

Soil composition varies with presence of *Celastrus orbiculatus*

Olivia Holley¹, Autumn E. Sabo²

¹Penn State Behrend, ²Penn State Beaver

Introduction

Invasive plant species often have high growth rates and high specific leaf areas. These traits, along with a low amount of glucose per unit of biomass, result in many invasive species decomposing faster than natives growing in the same area. These characteristics common to invasive species have the potential to dramatically alter natural ecosystems. Further insight into these effects can aid the development of techniques to slow the spread of invasive species and protect and restore native communities. **During 2021, we studied an invasive woody vine, *Celastrus orbiculatus* (Oriental bittersweet), and expected that soils where it was present would have (1) higher pH, (2) a greater concentration of minerals, (3) a greater abundance of microbes and (4) faster litter decomposition compared to areas without *C. orbiculatus*.**

Methods

At 4 sites in Penn State Beaver's woods, we sampled

- Vegetation cover by species (Figs. 1, 2)
- Soil moisture, chemistry and microbes (Figs. 1, 9)
- Leaf litter depth in May and August (Fig. 1)

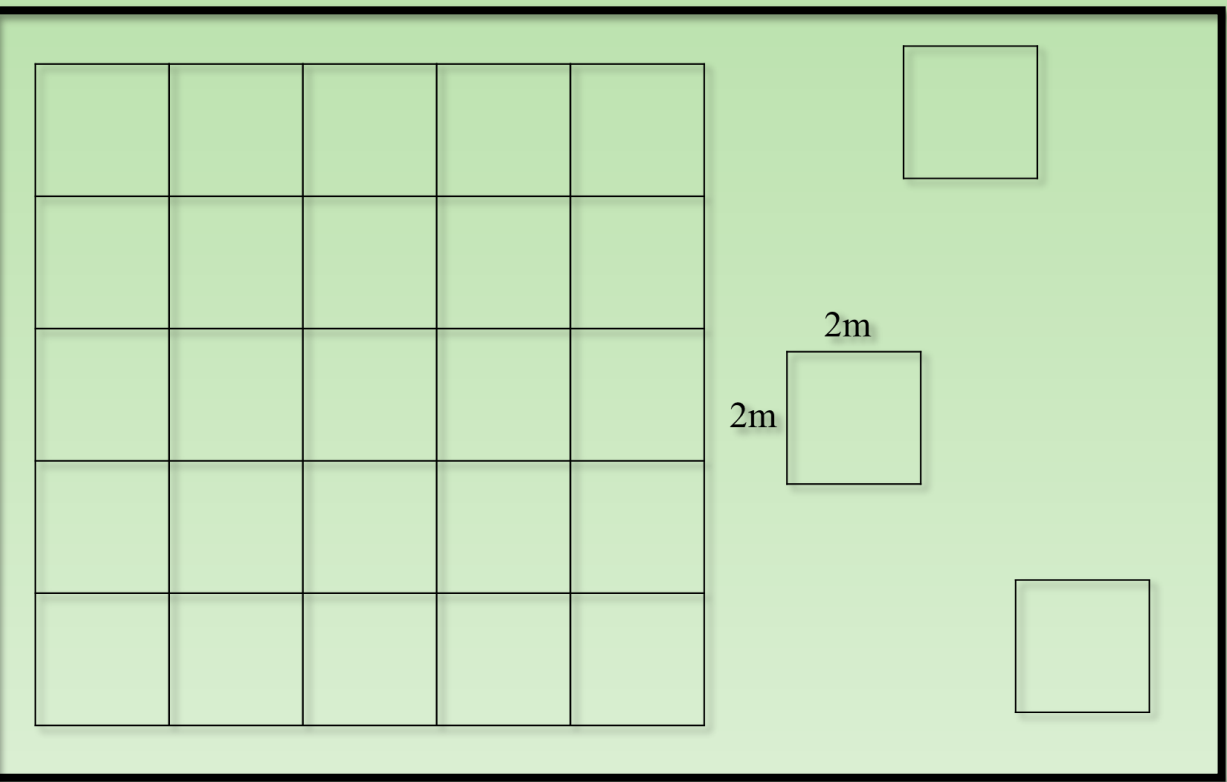


Fig. 1: Project design. Shown here is 1 of 4 sites in Penn State Beaver's woods. Each site had 28 4 m² plots where we measured vegetation, litter and moisture. Other variables were measured at only 8 of the 28 plots.



Fig. 2: Olivia Holley and Tommy Lutz measuring vascular species composition in a 4 m² plot.

Results

- In addition to showing data from plots with and without *C. orbiculatus* (Figs. 4, 6, 8), we present averages from 4 sites (Figs. 3, 5, 7) because *C. orbiculatus* was unevenly distributed. It was found in all sites but dominated most plots in Mess.
- Leaf litter average depth in May, August and loss through the summer, soil moisture and phosphorus concentrations in soil, were not significantly different between plots with and without *C. orbiculatus*.

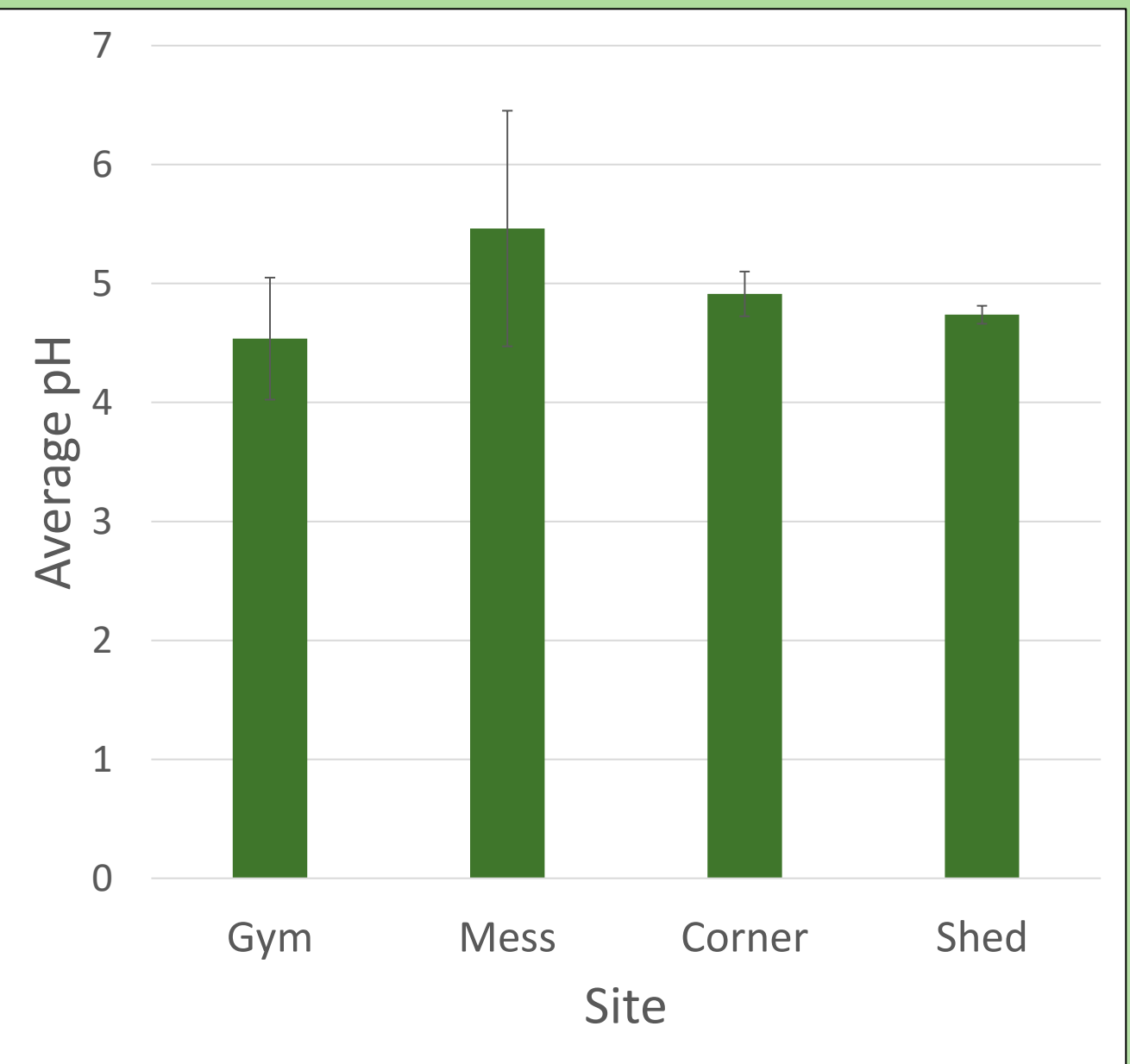


Fig. 3: Average soil pH (across 8 plots per site) and standard errors in 4 sites located across Penn State Beaver's woods.

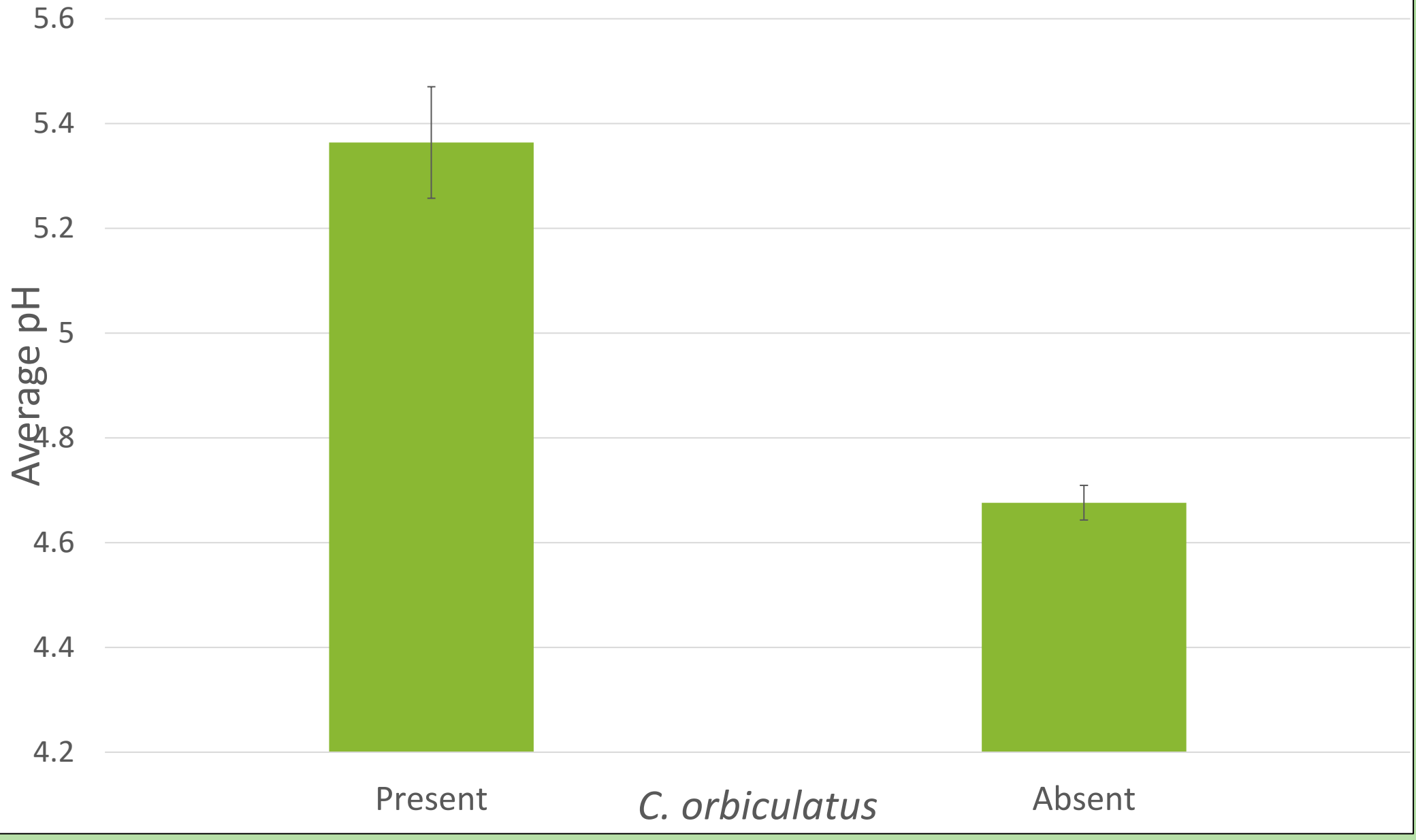


Fig. 4: Average soil pH and standard errors in plots with (11 plots) and without (21 plots) *C. orbiculatus* located in 4 sites across Penn State Beaver's woods ($P < 0.001$).

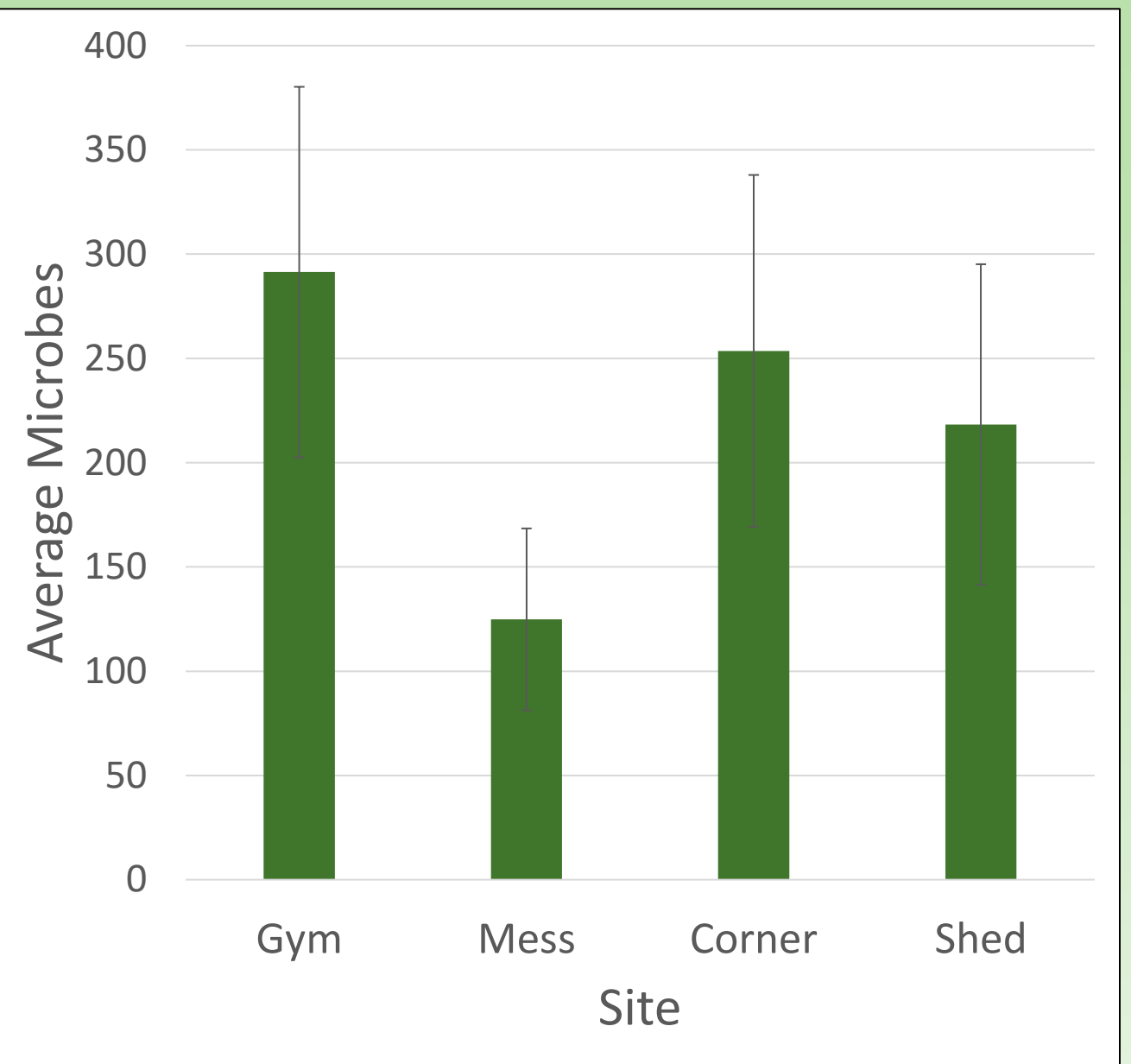


Fig. 5: Average soil microbial biomass (bacteria and fungi) and standard errors sampled from 8 plots in 4 sites located across Penn State Beaver's woods.

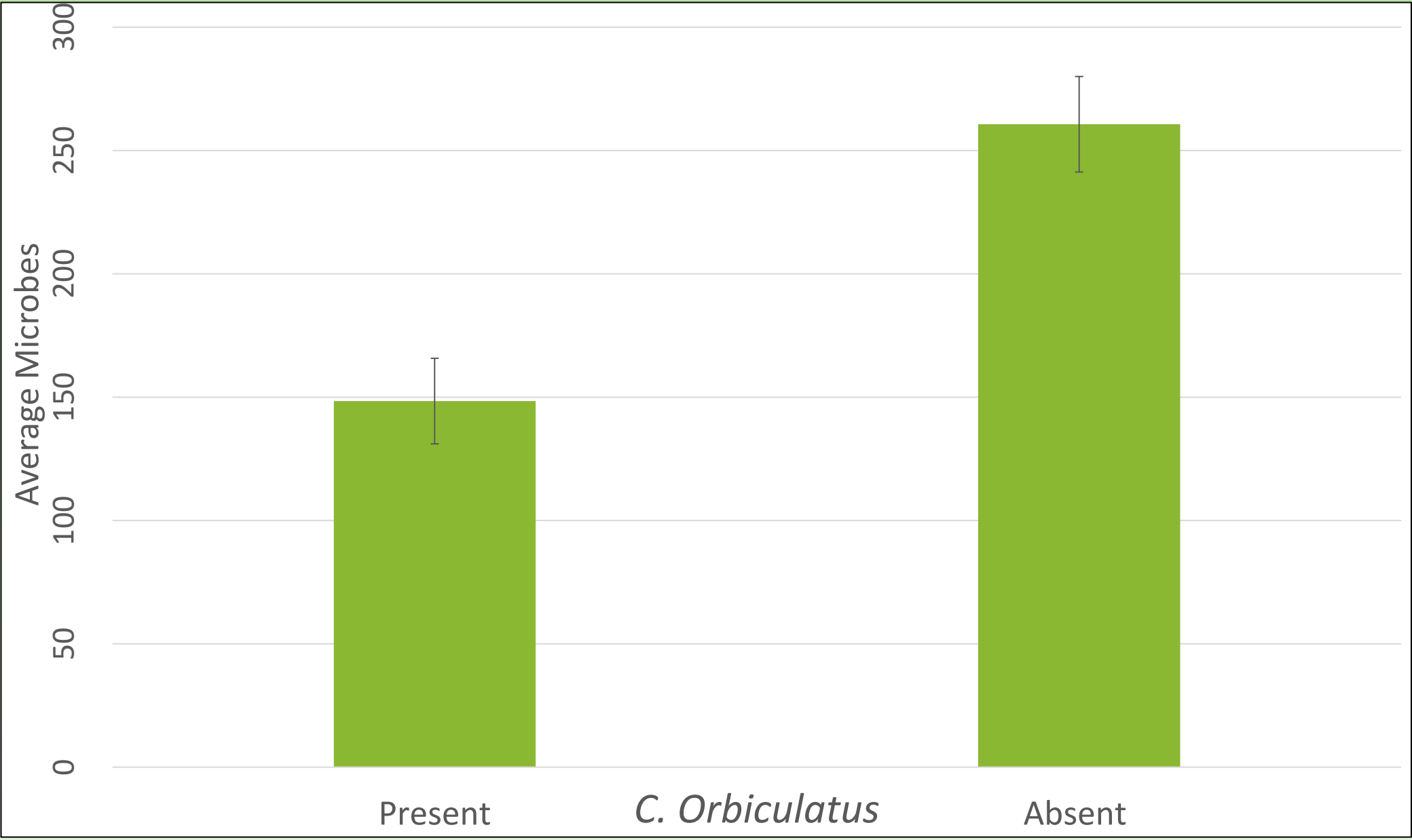


Fig. 6: Average soil microbial biomass (bacteria and fungi) and standard errors in plots with (11 plots) and without (21 plots) *C. orbiculatus* located in 4 sites across Penn State Beaver's woods ($P < 0.001$).

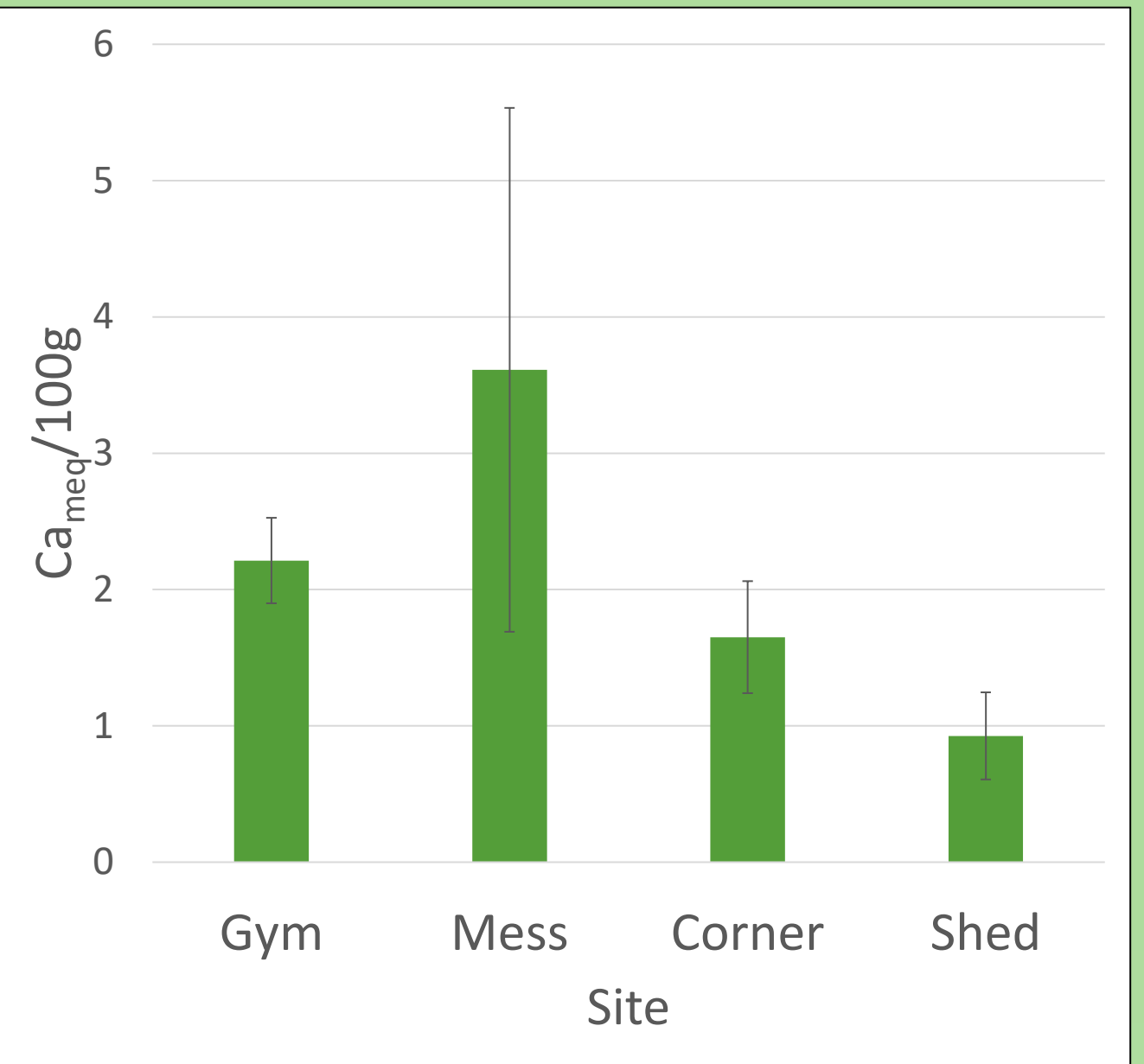


Fig. 7: Average Ca meq/100g (across 8 plots per site) and standard errors in 4 sites located across Penn State Beaver's woods. Results were similar for Mg meq/100g and K meq/100g.

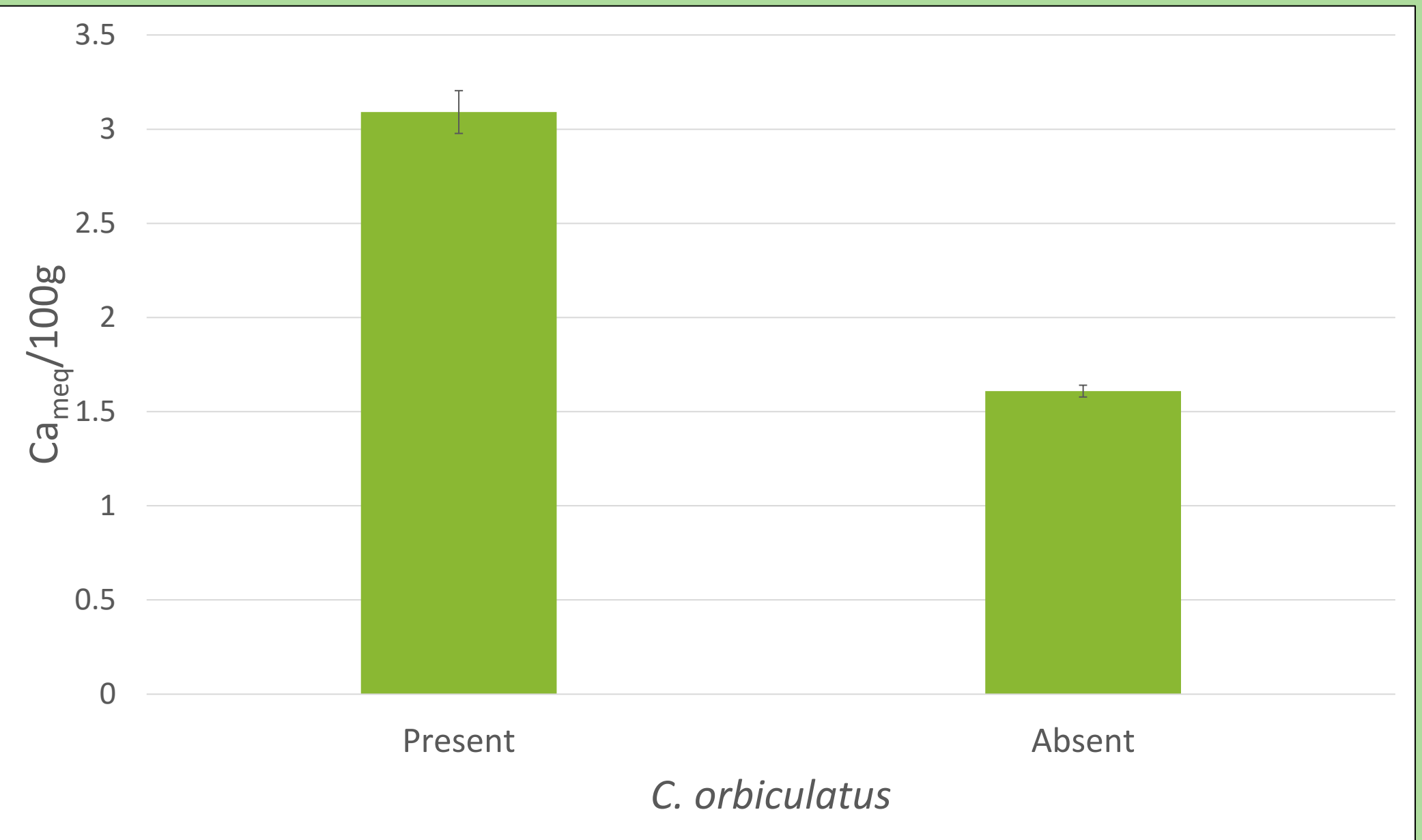


Fig. 8: Average Ca meq/100g and standard errors in in plots with (11 plots) and without (21 plots) *C. orbiculatus* located in 4 sites across Penn State Beaver's woods ($P < 0.001$). Results were similar for Mg meq/100g and K meq/100g.

Discussion

Based on preliminary analyses, we observed higher soil pH and a higher concentration of soil Ca, Mg and K where *C. orbiculatus* was present v. absent, partially supporting our hypothesis. Contrary to our expectations, soil microbial biomass was lower with *C. orbiculatus* v. without, and we found no relationships with soil phosphorous or leaf litter.

Our results agree with others who have found that invasive species contribute to greater nutrient concentrations in the soil. This may result in a positive feedback, facilitating invasive species attaining even greater dominance.

We will continue investigating mechanisms behind soil chemistry correlations since we did not find higher microbial biomass nor faster leaf litter decomposition with *C. orbiculatus*. Future observations post-removal of *C. orbiculatus* may help us confirm if the species caused changes to the soil or if soil conditions may have driven the patterns we observed in the species.

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Fig. 9: Olivia Holley (top left) and team estimating biomass of soil microbes using microBIOMETER.

Future Analyses

- Nesting plots within sites and adding plot as a random variable
- Canopy openness data
- Soil CO₂ flux data
- Separate bacteria and fungi microbial data