Anthropogenic impacts alter richness-abundance relationship in woody plant communities

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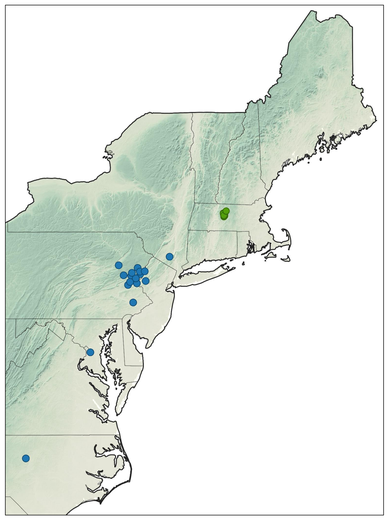
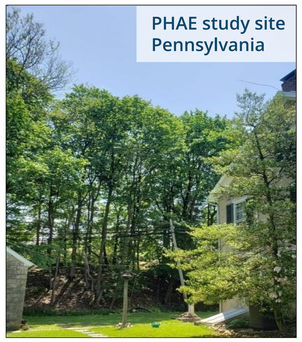
Background

Plant communities can be characterized in many ways, including species richness and abundance of individual plants, but the relationship among these characteristics may vary depending on environmental context.

The goal of our study was to assess how the relationship between species richness and individual abundance varies depending on human influence on a landscape.



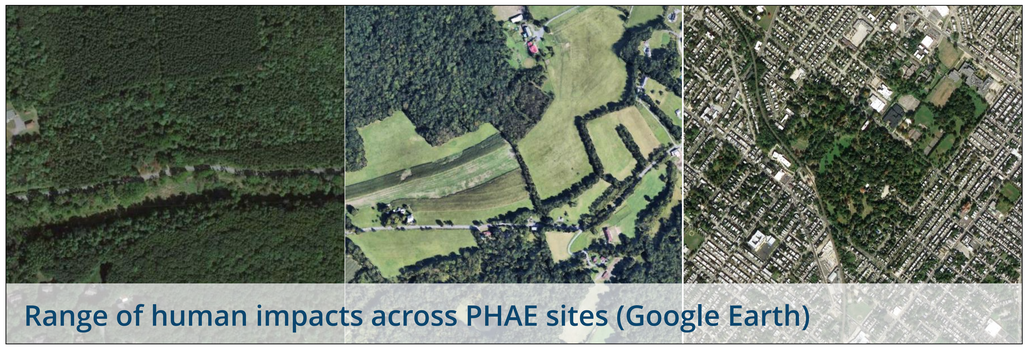


Map of study plot locations (PHAE, shown in blue) and Harvard Forest reference plots (NEON, shown in green)

Surveying plant communities

In 2020, we characterized woody plant communities in seventeen 400-m^2 plots In the American Northeast as part of an Ecological Research as Education Network (EREN) study focused on studying Plants in the Human-Altered Environment (PHAE). Woody plants with a diameter >1 cm at breast height (1.3 m) were identified to species and tallied to determine species richness and abundance in each plot.

Quantifying human impact

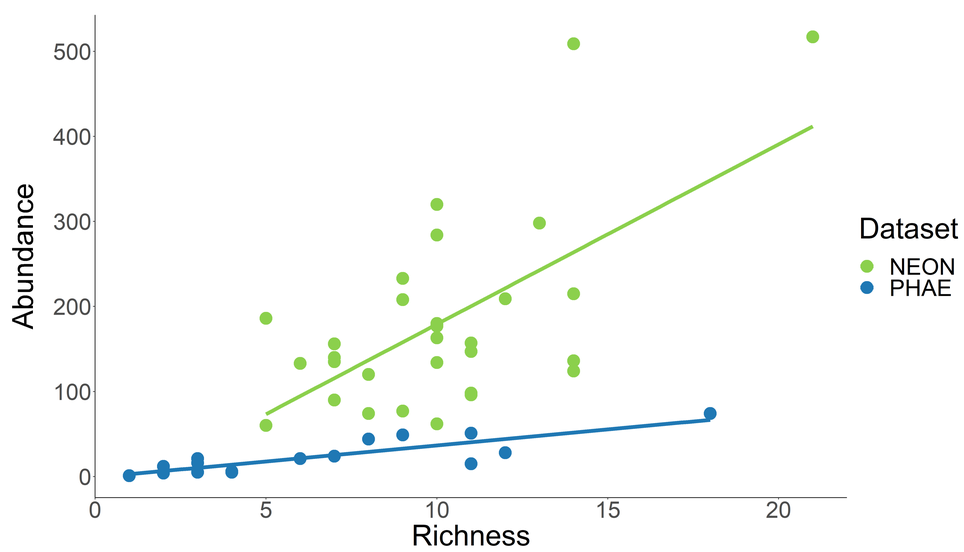


Range of human impacts across PHAE sites (Google Earth)

We compared these plant communities in human-altered environments (n=17) to reference woody vegetation plots of the same size (n=30) from the Harvard Forest site (central Massachusetts) of the National Ecological Observatory Network (NEON).

The relative human impact was quantified by estimating the area of impervious surface in the plot (average 15% in local plots, no impervious surface in NEON plots), as well as determining in-plot canopy cover using the National Land Cover Dataset (average 56% in local plots, average 83% in NEON plots).

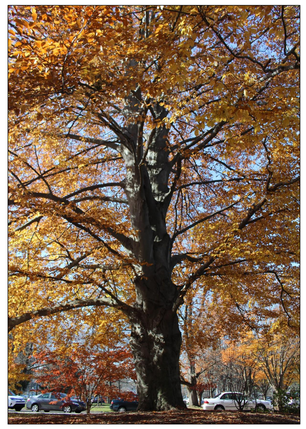
Human impact alters the richness-abundance relationship



Although the relationship between richness and abundance is positive in both reference and human-impacted (PHAE r = 0.85; NEON r =0.62), woody plant abundance is much lower even as species richness increases in landscapes affected by humans (ANCOVA, $p_{interaction}$ = 0.003).

Conclusions

This result suggests that human impacts have a more negative effect on abundance than richness, perhaps due to retention of larger diameter woody plants and removal of smaller woody plants during land conversion activities.



Humans may curate landscapes to contain fewer yet larger trees, so that overall woody plant abundance is low relative to the number of species

By comparing local human-altered environments to reference sites, we can better understand the effects of our anthropogenic influence in these landscapes.

Acknowledgments

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Reference data were obtained from the NEON Woody Plant Vegetation Structure data product (data.neonscience.org/data-products/DP1.10098.001).

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