# Does seed predation limit velvet mesquite (*Prosopis velutina*) recruitment in grasslands?


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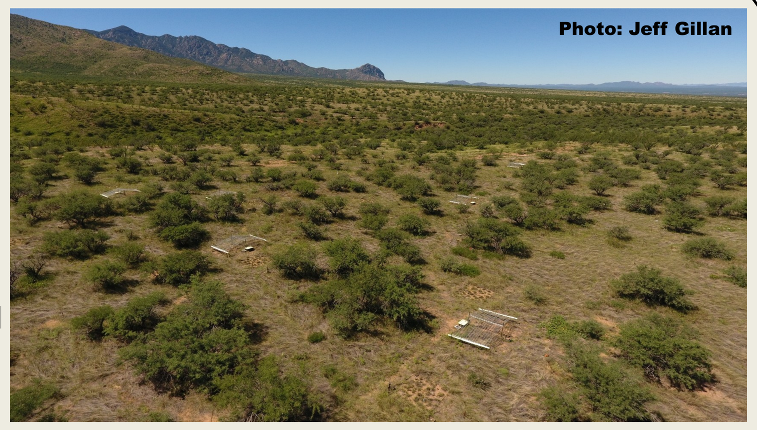
## Background




- Sonoran Desert grasslands like those at the Santa Rita Experimental Range have seen substantial increases in velvet mesquite (*Prosopis velutina*) establishment in the past century.[1]
- The abiotic (precipitation/ temperature) and biotic constraints to shrub recruitment (livestock grazing, ants and small mammals) are not well known.[2]

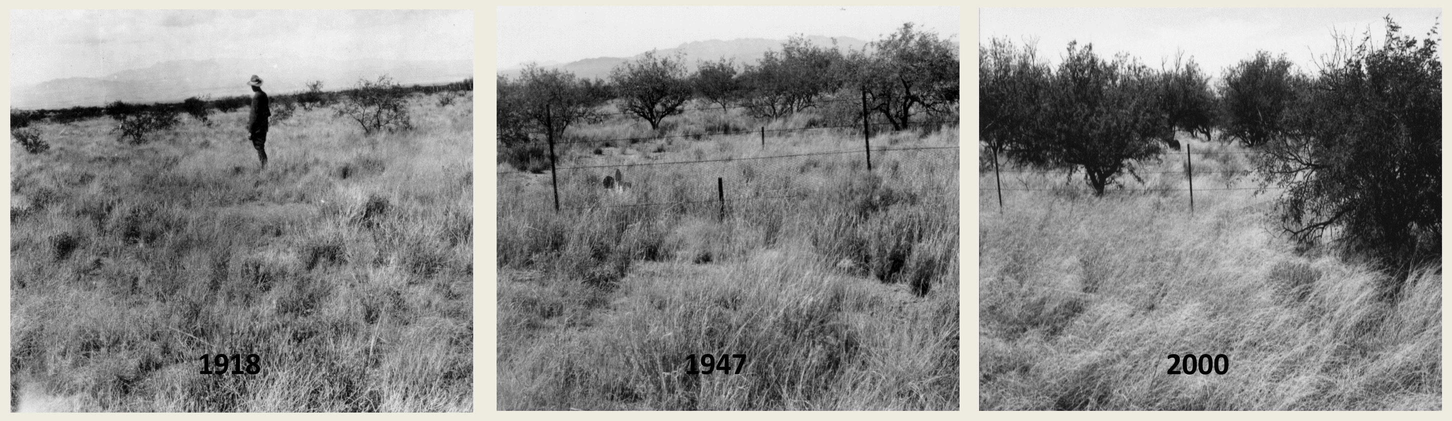



**Figure 1.** Repeat photography of velvet mesquite cover at the Desert Grassland Station exclosure (study site) from 1918 to 2000. Photos were obtained via the Santa Rita Experimental Range Repeat Photography Archive (Station 091).

- Mesquite pods and seeds produced in summer/autumn are highly nutritious forage for ants and small mammals and may be preferred in winter/early spring when other food sources (grass seed/insects) are low.[3]

***Are levels of seed predation during winter/spring high enough to potentially limit shrub recruitment?***

## Hypotheses

- Levels of seed predation during the winter-spring will increase with increasing temperature and precipitation as ants and small mammals become more active.
- Reduced vegetation cover via simulated heavy grazing will deter seed predation by ants and small mammals.
- Seed disappearance will be highest when both ants and small mammals are present.

## Methods

**Automated Rainfall Manipulation Systems (ARMS)[4] used to manipulate precipitation (PPT) (Fig. 2).**

- 10 (2.5 X 5 m) plots → ambient PPT (Control)
- 10 (2.5 X 5 m) plots → +65% PPT (Wet)
- 10 (2.5 X 5 m) plots → -65% PPT (Drought)


**Within Each PPT Treatment:**
- "Grazing"/Clipping (half of plot to height of 15 cm)
- Rodent and/or Ant Exclusions (10 cm in diameter areas)


### Seed Predation

- Seed disappearance, a proxy for seed predation, recorded for the first four days, then weekly.
- Seeds (5 per Exclusion treatment) were monitored from January to March 2017 (9 weeks).


### Ants

- Ants were captured monthly via pit fall traps placed in each Clipped X PPT treatment.
- Ants were identified to species (if possible).


**Figure 2.** Field set up of ARMS (above with Wet PPT treatment outlined in blue and Drought in orange) and exclusion treatments (below). Control/ambient PPT treatment not shown.

## Results

### Seed Predation

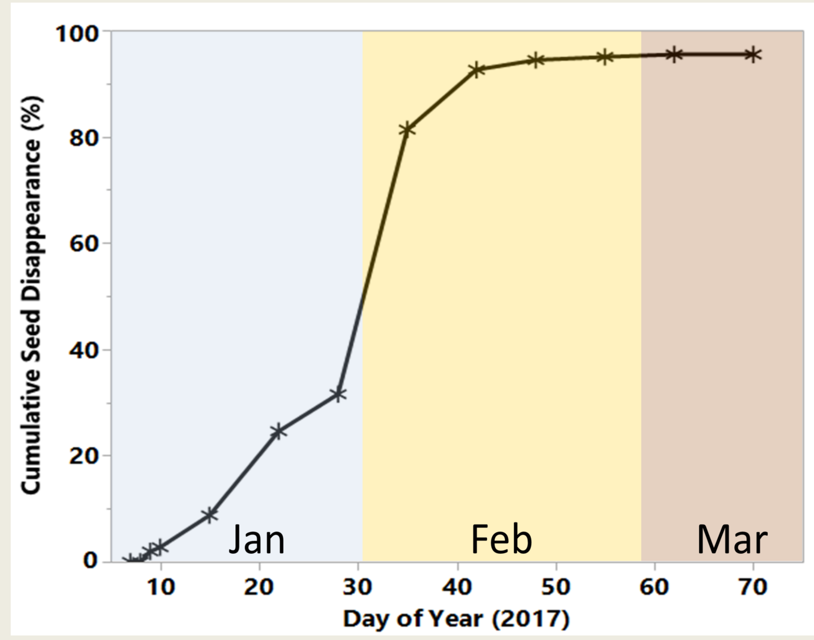
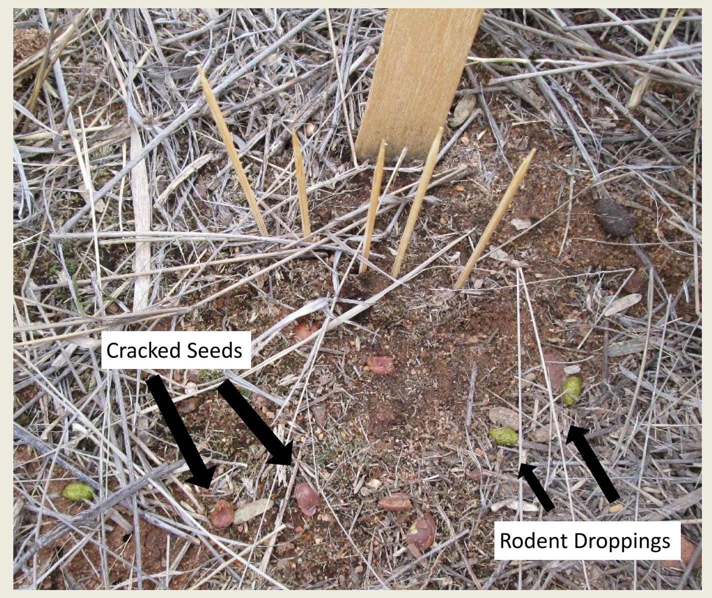



**Figure 3.** Cumulative seed disappearance (%) over all treatments by day of year of collection during the winter to early spring of 2017.

- Cumulative seed disappearance rose from 31.5 % in January to 95.5 % in March 2017 (Fig. 3).



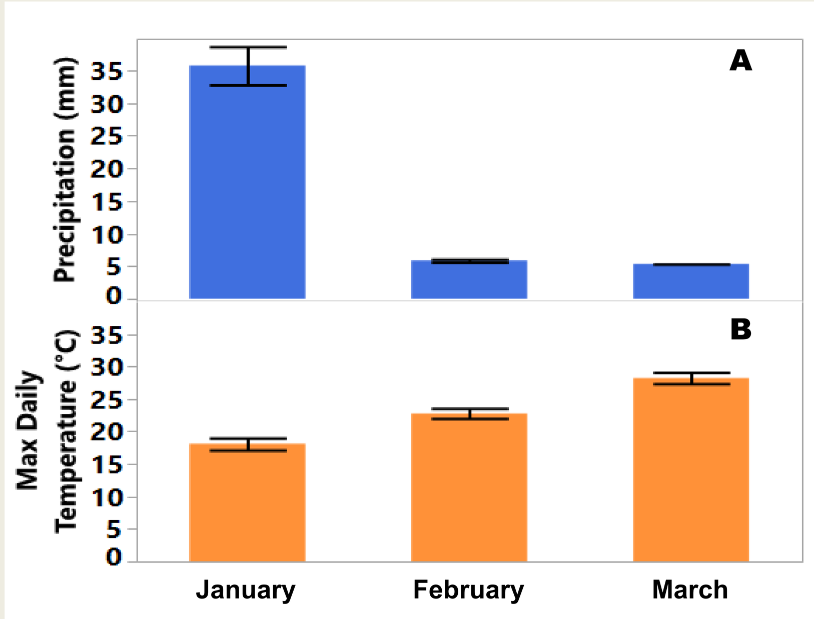




**Figure 4.** Mean (± SE) precipitation (mm) (A) and maximum daily temperature (°C) (B) in January, February, and March 2017.

- Cumulative seed disappearance increased with rising max daily temperatures (Figs. 3 and 4B).
- Seed disappearance was higher in unclipped treatments regardless of precipitation (Fig. 5).

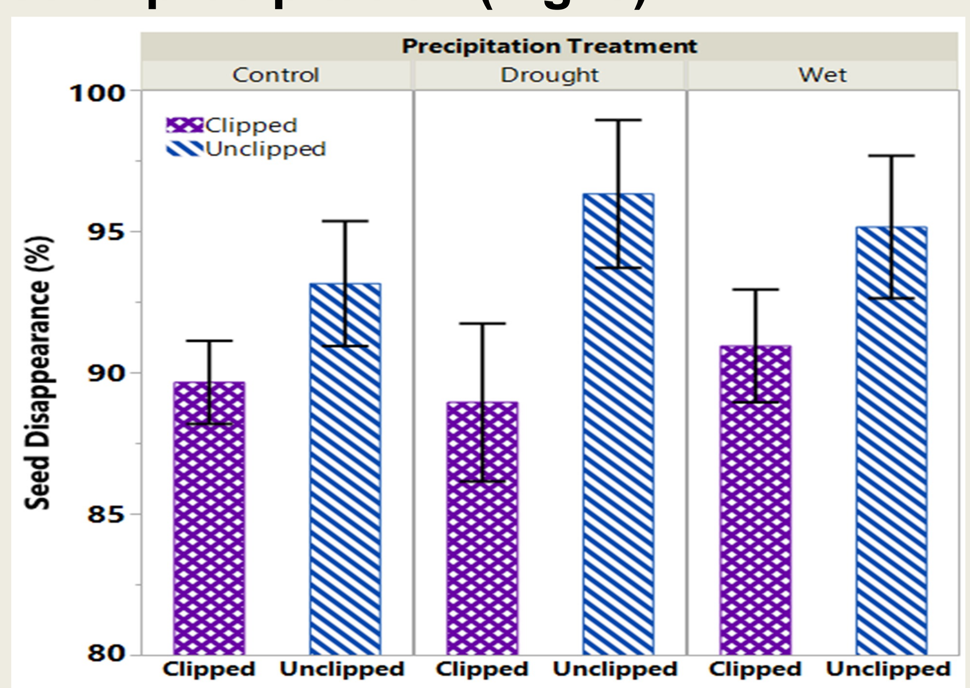



**Figure 5.** Seed disappearance (mean ± SE, %) pooled across exclusion treatments by clipping and precipitation treatments. Significant whole model effect of grazing treatment (ANOVA: $F_{(2,227)} = 7.1$, $p = 0.01$); PPT and interaction were not significant.

- Seed disappearance was significantly higher in areas accessible to both ants and rodents (Fig. 6).

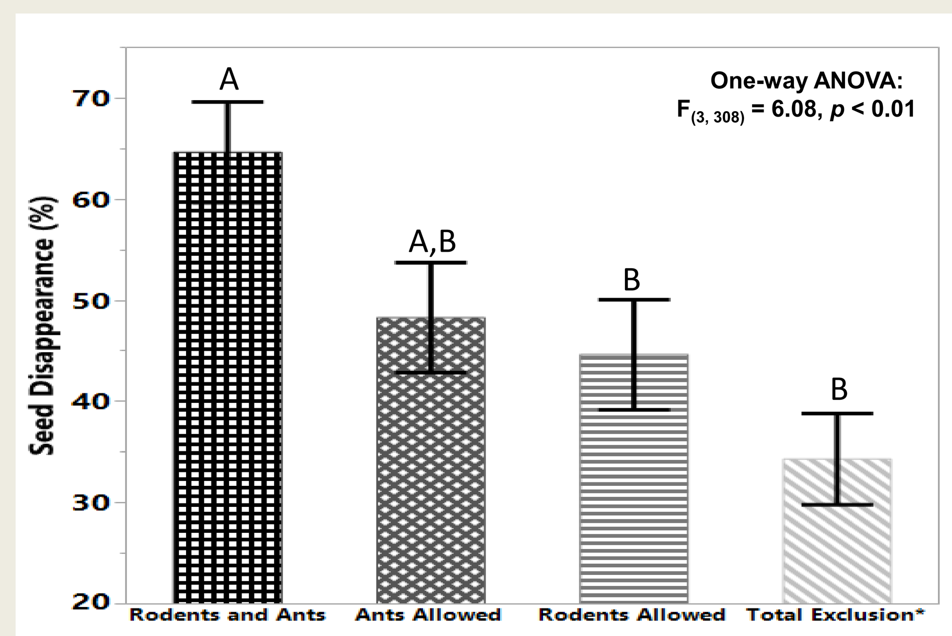



**Figure 6.** Seed disappearance (mean ± SE %) per exclusion treatment. Letters indicate post-hoc Tukey's HSD results, where different letters indicate a significant ($p$<0.05) difference. * Ants and other insects burrowed into Total Exclusion treatments and consumed seeds.

## Results

### Ants

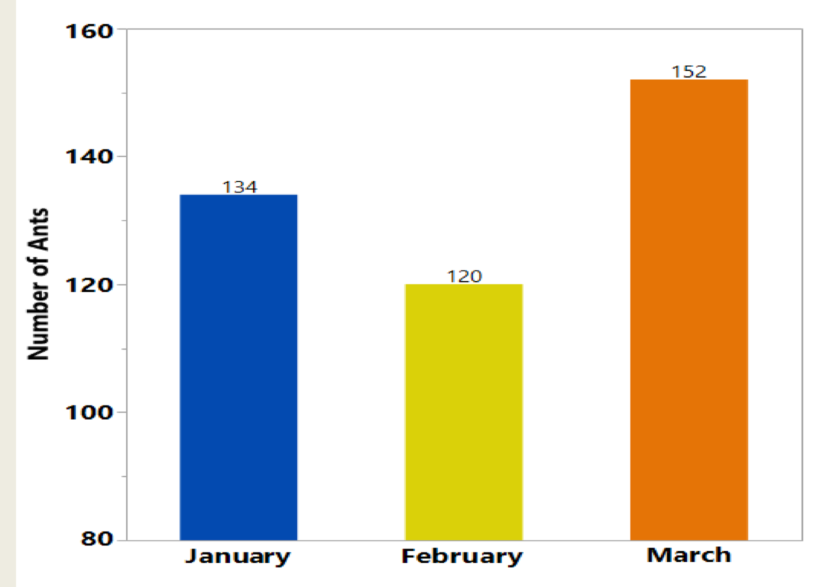



**Figure 7.** Total number of ants captured at study site per month in 2017.

- Increasing trend in number of ants with rising max daily temperatures from January to March (except February) (Fig. 7).

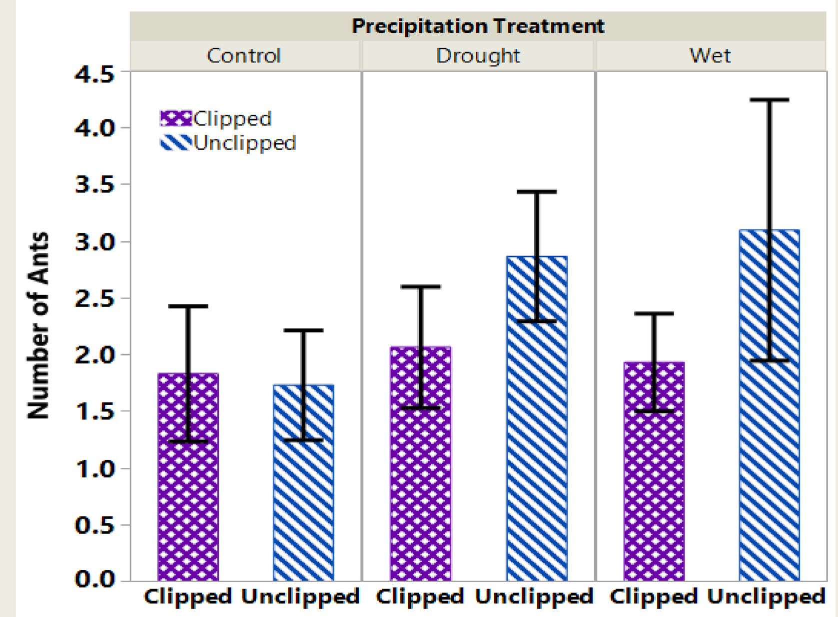




**Figure 8.** Mean (± SE) number of ants captured in clipping and precipitation treatments pooled across January, February, and March 2017. No significant effects between treatments and interactions.

- Mean number of ants in unclipped treatments were higher in drought and wet PPT treatments (Fig. 8).
- Out of 19 total ant species, the five most abundant found at site are known seed predators/foragers (Table 1).

**Table 1.** Top five ant species relative abundance and habit across the site.

| Ant Species | Relative Abundance (%) | Known Seed Predator/Forager? |
|---|---|---|
| *Formica* sp. | 30.8 | Yes |
| *Pheidole* sp. 1 | 21.8 | Yes |
| *Tetramorium spinosum* | 10.8 | Yes |
| *Pheidole* sp. 2 | 9.2 | Yes |
| *Odontomachus* sp. | 4.6 | Yes |

## Conclusions

- Ant/rodent seed predation during winter/spring is more related to temperature than precipitation.
- Velvet mesquite seeds deposited in ungrazed Sonoran Desert grasslands are highly vulnerable to winter/spring seed predation by ants and small mammals. Thus, areas with no to light grazing should be more resistant to mesquite encroachment than heavily grazed areas.
- These results indicate that seed disappearance fluctuates with seasonal and inter-annual abundance of ant and rodent seed predators.

## References


**1.** McClaran, M. P. 2003.RMRS-P-30. USDA FS, Rocky Mtn Research Station, Tucson, AZ. **2.** Eldridge, D.J. et al. 2011. *Ecology Letters* 14(7): 709–22. **3.** Weltzin, J. F., S. Archer, and R. K. Heitschmidt. 1997. *Ecology* 78(3): 751–63. **4.** Gherardi, L. A. & Sala, O. E. 2013. *Ecosphere*, *4*(2), 1-10.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