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An Examination of the Count, Viability, and Characterization of Microbes within the Rainwater Supply of the Landscape Evolution Observatory to Identify Impacts on the Soil Microbiome.

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The Landscape Evolution Observatory (LEO), located at the University of Arizona Biosphere 2, is a facility with unique potential to study Critical Zone behaviors. This infrastructure consists of three artificial landscapes that can be manipulated to observe and track ecohydrological, pedological, and biogeochemical processes. At LEO, we are interested in characterizing microbial communities and in developing noninvasive methods to deduce soil communities from the microorganisms measured in landscape outflow. While sterilizing incoming rainwater for smaller scale experiments may be feasible, LEO's substantial scale hinders our ability to perform the same treatment. Thus, it is crucial to determine how microbes in the rainwater supply for LEO and its miniature model (miniLEO) may impact the microbial communities within these systems, and whether the impacts are common to the two systems. In this study, we identified key locations in rainwater supply systems such as filtration systems and water storage tanks. We used flow cytometry to count cell abundance, cell viability assays to identify active microbial growth, and 16S rRNA amplicon sequencing to characterize microbial communities in soil, slope discharge, and rainwater. We found that microbial abundance was lowest after treatment by the reverse osmosis system and at each subsequent treatment point, and microbial populations became elevated due to growth in incompletely flushed parts of the system (i.e. storage tanks). Water flow from an initial rain event had the highest microbial abundance and viability ratios (i.e. live versus dead cells), which decreased with subsequent rain events. Finally, we analyzed rainwater microbial community composition to identify microbes inhabiting the water supply system of LEO and to identify the strains that seed communities within the LEO soil and discharge. We describe the morphological and physiological traits that may be relevant to explaining the presence of key taxa found in LEO water and soil. The ratio and abundance of microbes in each part of the system show that the rainwater filtration and delivery system was efficient in reducing levels of water-borne microbes in the rainwater for LEO and miniLEO. Our results from this analysis is important due to constraining the impacts of rainwater on the LEO soil microbial communities and their roles in soil formation within this experimental system.