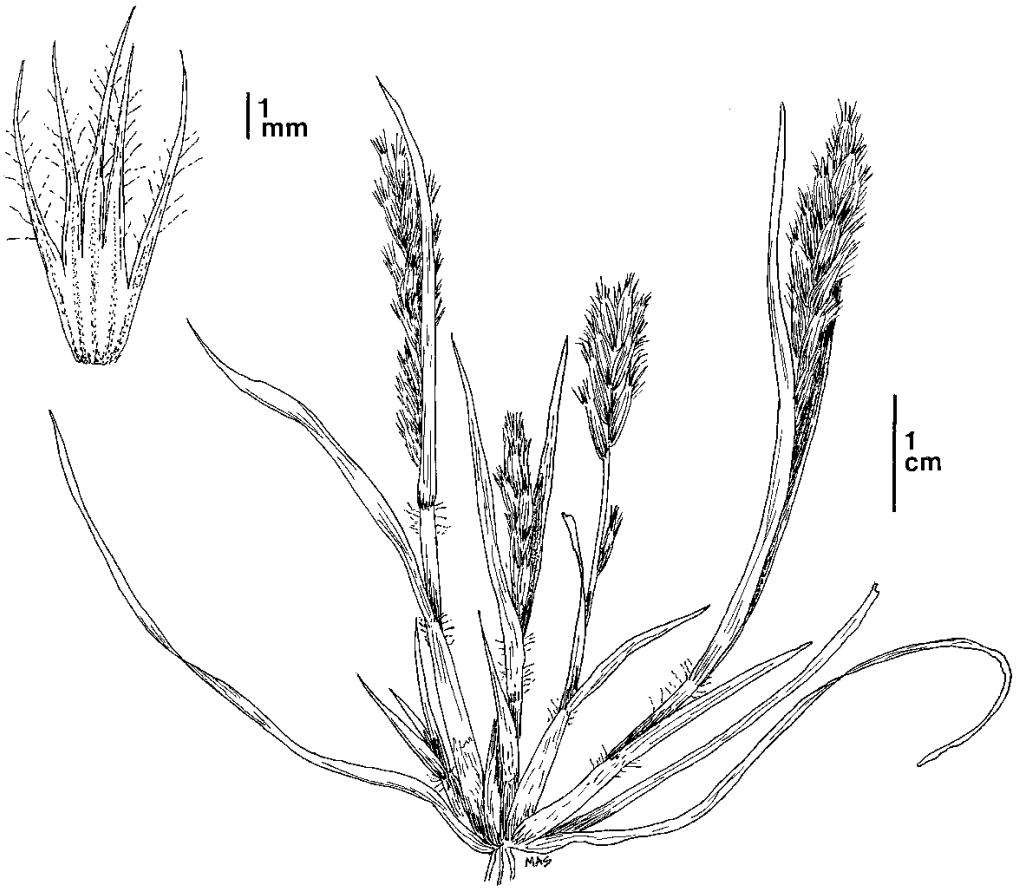
PHOENIX FIELD ECOLOGICAL RESERVE

SACRAMENTO ORCUTT GRASS MONITORING PLAN
WITH
2015-2017 RESULTS & DISCUSSION



PREPARED BY THE
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
NATIVE PLANT PROGRAM

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EXECUTIVE SUMMARY

Sacramento Orcutt grass (*Orcuttia viscida*) is an annual plant that is designated as endangered under the California Endangered Species Act and federal Endangered Species Act. Sacramento Orcutt grass is only found in vernal pools on remnant depositional stream terraces in eastern Sacramento County, and there is a population of Sacramento Orcutt grass at the approximately eight-acre California Department of Fish and Wildlife (CDFW) Phoenix Field Ecological Reserve (Reserve).

Invasive waxy mannagrass (*Glyceria declinata*) is also present in vernal pools on the Reserve, and can compromise the integrity of vernal pools supporting Sacramento Orcutt grass. Efforts to control waxy mannagrass on the Reserve in the past have been largely successful, demonstrating that waxy mannagrass control is possible, but waxy mannagrass is no longer being controlled on the Reserve. If populations of waxy mannagrass on the Reserve are left unmanaged and expand, they will continue to threaten Sacramento Orcutt grass.

Two monitoring macroplots (A and B) were established on the Reserve in 2014 to monitor the frequency of Sacramento Orcutt grass, waxy mannagrass, and other plant species, and as a reference for photomonitoring. Sacramento Orcutt grass has been regularly observed on the Reserve for several decades, and Sacramento Orcutt grass was present in both macroplots on the Reserve every year from 2014 to 2017. Based on these observations, the Sacramento Orcutt grass population at the Reserve appears to be relatively stable at this time. Between 2014 and 2017, 2015 appears to have been the “best” year for Sacramento Orcutt grass, 2014 appears to have been the “worst” year, and 2016 and 2017 were somewhere in between.

A threshold for management action to control waxy managrass on the Reserve was set for a waxy mannagrass frequency ($1m^2$) of ten percent or greater. Waxy mannagrass was not observed at all within Macroplot A, but waxy mannagrass was observed in Macroplot B, and the management threshold was exceeded by the frequency confidence interval in both 2015 and 2017. As a result, a management action should be triggered in Macroplot B in 2018, and CDFW staff should cut and remove each waxy mannagrass plant above the root system, prior to seed development.

Pilot data for this monitoring plan was collected in 2014, and the monitoring plan presented in this report was implemented from 2015 to 2017. Implementation of the monitoring plan presented in this report is expected to continue into 2021 or later. The monitoring plan presented in this document should continue to be implemented by CDFW staff to facilitate the adaptive management of Sacramento Orcutt grass at the Reserve.

PHOENIX FIELD ECOLOGICAL RESERVE SACRAMENTO ORCUTT GRASS MONITORING PLAN

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

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1. INTRODUCTION

Sacramento Orcutt grass (*Orcuttia viscida*) is an annual plant that is designated as endangered under the California Endangered Species Act and federal Endangered Species Act. Sacramento Orcutt grass is only found in vernal pools on remnant depositional stream terraces in eastern Sacramento County. A population of Sacramento Orcutt grass occurs within vernal pools at the approximately eight-acre California Department of Fish and Wildlife (CDFW) Phoenix Field Ecological Reserve (Reserve) (Figures 1 and 2).

The Reserve was donated to CDFW in 1979 by the Sacramento Savings and Loan Association at the request of Westwood Homes, Inc., the developer of the adjoining Rollingwood development. The Reserve was established as mitigation for this nearby development and is currently managed by CDFW. CDFW manages the Reserve to conserve onsite vernal pools which support populations of the endangered Sacramento Orcutt grass and the rare pincushion navarretia (*Navarretia myersii* ssp. *myersii*) which has a California Rare Plant Rank of 1B.1. The Reserve is now surrounded on all sides by dense single-family residential housing. There is no public access to the Reserve, but trespass by neighboring residents appears to be frequent.

A land management plan was prepared for the Reserve in 2006, but was not implemented (ESA 2006). The 2006 land management plan includes important background information on the soils, hydrology, plants and animals of the Reserve, and includes several goals and tasks for management of the Reserve that remain valid. Despite the goals and tasks for management of the Reserve, management of the reserve has been limited to infrequent control of the vegetation that grows along the fences surrounding the Reserve, and the non-CDFW effort described in the following paragraph. One of the tasks identified in the 2006 management plant is: “survey all vernal pools and swales annually during the spring for the presence of mannagrass (*Glyceria* species) and eradicate all plants using mechanical means before they set viable seed”.

The invasive waxy mannagrass (*Glyceria declinata*) is present in vernal pools on the Reserve, but the areas that support Sacramento Orcutt grass remain largely free of the weed. In 2007 and in some of the subsequent years John Gerlach undertook efforts to weed waxy mannagrass from the pools on the Reserve that support Sacramento Orcutt grass. Mr. Gerlach cut each waxy mannagrass plant at the upper end of its root system and removed the upper portion of the plant, effectively killing it. These efforts appear to have eliminated or significantly reduced waxy mannagrass in Sacramento Orcutt grass pools on the Reserve.

This Phoenix Field Ecological Reserve Sacramento Orcutt Grass Monitoring Plan (Monitoring Plan) should be implemented by CDFW staff at the Reserve. The purpose of the Monitoring Plan is to monitor the status of the Sacramento Orcutt grass population at the Reserve in order to identify and alleviate threats from competing species such as waxy mannagrass or other factors before they become prohibitively expensive to address. This Monitoring Plan provides background information on the monitoring approach used, detailed instructions on how to collect both qualitative and quantitative data on populations of Sacramento Orcutt grass, waxy mannagrass and other plant species, and management implications of potential results. The Monitoring Plan is intended to provide a foundation for management of Sacramento Orcutt grass at the Reserve, but it is not intended to be so rigid as to preclude adaptation and flexibility in the future. The monitoring consists of two parts:

1. Spring nested frequency monitoring of plants within the two sections of vernal pools on the Reserve that contain Sacramento Orcutt grass; and
2. Photomonitoring of the Reserve.

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

0 0.25 0.5 Miles

Figure 1
Regional Location of Phoenix Field Ecological Reserve

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Base Imagel: NAIP 2016

N

0 0.015 0.03 0.06 Miles

Figure 2
Approximate Locations of Rare Plants at Phoenix Field Ecological Reserve

1.1. SITE DESCRIPTION

The Reserve is generally open with annual and perennial vegetation that is generally low to the ground. The topography consists of interconnected seasonally-inundated vernal pools and swales with higher mima mounds in the upland areas. Vernal pools on the Reserve are near the top of the local watershed, and therefore receive their water from surface runoff in the immediate vicinity. The Reserve is impacted by the nearby residential housing and related offsite irrigation which has altered the hydrology of the vernal pools. Currently, surface and ground water drainage onto the Reserve from the north and east are intercepted by a drain system that runs along the entire northern and eastern boundaries. A drain system and weir have also been constructed along the western edge of the Reserve to convey runoff from residences into the storm water sewer system. As a result of these drainage systems and loss of habitat, approximately two acres of watershed that would have drained into the pools on the Reserve has been lost, resulting in an estimated five to eight week delay in the initial filling of the main vernal pool on the Reserve. Runoff from the irrigated horse pasture that is South of the Reserve has resulted in severe degradation of portions of vernal pools on the Reserve adjacent to the pasture.

Vegetation on the mima mounds grows somewhat taller than elsewhere on the Reserve, and vegetation in the pools and swales grows somewhat shorter than elsewhere on the Reserve. Shrubs and trees are only present around the perimeter of the ecological reserve adjacent to fencing and neighboring houses. One large and several smaller *Quercus douglasii* trees occur in the southeast corner of the Reserve. Soils on the Reserve are primarily mapped as Red Bluff-Redding complex gravelly loam (NRCS 2014).

2. ECOLOGICAL MODEL

See Figures 3 and 4 for ecological models of Sacramento Orcutt grass and waxy mannagrass (*Glyceria declinata*).

2.1. LIFE HISTORY OF SACRAMENTO ORCUTT GRASS

An overview of the life history of Sacramento Orcutt grass is presented in the 2005 U.S. Fish and Wildlife Service Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. A brief synopsis of Sacramento Orcutt grass life history is presented below, with information from the 2005 Recovery Plan and other sources.

Sacramento Orcutt grass is an annual plant of the grass family (Poaceae). Seeds of *Orcuttia* species germinate underwater in January and February (Griggs 1980, Griggs and Jain 1983, Keeley 1998), after being colonized by aquatic fungi (Griggs 1980, 1981). Cold treatment and other forms of stratification have promoted germination in some species of *Orcuttia* (Keeley 1988, Griggs 1974, Stone et al. 1988) and may benefit Sacramento Orcutt grass as well. Sacramento Orcutt grass grows underwater for three months or more and has evolved specific adaptations for aquatic growth (Keeley 1998). Among these adaptations is the formation of three different leaf types: a well-developed rosette of juvenile leaves (Keeley 1998), floating-leaves that form as water in the pool warms and remain as long as the standing water lasts (Hoover 1941; Griggs 1980, 1981; Reeder 1982; Keeley 1998), and typical terrestrial leaves that form as soon as pools dry, normally in June or July (Hoover 1941; Griggs 1980, 1981; Reeder 1982; Keeley 1998).

Inflorescences appear within a few days after the water evaporates, and Sacramento Orcutt grass flowers in May and June (S. Cochrane in litt. 1995, Reeder 2012). June and July are the

Figure 3. Ecology of Sacramento Orcutt Grass (*Orcuttia viscida*)

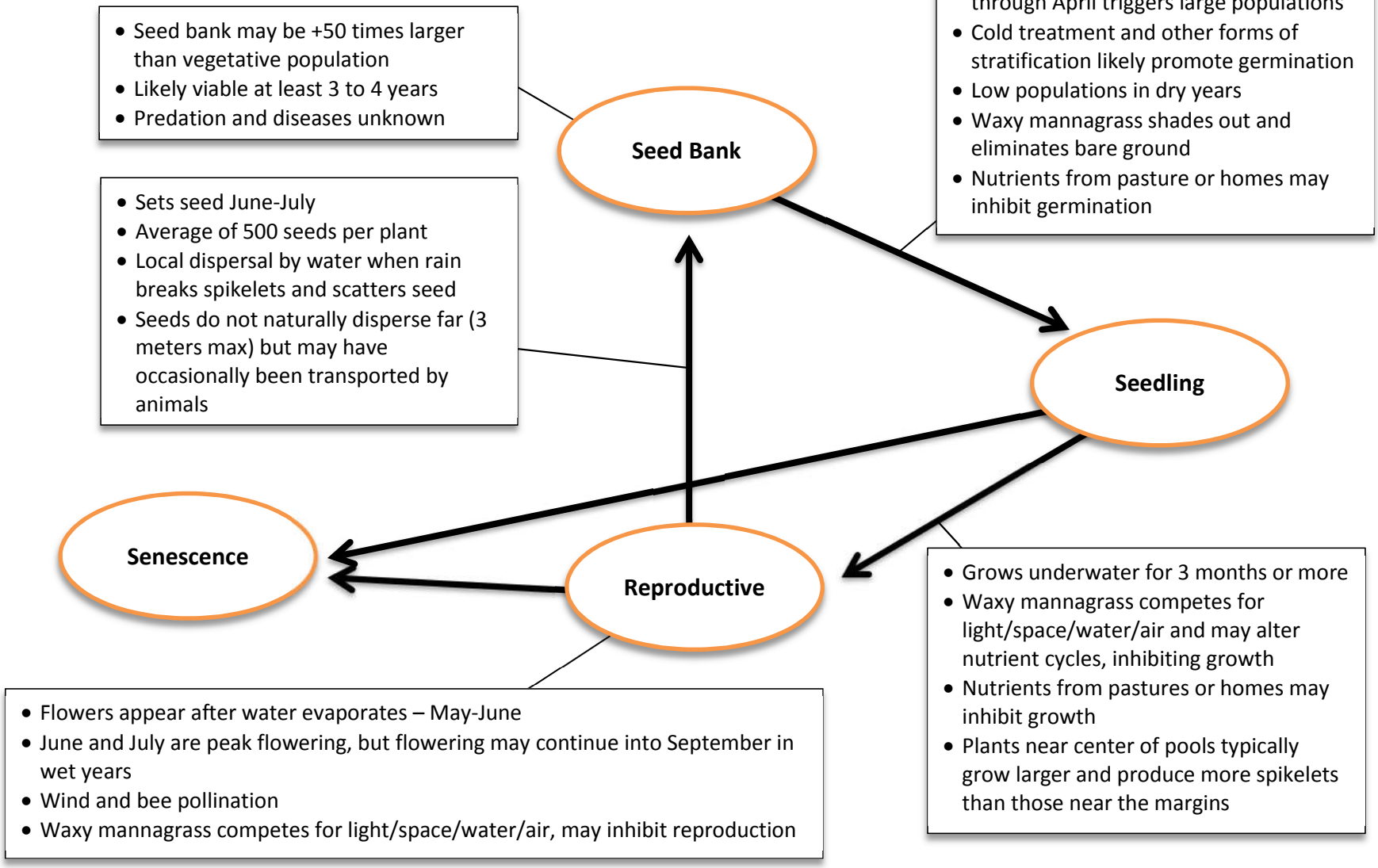
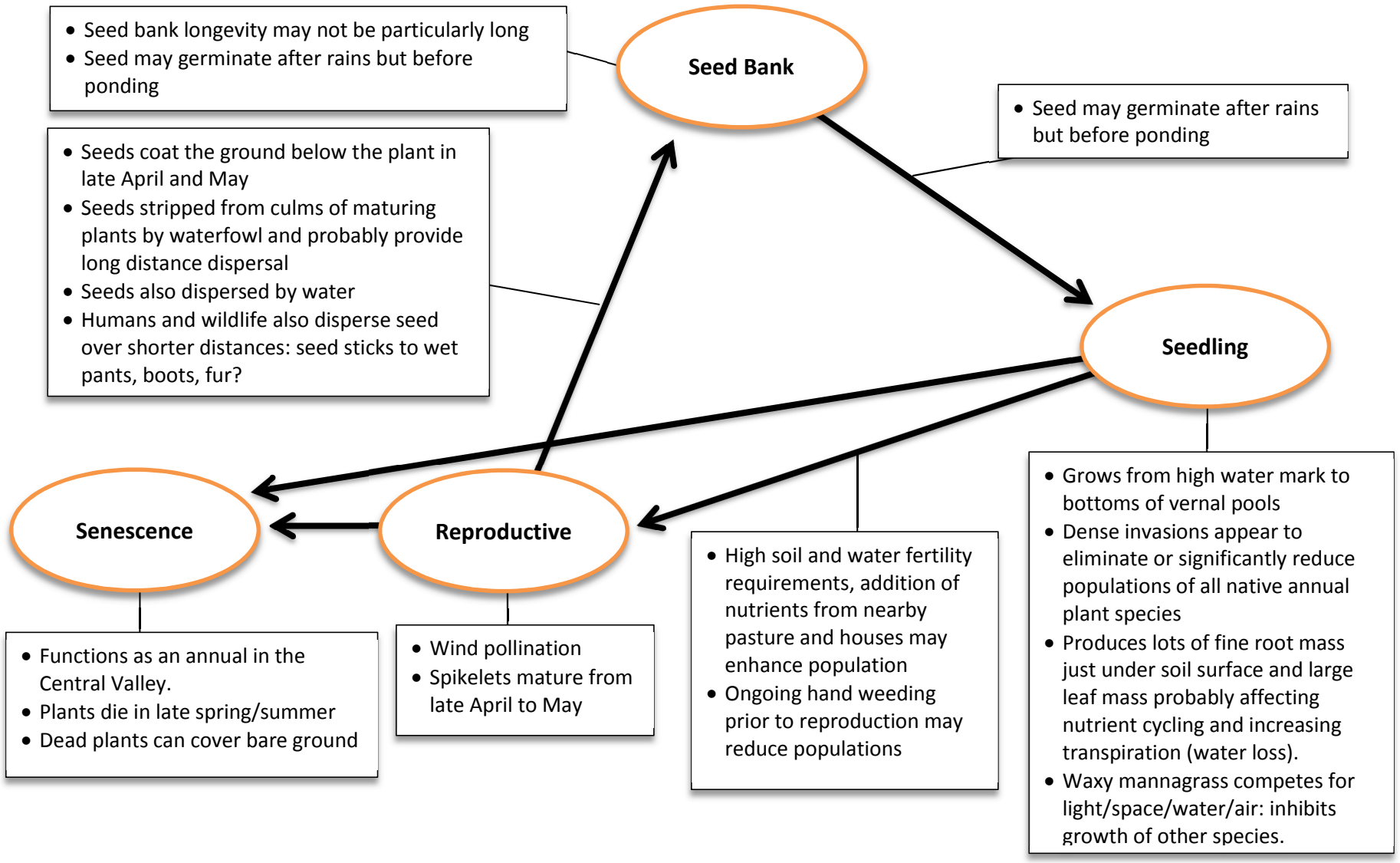


Figure 4. Ecology of Waxy Mannagrass (*Glyceria declinata*)



peak months of flower production for most species of *Orcuttia*, although flowering may continue into August and September in years of above-normal precipitation (Griggs 1980, 1981). Late-spring rains may prolong the flowering season (Griggs 1981, Griggs and Jain 1983), but inundation is more likely to kill flowering individuals (J. Silveira in litt. 1997). Based on the timing of flower development and estimates of genetic diversity, the genus *Orcuttia* is believed to outcross (Griggs 1980, Griggs and Jain 1983). Sacramento Orcutt grass is adapted for wind pollination, but also provides a source of pollen for native bees (Griggs 1974, Stone et al. 1988).

Plants set seed in June and July (Holland 1987), and spikelets break apart and scatter their seeds when autumn rains arrive (Reeder 1965; Crampton 1976; Griggs 1980, 1981). Seeds likely do not disperse far under natural conditions. In a 6-year period, an experimental population spread at most 3 meters (10 feet) from the seed source, and 95 percent of plants were within 30 centimeters (11.8 inches) of the source (R. Holland in litt. 1986). A demographic study conducted from 1974 to 1978 (Griggs 1980, Griggs and Jain 1983) indicated that Sacramento Orcutt grass produced an average of 500 seeds per plant. At one site in 1978, 88 percent of plants survived to maturity. The size of the seed bank stored in the soil was about 44 times as great as the population of growing plants (Griggs 1980, Griggs and Jain 1983). Seed production in the *Orcuttia* genus can vary two- to three-fold among years (Griggs 1980, Griggs and Jain 1983).

The number of Sacramento Orcutt grass plants varies with rainfall. Large numbers of plants grow only in years when seasonal rainfall exceeds 40 centimeters (15.7 inches), particularly when heavy rains begin in November and continue through the end of April (Holland 1987). Sacramento Orcutt grass is apparently less likely to germinate in years of below-normal precipitation than other members of the Orcuttieae tribe of grasses (Griggs 1980, Griggs and Jain 1983). Genetic diversity between populations of Sacramento Orcutt grass was low based on studies of enzyme systems; however, plants from the primary area of concentration had alleles that did not occur in other areas. The amount of genetic variation occurring among related individuals was about equal to that within populations (Griggs 1980, Griggs and Jain 1983).

2.2. Life History of Waxy Mannagrass

Waxy mannagrass is an invasive plant in the grass family (Poaceae) that is native to Europe. Waxy mannagrass is described as a perennial plant, but it functions as an annual plant in California. Waxy mannagrass seedlings have been observed to germinate after the first fall rains but before ponding, developing terrestrial leaves first, and later aquatic leaves after inundation of pools (Gerlach 2012).

In the Central Valley of California, waxy mannagrass spikelets mature from late April through May. Seeds are dispersed by floating on the surface of water or by becoming attached to waterfowl and grazing animals. Waterfowl, in particular, are strongly attracted to maturing plants and strip the seed from the culms with their bills (DiTomaso et al. 2013). This is likely the main method of long-distance seed dispersal.

Waxy mannagrass is reported to compromise the integrity of vernal pools and threaten endemic and endangered plants (DiTomaso et al. 2013). Waxy mannagrass greatly reduces the amount of photosynthetically active radiation from the surface to the bottom of vernal pools throughout the season (Gerlach 2012). Dense waxy mannagrass invasions appear to eliminate or significantly reduce populations of all native annual plant species, such as Sacramento Orcutt grass, from vernal pools. In addition, waxy mannagrass produces a considerable fine root mass

on or just under the surface of the soil that can change nutrient cycling in the vernal pools and negatively impact vernal pool hydrology through increased transpiration.

Studies of waxy mannagrass control techniques suggest that hand pulling or clipping the above-ground portion of plants before they set seed may be one of the best management techniques, particularly in small areas that have not been heavily invaded (Gerlach 2012). Heavy continuous grazing of waxy mannagrass-invaded pools can greatly reduce cover of the weed, but also results in significant hoof punching that converts vegetation to spikerush (*Eleocharis macrostachya*), and an increase in the severity of algal blooms from nutrient addition (Gerlach 2012). Weed whips could be an effective strategy to simulate grazing without the negative effects, particularly if a source of water is available to artificially manipulate the germination and growth of waxy mannagrass (Gerlach 2012).

3. MANAGEMENT OBJECTIVES

The vegetation metric to be used for monitoring at the Reserve is frequency, because frequency estimation is especially sensitive to changes in spatial arrangement, and CDFW is particularly interested in detecting changes in the spatial arrangement of Sacramento Orcutt grass and the invasive waxy mannagrass.

Measuring above-ground expression of annual plant species such as Sacramento Orcutt grass provides a quantitative annual record of the populations; however, annual plant species populations are known to fluctuate in response to environmental conditions. Therefore, above-ground expression of Sacramento Orcutt grass may not be a good metric for making short term management decisions. A management objective and response based on Sacramento Orcutt grass frequency will therefore not be used for adaptive management at this time, but may be added in the future, if considered necessary. Instead, the monitoring for adaptive management will focus on a habitat indicator that CDFW may have some management control over: frequency of waxy mannagrass (*Glyceria declinata*).

The initial management objective is:

- Maintain a frequency of 10 percent or less (1 m^2 quadrat) of waxy mannagrass (*Glyceria declinata*) in Macroplot A and Macroplot B at Phoenix Field Ecological Reserve in every year. (This is a target/threshold type of management objective.)

4. MONITORING DESIGN

4.1. SPRING FREQUENCY MONITORING

As part of the Monitoring Plan, nested frequency monitoring within two specific macroplots will be conducted, and monitoring photographs will be taken (Figure 5). The monitoring macroplots were deliberately placed to contain all Sacramento Orcutt grass plants found on the Reserve in 2014; however, a few Sacramento Orcutt grass plants have been found just outside of the southeast corner of Macroplot B in some years. Upland areas within the two monitoring macroplots were excluded from the frequency evaluation because these areas are unsuitable for Sacramento Orcutt grass. The actual areas within the rectangular Macroplots that will be evaluated are presented in Figures 6 and 7 which also show the 1 $meter^2$ (1 meter by 1 meter) frequency quadrats that were sampled in 2017. The nested frequency design also utilizes 0.25 $meter^2$ (0.5 meter by 0.5 meter) and 0.0625m^2 (0.25 meter by 0.25 meter) quadrat sizes.

Latitude/Longitude Coordinates of Photopoints and Macroplots (NAD83)					
Macroplot A	Latitude	Longitude	Macroplot B	Latitude	Longitude
NE Corner	38.655564	-121.214792	NE Corner	38.656322	-121.215301
NW Corner	38.655464	-121.215047	NW Corner	38.656232	-121.215584
SE Corner	38.655131	-121.214504	SE Corner	38.655923	-121.215079
SW Corner	38.655018	-121.214765	SW Corner	38.655828	-121.215357
Photopoint C	38.654772	-121.215667			

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Base Imagel: NAIP 2016

N

0 0.01 0.02 0.04 Miles

Figure 5
Locations of Monitoring Macroplots at
Phoenix Field Ecological Reserve

Figure 6

Phoenix Field Ecological Reserve

Macroplot A Frequency Quadrat Locations, 2017

91 Frequency Quadrats

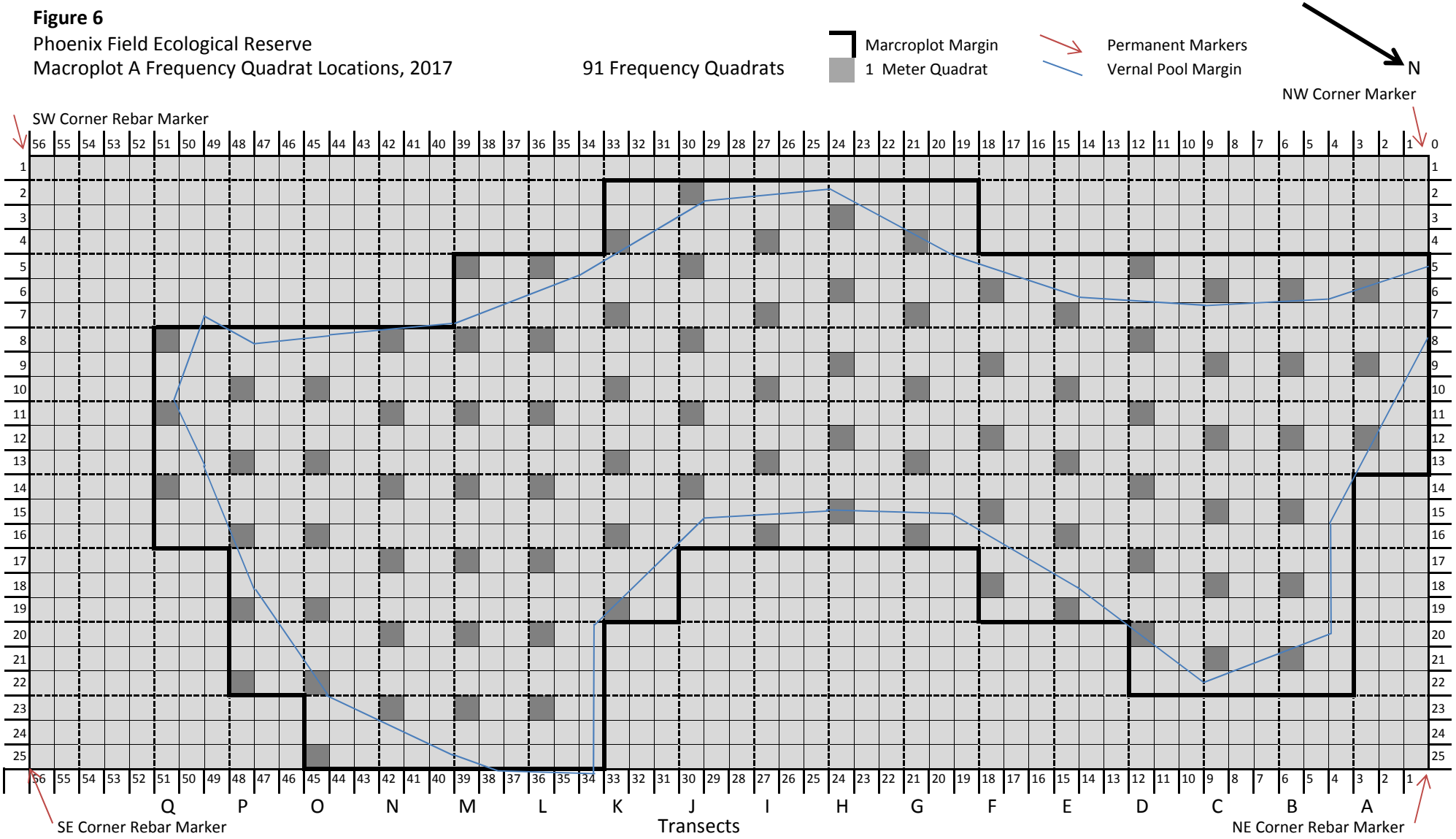
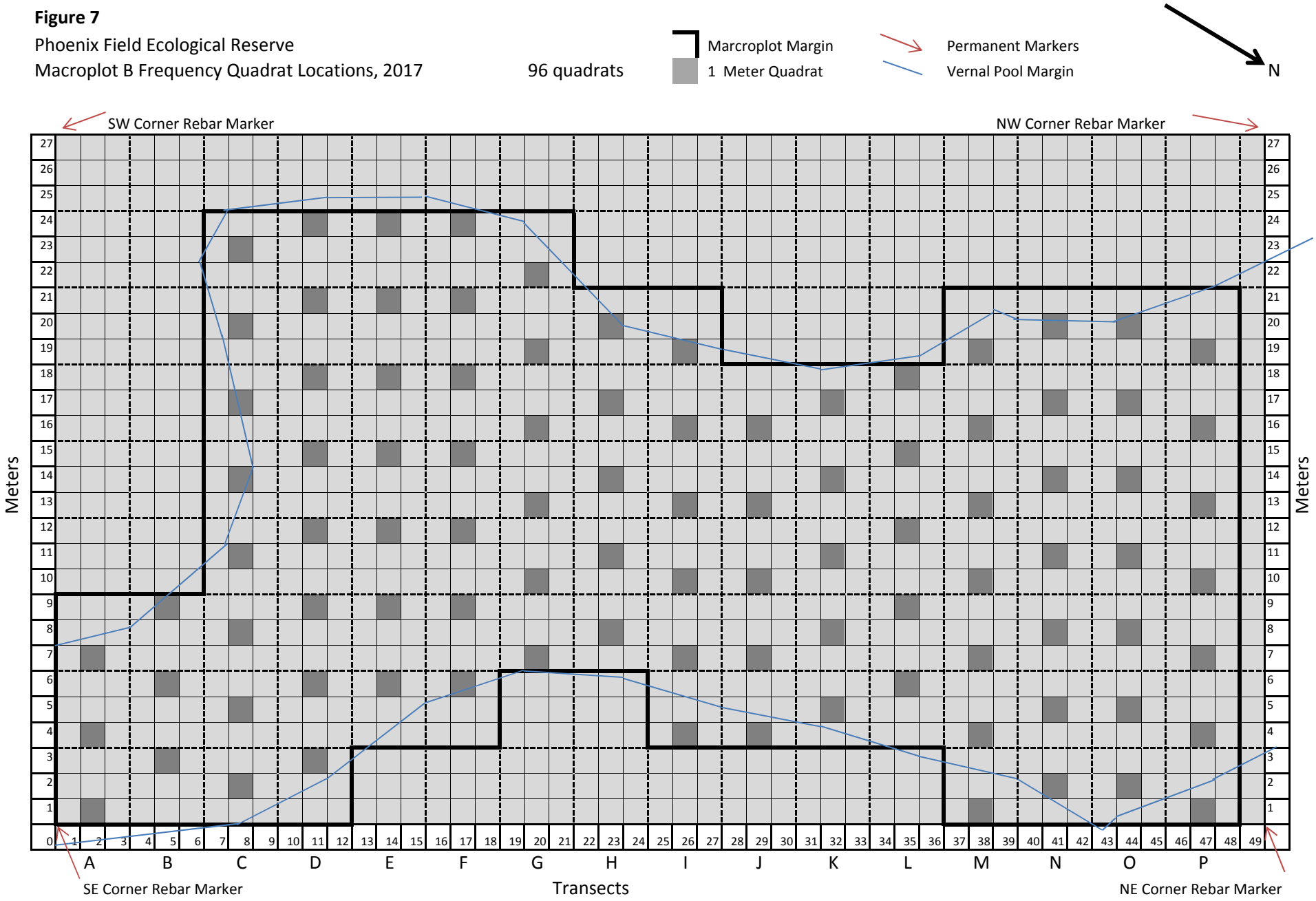


Figure 7

Phoenix Field Ecological Reserve

Macroplot B Frequency Quadrat Locations, 2017

96 quadrats



This protocol is designed to be completed by two to three monitors over two or three field days each year, and is designed to be easily accomplished by volunteers or CDFW staff with limited training. The monitoring should be conducted when both Sacramento Orcutt grass and waxy mannagrass are evident and easily identifiable, likely in May or June. A scouting visit to the Reserve should occur in late April or May.

4.1.1. Sampling Objective

The sampling objective is to be 90 percent confident that our frequency estimates are within +/- 10 percent of the actual frequency values.

4.1.2. Before Going into the Field

Determine the quadrats to sample using systematic random sampling, and fill in the appropriate quadrat locations on the Nested Frequency Data Sheets for Macroplots A and B. Examples of the $1m^2$ frequency quadrats sampled in 2017 can be seen in Figures 6 and 7.

Print out all of the necessary data sheets. These include:

- Photomonitoring Log, Phoenix Field Macroplot A
- Photomonitoring Log, Phoenix Field Macroplot B
- Photomonitoring Log, Phoenix Field Photopoint C
- Nested Frequency Data Sheet, Phoenix Field Macroplot A
- Nested Frequency Data Sheet, Phoenix Field Macroplot B
- California Native Species Field Survey Form
- Qualitative Monitoring Datasheet

Reserve a date in late April or May for one or two people to check vernal pool water levels and see if Sacramento Orcutt grass is evident and identifiable. Also reserve several possible additional dates in mid-May and early June to do the monitoring. In 2014, the monitoring was conducted on June 5 and June 10; however, in that year it may have been better to conduct the monitoring approximately two weeks earlier. The weather can be very hot at this time of year, and the Reserve provides little shade. Plan to do the field work as early as possible in the morning to avoid excessive heat, and take breaks often.

Contact the Reserve manager in the North Central Region office prior to the visit (Ms. Helayna Pera in 2017) and secure a key or ensure that you will be able to gain access to the Reserve.

At least three people should plan to be at the site to do the monitoring, and it may take one to two days to complete. At least one of the monitors should be able to positively identify all of the plant species being monitored. All monitors should familiarize themselves with the species being monitored, the Reserve, this Monitoring Plan and the data that has been previously collected. Request field assistance from North Central Region staff, if necessary, and reserve vehicles for transportation. If desired, additional visits to the site to conduct the photomonitoring portions of the protocol may be scheduled in winter and spring.

Gather the field equipment and materials listed in Figure 8.

Frequency data will be collected on the following species or groups of species:

- Waxy mannagrass (*Glyceria declinata*)
- Spikerush (*Eleocharis macrostachya*)
- Sacramento Orcutt grass (*Orcuttia viscida*), and

Figure 8: Equipment Checklist

Marking

- ☐ Re-bar, ~50cm long, to replace any permanent field monuments that are missing
- ☐ Lots of pin flags
- ☐ Pink flagging
- ☐ Pink spraypaint and disposable gloves

Measuring

- ☐ Meter tapes
  - Tape, at least 55m long (2+)
  - Tape, at least 25m long (1+)
- ☐ Screwdrivers to anchor meter tapes
- ☐ Retractable tape measure
- ☐ Compass, set to the proper declination (16'east declination)
- ☐ 1m PVC quadrat, with 50cm and 25cm nested quadrats

Documenting

- ☐ Clipboards (2)
- ☐ Data Sheets
  - Photomonitoring logs (for macroplots A and B)
  - Nested Frequency datasheets (for macroplots A and B)
  - Qualitative Monitoring Datasheet
  - California Native Species Field Survey Forms
- ☐ Graph Paper
- ☐ Field Notebook
- ☐ Mechanical Pencils
- ☐ Camera (with batteries, memory card, and lens with focal length of approximately 18mm (27mm on a "full frame" camera)
- ☐ Tripod

Other Tools

- ☐ Sledgehammer
- ☐ Leather Gloves
- ☐ Hand Lens
- ☐ Plant Dissection Kit
- ☐ Plastic zip-lock bags
- ☐ Plant Press with Newspaper, etc.
- ☐ Calculator
- ☐ Shade canopy or umbrella
- ☐ Food and Water
- ☐ Field Clothes
- ☐ Weed-resistant footwear (e.g. leather boots)
- ☐ Sharpie
- ☐ Key to gate

Reference

- ☐ Monitoring Protocol with Appendices
- ☐ Maps
- ☐ The Jepson Manual
- ☐ Other Floras/Guidebooks
- ☐ Measuring and Monitoring Plant Populations Manual

- Any non-native plants other than waxy mannagrass. Non-native plants that may be encountered within macroplots include, but are not limited to:
    - Barbed goat grass (*Aegilops triuncialis*)
    - Pacific bent grass (*Agrostis avenacea*)
    - Silver hair grass (*Aira caryophyllea*)
    - Large quaking grass (*Briza maxima*)
    - Small quaking grass (*Briza minor*)
    - Ripgut grass (*Bromus diandrus*)
    - Soft chess (*Bromus hordeaceus*)
    - Bermuda grass (*Cynodon dactylon*)
    - Storksbill (*Erodium* spp.)
    - Rye grass (*Festuca perennis*)
    - Dwarf rush (*Juncus capitatus*)
    - Hairy hawkbit (*Leontodon saxatilis* ssp. *longirostris*)
    - Rabbitfoot grass (*Polypogon monspeliensis*)
    - Winter vetch (*Vicia villosa*)

Section 9 contains a field identification aid for Sacramento Orcutt grass. Field identification aids for waxy mannagrass and other plant taxa are available via https://calphotos.berkeley.edu/. Additional species may be included in the frequency monitoring at any time in the future if CDFW decides that it may be useful or informative. If, for instance, a new plant begins encroaching into the vernal pool habitat, that plant should be monitored specifically. Alternatively if it becomes clear that the monitoring of a species is not contributing any useful information for the monitoring or management of the site, that species should no longer be monitored.

4.1.3. In the Field

Locate Macroplots

The driveway and access gate for the Reserve is right next to the house located at 9094 Shady Hollow Way, Fair Oaks, CA 95628. To get to the Reserve from Highway 50:

- Travel 1.8 miles north on Hazel Avenue
- Turn right on Sunset Avenue
- Turn left on Runway Drive
- Turn right on Aeronautic Way
- Turn left on Tarmac Way
- Turn right on Susan Oak Drive
- Turn left on Shady Hollow Way
- Turn right into the driveway for the Reserve

Once at the Reserve, monitors should locate rebar monuments for macroplots A and B (see Figure 5). Macroplot A is located within a 25-meter by 56-meter rectangle that is marked with rebar that has been hammered into the ground at each of its four corners. To back-up the rebar monuments of Macroplot A, U-shaped metal stakes have been hammered flush to the ground to the north and south of each rebar monument.

Macroplot B is located within a 27-meter by 49-meter rectangle that is marked with rebar that has been hammered into the ground at each of its four corners. Aluminum tags have also been attached to the monuments. To back-up the rebar monuments for macroplots, U-shaped metal

stakes have been hammered flush to the ground to the north and east of each rebar monument for Macroplot B.

The macroplots were deliberately placed to encompass all Sacramento Orcutt grass plants that were found at the Reserve in 2014. The eight rebar monuments also serve as locations for the photomonitoring.

If any of the rebar monuments are missing, they should be replaced before monitoring begins. If a rebar monument cannot be relocated, monitors should try to find the U-shaped metal stakes that were hammered into the ground near the location of the previous rebar monument. If a metal detector is available, it may aid in finding the U-shaped metal stakes. If a metal detector is not available and the U-shaped metal stakes cannot be found, the monitors should use meter tapes, the remaining rebar monuments and compass bearings to place new rebar monuments in the appropriate positions, and continue the monitoring. Monitors should also add additional back-up monuments if necessary. Any missing and replacement monuments should be documented in the field notes for the day. The coordinates of the plot monuments are presented in Table 1. Once the plot monuments have been located, use meter tapes and a compass to delineate the extent of the plots (see Figure 5).

Macroplot Monument	**Latitude and Longitude**
Macroplot A, northeast corner	38.6555637, -121.2147920
Macroplot A, southeast corner	38.6551308, -121.2145042
Macroplot A, southwest corner	38.6550184, -121.2147649
Macroplot A, northwest corner	38.6554639, -121.2150465
Macroplot B, northeast corner	38.6563218, -121.2153008
Macroplot B, southeast corner	38.6559229, -121.2150794
Macroplot B, southwest corner	38.6558282, -121.2153569
Macroplot B, northwest corner	38.6562324, -121.2155837
Photopoint C	38.654772, -121.215667

Table 1. Latitude and Longitude of Plot Monuments in Decimal Degrees

Collect Data

To set up the baseline meter tapes for macroplot A, monitors should loop the end of one of the longer meter tapes (at least 55m long) around the rebar monument at the northwest corner of

the macroplot. A monitor should walk the meter tape to the southwest corner of the macroplot, kicking down and trampling as many standing weeds as possible along the way, so that the meter tape comes as close as possible to laying directly on the ground and is not supported by dead vegetation. The monitor should wrap the loose end of the tape around the rebar monument at the northwest corner of the macroplot so that it stays in place, and leave the tape on the ground. The monitors should do the same thing with the other long meter tape (at least 55m long), from the northeast corner of the macroplot to the southeast corner of the macroplot so that there are two parallel baselines.

Setting up the baselines for Macroplot B is similar to setting them up for Macroplot A, except that monitors should lay one of the longer meter tapes (at least 55m long) from the monument at the southeast corner to the monument at the northeast corner, and from the monument at the southwest corner to the monument at the northwest corner.

One of the monitors should hold the components for the nested PVC quadrat frame and one of the monitors should hold the clipboard with the Nested Frequency datasheets. Monitors should do the following to collect the nested frequency monitoring data:

1. Lay the short meter tape (at least 25m long) so that it intersects both of the baselines at the appropriate location for each transect identified on the Nested Frequency datasheets. For example, the first transect of Macroplot A (Transect A) the short meter tape could begin 1 meter along the baseline from the northwest corner, and be laid along the ground so that it crosses the other baseline at 1 meter from the northeast (See Figure 6). Use a screwdriver stuck in the ground or other object as the anchor point for the beginning of the meter tape. Try to avoid trampling the northeast corner of macroplot B before data is collected there.
2. Lay the PVC Quadrat Frame so that the bottom left corner of the 1 m^2 frame opening is at the distance along the transect indicated on the Nested Frequency datasheet. The quadrat should always be laid so that the smallest of the nested quadrats (0.25 m^2) is in the bottom left corner of the frame (Figure 9). Lay down the 0.5 m^2 and 0.25 m^2 right-angle PVC inserts as needed. If the quadrat falls on a slope hold the quadrat frame in position horizontally as close as possible to the ground, and imagine that the frame is projected straight down upon the ground.
3. Look for the plants being monitored within each of the quadrat frame sizes. The following rules should be followed when looking for plants:
    - Only the area inside of the PVC quadrat frame as viewed from above is considered for determining presence/absence. If a plant only occurs underneath the PVC quadrat frame, then the plant is considered to be absent from the quadrat.
    - Only the portion of the plant where the stem meets the ground (rooted area) is considered for determining presence/absence. If a plant is rooted to the ground outside of the PVC quadrat frame, but branches of the plant fall within the PVC quadrat frame, the plant is considered to be absent from the quadrat.
    - Data should only be collected for plants that are determined to be from the current season's growth. Plant carcasses from the previous year should not be considered as plants for the purpose of determining presence/absence.

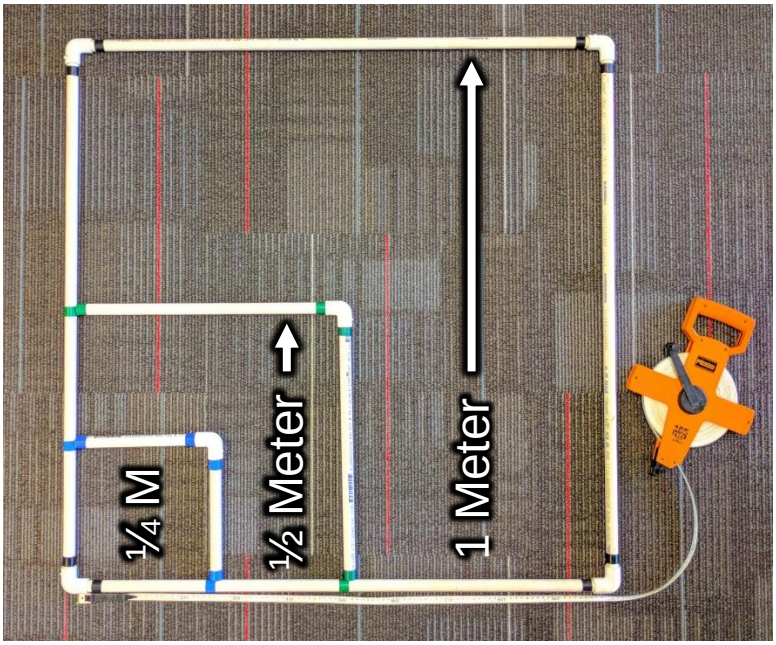


Figure 9. Nested Frequency Quadrats

4. Record presence/absence data on the appropriate datasheet for each of the species being monitored. For each quadrat listed on the nested frequency datasheet, the monitors should record a 0, 1, 2 or 3 for the species as follows:
    - "0" if no plants of that species are within the entire 1 m^2 PVC quadrat frame
    - "1" if plants of that species are within the 0.25 m^2 section of the PVC quadrat frame
    - "2" if plants of that species are within the 0.5 m^2 section of the PVC quadrat frame but not 0.25 m^2 section of the PVC quadrat frame
    - "3" if plants of that species are within the 1 m^2 section of the PVC quadrat frame but not the 0.25 m^2 or 0.5 m^2 sections of the PVC quadrat frame.

Complete a qualitative monitoring datasheet and take monitoring photos for each macroplot that data was collected from before leaving the field site (see Section 4.2).

4.1.4. Back in the Office

- Scan, save and re-name all field data sheets. The current project folder is: U:\groups\HCPB\Shared Folders\NPP\Section 6\2014\Priority Plant Surveys\Project Files\Phoenix Field Files. This project folder is likely to change in the future.
- Enter the field data into excel spreadsheets, perform quality control and analyze the data. Chi square tests should be performed to test whether or not a significant change in frequency has occurred between two years (Elzinga et al. 1998).
- Compare the results with previous years results and make graphs of the data (Elzinga et al. 1998). Make conclusions. Talk to the Reserve manager about adaptive management of the site. **This is the most important part of adaptive management!**
- Download and rename field photos (Section 4.2) and compare them with monitoring photos from previous years.

4.2. ANNUAL PHOTOMONITORING FOR ADAPTIVE MANAGEMENT

Photomonitoring should be conducted for a macroplotplot whenever data is collected for that macroplot, or whenever you would like to quickly document the condition of the Reserve. If the Reserve is visited when the rare pincushion navarretia is blooming (likely in April and/or May) monitoring photographs should also be taken at Photopoint C, and a California Natural Diversity Database field survey form should be completed for pincushion navarretia. The pincushion navarretia population that was present in 2016 is located at approximately 38.654427°, -121.215506°.

4.2.1. BEFORE GOING INTO THE FIELD

The monitor conducting the photomonitoring should be trained and familiar with the proper use of a field compass and whatever digital camera and tripod will be used. The following equipment is required:

- Clipboard with photomonitoring log sheets (Section 9)
- Pen or pencil
- Digital camera with fully-charged batteries and available memory: a compact digital SLR camera with a standard 18-55mm zoom lens is preferred for ease of photo comparison.
- Tripod
- Compass set to the correct declination for the site (16 degrees east)

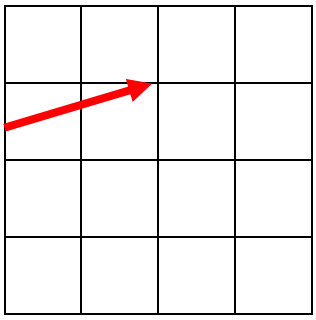
To duplicate approximately the same field of view from year to year, the camera should be set to a focal length that is equivalent to a focal length of approximately 27mm on a “full frame” camera such as a 35mm film camera or a Nikon “FX” camera and lens. Monitoring photographs for the initial 2014 photomonitoring were taken using a Nikon “DX” camera and lens, set to a focal length of 18mm, which is equivalent to 27 mm on a “full frame” camera and lens. Before visiting the site, check the specifications for digital cameras that may be used for the monitoring to see if photographs can be taken with the correct field of view. If the camera equipment to be used cannot duplicate this field of view, the closest field of view possible should be used.

4.2.2. IN THE FIELD

All monitoring photographs are taken from a plot monument. Refer to the photomonitoring datasheet (Section 9) for the locations of monuments, and the order that monitoring photos should be taken. Once at the location of the monitoring photograph, do the following:

- **Set up the tripod and camera** so that the center of the camera lens is 5 feet (152cm) above the ground (the maximum height for many tripods), and directly above the appropriate location on the ground.
- **Populate Each Page of the Photomonitoring Log** with the date, photographer name, focal length, camera, lens and camera settings, and any other relevant information.
- **Take a “Slate” Photo** of the first page of the Photomonitoring Log sheet itself before taking all of the monitoring photos on that page. Take a photo of the next page of the Photomonitoring Log before taking all of the photos that are listed on that page, and so on, until all monitoring photos have been taken.
- **Take monitoring photos** in the order that they are listed on the photomonitoring datasheet. Follow these rules:
    - Use the field compass to ensure that all photos are taken in the direction indicated in the Photomonitoring Log.

- Make sure that the camera's zoom lens is set to the correct focal length (e.g. 18 mm on a Nikon d3100/d3300).
- Set up the camera so that the horizon is 1/4 of the way down from the top of the frame. Many cameras have a focus point at this location within the viewfinder.
- Make sure the horizon in the viewfinder is as horizontal as possible.
- Make sure that the camera focuses properly before taking the picture, and use the preview function of the camera to make sure that the photo has been taken correctly.



Center the horizon in the camera viewfinder at the area indicated with the red arrow

4.2.3. Back In the Office

Save all monitoring photos in the in a folder on the shared drive that corresponds with the date of the field visit, for example: "U:\groups\HCPB\Shared Folders\NPP\Section 6\2014\Priority Plant Surveys\Project Files\Phoenix Field Files\Monitoring Data\2017\20170607"

Carefully change the names of the photo files using the following convention: [uppercase letter of plot][lowercase letter of the photopoint][four digit year][two digit month][two digit day of the month]. For example if a photo is taken at Photopoint a of Macroplot B, on June 7, 2017 the file should be named "Ba20170607".

All properly named monitoring photos should be saved in the following folder on the shared drive: U:\groups\HCPB\Shared Folders\NPP\Section 6\2014\Priority Plant Surveys\Project Files\Phoenix Field Files\Put all renamed monitoring photos here. The location of this folder may change in the future.

With the monitoring photos saved, use the Windows Photo Viewer program and the left and right arrow keys on the keyboard to compare monitoring photos with those taken during previous site visits and look for signs of excessive impacts from grazing and other differences in site condition. If the monitoring photos are misaligned, it may be difficult to interpret the differences between monitoring photos. It is possible to align the monitoring photos more precisely by carefully manipulating them using Photoshop or other photo editing software. This is helpful for showing precisely how specific areas of the ground (e.g. a gopher mound or group of cobbles) have changed over the years. Guidelines for aligning monitoring photos using Photoshop CS6 is provided as an appendix to this Monitoring Plan.

Talk to the Reserve manager about the management of the site. **This is the most important part of adaptive management!**

5. RESPONSIBLE PARTIES

CDFW staff in the Native Plant Program or North Central Region (Region 2) should implement this Monitoring Plan and report results and recommended actions annually to the Reserve manager. The Reserve manager should make decisions on how to adaptively manage the Reserve.

6. FUNDING

CDFW staff in the Native Plant Program used grant funding from the U.S. Fish and Wildlife Service Cooperative Endangered Species Conservation Fund (F15AP00059) and other funding sources including funds from the Rare and Endangered Species Preservation Fund to prepare this Monitoring Plan and collect monitoring data. Collection of pilot data in 2014 was funded by the Rare and Endangered Species Preservation Fund. CDFW staff in the Native Plant Program are expected to continue implementation of this Monitoring Plan from 2018 to 2021, funded by another grant from the U.S. Fish and Wildlife Service Cooperative Endangered Species Conservation Fund. Continuation of this Monitoring Plan after 2021 is likely dependent on the ability of staff in the Native Plant Program to use staff time funded by the Rare and Endangered Species Preservation Fund, general fund, and other programs to do so. Field helpers can often be borrowed from other CDFW programs if the appropriate program managers approve the work as cross training for their staff. Implementation of this Monitoring Plan could also be implemented by staff in CDFW's North Central Region or by CDFW volunteers. It is estimated that annual implementation of this Monitoring Plan will require the following:

In-office preparations: 16 hours by one environmental scientist or senior environmental scientist (specialist) = **16 hours**

Field visit to check phenology (optional): 8 hours by one environmental scientist or senior environmental scientist (specialist) and one other field helper = **16 hours**

Field visits to collect data: 16 hours by one environmental scientist or senior environmental scientist (specialist) and two or three other field helpers = **56 hours**

In-office data analysis and reporting: 24 hours by one environmental scientist or senior environmental scientist (specialist) = **24 hours**

TOTAL STAFF TIME NEEDED: Approximately **112 hours per year**

Preparation of periodic summary reports and presentation of results will likely require additional time. A summary report for 2015-2017 has been prepared, and another summary report will be prepared in 2021 that will cover the period from 2015-2021. Prepare a summary report no less frequently than every third year of monitoring.

7. MANAGEMENT IMPLICATIONS OF POTENTIAL RESULTS

Management Implication 1: If any portion of the 90 percent confidence interval for waxy mannagrass frequency (1 meter^2) exceeds 10 percent in Macroplot A or Macroplot B, CDFW shall organize and initiate a waxy mannagrass cutting effort in the following year, before waxy mannagrass seeds have set.

The management implication above can be changed at any time in the future, if deemed necessary. For example, the 10 percent (1 meter^2) frequency threshold of waxy mannagrass to trigger a management response could be increased to 15 percent is CDFW wanted to reduce management effort at the Reserve, or the frequency threshold could be decreased to five percent if CDFW wanted to significantly reduce or eliminate the amount of waxy mannagrass on the reserve by cutting mannagrass more frequently.

Additional management implications can also be added at any time in the future, but any additional management implications should be documented in future monitoring reports, and related to monitoring.

Furthermore, monitoring methods can be changed in the future, as necessary, to adapt to new threats or changing conditions. This monitoring plan is intended to lay a strong foundation for management of the Reserve, but is also intended to be adaptive to new threats and changing conditions.

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9. DATA SHEET EXAMPLES

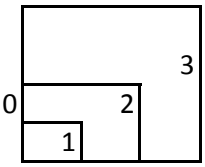
The following pages are examples of field data sheets that may be used or modified for monitoring.

Nested Frequency Data Sheet: Phoenix Field Macroplot A

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

Randomly select a transect start:	**0m**	**1m**	**2m**

Nested Qudrat Code

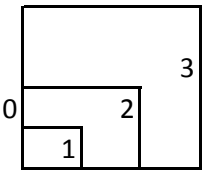
Species Code	Description	Transect	Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**A**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(use random start distance selected above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**B**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 3m to start distance selected above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**C**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 6m to start distance selected above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot A

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Qudrat Code

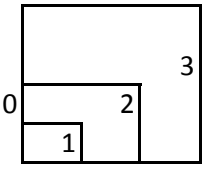
Species Code	Description	Transect	Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**D**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 9m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**E**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 12m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**F**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 15m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot A

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Qudrat Code

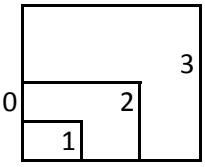
Species Code	Description	Transect	Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**G**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 18m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**H**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 21m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**I**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 24m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot A

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Qudrat Code

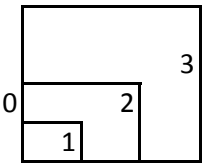
Species Code	Description	Transect	Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**J**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 27m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**K**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 30m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**L**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 33m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot A

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

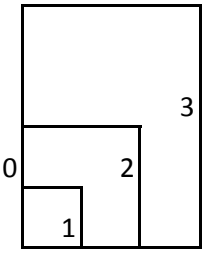
Species Code	Description	Transect	Nested Qudrat Code Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**M**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 36m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**N**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 39m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**O**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 42m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot A

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Qudrat Code

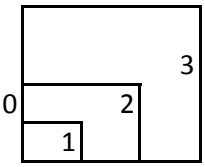
Species Code	Description	Transect	Quadrat Number							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**P**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 45m to start distance above)								
Randomly pick a 1, 2 or 3m start for Quad1 (NOT 0, 1 or 2: see map), then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**Q**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 48m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot B

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

Randomly select a transect start:	**0m**	**1m**	**2m**

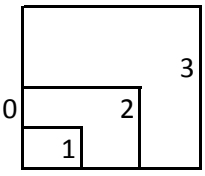
Species Code	Description	Transect	Quadrat Number							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**A**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m (use random start distance selected above)								
OI	Other Invasive									
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**B**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m (add 3m to start distance selected above)								
OI	Other Invasive									
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**C**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m (add 6m to start distance selected above)								
OI	Other Invasive									

Nested Frequency Data Sheet: Phoenix Field Macroplot B

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Quadrat Code

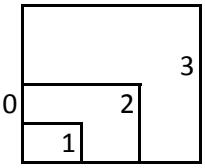
Species Code	Description	Transect	Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**D**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 9m to start distance above)								
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**E**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 12m to start distance above)								
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**F**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 15m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot B

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Quadrat Code

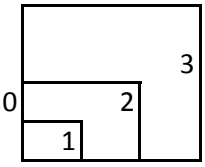
Species Code	Description	Transect	Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**G**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 18m to start distance above)								
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**H**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 21m to start distance above)								
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**I**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 24m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot B

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

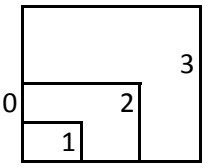
Species Code	Description	Transect	Nested Quadrat Code: Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**J**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 27m to start distance above)								
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**K**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 30m to start distance above)								
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**L**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 33m to start distance above)								

Nested Frequency Data Sheet: Phoenix Field Macroplot B

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

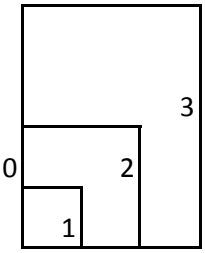
Species Code	Description	Transect	Nested Quadrat Code: Quadrat Number 1	2	3	4	5	6	7	8
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**M**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m (add 36m to start distance above)								
OI	Other Invasive									
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**N**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m (add 39m to start distance above)								
OI	Other Invasive									
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**O**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m (add 42m to start distance above)								
OI	Other Invasive									

Nested Frequency Data Sheet: Phoenix Field Macroplot B

Date:

Field Personnel:

Nested Quadrat Codes:	
1	present in 25 cm x 25 cm area
2	present in 50 cm x 50cm area
3	present in 100 cm x 100 cm area
0	Not Present



Greyed out quadrat cell are outside of the vernal pool and were excluded (see figures in the monitoring plan)

transect start from page 1:	**0m**	**1m**	**2m**

Nested Quadrat Code

Species Code	Description	Transect	Quadrat Number							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Randomly pick a 0, 1, or 2m start for Quad1, then place other quads systematically (add 3m to the start for each consecutive quad)-->										
GLDE	Waxy Mannagrass	**P**								
ELMA	Eleocharis macrostachya									
ORVI	Sacramento Orcutt Grass	_____ m								
OI	Other Invasive	(add 45m to start distance above)								

Photomonitoring Log: Phoenix Field Macroplot A

Shoot all with a focal length equivalent to 27mm on a full frame camera (e.g. 18mm on a Nikon dx lens). All photos should be shot from 5 feet above the ground, and the subject should be centered in the center and top 1/4 of the frame.

Date of observation: _____ **Camera and Lens:** _____

Observer(s): _____ **Focal Length:_____** **Camera Setting:** _____

Photo point	From	Toward	Description/Notes	Photo file name in camera
a	NW Marker	Center of pool		
b	NW Marker	NE Marker (bearing 60°)		
c	NW Marker	SE Marker (bearing 120°)		
d	NW Marker	SW Marker (bearing 160°)		
e	NW Marker	Opposite of pool (bearing 300°)		
f	NE Marker	Center of pool		
g	NE Marker	SE Marker (bearing 140°)		
h	NE Marker	SW Marker (bearing 180°)		
i	NE Marker	NW Marker (bearing 240°)		
j	NE Marker	Opposite of pool (bearing 0°)		

Photomonitoring Log: Phoenix Field Macroplot A

Shoot all with a focal length equivalent to 27mm on a full frame camera (e.g. 18mm on a Nikon dx lens). All photos should be shot from 5 feet above the ground, and the subject should be centered in the center and top 1/4 of the frame.

Date of observation: _____ **Camera and Lens:** _____

Observer(s): _____ **Focal Length:_____** **Camera Setting:** _____

k	SE Marker	Center of pool		
l	SE Marker	SW Marker (bearing 240°)		
m	SE Marker	NW Marker (bearing 320°)		
n	SE Marker	NE Marker (bearing 340°)		
o	SE Marker	Opposite of pool (bearing 140°)		
p	SW Marker	Center of pool		
q	SW Marker	NW Marker (bearing 340°)		
r	SW Marker	NE Marker (bearing 0°)		
s	SW Marker	SE Marker (bearing 60°)		
t	SW Marker	Opposite of pool (bearing 180°)		

Photomonitoring Log: Phoenix Field Macroplot B

Shoot all with a focal length equivalent to 27mm on a full frame camera (e.g. 18mm on a Nikon dx lens). All photos should be shot from 5 feet above the ground, and the subject should be centered in the center and top 1/4 of the frame.

Date of observation: _____ **Camera and Lens:** _____

_____

Observer(s): _____ **Focal Length:**_____ **Camera Setting:** _____

Photo point	From	Toward	Description/Notes	Photo file name in camera
a	NW Marker	Center of pool		
b	NW Marker	NE Marker (bearing 70°)		
c	NW Marker	SE Marker (bearing 130°)		
d	NW Marker	SW Marker (bearing 170°)		
e	NW Marker	Opposite of pool (bearing 310°)		
f	NE Marker	Center of pool		
g	NE Marker	SE Marker (bearing 150°)		
h	NE Marker	SW Marker (bearing 190°)		
i	NE Marker	NW Marker (bearing 250°)		
j	NE Marker	Opposite of pool (bearing 10°)		

Photomonitoring Log: Phoenix Field Macroplot B

Shoot all with a focal length equivalent to 27mm on a full frame camera (e.g. 18mm on a Nikon dx lens). All photos should be shot from 5 feet above the ground, and the subject should be centered in the center and top 1/4 of the frame.

Date of observation: _____ **Camera and Lens:** _____

_____

Observer(s): _____ **Focal Length:_____** **Camera Setting:** _____

k	SE Marker	Center of pool		
l	SE Marker	SW Marker (bearing 250°)		
m	SE Marker	NW Marker (bearing 330°)		
n	SE Marker	NE Marker (bearing 350°)		
o	SE Marker	Opposite of pool (bearing 150°)		
p	SW Marker	Center of pool		
q	SW Marker	NW Marker (bearing 350°)		
r	SW Marker	NE Marker (bearing 10°)		
s	SW Marker	SE Marker (bearing 70°)		
t	SW Marker	Opposite of pool (bearing 190°)		

Photomonitoring Log: Phoenix Field Photopoint C

Shoot all with a focal length equivalent to 27mm on a full frame camera (e.g. 18mm on a Nikon dx lens). All photos should be shot from 5 feet above the ground, and the subject should be centered in the center and top 1/4 of the frame.

Date of observation: _____ **Camera and Lens:** _____

Observer(s): _____ **Focal Length:_____** **Camera Setting:** _____

Photopoint established west of the pool with *Navarretia myersii* subsp. *myersii*, 2 meters north east of a blue oak tree. Monument located at 38°39'17.18", -121°12'56.40"

Photo point	**From**	**Toward**	**Description/Notes**	**Photo file name in camera**
a	Plot C monument	Southeast (135°)		
b	Plot C monument	East (90°)		
c	Plot C monument	Northeast (45°)		

California Department of Fish and Wildlife Phoenix Field Ecological Reserve Qualitative Monitoring

Date: Weather:

Field personnel:

Location(s) visited:

Describe the phonological condition of vegetation, soil saturation, soil disturbance, water levels and levels of residual dry matter:

Describe any particularly abundant or notable plants or wildlife observed, including the abundance of Sacramento orcutt grass and pincushion navarretia:

Describe visible threats and disturbances and any missing field markers:

Describe weed infestations and the condition of trees and non-native species growing along perimeter fences:

Describe any evidence of trespassing:

Photographs taken:

Recommendations:

Partial Plant Species List for Phoenix Field Ecological Reserve updated 7/6/2018

Family	*Genus*	*Species*	*Variety or Subspecies*	Common Name	Native (Yes/No)
Agavaceae	*Chlorogalum*	*angustifolium*		narrow-leaved soaproot	Y
Agavaceae	*Chlorogalum*	*pomeridianum*		soap plant	Y
Apiaceae	*Eryngium*	*vaseyi*		coyote-thistle	Y
Apiaceae	*Lomatium*	*caruifolium*	var. *denticulatum*	carraway-leaved lomatium	Y
Apiaceae	*Lomatium*	*marginatum*		Hartweg's lomatium	Y
Apiaceae	*Sanicula*	*bipinnata*		poison sanicle	Y
Apiaceae	*Sanicula*	*bipinnatifida*		purple sanicle	Y
Apiaceae	*Sanicula*	*crassicaulis*		Pacific sanicle	Y
Asteraceae	*Achillea*	*millefolium*		common yarrow	Y
Asteraceae	*Achyrachaena*	*mollis*		blow-wives	Y
Asteraceae	*Blennosperma*	*nanum*		yellow carpet	Y
Asteraceae	*Centaurea*	*solstitialis*		yellow star-thistle	N
Asteraceae	*Centromadia*	*fitchii*		Fitch's spikeweed	Y
Asteraceae	*Hesperevax*	*caulescens*		hogwallow starfish	Y
Asteraceae	*Holocarpha*	*virgata*		narrow tarplant	Y
Asteraceae	*Hypochaeris*	*glabra*		smooth cat's-ear	N
Asteraceae	*Lasthenia*	*californica*	subsp. *californica*	California goldfields	Y
Asteraceae	*Lasthenia*	*fremontii*		Fremont's goldfields	Y
Asteraceae	*Layia*	*fremontii*		Fremont's tidy-tips	Y
Asteraceae	*Leontodon*	*saxatilis*	subsp. *longirostris*	hairy hawkbit	N
Asteraceae	*Matricaria*	*discoidea*		pineapple weed	Y
Asteraceae	*Micropus*	*californicus*		Q-tips	Y
Asteraceae	*Microseris*	*douglasii*		Douglas' microseris	Y
Asteraceae	*Psilocarphus*	*brevissimus*		woolly marbles	Y
Asteraceae	*Senecio*	*vulgaris*		common groundsel	N
Asteraceae	*Soliva*	*sessilis*		South American soliva	N
Boraginaceae	*Amsinckia*	*intermedia*		common fiddleneck	Y
Boraginaceae	*Plagiobothrys*	*greenei*		Greene's spiny-nut popcornflower	Y
Boraginaceae	*Plagiobothrys*	*stipitatus*		Great Valley popcornflower	Y
Brassicaceae	*Thysanocarpus*	*curvipes*		fringepod	Y
Campanulaceae	*Downingia*	*bicornuta*	var. *picta*	mountain bristled downingia	Y
Campanulaceae	*Downingia*	*concolor*		spotted throat downingia	Y
Campanulaceae	*Downingia*	*cuspidata*		toothed downingia	Y
Campanulaceae	*Downingia*	*pusilla*		dwarf downingia	Y
Caryophyllaceae	*Minuartia*	*californica*		California sandwort	Y
Caryophyllaceae	*Cerastium*	*glomeratum*		sticky mouse-ear chickweed	N
Caryophyllaceae	*Stellaria*	*media*		common chickweed	N
Crassulaceae	*Crassula*	*aquatica*		water pygmy weed	Y
Cyperaceae	*Eleocharis*	*macrostachya*		common spikerush	Y
Elatinaceae	*Elatine*	*californica*		California waterwort	Y
Euphorbiaceae	*Euphorbia*	*ocellata*		contura creek spurge	Y
Euphorbiaceae	*Croton*	*setiger*		doveweed	Y
Fabaceae	*Acmispon*	*wrangelianus*		Chilean trefoil	Y
Fabaceae	*Lupinus*	*bicolor*		miniature lupine	Y
Fabaceae	*Trifolium*	*depauperatum*		dwarf sack clover	Y
Fabaceae	*Vicia*	*villosa*	subsp. *villosa*	winter vetch	Y
Fagaceae	*Quercus*	*douglasii*		blue oak	Y
Gentianaceae	*Centaurium*	*tenuiflorum*		slender centaury	Y
Gentianaceae	*Cicendia*	*quadrangularis*		timwort	Y
Geraniaceae	*Erodium*	*botrys*		long-beaked filaree	N
Geraniaceae	*Erodium*	*cicutarium*		redstem filaree	N
Geraniaceae	*Geranium*	*molle*		wild geranium	N
Iridaceae	*Sisyrinchium*	*bellum*		Western blue-eyed-grass	Y

Family	*Genus*	*Species*	*Variety or Subspecies*	Common Name	Native (Yes/No)
Isoetaceae	*Isoetes*	*nuttallii*		Nuttall's quillwort	Y
Isoetaceae	*Isoetes*	*orcuttii*		Orcutt's quillwort	Y
Juncaceae	*Juncus*	*bufonius*		toad rush	Y
Juncaceae	*Juncus*	*bufonius*	var. *occidentalis*	western toad rush	Y
Juncaceae	*Juncus*	*capitatus*		dwarf rush	N
Juncaceae	*Juncus*	*kelloggii*		Kellogg's dwarf rush	Y
Juncaginaceae	*Triglochin*	*scilloides*		flowering-quillwort	Y
Lamiaceae	*Pogogyne*	*zizyphoroides*		Sacramento beardstyle	Y
Lamiaceae	*Trichostema*	*lanceolatum*		vinegar weed	Y
Liliaceae	*Calochortus*	*luteus*		yellow mariposa	Y
Lythraceae	*Lythrum*	*hyssopifolia*		hyssop loosestrife	N
Malvaceae	*Sidalcea*	*calycosa*		vernal pool checkerbloom	Y
Marsileaceae	*Pilularia*	*americana*		American pillwort	Y
Montiaceae	*Calandrinia*	*menziesii*		red maids	Y
Montiaceae	*Claytonia*	*perfoliata*		miner's lettuce	Y
Montiaceae	*Montia*	*fontana*		water chickweed	Y
Onagraceae	*Clarkia*	*purpurea*		purple clarkia	Y
Onagraceae	*Clarkia*	*unguiculata*		elegant clarkia	Y
Onagraceae	*Epilobium*	*cleistogamum*		cleistogamous boisduvalia	Y
Orobanchaceae	*Castilleja*	*campestris*	subsp. *campestris*	yellow owl's clover	Y
Orobanchaceae	*Triphysaria*	*eriantha*		butter-and-eggs	Y
Papaveraceae	*Eschscholzia*	*californica*		California poppy	Y
Papaveraceae	*Eschscholzia*	*lobbii*		frying pans	Y
Phrymaceae	*Diplacus*	*tricolor*		tricolor monkeyflower	Y
Phrymaceae	*Erythranthe*	*guttata*		spotted monkeyflower	Y
Plantaginaceae	*Callitriche*	*longipedunculata*		longstock water-starwort	Y
Plantaginaceae	*Callitriche*	*marginata*		winged water starwort	Y
Plantaginaceae	*Collinsia*	*heterophylla*		Chinese houses	Y
Plantaginaceae	*Gratiola*	*ebracteata*		bractless hedge-hyssop	Y
Plantaginaceae	*Plantago*	*elongata*		coastal plantain	Y
Plantaginaceae	*Veronica*	*peregrina*	subsp. *xalapensis*	purslane speedwell	Y
Poaceae	*Aegilops*	*triuncialis*		barbed goat grass	N
Poaceae	*Aira*	*caryophyllea*		silver hair grass	N
Poaceae	*Avena*	*barbata*		slender wild oat	N
Poaceae	*Avena*	*fatua*		wild oat	N
Poaceae	*Briza*	*maxima*		large quaking grass	N
Poaceae	*Briza*	*minor*		small quaking grass	N
Poaceae	*Bromus*	*diandrus*		ripgut grass	N
Poaceae	*Bromus*	*hordeaceus*		soft chess	N
Poaceae	*Cynodon*	*dactylon*		Bermuda grass	N
Poaceae	*Deschampsia*	*danthonioides*		annual hair grass	Y
Poaceae	*Festuca*	*bromoides*		brome fescue	N
Poaceae	*Festuca*	*perennis*		rye grass	N
Poaceae	*Glyceria*	*declinata*		low manna grass	N
Poaceae	*Hordeum*	*marinum*	subsp. *gussoneanum*	Mediterranean barley	N
Poaceae	*Hordeum*	*murinum*	subsp. *leporinum*	hare barley	N
Poaceae	*Melica*	*californica*		California melic	Y
Poaceae	*Orcuttia*	*viscida*		Sacramento orcutt grass	Y
Poaceae	*Phalaris*	*lemmonii*		Lemmon's canary grass	Y
Poaceae	*Poa*	*annua*		annual blue grass	N
Poaceae	*Polypogon*	*monspeliensis*		annual beard grass	N
Polemoniaceae	*Navarretia*	*leucocephala*		white headed navarretia	Y
Polemoniaceae	*Navarretia*	*leucocephala*	subsp. *minima*	little white navarretia	Y
Polemoniaceae	*Navarretia*	*myersii*	subsp. *myersii*	pincushion navarretia	Y

Family	*Genus*	*Species*	*Variety or Subspecies*	Common Name	Native (Yes/No)
Polemoniaceae	*Navarretia*	*tagetina*		marigold navarretia	Y
Polygonaceae	*Rumex*	*crispus*		curly dock	N
Primulaceae	*Primula*	*clevelandii*	var. *gracilis*	Padre's shooting star	Y
Primulaceae	*Primula*	*hendersonii*		mosquito bill(s)	Y
Ranunculaceae	*Delphinium*	*hansenii*		Hansen's larkspur	Y
Ranunculaceae	*Delphinium*	*variegatum*		royal larkspur	Y
Ranunculaceae	*Ranunculus*	*bonariensis*	var. *trisepalus*	vernal pool buttercup	Y
Ranunculaceae	*Ranunculus*	*californicus*		California buttercup	Y
Rosaceae	*Pyrus*	*calleryana*		Callery pear	N
Rubiaceae	*Galium*	*aparine*		goose grass	Y
Rubiaceae	*Galium*	*nuttallii*		San Diego bedstraw	Y
Themidaceae	*Brodiaea*	*coronaria*		garland brodiaea	Y
Themidaceae	*Brodiaea*	*elegans*		harvest brodiaea	Y
Themidaceae	*Brodiaea*	*minor*		small brodiaea	Y
Themidaceae	*Dichelostemma*	*capitatum*		blue dicks	Y
Themidaceae	*Triteleia*	*hyacinthina*		white brodiaea	Y
Themidaceae	*Triteleia*	*laxa*		Ithuriel's spear	Y
Violaceae	*Viola*	*pedunculata*		johnny-jump-up	Y


Orcuttia viscida field photo

PHOENIX FIELD ECOLOGICAL RESERVE SACRAMENTO ORCUTT GRASS MONITORING RESULTS AND DISCUSSION 2015-2017

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

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1. INTRODUCTION

This document summarizes the 2014-2017 monitoring results from implementation of the 2018 Phoenix Field Ecological Reserve Sacramento Orcutt Grass Monitoring Plan (Monitoring Plan). The Monitoring Plan is included as Part 1 of this report and includes detailed instructions on how to implement the monitoring protocol for Sacramento Orcutt grass (*Orcuttia viscida*) at the California Department of Fish and Wildlife (CDFW) Phoenix Field Ecological Reserve (Reserve). The purpose of the Monitoring Plan is to facilitate adaptive management of the populations of Sacramento Orcutt grass at the Reserve. Implementation of the Monitoring Plan began in 2014 as a pilot study, and the work was partially grant funded in 2015. The monitoring is expected to continue annually into 2021 or later. This document includes an interpretation of results, an assessment of the monitoring project, and management recommendations. The results and recommendations in this document are a critical step in the adaptive management process.

2. SUMMARY OF RESULTS

This document reports on the result of the following monitoring components:

1. Spring nested frequency monitoring of plants within the two sections of vernal pools on the Reserve that contain Sacramento Orcutt grass; and
2. Photomonitoring of the Reserve.

In addition, precipitation information generated using a PRISM climate model is presented, residual dry matter calculations from 2015 are presented, and general observations of other rare plants on the Reserve are reported.

2.1. SPRING NESTED FREQUENCY MONITORING

The Locations of Macroplots A and B are presented in Figure 5 of the Monitoring Plan.

Sacramento Orcutt grass was present in each monitoring macroplot every year from 2014 to 2017, with most plants found in the deepest portions of pools (Figures 1 and 2). Invasive waxy mannagrass (*Glyceria declinata*) was not observed at all within Macroplot A from 2014 to 2017, but waxy mannagrass was observed within several of the random quadrats that were sampled within Macroplot B, particularly in the northeast corner of the macroplot. Native common spikerush (*Eleocharis macrostachya*) was not observed at all within Macroplot A from 2014 to 2017, but common spikerush does occur extensively in Macroplot B, with a dense concentration of common spikerush in the northern part of Macroplot B (Figure 3). Other non-native plants were within the monitoring macroplots every year, particularly in uplands near pool margins.

Sacramento Orcutt grass

In Macroplot A, the frequency ($1m^2$) of Sacramento Orcutt grass was under 50 percent in 2014 and was significantly higher in 2015. The frequency ($1m^2$) of Sacramento Orcutt grass was significantly lower in 2016 than in 2015, and there was no significant difference between frequencies in 2016 and 2017 (90 percent confidence levels) (Figure 4).

The changes in Sacramento Orcutt grass frequency in Macroplot B were similar to those observed in Macroplot A. The frequency ($1m^2$) of Sacramento Orcutt grass was under 40 percent in 2014, and was significantly higher in 2015. The frequency ($1m^2$) of Sacramento Orcutt grass was significantly lower in 2016 than in 2015, and there was no significant difference between frequencies in 2016 and 2017 (90 percent confidence levels) (Figure 5).

Figure 1
Number of years that *Orcuttia viscida* was in a random 1m^2 quadrat within a 9m^2 (3m x 3m) area, 2015-2017Phoenix Field Ecological Reserve Macroplot A

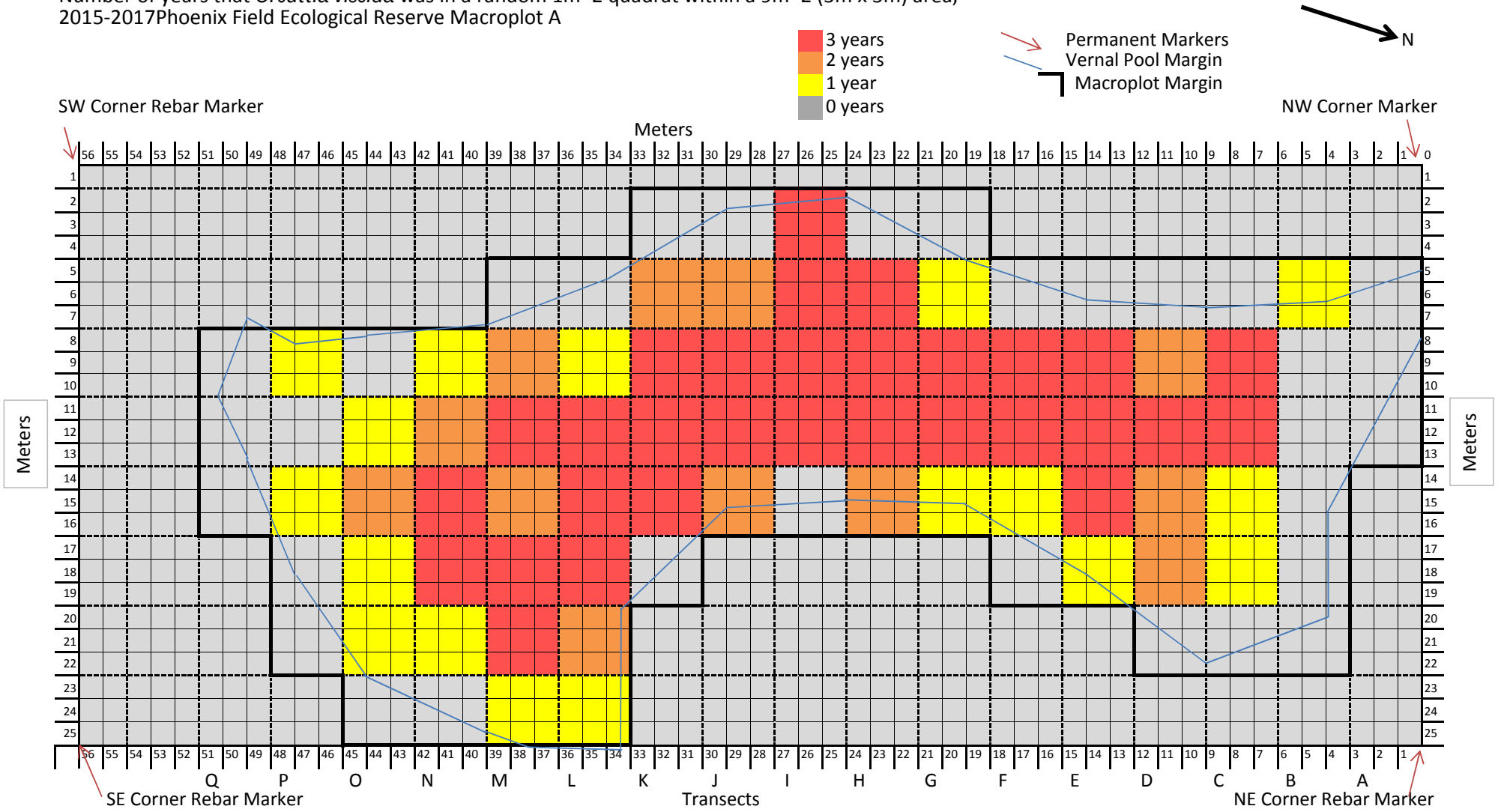


Figure 2: Number of years that *Orcuttia viscida* was in a random 1m^2 quadrat within a 9m^2 (3m x 3m) area, 2015-2017
Phoenix Field Ecological Reserve Macroplot B

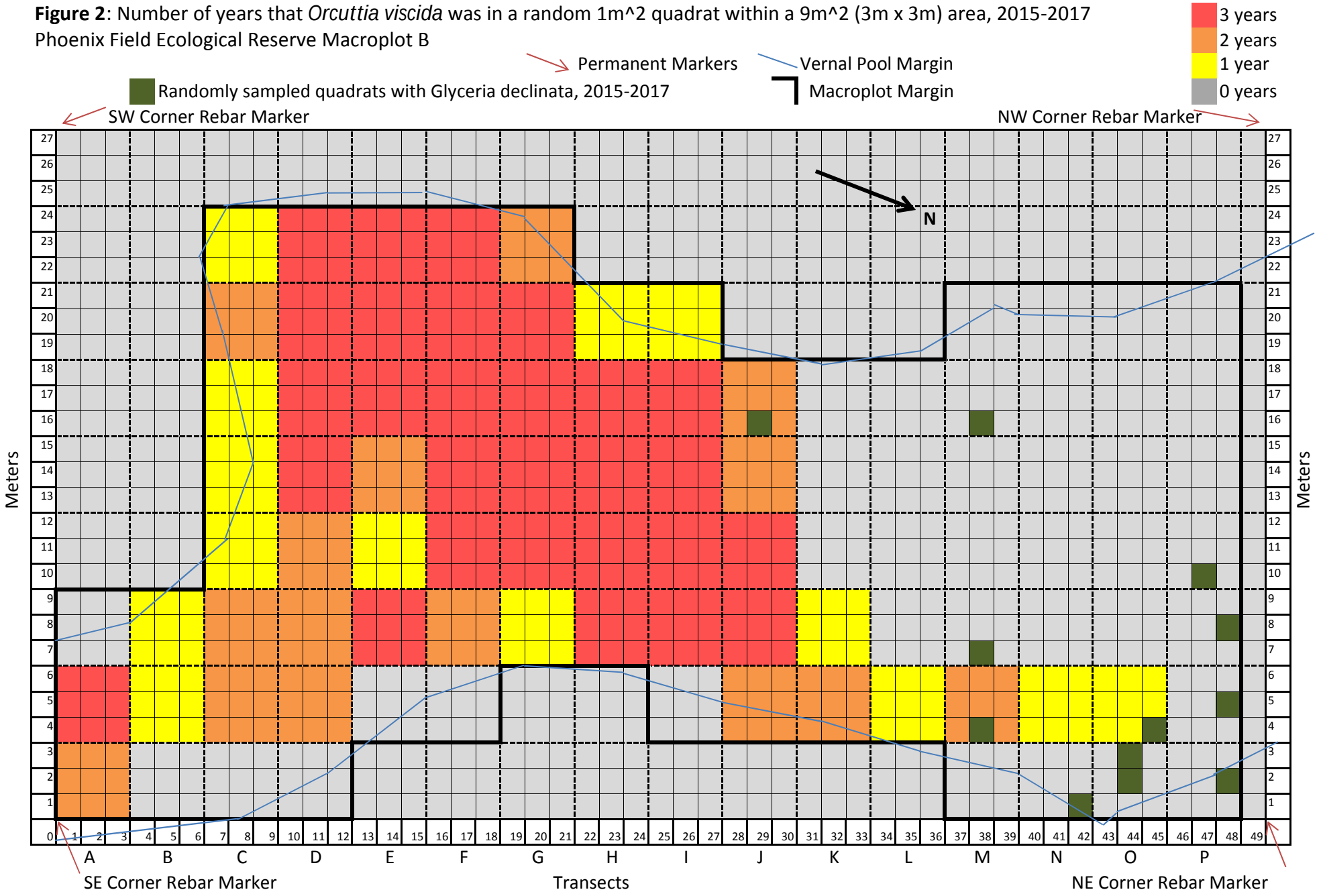
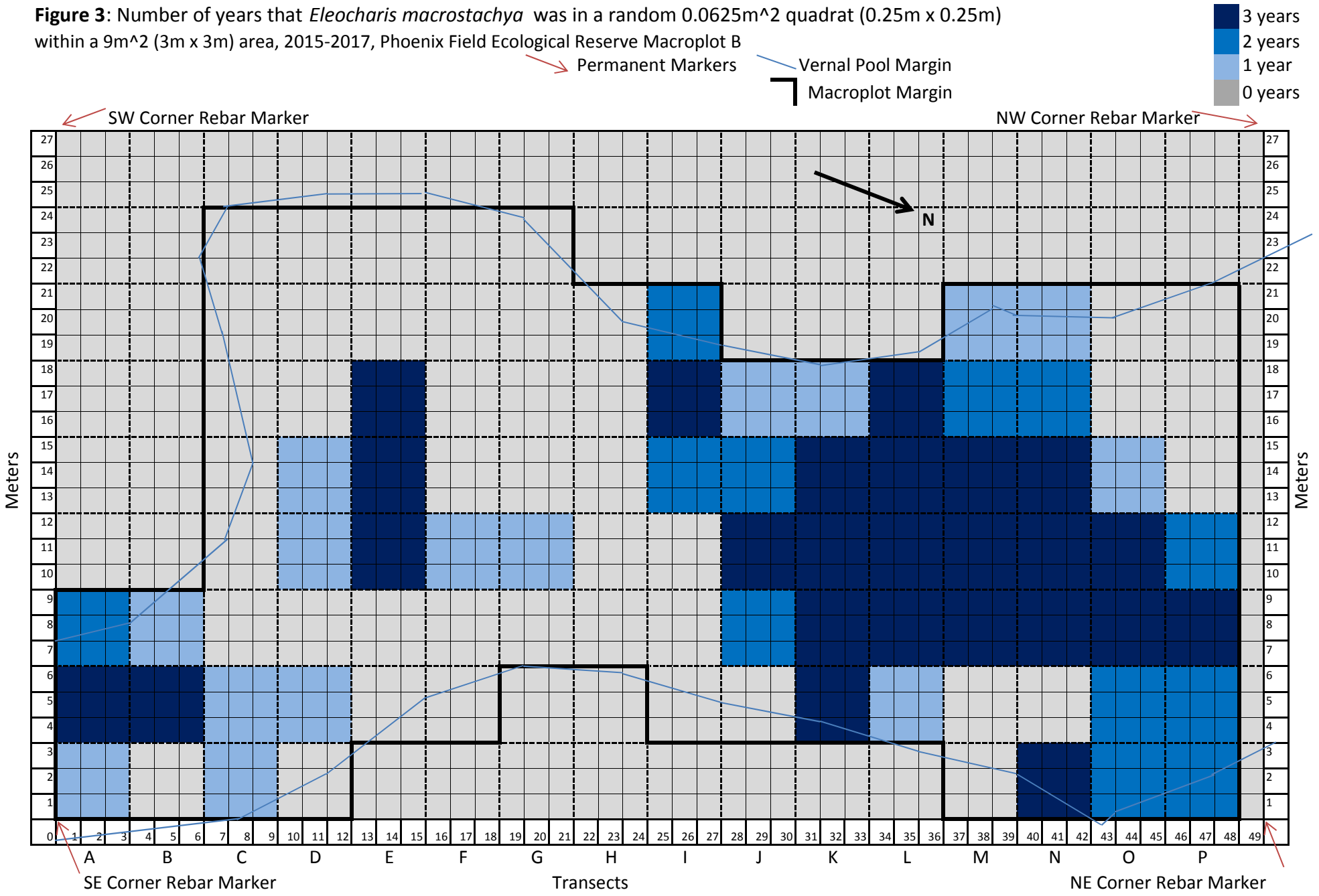
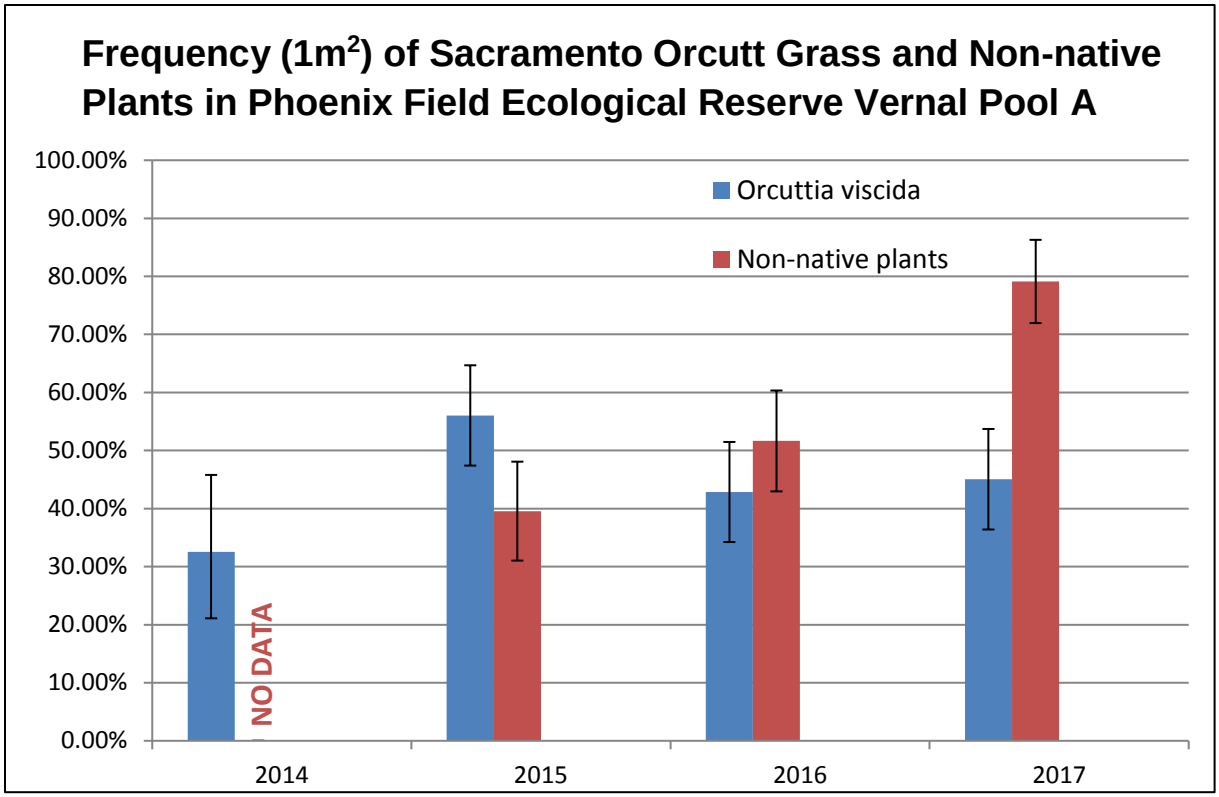


Figure 3: Number of years that *Eleocharis macrostachya* was in a random 0.0625m^2 quadrat (0.25m x 0.25m) within a 9m^2 (3m x 3m) area, 2015-2017, Phoenix Field Ecological Reserve Macroplot B





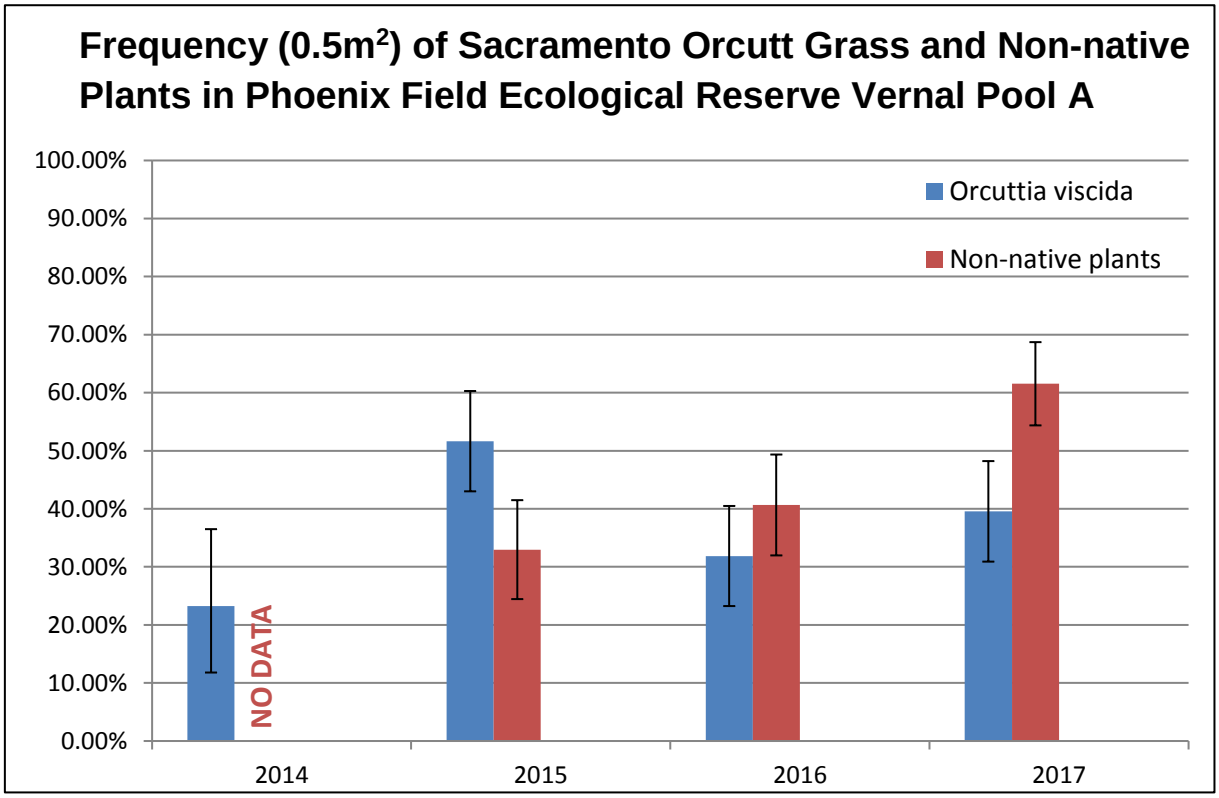
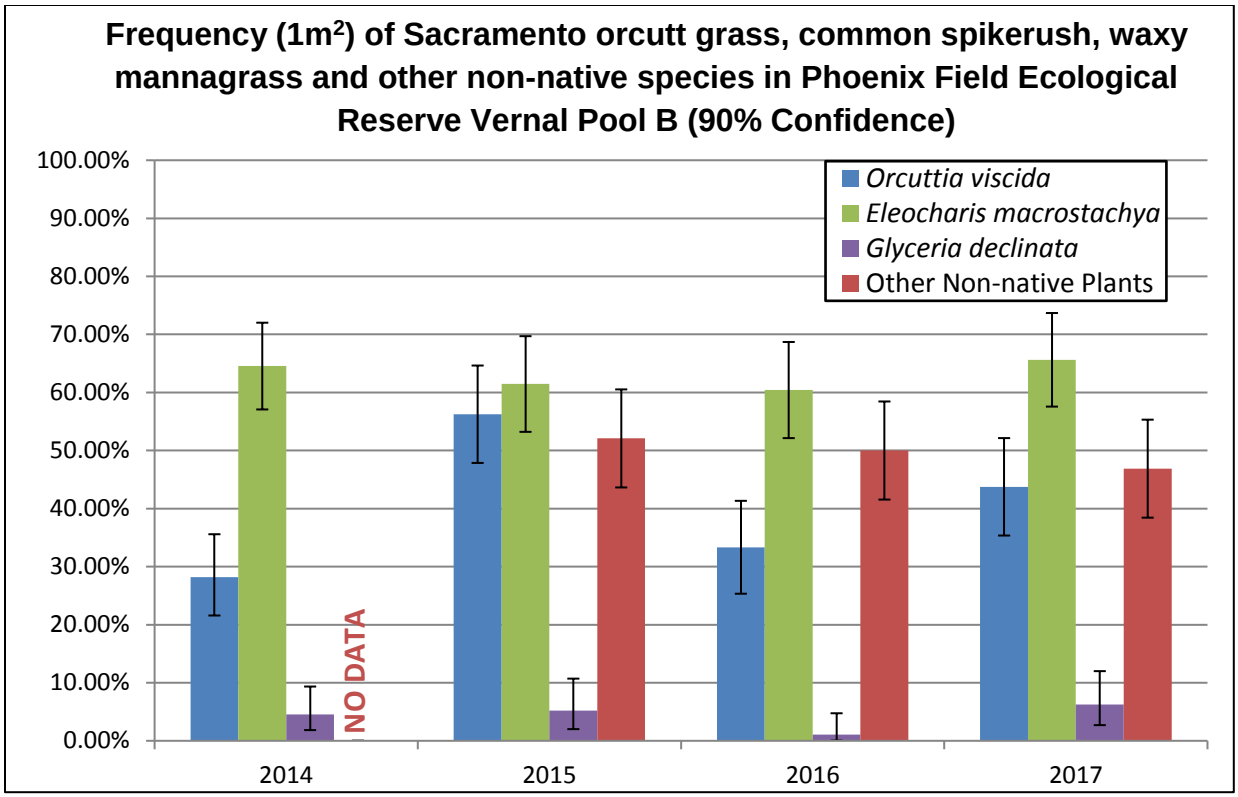


Figure 4: 2014-2017 Results of Frequency Monitoring in Pool A at Phoenix Field Ecological Reserve



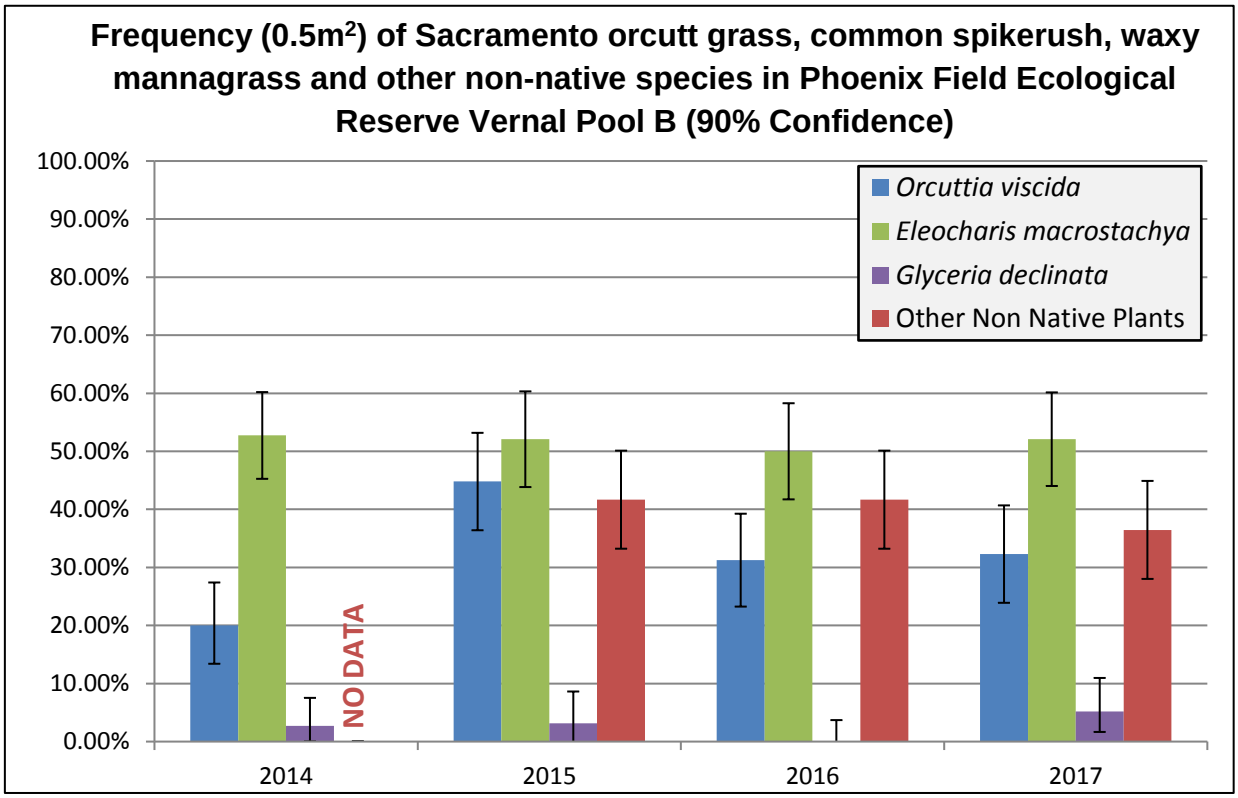


Figure 5: 2014-2017 Results of Frequency Monitoring in Pool B at Phoenix Field Ecological Reserve

Between 2014 and 2017, 2014 may have been the “worst” year for Sacramento Orcutt grass, and 2015 may have been the “best” year, with 2016 and 2017 somewhere in between.

While there was a significantly higher frequency of Sacramento Orcutt grass in 2015, relative to 2014 and 2016, the frequency of Sacramento Orcutt grass was otherwise relatively similar from 2014 to 2017. This result shows that although there may have been large differences in the number of Sacramento Orcutt grass plants present on the Reserve in different monitoring years, Sacramento Orcutt grass occupied a similar spatial arrangement each year.

Waxy mannnagrass

No waxy mannagrass was detected in Macroplot A between 2014 and 2017.

Low frequencies ($1m^2$) of waxy mannagrass were detected in Macroplot B every year between 2014 and 2017, with the 90 percent confidence interval for the $1m^2$ frequency estimates exceeding ten percent in both 2015 and 2017 (see Figure 5).

Common spikerush

No common spikerush was detected in in Macroplot A between 2014 and 2017,

The frequency ($1m^2$, $0.25m^2$, and $0{,}0625m^2$) of common spikerush in Macroplot B was not significantly different between any of the monitoring years from 2014 and 2017 (90 percent confidence interval) (see Figure 5).

Other non-native species

The frequency ($1m^2$, $0.25m^2$, and $0{,}0625m^2$) of other non-native plant species in Macroplot A appears to have significantly increased from 2015 to 2016, and significantly increased again from 2016 to 2017 (90 percent confidence interval) (see Figure 4).

The frequency ($1m^2$, $0.25m^2$, and $0{,}0625m^2$) of other non-native plant species in Macroplot B was not significantly different between any of the monitoring years from 2015 and 2017 (90 percent confidence interval) (see Figure 5).

2.2. Residual Dry Matter

On September 22, 2015 the amount of residual dry matter (RDM) in upland areas of the Reserve was estimated to be 2,081 ± 351 pounds per acre (90 percent confidence). This estimate was conducted by clipping and weighing RDM from 17 random one square foot quadrats on the Reserve that were not within vernal pools.

2.3. Annual Photomonitoring for Adaptive Management

Forty-three monitoring photo positions were used at the Reserve. Monitoring photographs were taken whenever frequency data was collected at one of the two macroplots. Monitoring photographs were also taken opportunistically during other visits to the Reserve. Some of the monitoring photos from 2014-2017 are presented in Figures 6 through 11. Monitoring photographs from all 43 monitoring photo positions are on file with CDFW’s Native Plant Program.

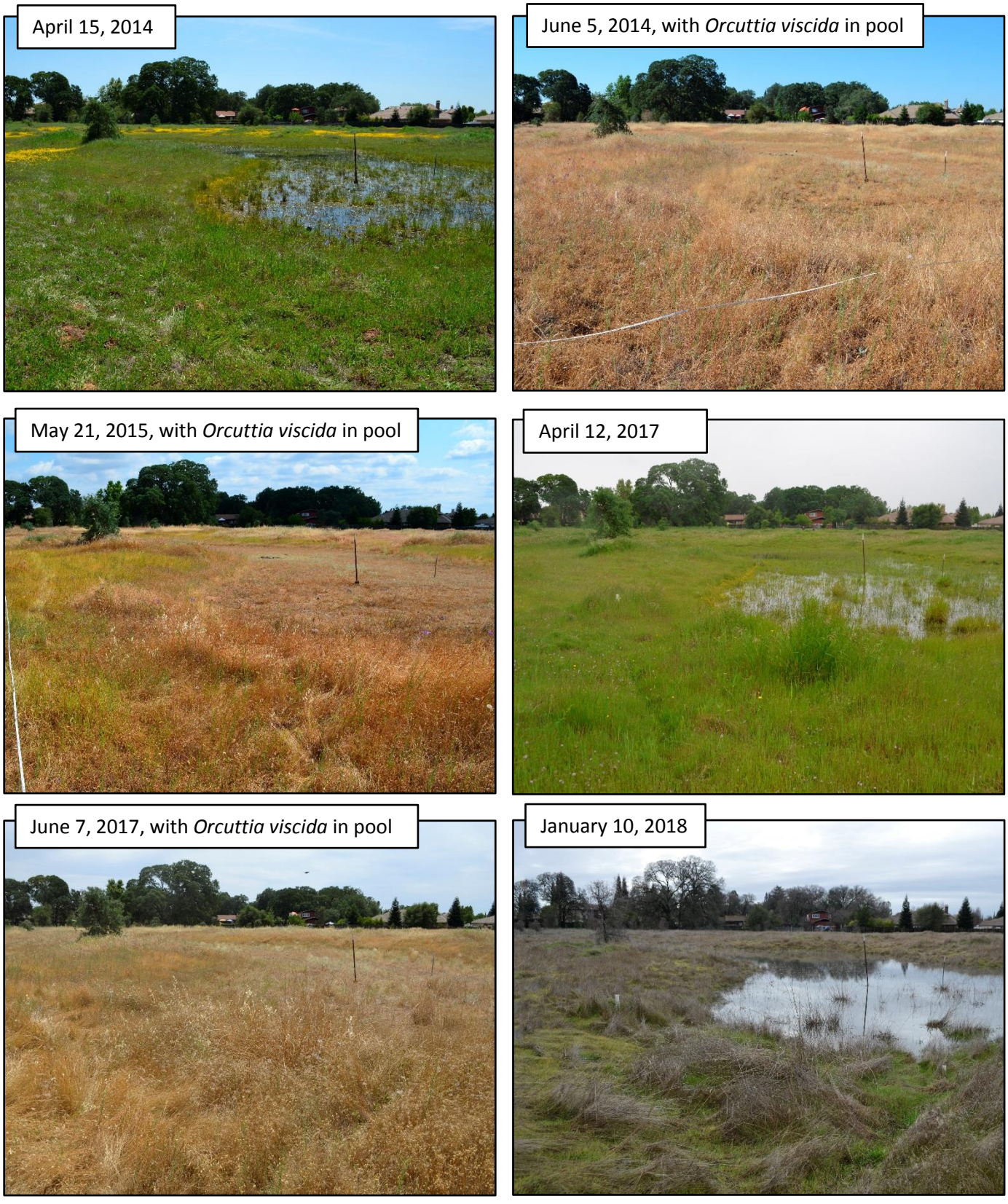


Figure 6

Photopoint Ah 2014-2018, view to the south (180°) of the northeast corner of Macroplot A

April 15, 2014

June 5, 2014, with *Orcuttia viscida* in pool

May 21, 2015, with *Orcuttia viscida* in pool

April 12, 2017

June 7, 2017, with *Orcuttia viscida* in pool

January 10, 2018

Figure 7

Photopoint Ak 2014-2018, view to center of pool from southeast corner of Macroplot A

June 10, 2014

May 21, 2015

April 12, 2017

June 7, 2017

January 10, 2018 removal of vegetation growing along northern fence of the Reserve

Figure 8

Photopoint Be 2014-2018, view to the northwest (310°) of the northwest corner of Macroplot B

June 10, 2014, with *Orcuttia viscida* in pool

May 21, 2015, with *Orcuttia viscida* in pool

April 12, 2017

June 7, 2017, with *Orcuttia viscida* in pool

January 10, 2018

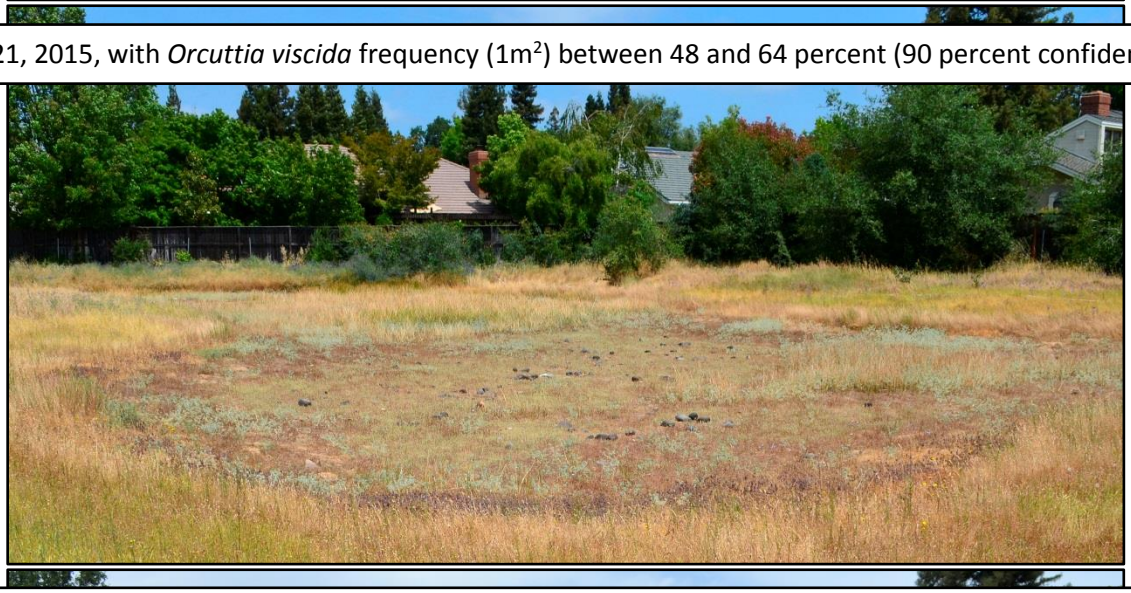
A patch of common spikerush (*Eleocharis macrostachya*) is present on the right side of photos, and Sacramento Orcutt grass (*Orcuttia viscida*) generally occurs to the left of and behind this large patch of common spikerush. Sacramento Orcutt grass is generally not found in areas with a high density of common spikerush (compare Figures 2 and 3).

Figure 9

Photopoint Bf 2014-2018, view to the center of pool from the northeast corner of Macroplot B

June 10, 2014, with *Orcuttia viscida* frequency ($1m^2$) between 21 and 36 percent (90 percent confidence)

May 21, 2015, with *Orcuttia viscida* frequency ($1m^2$) between 48 and 64 percent (90 percent confidence)



June 7, 2017, with *Orcuttia viscida* frequency ($1m^2$) between 35 and 52 percent (90 percent confidence)

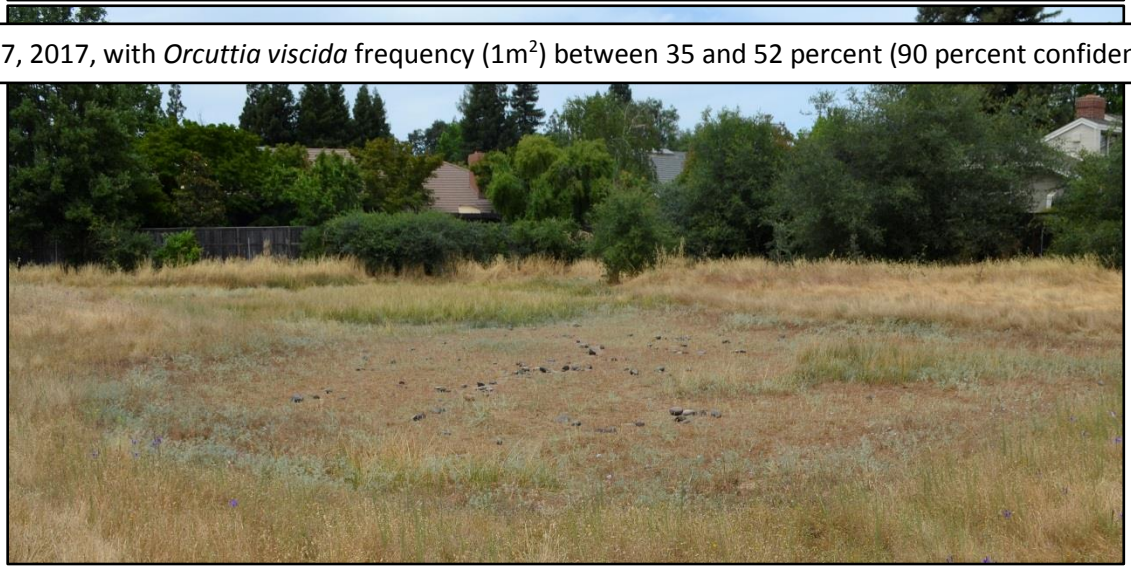


Figure 10

Photopoint Br 2014-2018, view to the north (10°) from the southwest corner of Macroplot B

This photopoint shows the location of most of the *Navarretia myersii* ssp*. myersii* that is known to occur on the Reserve.

June 5, 2016, with locations of *Navarretia myersii* ssp*. myersii* flagged.

April 12, 2017

January 10, 2018

Figure 11

Photopoint Ca 2016-2018, view to the southeast (135°) from the Plot C Monument

2.4. PRECIPITATION

Precipitation information generated using a PRISM climate model is presented in Figure 12 (PRISM 2017). Sacramento Orcutt grass germinates in the fall after the onset of winter precipitation, and peak bloom is in June and July. September to June precipitation is therefore assumed to be an important factor for Sacramento Orcutt grass growth and survival. Overall, there was a positive trend in growing season precipitation from September 2013 to June 2017 (see Figure 12).

2.5. OTHER OBSERVATIONS

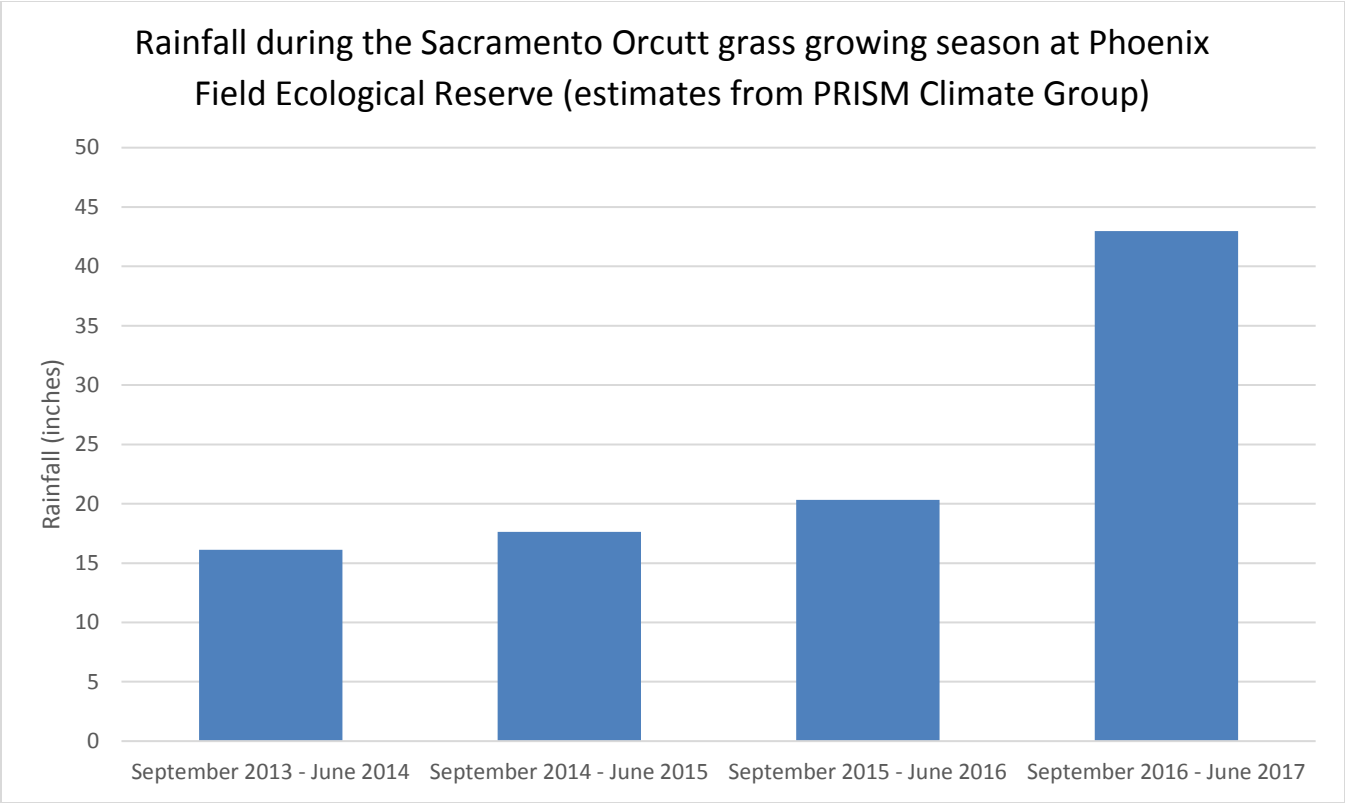
In addition to Sacramento Orcutt grass, the rare pincushion navarretia (*Navarretia myersii* subsp. *myersii*) (California Rare Plant Rank of 1B.1) was also observed on the Reserve, and a photopoint was established to monitor the population. The monument for this photopoint is located two meters north-east of a blue oak (*Quercus douglasii*), at approximately 38°39'17.18" and -121°12'56.40". On May 5, 2016, approximately 200 to 1,000 pincushion navarretia plants were visually estimated to occur in small pools near the established photopoint on the Reserve. The pool was visited again on April 12, 2017, and monitoring photographs were taken; however, the pool was still inundated and pincushion navarretia was not yet evident.

On January 10, 2018 CDFW staff from the North Central Region, with help from CDFW volunteers and the CDFW Native Plant Program removed vegetation that was growing along the north fence and a portion of the east fence of the Reserve for fire control purposes, and to remove non-native trees and vegetation. CDFW's North Central Region is responsible for management of the Reserve. Vegetation was cleared using chainsaws and hand loppers, and the vegetation was dragged to the empty, privately-owned lot near the access gate where it was chipped, and left on the lot with permission from the landowner. A medium-sized Callery pear (*Pyrus calleryana*) was removed from just inside the access gate, in addition to many small- to medium-sized interior live oaks (*Quercus wislizeni* var. *wislizeni*), and other woody, non-native, ornamental plants. One small interior live oak tree (approximately 8 feet in height) was cut down near the boundary of the pool supporting Sacramento Orcutt grass within Macroplot B to eliminate impacts to the pool from excessive shading in the future, were the tree to grow larger.

3. INTERPRETATION OF RESULTS

With only four years of monitoring data, it is difficult to make strong conclusions; however, because growth and reproduction of a considerable number of Sacramento Orcutt grass plants occurred within monitoring macroplots every year of monitoring from 2014-2017, and there are records of Sacramento Orcutt grass observations at the Reserve for several decades, the Sacramento Orcutt grass population at the Reserve appears to be relatively stable at this time.

Waxy mannagrass was not detected within Macroplot A from 2014 to 2017, but was detected within Macroplot B at relatively low frequencies every year during this same period. The Sacramento Orcutt grass pools in Macroplots A and B were highly invaded with waxy mannagrass in the past (see Photo 25 in Gerlach 2012), but efforts by Dr. Gerlach to remove waxy mannagrass in 2007 and subsequent years have greatly reduced the amount of waxy mannagrass within these pools. The population of waxy mannagrass within the macroplots on the Reserve does not appear to be expanding rapidly at this time, but the conditions that would allow waxy mannagrass populations to expand rapidly are not known, and could occur again in the future. Despite the low frequencies of waxy mannagrass within macroplots from 2014-2017, without management, the possibility continues to exist that the waxy mannagrass population will



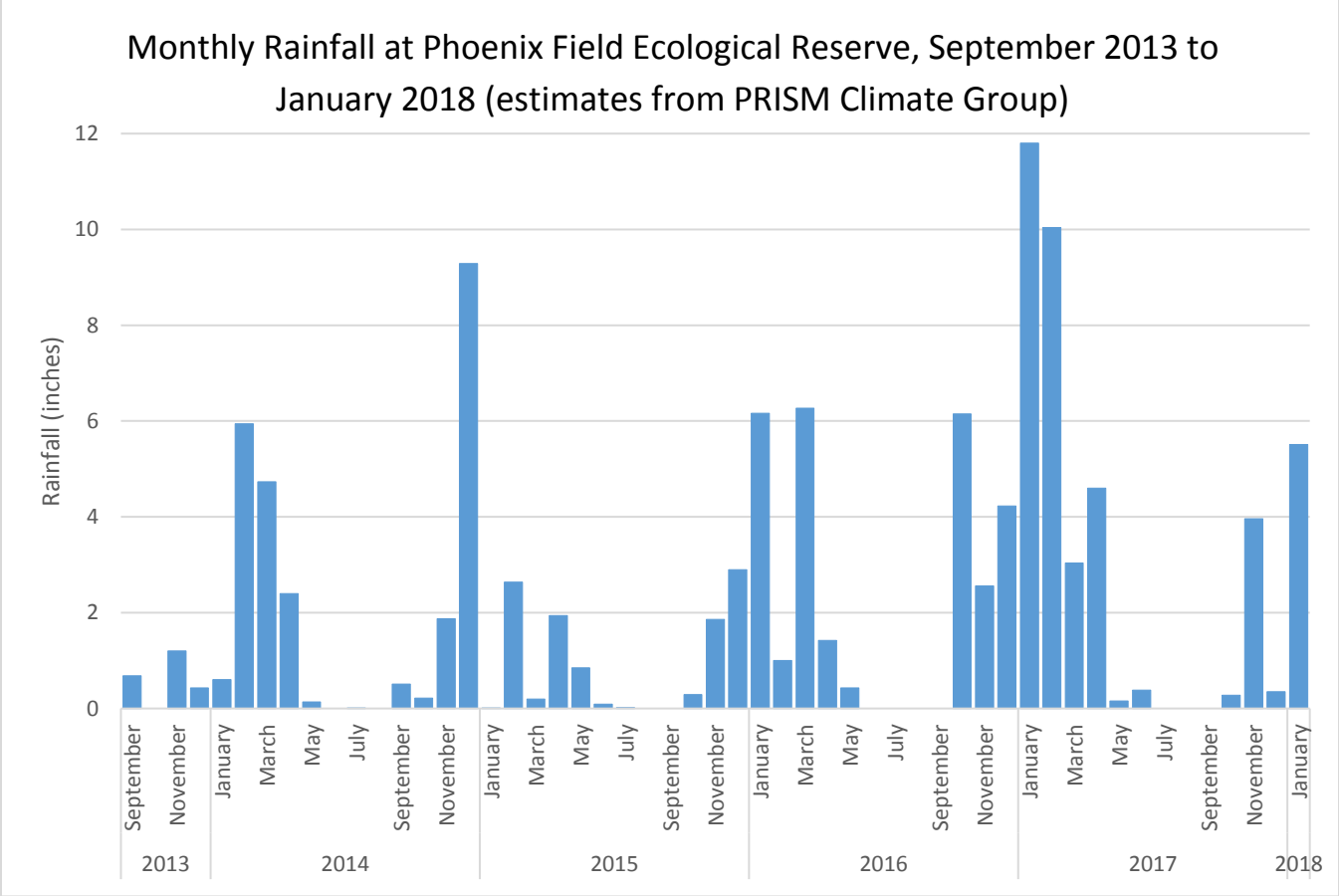


Figure 12

Estimates of Rainfall at Phoenix Field Ecological Reserve, September 2013 – January 2018

expand within Sacramento Orcutt grass pools on the Reserve, negatively affecting Sacramento Orcutt grass.

A dense patch of common spikerush occupies a large portion of the north part of Macroplot B and appears to occupy a somewhat different niche than Sacramento Orcutt grass (see Figure 10). While the two species can occur in the same area, there is some spatial differentiation in where the two species occur in Macroplot B (see Figures 2 and 3). If the patch of common spikerush were expanding, it could pose a threat to the Sacramento Orcutt grass in Macroplot B. Based on the frequency data collected from 2014-2017, the patch of common spikerush does not appear to be significantly shrinking or expanding at this time.

The increase in frequency of non-native plants in Macroplot A from 2015 to 2017 may be due to increased rainfall in 2017; however, field notes indicate that some species were incorrectly considered to be non-native in 2017, and therefore the frequency estimates from 2017 likely overestimate the actual frequencies of non-native plants in 2017.

Based on the frequency data collected so far, 2015 appears to have been the “best” year for Sacramento Orcutt grass on the Reserve. The rainfall for the 2014-2015 growing season was unique from the other growing seasons of the monitoring period because December 2014 rainfall was very high (over 9 inches, which is more than double the rainfall during this same month in other growing seasons). Furthermore, December 2014 rainfall was followed by very little rainfall in the following months (approximately 5.7 inches of total rainfall in the months of January-June 2015, which is less than half of the rainfall in this same time period for other monitoring years). Although this anecdotal observation is only based on one year, Sacramento Orcutt grass may occur over a greater area within pools in years with early rainfall, followed by a period of relatively low rainfall.

Monitoring photographs taken during frequency estimation (in May or June) are generally similar, even in years with significantly different frequencies of Sacramento Orcutt grass (see Figure 10).

Residual dry matter on the Reserve is relatively high and contributes to the accumulation of thatch in upland areas, but because Sacramento Orcutt grass only occurs in areas that are largely unaffected by thatch, this thatch is unlikely to directly impact Sacramento Orcutt grass.

4. ASSESSMENT OF THE MONITORING PROJECT

The monitoring project has been largely successful. Our methods resulted in basic baseline photomonitoring and frequency data that can easily be collected again in the future. Furthermore, simply by visiting the Reserve to collect frequency data, we are better able to identify the areas that are at highest risk from the spread of waxy mannagrass, and target those areas for waxy mannagrass eradication efforts. The monitoring is also relatively time-efficient. It is possible for the monitoring data to be collected in only one day if at least two field workers familiar with the methods get an early start, and avoid overexertion in the summer heat.

Monitoring photos taken during frequency estimation in 2016 were taken using an incorrect camera setting and were severely underexposed. The image quality of those photos is therefore very low, and they were not included in this report. Additionally, attempts to precisely align monitoring photos has been difficult. Precise alignment of monitoring photos is important because it allows direct comparison of specific areas of the ground in the photograph, and it may be very difficult to determine which areas of the ground are the same if two monitoring photos are even slightly misaligned. Differences in perspective resulting from photographs taken

with different cameras, from slightly different positions and in slightly different directions can be very distracting, and may require careful correction with photo editing software such as Adobe Photoshop before insightful comparisons become possible. Because correcting the differences in perspective requires photo editing expertise and a considerable time commitment, every effort should be made to standardize monitoring photos as much as possible in the field. A workflow for correcting images in Photoshop has been included with this report as Appendix A.

5. MANAGEMENT RECOMMENDATIONS

The management objective and management implication identified in the Monitoring Plan are repeated below, with a discussion of whether the management implication should be triggered based on the monitoring results.

5.1. MANAGEMENT OBJECTIVE #1

Maintain a frequency of 10 percent or less (1 m^2 quadrat) of waxy mannagrass (Glyceria declinata) *in Macroplot A and Macroplot B at Phoenix Field Ecological Reserve in every year. (This is a target/threshold type of management objective.)*

Management Implication from Monitoring Plan: If any portion of the 90 percent confidence interval for waxy mannagrass frequency (1 m^2) exceeds 10 percent in Macroplot A or Macroplot B, CDFW shall organize and initiate a waxy mannagrass hand pulling effort in the following year, before waxy mannagrass seeds have set.

Recommendation: The 90 percent confidence interval for waxy mannagrass exceeded ten percent in both 2015 and 2017, therefore the management implication should be triggered in 2018. Targeting the general locations where waxy mannagrass was identified in Macroplot B between 2014 and 2017, CDFW staff should use clean rubber boots to wade into pools and cut each waxy mannagrass plant above the root system to remove the upper portion of the plant, effectively killing it. This method was used by Dr. John Gerlach to effectively control waxy mannagrass on the Reserve in 2006 and subsequent years. CDFW staff will visit the Reserve in early April to check the phenology of waxy mannagrass, and initiate the control effort shortly thereafter, prior to seed dispersal.

5.2. OTHER RECOMMENDATIONS

If time allows, CDFW should more closely monitor the small pincushion navarretia population on the Reserve and visit the Reserve it at the appropriate time of year to monitor both the pincushion navarretia and Sacramento Orcutt grass populations at the same time, perhaps in late May to early June.

6. REFERENCES

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7. REVIEWERS

This document was prepared by Jeb McKay Bjerke, a senior environmental scientist (specialist) in the CDFW's Native Plant Program. The following individuals reviewed this document:

- Isabel Baer, CDFW Native Plant Program
- Cherilyn Burton, CDFW Native Plant Program
- Katie Gross, CDFW California Natural Diversity Database
- Helayna Pera, Reserve Manager, CDFW Region 2

Workflow for Aligning Monitoring Photos in Photoshop

This procedure provides a rough outline of a technique for aligning monitoring photos taken from the same location using Photoshop CS6.

1. Open Photoshop CS6
2. Under "**File**", select "**Scripts**" > "**Load Files into Stack**"
3. Select "**Browse**" and select all monitoring photos you would like to align
    a. Only check "**Attempt to Automatically Align Source Images**" if there are lots of buildings or other visually distinct aspects to the image, and even then, this may not work well. If the result does not look good, start over and uncheck this box.
4. Select "**Image**", and "**Canvas Size**" and increase the vertical and horizontal canvas size by a few inches.
5. Select the top layer in the layers window, select "**Filter**" and "**Lens Correction…**" For "**Edge**" select "**Edge Extension**". Select **OK**.
    a. **NOTE:** For photos taken with an SLR camera (Nikon d3100/d3300) a lens profile is available, and should be used. The Native Plant Program point and shoot Sony camera does not have a lens profile, so skip the lens correction step for photos taken on the Sony.
6. Use the **eye button** to make the top layer that was just corrected invisible, click on the next layer down to select it, and repeat Step 5 for all remaining monitoring photos.
7. Make the top layer visible again and click it to select it in the layers window. Click and hold the **eyedropper icon** in the tools window, and select the **ruler tool** in the submenu.
8. Click and hold on a specific feature on the horizon on the left side of the image, and drag a ruler line to a specific feature on the horizon on the right side of the image. Click the "Straighten Layer" button at the top of the window. Repeat steps 6 and 7 for the remaining layers so that the horizon is straightened in the same way for all monitoring photos.
9. Select a reference photo with lots of landmarks and identifiable features, and move it down to the bottom layer in the layers window. (This will be your Reference Photo)
10. Make all layers invisible in the layers window, except for the bottom two layers. Make the layer above the bottom layer about 50 percent transparent by selecting it in the layers window, and using the "**Opacity**" slider, so that you can see features from both images at the same time.
11. Use the "**Move Tool**" by pressing **V** on the keyboard, and dragging the top layer so that it matches the bottom layer as best as possible. Getting the horizon to match as much as possible is a good first step. Matching features in the foreground is more difficult. There are several techniques that can be used to help with this:
    a. Resizing the layer by holding the **shift key** (to maintain aspect ratio) and clicking and dragging a corner of the layer. -> be sure that "**Show Transform Controls**" is checked.
    b. "**Edit**" > "**Transform**" > "**Warp**" can be used to drag features to where they need to be. If a rock or tree needs to be moved to line up with the same rock or tree underneath, simply drag it and move it. You will likely need to go back to other areas of the photo to stretch everything into the right place. Just work on the photo until you are happy with

the result. (**Important note**: do not accept the changes and apply the transformation by pressing the "**enter**" key until you are completely happy with the result. Every time you accept a transformation, the act is destructive, and it permanently degrades the quality of the image)

c. "**Edit**" > "**Transform**" > "**Perspective**" can also be used if a side of the image is skewed in one way or the other. Grab the edge you want to move and move it. I have only used this successfully a few times, typically if most to the telephone poles are leaning in one direction, for instance.

d. Once you have begun transforming the layer, you cannot turn the layer on and off to check your work anymore, and you should therefore use the "**Opacity**" slider to see what is underneath and check your work.

12. When you have completed a layer, make it invisible with the eye button, and make the next layer above visible, select it, and continue with Steps 8, 9 and 10 until you have edited all of the layers.
13. Select "**File**" > "**Save As**" and save the photoshop file as the photopoint name in the appropriate location on the U Drive, for example: U:\Groups\HCPB\Shared Folders\NPP\Section 6\2014\Priority Plant Surveys\Project Files\Butte County Limnanthes Files\Stone Ridge\All renamed photos here for comparison**Aligned Photos\Aq**
(You might need to make a new Aligned photos folder in renamed photos folder)
14. Make all layers visible and select all layers. Select "**View**" > "**Show**" > "**Layer Edges**" to give you an idea of where all of the layers overlap. Select the Rectangular Marquee Tool from the toolbar window (a dashed rectangle).
15. Draw a selection within the area that all (or most) of the layers overlap. -> The layer edges will disappear once you start to draw your rectangle so be sure to get a good idea of where to draw before you start.
16. After the photoshop file has been saved, crop the image down by selecting "**Image**" > "**Crop**"
17. Make only the top layer visible and select it. If there are any areas along the edges where you can see the transparency underneath and want to fill it in with camouflage, select the area using the **magic wand tool** from the toolbar. After selecting the transparency, select "**Select**" > "**Modify**" > "**Expand**" and increase the selection by **5** pixels.
18. Next click "**Edit**" > "**Fill…**" and select "**Content Aware**" to fill the blank areas.
19. Next click "**File**" > "**Save as**", change the file type to JPEG and save the file in the appropriate photopoint folder on the U drive, with the filename corresponding with that photopoint and the date the photo was taken.
20. Repeat steps 15, 16 and 17 for the remaining layers.