to be monitoring but also mentioned that time, money and expertise prohibit monitoring for most organisms.**
- ▣ Previous studies examining both butterflies and bees in TGP found they were negatively correlated so efforts to target one species cannot appreciably spillover to the other (Davis et al. 2008)
- ▣ Monitoring for bees specifically is necessary to better identify effective conservation strategies and provide specific information to managers.

**Only 11% of managers considered bees in the design or management of their habitats which means we are largely relying on current efforts for bee conservation.**



**But how we manage these landscapes can make a huge difference in bee conservation efforts!**

# Acknowledgements

29

## **Collaborators:**

Claire Kremen  
Tiffany Knight  
Raelene Crandall  
Stephen Hendrix

## **Current Students:**

Nicholas Anderson  
Brenna Decker

## **Previous Students:**

Nicole Wonderlin  
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# Questions?

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