Monarch Butterfly Overwintering Site Habitat Management Plan for Hueneme Masonic Cemetery

Oxnard, California

Monarch habitat at the site. Photo by Daniel E. Meade.

Prepared for Ventura County Resource Conservation District by

Charis van der Heide, Daniel E. Meade, and Stu Weiss

March 2021

ACKNOWLEDGEMENTS

Funding and coordination for this plan was provided by California Resource Conservation District and the Ventura County Resource Conservation District. Thank you to the Xerces Society for Invertebrate Conservation for guidance and database support. Thank you to Emma Pelton and Samantha Marcum for the template used for this report based upon Lighthouse Field Management Plan by Pelton et al. 2017 and U.S. Fish and Wildlife Service Coastal Program Monitoring Framework by Marcum et al. 2014.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 BACKGROUND AND GOALS

Every fall monarch butterflies migrate to the coast of California from across western North America to escape inland winter weather. The western population of monarch butterflies (*Danaus plexippus plexippus*) suffered steep declines within the last three years, leaving less than 1% of the estimated population in the 1980s returning to the coast of California to overwinter (The Xerces Society for Invertebrate Conservation 2020). The population reached a record low in 2020 with less than 2,000 individual butterflies in all of California during the Western Monarch Thanksgiving Count.

Monarch butterflies inhabit groves of trees along the coast of California starting October 1st through March 15th, a time period known as the monarch overwintering season. Monarch butterflies gather in clusters or aggregations in branches of these trees for first portion the season, called autumnal roosting, or for the duration of the season, called overwintering.

The Hueneme Masonic Cemetery site was first documented in 1985 by Nagano and Lane (1985) and according to Xerces Society records and has since been visited and butterflies counted by Walter Sakai in 2000 and various volunteers of the Western Monarch Thanksgiving Count over the more recent years. The property supported a modest number of monarch butterflies in blue gum eucalyptus trees (*Eucalyptus globulus*), and is known as Xerces Society #3146 and Blue Gum Grove site, Oxnard.

1.1 SITE MANAGEMENT GOALS

The purpose of this plan is to provide guidance for restoration and improvement of the Hueneme Masonic Cemetery site for the benefit of both transient and overwintering monarch butterflies. A planting plan is included to replace roosting trees that have fallen, been removed, or are planned for removal, and to increase abundance of nectar sources for butterflies and other pollinators. This will result in improvement of protective roosting habitat for autumnal and overwintering monarch butterflies, and will benefit pollinators in general.

The overall goal of this site management plan is to restore, maintain and improve the quality of monarch overwintering habitat at Hueneme Masonic Cemetery. This includes supporting the health of existing vegetation, adding vegetation that will improve microclimate conditions required for roosting, and increasing nectar sources for monarchs and other pollinators.

Specific goals of this site management plan are to:

1. Assess the current habitat and summarize how monarchs have used the site,
2. Provide management actions to improve the habitat conditions to better support the overwintering monarchs based on the habitat assessment and analysis,
3. Provide recommendations for implementation priorities and guidance for continued monitoring.

1.2 VENTURA COUNTY RESOURCE CONSERVATION DISTRICT

The Ventura County Resource Conservation District (VCRCD) has prioritized the enhancement of monarch butterfly overwintering habitat in Ventura and Santa Barbara Counties. The primary focus of this program is habitat restoration as described by detailed site management plans. These management plans provide expert long-term guidance for restoration and enhancement of monarch overwintering and nectar habitat. Proposed restoration sites are at documented overwintering habitat that contribute to the habitat network across Ventura and Santa Barbara Counties for monarch butterflies. The VCRCD will fund as much of the management plan recommendations as feasible. Perhaps more importantly, these management plans will act as guiding documents for funding future restoration and long-term enhancement and management.

2 SITE DESCRIPTION

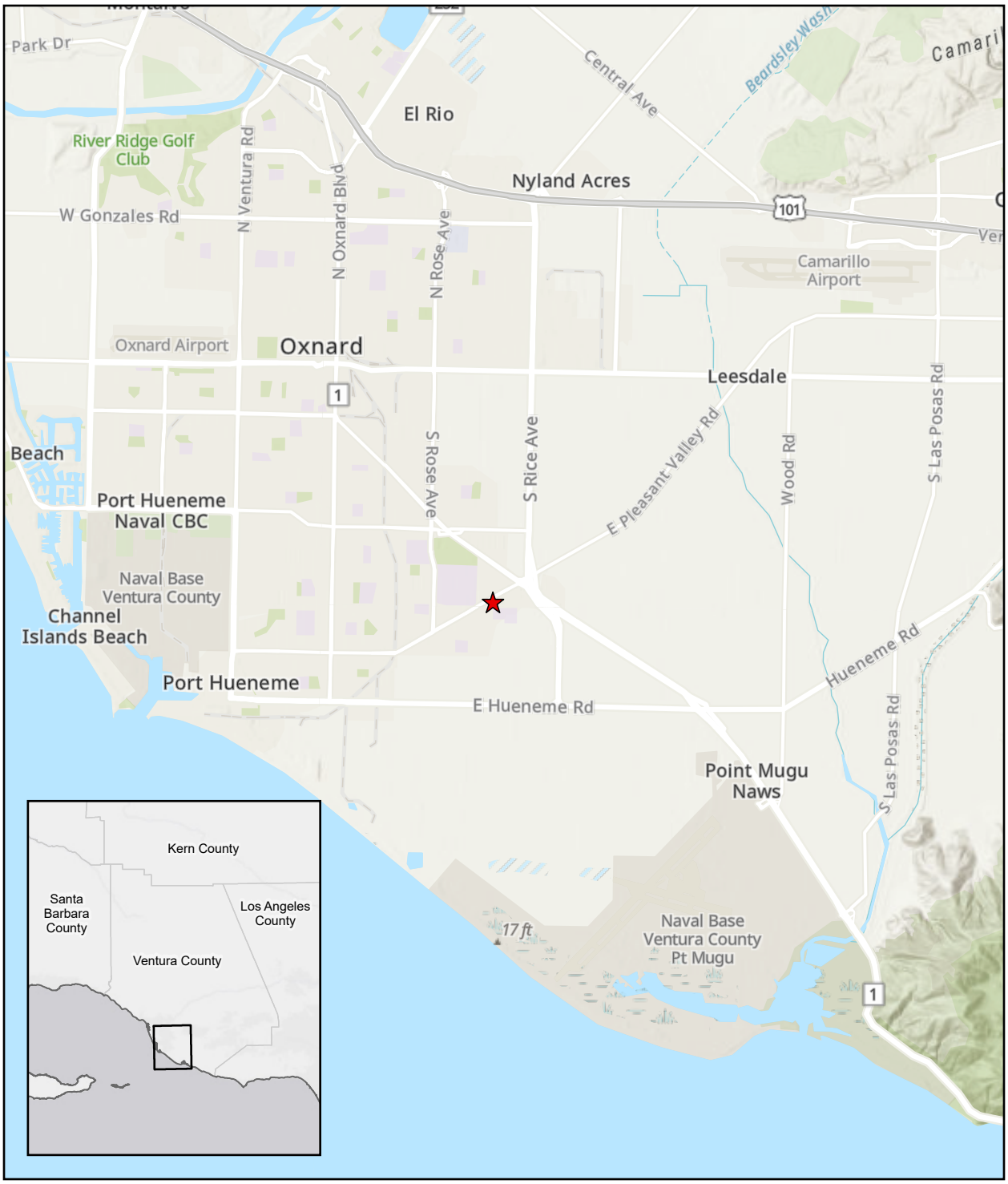
Hueneme Masonic Cemetery is located at 2242 East Pleasant Valley Road within the urban setting of the City of Oxnard, as shown in Figure 1. The entrance is on the southern boundary of the property along Etting Road. It is on the flat alluvial flood plain of the Santa Clara River approximately 2.7 miles (4.3 km) from the Pacific Ocean. Soils are Hueneme sandy loam, a poorly drained but loose soil with a highwater table classified as Farmland of statewide importance. The site is surrounded by residential neighborhoods, Oxnard College, Ocean View Junior High School and agricultural fields.

The site is dominated by blue gum eucalyptus with native and non-native herbaceous understory. Monarch habitat consists of a north-south windrow of eucalyptus trees on the western property boundary that extends east along Etting Road into the adjacent property to form an "L". Inside the right angle of the "L" is a location where monarchs are most likely to aggregate, as shown in Figure 2. Another location where enhancement could create an aggregation site is located at the north end of the windrow where two existing large trees establish the anchor for a circle of trees that would be formed by additional plantings. This circle of trees would improve protection from north winds for the entire site and is an attractive feature for monarch butterflies. Two monarch aggregation locations are possible at the Hueneme Masonic Cemetery.

Adjacent to the western property boundary of the site is a parcel approved for development of the CECD/Etting Road Affordable Apartments. The project is scheduled for 2021 and will remove 16 live eucalyptus trees and 3 dead trees from the north-south windrow and elsewhere on the property. Trees to be removed and to remain are shown on Figure 5. We include recommendations for planting trees to compensate for the planned removal of eucalyptus trees for the apartment project. This plan is developed as a voluntary effort to enhance and restore habitat for monarch butterflies and is not associated with mitigation for the development of the adjacent project.

Representative photographs of the site are included in Appendix A.

Figure 1. General Location



Legend

★ Project Location

N

0 1 2 Miles

Ventura County RCD
Oxnard Masonic Cemetery
Map Center: 119.14686°W 34.16398°N
Oxnard, Ventura County

USGS Quadrangle: Oxnard

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
October 05, 2020 07:55 PM by JBB

Figure 2. Project Site

Legend

Blue Gum Grove Focus Area

Blue Gum Grove

N

0 50 100 Feet

Ventura County RCD
Map Center: 119.14906°W 34.16253°N
Oxnard, Ventura County

Imagery Source: World Imagery 2018

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
October 08, 2020 01:18 PM by JBB

2.1 LEGAL STATUS AND PROTECTION OF MONARCHS AND HABITAT

2.1.1 Federal

The monarch butterfly was petitioned to be listed as a threatened species with an associated Section 4(d) rule under the federal Endangered Species Act (ESA) in 2014. The listing decision was published on December 15, 2020 stating that listing as endangered or threatened under the ESA was warranted but precluded (USFWS 2020). This means the monarch butterfly is officially a Candidate for listing, although the designation offers no federal protection. The United States Fish and Wildlife Service (USFWS) will review its status annually and listing could occur in the near future.

2.1.2 State

The monarch butterfly is designated as a Species of Greatest Conservation Need in the state of California, and is included in the State Wildlife Action Plan. The California Department of Fish and Wildlife (CDFW) recognizes the species as a Special Status Invertebrate. The California Coastal Commission (CCC) designates all monarch overwintering sites within the Coastal Zone (approximately 1,000 yards inland from the mean high tide line of the sea) to be Environmentally Sensitive Habitat Areas (ESHA). The Hueneme Masonic Cemetery is located outside of the coastal zone.

2.2 PERMITTING

It is not expected that permits from local, state, or federal agencies will be necessary for planting trees, shrubs, or other flowering plant species at the site.

3 HEMISPHERICAL PHOTOGRAPHY

The quality of an overwintering site depends on the very local microclimates driven by the forest canopy structure. The trees and understory intercept solar radiation (insolation) and block the wind. Monarchs generally are seeking wind sheltered spots that have a mix of insolation conditions– full sun, dappled sun, and full shade. When winds are too great (>~2 m/s [5 mph] at ground level, monarchs will leave the cluster sites (if they can fly) and find other sites within the grove that provide better wind shelter. If wind exposure is too severe, they may abandon the site entirely. If conditions are too sunny or too shady, they will adjust their local distributions, depending on the time of year and their need for cool or warmer temperatures. In a very real sense, the individual decisions of butterflies whether conditions are suitable or unsuitable lead to "crowd sourcing the microclimate."

Hemispherical, or "fisheye" photography provides a repeatable quantitative method for characterizing forest canopies and microclimate. Images are obtained using specialized equipment, and analyzed using image processing software that differentiates sky from obstructions, and calculates the geometry of openings and solar paths to estimate sky exposure and insolation. The method was first applied to monarch overwintering grounds in 1990 (Weiss et al. 1991), and since has been applied to numerous monarch sites in California (and Mexico).

3.1 APPLICATION AT HUENEME

In November 2020, a series of 22 hemispherical photographs were taken with a Nikkor 8 mm "fisheye" lens. The camera, mounted on self-leveling gimbals so that it always points straight up, was oriented north with a compass. Photos were spaced ~ 10 m apart, and one line was just east of the western row of trees, and another line was just north of the southern line of trees. A GPS point was taken at each photopoint using Avenza maps, with an aerial photo backdrop to assure locational accuracy. Photographs were analyzed using the program Hemiview 2.1. Hemiview places two grids over the photograph (Figure 3a). One grid is a "skygrid" in which the hemisphere is divided into 45º azimuth wedges, and 5º zenith angle increments. The second grid is the insolation figure that shows the sun path during the overwintering period. Photographs are classified into sky and obstruction using a grey-scale threshold.

Several site factors were extracted from the photographs:

1. ISFU – Indirect Site Factor Uncorrected, the fraction of visible sky in all directions. The vast majority of monarch cluster sites have ISFU values between 0.15 and 0.30.

2. October/March, November/February, and December/January potential direct insolation – calculated from fraction of unobstructed monthly sunpaths assuming clear skies with a simple insolation model. Because sunpaths are symmetrical around the winter solstice, December and January have essentially the same values, as do November and February, and October and March.

3. Wind Site Factors (WSF) – the fraction of sky visible in eight compass directions (octants) centered on cardinal directions, a measure of relative wind exposure. WSF > 0.30 (30% of the octant open) are definitely too wind exposed, lower values (0-0.2) are ideal especially for protection from storm winds. Strong winds are possible from all directions, but most likely from certain directions. Storm winds from the SE are generally the strongest. Dry/warm northerly and easterly Santa Ana winds can be particularly stressful for monarchs in October-November.

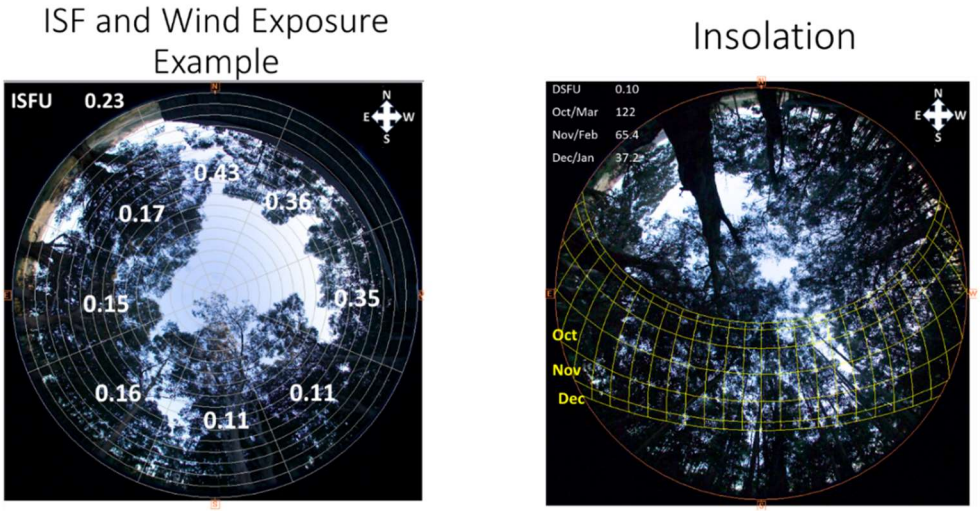


Figure 3a. Site Factor Explanation. Factors are exhibited in example photographs below (Figure 3b).

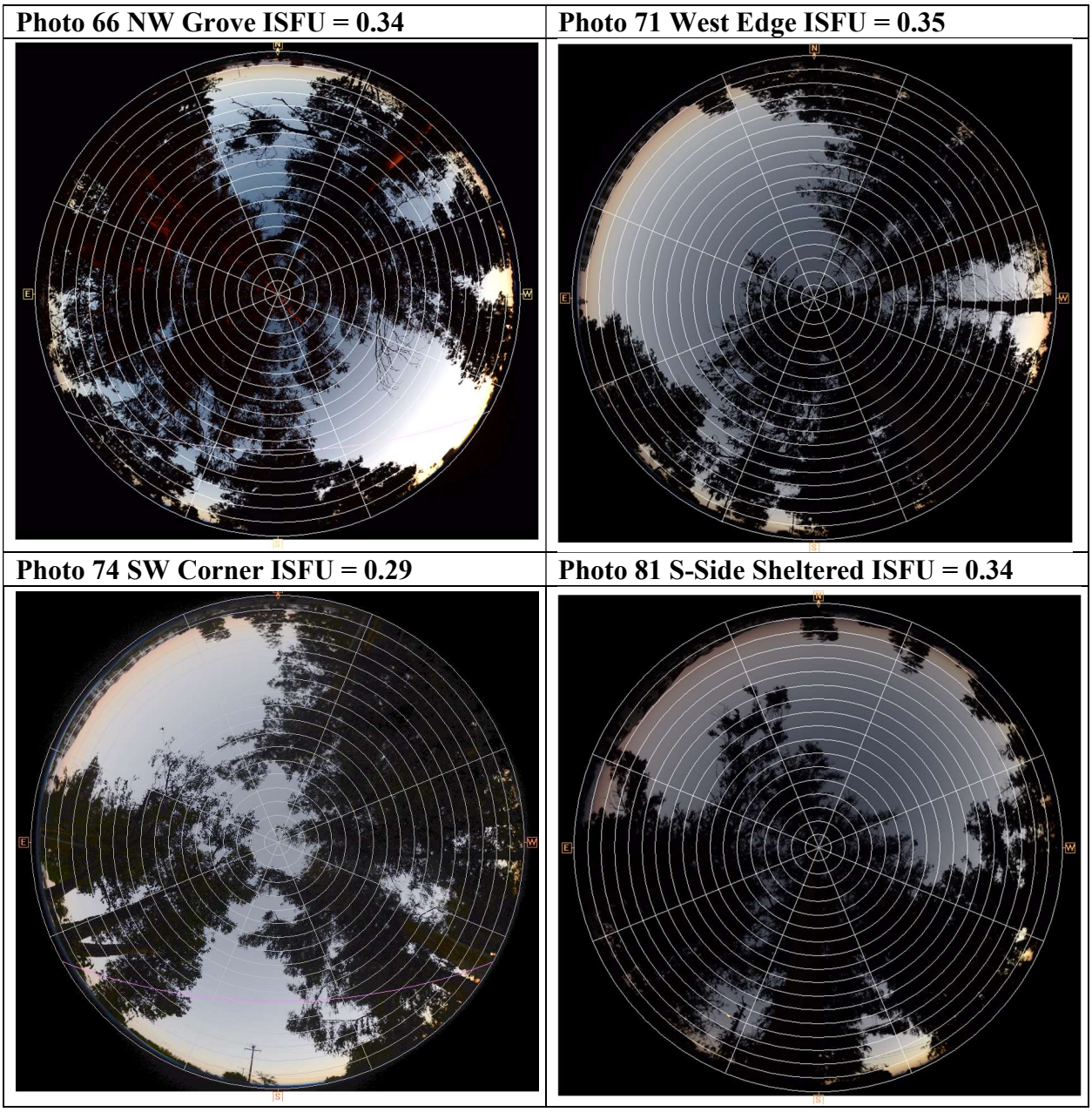


Figure 3b. Example Photographs. Selected photographs show the range of conditions.

1. Photo 66 is in the NW corner, and is a small grove of trees that has high potential as a cluster site if the wind shelter is increased from the SW and N.
2. Photo 71 is along the western row of trees, with a significant gap in which a dead tree trunk is observed. The E and NE octants are open, and the southern row of trees extends from the S to SE. The apartment buildings occupy the lowest 5º of the image to the NE.
3. Photo 74 is the SW corner. Note the large gap to the S, and the open sky to the NE. NW, W and SW are all well covered. The southern edge trees are blocking the E and SE.
4. Photo 81 shows a site along the south edge, well-sheltered from SW, S, SE, and E while open to the NE, N and NW.

The ISFU map of visible sky (Figure 4a) shows a range from 0.28 to 0.61. The high values are driven by the locations along single rows of trees. But the relatively low values (< 0.3) at the NW and SW corners indicate promising opportunities for increasing canopy cover.

Figure 4a. ISFU Map of Visible Sky. The orange circles are those sites < 0.30.

The insolation map (Figure 4b) shows monthly insolation as graduated circles for each month, laid on top of each other. Some representative photos are shown for different situations. Because the southern trees block most of the sunpaths, insolation is low at most sites except at substantial gaps along the south edge, such as in the SW corner. The higher insolation sites along the west edge are exposed from the SE, hence receive high morning insolation and afternoon shade.

Because the photographs are taken from ground level, it may not fully represent conditions higher in the canopy where monarchs typically cluster. And the dappled light that comes through the upper canopy may provide enough light for the monarchs to thermoregulate on the wind-sheltered side of the trees.

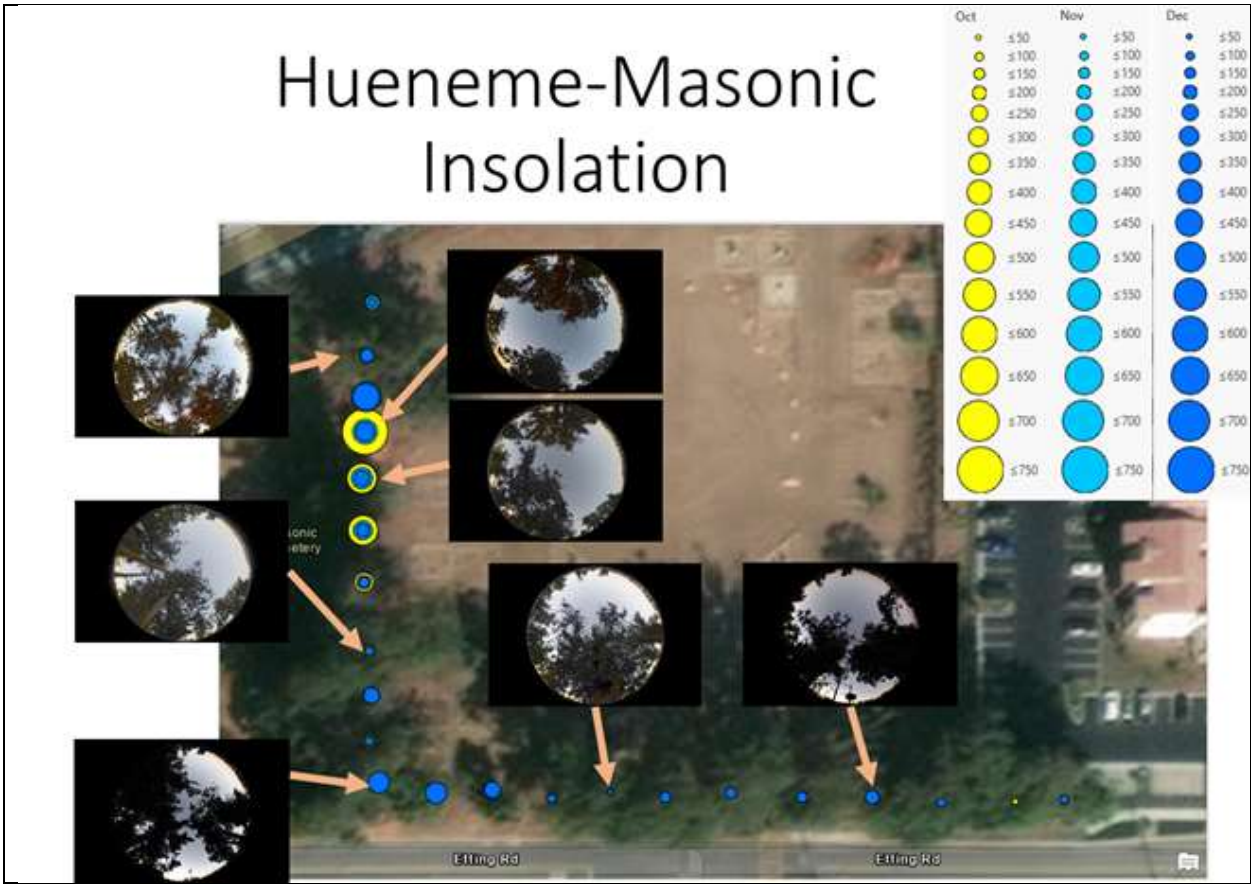


Figure 4b. Monthly Insolation. Graduated circles are place on top of each other in the order October (bottom), November, December (top). When only the blue December circle is visible it means that October and November have less insolation than December (all but four sites).

The wind "roses" map below (Figure 4c) shows relative wind exposure from 8 directions, with example photographs. Along the south edge, NE, N, and NW are open, while the other directions are closed except where a gap exists to the S. Along the west edge, NE, E, and SE are generally open. The main exceptions are at the second and third sites from the northern end of the western row, where the group of trees extending east from the main row provides some shelter.

The generally good westerly shelter along the west edge will be severely affected by cutting the trees that extend into the neighboring property to the west. The replacement of this wind shelter by interplanting among the remaining trees and the establishment of a second dense row is an essential component of the site plan.

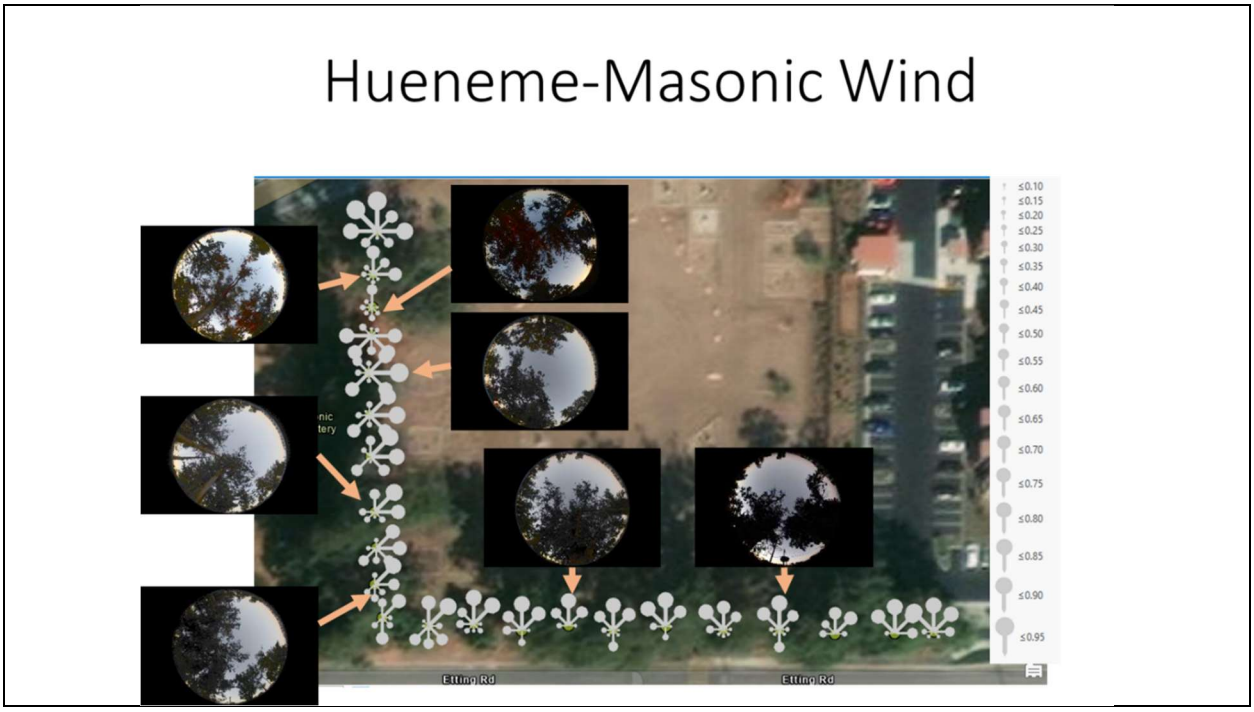


Figure 4c. Wind "Roses". A wind rose is a circular display of how wind speed and direction are distributed at a given location for a certain time period. The size of the "petal" equates to the speed of wind from that direction. The larger the "petal" means there is more wind coming from that direction. Smaller "petals" mean there is more wind protection in that direction.

Many trees will be removed from the western row, shown in Figure 5. The new buildings will replace some wind shelter, which is simulated in Figure 4d. The buildings are 85' from the property edge, and are three stories (30') tall. The effective elevation angle at the closest point due W is arctangent (30/85) = 19.4^{o}. In other directions, the distance increases by 1/cos (angular difference); at 45^{o} off (SW or NW) the elevation angle becomes 13.7^{o}, and at 67.5^{o} it becomes 7.4^{o}. These values were used to draw in the view of the new buildings in the photograph below.

At this site, the buildings reduce wind exposure from 0.77 to 0.65 (due W), from 0.52 to 0.45 (SW) and from 0.34 to 0.26 (NW). For a completely clear view, the buildings reduce the completely open sky (1.0) to 0.66 (due W) and 0.74 (SW and NW).

Therefore, the new buildings will replace some of the wind shelter, but are not sufficient for full replacement. Importantly, these reductions in wind exposure will be reduced with height on the trees, so that there will be no effect at 30' (10 m) height.

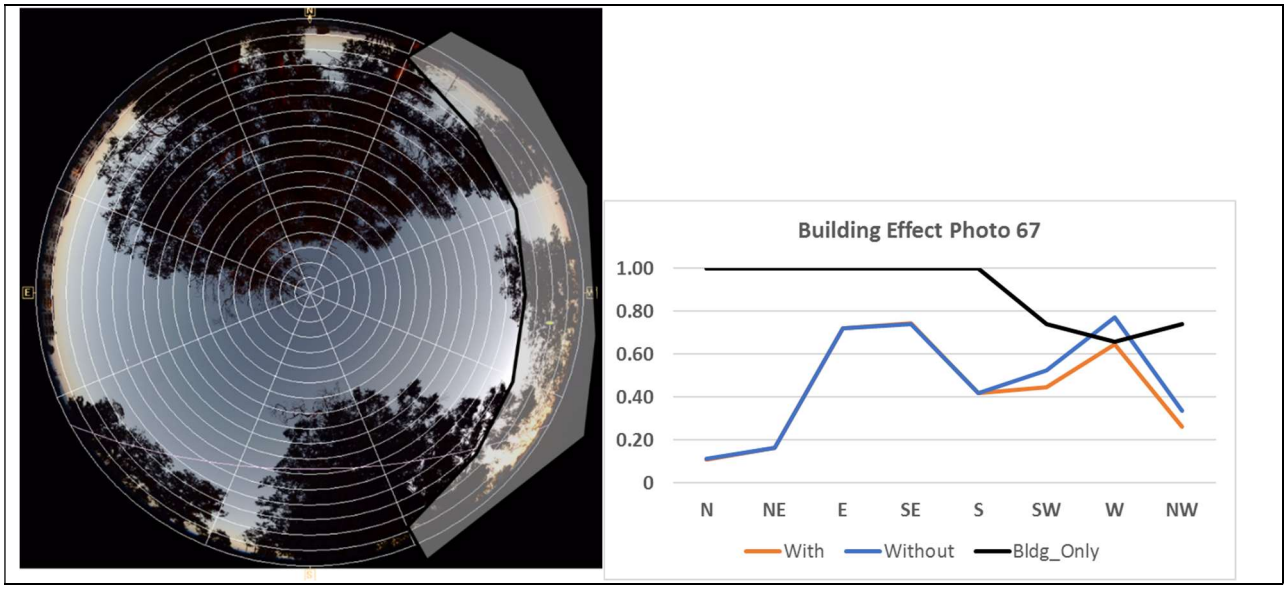


Figure 4d. Effects of the new buildings along the west edge. New buildings are shown with grey shading.

3.2 Conclusions from Hemispherical Photography

The analysis shows the following site characteristics and recommendations:

1. The best current potential for creating monarch habitat with good wind shelter and high insolation are near the NW corner row (Photo 67), where a clump of trees extends farther east, and the wind gaps can be sealed with rapidly growing trees like various eucalyptus.
2. The second area with high current potential is the SW corner, where sealing up the gaps to the NE and S is feasible. Planting additional tall-growing trees east and north of the corner will eventually create a wind-protected gap with dappled light. Retention of as many trees on the western edge as possible near this corner can provide wind shelter from the W and NW.
3. The single rows of trees are currently dense enough to provide good wind shelter on the leeward sides, but have nearly full exposure on the windward sides. A second row of trees with similar heights and density will eventually provide a "sandwich" with a zone of wind shelter between the rows. This observation holds for both the western southern edges.
4. On the western edge, the second row should be as far from the existing row as feasible, given the locations of the graves. On the southern edge, the second row should be planted ~ 30 ft (10 m) from the existing row.

5. The loss of a large fraction of the western row will require many trees to be planted as replacements. Interplanting in gaps in the existing row, and planting a new second row are critical. Trees should be dense enough along the row to provide full canopy coverage at heights of 15-50 ft (5-15 m). The additional row should be planted as far east of the existing trees as feasible given the constraints of the grave sites.
6. The new buildings will not replace the lost wind shelter on the western edge, especially higher in the canopy where monarchs cluster.
7. The lower gaps can be filled with species such as live oaks and toyons. The high light in these gaps will encourage growth.
8. A second row along the south boundary will create opportunities for cluster sites.
9. Trees well-away from the main rows (100+ ft, or 30+ m)) can provide important wind shelter by breaking the wind and causing turbulence. Planting scattered trees (including valley oaks) in the large open areas where feasible can serve this function.
10. Insolation is less of an issue, with sunny sides of trees allowing for full sun, and dappled light filtering through the canopies providing some light on the shady sides. Insolation between parallel rows of trees will have enough variability - full sun, dappled, shade – for monarchs to find cluster sites.

4 OVERWINTERING MONARCHS AT HUENEME MASONIC CEMETERY SITE

The first documented survey of the Hueneme Masonic Cemetery site was in February 1985 when 15 monarchs were observed patrolling and seeking shelter (Nagano and Lane 1985). The butterflies he observed were not clustering and he speculated whether the site offered overwintering habitat earlier in the season. At this time the site consisted of a tight row of eucalyptus trees forming a windbreak. In 2015, this site was suspected of being a potential autumnal bivouac site (per David Marriott, 9/30/2015). An autumnal bivouac site provides shelter for transient monarchs in the mild fall months of October, November and mid-December. The monarchs abandon the site by mid-December and January during the heavier winter storms in favor of sites with more protective habitat (Sakai et al. 1989, Nagano and Sakai 1990).

Western Monarch Thanksgiving Count (WMTC) and New Year's Count (NYC) surveys were conducted in 2015 through 2020 overwintering seasons (The Xerces Society for Invertebrate Conservation 2021). These data are presented in Table 1 below. The monarchs were observed roosting on the eastern side of the windrow of trees, as shown on Figure 5. We are not aware of any other observations from the site. Appendix B includes the site assessments and count records from the Xerces Society Western Monarch Overwintering Sites Database, as of October 2020.

Table 1 Monarch Count Data for Hueneme Masonic Cemetery site

Date	Monarch Count Record
February 10, 1985	15
November 29, 2015	0
November 28, 2017	0
November 29, 2017	0
December 3, 2017	2
January 7, 2018	0
November 29, 2018	6 (3 flyers, 3 sunners)
November 30, 2019	0
November 20, 2020	2 flyers
Data source: The Xerces Society for Invertebrate Conservation 2021, Nagano and Lane 1985	

5 CULTURAL RESOURCES

The Hueneme Masonic Cemetery is a historical cemetery established in 1898 by leaders of the Hueneme/Oxnard community. Prominent family members in the early farming, banking, and business community including several civil war veterans are buried there. The site was neglected for about 50 years until a new owner, Roberto Garcia, bought the cemetery in 2014 and began clean -up and restoration. Mr. Garcia, who owns and operates Garcia Mortuary of Oxnard set a goal of bringing the cemetery back from neglect and restoring it as a protected historical site. Overgrown vegetation has been removed, headstones reset, and plots restored. Currently, enhancing the site for community use is one of his goals with the establishment of a pollinator garden and improved monarch butterfly habitat. This restoration plan advances that goal.

Hueneme is derived from the Chumash work meaning “half-way” or “resting place”. It is thought the half-way point is reference to a departure location for the Channel Islands where trade and travel occurred among Chumash groups as far away as San Luis Obispo. Pt. Mugu is 19 miles from Santa Cruz island across the Santa Barbara channel where Chumash people manufactured shell beads. Chumash use of the tomol, or ocean-going planked canoe, allowed extensive trade and fishing activities along the California coast. Records of occupancy by Chumash first peoples place them at Santa Clara River to the north and the large village of Muwu at Point Mugu.

Restoration work will include minimal soil disturbance to install plants, broadcast seeding, and hand weeding. Consultation with the cemetery owner and tribal representative is recommended to discuss the restoration plan prior to soil disturbance.

6 HUENEME MASONIC CEMETERY SITE HABITAT MANAGEMENT PLAN ACTIONS

The overall goal of this site management plan is to restore, maintain and improve the quality of monarch overwintering habitat at the Hueneme Masonic Cemetery site. The purpose of these goals is to sustain monarch butterfly use of the Hueneme Masonic Cemetery aggregation site for the short-term and to increase the monarch population in the long-term. The management approach is to improve monarch butterfly habitat by strategic tree and shrub planting and grove management and increase native nectar resource availability. Specific actions of this plan are to 1) protect existing trees and increase the number of trees and shrubs for roosting and wind barriers and 2) plant fall and winter-flowering nectar plants to sustain monarchs' energy through the overwintering season.

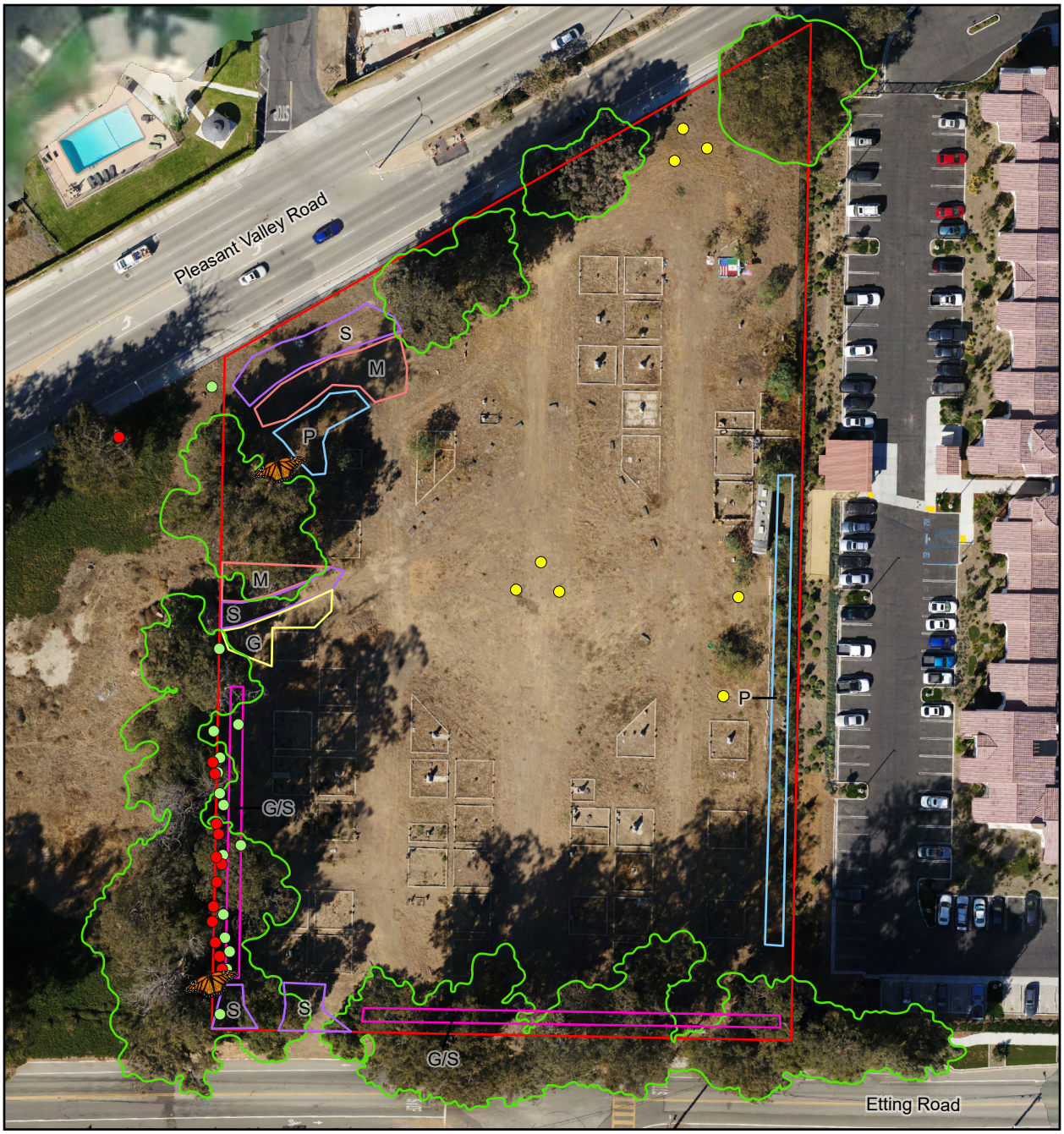
6.1 TREE AND SHRUBS FOR WIND BARRIERS

Tall trees for roosting and wind protection are vital to the continued quality of monarch overwintering sites. The planting plan identifies two locations for aggregation sites and actions required to 1) maintain and enhance the aggregation site in the southern inside corner "L" of the windrow and 2) create an additional aggregation site at the north end of the windrow, shown in Figure 5. Additionally, saplings and resprouting eucalyptus stumps will be allowed to recover (see Section 5.1.3). This will help close wind gaps and create several layers of wind barriers. Figure 5 shows the location of tree planting areas. Table 2 lists the acreages proposed for tree protection and plantings.

Table 2 Tree Protection and Enhancement Areas

Tree Protection and Enhancement Areas	**Area (ac)**
Eucalyptus globulus	0.02
Eucalyptus sideroxylon and *E. globulus*	0.06
Eucalyptus sideroxylon	0.07
Monterey cypress (*Hesperocyparis macrocarpa*)	0.05
Trees to be preserved as feasible	1.06
Pollinator/Nectar Habitat	0.07
Total	**1.32**

Figure 5. Planting/Restoration Plan and Tree Map



Legend

- Oxnard Masonic Cemetery
- G — Eucalyptus globulus (0.02 acre)
- S — Eucalyptus sideroxylon (0.07 acre)
- M — Monterey cypress (0.05 acre)
- P — Pollinator/Nectar Habitat (0.07 acre)
- Trees to preserve, plant toyons
- G/S — Eucalyptus globulus and Eucalyptus sideroxylon (0.05 acre)
- Roost Location
- Tree to Remain
- Tree to be Removed
- Valley Oak

N

0 50 100 Feet

Ventura County RCD
Hueneme Masonic Cemetery
Map Center: 119.14882°W 34.16251°N
Oxnard, Ventura County

Imagery Source: World Imagery, 2018
Althouse and Meade, Inc., 10/13/2020

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
March 02, 2021 04:42 PM by SAF

6.1.1 In Defense of Eucalyptus Trees

Eucalyptus trees are important to monarch overwintering sites because they grow taller than native trees and provide suitable branching and canopy structure to sustain overwintering monarch aggregations (Meade et al 2018; Meade et al 2019; Griffiths and Villablanca 2015; Longcore, Rich, and Weiss 2020). This management plan supports and encourages the presence and growth of eucalyptus trees for the benefit of overwintering monarchs. Blue gum eucalyptus were introduced to California in the late 1800's from Tasmania. The trees have naturalized throughout the state. The intensity of the invasiveness of this species is under much debate. Blue gums can exhibit invasiveness and negative environmental impacts in some areas but these are poorly represented in scientific journals. Thus, in 2015, California Invasive Plant Council (Cal-IPC) conducted a review of the literature and concluded that the data warranted the blue gum be reassigned as "limited" invasive status from the previous "moderate" status (Wolf and DiTomaso 2016, Cal-IPC 2020). In this case, limited status represents the widespread distribution of blue gums throughout the state and identifies that significant ecological impacts are limited to specific regions and there is minimal or no impact in other areas (Cal-IPC 2020).

Contrary to popular opinion, there is no scientific evidence that blue gum eucalyptus trees produce an allelopathic effect to inhibit the growth of understory vegetation (Nelson et al. 2016). Nelson's study conducted at California Polytechnic State University, showed that germination and early seedling growth of five California native plants were not inhibited by blue gum eucalyptus chemical extracts. It is likely that any noticeable decrease of understory vegetation under eucalyptus trees is caused by the accumulation of fallen leaves, bark, and branches. Many native plants are regularly observed growing and thriving under eucalyptus tree canopies at monarch overwintering sites throughout the state.

Additionally, eucalyptus trees support a diversity of fauna. A 2015 study of eucalyptus woodlands in central California found that non-native eucalyptus and native oak groves had very similar bird community composition, species richness, and abundance (Fork et al., 2015). The study also reported similar abundance and richness of nonnatives in eucalyptus versus oak woodlands and thus no evidence of ''invasional meltdown." Invasional meltdown was initially described in 1999 as that case where invasive species foster the spread and establishment of other non-native and/or invasive species (Simberloff and Von Holle 1999).

6.1.2 Protect Existing Eucalyptus Trees

To the extend feasible the existing eucalyptus trees at Hueneme Masonic Cemetery site should be protected from root zone damage and not trimmed. Removal of up to 19 trees on the neighboring property to the west is anticipated in 2021. Trimming of branches on remaining trees should be minimized to preserve as much foliage on the remaining trees as possible. Trimmings should also be undertaken by a certified arborist with caution to preserve the remaining integrity of the monarch butterfly overwintering habitat.

6.1.3 Enhance Tree and Shrub Cover

Monarchs aggregate in the protected locations in groves with space for their gliding flight pattern. Aggregation sites typically have dappled light that penetrates the grove. The aim of the tree planting plan is to recreate and foster this arrangement of trees with an open interior in two locations on the project site.

In the southern corner location, two lines of eucalyptus trees are recommended in two offset rows located east and north of the existing windrows to enhance the existing windrows of eucalyptus (Figure 5). These second rows of trees next to the existing rows will add a layer of redundancy in the protection for the monarch habitat. We recommend installing a north-south row of trees east of the existing row at the western boundary and an east-west row of trees north of the existing row along the southern boundary of the property. We also recommend planting eucalyptus trees in two openings along the southern windrow in order to fill in these openings and protect the interior aggregation site.

These windrows shall be composed of blue gum (*Eucalyptus globulus*) and/or Karri (*Eucalyptus diversicolor*) spaced 10 feet apart. Both these species grow quickly and can obtain significant height that can relatively quickly support protection of the aggregation area. *E. diversicolor* does not have fertile seeds in California, and can be used if spread of trees is a concern, although maintenance activities proposed for this location should manage unwanted recruitment. A 10-foot spacing allows development of a windbreak within a few years and is common in many California groves.

Karri is a eucalyptus tree with stronger branch strength than the blue gum and does not produce fertile seed in southern California. This prevents the species from escaping or naturalizing beyond the planting locations (Urban Forest Ecosystem Institute 2021). However, karri may be less readily available compared to blue gum in nursery stock.

For the creation of an aggregation site at the north end of the windrow, strategic planting of wind barrier trees is needed to create a circle that incorporates two large existing trees. These two large trees form the anchor points for a circular aggregation site. We recommend planting a collection of Monterey cypress (*Hesperocyparis macrocarpa*), blue gum (*E. globulus*) and red ironbark (*E. sideroxylon*) in the northern area as delineated on the planting plan, Figure 5. Cypress and red ironbark trees west and north of the tree circle will reinforce a wind barrier for the monarch roosting location.

Toyon (*Heteromeles arbutifolia*) are recommended for planting between trees in the eucalyptus windrow in both locations as understory to aid in wind protection. The toyons will add additional cover and fill in wind gaps between trunks from ground level to the lower branches of trees. Toyons also provide winter fruit for other wildlife and are visually attractive.

Precise planting locations for each species can be flagged in the field by the project manager and monarch butterfly biologist as per the planting plant designations (Figure 5) and the planting palette (Table 3).

In addition, we recommend planting eight valley oaks (*Quercus lobata*) in a few areas to add to the diversity of native trees in the project area and reduce wind speed. Placement of valley oaks are marked on the planting/restoration plan in Figure 5. We are recommending planting three valleys oaks in the northwest corner to close a gap in the tree canopy along the northern boundary, two trees along the western boundary, and three trees in the center of the property. We recommend planting the valley oaks 20 feet apart. These valley oaks will add habitat for wildlife and shade for visitors to the Cemetery.

6.1.4 Encourage Eucalyptus Germination and Saplings

We recommend allowing eucalyptus trees to multiply naturally within the existing canopy and protection of volunteer saplings. Natural recruitment of saplings of eucalyptus and other trees in the monarch grove should be managed to maintain long term sustainability of the grove. Trees cut down at the base can regenerate by resprouting if the stump is left in place. Resprouts can take advantage of the trees existing root system to produce rapid growth. In the case that eucalyptus are removed at the base, we recommend allowing stumps to re-sprout.

Shoots of stump re-growth should be untrimmed for the first 3 years. After 3 years, the strongest stem can be selected and others pruned back to promote rapid growth of the one selected. The selected stem will likely be the tallest with the thickest trunk. Stems derived from a root crown resprout will have a stronger base connection than a top-stump resprout.

6.1.5 Tree Sourcing

When selecting native trees for planting, care should be taken to source trees from local stock and ensure that all the trees are healthy and free of pests or disease.

6.1.6 Hazard Tree and Tree Removal Guidance

When assessing the existing, standing eucalyptus trees at the site, take the roosting of monarchs and their wind protection barriers into consideration. Dead branches may be removed. Lower branches where monarchs have been observed to roost should be protected to the extent feasible. Public safety is important, and safety trimming should be carefully assessed regarding hazardous limbs overhanging areas frequented by people, like roads or paths, and trimmed as needed to maintain reasonable public safety.

6.2 NECTAR SOURCES AND POLLINATORS

Overwintering monarch butterflies require nectar sources to sustain themselves for the duration of the overwintering season (October 1st through March 15th). Fall, winter, and early spring flowering plants in close proximity to roosting monarchs provide an important source of nutrients to sustain the butterflies.

6.2.1 Increase Appropriate Nectar Sources and Pollinator Habitat

Nectar plants are recommended in two areas with a total of 0.07 acres of the Hueneme Masonic Cemetery site, shown in Figure 5. One area is in the northeast corner of the property in a sunny area south of the proposed tree planting areas. The other nectar location is a line along the eastern property boundary. The eastern boundary has been planted with an assortment of native nectar plants and additional plantings will enhance this area. The species are included in the Planting Palette listed in Table 3 below. These species are native to the region and selected based on their nectar availability for monarch butterflies and other pollinators (CNPS 2021). These species have flowering seasons between fall, winter and spring, when overwintering monarchs are present. We recommend all plantings be one gallon size, as feasible and available. The majority of these plants are being grown and provided by a generous donor to the project.

We include an additional list of popular garden plants in Table 4 that were chosen based on the quality of nectar they provide for monarchs and will add to the existing pollinator garden on site (The Xerces Society for Invertebrate Conservation 2019). These garden plants are recommended for use throughout the project site to adorn gravesites and other areas as desired by the cemetery owners and volunteers. These species have flowering seasons between fall, winter and spring, when the overwintering monarchs are present. Seeds may be spread and container plants installed in desired areas.

Table 3 Planting Palette. Trees, shrubs and nectar plants.

Wind Barrier Plants (1.06 acres)				
Common Name	***Scientific Name***	***Plant Type***	***Flowering Season***	***Quantity***
Blue Gum	*Eucalyptus globulus*	Tree	Fall, Winter, Spring	28
Red ironbark	*Eucalyptus sideroxylon*	Tree	Fall, Winter, Spring	24
Monterey cypress	*Hesperocyparis macrocarpa*	Tree	Spring, Summer	20
Toyon	*Heteromeles arbutifolia*	Shrub	Summer	98
Valley oak	*Quercus lobata*	Tree	Winter, Spring	8
Native Pollinator/Nectar Plants (0.1 acres)				
Common Name	***Scientific Name***	***Plant Type***	***Flowering Season***	***Quantity***
Yarrow	*Achillea millefolium*	Perennial herb	Spring, Summer	10
Deerweed	*Acmispon glaber*	Perennial herb	Winter, Spring, Summer	10
Ceanothus	*Ceanothus spp.*	Shrub	Winter, Spring	10
Western Redbud	*Cercis orbiculata (should this be Cercis occidentalis?)*	Shrub	Winter, Spring	5
Coast Sunflower	*Encelia californica, E. farinosa*	Shrub	Winter, Spring	20
California Fuchsias	*Epilobium canum*	Perennial herb	Summer, Fall	10

Common Name	***Scientific Name***	***Plant Type***	***Flowering Season***	***Quantity***
California Buckwheat	*Eriogonum fasciculatum*	Shrub	Spring, Summer, Fall	20
Flannel bush	*Fremontodendron "California Glory"*	Shrub	Spring, Summer	10
Great Valley Gumweed	*Grindelia camporum*	Perennial herb	Spring, Summer, Fall	10
Holly Leaf Cherry	*Prunus ilicifolia*	Shrub, Tree	Winter, Spring	10
White Sage	*Salvia apiana*	Shrub	Winter, Spring, Summer	10
Clevland sage	*Salvia clevelandii, S. brandegeei*	Shrub	Spring, Summer	5
Black Sage	*Salvia mellifera*	Shrub	Winter, Spring, Summer	10
Hummingbird Sage	*Salvia spathacea*	Perennial herb	Winter, Spring, Summer	16
Elderberry	*Sambucus nigra*	Shrub, Tree	Spring, Summer	10
Goldenrod	*Solidago velutina*	Perennial herb	Summer, Fall	8
Total				**344**
Sources: The Xerces Society for Invertebrate Conservation 2019, CNPS 2021				

Table 4 Additional Recommendations for Garden Nectar Plants

Garden Nectar Plants			
Common Name	***Scientific Name***	***Plant Type***	***Flowering Season***
Anise hyssop	*Agastache foeniculum*	Perennial herb	Summer, Fall
Borage	*Borago spp.*	Annual herb	Year round
Calendula	*Calendula officinalis*	Perennial herb	Year round
Lanceleaf coreopsis	*Coreopsis lanceolata*	Perennial herb	Spring, Summer, Fall
Coneflower	*Echinacea spp.*	Perennial herb	Summer, Fall
Joe Pye weed	*Eutrochium maculatum*	Perennial herb	Summer, Fall
Lavender	*Lavendula spp.*	Shrub	Year round
Blazing star	*Liatris spicata*	Perennial herb	Spring, Summer
Bee balm or wild bergamot	*Monarda fistulosa*	Perennial herb	Summer, Fall
Foothill penstemon	*Penstemon heterophyllus*	Perennial herb	Spring, Summer
Showy goldenrod	*Solidago speciosa*	Perennial herb	Summer, Fall
Aster	*Symphyotrichum spp.*		Summer, Fall
Zinnia	*Zinnia spp.*	Annual herb	Year round
Sources: The Xerces Society for Invertebrate Conservation 2019, CNPS 2021			

6.3 MILKWEED GUIDANCE

The presence of milkweed is discouraged in the immediate vicinity of the monarch overwintering sites because it can cause the monarchs to break their reproductive diapause during overwintering and reduce their life span.

Tropical milkweed (*Asclepias curassavica*) should not be planted because it can harbor a monarch butterfly parasite, *Ophroyocustis elektroscirrha* (OE) that causes deformities and death of monarchs. We recommend that planting focus on pollinator habitat and nectar sources for monarchs.

Native milkweed plants are not recommended for this restoration effort. Milkweed plantings are recommended at least 1 mile from overwintering sites. Species of milkweed native to the region include: narrow leaf milkweed (*Asclepias fascicularis*), Kotolo milkweed (*Asclepias eriocarpa*), and California milkweed (*Asclepias californica*).

6.4 PLANTING PRIORITY

These recommended habitat management actions may be implemented at the site all at once or in phases as resources allow. If a phased approach is preferred, we recommended the following priority be given to the enhancement actions:

1. Protect existing eucalyptus trees and encourage the growth of saplings,
2. Restore tree canopy in the grove by planting Monterey cypress and eucalyptus trees,
3. Increase wind protection in the grove by planting toyon, and
4. Increase appropriate nectar sources.

7 INSTALLATION AND MONITORING

The implementation of this habitat management plan at the Hueneme Masonic Cemetery site will be managed and maintained by VCRCD with the assistance of the Cemetery staff and community volunteers.

7.1 INSTALLATION

The plants will be installed using the best horticultural practices to ensure health and survival of the plantings and continued use by overwintering monarch butterflies. Appendix C includes detailed instructions for the best management practices for tree planting and aftercare.

7.2 IRRIGATION

The VCRCD and the Cemetery will provide appropriate irrigation to supplement natural rainfall for the plantings for least 3 year or until plants are self-sustaining and established. For the first year, the plantings shall receive a generous soaking of soil surrounding each plant once per week during the dry season (May through October) and at least once per month during the wet season (November through April) unless significant rainfall occurs. Irrigation may become less frequent in the second and third year, as needed until plants are established. Mulch shall be used to support plantings and prevent loss of moisture from the soil.

7.3 PROTECTION

Wildlife/deer fencing, either around the individual plants or around the larger planting area, can be temporarily installed to prevent over-browsing until the plants are established. Gopher baskets may be necessary to prevent below-ground herbivory from destroying plantings.

7.4 MONITORING OF PLANTINGS

The VCRCD and the Cemetery will maintain the integrity of the monarch overwintering habitat enhancement efforts by ensuring the survival of the trees, shrubs and nectar plantings. The VCRCD and the Cemetery will monitor the restoration plantings on a regular or annual basis and address issues as they arise. To track the success of habitat recovery an annual assessment of site condition, annual monitoring is recommended. The site assessment should count material planted and document survival rates. Replacement of dead trees or nectar plants is recommended.

The plantings will be monitored annually for 5 years or until plants are determined to be established and thriving. Plants that fail in the initial 3 years shall be replaced in kind to maintain the number of plants recommended in planting areas.

7.5 WEEDING AND MAINTENANCE GUIDANCE

The site will be maintained using the best horticultural practices to ensure health and survival of the plantings (refer to Appendix C). The site shall be weeding periodically and at least every three months to keep coverage of weeds to a minimum and ensure survival of plantings.

Bare soil at the site may be covered with mulch or other organic ground covering to maintain soil moisture.

7.6 PHOTO POINTS

Permanent Canopy Sampling Points will be established at a minimum of 3 locations throughout the Restoration Area to help document changes in canopy cover through time. Sampling

conducted at designated Canopy Sampling Points will be conducted within the same 2-week time period each year.

Permanent Photo Stations will be established at a minimum of 5 locations throughout the Restoration Area to document changes in site conditions through time. Photo stations will be utilized to help assess changes in non-native cover across the site. Photos will be taken from the same cardinal direction at Photo Stations during the same 2-week time period each year.

8 MONARCH MONITORING

Monitoring overwintering monarchs' use of the Hueneme Masonic Cemetery site is important for assessing the effectiveness of this restoration plan. VCRCD and the Cemetery staff shall partner with the Xerces Society for Invertebrate Conservation to conduct monarch population estimates at least twice during the overwintering season for the Western Monarch Thanksgiving Count and the New Year's Count. As resources allow, monarch counts may be conducted every two weeks through the overwintering season to gather a fuller understanding of the monarchs' usage at the site. The habitat assessment form should be completed once per season for the site. Count data sheets and habitat assessment will be submitted to the Xerces Society for Invertebrate Conservation. Standard protocols and data sheets for monitoring monarch clusters (Monarch Counts) and habitat assessment are available at www.westernmonarchcount.org.

9 SIGNAGE

Signage at the Hueneme Masonic Cemetery site may be installed and used to educate visitors about the importance of monarch overwintering and pollinator habitat and information about this restoration project.

Signage to identify the monarch aggregation grove should be installed at the entrance to the Cemetery and along the western boundary to inform workers and the public of the habitat value of the site and related tree management issues. Signs would be placed on low posts approximately 30 feet apart or at a frequency readily visible. Suggested language is Monarch Preserve, Sensitive Habitat, Contact Ventura County Resource Conservation District.

Signage may also include Xerces Society's Pollinator Habitat sign, VCRCD Habitat Restoration Project information signage and interpretive signs about the monarch migration and the importance of overwintering sites.

10 REFERENCES

California Invasive Plant Council (Cal-IPC). 2020. The Cal-IPC Inventory, Plant Profiles. https://www.cal-ipc.org/plants/inventory/

California Native Plant Society (CNPS). 2021. Calscape Plant Database. Available at CalScape.org. Accessed February 2020 and January 2021.

Calvert, William H. 1991. Monarch butterfly overwintering site locations in Santa Barbara County, California. Center for Conservation Biology, Department of Biological Sciences, Stanford University.

Fork S, Woolfolk A, Akhavan A, Van Dyke E, Murphy S, Candiloro B, Newberry T, Schreibman S, Salisbury J, Wasson K. 2015. Biodiversity effects and rates of spread of nonnative eucalypt woodlands in central California. Ecol Appl. 2015 Dec;25(8):2306-19. doi: 10.1890/14-1943.1. PMID: 26910957.

Green PT, O'Dowd DJ, Abbott KL, Jeffery M, Retallick K, Mac Nally R. Invasional meltdown: invader-invader mutualism facilitates a secondary invasion. Ecology. 2011 Sep;92(9):1758-68. doi: 10.1890/11-0050.1. PMID: 21939072.

Griffiths, J., and F. Villablanca. 2015. Managing monarch butterfly overwintering groves: making room among the eucalyptus. California Fish and Game 101:40-50.

Longcore, Rich, and Weiss 2020. Nearly all California monarch overwintering groves require non-native trees. California Fish and Wildlife 106(3):220-225

Meade, Daniel E., Jessica Griffiths, Charis van der Heide, Francis Villablanca. 2018. Monarch Butterfly Overwintering Sites, Santa Barbara County, Santa Barbara. Althouse and Meade, Inc., Paso Robles, California.

Meade, Daniel E. 1999. Monarch Butterfly Overwintering Sites in Santa Barbara County, California. Althouse and Meade, Inc., Paso Robles, California.

Meade, Daniel E., Charis van der Heide, and Jessica Griffiths. 2019. Monarch Butterfly Habitat on the Razor's Edge - Native and Non-native Vegetation in California and Occam's Razor. Non-published letter. Althouse and Meade, Inc.

Nagano, C.D. and J. Lane. 1985. A survey of the location of Monarch Butterfly (Dananus plexippus [L.]) overwintering roosts in the state of California, U.S.A. : First year 1984-1985. The Monarch Project.

Nagano, C.D. and W.H. Sakai. 1990. The Monarch Butterfly. Pp. 367–85 In Audubon Wildlife Report1989/1990. Chandler, W.J. and L. Labate. (Eds.). Academic Press, San Diego, California.

Nelson, Kristen, Matt Ritter, Jenn Yost. 2016. Evaluating the myth of allelopathy in California Eucalyptus globulus (Myrtaceae) plantations. California Polytechnic State University, San Luis Obispo, CA. June.

Northern Chumash Tribal Council. 2017. Chumash Sacred Sites within the California Central Coast, https://northernchumash.org/chumash-sanctuary/

Pelton, Emma, Bill Henry, Samantha Marcum, Candace Fallon, Sarina Jepsen, and Scott Hoffman Black. 2017. Monarch Butterfly Overwintering Site Management Plan for Lighthouse Field State Beach. Santa Cruz, California. October.

Sakai, W. H., J. Lane, A. V. Evans, J. Schrumpf & M. Monroe. 1989. The wintering colonies of the monarch butterfly (Danaus plexippus (L.): Nymphalidae: Lepidoptera) in the state of California, U.S.A. California Department of Fish and Game Contract Report FG7551. 38 pp.

Sakai, W. H., and W. C. Calvert. 1991. "Statewide Monarch Butterfly Management Plan for the State of California Department of Parks and Recreation. Final Report, June 1991." Interagency Agreement No. 88-11-050 between California Department of Parks and Recreation and Santa Monica College. 160 pp. Sacramento: California Department of Parks and Recreation.

Simberloff, D., and B. Von Holle. 1999. Positive interactions of nonindigenous species: invasional meltdown? Biological Invasions 1:21–32.

U.S. Fish and Wildlife Service (USFWS). 2020. Assessing the status of the monarch butterfly. https://www.fws.gov/savethemonarch/ssa.html. Last updated: December 17, 2020. Accessed on December 22, 2020.

The Xerces Society for Invertebrate Conservation. 2017. Protecting California's Butterfly Groves: Management Guidelines for Monarch Butterfly Overwintering Habitat. Portland, OR: The Xerces Society for Invertebrate Conservation, 32 pp.

The Xerces Society for Invertebrate Conservation. 2019. Monarch Nectar Plants: California. https://xerces.org/publications/plant-lists/monarch-nectar-plants-california

The Xerces Society for Invertebrate Conservation. 2020. Western Monarch Call to Action. Serial Number: 19-001, Version Number: 02. Originally released January 2019; updated January 2020. https://xerces.org/sites/default/files/publications/19-001_02.pdf

The Xerces Society for Invertebrate Conservation. 2021. The Western Monarch Thanksgiving & New Year's Count Data. https://www.westernmonarchcount.org/

Urban Forest Ecosystem Institute. 2021. SelecTree: A Tree Selection Guide. Cal Poly, San Luis Obispo. https://selectree.calpoly.edu/tree-detail/eucalyptus-diversicolor

Weiss, Stuart. B., Paul M. Rich, Dennis D. Murphy, William H. Calvert, and Paul R. Ehrlich. 1991. Forest canopy structure at overwintering monarch butterfly sites: measurements with hemispherical photography. Conservation Biology 5:165-175.

Wolf, Kristina M., Joseph DiTomaso. 2016. Management of blue gum eucalyptus in California requires region-specific consideration. California Agriculture, 70(1), January–March. http://californiaagriculture.ucanr.edu

11 APPENDICES

Appendix A. Site photos, 2020.

Appendix B. Site assessment and count records from the Xerces Society Western Monarch Overwintering Sites Database 2020.

Appendix C. Best management practices for tree planting and aftercare.

Appendix A Site Photos

Photos were taken during a site visit on October 7, 2020 by Dan Meade.

Photo 1. Looking southwest toward the southwestern corner of the site. These blue gum eucalyptus trees make up the southern monarch roosting area.

Photo 2. Looking northwest to the northwestern corner of the site. These trees make up the northern monarch roosting area.

Photo 3. Looking north at the center of the site and the northern boundary with scattered trees. The valley oaks are proposed for this center area and in the gap in the right side of the northern boundary.

Photo 4. Looking south towards the eucalyptus windrow on the southern boundary of the site.

Photo 5. Looking west towards the western windrow of eucalyptus trees.

Photo 6. Looking west towards the western windrow of eucalyptus trees, closer view.

Appendix B

Site assessment and count records from the Xerces Society Western Monarch Overwintering Sites Database 2020.

Site Name: **Blue Gum Grove Site, Oxnard**

Sensitive Data (yes if checked)? ☐

SiteID: **3146**

County: **Ventura**

CNDDB #: 172

Aka: Etting Road at Olds Rd., Oxnard

Owner Name:	Mixed ownership
Property Name:	Unknown
Primary Land Use:	Residential

Land Use Update: 4 /16/2013
Ownership Update: 4/16/2013

Site Status: Unknown Status Update: 9/22/2014

Status Comment

Directions: "BLUE GUM GROVE" SITE, W END OF ETTING RD AT OLDS RD, JUST E OF PLEASANT VALLEY RD, OXNARD.

Site Description: This site may be an autumnal bivouac (per David Marriott, 9/30/2015).

Comment: Properties may include the Hueneme Masonic Cemetery and private residential dwellings and nursery crops.

Aspect of Site: **Slope of Site:** **Water Source:**

SITE CHARACTERISTICS (by date reported):

Source Code: SAK00F0001 **Source Year** 2000

Site Characteristics Date Reported: **xx/xx/2000**

Author First Name: Walter

Aggregation Type Reported:

Author Last Name: Sakai

Site Quality Reported: Unknown

Ecological Description: Roost trees are eucalyptus, planted in a tight row, forming a windbreak.

Aggregation Comments: Surrounding area is a floodplain utilized for agriculture, but gradually turning into housing tracts and industrial complexes

Cluster Tree Species

Scientific Name	Common Name
Eucalyptus spp.	eucalyptus species

Threats Comments:

SITE OBSERVATIONS

Dates portrayed with a "TC" in place of the date represent Thanksgiving Count data; "xx" for any portion of the date indicates only a portion of the date was reported for the observation.

11/30/19	0	
11/29/18	6	Untrained volunteer - 3 flyers, 3 sunners
01/07/2018	0	1 Jeruselum cricket
12/03/2017	2	
11/29/17	2	
11/28/17	0	
11/29/2015	0	
02/10/1985	15	
	8	Total # observations reported:
4_SourceReport_Test	4	Total # observations with monarchs present (>0):

Observation Data Source(s)

2000	Walter	Sakai	STATEWIDE SET OF FIELD SURVEY FORMS FOR MONARCH WINTERING SITES, SURVEYED UP TO AND INCLUDING WINTER 1999-2000.
2016	See: Observor	Xerces Society	Field Survey Form for Danaus plexippus overwintering sites, surveyed in winter 2015-2016
2018	See: Observer	Xerces Society	Field Survey form for Danaus plexippus Overwintering Sites, surveyed in winter 2017-18
2019	See: Observer	Xerces Society	Field Survey form for Danaus plexippus Overwintering Sites, surveyed in winter 2018-19
2020	See: Observer	Xerces Society	Field Survey form for Danaus plexippus Overwintering Sites, surveyed in winter 2019-20

Appendix C

Best management practices for tree planting and aftercare.

PUBLICATION **8046**

Planting Landscape Trees

GARY W. HICKMAN, County Director/Horticulture Advisor, University of California Cooperative Extension, Mariposa County; **PAVEL SVIHRA,** Horticulture Advisor, University of California Cooperative Extension, Marin and Sonoma Counties

UNIVERSITY OF CALIFORNIA
Agriculture
and Natural Resources
http://anrcatalog.ucdavis.edu

The performance of a landscape tree depends a great deal on how it is planted. Survival after initial transplanting, rate of growth and establishment, root development, and many other factors can be improved by proper planting techniques. Topics to consider when planting include the size and shape of the planting hole, whether to add soil amendments or fertilizer, pruning, staking, mulching, and watering.

PLANTING HOLE PREPARATION

Plant a young tree "high," whether it is bare-root, balled, or container-grown. Dig the hole no deeper than approximately 2 inches (5 cm) less than the depth of the soil in the container or the depth of the soil ball. Planting a tree too deeply or in loose soil may lead to the root ball settling below grade and potential crown rot problems.

Soils compacted by construction, vehicular traffic, or agricultural use must be broken up before planting to ensure adequate air and water penetration. After loosening compacted soil using a shovel or excavation equipment, irrigate thoroughly and delay planting for 2 weeks to allow the soil to settle. An evaluation of the soil drainage should be completed prior to planting. Dig a hole at the planting site and fill with water. The water should drain through the planting hole within 24 hours. If not, more extensive soil modifications may be necessary.

In soils of reasonable tilth, the planting hole should be at least twice the diameter of the container or root ball. In more compacted soil, the hole should be three to four times the diameter of the root ball. In either case, the sides of the hole should slope slightly in toward the bottom and should be roughened to allow easier root penetration. When planting bare-root trees, make the hole large enough to accommodate the roots without crowding. Backfill the hole with soil dug from the hole, or use more friable surface soil if the soil from the hole is mainly hard clods. With container-grown trees, take care to not cover the root ball top with soil because the finer-textured backfill soil can prevent the root ball from being wetted (fig. 1).

In order for a tree to grow well as it matures, its roots must grow into the soil of the planting site. Amending the backfill soil merely creates an artificial container through which the roots must grow. Limited research has found no benefit from backfill amendments.

If the soil at the planting site will not satisfactorily sustain a tree, extensive conditioning and modification of the entire rooting area would be needed, but this is seldom practical. Roots grow and develop in moist soil where oxygen is available. Roots grow little or not at all in dry soil, in compacted soil, or in soil that is saturated. Trees will have shallow roots if planted on shallow soils that have impervious layers or an underlying shallow water table.

UC PEER REVIEWED

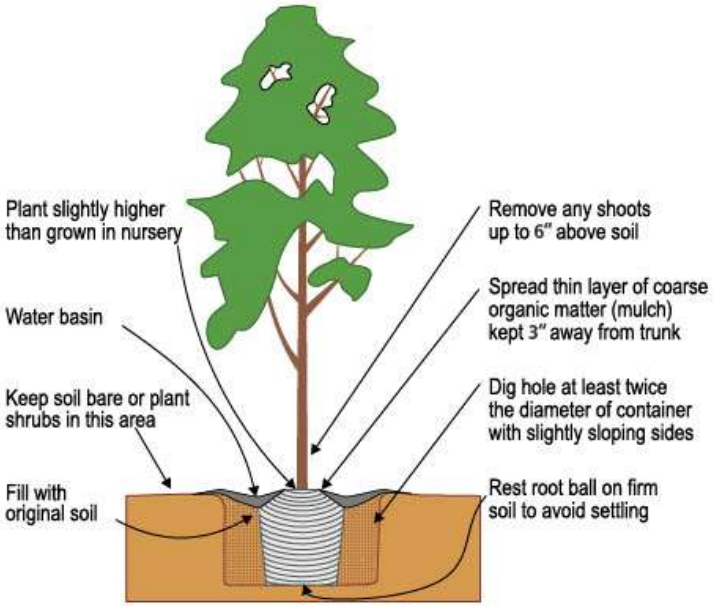


Figure 1. Proper planting of a container-grown tree.

FERTILIZING

Adding fertilizer, soil amendments, or root stimulants to the planting hole or backfill soil is not recommended. Most nursery-grown trees are well fertilized during production and seldom respond to fertilizing at planting except in the most infertile soils.

PRUNING

The less a young tree is pruned, the more total growth the tree will make. However, the growth may not be where you want it or where it will develop the most desirable tree structure. After planting, remove broken, dead, or diseased branches and branches that interfere with more desirably placed ones. Remove or cut back branches that will compete with the central leader (the topmost shoot). Leave small shoots along the trunk below where you want the lowest permanent branch; remove large low branches or cut them back to two or three buds. These low shoots will protect the trunk and increase its strength. Check the tree every 2 to 3 weeks during the growing season to see how it is doing; direct its growth by pinching back shoots that are too vigorous or shoots that you will not want later.

STAKING

Newly planted trees may need staking for protection, anchorage, or support (fig. 2). The type of staking depends on the landscape situation and the ability of the tree to stand upright. The more freedom to move the top of a tree has, the better it is able to develop structure to stand upright and withstand storms. Stakes are not necessary for trees that can stand by themselves or are planted where little or no protection is needed. Most conifers, trees with upright growth habits, and trees planted bare-root usually do not need support.

Figure 2. (A) Valley oak tied and staked too high. (B) Stakes and ties properly adjusted.

Stakes should not extend too high into the tree canopy, where they can injure the lateral branches; injured branches can be infested by insects or infected by pathogens. Stakes should not be higher than necessary to hold the tree upright while allowing the top to move in the wind. To find the correct height, grasp the trunk with one hand and bend the top. If the top returns to its upright position when released, tie the trunk at that height. The tie should provide some flexibility but should prevent the trunk from rubbing against the stakes. Tree stakes should be removed as soon as the tree has rooted well enough for support. In most cases, the stakes should not be left in place for more than 1 year.

Protective stakes are needed for trees that can stand without support but that need protection from equipment, vehicles, or animals. To protect trees from equipment and vehicles, stakes need only be high enough to be seen, so as not to be a tripping hazard. Three taller stakes with wire mesh or other covering may be needed to prevent animal damage.

Anchor stakes are needed for trees whose trunks can hold the trees upright but whose roots may not be able to support the trunks, particularly in a wind when the soil is muddy. Stakes used for protection are usually tall enough for attaching ties to the tree trunk to anchor the roots securely and still allow the top to move in the wind.

Support stakes are required for trees unable to stand by themselves. Top support for these trees should be as low on the trunk as possible but high enough to return the tree upright after deflection. Use two or three support stakes. Tie the trunk to them at only one height to allow the trunk below the tie to bend in the opposite direction from the top during a wind. Tie material should contact the trunk with a broad, smooth surface and it should be elastic enough to minimize trunk abrasion and girdling.

COMPETITION FROM TURF AND WEEDS

When trees are planted in a turfed area, keep the turf or other vegetation at least 12 inches (30 cm) away from the trunk of young trees for at least the first 2 years. The growth of young trees may be retarded by turf growing close to their trunks, even though additional water and fertilizer are applied (fig. 3). A 2-foot-diameter (60-cm) area of bare soil, or an area of mulch, around the tree trunk will also reduce damage to young trees by lawn mowers. Mechanical damage to the trunks of young trees can have a severe dwarfing effect.

WATERING

The basin for watering a newly planted tree should be constructed so that water will drain away from the trunk. Even if the soil is moist at the time of planting, thoroughly irrigate the tree to settle the soil around the root system. Remember that most of the root volume occupies a rather limited area, particularly through the first growing season. During this early period, lighter and more frequent watering than what is recommended for established trees is needed until the roots grow into the parent soil. One or two irrigations per week during high water-use periods may be desirable. If the parent soil is poorly drained, be careful not to overwater the tree. Once established, thorough, infrequent irrigation around the "dripline" (ends of branches) is most beneficial for good tree growth.

Figure 3. Maintaining an area of bare soil around young trees prevents other vegetation from competing for water and nutrients. The growth rate of the oak tree at left, planted in a 9-square-foot (0.8-sq-m) area of bare soil with sprouting weeds controlled by herbicide, surpassed the growth of a similar tree grown in turf (right). Both trees were planted as 1-year-old-liners in tree shelters.

FOR MORE INFORMATION

You'll find more information on planting and care of fruit trees in the following ANR publication:

California Master Gardener Handbook, Publication 3382.

Visit our online catalog at http://anrcatalog.ucdavis.edu. You can also place orders by mail, phone, or fax, or request a printed catalog of publications, slide sets, and videos from

University of California
Agriculture and Natural Resources
Communication Services
6701 San Pablo Avenue, 2nd Floor
Oakland, CA 94608-1239

Telephone: (800) 994-8849 or (510) 642-2431

FAX: (510) 643-5470

E-mail inquiries: danrcs@ucdavis.edu

An electronic version of this publication is available on the ANR Communication Services website at http://anrcatalog.ucdavis.edu.

Publication 8046

pr-12/01-SB/VFG ISBN 978-1-60107-224-5

This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Environmental Horticulture.