ASSESSING SEED SOURCES FOR ENHANCING RESTORATION SUCCESS IN INVADED ECOSYSTEMS

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INTRODUCTION

- Successful restoration of invaded ecosystems depends on establishing native plants with traits that limit further invasion.
- Faster growth, for example, can provide native species with a competitive advantage over invasive species during establishment through more efficient resource acquisition.
- Plant traits are known to vary among populations from different regions, which may be due to maternal affects or genetic differentiation across climate gradients.
- It is unknown whether planting native plants from sources that vary in temperature and precipitation can enhance restoration outcomes.
- **Objective**: Determine whether seed source (provenance) affects plant traits associated with growth and establishment of three native California shrub species sourced from four locations with differing climatic conditions.

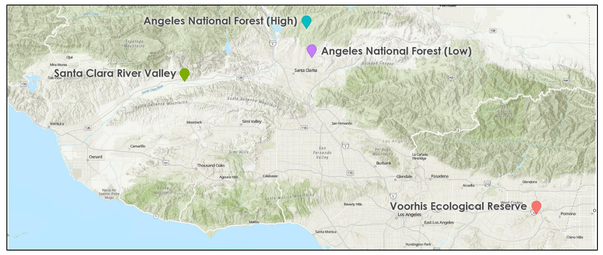

Figure 1 – Map of seed source locations across Southern California.

METHODS

- Study species: *Acmispon glaber* (Deerweed), *Eriogonum fasciculatum* (Buckwheat), and *Salvia mellifera* (Black Sage) (Figure 1).
- Seeds collected in Fall of 2023 from four sources (Table 1).
- 66 Plants were planted in Spring of 2024 in hedgerows alongside three agriculture sites in the Santa Clara River Valley (Figure 7).
- Plant traits related to competition with invasive species were collected.

Figure 2 – Three study species: **Left** – *Acmispon glaber* (Deerweed), **Middle** - *Eriogonum fasciculatum* (Buckwheat), **Right** – *Salvia Mellifera* (Black Sage).

RESULTS

SEED SOURCE CLIMATE DATA

Seed Source	Elevation [m]	Max VPD	Precip [mm]	Temperature [C]		
				Average	Min	Max
Voorhis	252	21.9	415.5	18.1	11.3	24.8
SCRV	142	22.1	419.4	17.3	10.3	24.3
ANF (High)	654	25.3	391.1	17.2	10.3	24.0
ANF (Low)	454	26.5	324.8	17.9	10.7	25.2

Table 1 - Climate data from PRISM for each of the seed provenance sites. Annual averages from 2003-2023.

SURVIVAL

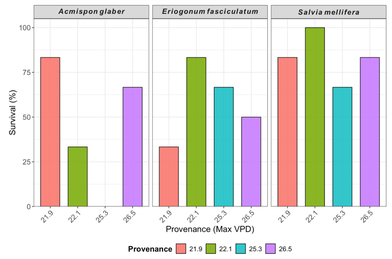

Figure 3 - Plant survival (%) up to February 2025 grouped by species and provenance max VPD. The interaction between species and provenance did not significantly affect on plant survival. (p=0.197).

GROWTH RATE

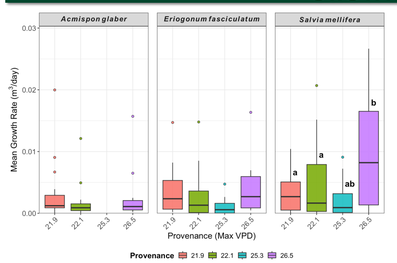

Figure 4 - Mean daily plant growth (m^3) between May 2024 and May 2025, grouped by species and provenance max VPD. There was a significant difference in growth rate between provenances for *Salvia mellifera* but not the other species rate (significant species:provenance $F_{5,153}$=3.36, P<0.01).

FINAL VOLUME

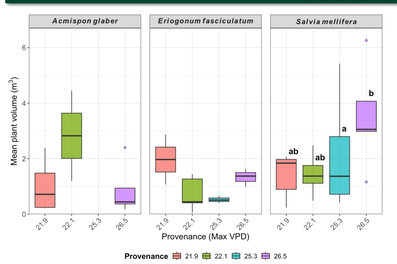

Figure 5 – Mean plant volume (m^3) after one year of growth in May 2025, grouped by species and provenance max VPD. There was a significant difference in final volume between provenances for *Salvia mellifera* but not the other species rate (significant species:provenance $F_{5,32}$=2.80, P<0.05).

VOLUME OVER TIME

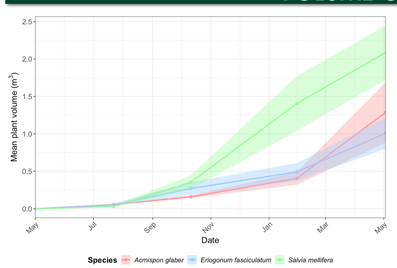

Figure 6 – Mean plant volume (m^3) between May 2024 and May 2025, grouped by species. Volume changed overtime (significant date $F_{4,156}$=345.29, P<0.001) and there was a trend for differences in size among species over time (significant species:date $F_{8,156}$=1.99, P= 0.0516). *Salvia mellifera* grew larger earlier than the other species.

DISCUSSION

- **Survival** – On average, survival did not significantly differ among species or provenance, indicating all seed sources had similar rates of success in establishment.
- **Growth Rate** – Growth rates were not significantly different among provenances for *Acmispon glaber* or *Eriogonum fasciculatum* but were significantly different among provenances for *Salvia mellifera*.
- **Volume** – *Salvia mellifera* had significantly different final volumes among provenances while the other species had no significant difference. *Salvia mellifera* also grew larger earlier than the other species, highlighting a difference in size over time among species.
- **Summary** – Provenance showed clear differences in growth rate and final size for *Salvia mellifera* but had little effect on the other species of interest.

Figure 7 – Native plants planted into a hedgerow at one of the three study sites in the Santa Clara River Valley in September 2024.

Figure 8 – Native plant hedgerow one year after planting in May 2025.

IMPLICATIONS

These findings suggest that to improve restoration success by making native populations more competitive with invasive species a focus on identifying species with competitive traits, such as faster growth or larger volumes, may be more effective than focusing on seed provenances alone.

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