Soil Fertility in the Sonoran Desert

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Introduction:

- Human interaction like deforestation, urbanization and pollution can affect soil fertility
- Higher elevations of the Sonoran Desert have less human interaction, potentially leading to higher levels of nitrogen & phosphorus and overall fertility
- High abundance of microarthropods such as mites found in soil indicate higher soil fertility
- Soil from higher elevations of the Sonoran Desert will have higher moisture levels due to more rainfall

Research Questions and Hypotheses:

Does human interaction in the Sonoran Desert affect overall soil fertility?

If we sample soil from both the high and low levels of the Sonoran Desert, then we will see that higher elevation soil is more fertile.

Results:

Nitrate & phosphate levels were higher at the high elevation (Figs. 1 and 2), as well as moisture levels (2.16 ± 0.12 %g/g as opposed to 1.34 ± 0.39% at lower elevations). Ammonia levels were higher at the low elevation. Neither elevation yielded any microarthropods.

Methods:

- Soil samples were collected from both the high (795 m) & low (438 m) elevations of the Sonoran Desert (3 each)
- Samples were put through Tullgren funnels and observed under a dissecting microscope for microarthropod counts
- Moisture levels were tested by drying samples at 95°C for 48 hours and calculating soil water content (%g/g)
- 10 g of soil were extracted in 50 ml of 2 M KCl and 0.5 M $NaHCO_3$ to extract mineral forms of nitrogen (NH_4, NO_2, NO_3) & PO_4
  - Soil particles were removed through centrifugation
  - Acidification was performed on the $NaHCO_3$ extracts to pH 2 using HCl
  - KCl and $NaHCO_3$ extract analysis was done on a flow injection autoanalyzer (Lachat QC800)

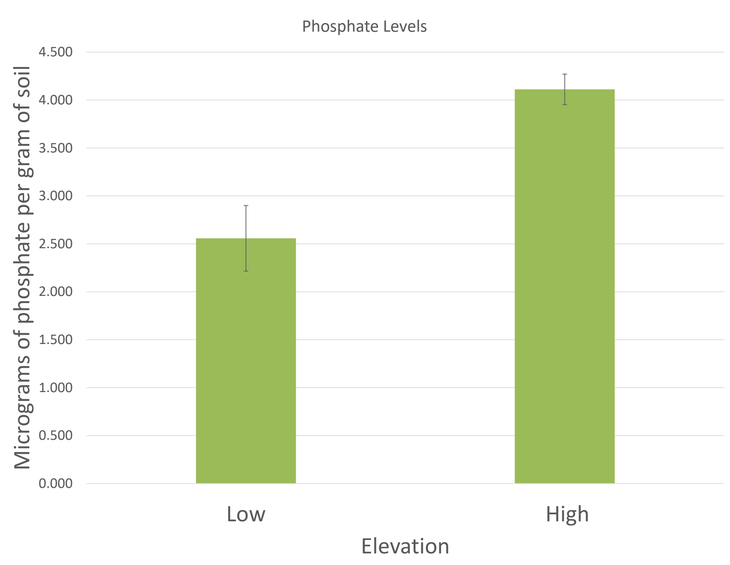


Fig. 1 Higher levels of phosphate were observed at higher elevations. Chart bars are an average of 3 samples taken for each elevation with standard error indicated by error bars.

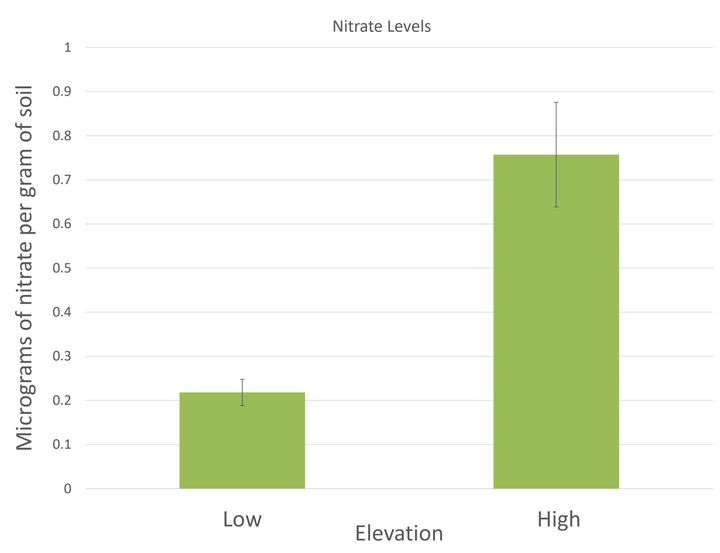


Fig. 2 Higher levels of nitrate were observed at higher elevations. Chart bars are an average of 3 samples taken for each elevation with standard error indicated by error bars.

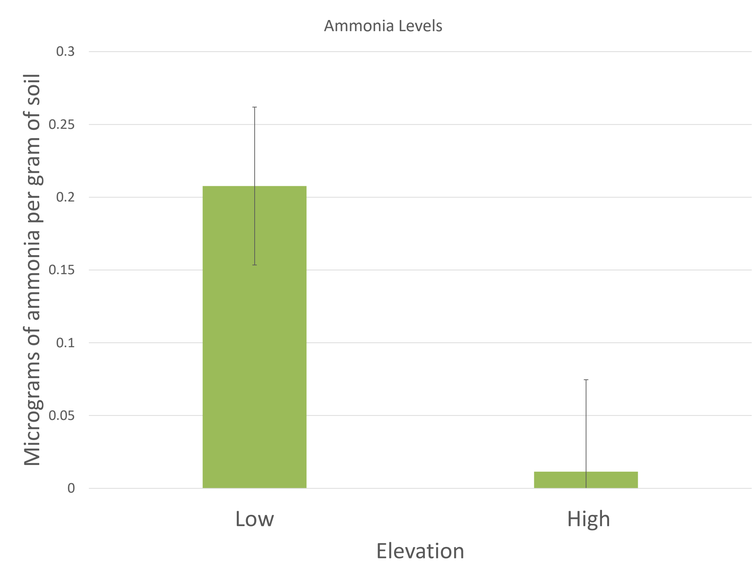
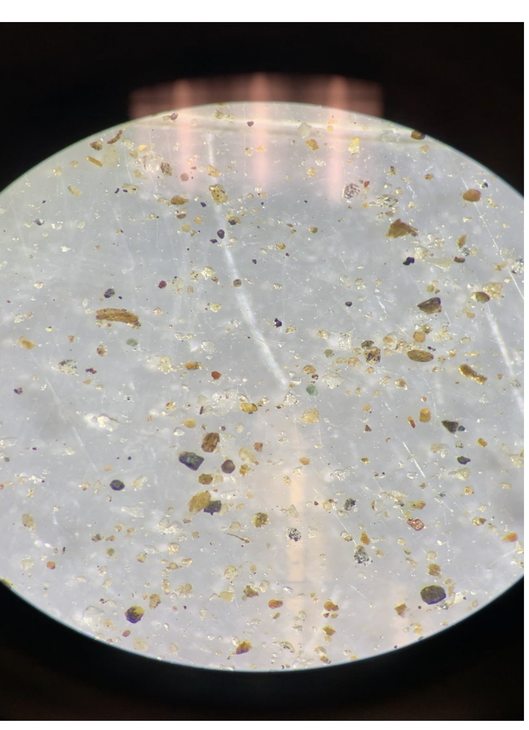


Fig. 3 Higher levels of ammonia were observed at lower elevations. Chart bars are an average of 3 samples taken for each elevation with standard error indicated by error bars.



Discussion:

Based on our results, we can accept our hypothesis that higher elevations of the Sonoran Desert have more fertile soil than the lower elevations. Although no microarthropods could be found in our samples, significantly higher levels of phosphate and nitrate, which are both essential nutrients for vegetation growth, were found at higher elevations. We can attribute this to climatic factors as well as the higher levels seeing less human interaction and therefore less disturbance of the land, including water run-off from the surrounding urban environments, trash and pollution. Excess ammonia can typically be found in store-bought fertilizers, which may explain the higher levels of this nutrient at lower elevations. Upkeep of certain areas of the Sonoran Desert may include the addition of soil not found naturally. Furthermore, ammonia-containing air pollution from urban environments may better reach the lower elevations of the Sonoran Desert. Soil is essential to life itself and public education on how human interaction can decrease its fertility might encourage people to help preserve one of a kind locations like the Sonoran Desert.

Acknowledgements: This material is based upon work done in ENV/IAP/LSC 394: BioArt – Sonoran & Arctic Environments. Student research & communication was supported by the National Science Foundation under grant number NSF OPP-1707867.