Waste not, want not: a pilot study on direct seeding over straw mulch as a means of revegetation in Stinson Gulch, CA.

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Introduction

Habitat restoration specialists of the Golden Gate National Recreation Area (GGNRA) utilize sheet mulching with salvaged cardboard and rice straw to suppress invasive plant biomass and protect bare soil from further invasion following soil disturbance. California native species are consequently also prevented from immediately colonizing the mulched area due to the lack of sunlight and space. Regularly purchasing nursery grown native plants for revegetation becomes expensive, varies in successful establishment, and requires increased active management. Former studies on the success of direct seeding recommend it as a supplemental method to planting, [2] but did not include seeding a fully mulched area. Successfully direct seeding over mulch may allow for quick, cost effective revegetation within a large area, and may create a seed bank after establishment. This pilot study aims to test mulch conditions necessary for successful establishment and growth of native species, comparing cardboard prevalence, age of straw, and depth of straw over the course of the 2017 growing season.

Stinson Gulch in Marin County, CA is a primarily riparian region with an intermittent creek flowing during the rainy season. The land, owned by MMWD, has been sheet mulched for several consecutive years by the GGNRA's Habitat Restoration Team to control *Ehrharta erecta*, an invasive grass. Ample mulched area and varying conditions across the parcel led to selection of the site.

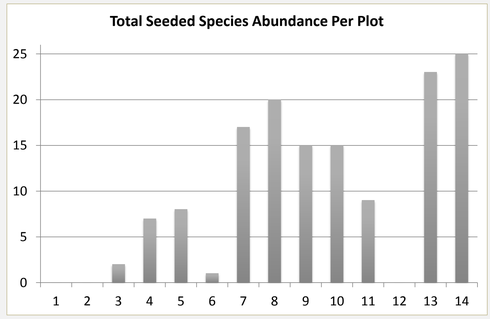
Methods

This study relied on mulching area data recorded at the earliest visit available from the Calflora database to define appropriate study areas. Fourteen 1 m^2 plots were randomly selected and each corner marked with a stake and flagging tape, all visually void of any existing vegetation. Conditions were assessed within each plot and each were hand seeded with 2.26 g/m^2 (20 lb/acre) of seed mix split between two treatments: 7 receiving a full broadcast, and 7 receiving a half broadcast followed by a second half broadcast 28 days later based on previous research suggesting at least a 2 week interval between seedlings [3]. The cleaned seed mix included nine shade-tolerant, perennial herbaceous and grass species and was sourced from seed stock collected in watersheds adjacent to the site by GGNRA personnel. All seed was broadcasted over the top of the plots without disturbing existing mulch.

Seed Mix	Grams	Seeds
Bromus carinatus	0.8	120
Elymus glaucus	0.3	50
Heracleum maximum	0.25	19
Eschscholzia californica	0.25	179
Melica californica	0.25	172
Helenium puberulum	0.25	611
Mimulus aurantiacus	0.2	957
Horkelia californica	0.25	634
Scrophularia californica	0.05	291

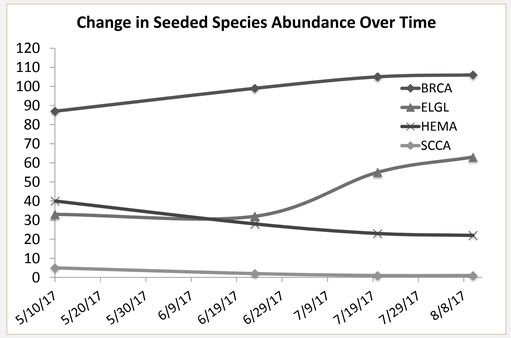
Results

No statistical significance was found regarding the total species abundance between the two treatments, or compared to straw age and straw depth. The presence of cardboard did significantly affect plant success ($p=0.0359$), although several plots with the highest recruitment did not have cardboard underneath.

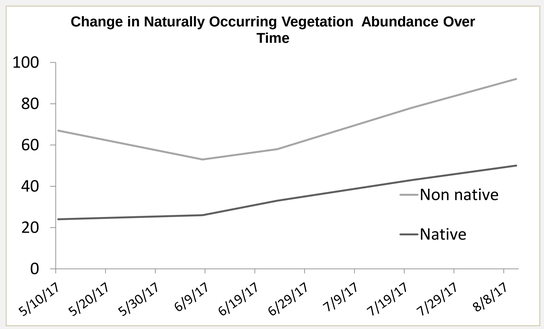


Images of plots 2, 5, 7, and 10 for total abundance

Perennial grass species proved to be more successful than perennial herbaceous species, with *Bromus carinatus* and *Elymus glaucus* setting seed at 21.7% and 42.8% respectively of the total abundance per species. No herbaceous species set seed, however, *Heracleum maximum* grew substantially and may set seed next season.



Both native and non native species emerged through the straw naturally, and although the trend for native species was positive, the non native species increased in abundance more rapidly. *Ehrharta erecta* comprised 28.2% of invasive species present.



Discussion

Although the results between the two treatments and abundance of direct seeded species were not significant, most plots proved that the overall method of direct seeding over mulch for revegetation is effective on a small scale. In the interest of conserving time and monetary resources, collecting native seed from the watershed and broadcasting over mulched areas will certainly aid in the restoration process. Across GGNRA lands, this may be a helpful technique on restricted resources. On a larger scale, more years of observation would be required to understand the quality of seed bank and longevity of perennial plants.

Straw age and depth showed no significance in relation to total abundance, however the presence of cardboard significantly correlated. Sheet mulching may provide some level of nutrition, moisture retention, or improved straw condition.

Perennial grasses were overall more successful than herbaceous species, perhaps due to multiple factors. Two of the three grass species sown faired well in competition with naturally occurring native and non native species, and were able to set seed quickly, thus participating to the seed bank. Nearly all grasses went to seed between plots 8 and 12. This level of competition within a small plot dense with various seeds may have eliminated many herbaceous species early on in the experiment. Seed viability may have also varied due to age and quality of containment until dispersal. Freshly collected seeds would most likely yield more positive results. Foraging animals, namely birds and burrowing mammals, may have also contributed to seed loss.

Plots 1, 2, and 12 received the most direct sunlight throughout the day which may have left straw conditions in these areas drier and ill suited for germination.

Plots 13 and 14 were mowed once by MWD personnel and rebounded with some of the highest abundance of all plots, mainly in perennial grass regrowth.

Non native or invasive plant species will require treatment as straw continues to break down. A seed bank of native species may mitigate this affect and stand to better out compete invasive species.

References

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Acknowledgements

I'd like to thank Maria Alvarez, Dale Smith, John Anderson, and Sydney Fitch for assisting with data collection and project design. I would also like to thank Christine Sullivan, Julian LoGuidici, Jamie Baxter, and Patrick Nicholson for editing assistance. Finally, thank you to the GGNRA Natural Resources Department for providing equipment and time allowance dedicated to this project.