



Biological soil crusts stabilize degraded soils of the Brazilian Pampa affected by sandization

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Biological soil crusts (biocrusts) are a main factor in the protection of arid and semiarid ecosystems. They are key contributors to soil stabilization and erosion control through the aggregation of particles and the provision of a continuous surface cover. In the Brazilian Pampa, vegetation disturbance and soil degradation led to an expansion of sandization areas. These areas are quickly covered by biocrusts, which show the same soil-stabilizing effects as in other geographic regions but have not been investigated in this biome before.

The present study aims to expand our knowledge on the occurrence of biocrusts in sandization areas of the Brazilian Pampa and to analyse their distribution patterns related to the local topography. We focused on two research sites, where the presence of biocrusts seemed essential for soil protection. At these sites, first, the different biocrust types were assessed and a taxonomic survey was conducted. Second, UAV-based imagery was created to classify the communities. A random forest approach was applied to understand the relation between biocrust abundance and topography.

We observed that biocrusts are widespread in areas prone to sandization, with a coverage of approximately 25% of the surface area. They are mostly dominated by cyanobacteria, but also bryophytes play a key role. In this study, the cyanobacterial genus *Stigonema* was predominant at both study sites, while *Campylopus pilifer* was the dominating moss species. The mapping confirmed all major biocrust types including rolling, pinnaced, rugose, and smooth crusts. The biocrust distribution was influenced by local topography, but also the establishment of vascular plants. Slope and aspect had a strong influence on biocrust development, but the presence of protective topographic positions against atmospheric influences most prominently facilitated their occurrence.

This pilot study proved that biocrusts can play a key role as ecosystem engineers in the Brazilian Pampa with a positive effect on general vegetation growth and soil stabilization. Despite their significant impact in sandization areas, biocrusts are not in the focus of research, yet, and should

be further studied to constrain future soil degradation.