

# Changes in soil microbial communities and processes across a land-use gradient

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## RESEARCH OBJECTIVE

To advance our conceptual and practical understanding of the fundamental relationships between soil microbial communities and soil biogeochemical cycling

## SYNOPSIS

- We know that microbial communities are a key driver of carbon and nutrient dynamics in terrestrial dynamics.
- We do not know how belowground community structure is linked to soil processes. *Do we need to study soil microbial communities if we want to understand and predict terrestrial biogeochemical cycling?*

## METHODS

- Research focused on 4 land-use types in the Calhoun Experimental Forest, South Carolina (Fig. 1)
- Conduct complete biotic and abiotic characterization of the soils at each site (Fig. 2)
- Use molecular techniques to compare bacterial, fungal, archaeal, and metazoan communities across seasons and across sites. (Fig. 3)
- Use stable isotope techniques to compare carbon and nutrient dynamics across the sites/seasons (Fig. 4)



Fig. 1: Representative sites from the land-use gradient (N=3 per land-use type) in the Piedmont region of South Carolina.

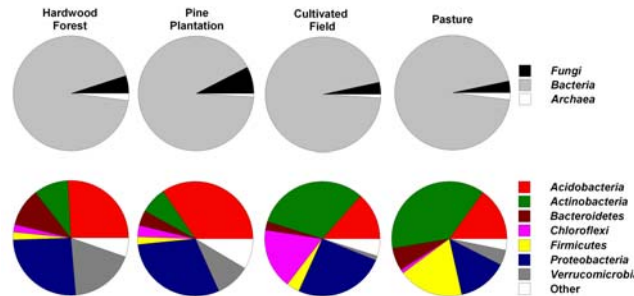


Fig. 3: Differences in microbial communities across the 4 land-use types in September 2006. Fungal, bacterial, and archaeal abundances estimated by quantitative PCR. Abundances of bacterial phyla determined from clone libraries of 16S rDNA.

**All of the soils are bacterial-dominated but there are significant differences in bacterial:fungal ratios and the types of bacteria found across the gradient.**

## FUTURE WORK

- Proteomic analysis of soil microbial communities
- Identify microbial groups associated with the decomposition of individual substrates
- Comparison of soil viral communities
- Influence of N deposition on soil carbon dynamics
- Analyses of microbial volatile organic compound (VOC) production

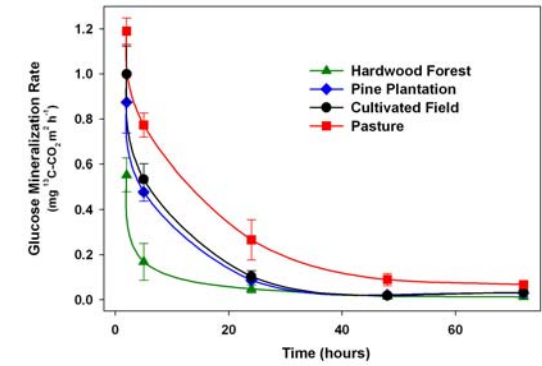


Fig. 4: Results of a field pulse-chase experiment conducted over 72 h in Dec. 2006 where <sup>13</sup>C-labeled glucose was added to soils.

Soils are distinct with respect to their ability to mineralize glucose. Preliminary analyses suggest that these differences in carbon dynamics are correlated with shifts in bacterial community composition between land-use types.

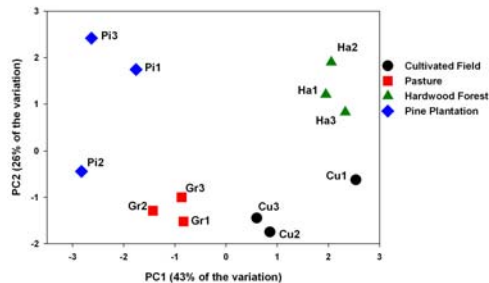


Fig. 2: Principal components analyses of the soils from the four land-use types based on measured environmental characteristics (pH, texture, moisture, nutrient contents, microbial biomass, etc.)

*Soils from similar land-use types are similar with respect to general edaphic characteristics and land-use has an important influence on soil properties.*

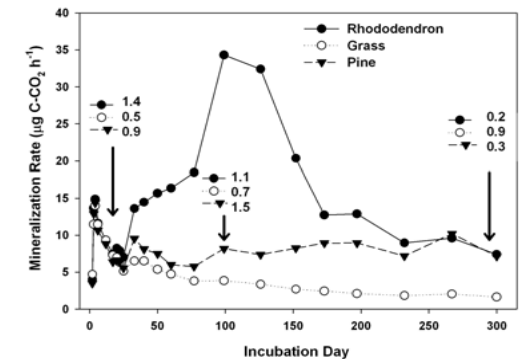


Fig. 5: Results of the "microbial succession study" showing C mineralization rates as rhododendron litter decomposes with 3 different source inocula. We used molecular techniques to assess fungal:bacterial ratios at 3 different time points (indicated with arrows).

*All inocula are not created equally, i.e. distinct microbial communities yield distinct C dynamics even though all of the microorganisms are consuming the same type of litter. An explicit understanding of microbial communities is essential if we want to predict terrestrial C dynamics.*

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