An Analysis of Chicago Slag Composition and How the Performance of Rare Native Illinois Species *Dalea foliosa* and *Tetraneuris herbacea* in Slag Could Guide Future Restoration Efforts

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Introduction

Former Chicago steel manufacturing site, Big Marsh Park, has experienced land degradation due to the deposition of slag onto the land. While land disturbance has altered the composition of the soil, this slag-site has proven its ability to host different plant species. As this site has been significantly altered from what it once was, ecologists working with the site have encouraged a novel-ecosystem[4] restoration approach. However, there is little guidance provided for novel ecosystems as the novel ecosystem lens[5] is relatively new and many of these sites have not been studied. In order to form effective restoration plans for Big Marsh Park there is a need to further study the site and obtain essential soil profile information. For this study we focus on the Mars site (an area of the park nicknamed "Mars" due to the red color of the slag deposits) located in Big Marsh Park. Rare plant species *Dalea foliosa* and *Tetraneuris herbacea* are both native to Illinois but thrive in different ecological niches. *T. herbacea* is a predominately alvar species and *D. foliosa* is a dolomite prairie species. Through soil analysis of the Mars site and observation of how these plants perform in Mars site slag we can determine what kind of ecosystem the slag-site most likely resembles. The soil composition of this site will serve as a basis for what plant species the site is better suited to sustain and can help determine what type of ecosystem this site aligns itself with the most. This information can provide further guidance for restoration efforts in Big Marsh Park.

Hypothesis

As Big Marsh Park was once wetlands prior to land degradation and is found in the Calumet[6] region which was formed via glacial deposition similar to the ways in which alvar ecosystems are formed the site may be better suited to host alvar species such as the *T. herbacea*.

Methods

- Observed and recorded survival and height for *D. foliosa* & *T. herbacea* seedlings that were planted in Mars Site Slag and kept in a greenhouse.
- Harvested seedlings for both species by separating the roots and shoots. Washed the roots clean.
- Recorded biomass for both underground (roots) and aboveground (shoots) plant tissue for both species.
- Visited Mars site in Big Marsh Park to collect three soil samples. Soil samples were collected at least 50 meters apart from each other.
- Conducted analysis of soil samples to find average pH of the site, average moisture, nutrient availability, and texture composition.
- Compared the data collected from our site to that of an alvar ecosystem (North Shore Alvar State Nature Preserve) and a dolomite prairie ecosystem (Midewin National Tallgrass Prairie) using the UC Davis NRCS Soil Web[7] tool.

Results

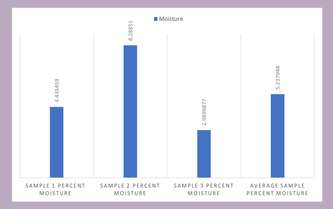

Figure 2. Percent moisture for samples collected from Big Marsh Park in Mars site. The average moisture percentage was used to calculate estimated dry weight for nutrient extraction and analysis.

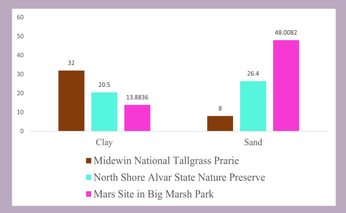

Figure 7. Comparison of shallow depth soil texture found between Mars Site, the North Shore Alvar State Nature Preserve, and Midewin National Tallgrass Prairie. Both the Mars Site and North Shore Alvar State Nature Preserve were more closely aligned being higher in sand percentage and lower in clay when compared to the Midewin site. Soil data sourced from UC Davis NRCS Soil Web.

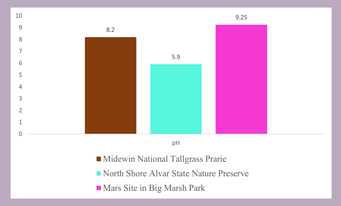

Figure 8. Comparison of pH level found at s for the Mars Site, the North Shore Alvar State Nature Preserve, and Midewin National Tallgrass Prairie. The average pH of the Mars Site was calculated by taking the average of the three samples collected: 9.14 (S1), 9.25 (S2), and 9.36 (S3). Soil data sourced from UC Davis NRCS Soil Web.

Images 1 and 2. The left image is a *Dalea foliosa* seedling (common name: leafy prairie clover). The right image is a *Tetraneuris herbacea* seedling (common name: lakeside daisy).

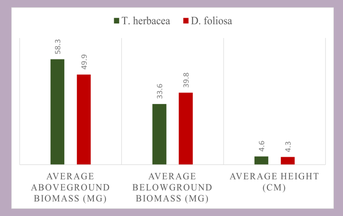

Figure 1. Average shoot biomass, root biomass, and height recorded for the *T. herbacea* and *D. foliosa* in slag trays. *T. herbacea* exhibits higher height and shoot biomass.

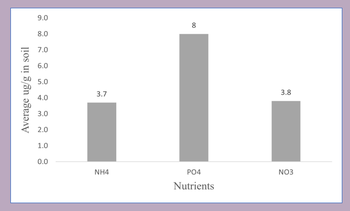

Figure 6. Plant available nutrient content for ammonium, phosphorus, and nitrate (ug/g in soil) of slag collected from Mars site.

Findings

- The *T. herbacea* seedlings had higher survival rate, higher average height, and higher average aboveground bio-mass in the slag when compared to the *D.foliosa*.
- Mars site is closer in soil composition (clay & sand) to the North Shore Alvar State Nature Preserve but is closer in pH to the Midewin National Tallgrass Prairie.

Survival Census	
D. foliosa	***T. herbacea***
34/98	**76/98**

Table 1. 98 seeds of *D. foliosa and T. herbacea* were sowed into two separate trays containing slag on 04/07/22. This table presents the individuals alive for each species out of the 98 original seeds as of 06/21/22. *T. herbacea* had more individuals survive.

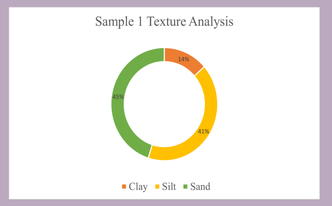

Figure 3. Sample 1 of slag collected from Mars Site in Big Marsh Park consists of 13.47% clay, 41.40% silt, and 45.12% sand. This sample falls under the category of **loam**.

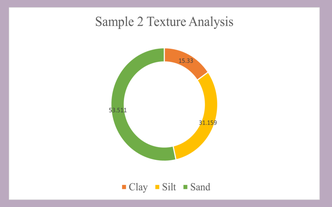

Figure 4. Sample 2 of slag collected from Mars Site in Big Marsh Park consists of 15.33% clay, 31.15% silt, and 53.51% sand. This sample falls under the category of **sandy loam**.

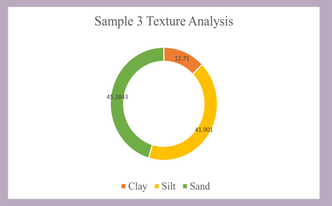

Figure 5. Sample 3 of Slag Collected from Mars Site in Big Marsh Park consists of 12.71% clay, 41.90% silt, and 45.38% sand. This sample falls under the category of **loam**.

Discussion

Observing the performance of two rare species on this site's slag is beneficial towards future restoration efforts as it provides insight for what species may thrive in such environments. The novel ecosystem lens considers that such sites should be self sustaining to a certain degree without intervention. The *T. herbacea's* performance in this slag has been positive and plans are in the works for these plants to be transferred to Big Marsh Park in the fall, where performance will be further assessed next season. Future observations of these plants and their performance on the actual site will provide further input regarding their compatibility. In our study, *T. herbacea* seeds were wild-collected and *D. foliosa* seeds were purchased from a commercial nursery. Seed source may have influenced species performance in the slag; further studies are needed to determine the impact of seed origin regarding species performance in slag. There is currently not enough data to categorize Mars site as an alvar ecosystem or encourage the creation of an alvar ecosystem on this site. Previous studies (Solandz, 2011)[8], have successfully re-established alvar species onto non-alvar land. However, there is no present evidence of the creation of self-sustaining alvar ecosystems. Our study has opened discourse regarding the potential that Mars site has as a novel ecosystem and how it may continue to evolve in the future as restoration efforts continue.

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Citations

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2. Northwestern University. Chicago Botanical Garden.
3. Amundsen High School.
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