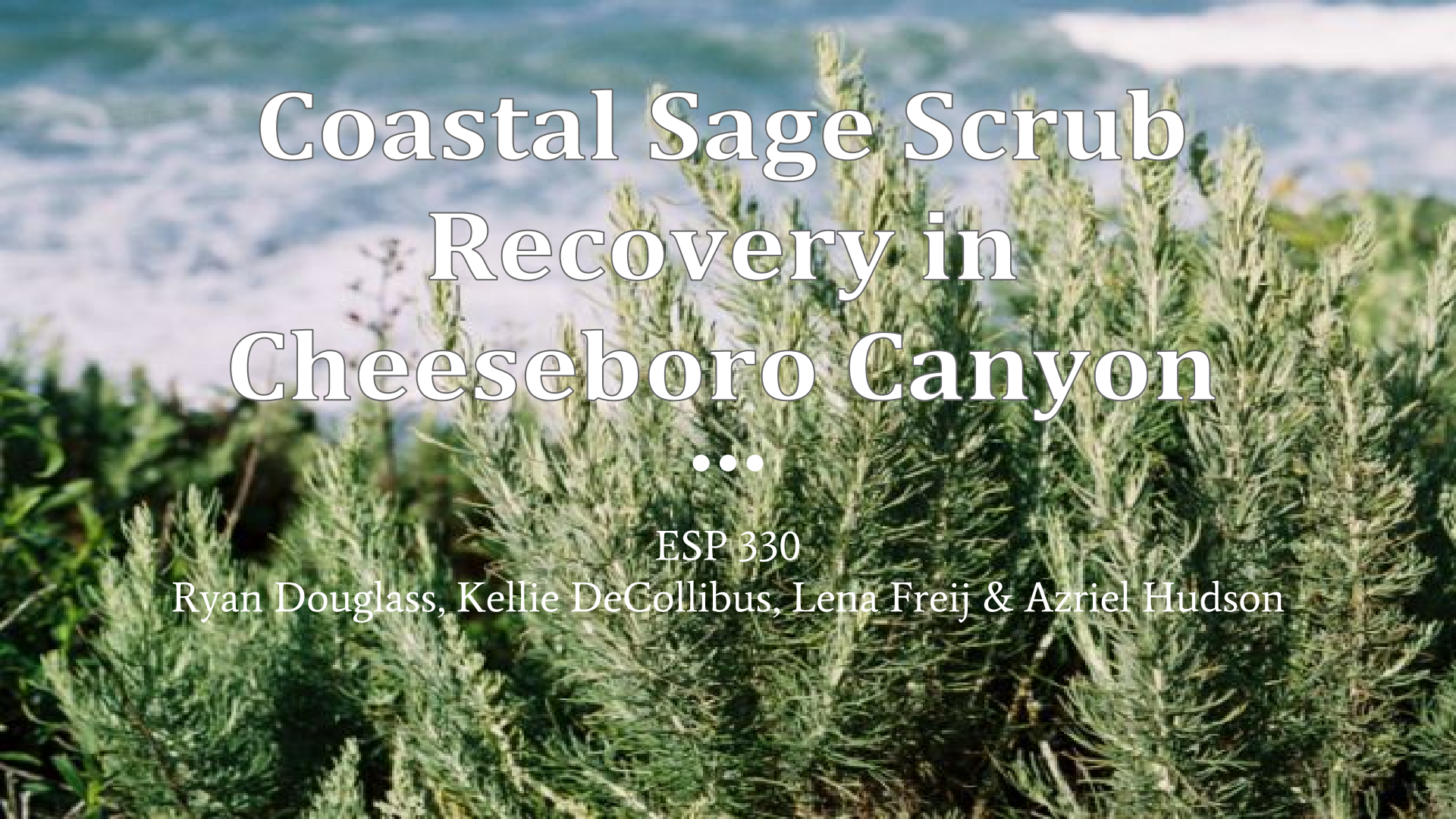


Coastal Sage Scrub Recovery in Cheeseboro Canyon

ESP 330

Ryan Douglass, Kellie DeCollibus, Lena Freij & Azriel Hudson

Introduction

Coastal Sage Scrub plant communities make up some of the most important ecosystems in California. Their recovery in the wake of various anthropogenic disturbances is key in the restoration of native habitats, which revitalize species biodiversity and ecosystem services. Analyzing the ways in which recovery occurs at the optimal rate will help to contribute to the success of restoration projects moving forward.

Figure 1. Close-up of Salvia leucophylla, one of the most frequently occurring CSS species found in our transecting.

Significance to Cheeseboro Canyon

Figure 2. A stunning photo of Cheeseboro Canyon from the NPS website, taken by Herbert Petermann

For over 150 years, ranchers made the canyons of Cheeseboro their home. While nearly all of the native plant communities adjusted poorly to the heavy grazing, most of them were replaced by European Annuals (National Park Service 2007). While still a beautiful addition to the California landscape, the history of disturbances in this area creates a great location to study recovering Coastal Sage Scrub habitats.

Disturbances

Most of Cheeseboro Canyon consists of invasive grass. The land has been substantially disturbed due to a variety of anthropogenic activities including:

- Hiking and horseback riding
- Natural gas infrastructure
- The introduction of exotic grasses and other invasive species
- Intensive cattle grazing
- Soil disturbances from the use of heavy machinery to maintain trails

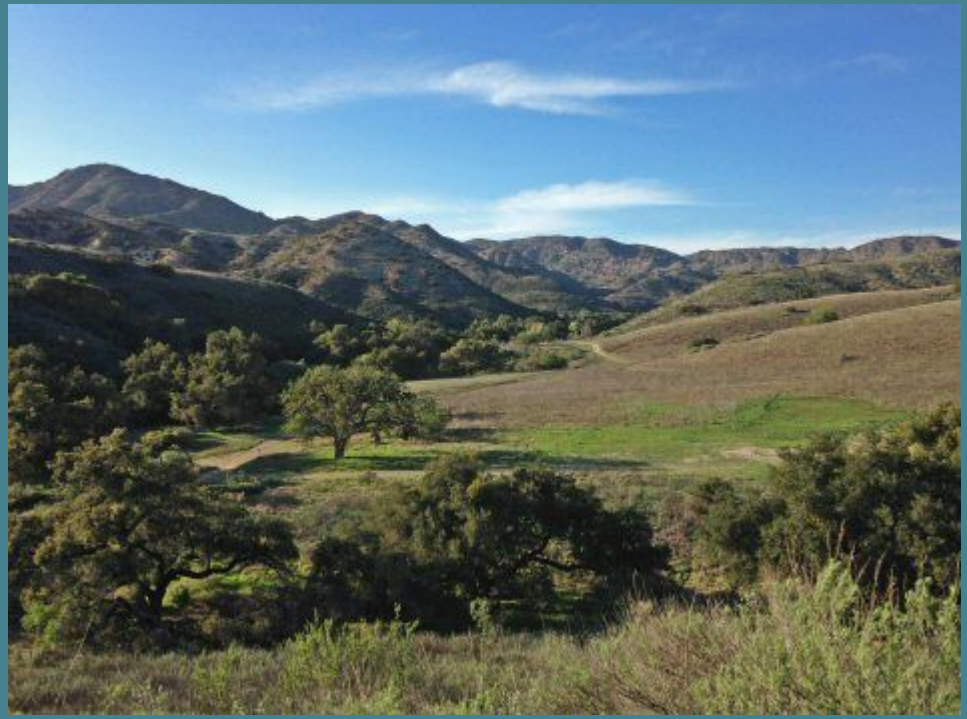


Figure 3. Photo showing Cheeseboro Canyon floor post-disturbnace.

Our Focus

This research project is aimed to find a correlation between differing plant groupings found in both stable and recovering boundaries of Coastal Sage Scrub habitats. To do this, we used a Chi-Square statistical analysis between 10 different sites in Cheeseboro Canyon. With this study, we hope to supplement the growing research that helps progress efforts in the recovery of one of California's rare and essential vegetation communities.

Hypotheses

- Working: There are significant differences in the assemblages of plant species found in recovering and stable boundaries.
- Null: There are not significant differences in the assemblages of plant species found in recovering and stable boundaries.

Determination of Sites

Before obtaining data on the field, our transects were chosen using the Time Slider Function on Google Earth, comparing growth of CSS boundaries within 1994, 2006, and 2016. Sites were identified as either expanding or stable boundaries and coordinates were taken of their exact location.

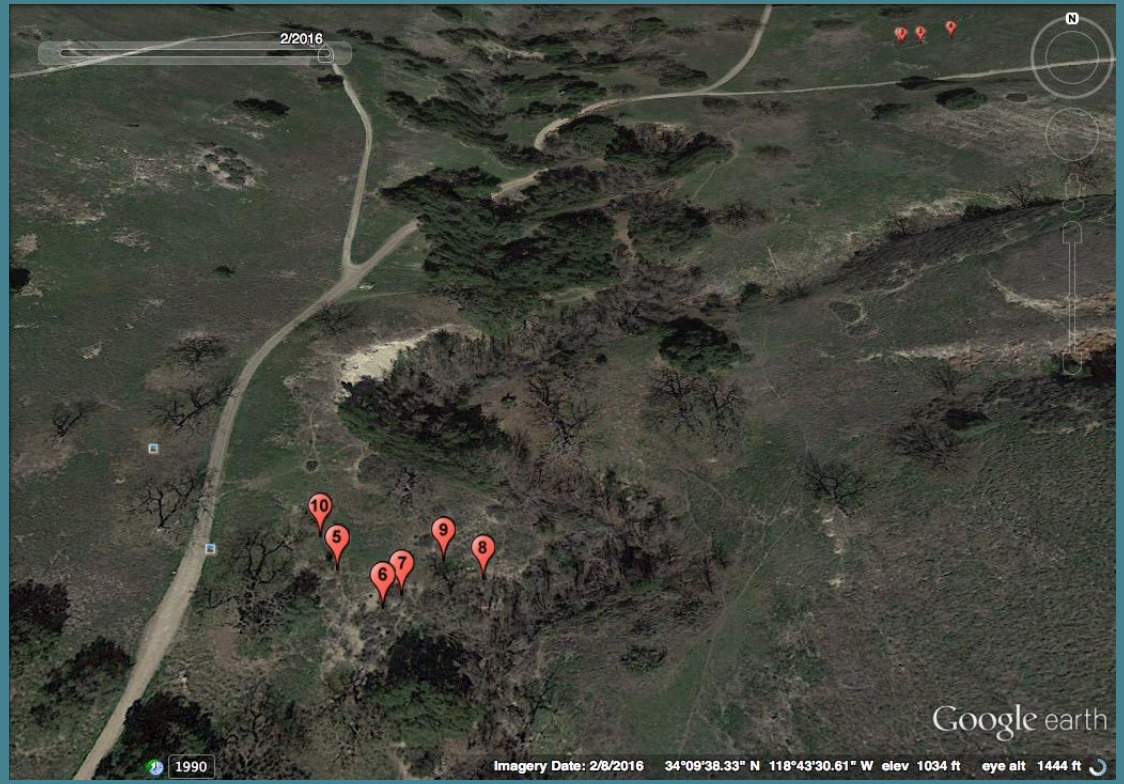


Figure 4. Our 10 chosen transects in Cheeseboro Canyon.

Study Site Description

Cheeseboro Canyon is located approximately 60 miles northwest of CSULB as part of the older and steeper region of the Santa Monica Mountains National Recreation Area. We conducted our research on April 13th, 2016 off of the Cheeseboro Canyon Trail. The weather was partly cloudy and warm at about 73 F. The wind fluctuated between 0-4 mph throughout our visit and relative humidity was about 33%.

Figure 5. One of our transect areas with CSS adjacent to exotic European grasses.

Field Methodology

We used a 10 meter Point Transect to obtain our data, identifying each species at 1 meter intervals. As shown in Figure 6, we started at point 0, and collected data until point 10, creating 11 total data points for each location. We collected data for 10 different sites, creating 110 total data points for this study. All of the data collected were in locations consisting of clearly-distinguished Coastal Sage Scrub species next to grassland.

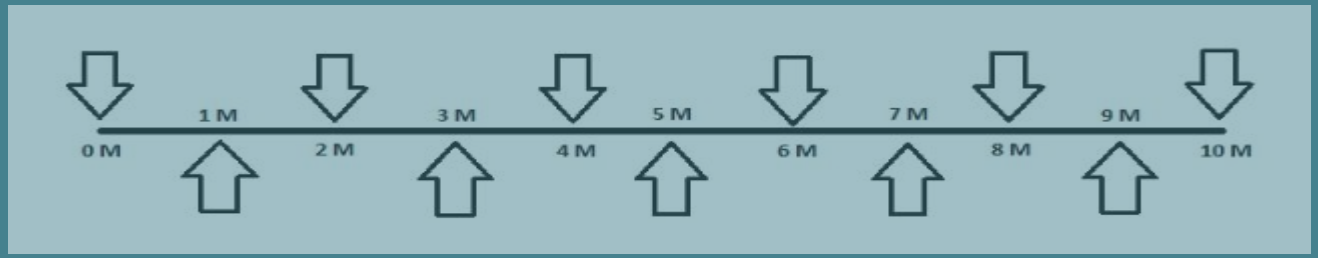


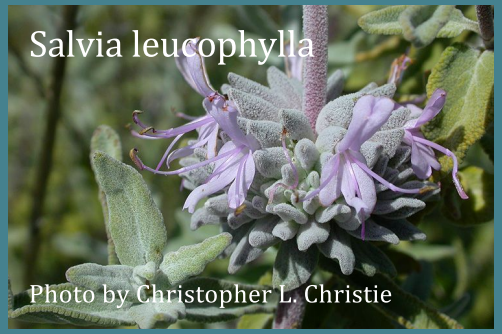
Figure 6. Diagram of 10 meter Point Transect at 1 meter intervals

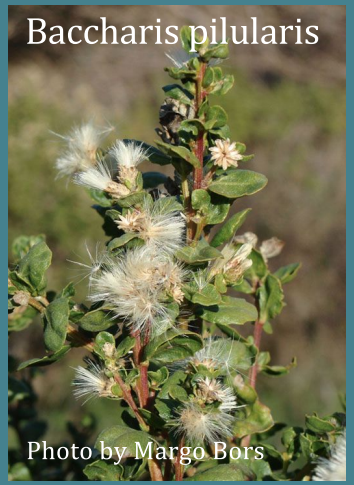
Data

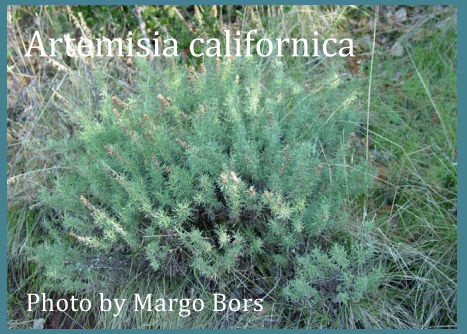
In order to analyze the species richness within the Cheeseboro Canyon area, alpha, beta, and gamma diversity are measured. Alpha diversity will tell us the species richness in the local CSS community or patches. Gamma diversity is essentially the alpha diversity at a larger scale, the entire Cheeseboro region. Beta diversity tells us the uniqueness of each CSS community within the region. To measure whether or not there are significant differences in the assemblages of CSS species found in recovering and stable boundaries, we used a Chi-Square statistical analysis.

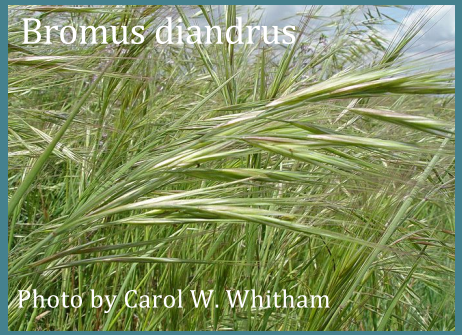
Figure 7. Lena and Kellie documenting species along one of our transect lines.

Species Discovered









Results - Transects

Alpha, beta, gamma diversity for Cheeseboro Canyon 04/13/16

Species	Common Name	1	2	3	4	5	6	7	8	9	10		Total #	# Sites	% of Sites	Stable	% Stable	Recoverin	% Recovering
Salvia Leucophylla	Purple Sage	3	3	4	4		6	3	2	5			30	8	80.00%	4	50.00%	4	50.00%
Artemisia Californica	Coastal Sage Brush	1	4	2				1	1				9	5	50.00%	1	20.00%	4	80.00%
Bromus diandrus	Ripgut Brome	5			6	1					1		13	4	40.00%	3	75.00%	1	25.00%
Heterotheca grandiflora	Telegraph Weed	1	2	2		3				2	4		14	6	60.00%	3	50.00%	3	50.00%
Hirschfeldia incana	Mustard	1			1								2	2	20.00%	1	50.00%	1	50.00%
Bare soil			2	2		2	2	3	4	4	1		20	8	80.00%	5	62.50%	3	37.50%
Centromadia Parryi	Pappose tarweed			1									1	1	10.00%			1	100.00%
Baccaris Pilularis	Coyote Brush					4	3	4	1		3		15	5	50.00%	4	80.00%	1	20.00%
Quercus Agrifolia	Coast live oak					1					2		3	2	20.00%	2	100.00%		
Stipa Pulchra	Purple needle grass								3				3	1	10.00%			1	100.00%
		11	11	11	11	11	11	11	11	11	11	Total	110	42		23	54.76%	19	45.24%

Alpha diversities	5	4	5	*3*	*5*	*3*	*4*	5	*3*	*5*	
Gamma diversity											10

	Each (S & R)	8		9
	Whole area		10	
	Beta diversity (S vs. R)		3	

Beta diversities	1	2	3	4	5	6	7	8	9	10		Averages
1		3	3	2	6	6	5	6	4	6	1	4.1
2	3		1	5	5	3	2	3	1	5	2	2.8
3	3	1		6	6	4	3	4	2	6	3	3.5
4	2	5	6		6	4	5	6	4	6	4	4.4
5	6	5	6	6		4	5	6	4	0	5	4.2
6	6	3	4	4	4		1	2	2	4	6	3
7	5	2	3	5	5	1		1	3	5	7	3
8	6	3	4	6	6	2	1		4	6	8	3.8
9	4	1	2	4	4	2	3	4		4	9	2.8
10	6	5	6	6	0	4	5	6	4		10	4.2

Most divergent site, with the fewest species shared (highest average β)	Site 4			Lowest (by Site #)						Highest
Least divergent sites, sharing more species (lower average β)	Sites 2 & 9			2 & 9	6&7	3	8	1	5	10	4

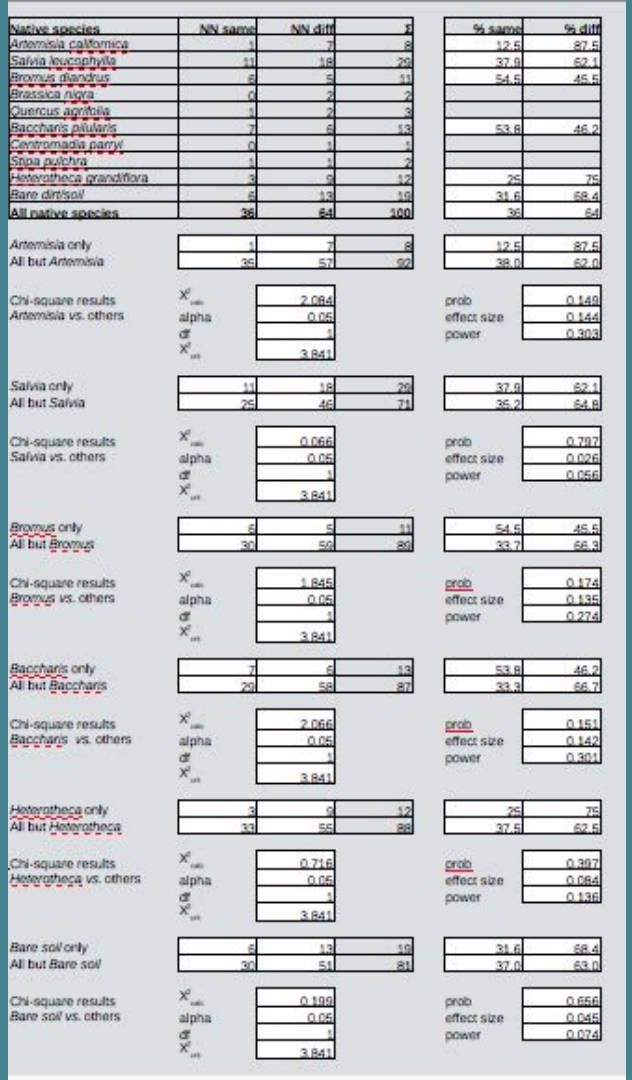
Results - Species Richness

- Alpha, Beta, and Gamma Diversity:
  - Stable transects: 6
    - 54% of sites were stable
  - Recovering transects: 4
    - 45% of sites were recovering
  - Stable vs. Recovering:
    - Alpha diversity:
      - Stable: 8, Recovering: 9
    - Beta: 3
    - Gamma: 10
  - Species Richness (all 10 transects):
    - Alpha
    - Gamma: 10
    - Beta
      - Most divergent site: Site 4 (Recovering)
      - Least divergent sites: Sites 2 & 9 (Stable and Recovering)

Figure 8. Salvia leucophylla specimen.

Results - Chi Square Analysis

- For all species found:
  - P-value > alpha
  - Calc < critical
- Contradicting findings of significance
- Trivial effect size
- Weak power size



Native species	NN same	NN diff	Σ	% same	% diff
Artemisia californica	1	7	8	12.5	87.5
Salvia leucophylla	11	18	29	37.9	62.1
Bromus diandrus	6	5	11	54.5	45.5
Brassica nigra	0	2	2		
Quercus agrifolia	1	2	3		
Baccharis pilularis	7	6	13	53.8	46.2
Centromadia parryi	0	1	1		
Sisyrinchium bellum	1	1	2		
Heterotheca grandiflora	3	9	12	25	75
Bare dirt/soil	6	13	19	31.6	68.4
All native species	**36**	**64**	**100**	36	64

Artemisia only	1	7	8	12.5	87.5
All but *Artemisia*	35	57	92	38.0	62.0
Chi-square results *Artemisia* vs. others	X^2_{calc}	2.064		prob	0.149
	alpha	0.05		effect size	0.144
	df	1		power	0.303
	X^2_{crit}	3.841			
Salvia only	11	18	29	37.9	62.1
All but *Salvia*	25	46	71	35.2	64.8
Chi-square results *Salvia* vs. others	X^2_{calc}	0.066		prob	0.797
	alpha	0.05		effect size	0.026
	df	1		power	0.056
	X^2_{crit}	3.841			
Bromus only	6	5	11	54.5	45.5
All but *Bromus*	30	59	89	33.7	66.3
Chi-square results *Bromus* vs. others	X^2_{calc}	1.845		prob	0.174
	alpha	0.05		effect size	0.135
	df	1		power	0.274
	X^2_{crit}	3.841			
Baccharis only	7	6	13	53.8	46.2
All but *Baccharis*	29	58	87	33.3	66.7
Chi-square results *Baccharis* vs. others	X^2_{calc}	2.066		prob	0.151
	alpha	0.05		effect size	0.142
	df	1		power	0.301
	X^2_{crit}	3.841			
Heterotheca only	3	9	12	25	75
All but *Heterotheca*	33	55	88	37.5	62.5
Chi-square results *Heterotheca* vs. others	X^2_{calc}	0.716		prob	0.397
	alpha	0.05		effect size	0.084
	df	1		power	0.136
	X^2_{crit}	3.841			
Bare soil only	6	13	19	31.6	68.4
All but *Bare soil*	30	51	81	37.0	63.0
Chi-square results *Bare soil* vs. others	X^2_{calc}	0.199		prob	0.656
	alpha	0.05		effect size	0.045
	df	1		power	0.074
	X^2_{crit}	3.841			

Discussion

Although p-values yielded us with statistically significant results to support our hypothesis, the comparison between calculated and critical values did not.

The most divergent site in our data was transect 4, which is a recovering boundary. This means that based on our data the species uniqueness was greatest in a recovering boundary. The least divergent sites were transects 2 and 9. Transect 2 was a recovering boundary, and 9 was a stable boundary, supporting our conclusion that more data and samples are necessary to develop a more accurate study

Biases

- Clusters of CSS plant communities were far and few between in Cheeseboro Canyon, making it difficult to access patches of CSS critters. Our data may be skewed to represent areas with more invasive grasses.
- Uneven topography created difficulty in retrieving data (Hilltop and Ripgut Grass).
- This is not an accurate representation of all of Cheeseboro Canyon given we were on foot throughout our study. We were limited to one region and a couple trails of the entire canyon.

Figure 9. Our team recording species in one of our transects.

Additional Questions

- Which species establish first in areas outside of recovering CSS boundaries? That is - are there species that act as facilitators for CSS recovery?
- What role can we play as restorationists and biogeographers in supporting CSS recovery most effectively?
- What other factors contribute to the expansion of CSS recovery in our study area?

Conclusion

Research has found that some plant species may act as facilitators for additional native plant establishment. This is very important knowledge for restoration work. Passive restoration is much more economically viable and requires fewer man hours and labor, so having the right setting for native CSS plant recovery is critical. Lastly, future research conducted on CSS plant community expansion should utilize higher sample sizes when doing data collection. This way, restoration projects can be more effective in implementing positive environmental progress moving forward.

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