



The Effects of Deer, Light, and Competition on *Podophyllum peltatum*

Erin Ziegler, Jacob Beidler, Douglas Becker and Rebecca A. Urban
Biology Department, Lebanon Valley College, 101 N College Ave, Annville, 17003



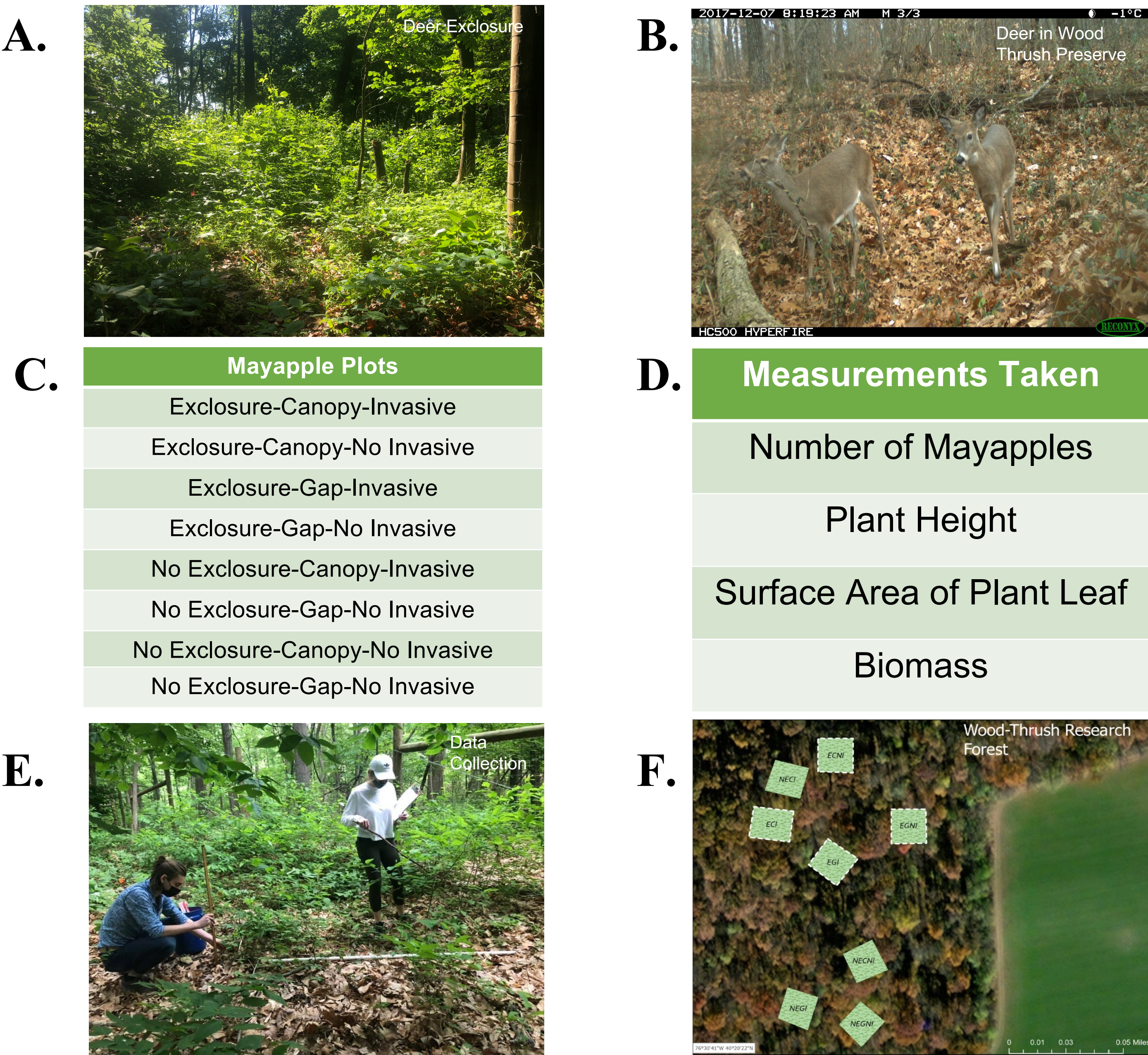
Background

Mayapples (*Podophyllum peltatum*) are an understory perennial woodland flowering plant characterized by short reproductive lifecycles in the early spring. They quickly bloom and produce seeds when resources such as light are abundant, prior to leaf out and canopy formation from more dominant deciduous woody plants. Spring wildflowers such as mayapples can be susceptible to changing environmental conditions. Forests throughout Pennsylvania are changing due to deer overabundance and the introduction of invasive species (Jackson et al. 2017). The objective of this study was to compare mayapple abundance, growth, and reproduction with increased light, reduced deer, and less competition from invasive species. We hold continued interest in understanding which of these factors will have the most extensive effects on the mayapples.

Methods

Mayapples naturally occurred in eight 20 m x 20 m plots that varied in deer (present vs. absent), invasive species (present vs. absent), and light availability (gap vs. canopy)

These experiments were conducted in the Wood Thrush Research Preserve at Lebanon Valley College (Annville, Pennsylvania, USA).



Results

Table 1. Total number of mayapples and % reproductive across the sampling plots

Plots	Total Number of Mayapples	Percent Reproduction
NE-C-I	63	0%
NE-C-NI	445	0%
NE-G-I	98	0%
NE-G-NI	92	0%
E-C-I	753	8.8%
E-C-NI	1557	9.8%
E-G-I	885	25.0%
E-G-NI	1716	29.0%



Figure 2. Photographs of mayapples across the experimental plots .

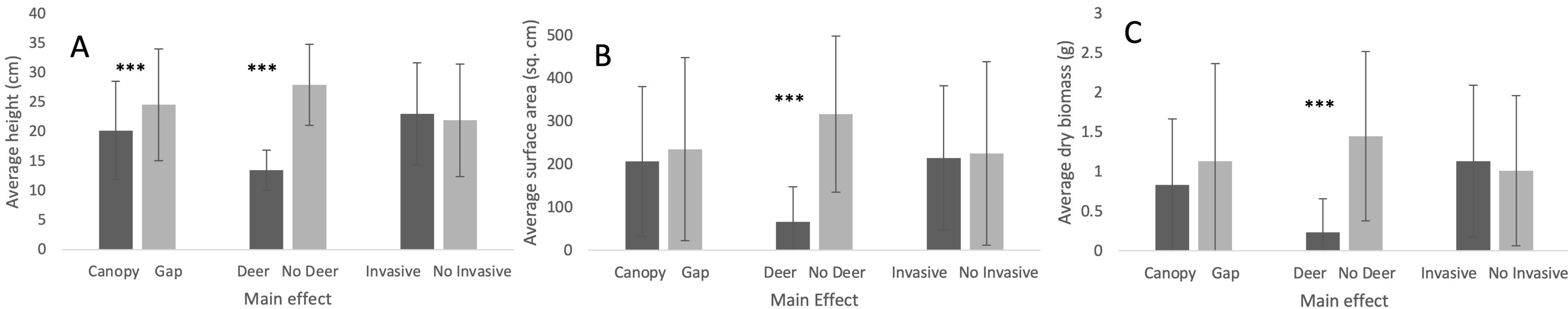


Figure 1. The effect of deer, light, and invasive species on the average height (A), surface area (B), and dry biomass (C) of Mayapples in the Wood Thrush Research Forest, Annville, PA. Error bars represent ± 1 standard deviation. Significant differences are represented by asterisks (*: $p \leq 0.05$, **: $p \leq 0.01$, ***: $p \leq 0.001$).

Discussion

The presence of deer and invasive species detrimentally affected the abundance of the mayapples, with deer being the strongest negative factor. Overall, plots with deer excluded, invasive plants removed, and canopy cover created conditions supporting high mayapple abundance. While the effects of deer, invasive plants, and light are evident in the present, continued research is needed to verify if these effects persist or if they change temporally, especially as forest gaps undergo succession. It will be important to study community dynamics in light gaps to determine if they become more similar to canopy locations or if differences that we observed presently persist more long-term. Research is also needed to understand more fully the competitive dynamics between spring wildflowers and how these interactions might alter the response of different plants to other environmental stressors.

Literature Cited

1. Aronson, M., and S.N. Handel. 2011. Deer and invasive plants suppress forest herbaceous communities and canopy tree regeneration. *Natural Areas Journal* 31:400–407.
2. Cote, S.D., T.P. Rooney, J.P. Tremblay, C. Dussault, and D.M. Waller. 2004. Ecological impacts of deer overabundance. *Annual Review Ecology Evolution and Systematics* 35:113–147.
3. Dávalos, A., V. Nuzzo, and B. Blossey. 2014. Demographic responses of rare forest plants to multiple stressors: The role of deer, invasive species and nutrients. *Journal of Ecology* 102:1222–1233.
4. Jackson, D.R., M.T. Wolf, and J. Finley. 2017. Regenerating hardwood forests: Managing competing plants, deer, and light. Available online at <https://extension.psu.edu/regenerating-hardwood-forests-managing-competing-plants-deer-and-light>

Acknowledgments

We thank the Edward H. Arnold and Jeanne Donlevy Arnold Grant and John Galat for funding our research. We also thank the many students who spent long hours in the continuous effort to clear invasive species from the plots.