



Left: CZO Sandstone Site

Does Root Morphology and Architecture Reflect Aboveground Species Composition?

Mieke Vrijmoet¹ and David Eissenstat²

¹Penn State University CZO REU, Bennington College

²Penn State University



Right: Roots being cleaned and prepped for scanning.

The architecture and morphology of roots remains sparsely documented and poorly understood in forest ecosystems.^{2,3} **What commonly measured aboveground traits can be used to predict belowground characteristics?**⁴

Research Questions

- To what extent are aboveground forest characteristics reflective of belowground morphology?
- Does root architecture and morphology in the O-Horizon reflect aboveground species composition?
- Does stand density or the importance value of the vegetation correlate with root length density or root biomass in the O-Horizon?

Research Methods and Study Site

- Collected samples of the soil O-Horizon at 13 locations at the Sandstone Site, part of the Susquehanna Shale Hills Critical Zone Observatory.
- Each sample location represented by two O-Horizon cores taken within a 10m x 10m plot of surveyed vegetation.
- Three tree species present in plots: Sweet Birch (*Betula Lenta*), Red Maple (*Acer rubrum*), and Oak species (mainly *Quercus prinus*, *Quercus rubra*).
- Species composition and tree density varied, slope position held constant.



Collecting O-Horizon samples on a rainy day in the field.

- Cleaned roots were scanned and measured in WinRhizo.⁵ Information for each sample included total root length, root tip density, root volume and diameter, and root surface area.
- Analyzed measurement data to determine which forest traits were correlated with the root traits. Root traits were averaged from the two samples measured within each plot.

Results

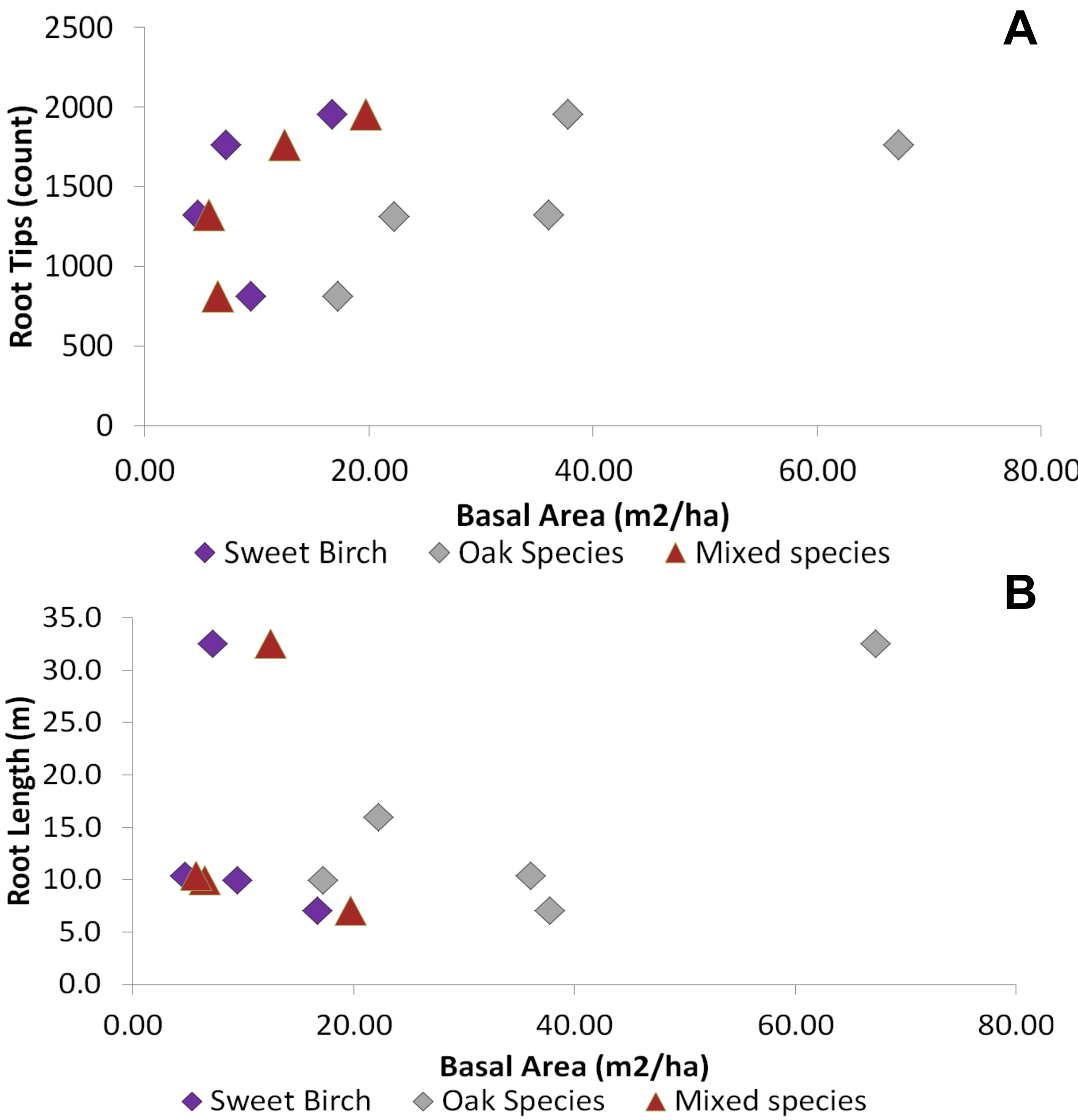


Fig. 1. Relationship of A. number of root tips and B. total root length in O-horizon with tree basal area (of trunks) for oak dominated, birch dominate and mixed plots. We found no evidence of increasing root number or length with increasing aboveground stand biomass. We also did not find that oaks differed from birch in number or length of roots. Both Birch dominated plots and Oak-dominated plots showed a variety of root length densities.

	Avg Individual Root Length (mm)	Average Diameter (mm)
Sweet Birch dominated	9.0+/-4.1	0.25+/-0.06
Oak Species dominated	4.2+/-3.0	0.25+/-0.05
Mixed species	3.9+/-2.11	0.25+/-0.07

Table 1: Root Morphology varied slightly between Oak and Birch plots. Oak species seem to have shorter roots, but more samples are needed.

Conclusions

Root architecture and morphology do not reflect aboveground species composition or stand density. Belowground species distribution and architecture may not be in parallel to that observed aboveground, or a more precise assessment is needed.

Discussion

- Limited range of species compositions and density sampled.
- Future research may sample a more diverse array of sites with more tree species, more diverse plots, and range of densities.
- Assumed even distribution of roots within plots, but the lateral distribution of roots should be tested and accounted for more precisely in future O-Horizon surveys.^{6,7}
- Commonly measured forest composition measurements may not be enough to assess belowground root architecture.
- Soil traits, understory composition, or other tree measurements, could potentially serve as predictors.

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