

# Oh Deer! Impacts of Deer on Forest Ecosystems

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## Introduction



Plant coverage measurements being taken in a deer enclosure

Deer enclosures are a common tool used by ecologists to determine effects of deer presence on plant life in an ecosystem.

We were tasked by Matt Dykstra, the head of the Calvin University Ecosystem Preserve, to analyse data taken from Pierce Cedar Creek Institute. His goal is to ensure the long-term survival of species, with a particular focus on native and rare plants. Matt asked us to evaluate how white-tailed deer overpopulation affects forest understory and ecosystem health by analyzing changes in vegetation cover inside and outside the enclosures over a nine-year period. The data included measurements of plant coverage by species for four different sites, each with a control and a fenced area. There were measurements taken twice a year, once in spring and once in summer.

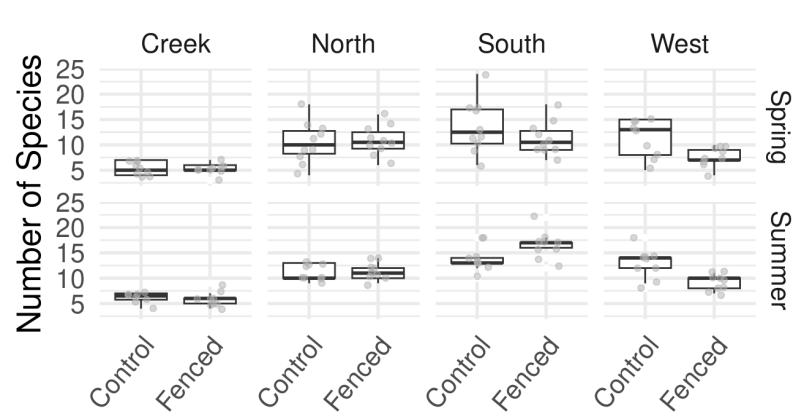
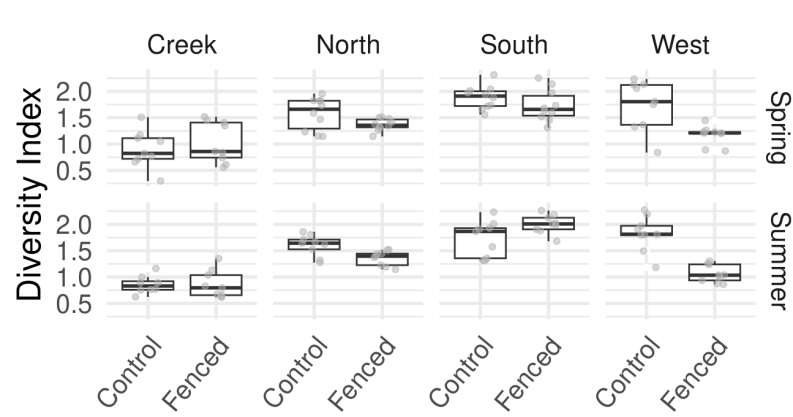
White-tailed deer have been found to have a significant effect on understory plants. It has been found that they reduce the survival rates of tree saplings (Russel et al. 2001), reduce the prevalence of shrubby plants (Joseph et al. 2008) and their impacts are generally more concentrated in areas of partial cover (Gerhardt et al. 2013).

## Research Question

**How does deer presence affect plant diversity, controlling for possible effects of season and site?**

To answer this, we calculated the richness and Shannon-Wiener diversity index from the data we were given for each combination of site, season, and year.

## Data Exploration



We can see in these graphs an inconsistent effect of the enclosures on diversity and number of species across the different sites. This could point to external factors not in the data having an impact we can't model.

## Statistical Modeling

We fitted a linear model with the response variable diversity. Predictors we included were:

- Interaction between site and fencing, meaning the effect of fencing varied by site
- Random effect of season nested in site nested in year, allowing for more variation across seasons, sites, and years

Our model passed tests for linearity and normality, independence, and constant variance of residuals.

## Results

Our model shows very strong evidence (p-value < 0.0001) that suggests fencing and site interact in affecting plant diversity. The direction of this effect is ambiguous, and varies by site, season, and year. This may suggest that fencing does not have much of an effect at all and there are other variables at play.

## Our Experience

- We tackled and overcame challenges in independent residual assessments, which is crucial in ensuring the accuracy and reliability of linear model fitting.
- We learned how to create graphics containing multiple variables and how to format them cleanly.

## Acknowledgements

- Thanks to our project partner, Matt Dykstra, for providing us with this interesting project to work on, and suggesting to use the Shannon-Wiener diversity index in our analysis.
- Thanks to Professor DeRuiter, for helping us with data wrangling, diversity calculations, and other problems that came up.

## Works Cited

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