Water Availability Impacts on Saguaro Cactus Branching
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Introduction:
- Saguaro can hold well over a ton of water within itself (Drever, 2003).
- The Sonoran Desert receives an annual rainfall of 3-20 inches every year.
  - In the winter precipitation tends to be lower, while in the summer many monsoons add to a greater precipitation (Enzi, 2019).
- Many studies have found that cacti branching can be attributed to both geography and summer rainfall (Lin, 2020).
- It is possible that human disturbances can affect the amount of water a cactus may receive.
  - Disturbances including: agricultural development and man-made water sources.
- We hypothesized that cactus branch growth is greater in areas with higher water availability than in areas with lower water availability.

Methods:
To test the hypothesis that saguaro branching is impacted by water availability, four individual saguaros were observed at four locations around Phoenix, Arizona. The locations chosen for these measurements were: Estrella Mountain Regional Park, The Salt River, Saguaro Lake, and Theodore Roosevelt Lake. The following sequence of events was conducted for each site:
- Individual Saguaros were identified and chosen at random based on their estimated proximity to the nearest water source.
- Soil moisture readings were taken at the base of each cactus, using a soil moisture probe. Each reading was repeated 5 times and the average was recorded in the data tables below.
- The number of branches (arms) the Saguaro had was observed and recorded, as well as any notable nearby plant species or observations regarding the landscape features.
- The GPS location of the individual was recorded, and the distance from the water source was calculated using an online Coordinate Distance Calculator.
- Measurements were then graphed and statistically analyzed using Pearson’s Correlation.

Results:
Measurements showed a slight negative relationship between total number of Saguaro branches and distance from the nearest water source. Additionally, a slight positive relationship showed a slightly positive association present between variables (0) and positive association between variables (1) for graph 2.

Discussion and Conclusion:
- Evidence supported no statistically significant differences between saguaro branch growth and proximity to the nearest water source or soil moisture content.
  - The data collected did not yield statistically significant results. The Pearson’s Correlation Coefficient yielded a value between no association present (0) and an inverse association between variables (−1) for graph 1, and a value between no association present (0) and positive association between variables (1) for graph 2.
- Sources of variation not accounted for during experimentation.
  - There could have been several unaccounted for sources of variation in this experiment, unable to be addressed using the methodology conducted here. It is possible that annual rainfall in specific areas farther from the natural water source could have allowed for greater water availability at larger distances. Additionally, anthropogenic changes to the desert landscape could account for variation in growth.
- Age and weathering factors are out of our control.
  - The age of the saguaro cacti could have an impact on branching that was unaccounted for. Saguaroos have been shown to grow in height before any branching occurs. There was no definitive way to determine each individual’s age in this experiment. Potentially some of the branchless individuals observed could have been juveniles. Additionally, weathering and physical alterations could have removed branches from Saguaroos (either by being broken off or burned off).
- Future research direction.
  - Further study of this matter would require exploration of sources of water availability and growth variation including: age of each individual Saguaro cactus, average precipitation received in each area annually, and potential anthropogenic inputs of water.

References:
- Mikayla Brown and Joseph Herrel. "A Decade of Flowering Phenology of the Keystone Saguaro Cactus (Carnegiea Gigantea)." New College of Interdisciplinary Arts & Sciences, Arizona State University – West Campus, Phoenix, AZ 85069

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