Gerbils of the Namib Desert – are they ecological engineers*?

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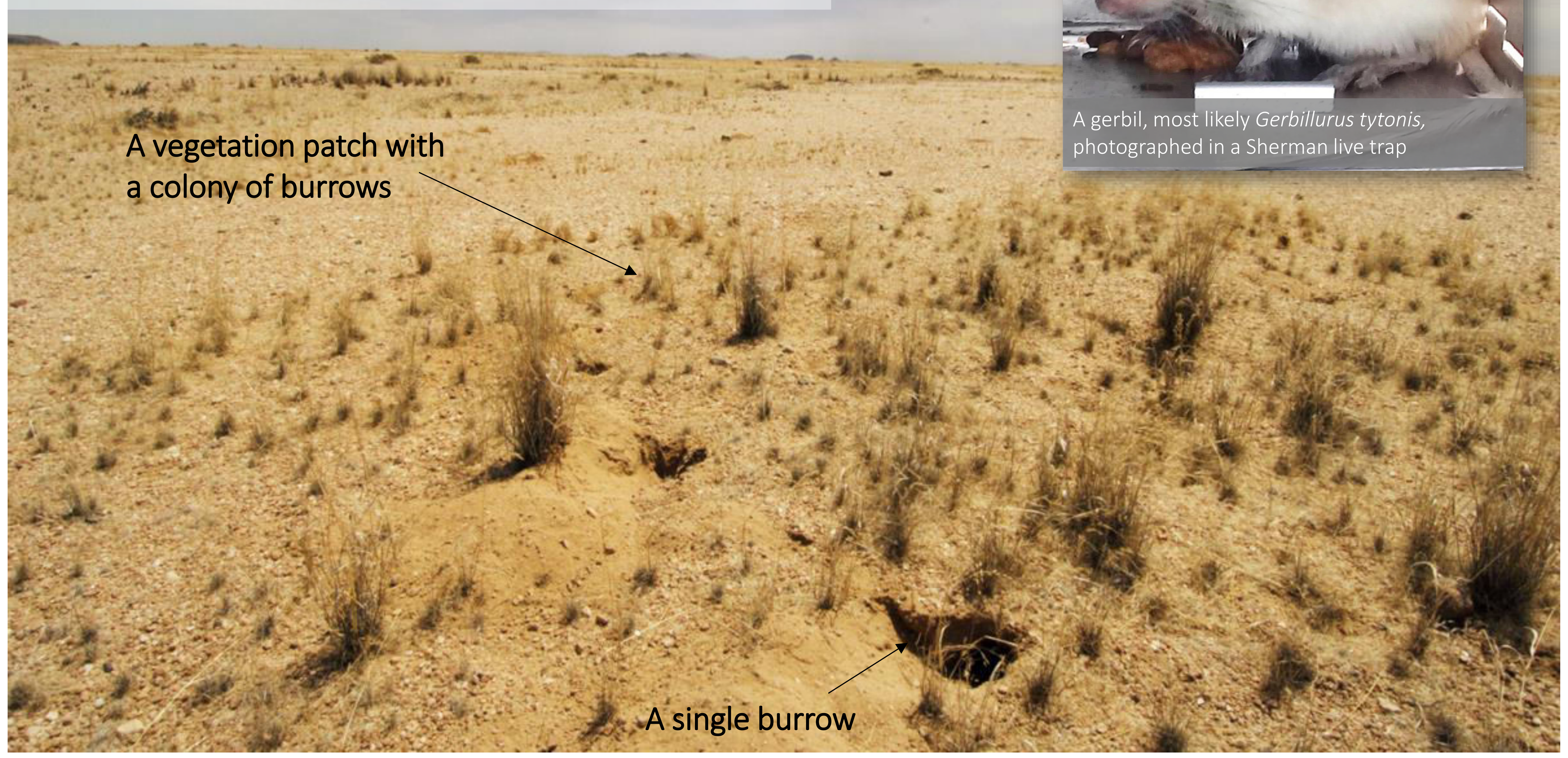
Halle on his 4x4

During other studies on the gravel plains of the Husab area in the Namib Desert, we observed that gerbils mostly dig their burrows in colonies and that these colonies always support vigorous grass growth, even when no other vegetation can survive.

We also saw that zebras eat these grasses and, putting two and two together, decided that we should investigate whether these humble little animals could actually be ecological engineers* and in this way provide other species with food.

This was especially important in view of the large mine called Husab Uranium Mine, which affected a large number of gerbils. It was therefore possible that the mine's impact could be related to not only the gerbils themselves, but also the functionally important role that they play. We realised that if we wanted to really understand the extent of the mine's impact, we have to understand these relationships much better. For this reason, the mine sponsored a Masters study at NUST to determine whether the gerbils are actually engineers.

Gerbil burrows are ubiquitous on the gravel plains of the Namib. They occur in small colonies and where they are, the vegetation tends to be bigger and remain longer after rain. Zebras and oryx love this grass, which made us wonder whether the gerbils could be ecological engineers that create a suitable habitat for the large herbivores.



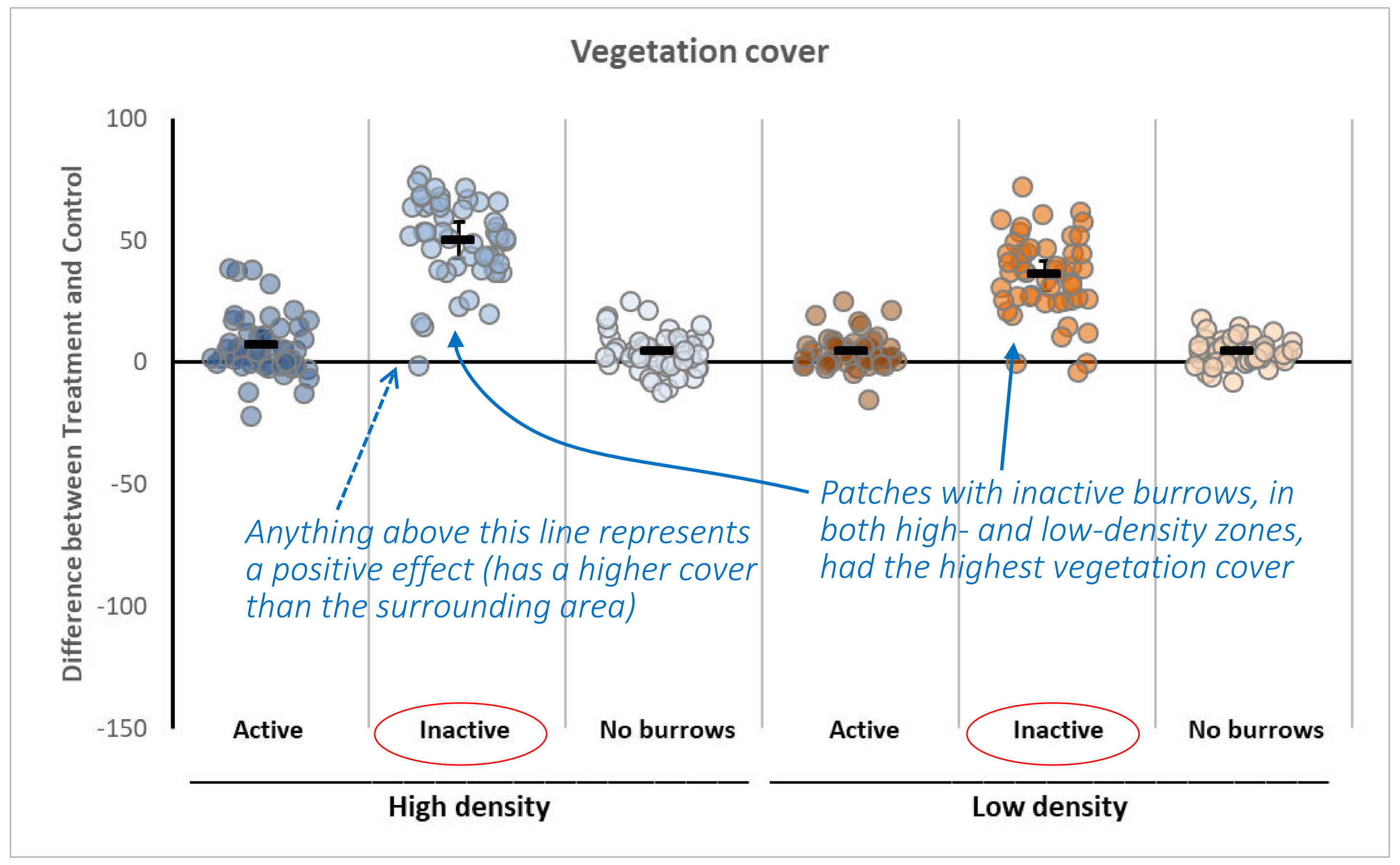
A gerbil, most likely *Gerbillurus tytonis*, photographed in a Sherman live trap

The experiment

We hypothesized that the burrowing activities of gerbils (a form of "bioturbation") would improve water infiltration and retention, and that their droppings would fertilise the soil, supporting more vigorous plant growth when compared to patches with and without any burrows.

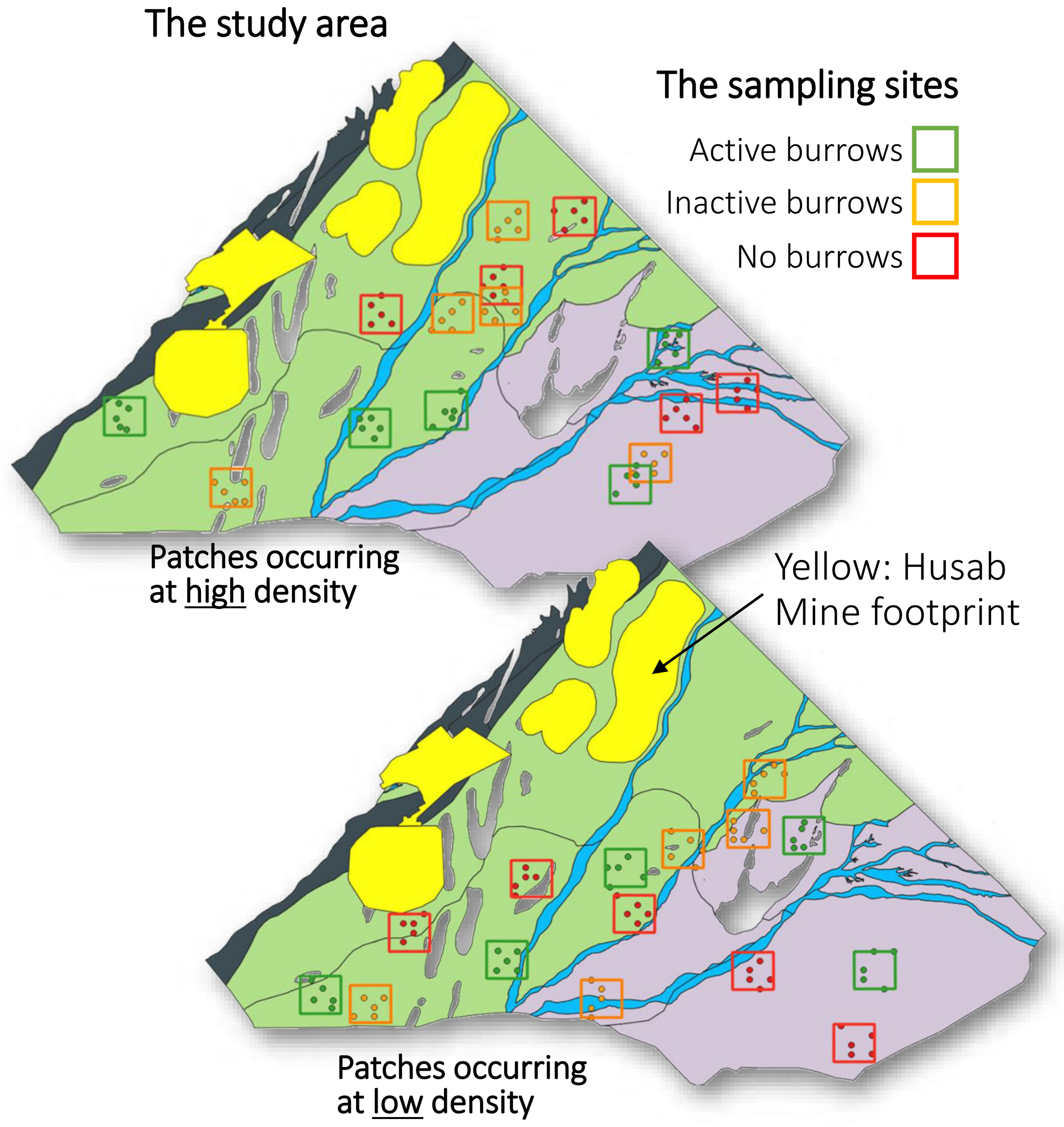
We thought that there might further be a difference between patches with active burrows (burrows with obvious signs of recent activity such as tracks and droppings), patches with inactive burrows (burrows without signs of activity) and patches without any burrows (there are many such vegetation patches without any burrows in the desert). **Halle Shaanika, a Masters student at NUST**, then designed an experiment to test this hypothesis. Apart from water infiltration, he also looked at vegetation cover and abundance and some soil variables.

Because the real issue was not the absolute difference between the types of patches, but whether the patch types differed in how much they changed conditions for vegetation and water from that of the surrounding area, he measured these variables each time on a patch of vegetation (with or without burrows), as well as on an area about 20 m away that was of similar size but did not show a recognizable patch. This "control" area represents the average condition of the gravel plain. If gerbils are ecological engineers, they will make it more amenable for life, more even than whatever other physical process may also cause vegetation patches



Here the net effect of active and inactive burrows in high- and low-density zones are compared with vegetation patches where there were no burrows at all.

Mining activities affect the gerbil burrows



Vegetation patches can be caused by other processes as well, so it was important for us to show whether the gerbils, through their burrowing activities, was just as good or better than the physical processes** that also cause patches.

Results

Halle discovered that patches with inactive burrows supported the highest cover and abundance of vegetation and improved water infiltration the most. These inactive burrows furthermore showed the highest values of the soil properties that are important for plant growth.

Why would the inactive burrows have the highest effect? We think that this is because it takes some time for the effects of bioturbation to become evident – active burrows are simply too young to have received enough rain and seeds to stimulate grass growth.

His results cannot conclusively prove that there are more zebras here than there would be without gerbils (it would be impossible to devise such an experiment), but they are highly suggestive that the gerbils are in fact ecological engineers.

Halle thus concluded that any negative impact to the gerbils will most likely also affect the zebras negatively.

Acknowledgments

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Polygonal vegetation patches in the central Namib have been ascribed to gerbil burrowing activity (Cox 1984 [a correlative study that could not definitively assign causation]; Louw & Seely, 1982) but also to a number of other potential sub-surface structures or physical processes (Ollier & Seely, 1977; Watson, 1980). For instance, polygonal cracking of the lithosol layer as a result of wetting and drying cycles that cause differential contraction in the fine clay fraction could result in preferential water flow and thus patterned vegetation growth.

***Ecological engineering is a thing..** Ecologists have long recognized that organisms can have important bioturbation impacts on physical and chemical processes occurring in the environment. In 1837 Charles Darwin discovered that bioturbation by fossorial organisms is a soil forming process. Indeed, Darwin devoted an entire chapter of his last published book to the effects of earthworms on soil formation. Engineers are organisms that directly or indirectly modulate the availability of resources (for themselves and for other species), by causing physical state changes in biotic or abiotic materials. In so doing they modify, maintain and/or create habitats (ecological engineering) for the benefits of other organisms in the ecosystem.

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