The role of microbial biodiversity in soil carbon stabilization

Dr. Jessica Ernakovich[1], Dr. Jeff Baldock[1], Dr. Courtney Creamer[2], Dr. Jonathan Sanderman[3], Dr. Karsten Kalbitz[4], Dr. Mark Farrell[1]
[1]CSIRO Agriculture, [2]US Geological Survey, [3]Woods Hole Research Center, [4]Dresden University of Technology

Soil organic matter (SOM) is a critical natural resource that needs to be properly managed. New insights into the mechanisms that control the stability of organic matter have revealed the importance of microbial processes in the accumulation of SOM. Despite this, little is known about biodiversity-function relationships in microbial communities, particularly the role of microbial biodiversity in soil carbon (C) stabilization. In macroecology, diversity-function relationships indicate that increases in species diversity result in increases in ecosystem productivity. Similar trends have been found in microbial culture studies, but manipulations of microbial diversity directly in soils have found variable impacts on the magnitude and direction of ecosystem function.

We took advantage of a management-induced difference in microbial biodiversity between remnant woodland and perennial pasture on the same soil type on the Fleurieu Peninsula, South Australia. We varied the biodiversity in soil microcosms by sterilization and inoculation with a dilution-series of native microbial communities. We tracked the fate of 13C-labelled litter (mixed grasses and eucalypts; 20 at%) during a year-long incubation into 13CO2 and stable soil fractions. Biodiversity was explored using IonTorrent sequencing of 16S and ITS genes. SOM chemistry was evaluated using NMR spectroscopy.

In early stages of the incubation, microbial diversity had no effect on the loss of litter-derived CO2 from the system. By three months, a trend emerged from the pasture soil microcosms, showing that increased biodiversity led to lower total CO2 production. NMR spectroscopy revealed that SOM chemistry in microcosms with higher microbial diversity was more similar than those with lower diversity across the dilution series. Together with additional mass spectrometry and NMR data, we expect to find that microorganisms with higher microbial diversity process C more efficiently. We expect results from this study to provide new insights into the importance of microbial biodiversity in the management of SOM.