Variation in soil composition across land types and its influence on native bee nesting

Anna Vold[1]
avold@wellesley.edu

Background

- Native ground-nesting bees are the most abundent pollinators in the tallgrass prairie in western Minnesota. Studies suggest that these bees find sandy, less dense soils easier to build nests in.
- To determine the nesting habitats of ground-nesting bees and the variation across the sampling area, soil was collected from 8 sites in western Minnesota as part of The Echinacea Project, a long-term study investigating the effects of habitat fragmentation in the prairie.
- Each sample was analyzed to determine percent sand, silt, and clay using the micropipette soil analysis method.
- This project examined the soil variation between sites, land uses, and the degree to which this correlates with bee presence/absence.

Questions

- Does soil vary between sites and land use?
- Does soil texture relate to bee presence?

Method

- We examined 8 sites spanning 6400 hectares part of The Echinacea Project with 3 land types per site(old field, remnant prairie, and restoration), each site contained 60 random points.
- We collected 10 soil samples from each location plus any additional points where a bee was captured.
- Soil texture was assessed using the micropipette soil textural analysis established by Miller & Miller (1987),

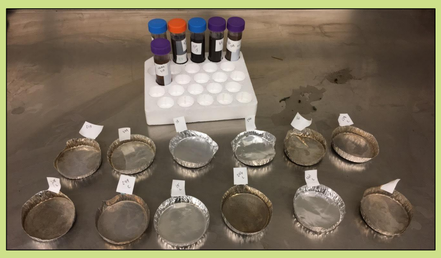
Calculations:

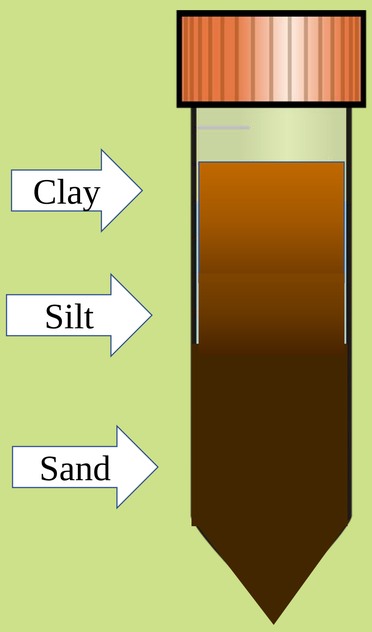
1) $\%\,Sand = (Sand\ g/Total\ g) \times 100$

2) $\%Silt + Clay = 100 - \%Sand$

3) $\%Clay = Clay\ g \times (\%Silt + Clay)$

4) $\%Silt = 100 - \%Sand - \%Clay$





Results

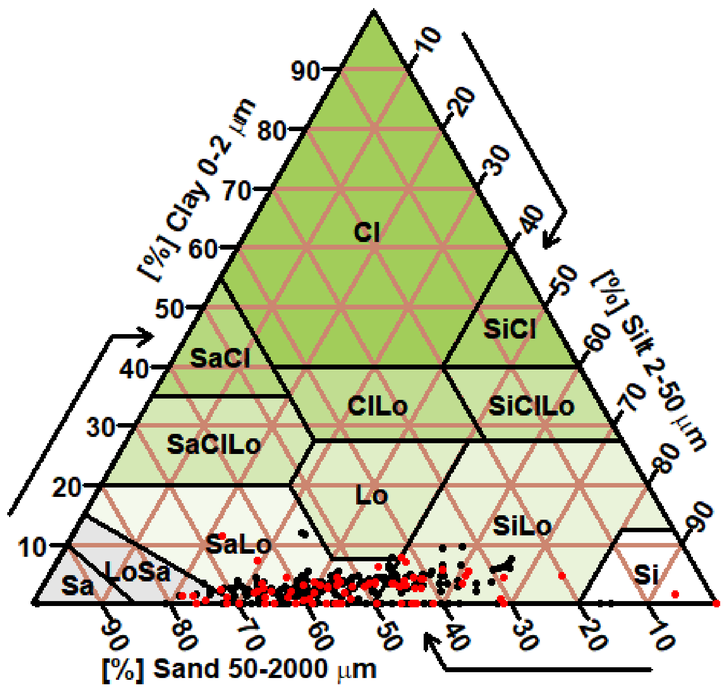


Figure 1. Soil types by All Sites. Soil types based on percent sand, silt, and clay (n= 337). Percentages determined using a micropipette texture analysis. Red dots represent soil samples where a bee was present versus black dots where a bee was not found. Most samples fell under sandy loam, silty loam, or loamy sand.

Hegg Lake, Minnesota, one of 8 sampling locations

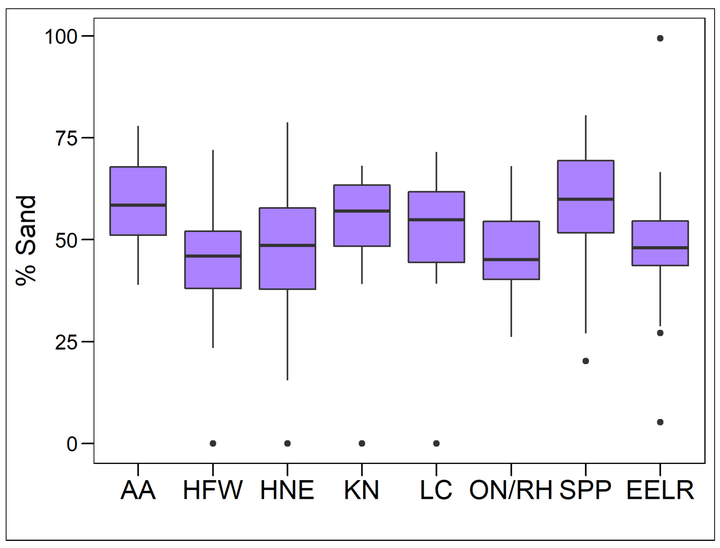


Figure 2. Percent sand variation across all eight sampling locations. Variation in mean sand percentages per location is significant ($p < 0.001$, n=337)

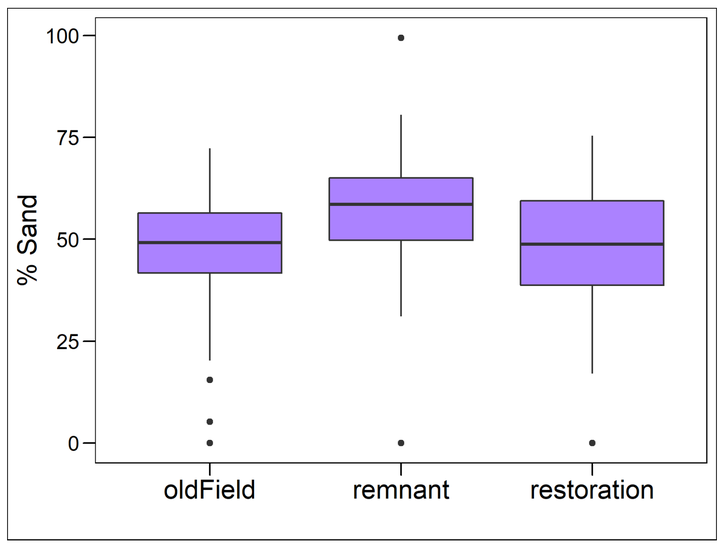
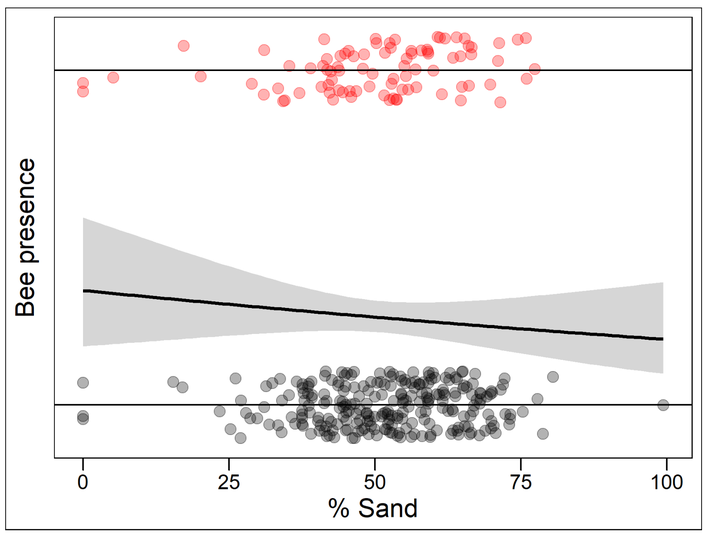
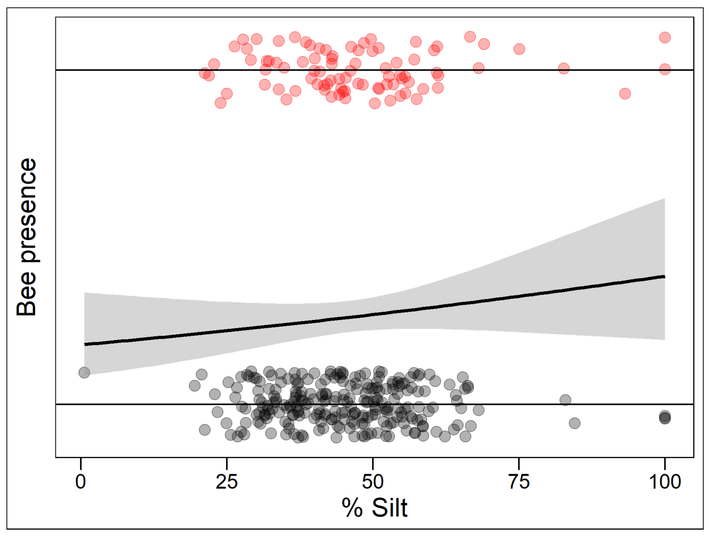


Figure 3. Percent sand variation across land use. Variation in mean sand percentages is significant ($p < 0.001$, n=337)





Figures 4 and 5 . Percent sand or silt vs. bee absence or presence. Red dots represent bee presence and black dots represent bee absence. Little variation exists between samples with and without a bee. (n=337).

- The percent of sand has no strong correlation with presence ($p > 0.05$) .
- The percent of silt also has no strong correlation with bee presence ($p > 0.05$)

Discussion and Conclusion

- A majority of samples contain higher percentages of sand and silt compared to clay, placing them in the sandy loam, silty loam, or loamy sand categories.
- According to an ANOVA , differences observed in sand percentage across sites and land use are significant.
- Remnant prairies tend to have slightly higher percentages of sand compared to other land uses.
- Surprisingly, there is no evidence that the percent of sand of silt has any influence on bee presence .

References

- Dilustro, J., Collins, B., Duncan, L., Sharitz, R. 2002. Soil texture, land-use intensity, and vegetation of fort benning upland forest sites. *The Journal of the Torrey Botanical Society* 129:289-297.
- O'Toole, C., & Raw, A. 1991. Bees of the world. *Blandford Press.*
- W. P. Miller & D. M. Miller. 1987. A micro-pipette method for soil mechanical analysis. *Communications in Soil Science and Plant Analysis*, 18:1, 1-15.

Acknowledgments

- Team Echinacea
- Stuart Wagenius
- Kristen Manion
- Louise Egerton-Warburton
- Michael LaScaleia
- Alden Griffith
- Funding provided by NSF (1557075)