Microbial Diversity and Habitability of Extreme Arid Regions of the Atacama Desert, Chile.

K.J. Califf[1], J.G. Caporaso[1], and J.W. Neilson[2], [1]Center for Microbial Genetics and Genomics, Northern Arizona University, kcaliff@gmail.com, [2]Department of Soil, Water and Environmental Science, University of Arizona.

Arid and hyperarid desert ecosystems provide terrestrial analogs for extraterrestrial planetary environments due to the scarcity of water and organic carbon. As such, research on the microbial assemblages present in extreme desert ecosystems provides insights into the potential microbial signatures of planetary environments. Research has shown that desert microbial communities are clearly distinct from non-desert communities being characterized by low diversity, higher relative abundances of genes associated with osmoregulation and dormancy and lower abundances of genes associated with nutrient cycling and catabolism of plant derived organic compounds [1].

The Atacama Desert in northern Chile includes hyperarid regions that have been devoid of vegetation for millions of years and precipitation events are extremely rare [2-4]. These regions support extremely low diversity and unique soil microbial communities [5]. In an effort to understand the environmental drivers controlling microbial diversity and taxonomic composition under these extreme conditions, two west-east elevational transects were established crossing the Atacama Desert from the hyperarid central plateau to arid, vegetated regions of the Andes with > 100 mm mean annual rainfall. The transects cover a vegetation gradient from 0 to 9% plant cover, an elevational gradient of over 3500 meters, and soil organic carbon concentrations of 0.02 – 0.7%. Soil samples were collected from three sample pits at each of 10 to 12 site locations along each of these transects.

Results from these transects showed that the microbial communities of the hyperarid regions were distinct and that sites with vegetation supported more diverse communities than sites without vegetation. This diversity increased with elevation. Our results also show that sites with vegetation are more similar in microbial community composition to other sites that also have vegetation than they are to non-vegetated sites. Further, our hyperarid sites show a six-fold decrease in phylogenetic diversity when compared to the vegetated regions.

Soils are known to support a high degree of functional redundancy, but the major differences in phylogenetic diversity between the hyperarid and the vegetated regions across the Atacama transects lead to the question of whether there are key components of microbial soil diversity vital to sustaining perennial vegetation in arid ecosystems that are lost below a specific precipitation threshold. This research also highlights the need to understand below ground shifts in soil microbial diversity to parallel current research documenting above ground shifts in plant diversity associated with increasing temperatures or aridity. Despite concerns over increased desertification driven by climate change, little is known about arid-soil microbial diversity, let alone the impact of decreased precipitation on that diversity or its relationship to the sustainability of vegetation.

References: [1]Fierer N. et al. (2012) *PNAS*, *109*, 21390–21395. [2] Houston J. and Hartley A.J. (2003) *Int. J. of Climatology*, 23, 1453-1464. [3] Dunai T.J. et al. (2005) *Geology*, 33, 321-324. [4] Quade J. et al. (2008) *Quarternary Research*, 69, 343-360. [5] Drees K.P. et al. (2006) *App and Env Microbio*, 72, 7902-7908.