Preprint:

# Importance of above- and below-ground habitat features for ground-nesting bees

**Elinor M. Lichtenberg[1], Shannon M. Collins[1,2], Avery E. Pearson[1]**

elichten@unt.edu

(1) Department of Biological Sciences and Advanced Environmental Research Institute, University of North Texas

(2) The Phoenix Conservancy

## INTRODUCTION

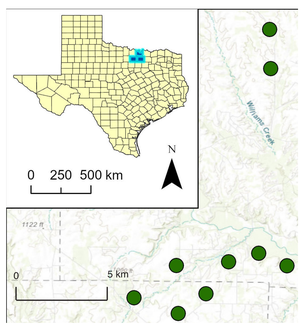
Human impacts are dramatically altering biodiversity and ecological functioning. Predicting how habitat composition alters communities of mobile ecosystem service providers remains a major challenge, in part because non-trophic resources such as suitable nesting habitat have received relatively little attention. Belowground soil characteristics may be critical for bee nesting and survival. However, most research uses bare ground as a proxy for nesting habitat.

## QUESTIONS

1. Do habitat features associated with food or nesting more strongly impact ground-nesting bee biodiversity?
2. Are above- or below-ground nesting habitat features more important determinants of ground-nesting bee biodiversity?

## STUDY SYSTEM

We collected habitat and insect data on 9 spatially-independent ranch sites that use rotational grazing over 2 years (2021, 2022) in the southern Great Plains (highlighted counties). We sampled each site in the spring, summer, and fall bloom periods.




### Bee sampling

Vane & pan traps


Netting


### Habitat factors

Floral abundance
Vegetation cover

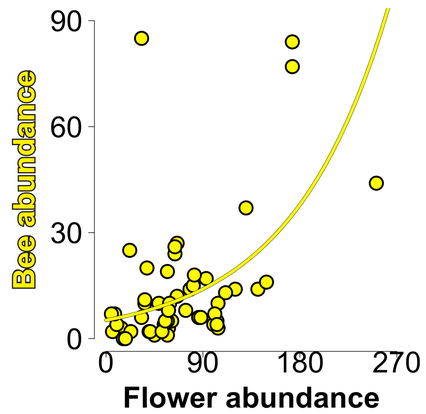

Vegetation biomass


Soil texture (% sand)
Soil compaction (bulk density)
Soil depth


## HABITAT IMPACTS ON BEES

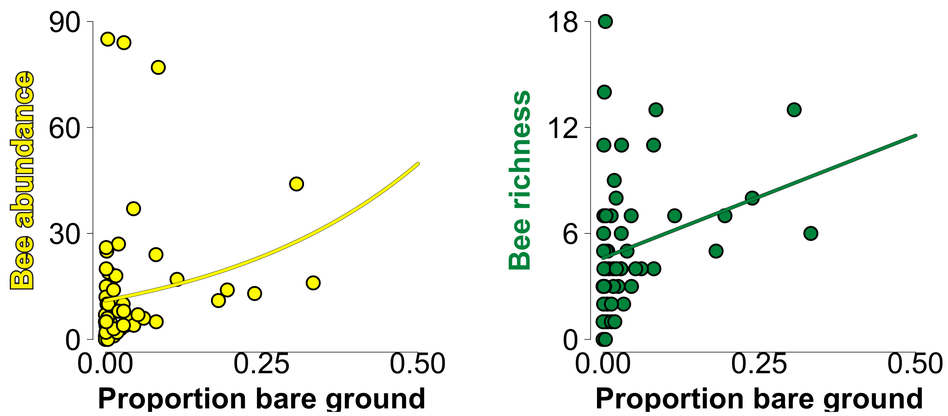
**Floral food**

More flowers increase ground-nesting bee abundance but not richness.



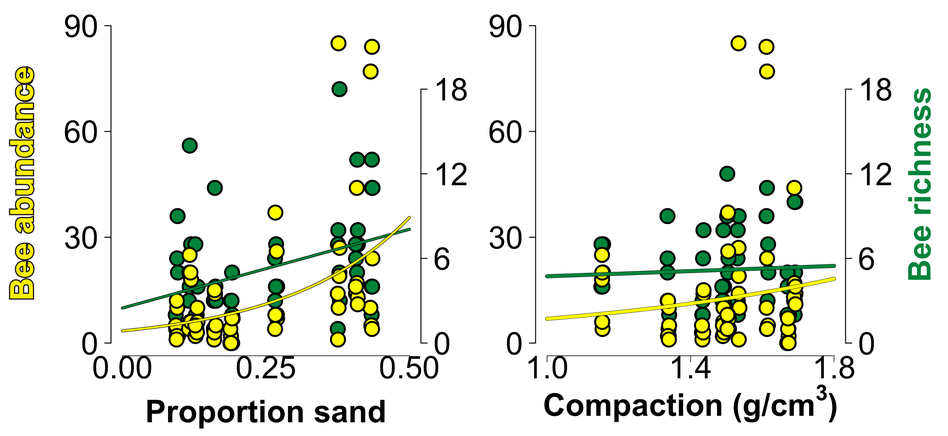

**Shelter above ground**

Bare ground cover and vegetation biomass (standing and litter) do not affect ground-nesting bee abundance or richness.




**Shelter below ground**

Sandier and more compacted soils increase bee abundance and richness.



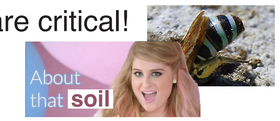

## GRAZING REST PERIOD IMPACTS ON HABITAT

Pastures with longer rest since last livestock grazing event prior to when we sampled had:

- Higher floral abundance
- More bare ground
- No direct impact on bee abundance or richness

## IMPLICATIONS

- Habitat features associated with nesting can be more limiting than food availability in grasslands.
- Soil properties are critical!




- Geographic variation in importance of soil texture? North Texas & Great Plans soils often high clay content, most research on ground-nesting bee soil texture preferences in sand & loams.

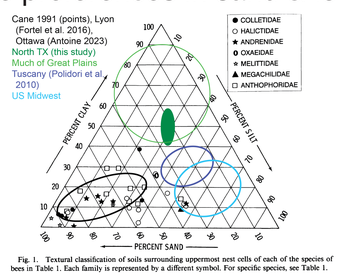



Fig. 1. Textural classification of soils surrounding uppermost nest cells of each of the species of bees in Table 1. Each family is represented by a different symbol. For specific species, see Table 1.

- Potential for management to conserve pollinators may be limited by soil properties.

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