

Grassland vs. Shrublands

Is there a difference in water infiltration rates?

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Introduction

Do water infiltration rates differ from the grassland to the shrubland areas of the Jornada Basin Experimental Range?

Although we are not investigating the morphology and structure of the soil, we realize that infiltration rate is directly related to these concepts. We also understand that erosion causes depletion of valuable nutrients from the soil. Rainwater that does not infiltrate will ultimately cause erosion.

The objective of this experiment is to determine if water infiltration rates are significantly different in the grasslands (black grama) versus the shrublands (mesquite bush).

Our hypothesis is that the grasslands will show significant difference in water infiltration speed at JER.

Conceptual Models

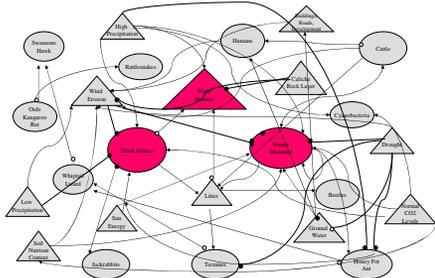


Figure 1: Beth Rewalt's Conceptual Model: Research focused on the relationship of water infiltration rates in the soil near Black Grama and Honey Mesquite.

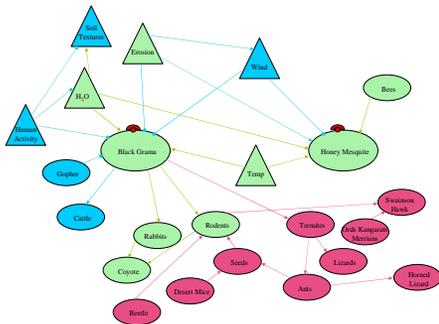


Figure 2: Libby Hamilton's Conceptual Model: Biotic and abiotic relationships of the Jornada experiment range ecosystem as it relates to water infiltration.

Materials and Methods

Materials:
 100 ml graduated cylinder
 Stopwatch
 Ruler
 Charting Materials
 washcloth
 writing utensils
 metal cylinder

Methods:
 Soak a washcloth with 750 ml water. Place the cylinder over the soaked site and push it into the ground until it reaches the 3 cm mark. Then pour 100ml of water into the cylinder and record the amount of time it takes for the water to completely infiltrate the soil. Our protocol demonstrates simple random sampling methods. The sites consist of 3 grassland plots and 3 shrub land plots. Collection will consist of four samples between the transects at each plot. Complete protocol and sampling methods can be viewed at www.ecoplexity.org and www.asombro.org.

Results

Water Infiltration Speed
 The histograms below show a significant difference in water infiltration speed between shrub land and grasslands at the JER. After running the data we determined that we should run non parametric tests because we had an outlier.

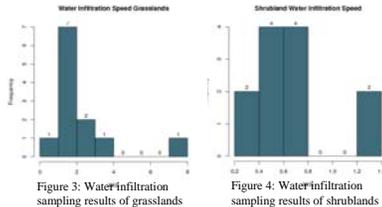


Figure 3: Water infiltration sampling results of grasslands
 Figure 4: Water infiltration sampling results of shrublands

The test performed was: Wilcoxon rank sum test with continuity correction (our dataset had 2 groups).
 There are significant differences in the population medians among groups. (the p-value for the statistical test was: **0.001**)
 The test statistic was: **W = 12**
 The sample medians from your dataset were as follows:
median in Grasslands was .58
median in Shrublands was 1.48

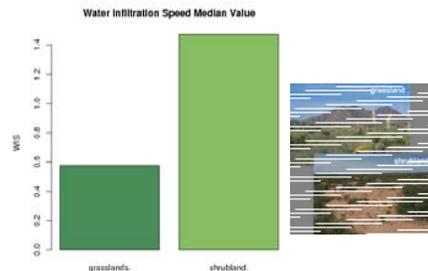


Figure 5: Mean values of water infiltration sampling results of grasslands/shrublands at JER

The bar graph demonstrates the significant differences between the water infiltration speeds in the grasslands vs. the shrub lands. The grasslands showed a much faster speed of infiltration (almost twofold) than the shrub land. These results confirm our hypothesis.



Figure 6: Pre-soaking grassland, Black grama plot area to prepare for study of water infiltration speeds.



Figure 7: Beth placing cylinder in Black grama grassland plot to time speeds of water into the soil.



Figure 8: Libby performing data analysis of samplings from grasslands and shrublands

Conclusions

Infiltration speeds vary greatly in the two areas. The grassland had a much higher speed of infiltration than the shrub lands. The main reasons that we believe water infiltration speeds differ are:

- Type of root systems: The root systems found in the grasslands are much more shallow and spread out in a fibrous root system. The root systems in the shrub land are tap roots. Water infiltration occurs at a much faster rate in the fibrous root system as opposed to areas that are dominated by tap rooted plants.
- Soil texture: Soil type has a significant impact on infiltration speed. Infiltration happens quickly in soil particles (sand, gravel) due to the larger pore sizes. The grasslands demonstrated a sand and gravel soil texture. Clay has smaller pores so infiltration is much slower. The shrub land had a larger percentage of clay particles than the grasslands.
- Water holding capacity: Water holding capacity may be more important than water infiltration in determining soil moisture ability. This study shows the relationship between water infiltration rate and one aspect of desertification
- Human Activity: Human activity plays a direct role in erosion of soil. This erosion leads to a change in the pattern of the ecosystem. As the erosion continues the infiltration rate of water changes therefore leaving the opportunity for mesquite to overtake the Black grama.
- Water infiltration and desertification are directly linked through the points listed above. As the root systems, soil textures, water holding capacity, and human activity change so does the ecosystem and the outcome in this particular area of interest is desertification.

Plan for classroom implementation

An initial approach to this activity would include soil structure, morphology labs and instruction on textures using the soil triangle, soil profiles.

A field trip to the JER would help facilitate a better understanding of ecoplexity in this area and terminology needed to do participate in further investigation.

An idea for classroom implementation is to conduct field work at our school yard using a similar protocol. The students will be able to choose three sites and hypothesize how each site ranks in terms of infiltration rates. Data can be collected and analyzed. Students will make connections and make correlations between infiltration rate, soil composition, soil texture, compaction and the vegetation found at the sites that they tested.

The Asombro Institute staff can visit to help the students with data analysis as well as interpretation.

Protocols mentioned in implementation section can be found at www.asombro.org and www.ecoplexity.org.

Acknowledgments

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For further information

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