YEAR 5 (2020) ANNUAL MONITORING REPORT

PALLID MANZANITA HABITAT ENHANCEMENT AND CONSERVATION PLAN FOR THE CHABOT SPACE AND SCIENCE CENTER



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JANUARY 31, 2021

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Section 1. Introduction

1.1 Summary

The purpose of this report is to present the results of the 2020 annual monitoring (Year 5) of the Pallid Manzanita Habitat Enhancement and Conservation Plan (HECP). All monitoring activities were carried out by Friends of Sausal Creek (FOSC) as specified in the HECP, with minor modifications. Per the HECP (Chabot Space & Science Center 2015), the site was monitored for five years, ending December 31st of 2020. Year 5 extends from January 2020 to December 2020.

This report addresses activities completed through December 31, 2020 and a summary of implemented actions, performance criteria, monitoring methods, locations sampled, representative photographs, monitoring results, trends, and recommendations.

The site continues to show great promise in regards to its *Arctostaphylos pallida* (pallid manzanita) population. Beginning in 2015, mature tree removals and monthly volunteer workdays at the occupied pallid manzanita site at Chabot Space and Science Center (CSSC) have cleared competing vegetation and litter and promoted robust natural Pallid recruitment. The observed seedlings are presumably germinated from the existing soil seed bank. Due to the presence of dead manzanitas in this area, it is assumed that an abundant and viable soil seed bank exists, and additional pallid manzanitas will continue to germinate. Based on these observations continued germination will be supported with additional tree removals.

Seedling surveys conducted in May of 2020 revealed 119 living seedlings present on the site. This presence has been consistent since the Year 1 monitoring conducted in 2016 when around 100 seedlings presumed to be pallid manzanita were surveyed. While some seedlings recorded in the past 3 years have senesced, others appear to be first or second year recruits. Additionally many seedlings are becoming sizeable. Some seeding clusters are so densely populated that counting individuals within the clusters is becoming more challenging, and may slightly skew recruitment population numbers. In 2020, the monitoring crew dedicated more time to sorting through these dense clusters. Another exciting development this year was that 18% of the recorded pallid seedlings flowered and fruited, most for the first time.

The Year 5 monitoring and maintenance work was completely altered due to the COVID-19 pandemic and subsequent Shelter In Place (SIP) orders. There were very few workdays, and volunteer work was limited to specific tasks and kept to a minimum number of people at any time. It was necessary to utilize more FOSC staff members in place of volunteers this year to complete monitoring and perform prioritized invasive plant removal, which was focused on larger shrubs and plants in proximity to pallid seedlings.

FOSC staff and volunteers conducted seedling monitoring in 2020 to re-document tagged seedlings from the previous year as well as tag newly discovered seedlings. All seedlings were once again measured and given a vigor rating. As noted above, extra time was spent trying to identify individuals that are now growing in dense clusters to get data on as many seedlings as possible in the last year of this reporting.

Despite limitations, vegetation monitoring was also performed this year. All three non-native plant covers fell below the HECP target of 20%. The site contains a significant amount of non-native grasses. However, native shrubs, including the pallids themselves, are now more established and taking up more space to block non-native plant growth. Since the site is undergoing conversion to a woodland and/or scrubland ecosystem, priorities in 2020 were to remove shrubs, both non-native and natives, that were encroaching on pallid seedlings.

FOSC is committed to and will continue restoration work to ensure the survival of the pallid manzanita, an effort which has been largely underfunded for the past five years. CSSC, the organization responsible for the pallid mitigation, assisted in pursuing funding for the original tree removals in 2015, but has not been in a position to provide additional funding nor has it assisted in obtaining alternative funding sources. We will continue our attempts to locate additional funding as well as continue to appeal to CSSC for financial assistance. FOSC is grateful for the three years (2017, 2019 and 2020) of partial support from the Alameda County Fish and Game Commission (ACFGC). Further, the ongoing guidance of expert Lech Naumovich has been instrumental in the project success. Naumovich is the author of the 2017 *East Bay Regional Park District Pallid Manzanita Management Plan.*

A brief summary of the performance criteria and 2020 site status is included in Table 1 below.

Performance Criteria	IS SITE ON TRACK TO MEET PERFORMANCE CRITERIA?	Comments
A minimum of 21 pallid manzanita plants will be established at the CSSC site within five years from the date of completion of the first phase of invasive tree removals and Fire Abatement Requirements (December 30, 2014) and will be maintained in perpetuity.	Yes	Between April and November 2020, 119 live pallid manzanita seedlings were observed on site. Of these plants, 78% were in healthy (vigor class 3) condition, and 18% produced fruits.
The CSSC site will contain less than 20% cover of invasive [non-native] plant species within five years and shall be maintained annually.	Yes	Based on the 2020 monitoring data, non- native species in the > 2 meter, 1-2 meter and < 1 meter ranges were an average of 3%, 3%, and 15% cover respectively. (See Table 5 for a detailed breakdown).
Areas around existing pallid manzanita individuals at the CSSC site will be clear of competing vegetation.	Yes	Despite limited workdays in 2020, competing vegetation in pallid manzanita habitat was cleared. Workdays in the future will continue to remove competing vegetation.
Monitoring of the existing CSSC pallid manzanita population will occur on an annual basis provided that the soil is dry enough. Annual monitoring will be conducted for five years if performance standards are met, or longer until performance standards are met.	Yes	Monitoring occurred in 2020 and is not necessary in 2021 as performance criteria were met in 2020. FOSC hopes to monitor the site every 3-5 years hereafter.

TABLE 1. SUMMARY OF PERFORMANCE CRITERIA AND SITE STATUS

1.2 Project Background

Pallid manzanitas (*Arctostaphylos pallida*) have been listed as Endangered by the State of California since 1979 and recognized as Federally Threatened since 1998. The population at the Chabot Space and Science Center (CSSC) showed dramatic decline between 1995 and 2015. The 1995 Environmental Impact Report¹ identified 21 individuals. When active management at CSSC began in 2015 with the finalization of the Habitat Enhancement and Conservation Plan (HECP)², only three mature pallid manzanitas were present at the site. Of these three plants, only one has survived to date from the original 21. Of further concern, prior to active management beginning in 2015, was the minimal regeneration of pallids on-site. This demonstrated that the population was trending toward extirpation. As cited in the HECP, some of the possible reasons for the population decline include lack of vegetation management (causing pallid manzanitas to be shaded out); fire suppression; and potential *Phytophthora cinnamomi* infection. Although *P. cinnamomi* testing of soil at the CSSC site in 2016 was negative, these results do not ensure that the pathogen is not present.

The HECP specifies two overarching management goals for maintaining pallid manzanitas on site. First, to create viable habitat for the pallid manzanita by reducing overstory competition and removing trees and non-native shrubs. Second, to increase the pallid manzanita population to at least 21 individual plants. Monitoring the health of living pallid manzanitas and pallid manzanita recruitment also plays a key role in determining the success of restoration efforts and informing future management decisions. The HECP requires that germination experiments will be conducted to test various methods for pallid manzanita recruitment.

The HECP also specifies annual monitoring to document the health of individual pallid manzanitas and habitat conditions. The goal of annual monitoring is to assess any changes in the status of pallid manzanitas on site, assess the results of the germination experiment and future out-plantings (if instigated), and assess the success of weed abatement. During the five-year monitoring period, the required frequency of weed eradication and the status of the pallid manzanita population was evaluated. If the performance standard thresholds were not met at the end of the monitoring period, weed management and annual monitoring were to continue until standards are met. If at the end of the five-year monitoring period the performance standards were met, as they were, monitoring will then occur once every three years to ensure that conditions are maintained. Weed abatement in the area will likely be ongoing for an indefinite amount of time.

Overall site conditions have continued to improve during the last five years due to tree removals that have opened up the canopy and diligent vegetation management activities including

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¹ Environmental Science Associates. *Chabot Observatory and Science Center Environmental Assessment*. March 22, 1996.

² Chabot Space and Science Center. *Pallid Manzanita Habitat Enhancement and Conservation Plan*. October 2015.

recurring volunteer workdays. Davey Tree completed Phase 2 of tree removals as outlined in the HECP in December 2016. Friends of Sausal Creek , in partnership with CSSC, the East Bay chapter of the California Native Plant Society (EBCNPS), and the City of Oakland, has organized habitat improvement volunteer workdays at CSSC since February 2015. During these workdays, volunteers removed non-native plants and heavy wood litter from the sunny knoll above the parking lot and on the south side of the West Ridge Trail. As of 2020, most of the litter is gone, and managing the site includes removal of shrubs (both non-native and encroaching native shrubs), and annual invasive plants that are re-establishing at the site.

Improving habitat conditions through active management has resulted in a significant amount of natural recruitment at the CSSC pallid manzanita site since 2015. Seedling monitoring was established in Year 2 to determine what factors may be contributing to seedling mortality. This information may be used to direct effective management decisions at this site in the future. Furthermore, knowledge gained through observations at CSSC will inform the restoration of other pallid manzanita populations within the species' limited range.

Section 2. Goals, Performance Standards, and Monitoring Methods

2.1 Goals and Performance Standards

As detailed in the HECP, there were no original mitigation requirements in the 1996 Environmental Assessment prior to its development concerning the size of habitat to be set aside for the pallid manzanita. At the time of submission of the Environmental Assessment in 1996, there were 21 individual pallid manzanita plants. When the HECP was drafted in 2006, there were 11 individual plants. In October 2015 when the HECP was revised, there were 3 living plants remaining at the site, only one of which was from the original 1996 population. As of December 2020, only two of these three mature plants remain.

Based on the HECP, goals for the pallid manzanita are as follows:

- Restore the CSSC population to the original size prior to construction, at a minimum that would be 21 plants.
- Maintain CSSC occupied areas free of woody invasive plants by removal and continued maintenance of species that compete with the pallid manzanita for light and nutrients (this includes native and non-native species).
- Monitor and manage the CSSC pallid manzanita site population over the long term to ensure pallid manzanita individuals persist and thrive.

Performance Standards for the CSSC site are as follows:

- A minimum of 21 pallid manzanita plants will be established at the CSSC site within five years from the date of completion of the first phase of invasive tree removals and Fire Abatement Requirements (December 30, 2014) and will be maintained in perpetuity.
- The CSSC site will contain less than 20% cover of invasive [non-native] plant species within five years and shall be maintained annually.

- Areas around existing pallid manzanita individuals at the CSSC site will be clear of competing vegetation.
- Monitoring of the existing CSSC pallid manzanita population will occur on an annual basis provided that the soil is dry enough. Annual monitoring will be conducted for five years if performance standards are met, or longer until performance standards are met.

Adaptive management will be necessary, and the above performance standards may change over time to continue the habitat improvement necessary for the survival of the pallid manzanitas.

2.2 Maintenance and Monitoring Site Visits

Table 2 details all activities that were conducted from January 1, 2020 to December 31, 2020, as well as volunteer attendance. Due to COVID-19, the number of workdays and volunteers was extremely limited. Extra staff were utilized to complete monitoring in place of volunteers. The timing of monitoring and maintenance activities are summarized in Table 3.

	# of	Total	
Date	Volunteers	Hours	Activity
5/16/2020	1	1	Fence instillation around Big Trees plants near parking area
5/26/2020	2	12	Pallid seedling monitoring; native and non-native shrub removal (plus two staff)
6/29/2020	3	18	Vegetation cover class and photo monitoring; native and non-native shrub removal (plus two staff)
7/6/2020	1	1	Fence instillation around mature pallid near PAL Camp (across the street from the Big Trees population)
9/18/2020	2	6	Informal habitat enhancement workday; tree re-sprout removals, broom removal (plus three staff)
12/01/202 0	0	0	FOSC staff replaced failing temporary fencing along the Westridge Trail

TABLE 2. MONITORING AND MAINTENANCE ACTIVITIES CONDUCTED IN YEAR 5 (1/1/20-12/31/20)

Monitoring/ Maintenance Element	JAN 2020	Fев 2020	March 2020	April 2020	MAY 2020	JUNE 2020	JULY 2020	AUG 2020	Sept 2020	Ост 2020	Nov 2020	DEC 2020
Individual Plant Monitoring										x	x	х
Natural Recruitment Monitoring				x	x	x	x	x	x	x	x	
Vegetation Monitoring							x					
Photo Points and Other Documentation							x			х	х	х
Habitat Improvement Volunteer Work Days					х	х	x		х			
Stump Sprout Removal, Tarping							x					

TABLE 3. SUMMARY OF MONITORING AND MAINTENANCE ACTIVITIES CONDUCTED IN YEAR 5 (1/1/2020-12/31/2020)

2.3 Monitoring and Maintenance Methodology

The monitoring methods employed comply with the project's HECP and are described below. Monitoring in Year 5 was conducted by FOSC staff and volunteers.

2.3.1 Individual Plant Monitoring

For individual plant monitoring of the mature pallids on site as of Year 1 monitoring, the most important parameter to evaluate was survival. Additionally, plant vigor (overall health) was assessed both qualitatively, by examining a plant's appearance (percent senescence, presence of new growth, level of flower and fruit production), and quantitatively, by measuring plant growth (height and crown diameter).

In Year 5, individual plant monitoring was again conducted for the original two surviving individuals. Each plant was measured and given a vigor class (see Table 4). Photo points from each cardinal direction were re-taken (see Appendix A).

The individual plant monitoring data sheet can be found in Appendix B.

2.3.2 Germination Experiment Plot Establishment, Maintenance, and Monitoring

Two separate germination studies were established in Year One: the Seed Germination Study and the Soil Seed Bank Study. See Year 1 Annual Monitoring Report for complete methods. No new seedlings had sprouted in any germination study plots as of 2018, therefore the germination plot monitoring has ceased.

2.3.3 Natural Recruitment Monitoring

Natural recruitment was first observed in 2016 when 113 presumed live pallid seedlings and 45 dead seedlings were surveyed, but not tagged or monitored. These numbers are significant when compared to natural recruitment at other sites within the species' range where populations are in decline. As an actively managed restoration site, annual monitoring of seedling height, canopy, and vigor was critical to understanding the population dynamics of the species. Individuals were tagged in order to track their changes and collect data on vigor and size. The intention of seedling monitoring data is to reveal if there is a correlation between height/canopy and senescence, and whether there is a critical time in the season when senescence occurs. If trends are identified, then effective adaptive management measures may be taken to increase survivability of the most vulnerable plants.

In 2020, the site was re-surveyed for previously recorded (tagged) seedlings, seedlings that have been missed in previous monitoring efforts, as well as seedlings that are new recruits. In 2020 the data continued to be collected in centimeters even though original 2017 data had been collected in inches.

- For each seedling, the following metrics were recorded:
 - o Height of tallest live foliage in centimeters
 - o Canopy diameter of multi-stemmed seedlings in centimeters

 Plant vigor: The vigor classes are as follows: (3) dense foliage, no spotting or discoloration of leaves; (2) some leaf spotting or dieback; (1) sparse foliage, pronounced spotting and dieback; (0) dead.

Natural recruitment monitoring data is added to a spreadsheet and maintained by FOSC staff. A data monitoring form can be found in Appendix B. Raw data for 2020 is found in Appendix D.



Photo: A small seedling is measured at the monitoring workday (5/26/2020)

2.3.4 Planting Plots

Even though no germination has occurred in the germination plots, no nursery propagation or planting has been necessary due to the number of seedlings that have naturally recruited at the site.

2.3.5 Vegetation Monitoring

As specified in the HECP, vegetation monitoring was conducted as follows:

- Seven 100-foot transects were placed throughout the occupied pallid manzanita area. Transects ran northeast to southwest downhill from a 275' baseline placed along the West Ridge Trail. Due to the randomly selected starting point of the first transect, again only 7 transects (as opposed to 8 in 2018) fit along the baseline. This number was accepted as sufficient coverage. The first transect was randomly assigned at 13', the subsequent transects were placed every 30' thereafter (13', 43', 73'...).
- Cover of non-native and native plant species was recorded using the point-intercept method. The observer stopped every two feet beginning at two feet for a total of 50 points along each transect line. They recorded if the point intercepted a plant species, only noting the first species encountered, in three canopy classes based on the height of vegetation layers: <1 meter, 1-2 meters, >2 meters. The point was then recorded as a species hit. Soil surface cover of rock, bare, litter, stump, or other were also recorded at each point.

• Photos were taken of each transect. Point-intercept photos can be found in Appendix A.

The vegetation monitoring data forms can be found in Appendix B. Raw transect line data is found in Appendix C.



Photo: FOSC staff and volunteers collected point-intercept data to determine vegetation class cover (6/29/2020)

2.3.6 Photo Points

In November 2016, permanent photo points were established to capture relevant conditions on site. These points are to be monitored during the five-year monitoring period so that photos may be compared over time to qualitatively assess changes in plant and general site conditions as well as vegetative composition, cover, dominance, and structure.

See previous report for methods employed in the establishment of the photo points.

The photo point monitoring form can be found in Appendix B. Photos from these points are found in Appendix A. This year, some of the original 2016 photos were included for a side-by-side comparison of site changes.

2.3.7 Maintenance Methodology - Habitat Improvement Volunteer Workdays

The most important habitat management issue, for both current habitat and pallid manzanitas reintroduction, is the control of competing native and non-native vegetation. Monthly habitat improvement volunteer workdays were established in 2015. These have continued, although modified for public safety in 2020, for the primary purpose of removing competing vegetation at the CSSC pallid manzanita site. Workdays only occur in the dry season as damp soil conditions promote the spread of *Phytophthora cinnamomi*.

Volunteers who participate at the site for the first time are introduced to site protocol and history. On every workday that occurs, volunteers search for new pallid manzanita seedlings to tag.

During all maintenance and monitoring workdays, FOSC volunteers follow best management practices to prevent the introduction and/or spread of *Phytophthora* outlined in the "Hygiene [*sic*] Protocol for *Phytophthora cinnamomi*" from the *Vegetation Management Implementation Plan* by WRA, Inc., November 2013. These practices include disinfecting machinery, hand tools, footwear, and vehicles before and after leaving the site; avoidance of work during periods of precipitation (including fog drip); not removing plant or soil material from the site; and minimizing soil disturbance on site.

Section 3. Monitoring Results and Recommendations

This section outlines the results of Year 5 monitoring.

3.1 Individual Plant Monitoring

The two remaining mature pallids were again monitored in 2020. Individual number three, the largest plant by far, still has some live foliage, but remains in poor condition. It was discovered that one main branch of individual three is doing better than the rest of the plant but had been obscured by tall poison oak. Despite its poor condition, this plant is still producing some flowers and fruit. Individual two is still quite healthy as of 2020. It again has substantial new growth and produces flowers and fruits. See Table 4 below for an overview.

PLANT NUMBER	Неіднт	CROWN DIAMETER	ALIVE?	VIGOR	Notes
1	n/a	n/a	No	0 (Dead)	This plant senesced in 2018. UTM: 572157.77E, 4185935.19N
2	80 inches	140 inches	Yes	3 (Good)	Vigorous and very healthy in 2020. Tag #601 UTM: 572158.93E, 4185923.55 N
3	~84 inches	~109 inches	Yes	1 (Poor)	This plant fell in winter 2017 making measurements challenging and inaccurate. A few main branches with live foliage persist. The bulk of the plant has only a small amount of green growth at its tips. One main branch growing northwest from the main trunk had been surrounded by poison oak and other shrubs, but was cleared out this year. It looks healthier than the other parts of the plant. Tag #509 UTM: 572157.44E, 4185924.19N

TABLE 4. RESULTS OF INDIVIDUAL PLANT MONITORING (06/29/20	020)
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Photo points of individual plants can be found in Appendix A.

3.2 Germination Experiment Plot Monitoring

Year 5 has surpassed the two year time frame required for germination results. Consequently, FOSC no longer monitors the germination plot experiments from Year 1.

In 2016, Pallid Crew leader Judy Schwartz collected around 80 fruits (seed number unknown) from two pallid manzanitas at CSSC with considerations to 5% seed collection guidelines. The seeds not used for the Year 1 germination study are being stored at the FOSC nursery.

3.3 Natural Recruitment Monitoring

A single seedling survey took place in May of 2020. As in previous years, the crews also watched for seedlings while performing all other work tasks. In all, 119 living seedlings were recorded, 17 more than in 2019. This was in part due to extra time spent relocating seedlings in dense clusters. Seven previously undocumented plants were also found in 2020.

The total of 119 seedlings found in 2020 accounts for more individuals than have been found in any other year. Despite the dry winter, many seedlings were healthy, with 78% of individuals having a class 3 vigor rating. Many of the seedlings are also becoming sizeable, with again about 87% of seedlings (63 individuals) over 100 cm tall (see Figure 1 for seedling data). In other exciting developments, 22 seedlings, or about 18% of the population, flowered and produced fruits this year, many for the first time.



FIGURE 1. All SEEDLING HEIGHTS FROM 2017-2020

Individual #2 (tag number 601) is easily identifiable in this graph as the red dot. It was significantly taller than the rest of the seedlings in 2017, but many seedlings are closing in as of 2020. Individual #3 (the only remaining plant from the original population of 21) was omitted from this graph as it is substantially taller than the rest

FOSC staff still maintains that if more trees were cleared around the site edges, more seedlings would germinate on these edges. Attempts will be made to obtain tree removal funding around the site for vegetation management and fire prevention.



Photo: FOSC staff and volunteers measured all pallid manzanita seedlings and gave them a vigor rating (5/26/2020)

3.4 Vegetation Monitoring

Summary

The HECP states, "The CSSC site will contain less than 20% cover of non-native plant species within five years and shall be maintained annually." Cover of non-native trees and shrubs throughout the site is well below this goal with an average of 3%. Non-native forbs were found to be at 15% in 2020, just below the threshold of acceptable non-native cover as determined by the HECP performance standard. As noted in previous reports, most of this non-native cover is annual grasses which are harder to control and less threatening to the established pallids. Although this is the final year for fulfilling the HECP, FOSC plans to continue its efforts to keep non-native species (shrubs and trees in particular) from colonizing the site. Likewise, we will attempt to protect seedlings from encroaching native or non-native vegetation.

Another of the performance standards stated in the HECP is to "Maintain CSSC occupied areas free of woody invasive plants by removal and continued maintenance of species that compete with the pallid manzanita for light and nutrients." Included in this standard are both native and non-native trees and shrubs, classes > 2 meters tall and 1-2 meters tall respectively. In Year 5, the native tree and shrub cover nearly doubled from the 2019 numbers, with averages of 29% (trees) and 35% (shrubs). These numbers may reflect the sites natural tendencies towards becoming woodland or shrubland without management. The shrub cover percentage found in

2020 is almost identical to the percent cover recorded in 2016. As noted above, FOSC is committed to protecting the pallids from encroachment.

Photos of point-intercept transect lines can be seen in Appendix A. Raw transect line data can be found in Appendix C.

Following the summary of transect line data shown in Table 5 is further discussion of vegetation monitoring findings.

Transect Number	% COVER NATIVE VEGETATION > 2 METERS TALL	% COVER NON- NATIVE VEGETATION > 2 METERS TALL	VER NON- ATIVE ATION > 2 RS TALL WETERS TALL XER TALL		% COVER NATIVE VEGETATION < 1 METERS TALL	% COVER NON- NATIVE VEGETATION < 1 METERS TALL
1	72%	6%	16%	0%	74%	12%
2	6%	0%	36% 0%		74%	26%
3	22%	6%	50%	0%	86%	12%
4	0%	0%	44%	0%	20%	4%
5	16%	12%	18%	8%	90%	4%
6	36%	0%	28%	0%	58%	38%
7	50%	0%	52%	16%	92%	8%
Average	29%	3%	35%	3%	71%	15%
%Change from 2016	-9%	-14%	2%	0%	61%	0%

TABLE 5. SUMMARY OF TRANSECT LINE DATA (6/29/2020)

Tree cover (vegetation > 2 meters tall)

Mature non-native tree removal in Year 1 and continued seedling and sapling removal during volunteer workdays has resulted in a consistently low non-native tree species coverage. Despite a much lower number of workdays in 2020, only a 3% non-native tree cover was recorded. Native tree cover ranged from 0% to 72%, with a total average of 29%. This is due in part to random transect line placement, and in small part to an increase in tree re-sprout height over the last couple of years. Overall tree cover remains lower within the site than in surrounding areas.

Shrub Cover (vegetation 1-2 meters tall)

Cover of non-native shrubs along all transects was at 3% in 2020. Cover of native shrubs ranged from 16% to 52%. The combined average of native and non-native shrub cover for Year 5 is 38%, which is quite similar to what was found in Year 1, and is almost doubled from 2019.

Native shrubs along transects include poison oak (*Toxicodendron diversiloba*), California blackberry (*Rubus ursinus*), monkeyflower (*Mimulus aurantiacus*) and coyote brush (*Baccharis pilularis*). This large increase is probably due to the sites natural tendency towards becoming a woodland or shrubland. Native shrubs can also compete with pallid manzanita seedlings, and so despite the low number of workdays in 2020, many shrubs (particularly coyote brush and poison oak) were cleared from the vicinity of seedlings. Clearing non-native and native shrubs to keep them from competing with the pallid seedlings will be ongoing work until the pallids are more established.

Forb Cover (< 1 meters tall)

Total cover of non-native forbs ranged from 4% to 38%, while cover of native forbs ranged from 20% to 92% cover. As noted last year, the site continues to have a high percentage of native and non-native forbs, likely due to the lack of shading out. This year the non-native forb coverage was 15%, putting it again lower than the HECP performance goal of 20% or less. Again, most plants in the non-native class are annual grasses which seem to pose less threat to the pallid seedlings than woody plants.

Non-native Species

Numerous non-native species have been observed on site throughout the HECP timeline. Table 6 below details the majority of invasive species found as of 2016. Many of these are considered invasive weeds and are tracked by the California Invasive Plant Council (Cal-IPC). As native species have returned to the site during this project, so too have previously unobserved non-natives made their way in. These newer species have mostly been annuals, and primarily grasses. See the Species Key in Appendix C for an updated plant list. Non-native weed control efforts will continue to focus on shrubby species as well as invasive species in the immediate vicinity of pallid manzanita individuals. For this report, species believed to be most detrimental to the restoration of this site are listed **in bold**. Management priorities are focused on controlling these taxa.

TABLE 6. NON-NATIVE SPECIES PRESENT IN POTENTIAL PALLID MANZANITA HABITAT AREA BELOW WEST RIDGE TRAIL (INVENTORY COMPLETED BY MICHAEL UHLER ON 12/3/2016.)

SCIENTIFIC NAME	COMMON NAME	CAL-IPC RATING ⁷
Acacia melanoxylon	blackwood acacia	Limited
Briza maxima	rattlesnake grass	Limited
Bromus diandrus	ripgut brome	Moderate
Cirsium vulgare	bull thistle	Moderate
Conium maculatum	poison hemlock	Moderate
Cotoneaster pannosus	silverleaf cotoneaster	Moderate
Cynosurus echinatus	bristly dogtail grass	Moderate

SCIENTIFIC NAME	COMMON NAME	CAL-IPC RATING ⁷		
Cytisus scoparius	hairy-fruited broom	Moderate		
Ehrharta erecta	panic veldtgrass	Moderate		
Erigeron canadensis	Canada horseweed	-		
Eucalyptus globulus	Tasmanian blue gum	Limited		
Euphorbia oblongata	oblong spurge	Limited		
Genista monspessulana	French broom	High		
Hedera helix	English/Algerian ivy	High		
Hesperocyparis macrocarpa	Monterey cypress	-		
Hirschfeldia incana	Mediterranean mustard	Moderate		
Hypochaeris radicata	common cat's-ear	Moderate		
Lactuca virosa	wild lettuce	-		
Myosotis latifolia	common forget-me-not	Limited		
Oxalis pes-caprae	buttercup oxalis	Moderate		
Pinus radiata	Monterey pine	-		
Plantago lanceolata	English plantain	Limited		
Pyracantha sp.	Firethorn	-		
Rubus armeniacus	Himalayan blackberry	High		
Rumex acetosella	sheep sorrel	Moderate		
Rumex crispus	curly dock	Limited		
Silybum marianum	milk thistle	Limited		
Solanum nigrum	black nightshade	-		
Stellaria media	common chickweed	-		
Torilis arvensis	hedge parsley	Moderate		

7 California Invasive Plant Council rating as listed in the California Invasive Plant Inventory Database (Cal-IPC 2009): High – These species 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. Moderate – These species have substantial and apparent, but generally not 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, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread. Limited – These species are 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 rates of invasiveness. *Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.*

3.5 Photo Points

In Year 1, 12 photo points were established by Nomad Ecology, LLC and permanently marked with capped rebar less than one foot high. Photopoint UTM locations were recorded, but they were not referenced to permanent, readily identifiable objects. The coordinates recorded in Year 1 are meaningless unless a sub-meter GPS unit is used to locate the photopoints. Without access to a GPS unit with adequate accuracy, re-locating some photopoints is challenging. Only seven of the 12 photopoints were identified in Year 3.

Ρното Роілт	UTM	Тіме
1	572167.69E/4185920.36N	11:19 a.m.
2	572173.73E/4185910.83N	11:31 a.m.
3	572159.78E/4185911.26N	12:19 p.m.
4	572156.14E/4185906.57N	11:40 a.m.
5	572153.03E/4185918.17N	11:44 a.m.
6	572139.16E/4185932.68N	11:49 a.m.
7	572133.16E/4185926.74N	11:53 a.m.
8	572119.38E/4185925.25N	11:56 a.m.
9	572108.07E/4185930.77N	12:32 p.m.
10	572127.78E/4185940.78N	12:00 p.m.
11	572112.08E/4185958.24N	12:04 p.m.
12	572180.11E/4185929.28N	12:39 p.m.

TABLE 7. PHOTO POINT DATA (COLLECTED ON 11/2/2016)

Photo point photos can be seen in Appendix A. Please note that there are no photos for points 4, 8, 10, 11, and 12. Some original 2016 photopoints have been added to this year's report for side-by-side comparison of the site over time.

3.6 Habitat Improvement Volunteer Workdays

The intention in Year 5 was to recruit a crew that would attend multiple workdays to increase success in restoration and management. However, the COVID-19 pandemic greatly altered how the workdays were approached. There were fewer volunteers as there was minimal recruitment and workdays were kept small for public health safety. Instead of regular monthly meetings, the crews comprised of mostly FOSC staff, worked to maintain invasive plants and accomplish monitoring on a sporadic basis depending on local (SIP) orders.

Shrubs like French and scotch broom were removed in priority habitat areas. Native and nonnative trees cut in 2016 which had re-sprouted were tarped, and in some cases re-tarped. Some native shrubs and trees were also removed if they were encroaching on seedlings. Additional efforts went into clearing large patches of poison oak to keep the site more accessible to volunteers.

As noted above, volunteers were instructed to search for small seedlings as they worked. Thanks to this methodology, a few new recruits were discovered outside of the monitoring workdays.

Section 4.

Recommendations and Adaptive Management for Future Years

Overall, site conditions have improved considerably. Pallid manzanitas continue to germinate throughout the site due to the tree removals in 2015 and continued vegetation management by volunteers and FOSC staff. Goals and adaptive management recommendations for future years are outlined below with consideration to lessons learned in 2020.

Workday Goals

FOSC is hopeful that regular workdays will again occur in 2021 and beyond. Although the five year HECP has been completed, we plan to continue to support this site in future years by recruiting volunteers and clearing encroaching vegetation to keep non-native shrubs and trees (primarily) from reestablishing at the site.

One workday a month, or every other month, during the dry season is ideal. As the site continues to have new seedling recruitment every year, FOSC staff should survey for new seedlings and flag them before workdays so they will be visible to volunteers. Ideally group sizes will also remain small and be partially comprised of repeat and experienced volunteers. Volunteer recruitment should focus on the larger knowledgeable plant communities (such as CNPS) in an effort to attract people with an interest in and basic understanding of native plant restoration. People with an interest in learning natural resource management skills would gain valuable field experience. A graduate student would be an ideal candidate to develop a suitable research project that aligns with HECP performance standards.

This site is at risk for conversion to woodland or shrubland dominated by non-native species such as French broom (*Genista monspessulana*) as well as native shrubs like coyote brush (*Baccharis pilularis*). Plants other than those found in the maritime chaparral habitat of the pallid manzanita could quickly take hold and then overwhelm the volunteer labor force. The highest priority management actions in the future should include continuation of native and non-native shrub and tree removal. Continued poison oak (*Toxicodendron diversilobum*) clearing needs to occur to ensure that staff and volunteers will be able to safely work in the site. It is important to note that shrub and tree removal close to pallid seedlings should not occur from June to September when environmental stressors are most severe.

Furthermore, if there is enough volunteer help in future years, additional vegetation and duff removal could take place on the edge of the current site where additional pallid manzanita germination could be supported. This includes locations where seedlings are already growing as well as areas with known seed banks such as locations adjacent to the 21 pallid manzanita skeletons surveyed in 1995. The seedling clusters identified during this project are primarily adjacent to known locations of former pallid manzanitas, however not all of these sites have

yielded seedlings. More intensive vegetation and duff removal could improve conditions to promote germination. In addition to the removal of organic matter in seed bank locations, it is recommended that volunteers conduct more "scrape treatments" to remove the soil's O horizon so that the mineral soil most favorable to pallid manzanita germination is exposed.

See Table 8 below for our recommended site monitoring and maintenance schedule for future years.

Mapping

It is important to map the location of the 21 pallid manzanita plants identified in 1995 so that areas with the highest density seed banks are known. This information would help to prioritize restoration concentration in the future. Seedling concentration mapping would be challenging, but may be worthwhile, especially with individuals that are several years old. Additionally, this mapping could make relocating seedlings easier.

Phytophthora Prevention

All FOSC staff and volunteers will continue to follow the best management practices to prevent the introduction and/or spread of *Phytophthora* outlined in the "Hygiene [*sic*] Protocol for *Phytophthora cinnamomi*" from the *Vegetation Management Implementation Plan* by WRA, Inc., November 2013. All maintenance and monitoring workdays will continue to be cancelled during times when soil in the pallid manzanita habitat area is wet.

Poison Oak Management

Poison oak cover in the occupied pallid site has steadily increased due to more sun exposure following mature tree removal in Year 1. Without maintenance, the species could become so dense as to prevent volunteers from working at the site. Control of poison oak is challenging at CSSC as the use of herbicides such as glyphosate is not permitted on Oakland public lands. Even if permitted, it is not advisable given the sensitivity of the site. Natural alternatives could include the application of highly concentrated salt water or vinegar, however these treatments also have the potential to injure the pallid manzanita. Hand grubbing is probably the most effective way to control the plant, but requires people willing to risk exposure to poison oak. With appropriate personal protective equipment however, risk can be minimized. An effort to cut back and grub poison oak within the site, and particularly near seedlings took place in 2019 and 2020, but this effort will have to be an ongoing process.

Continued Tree Removal in Pallid Manzanita Habitat Area

Continued tree removal on the site, and particularly beyond the site edges will improve habitat for the pallid manzanita. Even though a drastic change of environment can lead to pallid mortality (as specified in the HECP), we recommend that tree removals proceed with the goal of removing as many trees as possible at one time, since phased tree removal becomes more difficult as more and more pallid manzanita seedlings begin to germinate. It seems highly likely that tree removals around the current pallid seedling populations would result in an increased number of seedlings and site expansion following the cleared areas. Unfortunately, currently there is no funding for additional tree removals. If tree removal were to be funded, we recommend starting with a pilot set of trees (10-20% of the total to be removed) to observe site and vegetation impacts of this procedure.

Maintenance and Monitoring of Germination Plots

FOSC no longer monitors the germination plot experiments that were established in 2016 as enough time has passed to have seen results. The site was last surveyed in March/April of 2018 and no germination was observed.

Monitoring of Naturally Recruited Pallid Manzanita Seedlings

2020 concludes the 5 year HECP requirements of annual seedling monitoring. This monitoring should be performed every 3-5 years from now on as noted in the HECP. FOSC is committed to ongoing maintenance of the site and will attempt to perform seedling monitoring every 2-3 years. Seedling data is in the process of being analyzed for patterns which may to help us see trends for survivorship.

To negate future inconsistencies in seedling monitoring data, we will strive to recruit individuals to join a Pallid Crew and participate in a monitoring training such as was conducted in 2018-2020. A spreadsheet containing the previous year's data has been managed by FOSC since 2017 and should be updated shortly after monitoring. This spreadsheet should be printed out for the monitoring workday so that observers will be able to discern possible errors at the point of data collection and inconsistencies may be addressed and resolved immediately.

Given the limited volunteer force available, it will likely not be possible to conduct two complete seedling censuses as originally intended. The past several years monitoring has been conducted in April to ensure that seedlings are relocated and flagged before volunteer workdays begin, though it is recommended that a second census be conducted in September-October when the majority of senescence will have occurred.

If a student or other interested parties are found to do more complete research at the site, some of these questions could be addressed:

- Is there a correlation between seedling size and senescence?
- Is there a critical time in the season when senescence occurs?
- Once seedling vigor has deteriorated, is it possible for them to rebound?

In future monitoring, it is crucial that data are collected on all seedlings. Notes should be made for every individual that was not relocated, as well as individuals found to be deceased so that all seedlings are accounted for.

Maintenance of Naturally Recruited Pallid Manzanita Seedlings

No irrigation for the pallid manzanita seedlings has occurred nor is it planned for the future. Since manzanita species can be sensitive to supplemental watering during dry months, summer watering is not recommended and would likely contribute to unintended mortality. If high summer mortality is observed in seedlings, shade structure installation could be considered for the following spring. However, seedling monitoring data collected up until this reporting period has not indicated a clear need for additional shading for seedlings of a particular height or vigor class. If shading is elected in the future, it is recommended to shade only a small number of the seedlings in each height class or location so as to not negatively impact all seedlings. It seems likely that small seedlings (under 30 cm's) would benefit the most from shade protection. Shade structure design may affect seedlings, as could the timing of shelter installation. It is advised for installation to occur in February if conditions permit (i.e. soil is not too damp as to promote *Phytophthora* spread), or no later than April after which time heat and drought stress becomes acute.

It is not recommended for germinated seedlings to be transplanted to other areas in the potential habitat zone since transplanting of pallid manzanitas is generally not successful and will likely result in death.

Vegetation Monitoring

During both Year 1 and 2 of vegetation monitoring, random placement of transects resulted in a concentration of data points in the southeast area of the site. Furthermore, randomly placed transects do not provide for the same degree of consistent comparison as do evenly spaced lines that cover every part of the site. In order to capture data that are most representative of the entire site and allow for meaningful comparisons over time, the protocol was modified in 2018 so that a permanent baseline was set, as well as the protocol of transect placements at 30 feet intervals (chosen to get seven to eight evenly spaced transect lines every year). A 2018 reporting error noted that transect lines would remain permanent. While the datum line was permanent, transect lines changed slightly every year when a new randomly selected starting point is used to get more accurate overall site averages. After a random start point was chosen, the transects were placed 30 feet apart from this starting point for a systematic sampling scheme. As mentioned in 2018 reporting, the start point for the baseline (0 feet) is a permanent landmark: the coast live oak located immediately south of the West Ridge Trail at the eastern edge of the pallid site.

If future vegetation monitoring occurs, the height categories of "<1 meter," "1-2 meters," and ">2 meters" should continue to be utilized instead of the original life form.

Lastly, it is critical that photos are taken of each transect at the time they are established and likewise that photos are taken of data sheets on the day of monitoring in case these papers are misplaced or damaged.

Photopoint Monitoring

Any future photopoint monitoring should be aligned with vegetation monitoring. For subsequent monitoring years, this data collection should occur in June when the greatest number of annual and perennial plants are at peak phenology. It is also important that photos are taken at the same time each year to allow for meaningful comparison of the site over time. Lastly, photos should be taken at the time of day when glare is least prominent. It is recommended that photos be taken when the sun is more directly overhead. The photographer should try to match the frame of the extents of the Year 1 photos (i.e., camera angle and zoom) so that the images can be meaningfully compared.

As indicated in section 3.5, only eight of the 12 photopoints established in Year 1 were found in 2020, partially due to lack of access to a GPS unit with adequate accuracy to locate the

photopoint coordinates, and partially due to vegetation growth. Some photopoints are also repetitive in their perspective; these could easily be skipped. In the future, it may be preferable to select 4-6 of the best representations of the site to repeat. In the future, staff or volunteers could use coordinates, the site map from The First Annual Monitoring Report, and photos from Year 1 to help find all 12 points if desirable. Replacing the current rebar posts that are less than one foot tall with taller posts or more visible caps could also be considered.

Individual Plant Photo Monitoring

In future years, photo monitoring of the two living mature pallids should occur. This could be done at the same time as the seedling monitoring that will occur every few years. As was done in Year 1, photographs should be taken of each individual plant from four directions to achieve a thorough qualitative assessment of these plants over time.

Planting

We are optimistic that natural germination from the seed bank will be adequate to achieve the HECP performance standards, and therefore will not be pursuing formalized planting plots in the foreseeable future.

Education and Outreach

In future years FOSC will run a monitoring workshop for all volunteers who will help with monitoring for the year. This workshop will teach proper protocol and methods for quality data collecting. All new volunteers will also be introduced to the history of the site, as well as learn site best management protocols.

Fencing

The occupied pallid manzanita site is adjacent to the West Ridge Trail, which is heavily used by runners, hikers, dog walkers, and bikers. There is no evidence of damage inflicted upon the site by these various users, but inadvertent or intentional damage from people or off-leash dogs remains a concern. It is hoped that an interpretive sign (which is in progress) can be completed and installed in 2021 to provide education to motivate trail users to stay out of the sensitive habitat. Similarly, fencing installed on the West Ridge Trail along the edge of the pallid manzanita site may help to prevent dogs or people from entering the site and could replace the orange plastic fencing that has been a placeholder. At this time the only fencing that has taken place was along the parking are of CSSC a part of an Eagle Scout project in 2019. Given the need for city approval and a lack of funding, fencing has been a challenge for FOSC staff to pursue. Eagle Scouts searching for a project will be directed to these fencing needs.

TABLE 8. RECOMMENDED MONITORING AND MAINTENANCE SCHEDULE

Monitoring/ Maintenance Element	Jan – Mar	April	Мау	JUNE	JULY	Aug	Sept	Ост	Nov - Dec
Individual Mature Plant Monitoring (every 3-5 years)		х						x	
Natural Recruitment Monitoring (every 3-5 years)		х						х	
Vegetation Monitoring				x					
Locate/retake Photo Points				x					
Habitat Improvement Volunteer Work Days (when dry) (annually)		x	x	x	x	x	X	x	x