Monarch Butterfly Overwintering Site Habitat Management Plan for Carpinteria Creek Site

Carpinteria, California

Monarchs roosting on western sycamore at Carpinteria Creek Site. Photo by Charis van der Heide.

Prepared for Ventura County Resource Conservation District by

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

April 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

LIST OF APPENDICES

1 BACKGROUND AND GOALS

Every fall monarch butterflies migrate to the coast of California from across western North America to escape the inland winter weather. The western population of monarch butterflies (*Danaus plexippus plexippus*) suffered steep declines within the last three years, leaving less than 1 percent 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 on branches of aggregation site trees for first portion the season, called autumnal roosting, or for the duration of the season, called overwintering.

The Carpinteria Creek Site was an active aggregation site in 1985 according to Xerces Society records and has been visited and recorded by numerous researchers and volunteers of the Western Monarch Thanksgiving Count. This site is known as Xerces Society Site 2799, Calvert Site 90 (Calvert 1991), Meade Site 99 (Meade 1999 and Meade et al. 2018) and also called Concha Loma and Salzgerber Meadow. It is known to be a prominent monarch overwintering site in the region.

1.1 SITE MANAGEMENT GOALS

The purpose of this plan is to provide guidance for restoration and improvement of the Carpinteria Creek site for the benefit of both transient and overwintering monarch butterflies. A planting plan is included to replace roosting trees that have fallen, add roosting trees and protective vegetation, remove invasive plants, and 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 Carpinteria Creek. 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 restoration 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

The monarch butterfly overwintering site at Carpinteria Creek is located in the Carpinteria Valley within the urban setting of the City of Carpinteria, as shown in Figure 1. The Carpinteria Creek site covers an approximately 0.22-mile (0.36 km) span of Carpinteria Creek and adjacent meadow and farm. Carpinteria Creek flows into the Pacific Ocean 0.16-mile (0.26 km) from the downstream end of the site, shown in Figure 2. The aggregation site is surrounded by residential neighborhoods, an industrial facility, and Salzgerber Meadow. The site encompasses several properties bordering the Carpinteria Creek corridor.

Carpinteria Creek monarch overwintering site is part of a well-developed riparian corridor with native and non-native herbaceous understory along the banks and emergent vegetation in the creek channel. The trees along the creek are composed of western sycamore (*Platanus racemosa*), black cottonwood (*Populus trichocarpa*), white alder (*Alnus rhombifolia*), ash (*Fraxinus* sp.), arroyo willow (*Salix lasiolepis*), blue gum eucalyptus (*Eucalyptus globulus*), wax-leaf privet (*Ligustrum japonicum*), and Monterey cypress (*Hesperocyparis macrocarpa*). The monarch roosting habitat extends into the Salzgerber Meadow with blue gum eucalyptus, coastal redwoods (*Sequoia sempervirens*) and coast live oaks (*Quercus agrifolia*).

Representative photographs of the site are included in Appendix A.

Figure 1. General Location

Legend

★ Project Location

N

0 400 800 Feet

Ventura County RCD
Map Center: 119.51553°W 34.39092°N
Carpinteria, Santa Barbara County

USGS Quadrangle: Carpinteria

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
October 08, 2020 02:32 PM by JBB

Figure 2. Site Map and Tree Map

Legend

- Ash
- Blue Gum
- Cottonwood
- Sycamore
- Wax-leaf privet
- White alder
- Willow
- Monterey Cypress
- Recent Roost
- Focus Area
- Project Boundary

N

0 100 200 Feet

Ventura County RCD
Map Center: 119.51641°W 34.39211°N
Carpinteria, Santa Barbara County

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

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
February 22, 2021 02:44 PM by SAF

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), including Carpinteria Creek. Local Coastal Plans (LCP) may or may not list monarch overwintering sites and therefore enforcement of the ESHA status of monarch overwintering sites is inconsistent.

The City of Carpinteria General Plan/Local Coastal Land Use Plan (GP/LCLUP) (April 2003) includes the protection and conservation of monarch butterfly tree habitat in Objective OSC-8 and Implementation Policies 37 – 40. This management plan complies with the GP/LCLUP objectives and implementation policies, especially Implementation Policy 38 which calls to "preserve and restore habitat used by sensitive, rare, threatened, and endangered species."

2.2 PERMITTING

A permit with the City of Carpinteria and a Lake and Streambed Alteration Agreement (LSAA) from the CDFW may be necessary in order to implement elements of this habitat management plan at the site, specifically the removal of large, downed tree trunks within the riparian corridor. The CDFW has jurisdiction within the vegetated riparian corridor and the removal of downed trunks may require machinery and be consider an alteration of riparian habitat, which would trigger the need for a LSAA. If the City determines that the proposed restoration is a "Project", a permit from the City may be required that could be appealed to the California Coastal Commission.

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 CARPINTERIA

3.1.1 Methods

In November 2020, a series of 14 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. Photographs were taken at approximately 10 m intervals along the creek bed (range 5-13 m). 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 right). One grid is a "skygrid" in which the hemisphere is divided into 45^{o} azimuth wedges, and 5^{o} zenith angle increments. The second grid is the insolation that shows the sun path during the overwintering period (Figure 3A left). Photographs are classified into sky and obstruction using a grey-scale threshold.

North is at the top of the photographs. On photographs used as examples, note that East and West are reversed compared with a standard map, because the photograph is looking upward, not downward.

Several site factors were extracted from the photographs, illustrated in the example site factor photos in Figure 3A. Site factors include:

1. Indirect Site Factor Uncorrected (ISFU) – the fraction of visible sky in all directions. Most monarch cluster sites have ISFU values between 0.15 and 0.30. The left photograph in Figure 3A has ISFU = 0.23. The right photograph has a much denser canopy with ISFU = 0.12.
2. Direct Site Factor Uncorrected (DSFU) – the fraction of potential annual direct solar radiation. The right photo in Figure 3A has DSFU = 0.10, meaning that 10% of the potential annual radiation can penetrate the canopy through the small gaps along the sunpaths. Monarchs like to cluster in spots that are not completely shaded, and sometimes they will seek full sun.
3. October/March, November/February, and December/January potential direct insolation – the 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. Values at ground-level do not necessarily reflect exact values higher in the canopy, as obstructions such as branches change along narrow sunpaths. Generally, values will increase higher in the canopy, but not necessarily if foliage is concentrated in the upper canopy and the mid and lower canopy is open. The right photo in Figure 3A is a particularly dark spot with low Oct, Nov, and Dec insolation.
4. Wind Site Factors (WSF) – the fraction of sky visible in eight compass directions (octants) centered on cardinal directions is a measure of relative wind exposure. WSF greater than 0.30 (30% of the octant open) are too wind exposed (such as the N, NW, and W directions in the upper photo in Figure 3A), while lower values of less than 0.20 are ideal for strong protection from storm winds for roosting monarchs. Between 0.20 and 0.30 is a transition zone that is suitable in moderate winds. Strong winds are possible from all directions, but most likely from certain directions. Winter storm winds come from the southeast and are generally the strongest. Dry and warm Santa Ana winds come from the north and east and can be particularly stressful for monarchs in October-November.

Interpolated maps of the site factors on the photographs use Radial Base Functions (RBF) with thin plate spline in ARCGIS Geostatistical Analyst. The power of RBF is that it is an exact interpolator, so that the surface goes through every photo point exactly. For more detail, consult the ARCGIS Pro 2.7 manual (2020).

In all maps, a 5-meter radius circle shows the cluster area as pointed out by Meade and van der Heide. It is marked by a large Canary Island palm tree among a locally dense grove of eucalyptus. The tree map is also shown for reference, although registration of the trees with the photographs is not perfect because of GPS errors in the forest and in the photo grid.

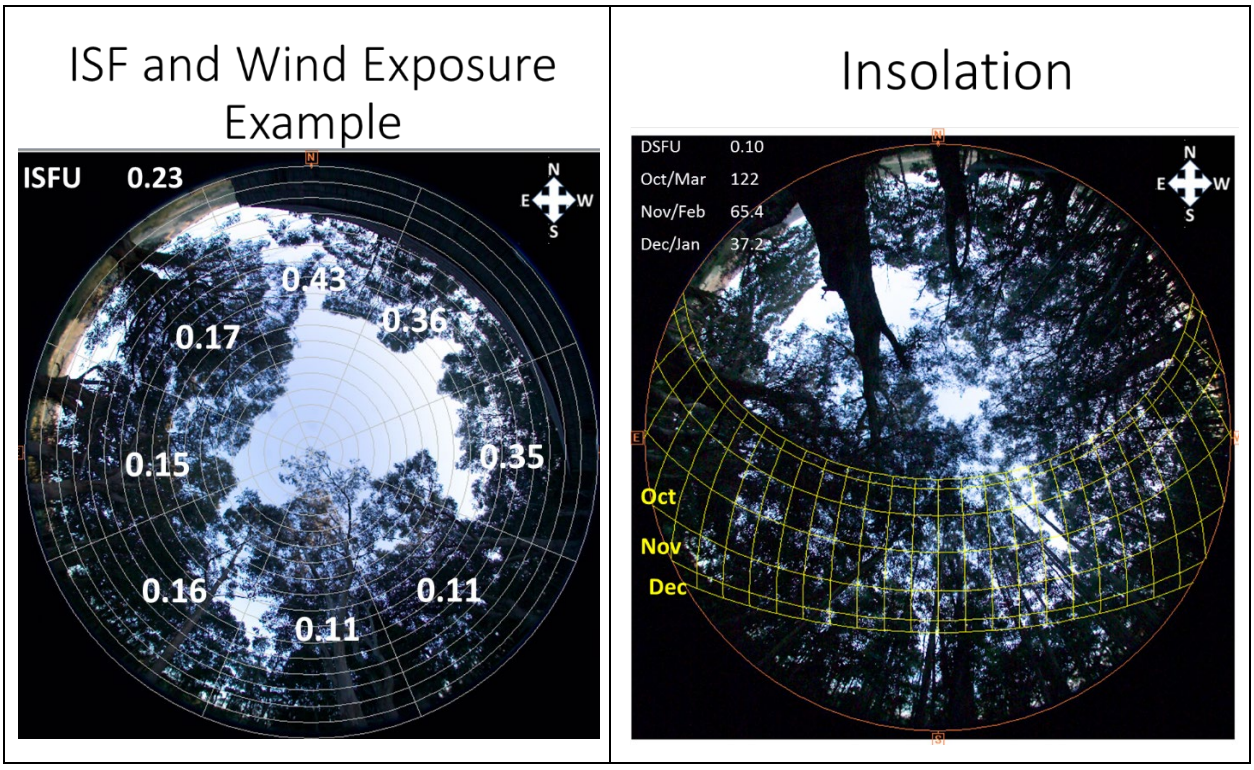


FIGURE 3A. SITE FACTOR EXPLANATION

3.1.2 Representative Photographs for Carpinteria Creek

Representative photographs from the Carpinteria Creek site show a range of conditions exhibited in the representative photographs in Figure 3B. The photo locations are shown on Figure 4A.

Photo 13: ISFU = 0.18

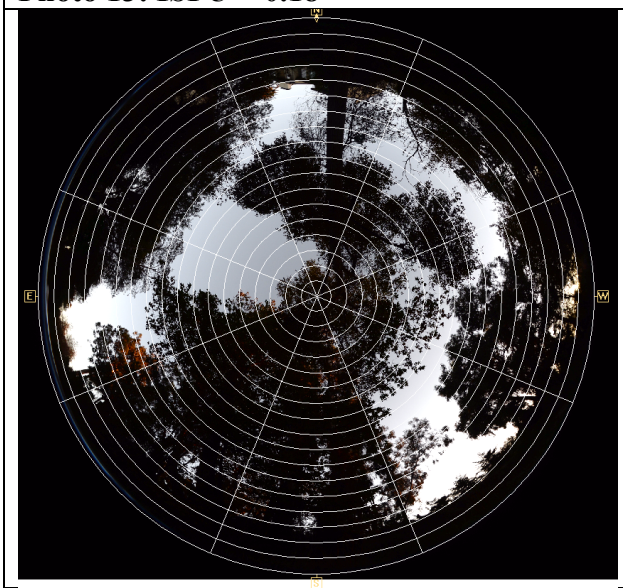


Photo 17: ISFU = 0.13

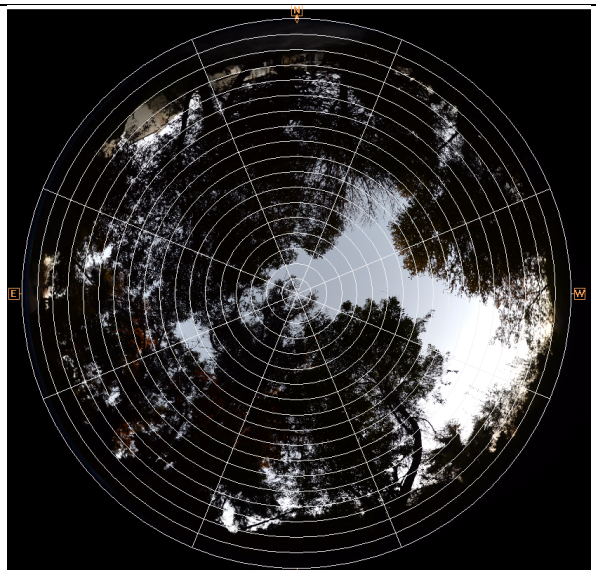


Photo 14: ISFU = 0.27

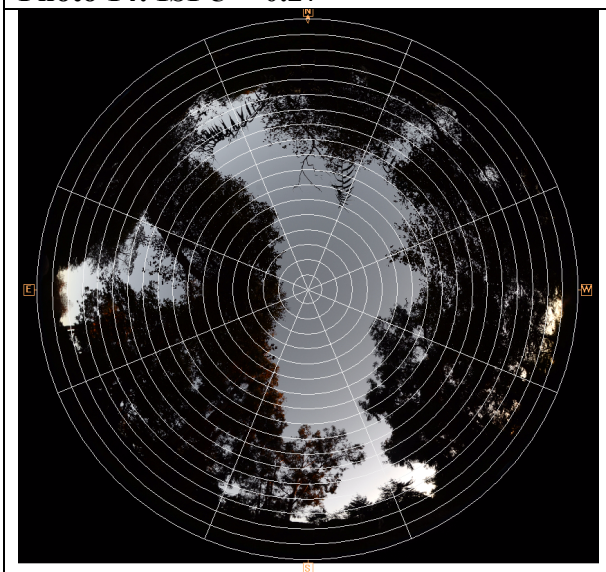


Photo 10: ISFU = 0.31

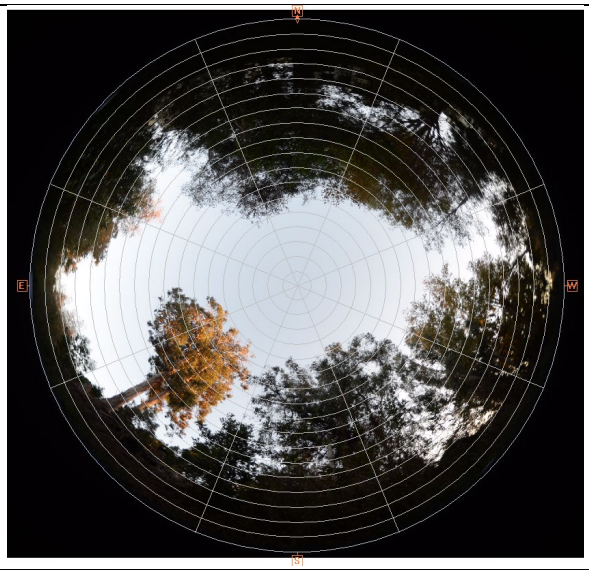


FIGURE 3B. REPRESENTATIVE PHOTOGRAPHS

Selected photographs show the range of conditions.

1. Photo 13 was taken below one of the frequent cluster sites. It is relatively dark (ISFU = 0.18) and the southern sky is blocked by a large tree on which the butterflies cluster on the north side. But this site is open to the SW, which is the result of a treefall.
2. Photo 17 is the densest canopy along the transect (ISFU = 0.13).
3. Photo 14 is taken opposite a gap along the south bank that allows substantial insolation and wind into the grove. The gap resulted from a treefall.
4. Photo 10 is at the western end of the cluster zone, and is much more open (ISFU = 0.31), with particularly open sky to the E and NE.

Figure 4A. Transect Line in Carpinteria Creek Monarch Butterfly Aggregation Site

Legend

Project Boundary Recent Roost Hemispherical Photo Location (meters)

N

0 25 50 Feet

Ventura County RCD
Map Center: 119.51604°W 34.3921°N
Carpinteria, Santa Barbara County

Imagery Source(s): USDA NAIP, 05/21/2020
Althouse and Meade, Inc., 10/13/2020

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
April 07, 2021 12:43 PM by SAF

3.1.3 ISFU (Visible Sky)

The ISFU map of visible sky (Figure 4B) shows a range from 0.11 (denser) to 0.35 (less dense). Nine of the fourteen sites are within the 0.15-0.30 range observed at most monarch cluster sites. One caveat is that the photos were taken from the creek bed, and the inevitable inclusion of the creek banks reduces ISFU by blocking the horizon, so that the values at the bank level will be larger than those taken from the bottom of the creek bed. The area in the center of Figure 4B with the smallest orange circles is where the monarchs are observed roosting.

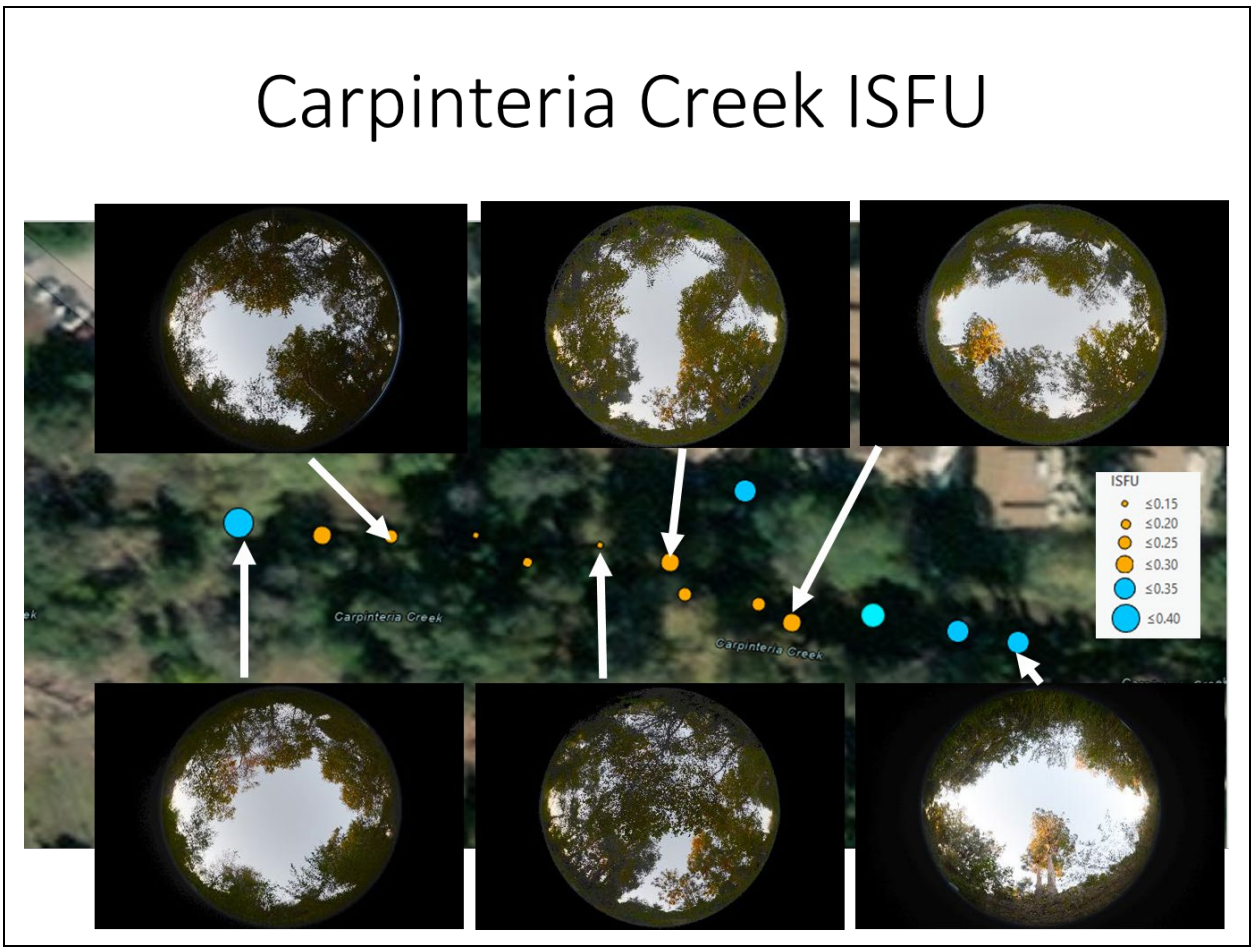


FIGURE 4B. ISFU MAP OF VISIBLE SKY
The orange circles are those sites < 0.30.

3.1.4 Monthly Insolation

The insolation map (Figure 4C) shows monthly insolation as graduated circles for each month, laid on top of each other. Some representative photos are shown for different situations. For the most part, the photo sites have low insolation during the overwintering season. In some places where gaps exist on the southern bank, the insolation is higher. The photo sites do not represent

the insolation conditions on the southern side of the trees on the bank, where monarchs can cluster or bask when they desire direct sun. The dappled light that comes through the upper canopy (note the small gaps in the trees) may provide enough light for the monarchs to thermoregulate on the northern sides of the trees overhanging the creek.

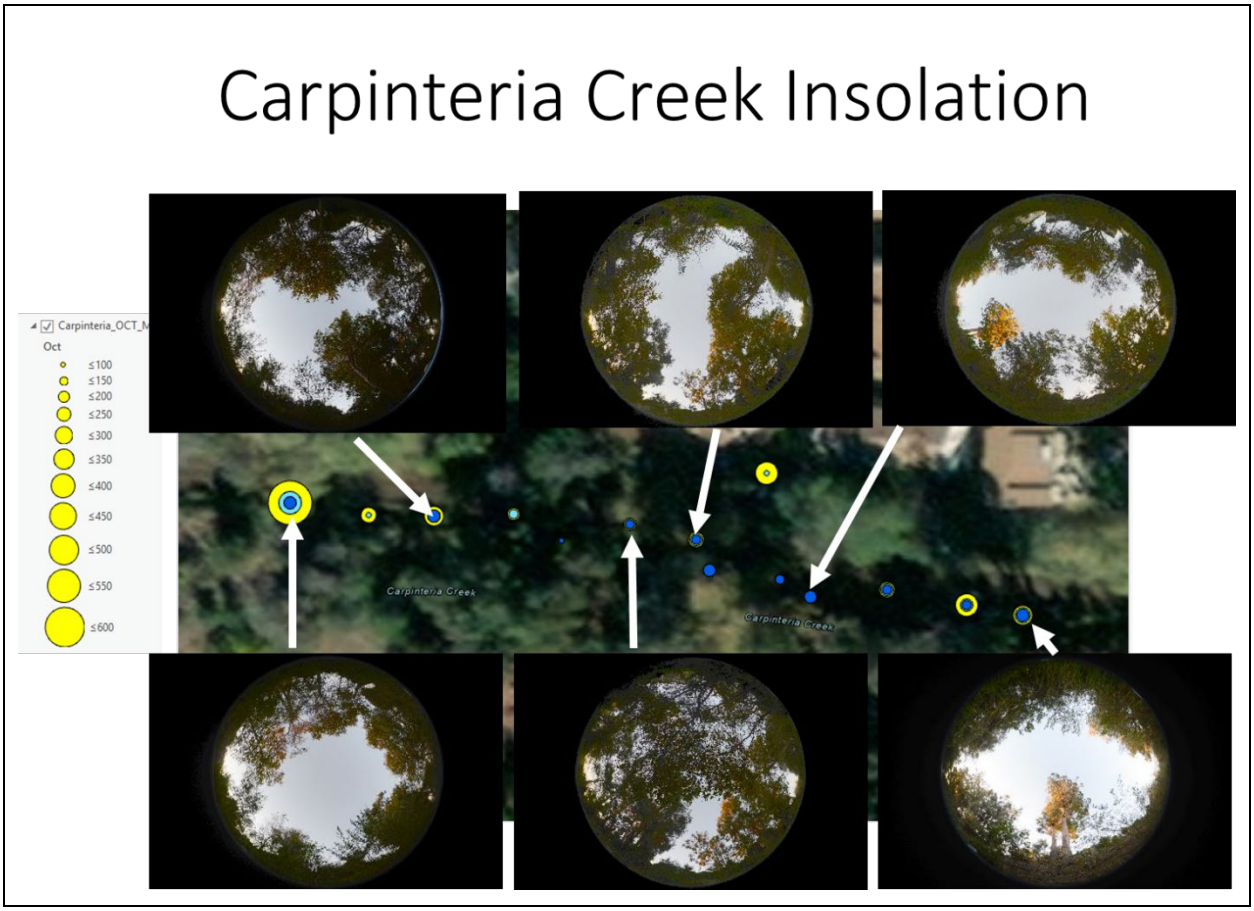


FIGURE 4C. INSOLATION

Graduated circles are place on top of each other in the order: October (yellow, bottom), November (light blue, middle layer), December (dark blue, top). When only the dark blue December circle is visible it means that October and November have less insolation than December.

3.1.5 DSFU (Direct Site Factor Uncorrected)

Photographs taken from ground level (and from the creek bed) may not fully represent conditions higher in the canopy where monarchs typically cluster. The Direct Site Factor Uncorrected (DSFU) map (Figure 4D) provides some insights into insolation higher in the canopy. This measure includes higher sunpaths in spring and summer and may better represent higher canopy positions. Values range from 0.14 to 0.59. In this map, several sites that have low insolation in October through March have intermediate DSFU values (0.20-0.40), which means there is more direct solar radiation higher in the canopy.

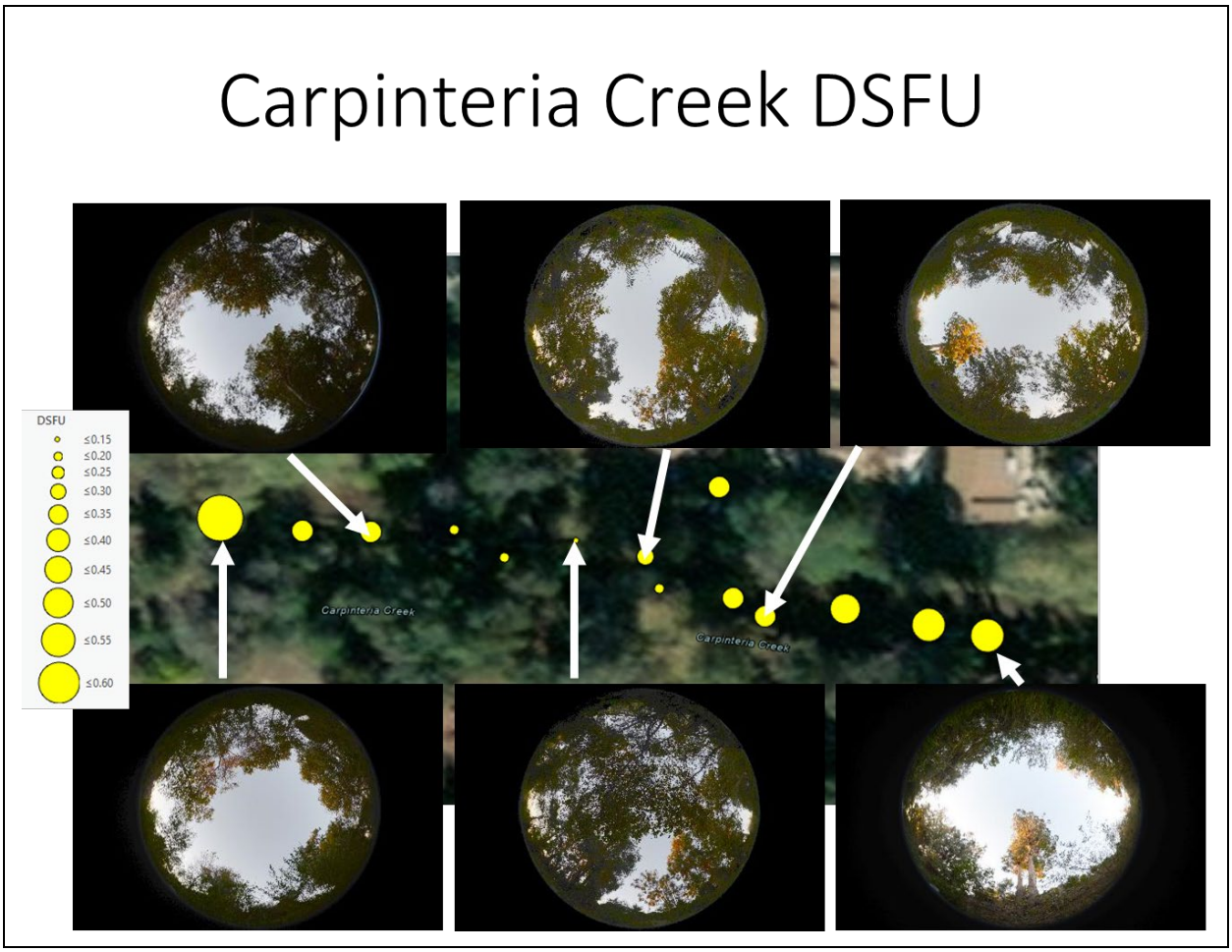


FIGURE 4D. DSFU (FRACTION OF ANNUAL POTENTIAL INSOLATION)

3.1.6 Wind exposure

The wind exposure map below (Figure 4E) shows relative wind exposure from 8 directions, with representative photographs. The size of the pin in each direction is proportional to the fraction of open sky in each sky octant. The same data are presented as line graphs in Figure 4F.
Starting at the east end (lower right photo, Photo 1), WSF-E is high (0.62), as is WSF-W (0.5), both in the direction of the creek. WSF-S is the lowest (0.12) because of the solo tree in that direction. Other directions range from 0.23 to 0.32. This pattern repeats for the next three photo sites (including Photo 2 in the upper left). The next photo shown (Photo 3 middle top) has high WSF-S because it is opposite a gap on the southern bank. The next photo site to the west (Photo 4 center bottom) is the best sheltered of all sites, with a maximal WSF-S of 0.32. Note that the next site W has low WSF-S so wind shelter is only 10 meters away. Further west (Photos 5 and 6), the sites open to the W and SW, while remaining well-sheltered from the northerly directions. In short, the eastern ends of the transect are highly exposed to E winds, and the western most sides to W and SW winds. Exposure to SE, S, and SW winds varies with the canopy gaps on the south bank. Exposure to northerly winds is generally quite low because of dense trees on the north bank, with a few exceptions.

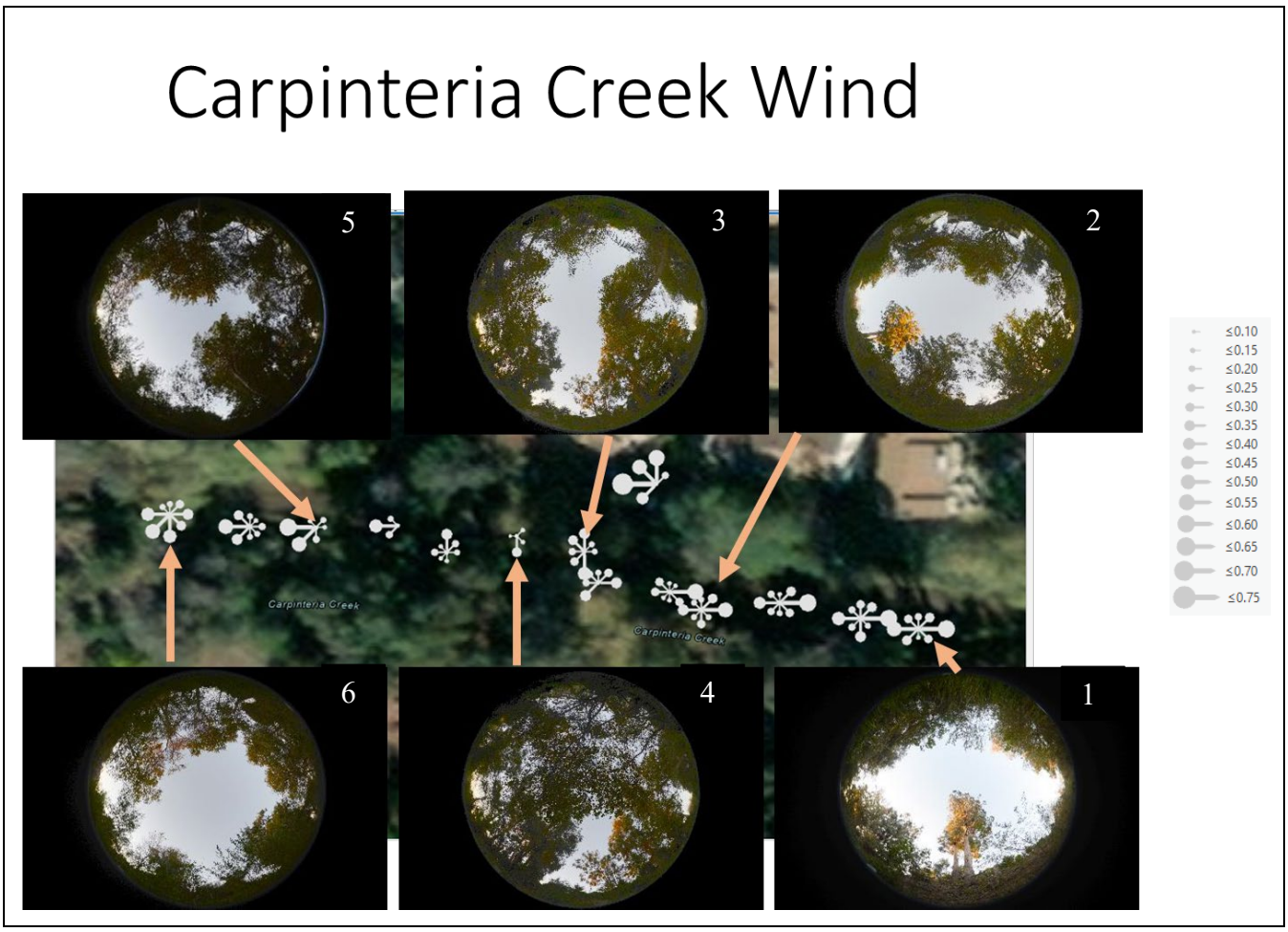


FIGURE 4E. WIND "ROSES"

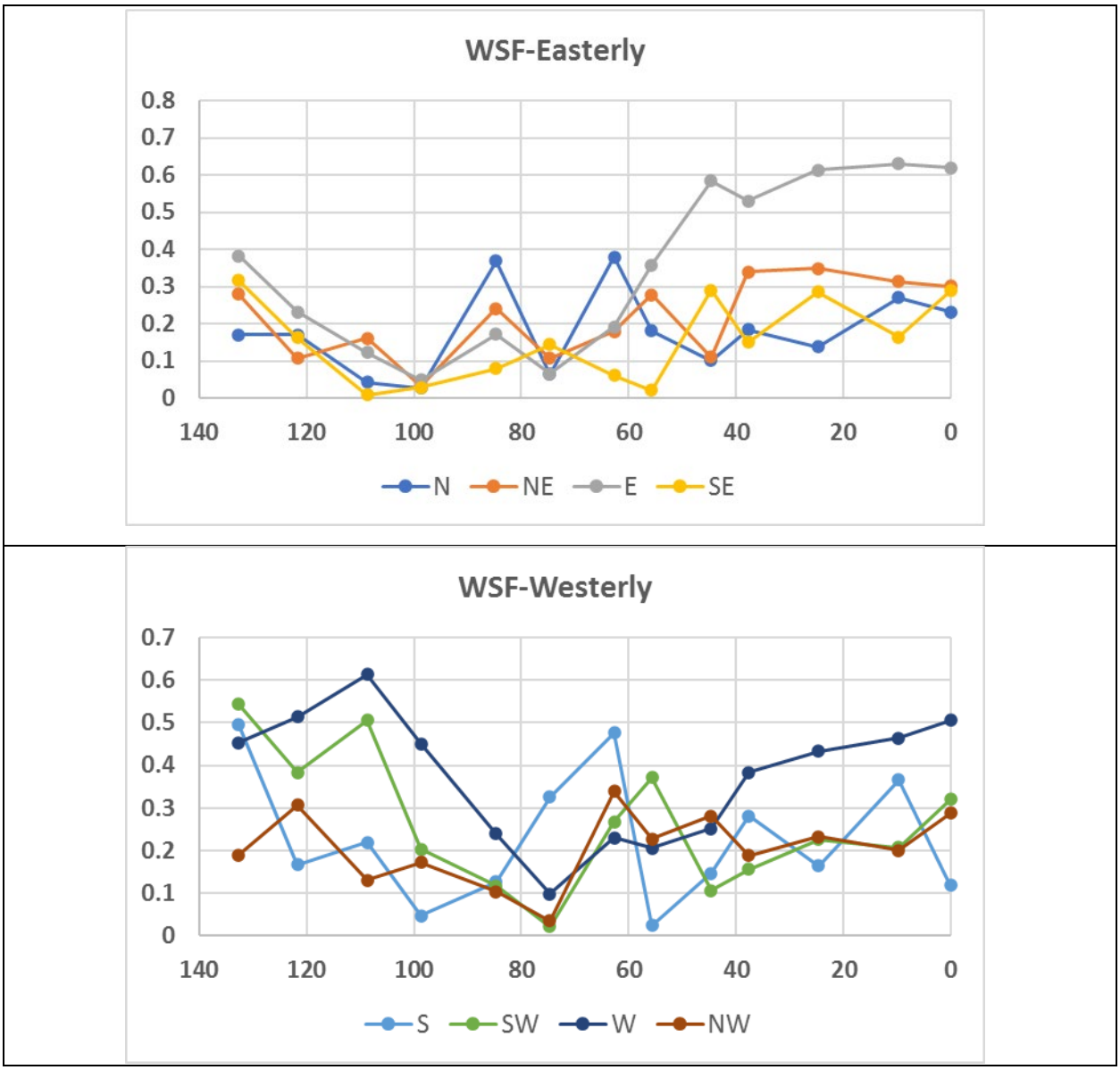


FIGURE 4F. WIND EXPOSURE GRAPHS

Prevailing winds during the overwintering season for the region are shown as wind roses in Figure 4G below with data from the Santa Barbara Municipal Airport (MRCC 2021). The wind roses for October 1 – March 31 show that prevailing winds are westerly, and southeasterly, but strong winds (at low frequencies) can come from almost any direction. The westerly winds limit occupancy at the western end of the transect. The strongest storm winds from the SE are particularly influential at all monarch overwintering sites. Dry warm NE and N winds are also a concern especially during the fall, as monarchs can be sensitive to desiccation (which is somewhat ameliorated by the permanent creek itself).

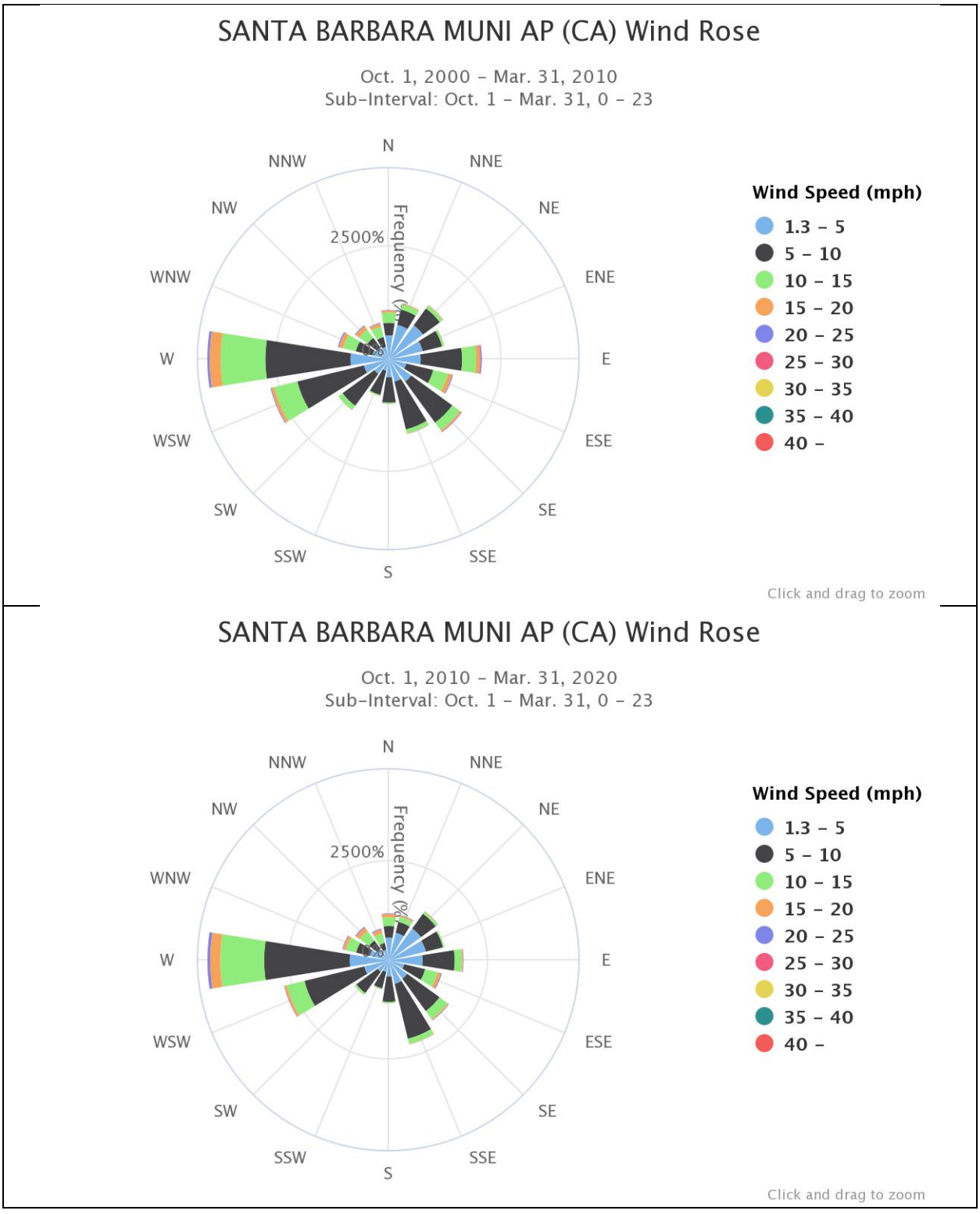


FIGURE 4G. WIND ROSES OF PREVAILING WINDS FOR THE REGION (MRCC 2021)

3.1.7 Conclusions from Hemispherical Photography

The analysis shows the following site characteristics and recommendations:

1. The 130 meter-long transect along the creek bed (Figure 4A) exhibits an approximately 80 m stretch with ISFU between 0.15 and 0.30, which is within the range of other monarch sites.
2. Insolation in the creek bed itself is low, except in select spots. However, at greater heights and on the south side of the trees, insolation is more than sufficient for monarchs.
3. The cluster sites over the creek bed on the north sides of the south bank trees receive some dappled light through the canopies.
4. Wind exposure varies with position and wind direction. The E-W orientation of the creek creates natural gaps in those directions. The eastern end of the transect has high exposure to E winds for approximately 50 m. The western end has high exposure to W winds for approximately 50 m as well. Because these represent prevailing wind directions, the main cluster sites are in the center of the transect.
5. Exposure to northerly winds (NW, N, and NE) are generally low across the transect, because the canopy on the north side of the creek is relatively continuous. But significant gaps to the north exist at 63 m and 85 m.
6. Exposure to southerly winds (SW, S, and SE) is low in the middle of the transect, except at a gap from a treefall around 60-80 m. However, good southerly wind shelter is available 10 m to the west and east.
7. The central part of the transect from approximately 40-80 m is the most suitable are from a wind exposure and canopy cover perspective. Within this area, monarchs can seek high insolation microsites that are not well-represented by the hemispherical photographs.
8. Tree plantings that seal up the southerly wind exposure within the cluster area are highly recommended. Tree species with porous canopies that allow for dappled light on the north-sides over the creek are most desirable. Species include blue gum eucalyptus, other eucalyptus species that have sparser canopies, and Monterey cypress. Native sycamores are deciduous and lose their leaves by January (in most years), however they do provide good autumnal roosting locations. Plantings of dense canopy trees, such as *Eucalyptus globulus* or live oaks, should be avoided on the south bank of the creek.
9. Planting dense canopy trees farther south from the creek bank can provide yet another layer of wind shelter, where light penetration is not as important. *Eucalyptus sideroxylon* are good for this purpose.
10. Planting some trees with dense canopies on the north bank to seal the gaps at 63 and 85 m would provide further protection from this direction.

4 OVERWINTERING MONARCHS AT CARPINTERIA CREEK SITE

According to the Xerces Society for Invertebrate Conservation count records, monarch butterflies at the Carpinteria Creek site were first documented by Walter Sakai in 1985 with his observation of 5,000 monarchs. Since then, the population at the site peaked in 1997 with 50,000 monarch butterflies and has fluctuated downward with a low of 17 in 2020 (The Xerces Society for Invertebrate Conservation 2021). The graph in Figure 5 and Table 1 show the WMTC records for the site. Appendix B includes the site assessments and count records from the Xerces Society Western Monarch Overwintering Sites Database, as of October 2020.

In recent years, monarchs roost primarily on western sycamore and blue gum eucalyptus and occasionally on the native cottonwood and willow trees over the center and southern bank of the creek. While the site has been mapped by The Xerces Society for Invertebrate Conservation to span a long section of the creek, monarchs are known to aggregate predominantly in a smaller area (shown in the tree map in Figure 2).

Historically, windrows of large eucalyptus trees extended along the southern bank of Carpinteria Creek and into the southwest and the northeast of the Salzgerber Meadow (Calvert 1991). The largest aggregations of monarchs were regularly observed in a main grove of trees in the northern end of the meadow. This grove was significantly damaged in a wind storm event in December 2007. The loss of many large eucalyptus trees changed the site and the monarchs have since shifted their aggregation locations to the trees overhanging the creek. The trunks of these fallen trees are scattered along the southern bank of the creek under a thick blanket of Cape Ivy (*Delairea odorata*) vines.

The monarch count data suggest that the utilization of the habitat by overwintering butterflies changed with the 2007 loss of trees in the meadow and along the creek. Count surveys occurred several times over the course of three overwintering seasons; one year prior to the tree loss and two years afterwards, shown in Figure 6. During the 1990-1991 season, the monarch overwintering population at Carpinteria Creek increased through the winter into the end of January. During the 1998-1999 and 2016-2017 seasons, the monarch population dropped dramatically in mid-December and almost disappeared in January. After several eucalyptus fell in the meadow windrows, the monarchs shifted to aggregate on western sycamores and eucalyptus on the opposite side of the creek. The blue gum eucalyptus trees are tall and evergreen and provide wind protection throughout the overwintering season. The western sycamore is a deciduous tree and decreases in wind protection capacity in January with the loss of leaves. This loss of leaves and wind protection corresponds with the loss of monarchs in the middle of the overwintering season.

When monarchs are present at a site in the first part of the overwintering season and abandon the site by mid-December or January, the site is referred to as an autumnal site. Monarchs are highly mobile during the overwintering season and use roosting habitat in a network across the landscape. They arrive and depart sites based on available suitable habitat and microclimates.

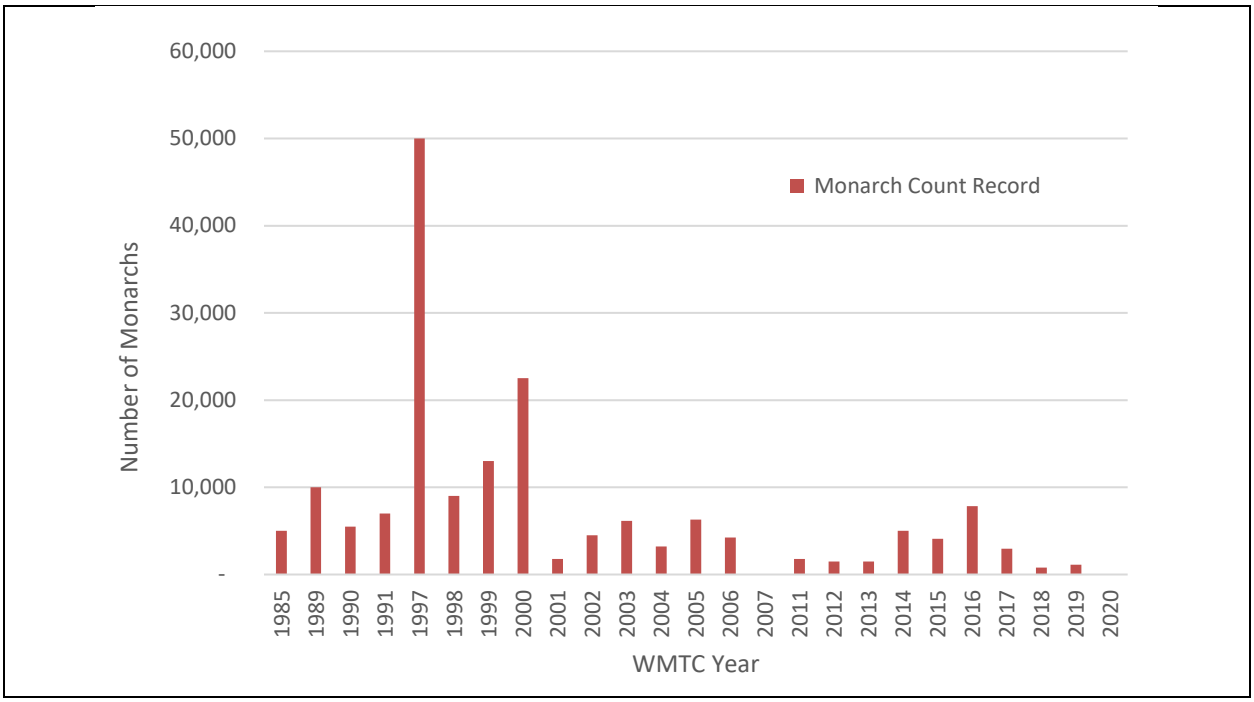
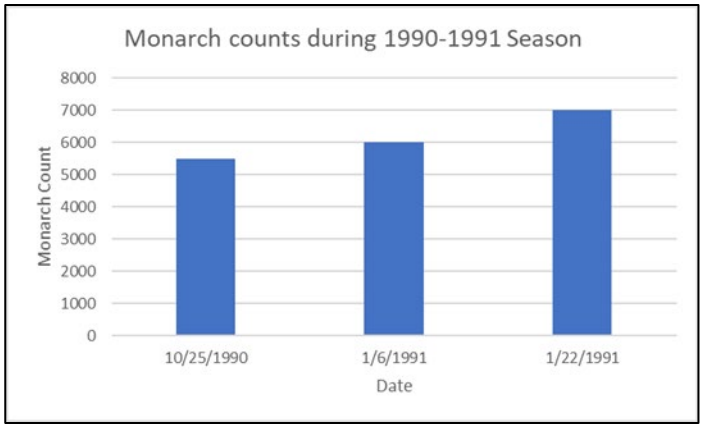


FIGURE 5. MONARCH COUNT DATA IN GRAPH FOR CARPINTERIA CREEK SITE
Data source: The Xerces Society for Invertebrate Conservation 2021

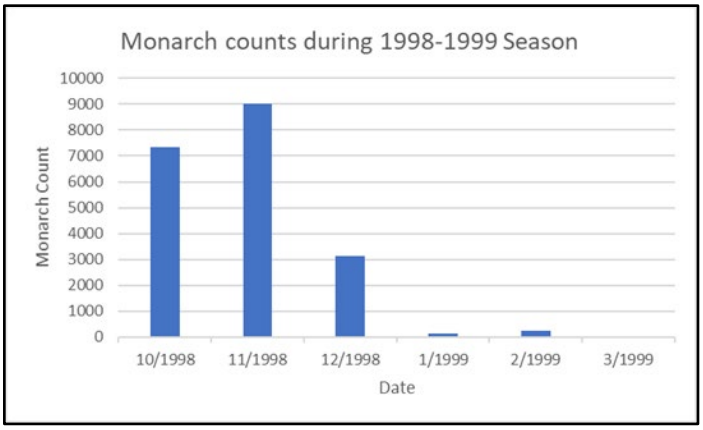
TABLE 1. MONARCH COUNT DATA FOR CARPINTERIA CREEK SITE

Date	Monarch Count Record	Date	Monarch Count Record
1985	5,000	2006	4,250
1989	10,000	2007	30
1990	5,500	2011	1,800
1991	7,000	2012	1,500
1997	50,000	2013	1,480
1998	9,000	2014	5,000
1999	13,000	2015	4,110
2000	22,500	2016	7,830
2001	1,800	2017	2,960
2002	4,500	2018	795
2003	6,150	2019	1,130
2004	3,200	2020	37
2005	6,300		

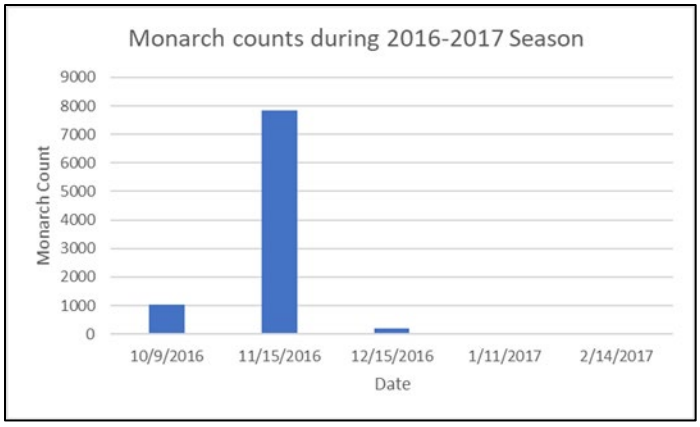
Data source: The Xerces Society for Invertebrate Conservation 2021



1990-1991 Season	Monarch count
10/25/1990	5500
1/6/1991	6000
1/22/1991	7000



1998-1999 Season	Monarch count
10/1998	7325
11/1998	9000
12/1998	3114
1/1999	147
2/1999	250
3/1999	0



2016-2017 Season	Monarch count
10/9/2016	1015
11/15/2016	7830
12/15/2016	182
1/11/2017	0
2/14/2017	4

FIGURE 6. MONARCH COUNTS DURING THREE SEASONS: GRAPHS AND DATA TABLES
Data source: Calvert 1991, Meade 1999, Meade et al. 2018

5 CULTURAL RESOURCES

Restoration work will include minimal soil disturbance to install plants, broadcast seeding, and hand weeding. Removal of downed trees on the top of bank could result in surface soil disturbance. The project does not intend to plant large trees that require deep excavations and will keep soil disturbance to a minimum. Consultation with the tribal representative is

recommended to discuss the restoration plan. If the Restoration Area is determined to be an area of cultural resource sensitivity, during restoration work activities requirements shall be followed as described below.

An archaeological monitor and a Native American monitor representing tribal groups with documented ancestral ties to the area as identified by the Native American Heritage Commission (NAHC) shall be onsite during all ground disturbance and subsurface activity that occurs at any enhancement site. Any Native American representatives of the Chumash on the NAHC list shall be welcome to visit the site, even if they are not the assigned monitor, so long as they notify and consult with land owners prior to arrival. Sufficient archaeological and Native American monitors shall be onsite to ensure that all activities that have potential to uncover or otherwise disturb cultural deposits are monitored.

No disposal of any materials including soils shall be removed from the site such that no screening of excavated soils is anticipated. If cultural materials are identified during monitoring of enhancement activities, the archaeological monitor shall identify, as best as possible, associated soil that may contain cultural materials and, if determined by the archaeological monitor, the Native American monitor(s), and/or the Most Likely Descendant (MLD) identified by the NAHC, screen it for evidence of such materials. If any cultural materials are discovered, including but not limited to skeletal remains and grave-related artifacts, traditional cultural sites, religious or spiritual sites, or other artifacts, all enhancement activities in that particular area shall cease until further direction has been provided.

If potential human remains are encountered during inspection of the Restoration Area, all work shall be immediately stopped and the County Coroner, NAHC and the MLD(s) identified by the NAHC shall be contacted. Human remains shall be left in situ and shall be excavated only to the extent necessary for the archaeological monitor and County Coroner to make the necessary determination as to whether the bone is human and whether it represents a modern forensic case. Unless required by the County Coroner, subsequent human remains shall not be excavated unless excavation is necessary to determine whether they are human in origin, and the extent of excavation shall be the minimum necessary to make the determination. If human remains are encountered during soil screening, the restoration team shall comply with all applicable State and Federal laws, including but not limited to, contacting the County Coroner, NAHC and the MLD(s). If the origin of any human remains discovered during monitoring or soil screen is determined by the Archaeological Specialist to be fill soil, the human remains shall be documented or reburied with any other human remains discovered in fill soil during soil screening in a location chosen in consultations with the Native American monitors and MLD(s).

6 CARPINTERIA CREEK SITE HABITAT MANAGEMENT PLAN ACTIONS

The overall goal of this habitat management plan is to restore, maintain and improve the quality of monarch overwintering habitat at the Carpinteria Creek site. The purpose of these goals is to sustain the use by the monarch population for the short-term and to increase the population in the long-term at Carpinteria Creek aggregation site. The management approach is to improve monarch butterfly habitat by strategic tree and shrub planting and grove management and to increase native nectar resource availability. The specific actions of this plan are to 1) protect and support existing trees and increase the number of trees and shrubs for roosting and wind barriers, 2) remove non-native plants (not including eucalyptus trees), and 3) plant fall and winter-flowering nectar plants to sustain monarchs' energy through the overwintering season.

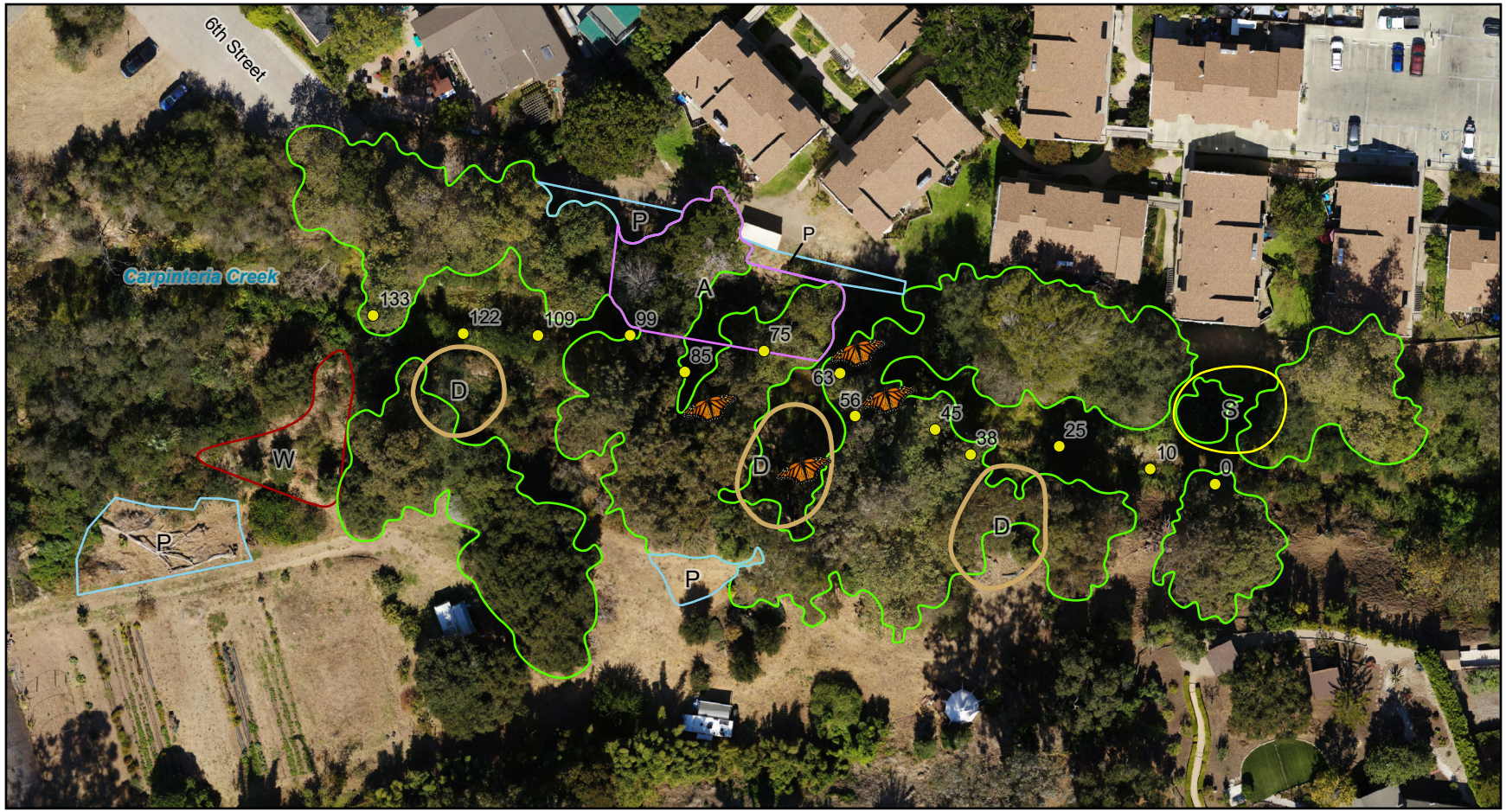
6.1 TREE AND SHRUBS FOR WIND BARRIERS

Tall trees for roosting and wind protection are vital to the continued quality of monarch overwintering sites. To ameliorate the loss of eucalypts from wind storms and age several years ago, site management will protect existing trees and add additional trees. Also, saplings and resprouting eucalyptus stumps will be allowed to recover. This will help close wind gaps and create several layers of wind barriers. Figure 7 shows the planting/restoration plan with 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)
Protect and Maintain Trees	1.32
Plant additional wind protection	0.06
Remove Cape Ivy and Arundo, encourage native trees	0.13
Remove downed trunks and non-natives, plant trees	0.13
Plant Sycamores	0.04
Pollinator/Nectar habitat	0.11
TOTAL	**1.79**

Figure 7. Planting/Restoration Plan



Legend

W	Plant additional wind protection
S	Plant Sycamores
P	Pollinator/Nectar habitat
	Protect and Maintain Trees
A	Remove Cape Ivy and Arundo, encourage native trees
D	Remove downed trunks and non-natives, plant trees
	Recent Roost
	Hemispherical Photo Location (meters)

N

0 50 100 Feet

Ventura County RCD
Map Center: 119.51611°W 34.39209°N
Carpinteria, Santa Barbara County

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

ALTHOUSE AND MEADE, INC.
BIOLOGICAL AND ENVIRONMENTAL SERVICES

Map Updated:
April 07, 2021 12:08 PM by SAF

6.1.1 In Defense of Eucalyptus Trees

Eucalyptus trees are important to monarch overwintering sites because they grow taller than the 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 trees 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 resigned 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 and Support Existing Trees

All of the existing trees, including eucalyptus and native trees, in the monarch aggregation habitat at Carpinteria Creek site are considered sensitive habitat by the California Coastal Commission and are designated as ESHA. Tree removal is prohibited and trimming of branches should be limited and undertaken by a certified arborist with caution to preserve the integrity of the monarch butterfly overwintering habitat.

Several coast redwoods were planted on the Salzgerber Meadow property along the creek to fill in some gaps between the eucalyptus trees. A few have died. These redwoods are a good addition to the composition to the grove and the remaining redwoods should be provided with regular irrigation to prevent further death.

The creek banks in the monarch roosting area are vegetated with native riparian trees and recruitment of saplings is occurring in the riparian understory. These include western sycamore, black cottonwood, and white alder. However, the banks are overgrown with non-native plants that are choking out these native riparian saplings. As part of the non-native plant removal effort (Section 5.3), we recommend taking care to protect these sapling trees and clear the vegetation around them to support healthy growth. Clearing and maintaining a one-foot radius circle around these native riparian saplings should be adequate.

6.1.3 Enhance Tree and Shrub Cover

Monarchs aggregate in protected locations in groves with space for their gliding flight pattern. Aggregation sites have wind protection with dappled light that penetrates the grove. The aim of the tree planting plan is to recreate and foster this grove of trees while maintaining an open interior over the creek and sunny basking areas on the south side of the grove.

Several large trees have fallen along the southern bank of the Carpinteria Creek site leaving large openings in the canopy and gaps for the wind to penetrate previously protected roosting areas. The fallen trunks are still present on the ground and have become over grown with vines. We recommend clearing the vines and trunks from these open areas to create space for planting new trees. After the removal of the large, downed trunks is complete, the precise locations for the tree plantings will be marked in the field by the project manager and monarch butterfly biologists. We recommend planting a combination of eucalyptus and native trees with 20-foot spacing in the areas delineated on the planting plan (Figure 7). Tree species include blue gum (*Eucalyptus globulus*), red ironbark (*Eucalyptus sideroxylon*), western sycamore (*Platanus racemosa*), and Monterey cypress (*Hesperocyparis macrocarpa*).

We recommend planting four western sycamores in the gap on the norther bank of the creek on the eastern end of the roosting area as shown on Figure 7 by area “S”. The remainder of the sycamore trees should be planted in the gaps on the south bank in the roosting area above the toe of the slope of the creek banks so they can get their feet wet, so to speak. These trees will provide low wind protection while they are young, and autumnal roosting locations when they mature.

The blue gum, red ironbark, and Monterey cypress are recommended to fill in the gap areas on the upper slopes and top of banks along the creek in the tree protection areas, indicated on Figure 7 as areas “D” and “W”. Starting from the creek and moving outward the arrangement of tree species is recommended as follows: sycamores closest to the creek in the wetter soil, eucalyptus

species next at the top of slope and top of bank, and Monterey cypress furthest from the creek and in open areas along the outsides of the existing eucalyptus and tree protection zone canopy.

If available, karri (*Eucalyptus diversicolor*) may also be planted. 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 in the area beyond the planting location (Urban Forest Ecosystem Institute 2021). However, karri may be less readily available compared to blue gum in nursery stock.

Both karri and blue gum grow quickly and can obtain significant height that can relatively quickly support protection of the aggregation area. Karri does not have fertile seeds in California, and since the location is along a creek, we recommend its use if stock can be acquired. Maintenance activities proposed for this location should manage unwanted recruitment on site. A 20-foot spacing allows development of a windbreak within a few years while still allowing for light penetration.

Toyon (*Heteromeles arbutifolia*) is recommended for planting between the eucalyptus and native trees in the upland terraces of the site as understory to aid in wind protection. 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 will be flagged in the field by the project manager and monarch butterfly biologist as per the planting plant designations (Figure 7) and the planting palette (Table 3).

Future planting may occur with additional plantings of trees on the adjacent properties upstream of the project site when permission is granted to the VCRDC or by the owners themselves. The same species arrangement would apply to these upstream properties.

6.1.4 Encourage Eucalyptus Germination and Re-sprouts

We recommend allowing the 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 utilized 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 trees 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 Guidance

When assessing live eucalyptus at the site for hazard or safety concerns, take the roosting of monarchs and their wind protection barriers into consideration. 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 MILKWEED

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 can provide this source of nutrients. Several nectar plants are available throughout the year in the Salzgerber Meadow and residences in the vicinity. Our recommendations will add to the diversity and seasonal availability of nectar resources for the monarchs near the roosting area.

6.2.1 Increase Appropriate Nectar Sources

Nectar plants are recommended in two areas with a total of 0.11-acre of the Carpinteria Creek site, shown in Figure 7. Species to include in the immediate vicinity of Carpinteria Creek site are listed in Table 3 below. These species are selected based on their nectar availability for monarch butterflies and other pollinators (The Xerces Society for Invertebrate Conservation 2019). These species are native to the region based on data from CalScape (CNPS 2021) and 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. Most of these plants are being grown and provided by a generous donor to the project.

TABLE 3. PLANTING PALETTE: TREES, SHRUBS AND NECTAR PLANTS TO BE PLANTED

Common Name	Scientific Name	Plant Type	Flowering Season	Quantity (1-gal)
Wind Barrier Plants (0.22-acre)				
Blue Gum	*Eucalyptus globulus*	Tree	Fall, Winter, Spring	8
Red ironbark	*Eucalyptus sideroxylon*	Tree	Fall, Winter, Spring	12
Monterey cypress	*Hesperocyparis macrocarpa*	Tree	Spring, Summer	4
Western Sycamore	*Platanus racemosa*	Tree	Winter, Spring	16
Toyon	*Heteromeles arbutifolia*	Shrub	Summer	10
Native Pollinator/Nectar Plants (0.11-acre)				
Yarrow	*Achillea millefolium*	Perennial herb	Spring, Summer	20
Deerweed	*Acmispon glaber*	Perennial herb	Winter, Spring, Summer	30
Ceanothus	*Ceanothus* spp.	Shrub	Winter, Spring	10
Coast Sunflower	*Encelia californica, E. farinosa*	Shrub	Winter, Spring	20
California Fuchsias	*Epilobium canum*	Perennial herb	Summer, Fall	15
California Buckwheat	*Eriogonum fasciculatum*	Shrub	Spring, Summer, Fall	30
Sea Cliff Buckwheat	*Eriogonum parvifolium*	Shrub	Winter, Spring, Summer, Fall	32
Flannel bush	*Fremontodendron* "California Glory"	Shrub	Spring, Summer	10
Great Valley Gumweed	*Grindelia camporum*	Perennial herb	Spring, Summer, Fall	5
Silver Lupine	*Lupinus albifrons*	Shrub	Winter, Spring, Summer	5
Holly Leaf Cherry	*Prunus ilicifolia*	Shrub, Tree	Winter, Spring	10
Black Sage	*Salvia mellifera*	Shrub	Winter, Spring, Summer	30
Hummingbird Sage	*Salvia spathacea*	Perennial herb	Winter, Spring, Summer	30
Elderberry	*Sambucus nigra*	Shrub, Tree	Spring, Summer	10
Goldenrod	*Solidago velutina*	Perennial herb	Summer, Fall	10
TOTAL				**317**

6.2.2 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*).

6.3 NON-NATIVE PLANTS

Even through eucalypts originate from Australia and Tanzania, for the purpose of this management plan and their importance to the monarch butterfly habitat eucalypts will not be discussed as non-native plants.

6.3.1 Species for Removal

Non-native and invasive plants can grow to dominate and out-compete trees and shrubs that compose the monarch overwintering habitat. Several species of highly invasive plants are present at the site and pose a threat to eucalypts and native trees and shrubs that form the monarch butterfly aggregation site. Non-native plants at the site include cape-ivy (*Delairea odorata*), English ivy (*Hedera helix*), giant reed (*Arundo donax*), kikuyu grass (*Pennisetum clandestinum*), and castor bean (*Ricinus communis*), as listed in Table 4 and shown on Figure 7.

Cape-ivy and English ivy are invasive, perennial vines that grow over existing vegetation and forms dense mats that suffocate and kill vegetation underneath. These two species have a Cal-IPC Rating of high. A high Cal-IPC rating is defined as species that have "severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically" (Cal-IPC 2020). These species are prevalent along the banks of Carpinteria Creek. The removal of these vines is important for the continued growth and health of the trees along the Carpinteria Creek corridor.

Giant reed is a tall perennial grass that is known to invade and threaten riparian and wetland areas outcompeting native species for water (Cal-IPC 2020). This species has a high Cal-IPC

Rating. One plant is identified in the creek bed at the site and this small plant should be removed before it has the opportunity to spread.

Kikuyu grass and castor bean have a limited Cal-IPC rating, which is defined as "invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic" (Cal-IPC 2020). Kikuyu grass is extensive on the north bank of the creek and may be aiding in bank stabilization. Kikuyu grass is not recommended for removal, but may be trimmed back in places as needed. The few castor bean plants may be removed opportunistically during vegetation removal efforts for the vines.

TABLE 4. LIST OF INVASIVE PLANTS AND ACTION AREAS

Scientific Name	Common Name	Cal-IPC Rating	Location Marked on Figure 7
Arundo donax	Giant reed	High	A
Delairea odorata	Cape-ivy	High	A
Hedera helix	English ivy	High	D
Pennisetum clandestinum	Kikuyu grass	Limited	-
Ricinus communis	Castor bean	Limited	-

Source: Cal-IPC 2020

6.3.2 Removal Methods

For giant reed, we recommend using the manual hand removal method given the location in the creek bed and the relatively small size of the plant. For manual removal, first cut the stems of the canopy near the surface to allow for easier access to the rhizomes (USDA 2014). Then, dig up and entirely remove the root mass, associated rhizomes and roots from the soil.

For cape-ivy and English ivy, manual removal of all the plant material, including stems, roots and rhizomes is recommended to prevent the resprouting from fragments of the plants (DiTomaso et al. 2013). Large blankets of the vines can be cut at ground level and rolled up and removed from the site. Vines in the upper portions of the trees can be cut from the base and left in the tree to avoid damaging the tree further.

Invasive plant material and debris should be bagged and disposed of as trash. It should not be chipped or composted. Persistent follow-up monitoring and removal of resprouts is essential for the success of removal efforts (DiTomaso et al. 2013). Monitoring should occur every two months the first year and every four months the second year to locate and remove resprouts. Follow-up removal efforts should occur before resprouts become established.

During removal efforts along the creek banks, care should be given to avoid disturbing eucalyptus and native tree saplings, including western sycamore, black cottonwood, and white alder. Care should be taken to clear the vegetation around the saplings to support healthy growth.

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 nurture resprouts. Provide sufficient water to existing redwoods.
2. Clear vegetation around eucalyptus and native tree saplings along creek banks to support healthy growth.
3. Remove non-native plants from creek banks.
4. Remove large, downed trunks from proposed planting areas.
5. Restore tree canopy in the grove by planting blue gum, red ironbark, Monterey cypress, and western sycamore.
6. Increase wind protection in the grove by planting toyon.
7. Increase appropriate nectar sources.

7 INSTALLATION AND MONITORING

The implementation of this habitat management plan at the Carpinteria Creek site will be accomplished by VCRCD with the assistance of property owners and community volunteers.

7.1 INSTALLATION

Plants will be installed using best horticultural practices to ensure health and survival of plantings and continued use of aggregation habitat 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 property owners 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 every

week during the dry season (May through October) and at least every 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 as needed 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 plants are established. Gopher baskets may be necessary to prevent below-ground herbivory from destroying plantings.

7.4 MONITORING OF PLANTINGS

VCRCD will maintain the integrity of monarch overwintering habitat enhancement efforts by ensuring the survival of trees, shrubs and nectar plantings. VCRCD will monitor restoration plantings on a regular basis and address issues as they arise. To track the success of habitat recovery annual monitoring is recommended to assess site conditions. 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 regularly 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 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 directions at Photo Stations during the same 2-week period each year.

8 MONARCH MONITORING

Monitoring overwintering monarchs' use of the Carpinteria Creek site is important for assessing the effectiveness of this restoration plan. VCRCD and the property owners will 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 Carpinteria Creek site may be installed and used to educate visitors and residents 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 fire road/Right of Way entrance at the end of 6th Street to inform workers and the public of the habitat value of the site and related tree management issues. Sign would be placed on a low post. Suggested language is Monarch Preserve, Sensitive Habitat, Contact City of Carpinteria and the 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.

Signage may be subject to approval by the City of Carpinteria and property owners.

10 REFERENCES

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

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.

City of Carpinteria. 2003. General Plan/Local Coastal Land Use Plan and Environmental Impact Report. State Clearinghouse Number 1997121111. April.

DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544p. Cape-Ivy Weed Report Excerpt, https://wric.ucdavis.edu/information/natural%20areas/wr_D/Delairea.pdf

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

Midwestern Regional Climate Center (MRCC). 2021. Cli-MATE Database. https://mrcc.illinois.edu/CLIMATE/Hourly/WindRose.jsp

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.

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., 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/

United States Department of Agriculture (USDA). 2014. Field Guide for Managing Giant Reed in the Southwest. Forest Service, Southwestern Region. TP-R3-16-11. September 2014.

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

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 & Count Records from the Xerces Society Western Monarch Overwintering Sites Database 2020**
- **Appendix C. Best management Practices for Tree Planting & Aftercare**

APPENDIX A. SITE PHOTOS, 2020

Appendix A Site Photos

Photos were taken during a site visits on October 7, 2020 by Dan Meade and on November 16, 2020 by Charis van der Heide.

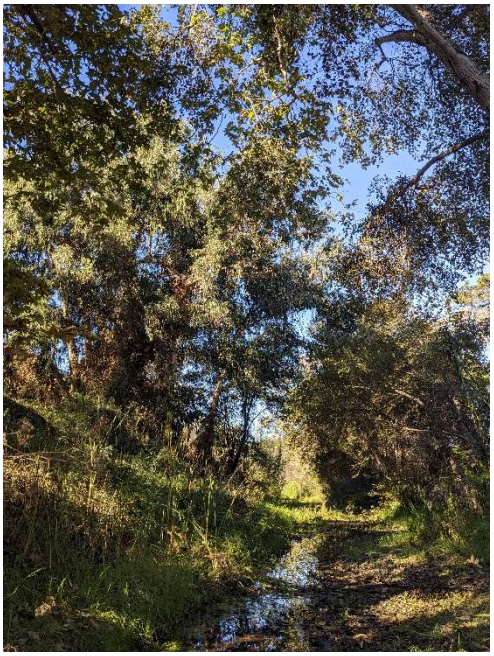


Photo 1. Looking southwest and downstream towards the monarch roosting area in the western sycamore.

Photo 2. Looking northeast and upstream towards the eastern end of the monarch roosting area. The north bank (on the left) is where we recommend planting western sycamore.

Photo 3. Near the monarch roosting area, looking south at the northern bank of the creek at an area covered with cape ivy recommended for removal.

Photo 4. Area on the northern bank by the Monterey cypress tree, looking southeast towards one of the areas recommended for nectar plants.

Photo 5. Looking north on the western end of the roosting site, south of the creek, at an area of fallen eucalyptus trees. This area is recommended for removal of logs and stumps and planting ecalyptus and Monterey cypress.

Photo 6. Looking north towards the creek from the south bank at an area of fallen eucalyptus trunks covered in English and cape ivy. This area is recommended for the removal of downed trunks and vines and replanted with trees and toyons.

Photo 7. Looking north on the eastern end of the roosting site, south of the creek, at an area of fallen eucalyptus trees and planted coastal redwood. This area is recommended for removal of logs and stumps and maintaining cover of coast redwoods and eucalyptus.

Photo 8. South of the creek are open fields and rows of planted milkweed.

APPENDIX B. SITE ASSESSMENT & COUNT RECORDS FROM THE XERCES SOCIETY WESTERN MONARCH OVERWINTERING SITES DATABASE 2020

Site Name: Carpinteria Creek

SiteID: 2799

CNDDB #: 1

Aka: Concha Loma
Salzgerber Meadow
Calvert Site 90; Meade Site 99

Site Status: Active Status Update: 12/1/2013

Status Comment

Sensitive Data (yes if checked)? ☐

County: Santa Barbara

Owner Name:	Private
Property Name:	Unknown
Primary Land Use:	PARKS

Land Use Update: 7 /9 /2010
Ownership Update: 9/1/2013

Directions: North of the Southern Pacific RR, east of Carpinteria Creek, west of Concha Loma Dr., and south of Callejon Drive.

Site Description: Most of site is flood plain on SE side of Carpinteria Cr. Bluff is lined with homes of Concha Loma Dr. Creek is lined w/ willows along the southern half of site; northern half is mix of sycamores, euc, and other trees. Dense poison oak.

Comment: Meade tagged tree at this site. Tree tag number 292.

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

SITE CHARACTERISTICS (by date reported):

Source Code: SAK88F0002 **Source Year** 1988

Site Characteristics Date Reported: **09/25/1996**

Author First Name: Walter

Aggregation Type Reported:

Author Last Name: Sakai

Site Quality Reported: Good

Ecological Description: ROOST TREES CONSIST OF EUCALYPTUS, WILLOWS, SYCAMORES, COTTONWOODS, AND COAST LIVE OAKS.

Aggregation Comments: INCLUDES TWO AREAS CONTAINING ROOST TREES, APPROXIMATELY 800 YARDS APART. FIRST SITE IS NEAR THE CORNER OF CALLE ARENA AND CONCHA LOMA; SECOND SITE IS NORTH OF KONO FARMS.

Cluster Tree Species

Scientific Name	Common Name
Eucalyptus globulus	blue gum
Platanus racemosa	western sycamore
Quercus agrifolia	coast live oak
Salix spp.	willow

Threats Comments:

Source Code: MEA99R **Source Year** 1999

Site Characteristics Date Reported: **xx/xx/1999**

Author First Name: Daniel

Author Last Name: Meade

Aggregation Type Reported: Autumnal

Site Quality Reported: Good

Ecological Description: On the east bank facing the Singing Springs Village condominiums, clusters of monarchs form in Blue gum eucalyptus and sycamore trees.

Aggregation Comments: Long been an important aggregations. Monarchs cluster on east bank and on east side of trees near an open field used for agriculture.

Cluster Tree Species

Scientific Name	Common Name
Eucalyptus globulus	blue gum
Platanus racemosa	western sycamore
Populus spp.	cottonwood
Salix spp.	willow

Threats Comments:

Source Code: CAL91R **Source Year** 1991

Site Characteristics Date Reported: **01/23/1990**

Author First Name: William

Author Last Name: Calvert

Aggregation Type Reported: Permanent

Site Quality Reported:

Ecological Description: Meadow adjacent to creek lined with windrows of tall eucalyptus. Part of creek bed to northwest lined with cottonwoods and willows. At head of meadow is a moderately large grove of eucalyptus in the shape of an L. This appears to be the main grove.

Aggregation Comments:

Cluster Tree Species

Scientific Name	Common Name
Eucalyptus spp.	eucalyptus species
Populus spp.	cottonwood
Salix spp.	willow

Threats Comments:

Source Code: XER14F0009 **Source Year** 2014

Site Characteristics Date Reported: **11/23/2013**

Author First Name: Donna

Author Last Name: Grubisic

Aggregation Type Reported:

Site Quality Reported:

Ecological Description: Eucs and buildings provide wind buffer. No morning light. Home gardens provide nectar.

Aggregation Comments:

Nectar Species

Scientific Name	Common Name
Eucalyptus globulus	Blue gum

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.

12/29/19	380	370 clustered in western sycamore trees, 10 flying
12/07/19	1,130	1130 clustered in sycamore trees
01/12/2019	175	140 clustered, 25 fliers, 10 loners/sunners
01/11/2019	200	190 clustered, 10 fliers
11/10/18	795	785 clustered in Willow and Sycamore, 10 fliers
11/03/18	270	
11/12/17	2,960	
01/11/2017	0	
12/04/2016	800	
11/15/2016	7,830	
10/09/2016	1,015	clustering on Willows, myoporum, sycamore, cottonwood and Eucs
12/03/2015	4,110	3860 clustered in 3 trees (Willow? And 2 Syca), 150 fliers, 100 loners. 1 mating monarch
11/19/2015	3,387	3145 clustered in 4 trees (2 ORN, 2 Sycamore), 100 fliers, 142 loners. *Count from 12/03/15 was higher so it was used for the TC count.
12/04/2014	2,907	2627 clustered in 3 trees (Walnut, Sycamore, Willow), 150 loners, 130 fliers. This count was not used for TC because the count on 12/1/2014 was higher and so it was used instead.
TC/TC/2014	5,000	
11/26/2014	3,775	Clustered in 3 trees: Willow, Myoporum, CA Sycamore. This count was not used for TC because the count on 12/1/2014 was higher and so it was used instead.
TC/TC/2013	1,480	Clustered in 1 CA Sycamore.
TC/TC/2012	1,500	
TC/TC/2011	1,800	
TC/TC/2007	30	
TC/TC/2006	4,250	
TC/TC/2005	6,300	
TC/TC/2004	3,200	
TC/TC/2003	6,150	
TC/TC/2002	4,500	
12/10/2001	1,800	Secondary Source (date): 71
11/15/2000	22,500	Secondary Source (date): 71
11/15/1999	13,000	Secondary Source (date): 71
03/xx/1999	0	
02/xx/1999	250	
01/xx/1999	147	
12/xx/1998	3,114	
11/23/1998	9,000	Monarch Program Thanksgiving Count (according to Sakai 2000)
11/xx/1998	2,890	
10/xx/1998	7,325	
01/08/1998	0	

11/23/1997	50,000	Secondary Source (date): 71
11/23/1997	8,000	
xx/xx/2000	20	B. Hansen to W. Sakai.
xx/xx/2000	0	
xx/xx/2000	30	B. Hansen to W. Sakai.
xx/xx/2000	0	
xx/xx/2000	0	B. Hansen to W. Sakai.
xx/xx/2000	350	300-400 observed. B. Hansen to W. Sakai.
xx/xx/2000	600	500-700 observed. B. Hansen to W. Sakai.
xx/xx/2000	1,500	B. Hansen to W. Sakai.
xx/xx/2000	1,000	900-1100 observed. B. Hansen to W. Sakai.
xx/xx/2000	1,150	1000-1300 observed. B. Hansen to W. Sakai.
xx/xx/2000	1,100	1000-1200 observed. B. Hansen to W. Sakai.
xx/xx/2000	300	B. Hansen to W. Sakai.
xx/xx/2000	1,700	1600-1800 observed. B. Hansen to W. Sakai.
xx/xx/2000	1,900	1800-2000 observed. B. Hansen to W. Sakai.
xx/xx/2000	1,500	1500+ observed. B. Hansen to W. Sakai.
xx/xx/2000	1,000	1000+ observed. B. Hansen to W. Sakai.
xx/xx/1993		flyers observed 1992-93
01/22/1991	7,000	Monarchs observed nectaring on eucalyptus and willow and drinking dew on meadow vegetation.
01/06/1991	6,000	Approx. 6000 located on southeast side of small L-shaped grove ~400m upstream of RR tracks. Roosting 8-20m with most between 12 an 15m.
xx/xx/1991	5,000	observed 1990-91
10/25/1990	5,500	Approx. 5-6000 clustered in the lower section of drainage; 2000 clustered north of RR tracks on the north face of eucalyptus row; 4000 located on both sides of eucalyptus stand along creek beginning approx. 400m north of RR tracks.
01/23/1990	750	Afternoon clusters on east side of creek. Approx. 4 clusters observed on a row of eucalyptus north of RR tracks. 3 more observed adjacent to creek ~500m north.
01/23/1990	750	500-1000 observed
xx/xx/1989	10,000	1988-89 season
10/23/1985	5,000	
	63	Total # observations reported:
	56	Total # observations with monarchs present (>0):

Observation Data Source(s)

1999	Daniel	Meade	Monarch Butterfly Overwintering Sites in Santa Barbara County, California
1991	William	Calvert	Monarch Butterfly Overwintering Sites in Santa Barbara County, California
2000	Walter	Sakai	STATEWIDE SET OF FIELD SURVEY FORMS FOR MONARCH WINTERING SITES, SURVEYED UP TO AND INCLUDING WINTER 1999-2000.
1998	Walter	Sakai	STATEWIDE SET OF FIELD SURVEY FORMS FOR MONARCH WINTERING SITES, SURVEYED IN WINTER 1997-98.
1988	Walter	Sakai	Field Survey Form for Danaus Plexippus at Concha Loma-Carpinteria Creek Site
2014		Xerces Society	Summary of Thanksgiving Count data from 1997-2014
1991	Walter & William	Sakai & Calvert	Statewide Monarch Butterfly Management Plan for the State of California Dept. of Parks and Recreation - Final Report
2014	See: Observor	Xerces Society	Field Survey Form for Danaus plexippus overwintering sites, surveyed in winter 2013-2014
2016	See: Observor	Xerces Society	Habitat Assessment Form for Danaus plexippus Overwintering Sites, surveyed in winter 2015-2016
2017	See: Observor	Xerces Society	Field Survey Form for Danaus plexippus Overwintering Sites, surveyed in winter 2016-17
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 & 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

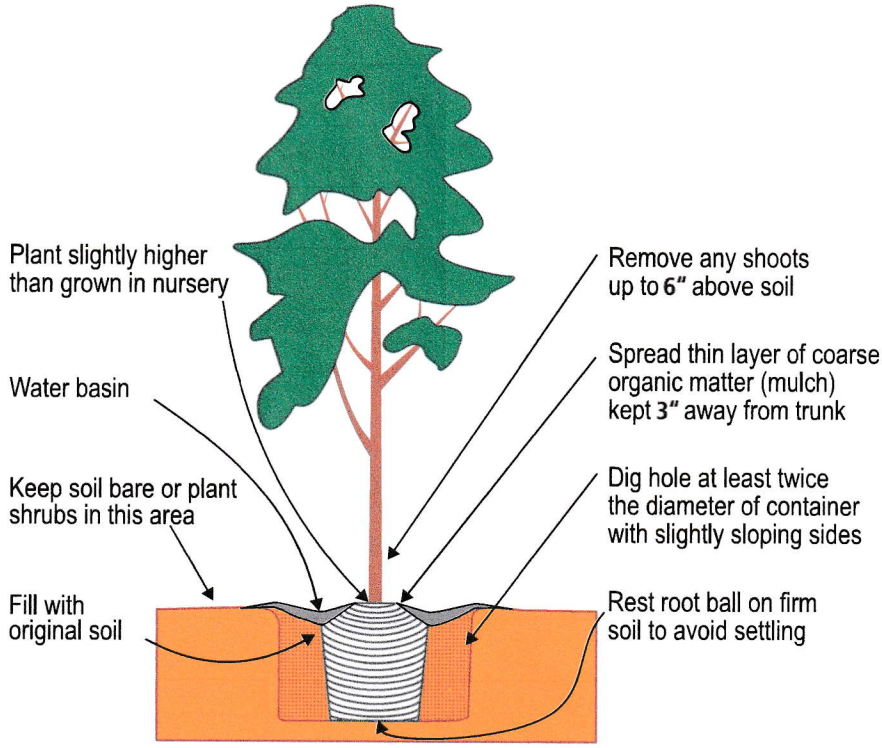


Figure 1. Proper planting of a container-grown tree.

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.

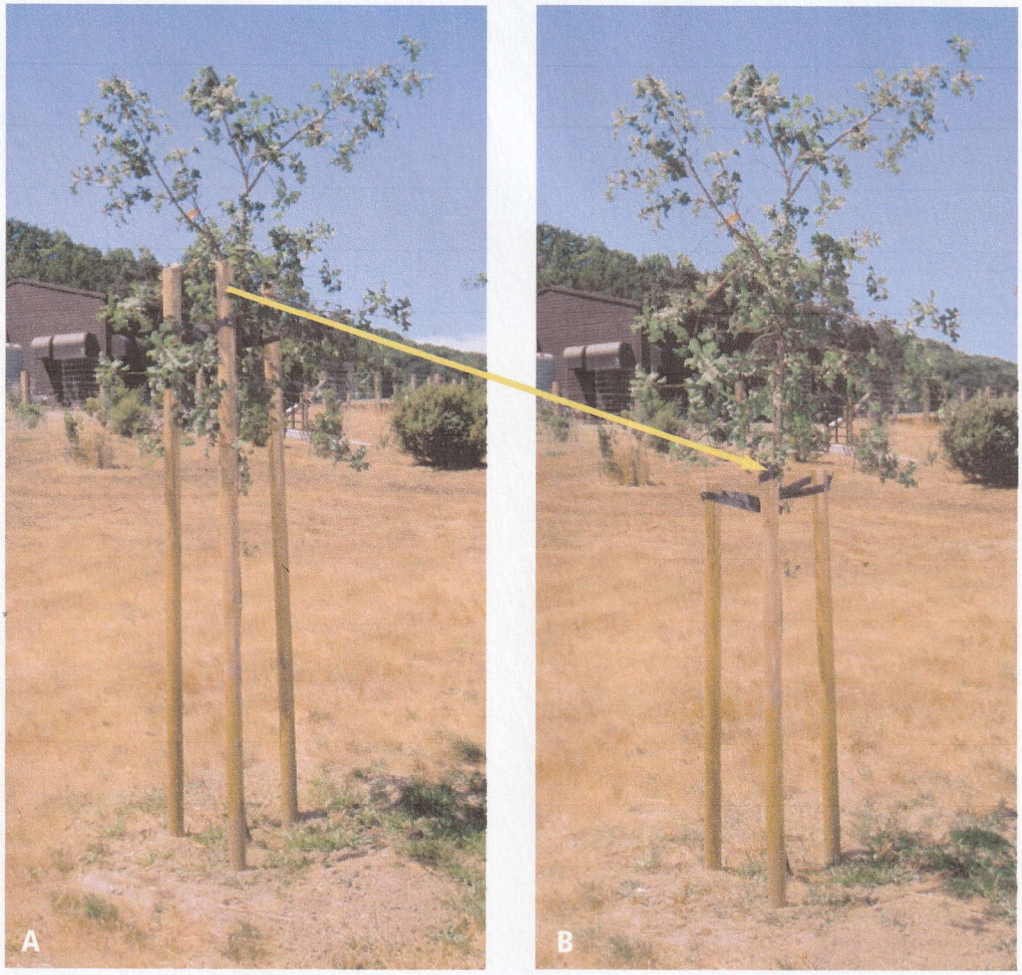


Figure 2. (A) Valley oak tied and staked too high. (B) Stakes and ties properly adjusted.

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.

UC PEER REVIEWED