Plant influences on soil biogeochemistry and taxonomic and functional diversity of soil microbial communities in a hyper-arid desert

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INTRODUCTION

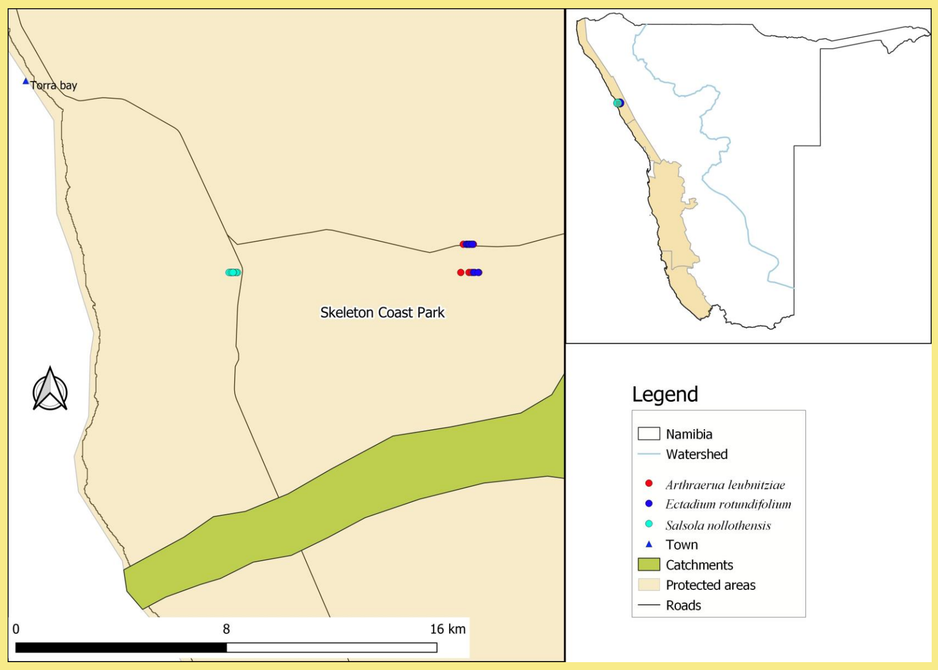
- Global surface temperatures are predicted to increase by 1.0 to 3.7 °C by the end of this century.
- This may result in significant shifts in the structure and the functionality of terrestrial biological communities.
- Increased aridity may reduce vegetation cover in drylands, which, in turn may indirectly affect soil microbial communities and their extracellular enzymes activities.
- Any change in soil microbial communities may directly influence rates of soil C and N cycling, and therefore modulate soil organic carbon (SOC) pools and stability.
- However, we have limited understanding of how soil microbial communities and SOC pools associated with vegetation in these important, yet sensitive systems will respond to the predicted climatic changes.
- The project aims to determine taxonomic and functional diversity of soil microbial communities, litter decomposition rates and measure SOC pools associated with plant hummocks in hyper-arid environments, in order to understand how ecological functions may be altered under climate-change future projections.

RESEARCH QUESTIONS

- How do plant hummocks affect soil microbes diversity relative to bare soil?
- Is the taxonomic of soil microbes heterogeneous within the same plant hummock?
- Is the soil metagenome from plant hummocks different from that of bare ground?
- How do plant hummocks affect soil carbon pools, and what is the stability of these pools?
- What are the litter decomposition rates in hyper-arid systems?

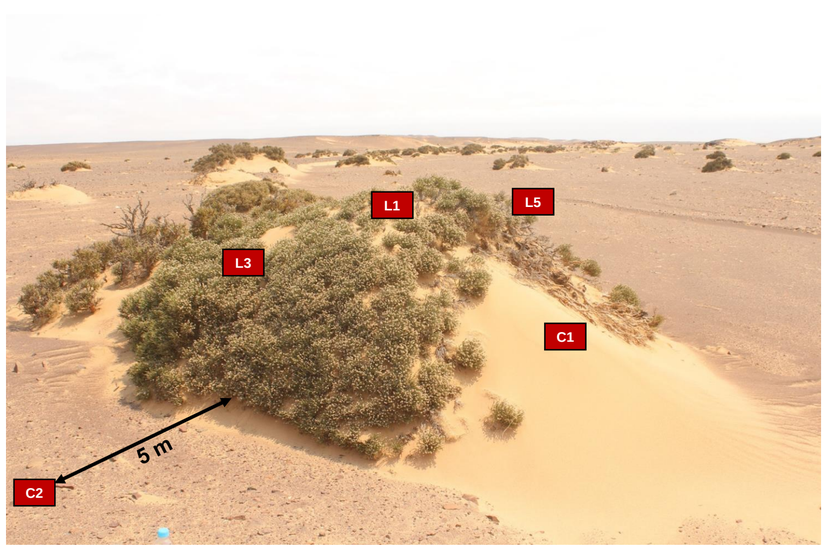
STUDY AREA

- The study was conducted in the Skeleton Coast National Park, Namibia.
- Vegetation is sparsely distributed, present primarily in 'hummocks'.
- Soils are ~97% sand.
- Climate: heavy fog and cold sea breezes.
- Temperature
  Daily min: 9°C to 13°C
  Daily max: 24°C to 29°C



METHODS

Soil sampling



- Soil samples were collected, in different directions relative to the prevailing wind direction, within the plant (*A. leubnitziae, E. rotundifolium* and *S. nollothensis)* hummock, at 0-5 cm depth.
- 5 replicates per plant, and 10 replicates per species.
- Samples are used to determine taxonomic and functional diversity of soil microbes and measure SOC pools.

DNA extraction

- Soil microbe DNA was extracted using the PowerSoil™ DNA Isolation Kit (MoBio, West Carlsbad, CA, USA), to determine taxonomic and functional diversity of soil microbial communities.

Litter decomposition

- 480 litterbags with 2 litter substrates (grass & shrub) were deployed (March 19 - May 20) under shrub canopy of three different species (*A. leubnitziae, E. rotundifolium* and *S. nollothensis)* and open space, with16 replicates per plant, and 10 replicates per species.
- Litterbags were collected at 0, 4, 8 and 14 month intervals to measure decomposition rate.

PRELIMINARY FINDINGS

- Soil samples collected within the plant hummock (L1, L3 & L5) had relatively high DNA concentrations as compared to control (C1 & C2) samples. This may be attributed to relatively high organic matter within the hummock compared to bare soil.
- 16S rRNA gene and ITS sequences have been obtained for the description of bacterial and fungal taxa and diversity of soil the microbiome. Shotgun metagenomics sequencing, as a means of investigating the metabolic capacity of the entire microbial community, have also been completed. Analysis of the data is in process.
- At four months after deploying the litterbags, we recorded some litterbags with a coating layer (from sucrose and acid secreted by microbes), which in turn provides a favourable microclimate for microbes to carry out their activities.