**Resilience of community structure in microbiomes of the Atacama Desert, Chile**

**Background:**

The highly specialized halophilic communities residing in halite nodules of the Atacama Desert are adapted to survive decades without rainfall. The majority of members in this halophilic community are salt-in strategists, and have proteomes that are highly adapted to function at high internal salt concentrations. A recent record-breaking rain event across the desert offered a unique opportunity to study the response of endolithic extremophiles to extreme weather perturbations.

**Results:**

Our longitudinal study collected microbiota samples before and after the rain, and used amplicon and whole metagenome sequencing to uncover functional adaptations across time. The higher-order taxonomic composition and functional potential of halite microbiomes significantly shifted following the rain event, and gradually recovered to its pre-rain state over the course of the following a year. The rain event favored taxa with higher isoelectric point proteomes, suggesting a decrease in selective pressure from high salt concentrations. Investigation of abundance profiles of individual organisms revealed that the fine-scale community structure not only underwent significant re-shuffling after the rain, but also failed to recover in the following year. This rearrangement is also reflected in the metabolome, where we observe that while the functional potential recovered fully in the year after the rain, the community functions are carried out by a different set of organisms when compared to the pre-rain communities.

**Conclusions:**

The overall taxonomic and functional structure as well as individual membership of halite extremophile communities is driven by salt concentration and water availability, and can be significantly altered by large-scale weather perturbations. While the higher order community structure is resilient and more dynamic, the individual membership can may take much longer to recover. However, the exact community membership is not vital to overall community functioning, as we observe persistence of functional niches despite membership rearrangement.

Major points results:

1. The community taxonomic composition at higher taxonomic ranks shifted as a result of the rain, and subsequently recovered in the following year
2. This shift is reflected in the functional potential of the community
3. Taxa with high-IEP proteomes were favored by the rain
4. The community individual members were significantly reshuffled by the rain
5. This reshuffling is also reflected in the functional landscape – the functional niches are constituted by new organisms after the rain