Determining if there is hybridization in the *Sclerocactus* populations of Swap Canyon Utah

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Introduction

A potential hybrid population of *Sclerocactus* was identified in southeastern Utah near Swap Canyon. It is suspected that these plants are a hybrid between the common *Sclerocactus parviflorus* and the endemic, endangered *Sclerocactus wrightiae.*

Because *S. wrightiae* is listed as endangered, ecologists and conservationists are determining the best method to protect the species from extinction. *S. wrightiae* habitat is currently being affected by the use of Off-Highway Vehicles (OHVs) and cattle grazing. Both of these disturbances destroy the cryptobiotic soil and aid in the erosion of soil and nutrients from the area. Recently, there has been an emergence of an herbivorous moth that has been decimating populations.[1] The potential hybridization at Swap Canyon could change permitting for cattle grazing within the area.

Objectives

- Determine if the Swap Canyon populations of *Sclerocactus* are of hybrid origin using genetic and morphological data.
- Determine the relatedness between the hybrid populations and the potential parent populations or if the current plants are F1 hybrids or backcrosses.

Methods

Morphological characteristics, such as the number of central spines, fruit color, number of leaf scales, central spine shape, and spine density were collected from five *Sclerocactus* populations both in and near Capitol Reef National Park in southeastern Utah. These included one *S. parviflorus* population, two *S. wrightiae* populations, and two potential hybrid populations. A CTAB extraction was performed using spines to isolate DNA from these *Sclerocactus* populations. Spines were clipped into small pieces to aid in the extraction process to further break down the cells to access genetic material. DNA was then amplified using Polymerase Chain Reaction (PCR). Six microsatellites were used to analyze genetic diversity between *Sclerocactus* taxa.

Results

Image 1. Potential hybrid individual observed at the Swap Canyon site, exhibiting dense spines like *S. parviflorus*.

Image 2. Potential hybrid individual observed at the Swap Canyon site, exhibiting spine density & yellow flowers like *S. wrightiae*.

Image 3. Swap Canyon site where specimens were collected.

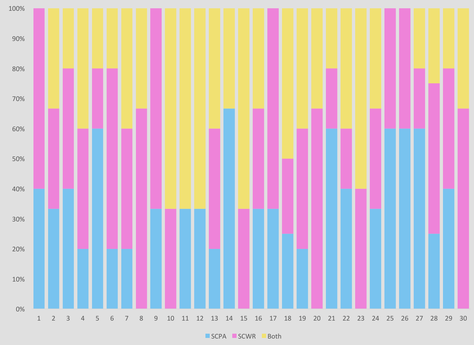

Figure 1. Morphological traits of the Swap Canyon (hybrid) 1 population sorted by species similarity.

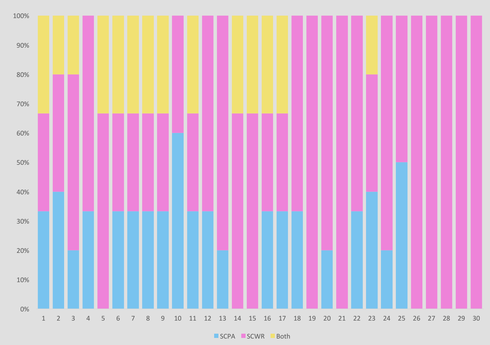

Figure 2. Morphological traits of the Swap Canyon (hybrid) 2 population sorted by species similarity.

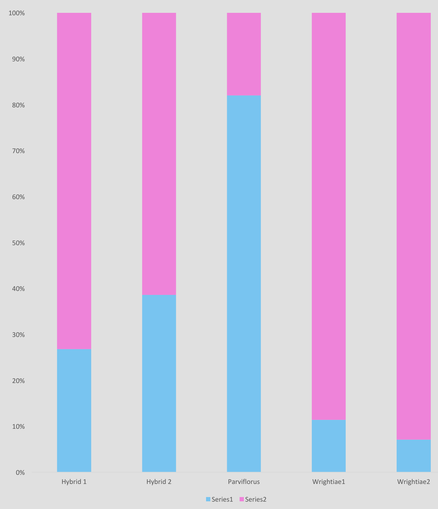

Figure 3. Genetic groupings of individuals by population. Results were analyzed using GenAlEx and Structure.

	Parviflorus	Hybrid 1	Hybrid 2	Wrightiae
Parviflorus	0.00			
Hybrid 1	0.13	0.00		
Hybrid 2	0.16	0.09	0.00	
Wrightiae	0.13	0.11	0.14	0.00

Table 1. Relatedness of each population of *Sclerocactus* in relation to the other varieties of *Sclerocactus*.

References

1. Borthwick, Sandy. “Results of 2015 Wright Fishhook Cactus (*Sclerocactus wrightiae*) Annual Repeat Sampling and Demographic Monitoring” *Capitol Reef National Park, Utah*, October 13, 2016

Results & Discussion

Based on measured morphological characteristics, these populations could be hybridizing. Nearly all of the individuals surveyed exhibited traits from both *S. parviflorus* and *S. wrightiae* (Figure 1 & 2). When these results were combined with genetic analyses, it was apparent that some hybridization had occurred between *S. parviflorus* and *S. wrightiae* in these populations. When the populations were compared using Structure, the hybrid population fell somewhere between *S. parviflorus* and *S. wrightiae* (Figure 3). Though the populations used in this study were not the original parent populations, these two species have been sharing specific alleles at the Swap Canyon locality. This hybridization event was likely caused by an environmental pressure, such as drought or the emergence of the moth, that caused the populations to decrease drastically. In order to survive the bottleneck, these cacti may have began to introduce new genes into the population simply because there were not other *S. wrightiae* populations close enough to pollinate with.

The hybrid populations were the most closely related to each other out of all of the populations; however, they were not identical and could be considered separate populations. It was also apparent that the second hybrid population was the most distantly related to *S. parviflorus*, indicating that the individuals are more closely related to *S. wrightiae* (Table 1). This could mean that the second hybrid population was initially a *S. wrightiae* population that began interbreeding with *S. parviflorus* due to the bottleneck. This might suggest that backcrossing has occurred within the Swap Canyon populations.

Conclusion

The *Sclerocactus* populations observed near Swap Canyon in southeastern Utah proved not to be solely *S. wrightiae* or *S. parviflorus*. Presumably, there was a bottleneck within the population at some point in time, causing the individuals to hybridize. Future ecological surveys and monitoring will have to be performed to confirm the health of the hybridizing populations. Furthering monitoring of these populations may affect cattle grazing permits and allowances within this area of Capitol Reef National Park. These populations could also be monitored to determine if there is still hybridization or if it was an isolated event because of an extreme pressure.

Acknowledgements

I would like to personally thank the Chicago Botanic Gardens, the Capitol Reef National Park staff, the CR Field Station, the Utah Native Plant Society, the Northwestern Plant Biology and Conservation grant, and the NSF, especially for the NSF-REU grant DBI-1757800. I would like to thank Deb Clark, who provided information about the hybrid populations.I would also love to thank my mentor, Matthew Wang, Jeremie Fant, Hilary Noble, Andrea Kramer, and my College First student, Carol Dai for all of their help and guidance throughout the summer!