Western Riverside County MSHCP
Biological Monitoring Program
Phacelia stellaris 2022 Management Study Protocol

Phacelia stellaris (with *Erodium cicutarium* and *Schismus barbatus*)

INTRODUCTION

Brand's Phacelia (*Phacelia stellaris*) is an MSHCP covered rare plant species endemic to Southern California and Baja California. It is a small annual in the borage family with pale purple flowers and lobed, hairy leaves. Habitat for the species includes coastal back dunes and sandy riverbeds. Current distribution of the species consists of 4 populations in coastal San Diego County, one population in San Bernardino County with less than 30 individuals, one population in Riverside County, and an unknown number of populations in Baja, Mexico (O'Brien and Fraga 2013; USFWS 2012). *Phacelia stellaris* was a candidate for federal endangered species status until 2013 when it was removed due to increasing population sizes in San Diego County (USFWS 2013a).

Due to its limited distribution and specialized habitat requirements, *Phacelia stellaris* is designated a Group 3 species and a Narrow Endemic Plant Species under the MSHCP (Dudek & Associates 2003). Monitoring must take place a minimum of every 8 years and site-specific surveys are required prior to development of any property within the designated survey area along the Santa Ana River and Temescal Wash in Corona. The MSHCP requires the conservation of 2 known populations along the Santa Ana River (at

Fairmont Park and in the Santa Ana Wilderness Area), however only one of these populations was extant at the time of the MSHCP implementation. This population is the subject of this Management Study.

The small extant population in Riverside County is adjacent to the Santa Ana River on Riverside County Regional Park and Open Space District property. This site is a somewhat open, sandy river bench, dominated by *Erodium cicutarium* (filaree), non-native mustard species, non-native grasses, and California croton. A horse trail ran through the center of the site but was re-routed around the population in 2017. This population appears to be struggling and was not observed by Monitoring Program biologists since 2013, despite multiple attempts to locate the species during the 2014 through 2016 growing seasons. However, the species has been found at the site in increasing numbers since 2018.

Presumed threats to the Riverside County population are hot inland temperatures and invasion by non-native species (O'Brien and Fraga 2013; USFWS 2012). The impacts of disturbance, however, are unclear. It has been variously reported that some disturbance appears to be beneficial to *Phacelia stellaris* (USFWS 2012) whereas trampling is a threat to the species (USFWS 2013b). For the Riverside County population, we have observed that the diversion of equestrian traffic around the site, in an effort to avoid trampling of *Phacelia stellaris*, has induced negative changes in habitat, specifically stabilization of substrate and increased invasion by weedy competitors.

The Santa Ana River bank habitat differs from the primarily coastal dune habitats of San Diego County populations. For this reason, duplication of San Diego management practices may not be appropriate. Due to the differing inland habitat and the unclear impacts of trampling disturbance, we assert that a controlled experiment is warranted to aid in determining the best approach to managing the Riverside County population of *Phacelia stellaris*.

Goals

1. Increase our knowledge of the habitat needs of *Phacelia stellaris*.
2. Provide appropriate and feasible management recommendations for this site.
3. Increase the health and robustness of this population.

Objectives

a. Determine whether or not invasive species removal increases the population size of *Phacelia stellaris* by using a controlled experiment to test for

significant increases within sample plots receiving invasive removal treatments.

b. Determine whether a limited disturbance regime increases the population size of *Phacelia stellaris* by using a controlled experiment to test for significant increases within sample plots receiving disturbance treatments.

c. Determine whether a combined approach of invasive species removal and disturbance is effective at increasing the population size of *Phacelia stellaris* and compare results to plots receiving only one treatment.

METHODS

Survey Design

The study site measures 47 meters by 5 meters and is centered over the population observed by the Monitoring Program in 2013. The site will be divided into 48 sample plots which measure 1 meter by 2.5 meters each (Fig. 1).

The location, size, and plot placement was chosen to cover the population site, to provide a large enough sample for data analysis, and to facilitate ease of treatment application from the spaces between plots. *Phacelia stellaris* observed outside of study plots will be monitored, but will not be included in the study.

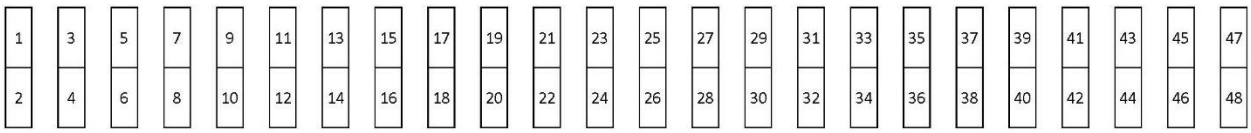

Figure 1. Diagram of sampling units.

The plots were assigned treatments with a randomized block distribution. Using Microsoft Excel, we generated random numbers within groups of four horizontally adjacent plots to obtain randomization while minimizing the clumping of treatments within the study site. The 4 treatments are weeding only (“W”), disturbance only (“D”), weeding + disturbance (“WD”), and control (no treatments applied, “C”; Fig. 2).

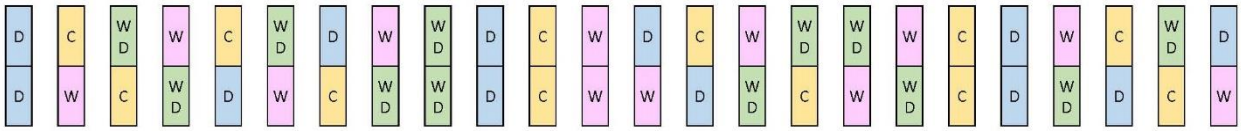

Figure 2. Diagram of treatment assignment.

Surveys and treatments will take place weekly beginning in January and will continue until two weeks after the last observation of *Phacelia stellaris*, or approximately

mid-April if no *Phacelia stellaris* are observed. Disturbance treatments will cease when the first individual of *Phacelia stellaris* is observed anywhere at the site; weeding treatments will continue until surveys are completed. Data collected will include point count of cover of the plant species within each plot, point counts of cover of ground attributes (e.g. "litter"), and count of *Phacelia stellaris* individuals.

In addition to the plot-based sample design, we will randomly select individual *Phacelia stellaris* plants occurring within treatment plots and measure their physical characteristics (e.g., diameter, height, and number of inflorescences) over the survey season and average those data across treatments types. In the event that low numbers of *Phacelia stellaris* germinate, resulting in sample sizes that are insufficient for data analysis, these data may be used to look for patterns in treatment response.

Field Methods

Wooden stakes (1.4 cm x 3.5 cm x 44 cm) will be used to mark the corners of each plot. The stakes will be driven down until approximately 5 cm remain above ground to keep them stable within the sandy substrate. Frames (1 m x 2.5 m, inside diameter) constructed from orange tent poles will be placed over the stakes to delineate plot boundaries during setup, treatment application, and surveying (Fig. 3). Colored tape applied to the tent poles will be used to aid in veg cover point count surveys. The plot number and assigned treatment for each plot will be labelled with a laminated label on the top right or bottom right corner stakes with the following codes: W (weeding only), W+D (weeding + disturbance), D (disturbance only), or C (control).

Figure 3. Plot frame placed at the corner stakes to delineate the plot boundaries during surveying.

Plot surveys

We will use personal digital assistants (PDAs) or paper data sheets to record data. Within each plot we will make cover estimations of the plant species and all ground

cover types by counting the number of "hits" at 32 points marked along the plot frame tent poles in an 8 x 4 grid pattern. A "hit" constitutes any plant species that touches the pole at point within the given grid. We will also count and record the total number of *Phacelia stellaris* individuals in each treatment plot. Flagging will aid in counting and will make occurrence locations visible in plot photos.

We will take a photograph of each plot from the end outside the study site (top or NW for odd-numbered plots, bottom or SE for even-numbered plots). Photos will be taken at the start and end of the survey season, from a height of 1.25 to 1.5 meters, with the plot centered and filling the field of view.

Weeding Treatment

Weeding will be done by hand or with small garden tools, with care taken to prevent disturbing the substrate and adjacent species that are not targeted for removal. If there are many small sprouts over a large area that need to be removed and it is impractical to remove them individually, sprouts can be removed by scraping the substrate surface. This may entail leaving behind roots. During weeding, we will avoid disturbing the substrate beyond a depth of 3 mm. A depth of 3 mm was chosen because the physical soil crust layer is typically densest within the first 3 mm of the layer and because permeability to water typically increases dramatically after about 5 mm (Belnap 2001).

A list of target species to be removed will be provided to surveyors (Appendix A). The list consists of species observed at the site historically and during a site evaluation in November 2016. Additional species may be added at the discretion of the Project Lead. According to the Candidate Conservation Agreement for Brand's Phacelia (CCA), the *Phacelia stellaris* site at Marine Corps Base Camp Pendleton is managed to benefit native dune species (USFWS 2013b). Likewise, plant species at our study site will be targeted for removal based on whether or not they belong in an open, semi-loose, sandy river-bench habitat. Thus, native species that are thought to be converting the habitat and stabilizing the substrate will be removed as well as invasive exotics. These determinations are made by using species descriptions in Jepson eFlora Online and by comparing local species to similar species identified in CCA reports.

Disturbance Treatment

We have anectdotally observed that *Phacelia stellaris* grows most abundantly at the transition between horse trails and adjacent undisturbed habitat (Fig. 4). We will attempt to mimic this disturbance by dragging a metal bow rake lengthwise down the center of the plot to create "trails". We will rake no deeper than the length of the rake's tines and once in each direction. We will rake as closely as possible to shrubs in the path that are not being removed, and we will rake over forbs. We will discontinue the raking

disturbance treatment in all plots when the first *Phacelia stellaris* individual is observed anywhere at the site.

By creating disturbance "trails", we hope to find out if some level of disturbance encourages the germination of this species, epecially when the potential for destruction by trampling is restricted. This information may be useful in creating a management

strategy, such as opening and closing the equestrian trail during different times of the *Phacelia stellaris* life cycle.

Figure 4. Study site in 2013. Pin flags indicate concentrations of *Phacelia stellaris* individuals in relation to the horse trails.

Field Procedure

Plot Setup

1. Prior to surveys and treatment applications, surveyors will delineate plot locations and boundaries using a sub-meter accuracy GPS unit (i.e., Trimble).
    a. Navigate to the southwest corner of the study area (UTMs 462317, 3759945) and drive the first stake into what will be the southwest corner of Plot 1.
    b. Extend the measuring tape parallel to the fencing along the site beginning at the first stake and for about 50 meters.
    c. Drive in 23 more stakes, every 2 meters on the measuring tape. These will mark the southwest corners for the 24 odd-numbered plots as illustrated in Figure 1.
        i. Pound each wooden stake into the substrate until approximately 5 cm remains above ground.
    d. Using the plot frame as a guide, mark the remaining corners of each plot with stakes in the same manner, according to Figure 1.
    e. Using a Sharpie permanent marker, label the inside of each stake with the assigned treatment for each plot with the following codes: W (weeding only), W+D (weeding + disturbance), D (disturbance only), or C (control).

Plot Treatments

1. Use the plot frame to delineate the plot boundaries by placing it over the four corner stakes of the plot (Fig. 3).
2. Determine the treatment for each plot by checking the label on its associated plot stakes: W (weeding only), W+D (weeding + disturbance), D (disturbance only), or C (control, no treatment).
    a. Weeding
        i. Using the provided species references, remove by hand or small tool all identifiable species targeted for removal, being careful not to disturb the substrate below a depth of 3 mm.
        ii. Collect weeded biomass in plastic bags. Biomass from different plots can be collected in the same bag(s).
    b. Disturbance
        i. Using the colored tape on the plot frame and measuring pole for reference, rake a path down the center of the plot, loosening the substrate. Do not go deeper than the length of the tines.
        ii. Rake as close as possible to shrubs and rake over forbs.
        iii. Rake twice, once in each direction.
    c. Weeding + Disturbance
        i. Do the disturbance first and then the weeding, as described above.
3. After applying all prescribed treatments, move to the next plot.
4. If *Phacelia stellaris* is observed, discontinue all disturbance treatments and immediately inform any other staff concurrently applying treatments. Inform Project Lead upon returning to the office.

Plot Surveys

1. Plot surveys will take place for every plot, irrespective of treatment assignment.
2. Use the plot frame to delineate the plot boundaries by placing it over the four corner stakes of the plot (Fig. 3).
3. Count and record the species at each of the 32 points on the plot frame for the plant species in the plot.
4. Count and record the presence of the following ground cover types at each of the 32 points on the plot frame:
    a. *Litter*. Dead, loose plant material.
    b. *Bare ground*. Any bare ground that is comprised only of sand/soil.
    c. *Moss / crust*. Biotic material, such as biological soil crusts or mosses.
    d. *Other*. Any ground cover that does not fit into the other categories, such as concrete or trash.
5. Count, flag if appropriate, and record the number of *Phacelia stellaris* individuals observed occurring in the entire plot.
6. Randomly select individual *Phacelia stellaris* plants within each treatment plot to measure and count reproductive structures.
    a. Using toothpicks, select and mark the 10 largest plants that can be seen by quickly looking over the whole plot.
    b. The toothpicks will aid in selecting the plants to measure, they will not be permanently installed to track plants.

c. For each individual:
    i. measure the diameter (width) record the measurement to the nearest 0.5 cm. The width is the longest diameter of the plant while measuring through the central axis of the plant.
    ii. measure and record height (to the nearest 0.5 cm).
    iii. count and record the number of inflorescences (buds, open flowers, fruits). Open flowers are characterized by visible stamens.

7. Take a digital photograph of the plot from the end outside the study site (top or NW for odd-numbered plots, bottom or SE for even-numbered plots). Photos

should be taken from a height of 1.25 to 1.5 meters. The photo should be centered on the plot and include the whole plot in the frame.

8. Remove flags/toothpicks and proceed to next survey plot.

EQUIPMENT LISTS

Plot Setup

- 144 Wooden stakes (1.4 cm x 3.5 cm x 44 cm)
- Mallet(s)
- Measuring tape (50 meters minimum length)
- PVC Plot frame(s)
- Sharpie permanent marker(s)
- Plot diagram

Plot Treatments

- Plot frame
- Measuring pole
- Species list and identification aids
- Small weeding tools
- Ruler (with measurements in mm)
- Gloves (optional)
- Plastic bags (to carry out and weigh biomass removed)
- Disturbance rake
- Plot diagram
- Protocol

Plot Surveys

- Plot frame
- Measuring pole
- PDA
- Pin flags
- Camera
- Paper data sheets and pencil for backup
- Plot diagram for reference
- Protocol

TRAINING

The Project Lead will meet with surveyors prior to data collection to review the field protocol and special survey needs, the survey schedule, and specific information regarding the treatments that will be applied. Questions about species identification are

also clarified and a field guide of species targeted for removal will be provided to surveyors for reference.

Training Results

Surveyors who complete the training will be able to perform the following tasks:

- Identify local vegetation species as well as most commonly occurring herb/grass, shrub, and tree species
- Use a PDA or paper datasheet to record data

DATA MANAGEMENT

We will collect data on PDA or paper data forms in the field. The Project Lead reviews survey objectives and ensures data forms accurately reflect those objectives. At the end of each survey day, data from PDAs are transferred to the database in the office. Once completed, the Project Lead and Data Manager review the entries and correct errors. The Data Manager verifies/validates the data once any errors have been corrected.

DATA ANALYSIS

The habitat data collected will be used to characterize the site as a whole, and to compare treatment responses by *Phacelia stellaris*. Specifically, we are interested in determining whether invasive species removal, a limited disturbance regime, or a combination of the two treatments is effective at increasing the population size of *Phacelia stellaris*. Summary statistics, including dominant species by mean percent cover, most commonly occurring species, and average soil compaction will be reported.

TIMELINE

- December: Set up and apply disturbance treatment.
- January: Apply weeding treatment.
- February – approximately April: Weekly surveys (counts and measurements).
- April (or 2 weeks after last observation of *Phacelia stellaris*): Final survey and vegetation survey.

LITERATURE CITED

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APPENDIX A. Species present during site assessment conducted 23 November 2016, and their associated treatment action (Weeding Only, and Weeding + Disturbance treatments). This list is not comprehensive; additional species may be appended as they are observed.

Species targeted for removal

- *Amsinckia menziesii*
- *Bromus sp.*
- *Eriodictyon trichocalyx*
- *Erodium cicutarium*
- *Heterotheca grandiflora*
- *Hirschfeldia incana*
- *Moss*
- *Salsola tragus*
- *Schismus barbatus*
- *Sisymbrium spp.*

Species not targeted for removal (do not disturb)

- *Ambrosia acanthicarpa*
- *Crassula connata*
- *Croton californicus*
- *Logfia sp.*
- *Pectocarya sp.*