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EFFECTS OF COMPETITION FROM INVASIVE PLANTS ON THE ENDANGERED PLANT *PENTACHAETA LYONII*

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Introduction and Objectives

Competition for light, water, and nutrients among plant species plays an important role in determining what plants occur at a particular site. Groups of plant species coexist despite their proximity and similar resource requirements. Co-occurring plant species are able to live together, in part, due to variation in characteristics such as timing of germination, depth and placement of roots, response to soil conditions, and use of pollinators.

Many plant communities include nonnative species that did not evolve with the resident native species. In a few cases, these alien species become invasive in their new habitats possibly due to an increased competitive advantage resulting from rapid adaptation or release from natural predators. Nonnative plant invasions can cause large changes in community composition. Some studies have shown reductions in the numbers or abundance of native species in areas that have been invaded by nonnative species. Other studies have shown that areas with high numbers of native species also have high numbers of nonnative species. Thus the exact relationship between native and nonnative species in nature is not completely clear and is likely dependent on the specific species involved. Because of the considerable competitive advantage of invasive species, and the relative swiftness of invasion, native species typically do

not have time to adapt to new competitive pressures. The result can be reduced population size or extirpation of native species within a community. This threat can be particularly serious for rare species.

California grasslands are heavily invaded by nonnative species. The native dominants in these habitats are various annual wildflowers and associated perennial bunchgrasses. In virtually every southern California grassland site nonnative annual grasses and herbaceous annuals have become naturalized members of the community (living and reproducing without human assistance). These invasive species have largely displaced native species and now dominate this vegetation.

Small pocket grasslands found in openings in Coastal Sage Scrub are habitat for *Pentachaeta lyonii*, a state and federally listed endangered annual sunflower, which only occurs in the Santa Monica Mountains and Simi Hills. Its distribution includes 21 occurrences with populations on both public and private lands. Historically, *Pentachaeta* was known to have had a wider distribution in the Los Angeles Basin, Catalina Island, and San Diego, but as many as 15 populations have been extirpated within recent decades, and most of the remaining populations are in decline. The U.S. Fish and Wildlife Service Recovery Plan for *Pentachaeta lyonii* identifies possible causes of decline as habitat destruction, alteration of habitat structure, and the introduction of competitive nonnative plants. Recent surveys indicate that alien competitors are encroaching upon remaining populations, and with the threat of displacement the loss of *Pentachaeta* appears to be imminent.

Surveys of both *P. lyonii* numbers and presence of invasive species indicate a possible relationship, but no competition studies have been done to clearly link *Pentachaeta* declines to competition from nonnative plants. The goal of this project was to examine competitive

interactions between *P. lyonii* and invasive, nonnative plants. With an understanding of how nonnative plants impact *P. lyonii*, the National Park Service will be better able to carry out its goal to manage threatened and endangered species on NPS lands in order to achieve stable or increasing populations. Results from this study will be used to complement community level studies that the park is conducting on *P. lyonii* in management decisions to recover the species.

Methods

The study was comprised of field and greenhouse components, which were designed to look at direct effects of competition on *Pentachaeta* from nonnative plants; and an observational study, which compared conditions in sites where *Pentachaeta* populations persist to sites where it historically occurred, but is locally extinct.

Three groups of co-occurring invasive species were identified as potentially important competitors: annual grasses, *Erodium species* and *Centaurea melitensis*. In the field study, twenty pairs of experimental plots were established for each group, divided between two locations. Pairs consisted of controls and competitor removals. After each of two growing seasons (2003/04 and 2004/05) inflorescences were counted as a measure of reproduction, and height was measured and compared between treatments. In the greenhouse experiment, these conditions were replicated under more controlled conditions, with *Pentachaeta* planted in pots with the three invasive plant types at both high and low densities. The observational study compared percent cover of nonnative plants in sites where *Pentachaeta* persists to sites where it has gone locally extinct.

Results and Discussion

In both field seasons, all three groups of invasive species had a significant negative impact on *Pentachaeta*. In all cases, *P. lyonii* produced significantly less inflorescences when in

competition with invasive plants than when growing alone. Additionally, *Pentachaeta* plants grown in competition with *Erodium* and with *Centaurea* species were shorter than *Pentachaeta* plants growing alone. The results from the greenhouse experiment support this finding. Under controlled conditions, competition from all nonnative species had a negative effect on *Pentachaeta* reproductive potential. *Pentachaeta* plants produced significantly fewer inflorescences when grown in pots with nonnative species in all cases (grass, *Erodium*, and *Centaurea melitensis*) at both low and high densities compared with plants grown alone. Furthermore, sites where *Pentachaeta* has gone locally extinct have greater invasive species presence than those sites where *Pentachaeta* has persisted. These combined findings indicate that invasive, nonnative species presence in *Pentachaeta* habitat can cause population declines in this species.

In order to create an effective management plan for endangered species, research must be done to investigate causes of decline. The results of this study show that nonnative plants have large negative impacts on *P. lyonii* and may be, in part, responsible for its decline This information is currently being used in conjunction with findings from ongoing NPS community-level research on *P. lyonii* to design and implement *P. lyonii* restoration projects throughout the park. These projects are an important asset for park resources, as they address two critical conservation issues: the recovery of an endangered species, and impacts of invasive, nonnative plants.