Pathways and Patterns of Plant Litter Chemistry throughout Decomposition
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Introduction
- Decomposition is the breakdown of dead organic material into smaller particles, releasing nutrients for plant and microbial production. It is vital for carbon regulation and nutrient cycling, soil formation, and fundamental to energy flow in food webs.
- Plant litter chemistry can alter decomposition, yet few studies have examined the chemical composition of plant litter throughout decay. The majority of studies measure the initial plant litter chemistry, focusing on carbon and nitrogen, and presume that the initial measures will explain how litter will behave throughout decomposition.
- The main goal of this project is to test the assumption that initial plant litter chemistry predicts the route taken by plant litter during decomposition and examine the chemical pattern change in systems with different biotic and abiotic environments.
- Figure 1 below demonstrates the three potential pathways by which litter chemistry can change during decomposition.

Results
- Figure 2 (left) and Figure 3 (right) above support all three hypotheses. Depending upon the parameter considered, chemically unique plants remained unique throughout decomposition, chemically unique plants converged throughout decomposition, and chemically similar plants diverged throughout decomposition.

Methods
- The litter samples were collected from archived Long-Term Ecological Research (LTER) study sites.
- The litter samples were single species, untreated, and from their native environment.
- The following analyses were conducted:
  1) Carbon to Nitrogen ratio measured using an elemental analyzer.
  2) Pyrolysis Gas Chromatography Mass Spectrometry (Py-GCMS) to measure major compounds detectable through mass spectrometry (lipids, lignin, proteins, phenols, etc.).
  3) Fiber analysis by conducting a sequential acid digestion.
  4) Phosphorous and micronutrients were measured by doing an elemental analysis on an inductively coupled plasma optical emission spectrometer (ICP-OES).

Discussion
- The results support all three hypotheses portrayed in figure 1.
- There is evidence that follow the pattern where unique initial chemistry maintains through time.
- There is also evidence for convergence of litter chemistry.
- However, there is also evidence for divergence of litter chemistry.

Future (continuing) Research
- We will continue to collect archived litter samples from completed decomposition studies across the LTER network and analyze the complete set of litter chemistry parameters.
- We have an ongoing project at the Central Arizona-Phoenix LTER site located in the White Tank Mountains studying cactus decomposition of two different cacti species: Opuntia chilcotica (Pancake prickly pear) and Cylindropuntia acanthocarpa (Buckhorn cholla).
- We hope to get a detailed look at cactus decomposition, an important yet understudied functional group in the Sonoran Desert, studying nutrient cycling and water dynamics.
- Once the samples are collected, we will run a handful of tests including: C:N ratios and an elemental analysis to measure phosphorous and micronutrients.
- We will then compare the chemical composition of leaf versus cactus litter, as well as the two different cacti species.

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