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Quantifying nutrient input from white-tailed deer calving sites

Research Highlights

- Large mammals can alter nutrient cycles, impacting local to landscape level ecosystem processes. As a result, researchers are actively trying to uncover the various mechanism in which these impacts occur.
- The role of calving on nutrient cycles has yet to be explored.
- We created experimental calving locations, in which we simulated the deposition of nutrients related to white-tailed deer calving.
- We explore the role of large herbivore calving on nitrogen cycling and carbon storage.

Research Summary

Historically, biogeochemical theory and models have assumed that nutrient cycling and carbon storage are moderated by nutrient limitation, water limitation, microbial activity, and abiotic characteristics. However, recent research indicates that animals contribute and remove nutrients within ecosystems, processes that drastically alter nutrient cycling and soil biogeochemistry. This new and exciting line of work has shown we have long overlooked an important aspect of nutrient cycles - the animals. As such, the new field of zoogeochemistry has evolved to explore how animals are impacting nutrient cycles.

White tailed deer are abundant and widespread throughout the northeast of the United States, and in southern Connecticut densities can reach beyond 23 deer/km^2. The role white-tailed deer play in nutrient cycle is an area of active research, and work has indicated that through the deposition of carcasses, they can drastically increase local nitrogen availability (Bump et al. 2009). Given plant growth in many ecosystems inhabited by white-tailed deer is limited by nitrogen, understanding the mechanism in which these animals interact with the nitrogen cycle can elucidate their role in forest ecosystem functioning.

Applying a nitrogen-rich urea solution to the soil to compare with simulated deer calving sites

Research Summary cont.

While the role of large herbivore carcasses and fecal matter deposition on nutrient cycles is actively being researched, the impact of birthing materials inputs during calving is unexplored. Birthing material expelled during calving is nutritiously rich. Additionally, calving normally occurs around the time of green-up and leaf-out, and may be an important source of nutrients during this period of transition. In this project we seek to identify and quantify the nitrogen pulses from white-tailed deer birthing material as well as how these pulses may impact carbon storage in the ecosystem.

During the summer of 2022, our team created 20 experimental calving sites as well as 10 control sites. At these sites we measured various pools of nitrogen and carbon within the ecosystem, including the nitrogen and carbon content of the plant leaves, plant stems, plant roots, and soil. We also explored a few other metrics, including the available nitrogen in the soil and the response of the microbial biomass.

This project will provide new insight into zoogeochemical processes. Specifically, we will explore a mechanism of herbivore impact that has yet to be explored – calving. As ecologists actively seek to 'animate' nutrient cycles, we hope to better understand the role of animals in soil dynamics and ecosystem nutrient budgets allowing for more accurate global nutrient models and ecosystem budgets.

Les Welker, Eli Ward, and Kristy Ferraro out in the field at Yale-Myers Forest

Taking soil samples at each site to measure nitrogen fluxes

Works Cited

Bump, Joseph K., et al. "Ungulate carcasses perforate ecological filters and create biogeochemical hotspots in forest herbaceous layers allowing trees a competitive advantage." *Ecosystems* 12.6 (2009): 996-1007.