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Assessing seed predation to inform the conservation and recovery of the critically endangered Nipomo Mesa Lupine, *Lupinus nipomensis*

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Assessing seed predation to inform the conservation and recovery of the critically endangered

Nipomo Mesa Lupine, *Lupinus nipomensis*.

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Background

Focal Species

Nipomo Mesa Lupine (*Lupinus nipomensis*)

- State of California and federally endangered plant
- Limited to a 2 sq. mile back dune area on the central California coast
- Threatened by the invasive grass *Ehrharta calycina*

Veldt Grass (*Ehrharta calycina*)

- Invasive, perennial African grass
- Introduced for grazing and agricultural purposes, leading to severe effects on native ecosystems
- Rapidly accumulates thatch layers and a large seed bank in introduced areas, adapting well to the mild Mediterranean climate of coastal California while smothering native plants.

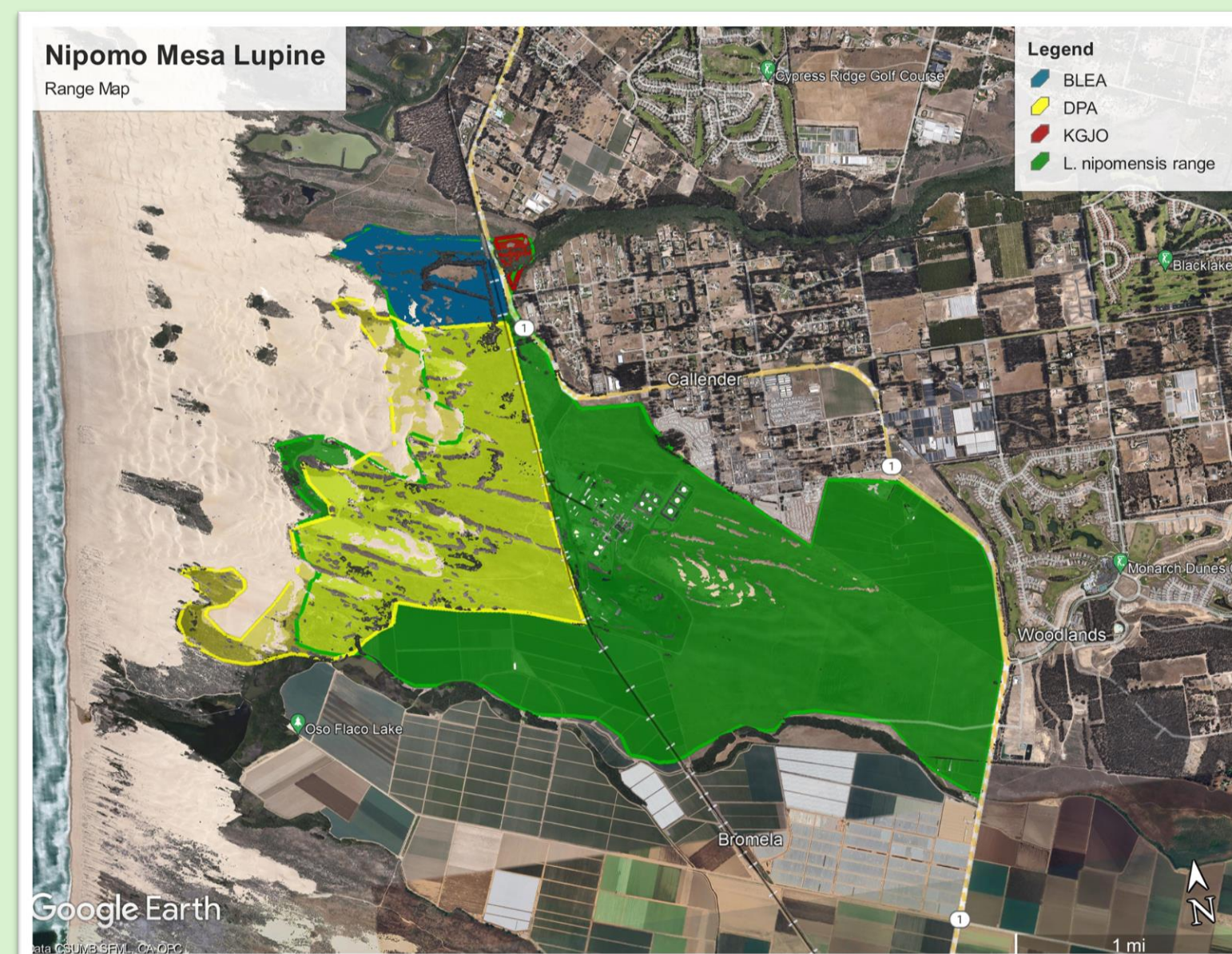
Heermann's kangaroo rat (*Dipodomys heermanni*) and Deer mouse (*Peromyscus maniculatus*)

- Adapted to the prevalence of veldt grass in dune ecosystems
- Extensive veldt grass cover has altered diets of rodents over recent decades
- Scatter-hoarding species, potentially facilitating seedling dispersal of predated plant species



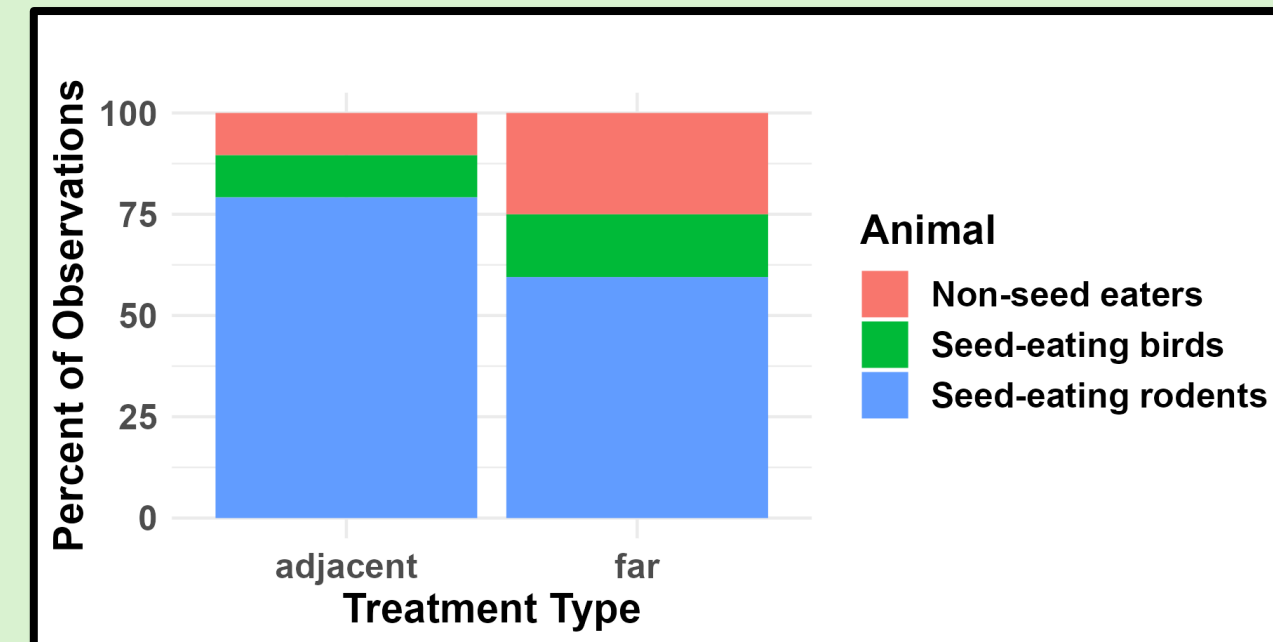
Study Area

Dune Protected Area (DPA), Oceano Dunes

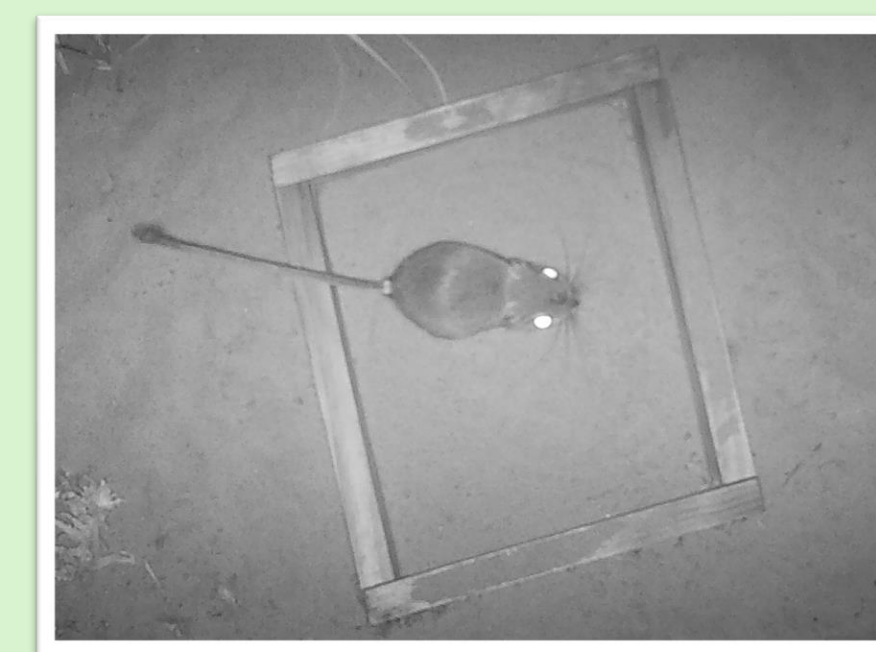


Results

Seed-eating rodents were the most abundant seed predators regardless of veldt proximity



Peromyscus maniculatus



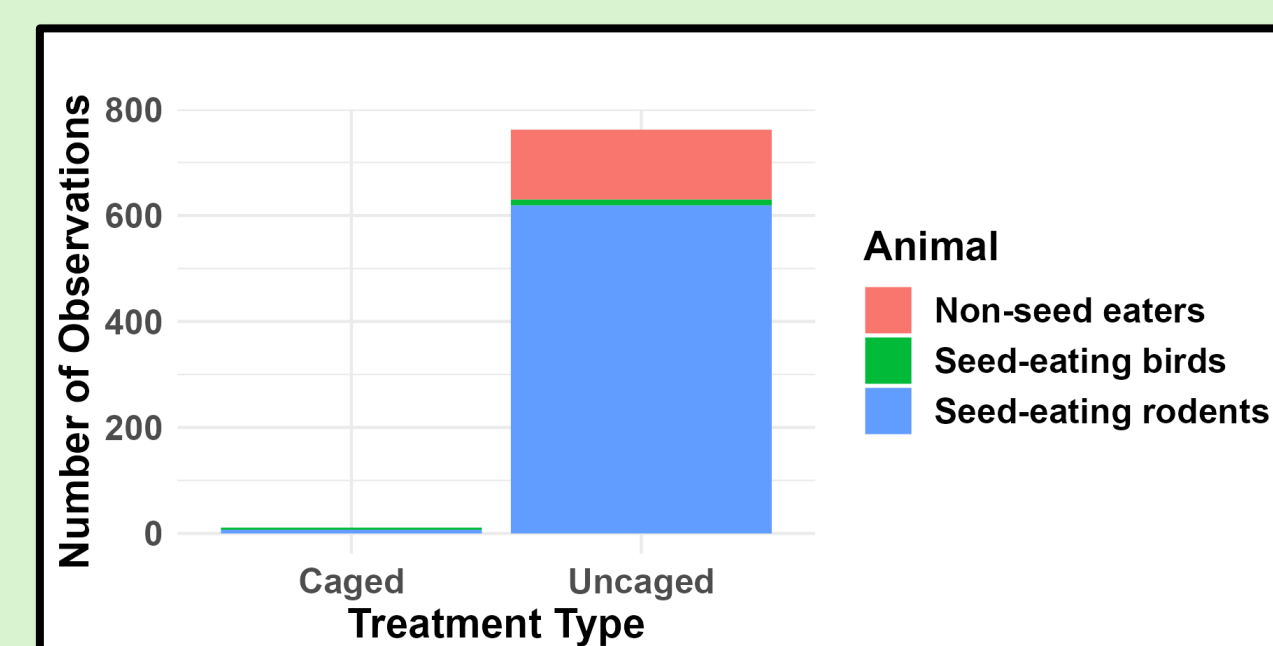
Dipodomys heermanni

Avian seed predators were also present but not in abundance

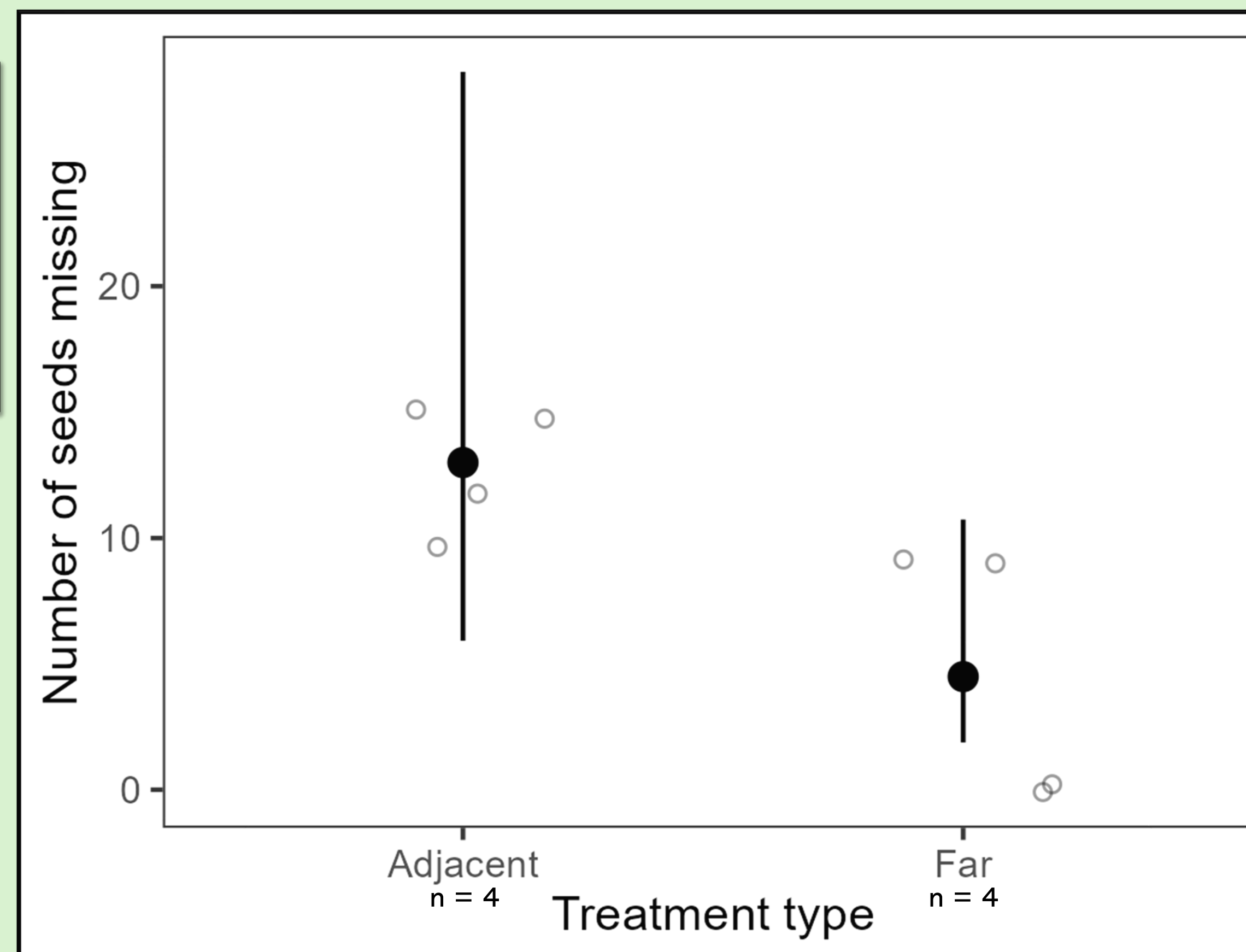


Melospiza crissalis

Caging reduced observations of seed-eating animals to near zero

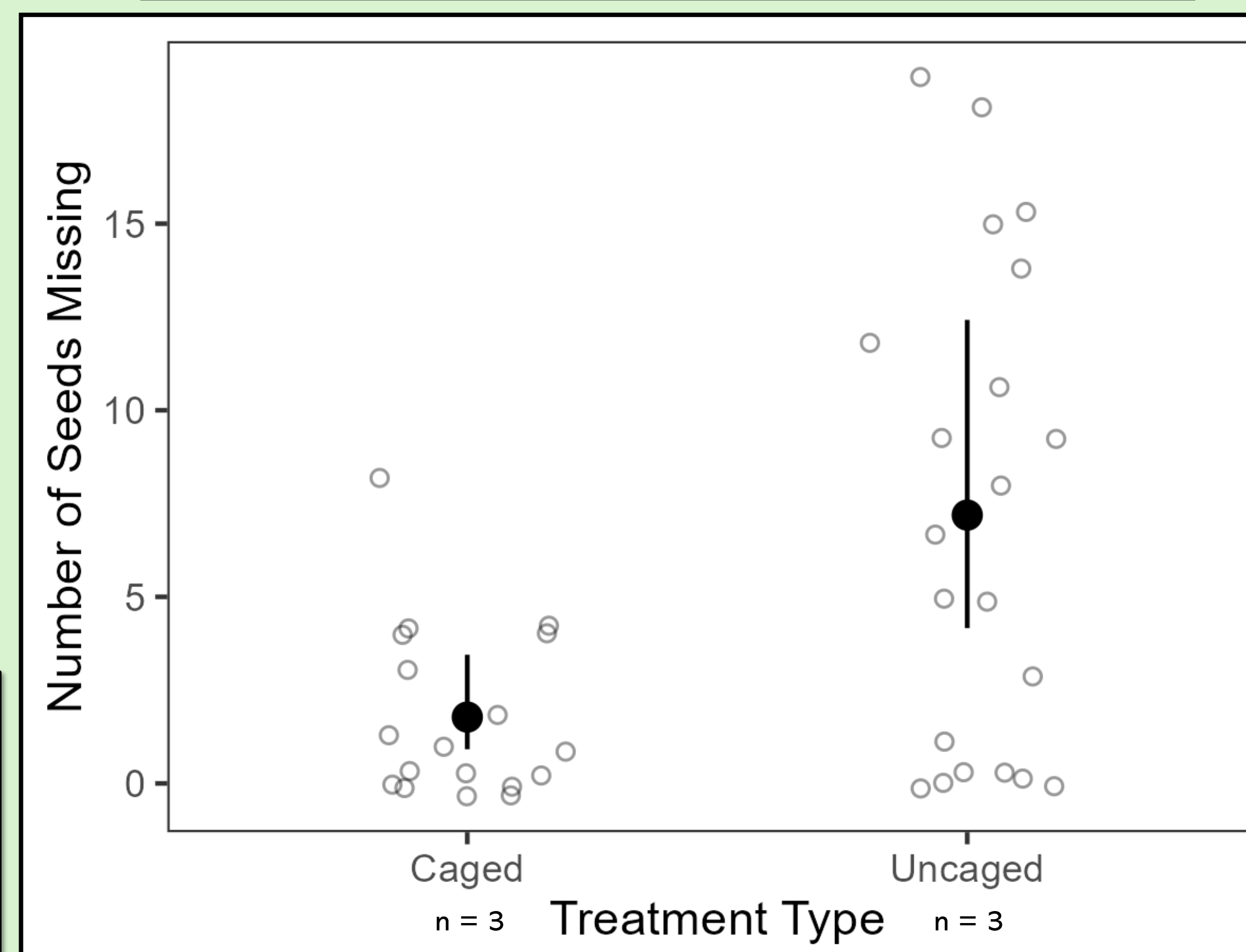


Most seeds were missing from stations deployed for >13 days adjacent to veldt grass



GLMM following a negative binomial distribution. Model predictions of number of seeds removed by rodents are by deployment. Deployment length (<13 days and >13 days) and veldt adjacency (<1m and >2m) are predictor variables. Lines represent 95% confidence interval

Caging significantly reduced seed predation regardless of deployment length



GLMM following a negative binomial distribution. Model predictions of number of seeds removed by rodents are by deployment. Caging is the sole predictor. Lines represent 95% confidence interval

Main Research Goals

- Document seed predation rates of Nipomo lupine
- Evaluate the influence of veldt grass cover and hardware wire caging on seed predation rates

Effect of Vegetation Cover on Predation Hypothesis:

Lupine seed would be consumed at a higher rate within areas adjacent to veldt grass due to increased rodent activity and foraging behavior.

Impact of Hardware-Wire Fences Hypothesis:

The presence of hardware-wire fences, or "cages," would reduce the activity of native rodents and subsequently decrease predation of *L. nipomensis* seeds.

Methods

Veldt-Lupine-Granivore Relationship

- Placed trail cameras and bait stations containing *L. nipomensis* seeds to monitor seed removal.
- Replicates were deployed at two distance treatments, adjacent (within veldt stand) to veldt and far from veldt grass (>2m from veldt).



Caging Lupine

- 3 x 3m, 0.6m-tall hardware cloth fenced plots were compared to unfenced seed box deployment locations.
- Same seed boxes and camera traps were deployed, in caged areas and uncaged areas



Statistical Modeling

- Generalized Linear Mixed Models (GLMMs) were performed in R using the "lme4" package
- Models followed a negative binomial distribution

Significance of Findings:

Establishing seed predation rate data now will enable us to assess whether, over time, a reduction in cover and food resources of veldt grass resulting from conservation actions will lead to a more stable equilibrium between granivorous rodents and the available native resources. Vulnerable species, like *Lupinus nipomensis*, are at a heightened risk of extinction spiral, meaning factors reducing plant recruitment can compound until a population is unable to sustain itself. Current seed predation rates of *L. nipomensis* by high densities of rodents in nearby veldt monocultures may be exceeding the tolerable range of predation, potentially contributing to the lupine population's downward trajectory. We hope that our results may help guide veldt management near extant lupine populations, and that our results that caging leads to significant reductions in seed predation will be considered by USFW and California State Parks for future conservation efforts to mitigate impacts on this critically endangered species.

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