CENTER FOR INVASIVE PLANT MANAGEMENT
GRANT SUMMARY

TITLE:
IMPACTS OF INVASIVE SPECIES AND RESTORATION OF EXOTIC ANNUAL GRASSLANDS IN SOUTHERN CALIFORNIA

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California grasslands are heavily invaded by exotic annual grasses and forbs; an ecological understanding of how they can be restored is still needed. Introduced grasses and forbs form competitive hierarchies in many California grasslands and have differential impacts on native forbs and grasses. Understanding competitive hierarchies, and how different invasive species impact different sensitive life-history stages of native plants can be useful in restoration because it may allow for successful opportunistic seeding or re-vegetating. Additionally, prescribed spring burns may also be effective at reducing exotic species and restoring native species. The research aimed to understand how invasive species impact the native forb communities and how fire and an understanding of competitive hierarchies can be used to develop effective management strategies in two contrasting grasslands.

We used the model species, *Erodium macrophyllum* (Geraniaceae), a rare native annual grassland forb, to test the hypotheses that (1) native and exotic grassland species would have differential competitive effects on a native forb and (2) prescribed spring burns will reduce the cover of exotic grasses and promote native species. For the experiments and results discussed below *E. macrophyllum* was not known to occur at either of the sites; the nearest natural populations were approximately 3-10 km away.

To test the first hypothesis we set up a field experiment in the invaded grasslands in Crown Valley at the Western Riverside County Multi-Species Reserve California. For this experiment we set up five paired 0.5 m^2 plots (30 plots total) in areas where the dominant species was either *Bromus diandrus* (exotic grass), *Erodium brachycarpum* (exotic forb) or *Amsinckia menziesii* (native forb) (referred to as matrix species). We randomly chose one of the paired plots to receive a weeding treatment, in which all growing vegetation was manually removed. Each plot was then seeded with 200 seeds of *E. macrophyllum*; the fates of all *E. macrophyllum* plants that germinated were followed each year for three years (2000-2003).

We found that weeding increased fecundity regardless of the matrix species treatment, although plants growing in the weeded *Bromus* plots had the greatest fecundity. According to the periodic stage-structured model we developed for *E. macrophyllum*, populations of *E. macrophyllum* had a positive growth rate when growing in the weeded

plots and in the non-weeded *Bromus* plots. Although it seems that *Bromus* has fewer negative effects on *E. macrophyllum*, this may not be the case because the *Bromus* plants were also less dense than *Erodium* and *Amsinckia*. Also according to the model, both native and exotic species seem to impact *E. macrophyllum* establishment, more than growth and reproduction. That is, establishment is a more sensitive life-history trait than reproduction.

To test our second hypothesis, we set up a field experiment at the Santa Rosa Plateau Ecological Reserve (Riverside County) using a split-plot design; main plots were replicated five times and sub-plots (0.5 m^2) replicated 10 ten times. For the main plots the treatment was a spring burn or a non-burned control and for the sub-plots, the treatment was either weeded or non-weeded. For the weeding treatment, we manually removed all exotic species growing in the interspaces of the native perennial bunchgrass *Nassella pulchra*. We seeded each sub-plot within the main plots with 200 seeds of *E. macrophyllum*.

Exotic grasses, such *Avena* spp. and *Bromus* spp., were severely decreased in burned plots; burning decreased grass cover from approximately 43% to 5%. However, burning had an opposite affect on exotic forbs; their cover increased from 15% to 45%. Native grass cover was decreased following burning, but increased from the weeding treatment. There was no effect of weeding or burning on the native forb community. The changes in species cover and alterations due to burning and weeding affected *E. macrophyllum*, however. Although burning decreased establishment, it increased fecundity. Weeding on the other hand increased both establishment and fecundity. According to the periodic matrix model constructed for *E. macrophyllum* at the Santa Rosa Plateau, population growth is only positive in the weeded plots; population growth was negative in both of the burning treatments (with or without weeding).

In conclusion, the results discussed above indicate that different exotic species have differential effects on the rare native forb *E. macrophyllum*. The experiments also elucidate some of the specific impacts invasive species have on the different life-history stages *E. macrophyllum*. Similarly, the results indicate that prescribed burns in California grasslands, while they may decrease invasive grasses, they will likely increase the abundance of the exotic forb, *Erodium brachycarpum*. The results from the Santa Rosa Plateau are currently in review for publication and the results from Crown Valley are in preparation for submission. This grant helped fund the dissertation research of Ian Gillespie.