Change Detection and Accuracy Assessment for the 2022 Orange County Vegetation Re-Map

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A Report to:
Natural Communities Coalition
2025

California Native Plant Society

Photos on Cover:

Top Left: *Opuntia littoralis* overlooking Lake Forest within Irvine Ranch Open Space.

Top Right: *Ceanothus crassifolius* overlooking The Nature Conservancy's Fremont conservation easement.

Bottom: Regenerating *Hesperocyparis forbesii* within Coal Canyon Ecological Reserve.

All photos taken by Bryce King

Suggested Citation:

Buck-Diaz, J., T. Reyes, L. Breidenthal, B. King, & J.M. Evens. 2025. Change Detection and Accuracy Assessment for the 2022 Orange County Vegetation Re-Map. Report to the Natural Communities Coalition. California Native Plant Society, Vegetation Program. Sacramento, CA

Acknowledgements

The project was funded through the Natural Communities Coalition (NCC). We are grateful to Danny Fry, NCC Science Coordinator, who provided land access, permits and partner communication for the project. We also want to thank Aerial Information Systems for providing the draft vegetation map and assisting with the map change analysis, specifically John Fulton and Ed Reyes. We also acknowledge the California Native Plant Society staff for their efforts on this project, including Laura Breidenthal and Bryce King who conducted the accuracy assessment field work, Adam Hoeft who assisted in coordinating field logistics and scoring, Tom Reyes for his production of graphics and analysis of change over time for this report, and Julie Evens for report editing and overall project guidance.

Abstract

The California Native Plant Society (CNPS) Vegetation Program conducted an independent accuracy assessment of a fine-scale vegetation re-map across natural lands of Orange County in collaboration with Aerial Information Systems (AIS) under a contract with the Natural Communities Coalition (NCC). This report provides a summary of the accuracy assessment allocation, field sampling methods, and accuracy results; it also provides a change comparison between the new 2022 map and the existing 2012 vegetation map where 32,000 acres or ~37% of the mapped area was burned within those past 10 years. California state standards (CDFW 2024) require that a fine-scale vegetation map should achieve an overall accuracy of 80%; after final scoring, the 2022 Orange County vegetation map received an overall accuracy of 84.6%. Within the recent fire footprints, we found an overall decrease in acres of coastal sage scrub and a corresponding increase in post-fire seral scrub types. Some sensitive natural communities such as Tecate cypress (*Hesperocyparis forbesii* Association) increased in acreage over the past 10 years in unburned areas. Other communities such as Cactus scrub (*Opuntia littoralis* Alliance) had a 17% decline in acreage due to recent fires, likely negatively impacting populations of the coastal cactus wren. This fine-scale vegetation re-map provides valuable insight into the ecological response of vegetation over time to inform long-term land management and conservation within the remaining natural lands of Orange County.

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Introduction

The California Native Plant Society (CNPS) conducted an independent, third-party accuracy assessment of an updated vegetation map in Orange County. This area includes a biologically diverse mix of habitats, including open grasslands, coastal sage scrub, chaparral, and coast live oak woodlands. The accuracy of the updated vegetation map was assessed, using a field-based sampling approach to collect vegetation data pertaining to specific map polygons and map units. An accuracy assessment analysis helps map users determine how much confidence can be assigned to each of the map units, and it provides an understanding of the map's appropriateness for various applications, such as species habitat modeling. CNPS has also compared the updated vegetation map (using 2022 imagery) to an existing vegetation map from 10 years prior (2012) to provide insight into change over time within vegetation.

Methods

Project Location

A field-based accuracy assessment was conducted across the natural lands of Orange County within the footprint of the fine-scale vegetation re-map created by Aerial Information Systems (AIS). For more information, see the separate AIS Vegetation Mapping Report (AIS 2025). The updated vegetation map covers approximately 86,000 acres of Orange County.

Accuracy Assessment Data Collection

To validate the updated vegetation map, an accuracy assessment (AA) effort was conducted through sample allocation, field data collection, and scoring analysis. A significant portion of the project area, particularly the inland mountain regions east of Irvine, were affected by fire in the years since the previous mapping effort (Figure 1). From 2012 to 2022, a total of 33 individual fire incidents burned 32,205 acres (~37%) of the project area (CalFire 2025). The vast majority of this acreage included the Canyon I/II fires of 2017 and the Silverado and Bond fires of 2020, which occurred within the inland portion of the project area. Given this fire history, CNPS estimated that at least 120 accuracy assessment surveys would be needed to test the accuracy of the re-mapped units. This estimate was determined through consideration of the size of the map area (85,705 acres), the number of vegetation types described in the original

vegetation classification report (AECOM 2013, 72 types), budget limitations, and stratification across burned and unburned areas.

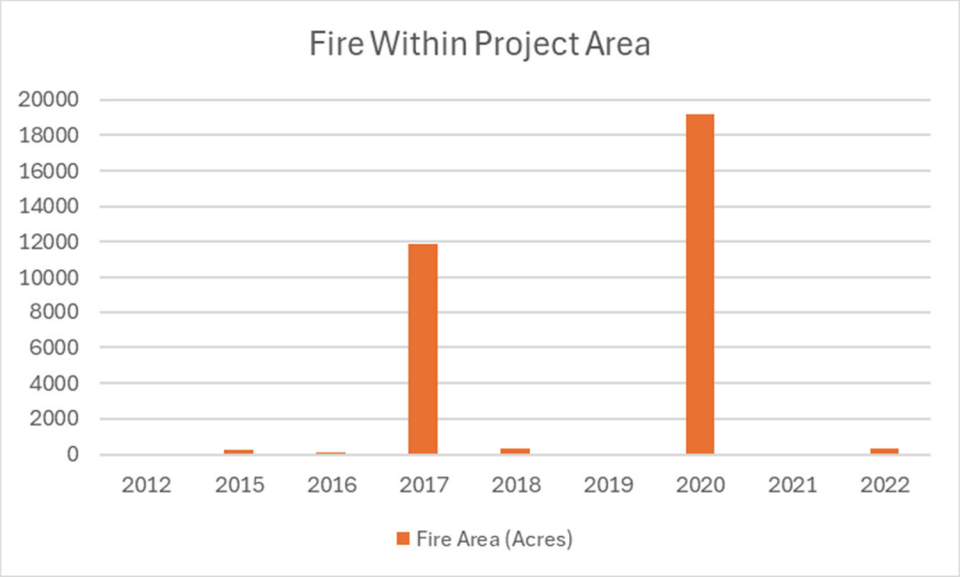

Figure 1. Summary of fire acreage within project area by year over the past 10 years.

A stratified random sampling design was employed (Cochran 1977, Thompson 2002) to obtain a proportional number of surveys within each vegetation type (map unit), depending on how common or rare the vegetation type was, to assess the accuracy of the map. Polygons were allocated by CNPS, and map units were further stratified for distribution within and outside of fire perimeters without regard to fire date, to assess vegetation succession and establishment. Distance from roads/trails was also used in the allocation (within 500 m) to ensure efficiency in the field. Miscellaneous map units coded under the 9000 series, such as anthropogenic and sparsely vegetated areas were excluded from the sample allocation, as were vegetation types that are typically stable after fire and were mapped with high degrees of accuracy in the previous mapping effort, (e.g. riparian and tree types such as the *Quercus agrifolia* Alliance). Any polygon with a pre-existing reconnaissance or verification survey by mappers was excluded from the allocation. Allocated polygons were selected at least 1 km away from other allocated polygons of the same map unit.

Each vegetation type was assigned a priority level (1-3) based on the number of occurrences per vegetation type – with rarer types (<50 polygons) having the highest priority of 1 and the more common types (>300 polygons) having the lowest priority of 3 for sampling (see Appendix A). The priority levels guided the field staff when they visited areas of allocated polygons. A total of 200 polygons were allocated across 28 map units. The number of allocated polygons exceeded the targeted goal of 126 to allow for some polygons to be omitted due to access and time constraints.

Property access and permitting were coordinated by Danny Fry (NCC). To prevent bias, CNPS field staff collected AA surveys without knowledge of the mappers' polygon attributes. Field data and photos were collected digitally using a custom designed ESRI Survey123 form on GPS-enabled tablets running ESRI's Field Maps application. Appendix B displays a screenshot of the Survey123 field form template used in the project and an example of a completed accuracy assessment survey form. Staff used digital field maps with highlighted priority levels to guide field work and to navigate to the allocated polygons. Each survey was stand-based, that is, both the type and the extent of the entire polygon were evaluated when possible. When a mapped polygon could be divided due to the presence of multiple vegetation types within the given minimum map unit (MMU) standards, a separate assessment was collected for each type. Some inaccessible polygons were assessed from a distance (projected) by using binoculars, a compass, and a laser rangefinder, if the identification of dominant species and stand characteristics was confidently discernable from a vantage point.

Previous vegetation surveys in the region resulted in a floristic classification (AECOM 2013) that was updated by CNPS in 2015 with input from the CDFW Vegetation Classification and Mapping Program (Buck-Diaz & Evens 2015). Appendix C in this report presents a newly updated field key to vegetation types of Orange County utilized by CNPS staff and AIS mappers to assess and determine the vegetation types within the mapping area. Recent key edits mainly incorporated nomenclatural updates to reflect shifts in the classification of California vegetation over the last decade, as published in the online Manual of California Vegetation (CNPS MCV 2025). These key edits did not alter the map unit concepts used for the map update, to maintain consistency and ensure a direct comparison between mapping efforts.

All field surveys were archived and shared through a standardized geodatabase, and staff performed data quality control prior to the accuracy assessment analysis. A set of digital photographs were taken for each survey and archived in folders by a unique polygon number specifically assigned for AA (e.g. OC1A###). Associated survey data, such as plant species, are contained within a series of tables, and other look-up reference tables provide functionality for linking data tables.

Accuracy Assessment Analysis

CNPS office staff compared the field-based versus the photo-interpreter based determinations or "calls" of vegetation type (map unit), and each assessed polygon was given a score for accuracy. All field calls were independently reviewed by CNPS office staff who were not involved in the field data collection, and a "Final call" was recorded in the scoring database. A fuzzy logic method was used, rather than simply denoting whether a sample was correct or incorrect. Each field-verified polygon was ranked according to the set of decision rules along a scoring scale, with a total of 5 possible

points for each. The set of database codes used to score each assessed polygon is summarized in Table 1.

Table 1. Scoring rationale of the accuracy assessment analysis with a key to coding choices

Code	Reason For Score	Score
A	Correct, perfectly meets key definitions for the vegetation type at the Alliance level (or other higher level map unit)	5
B	Correct at secondary level in the classification (e.g. at the Group or next level up in hierarchy)	4
C	Threshold/transition between PI call and Final call.	4
D	Correct at the Macrogroup level OR next level up in hierarchy.	3
E	Based on close ecological similarity.	3
F	Correct at the Division level but not at lower levels in the hierarchy.	2
G	Some floristic/hydrologic similarity.	2
H	Correct only at life form with minor floristic/hydrologic similarity.	1
I	No similarity above Formation and incorrect life form.	0
J	Survey removed because of significant change in polygon (e.g., the stand was burned, developed, or cleared since the base date of the imagery, in this case 2022).	N/A
K	Survey removed because it represents ≤ 10 percent of polygon	N/A
L	Survey removed because field data is incomplete, inadequate or confusing.	N/A
M	Supplementary point, not scored.	N/A

Scores were summed for each vegetation type, and then divided by the total possible score, and multiplied by 100 to generate the percent accuracy per type. Two forms of accuracy (users' and producers') can be estimated from the data (Story and Congalton 1986). Users' accuracy is conditional on the mapped classes and is defined as the probability that a location mapped as class "X" is in fact class "X". This provides an estimate of how well spatial mapping data actually represents what is found on the ground, i.e., if the user goes to a location mapped as sagebrush, what is the probability it is in fact sagebrush? Producers' accuracy, on the other hand, is conditional on the true vegetation class in the field. The producers' accuracy for class Y is the probability that a location of vegetation class Y in the field is mapped as class Y. Producers' accuracy may inform the producers of remotely sensed and mapped data how readily a mapping class may be detected by mapping whenever it occurs on the ground (Story and Congalton 1986, Lea and Curtis 2010).

Map Change Detection

CNPS compared the existing Orange County vegetation map produced in 2012 (AIS 2015) to an updated vegetation map produced using 2022 NAIP imagery (AIS 2025) through ArcGIS tools. This map comparison highlights change over a 10-year period within and across vegetation types, and additionally, change can be detected across structural and human impact attributes such as density for conifer, hardwood, shrub, and herb vegetation layers, as well as codes for disturbance, exotics and land-use (AIS 2025).

Explanatory variables or reasons for change across vegetation maps include 1) physical factors such as fire, erosion, and deposition; 2) ecological factors such as succession, decadence, stand maturation, type conversion, encroachment, and non-native expansion; and 3) anthropogenic factors such as scraping/clearing, development, agriculture, and even restoration. Non-physical changes between maps might include imagery shifts, changes in imagery quality, incorrect original mapping, improvement of older linework, and change in level mapped (classification). These types of non-physical changes were minimized in the Orange County remap, thanks to the efforts of AIS photo interpreters to retroactively adjust changes within the 2012 vegetation map (AIS 2025). The modifications made to the 2012 map require that any future comparisons between 2012 to 2022 should utilize the newest geodatabase for both 2012 and 2022 maps.

Results

Accuracy Assessment

CNPS staff conducted accuracy assessment (AA) field surveys within natural areas of Orange County. Field data collection occurred between October 3 – October 24, 2024, with the collection of 129 survey locations throughout the mapping area (Figure 2). Three surveys were removed from the scoring analysis due to incomplete or inadequate information collected and/or treatment as supplemental points to inform mapping.

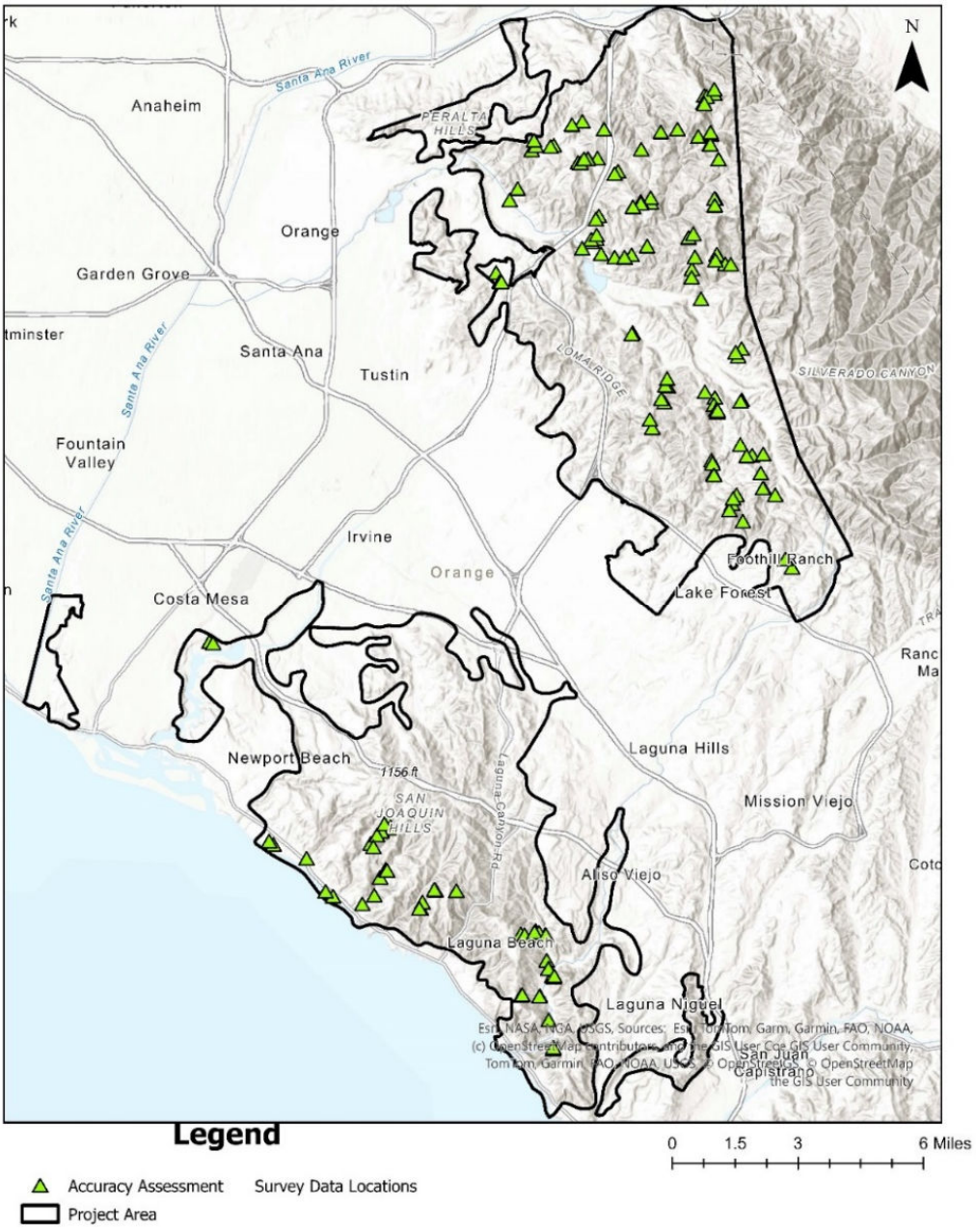

Figure 2. Accuracy Assessment Survey Locations

Many map units are relatively rare across the project area (see Appendix A), and not all map units were selected for sampling within the allocation. Table 2 provides a summary of the map units analyzed for accuracy within the map as well as a count by user and producer. The overall user's accuracy (degree of agreement between the map and the reference data) and the producer's accuracy (degree of agreement between the reference data and the map) for each map unit are reported.

Table 2. Percent accuracy of vegetation map units with sample size. Numbers in bold highlight types with less than 80% accuracy and a sample size of ≥ 5 surveys.

Map Class	User Count	User Accuracy	Producer Count	Producer Accuracy
Acmispon glaber Alliance	4	85%	**8**	**70%**
Adenostoma fasciculatum - Salvia mellifera Alliance	5	80%	3	73%
Adenostoma fasciculatum Alliance	4	80%	4	90%
Arctostaphylos glandulosa Alliance	4	90%	2	100%
Artemisia californica - Eriogonum fasciculatum Alliance	7	80%	10	88%
Artemisia californica - Salvia mellifera Alliance	7	89%	7	86%
Artemisia californica Alliance	7	89%	5	92%
Baccharis pilularis Alliance	6	83%	6	93%
California Annual and Perennial Grassland Macrogroup	6	83%	**9**	**60%**
Ceanothus crassifolius Alliance	3	100%	7	83%
Ceanothus megacarpus Alliance	1	60%	0	
Ceanothus tomentosus Alliance	5	88%	5	88%
Diplacus aurantiacus Alliance	4	100%	4	100%
Encelia californica Alliance	4	90%	2	100%
Eriogonum fasciculatum - Salvia apiana Alliance	0		2	80%
Eriogonum fasciculatum Alliance	**5**	**64%**	1	100%
Hesperocyparis forbesii Alliance	1	100%	2	90%
Heteromeles arbutifolia Alliance	3	100%	7	**77%**
Isocoma menziesii Alliance			1	60%
Malacothamnus fasciculatus Alliance	5	100%	13	**72%**
Malosma laurina Alliance	**8**	**78%**	4	95%
Opuntia littoralis Alliance	5	84%	2	100%
Quercus agrifolia Alliance			1	60%
Quercus berberidifolia - Adenostoma fasciculatum Alliance	6	93%	2	100%
Quercus berberidifolia Alliance	3	87%	5	100%
Quercus dumosa Alliance	**5**	**72%**	0	
Rhus integrifolia Alliance	3	73%	4	85%
Salvia apiana Alliance	4	90%	2	100%
Salvia leucophylla Alliance	5	100%	5	100%
Salvia mellifera Alliance	4	65%	2	100%
Sambucus nigra Alliance	**5**	**72%**	3	100%
Toxicodendron diversilobum Alliance	0		1	60%

The distribution of AA surveys across burned and unburned areas and the resulting accuracy scores are strong indicators of the final map's validity, despite significant change over time. For the assessed map units (n=129), the overall percent accuracy averaged 85%, which is similar to the calculated accuracy of the 2012 vegetation map (87%). Since California state standards (CDFW 2024) require that a vegetation map should achieve an overall accuracy of 80%, this map update met or exceeded these expectations across most vegetation types. A contingency table (Appendix D) displays the resulting vegetation calls for the field surveyors (user's final field calls) along rows and photo interpreters (producer's map classes) in columns. The numbers along the diagonal record the correctly matched calls between the map photo interpretation and field surveys.

About half of the map units that came in at a user's or producer's accuracy below 80% were types that were not sampled sufficiently to generate a statistically significant sample size (n<5), however general trends were noted. Of the remaining low scoring map units (n=5 or greater), some types were found to be confused with other ecologically similar units such as the *Eriogonum fasciculatum* Alliance which was confused with the *Eriogonum fasciculatum* - *Salvia apiana* Alliance and the *Artemisia californica* - *Eriogonum fasciculatum* Map Unit. Similarly, grassland habitats that contain shrub species that exceed a threshold of 10% cover or greater were placed within shrub map units such as the *Baccharis pilularis* Alliance or the *Sambucus nigra* Map Unit, thus decreasing the producer accuracy score for the California Annual and Perennial Grassland Macrogroup.

In another example, *Quercus dumosa* was found to have been over-mapped in the baseline 2012 mapping effort, where surveyed polygons were dominated by other shrubs including *Heteromeles arbutifolia* or *Rhus integrifolia*, without evidence of the vegetation having changed over the past 10 years. Thus, the *Quercus dumosa* type was reassessed across both the 2012 and 2022 maps to only delineate areas confirmed by surveys to contain *Quercus dumosa*.

After the map accuracy scoring was complete, AIS staff reviewed all assessed polygons to address issues in photo interpretation and attribution. Updates were made to the final map, and each polygon that differed in vegetation type was edited as needed. After the initial assessment review and polygon updates, the mappers evaluated the results of the AA overall to make corrections and conduct quality control across the entire map, so that the final map accuracy is higher than is reported in Table 2.

Map Change Detection (2012 vs. 2022)

The objective of the map comparison was to identify and interpret differences across a 10-year time frame, to guide future management actions and to gain an understanding of the trajectory of vegetation within this region of southern California. The minimum map unit and classification system used in 2012 were the same as those used in 2022 allowing a direct spatial comparison of vegetation types and acreages. About 80% of the map footprint is vegetated or has naturally occurring sparsely vegetated types. The remaining 20% of the area is mapped as unvegetated, mostly within map units such as urban development and agriculture. These ratios have not changed significantly over the last 10 years.

It is well known that fire has a strong influence on plant community composition and species distribution within California (Sugihara et al. 2006). The Fire and Resource Assessment Program (FRAP) publishes a statewide geodatabase of fire perimeters that includes wildfire history, prescribed burns, and other fuel modification projects. This resource allows users to better understand and interpret landscape-scale vegetation changes that are correlated with fire. Within the 10-year span between the two mapping efforts, a total of 32,205 acres (37%) burned within the project area (CalFire 2025) mainly in the Santa Ana Mountains. The frequency, intensity, and scale of fires in this area have significantly altered the patterns of plant communities present.

Approximately one-third (1/3) of the 16,500+ polygons changed map unit type across a decade of time; the majority of this change (23%) was a conversion to the “recently burned area” map unit. The net acres of change across each map unit type are reported in Appendix E. Figure 3 summarizes the largest net gain or loss in acres across 20 map units and illustrates the magnitude of the percent change within each type using a green (gain) to red (loss) scale.

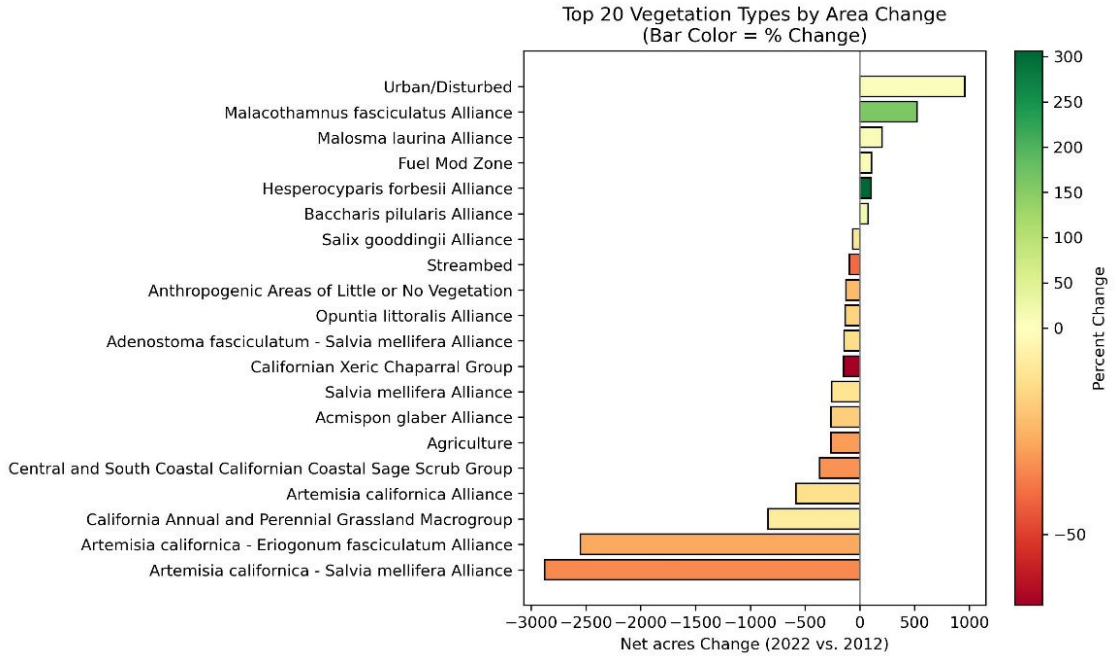

Figure 3. Change across vegetation map units showing a net gain or loss in acres between 2012 and 2022. The bars are color-coded by percent change relative to the original mapped acreage in 2012.

Coastal Sage Scrub

The majority of the net decline in acres over the past 10 years occurred in vegetation types of the California Coastal Sage Scrub Group in the Santa Ana Mountains. This group consists of numerous separately mapped vegetation types including *Artemisia californica*, *Artemisia californica – Eriogonum fasciculatum*, among others. *Artemisia californica – Salvia mellifera* had the largest loss of over 2,800 acres (35%) between 2012 and 2022 and the aggregated loss across the broader group of Coastal Sage Scrub types was 6,700 acres. Many of these areas burned and transitioned to the "Recently Burned Areas" map unit or to post-fire seral scrub types including the *Malacothamnus fasciculatum* and *Acmispon glaber* Alliances. However, in unburned areas, the updated map for 2022 captures an increase of coastal sage scrub across more than 600 acres due to a transition from grassland and seral scrub types.

Seral Scrub

Vegetation within the Central & South Coastal Californian Seral Scrub Group, such as the *Malacothamnus fasciculatum* and *Acmispon glaber* Alliances, is dominated by drought-deciduous and evergreen shrubs that proliferate after disturbance, including alluvial processes, clearing, grazing, and fire. Fire removes vegetation and the litter layer exposing seeds to light, and the heat can also stimulate germination of the seed

bank. These early seral, short-lived shrubs proliferate across the landscape after a disturbance and eventually relinquish their dominance to other coastal sage and chaparral shrubs and trees, within a predictable timeframe. *Acmispon glaber* declined moderately across the map area with a net change of more than 250 acres while *Malacothamnus fasciculatum* expanded its extent by more than 500 acres. Spatially these alliances shifted extensively, winking out in areas that are 16 years post-fire, dominating in areas that are 5 years post-fire, and not yet established in areas 2 years post-fire.

Chaparral

Vegetation within the California Chaparral Macrogroup declined by approximately 370 acres including map units of *Adenostoma fasciculatum – Salvia mellifera*, *Adenostoma fasciculatum*, *Arctostaphylos glandulosa*, *Ceanothus crassifolius*, and *Ceanothus megacarpus* Alliances. The *Ceanothus tomentosus* Alliance saw a net gain of 14 acres across areas that remained unburned over the past decade.

Tecate Cypress

One important, sensitive natural community of this region is the *Hesperocyparis forbesii* Association (Tecate Cypress), which forms stands along dry, exposed hillsides and ridgetops of the Santa Ana Mountains. The habitat of Orange County is the northernmost population for this species and is disjunct from other populations in San Diego County and Baja. The species is an obligate seeder with serotinous cones that does not resprout after fire. It has a California Rare Plant Rank of 1B.1 (CNPS 2025) and is threatened by a short fire return interval, which destroys young trees before they can reproduce and/or build up adequate seed reserves.

A description of Tecate cypress within Orange County was published in 1983 (Spenger, 1983) describing the species extent at about 1,000 acres, likely including cypress that was emerging at low cover through dense chaparral. This setting of emergent conifer at low cover would not get mapped today to the Cypress Veg Association. However, regeneration of cypress is documented in both the 2012 and 2022 maps within the conifer density attribute. Supplementary attributes for each polygon allow users to identify and quantify more than just the existing vegetation type. In this case, visible cover of conifer is estimated regardless of the overall vegetation type.

In 2006, a large fire swept over this northern-most population of Tecate cypress, damaging the majority of the mature individuals. The 2012 map delineated only 34 acres of the *Hesperocyparis forbesii* Association compared to 196 acres delineated in 1992 (<20% of the 1992 extent). The 2022 map update shows a net increase of more than 100 acres for a total of 136 acres of this type mapped at the alliance level.

Figure 4 depicts the spatial extent of the 1992 mapped acreage for the cypress in hatched red (196 acres), yellow polygons show the 34 acres mapped in 2012, and orange polygons show the current extent of 136 acres mapped in 2022. In addition to the association level mapping, the pink polygons delineate other vegetation types that have an estimated value for cypress density (typically 1-9%) and the light green polygons show cypress presence (captured in a Comment field with low cover of <1%). This total area spans just under 1000 acres, illustrating that the species' extent is similar to what was described in 1983, and that Tecate cypress is persisting across this landscape. Reducing the fire frequency in this region will be key to the long-term survival of Tecate cypress.

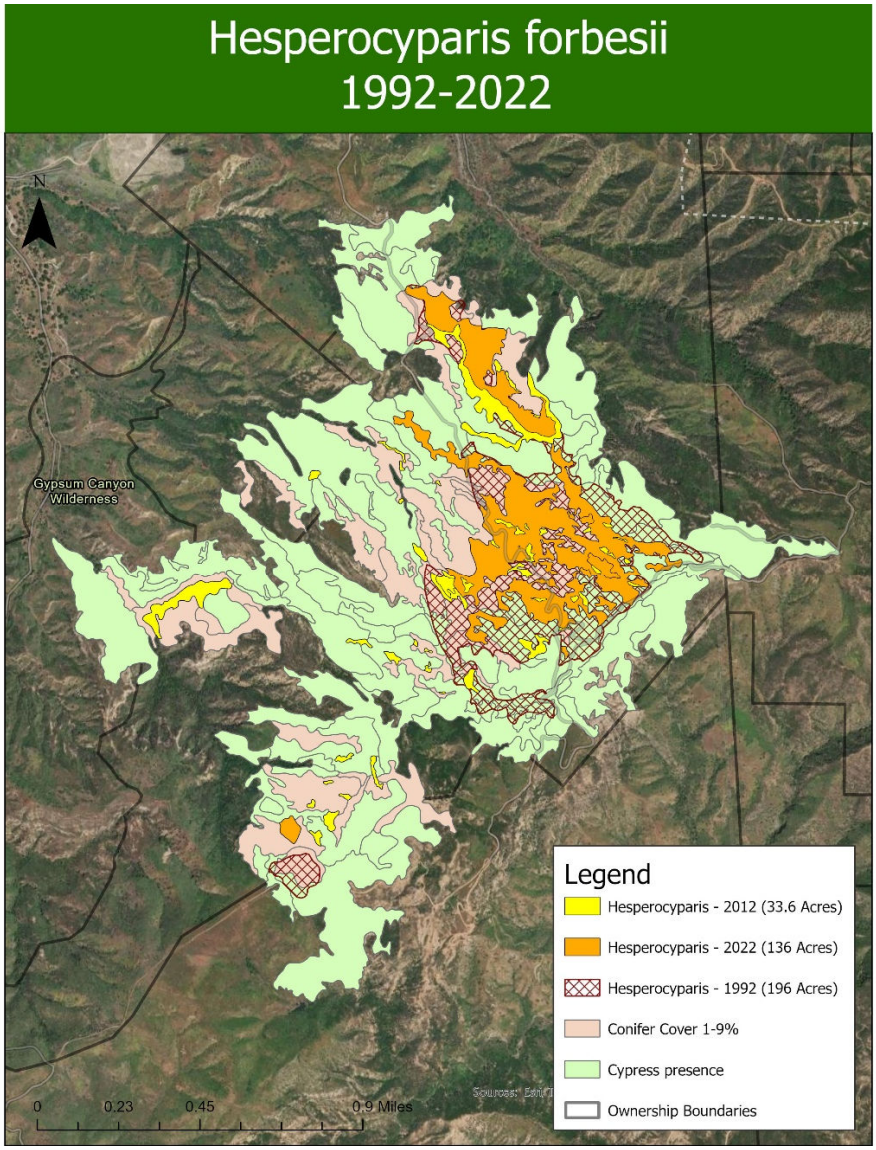

Figure 4. Tecate cypress association mapped across three different years (1992, 2012 and 2022). Additional vegetation types are highlighted based on 2022 map attributes

including conifer density (pale pink) and based on notes in a comment field for Cypress presence (light green).

Cactus Scrub

Cactus scrub is an example of a sensitive natural community while the dominant plant species, *Opuntia littoralis,* is not itself a rare species. Cactus scrub declined by 17% across Orange County within a 10-year time frame, which is concerning due to the reliance on this habitat by the coastal cactus wren. Spatially, cactus scrub stands have remained stable along the coastal region and in unburned areas of the central region. A 2023 summary from USGS (Lynn et al. 2024) shows a steady decline in the coastal cactus wren while other new studies from San Diego (Winchell et al 2022) have helped to solidify the habitat parameters that coastal cactus wren depend upon. These parameters could be used to further refine restoration plans for cactus scrub in Orange County. The updated vegetation map could be analyzed further for patch size and spacing, to plan for strategic plantings of *Opuntia* and/or other efforts toward conserving and expanding wren populations.

Other Map Attributes

In addition to vegetation alliance information, the 2012/2022 vegetation maps provide attributes such as density for the conifer, hardwood, shrub, and herb vegetation layers, as well as codes for disturbance, exotics and land-use (AIS 2025). These attributes can also be reviewed for change over the past decade with important implications; for example, changes in shrub cover have direct impacts in relation to habitat preferences for various wildlife species. Figure 5 illustrates changes in cover class of exotics in the central region, focused within various fire footprints, showing an increase of non-native plant species (purple colors) in some areas, e.g. from category 0 (no exotics observed) to category 2 (high exotics) as well as decreases in other areas (blue colors) likely due to the closure of the shrub canopy. By quantitatively analyzing change across various attributes of the vegetative map, informed management decisions can be made based on floristic characteristics as well as structural attributes and the overall quality of vegetation in the region.

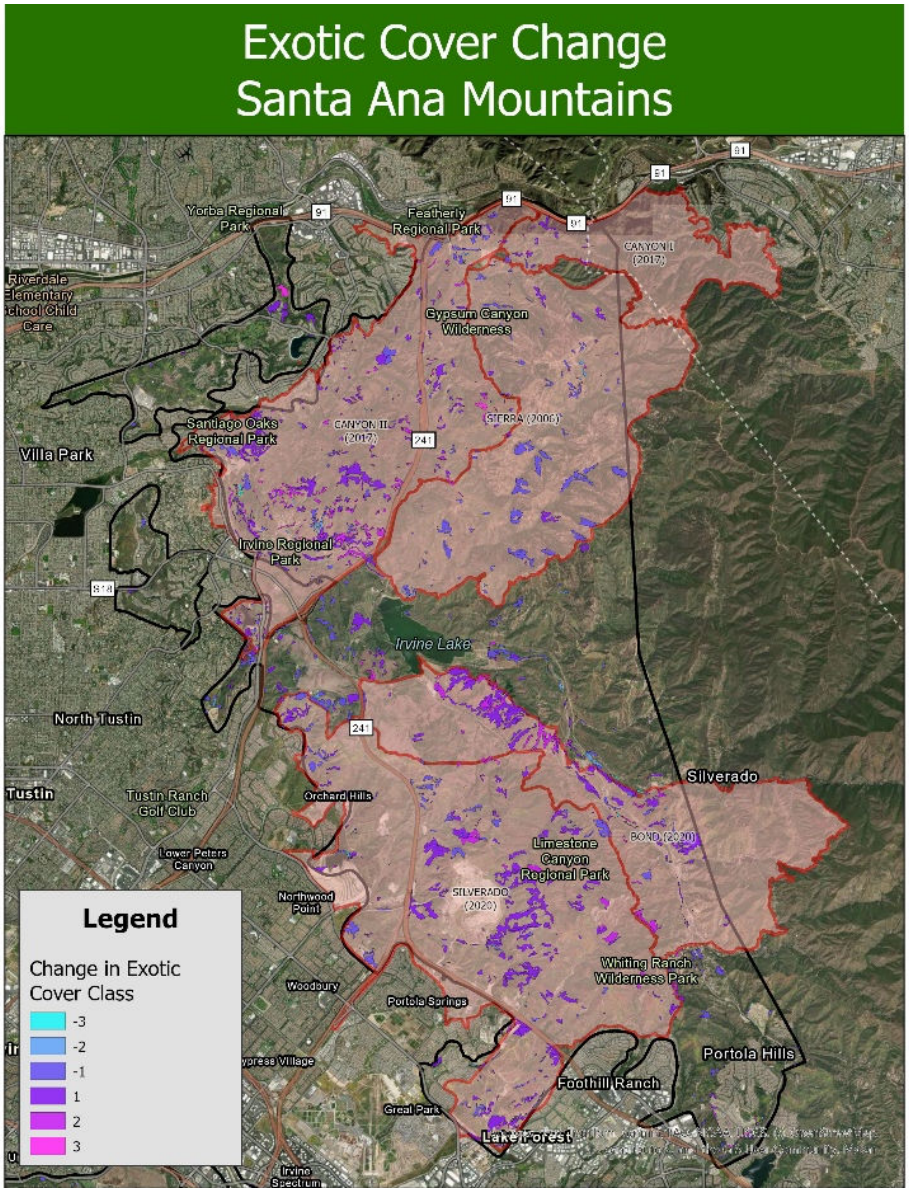

Figure 5. Change of exotic (non-native plant) cover class units in the Santa Ana Mountains region with increases displayed in purple values and decreases in blue values from the past 10 years.

Urban Conversion

Along the edges of the wildland-urban interface, numerous natural vegetation types (mostly consisting of grasslands and smaller amounts of coastal sage scrub) have been converted to urban / disturbed over the last 10 years. Some newly mapped urban areas encompassed large developments, while other losses occur along the edges of roads or existing urban zones. Figure 6 reports the acres of the natural vegetation types that

experienced the highest change in transitioning to the urban map unit, with the top 10 types adding almost 1,000 acres to this disturbed type.

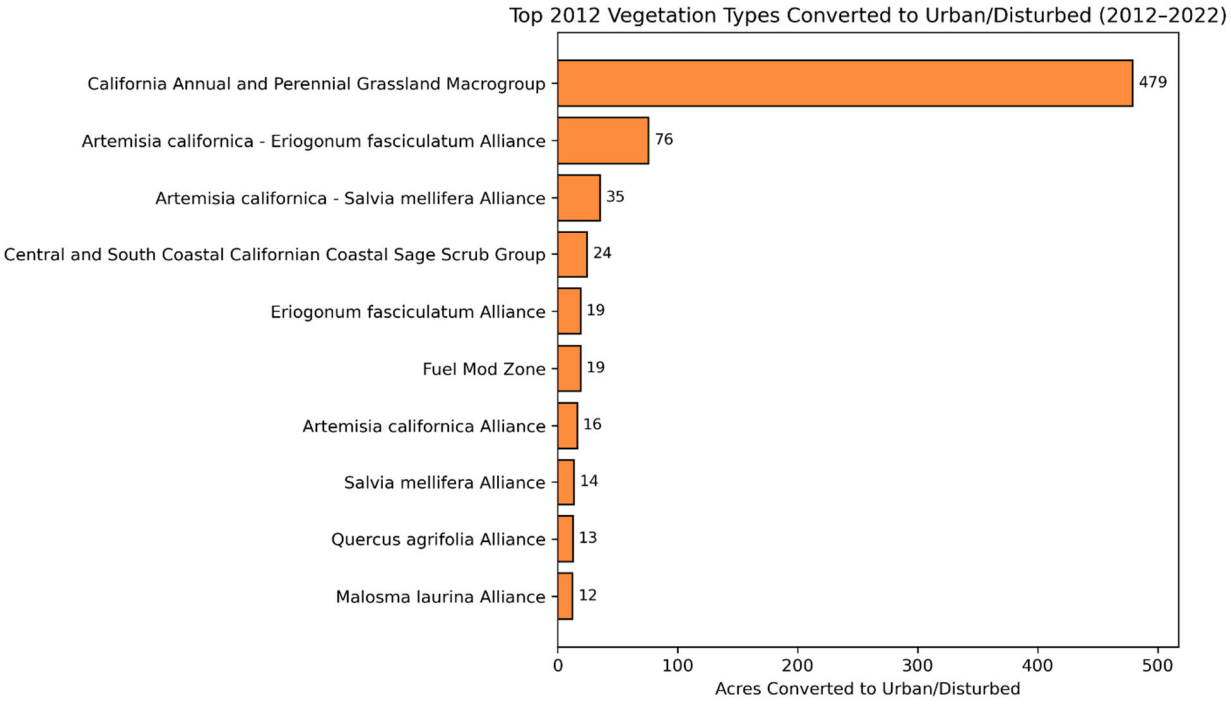

Figure 6. Acres of the top ten vegetation types converted to Urban / Disturbed between 2012 and 2022.

Discussion

The updated vegetation map based on 2022 imagery provides a new baseline for natural areas within Orange County. This area supports coastal scrub, chaparral, grasslands, wetlands and riparian corridors, and the map update represents these dominant vegetation types as well as plant cover and disturbance attributes across this landscape. Accuracy assessment is an integral part of fine-scale mapping and overall, the new map exceeded the accuracy standards set by the California Department of Fish and Wildlife. The 2022 map units are based on *A Manual of California Vegetation* (MCV), which quantitatively summarizes local and ecoregional studies into one source. The MCV also relates to the National Vegetation Classification Standards (NVC) with a goal that vegetation types and maps are comparable across the nation. One advantage of this re-mapping effort was the use of the same mapping standards and floristic classification to ensure continuity between the two products. This allows users to better understand and interpret vegetation patterns and trajectories across the region. This continuity allows an accurate analysis of true vegetation change over time versus differences due to mapping technique. Change was detectable across both floristic and structural characteristics of vegetation and can be reported using various scales of the classification, from the Alliance level up to broader Group and Macrogroup types.

The vegetation of Orange County has undergone fragmentation due to urban expansion as well as multiple, widespread fires causing vegetation change and succession. This map update effort was initiated to track these changes across this region, and a decadal interval is currently recommended for landscape scale monitoring. However, mapping vegetation 2-years post fire was too short of an interval to assign polygons to a meaningful vegetation type. At this interval, generic map units are typically assigned such as the “Recently Burned Areas – Undetermined Vegetation Type” map unit. It generally takes 3-5 years after a fire to development vegetation that can be assigned to an established vegetation alliance or group. For example, patterns within the 2017 fire footprint were accurately attributed at the alliance level 5-7 years post-fire. Thus, depending on the goals of the mapping effort, time since fire should be considered when triggering an ideal map update interval.

The Coastal Region of Orange County has been fairly stable over the past decade, as this area hasn’t seen a large-scale fire in over 30 years. Currently, a few small patches have burned creating a mosaic of habitats. California shrublands, particularly chaparral and coastal sage scrub, are adapted to fire and can benefit from fire disturbance through the enrichment of soils and an increase in biodiversity. A matrix of habitats is beneficial for pollinators and for a robust seed bank.

In the Central Region of Orange County, which has burned extensively over the past 10 years, we see a predictable trajectory to post-fire seral types including grassland, *Acmispon glaber*, and *Malacothamnus fasciculatus*. Post-fire recovery tends to be complex as it depends on fire severity, annual precipitation after the fire, and the combination of re-sprouters vs. seeders in the seed bank or in adjacent stands. One part of the study area, Santiago Canyon, has burned a total of eight times, and this area is now dominated by grasslands and the *Acmispon glaber* Alliance.

The map update can be used to identify and prioritize locations for targeted invasive species removal or other restoration efforts, as well as tracking and modeling habitats for sensitive plants, animals, and habitats. One limitation of the map is the broad category used for grasslands, which were all mapped under the California Annual and Perennial Grassland Macrogroup. This Macrogroup represents a mix of native and non-native types which are not distinguishable using remote sensing. Recent efforts in Alameda and Contra Costa Counties have taken county-wide vegetation maps, extracted the grassland polygons and prioritized areas for on-the-ground fine-scale grassland mapping. These pilot projects are field intensive but reveal a large amount of nativity within grasslands and provide the detail needed for land managers to strategically place trails away from highly native and intact grasslands and to make other decisions to protect and manage these habitats.

By following standard mapping conventions, the 2012 vegetation map for Orange County was updated in 2022 and compared to earlier versions, allowing for the quantification of change across the structure, composition, quantity, and quality of vegetation patterns. Repeat vegetation mapping can show stability, increase, or loss of certain plants or plant groups while overlays of fire perimeters and the availability of high-quality aerial imagery give context to interpret cause and effect. These analyses offer strong support for informed conservation and management decisions about individual species and natural communities across Orange County. The fine-scale map products can be used to update reference materials developed by the Natural Communities Coalition, including the Habitat Restoration and Enhancement Plan (NCC 2019), which is required by the County of Orange Central and Coastal Subregion Natural Community Conservation Plan & Habitat Conservation Plan (NCCP/HCP).

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Appendix A

Allocation Table

Vegetation Name	Polygon Count	Priority Rank	Goal	Number Allocated
Acacia (cyclops) Semi-natural Stands	52	0	0	0
Acmispon glaber Alliance	194	2	6	8
Adenostoma fasciculatum - Salvia mellifera Alliance	131	2	4	6
Adenostoma fasciculatum Alliance	381	3	6	10
Alnus rhombifolia Alliance	3	0	0	0
Arctostaphylos glandulosa Alliance	22	1	4	4
Arid West Freshwater Emergent Marsh Group	73	0	0	0
Artemisia californica - Eriogonum fasciculatum Alliance	931	3	6	12
Artemisia californica - Salvia mellifera Alliance	684	3	6	12
Artemisia californica Alliance	724	3	6	12
Arundo donax Semi-natural Stands	15	0	0	0
Atriplex lentiformis Alliance	6	0	0	0
Baccharis pilularis Alliance	118	2	4	6
Baccharis salicifolia Alliance	377	0	0	0
Bolboschoenus maritimus Alliance	3	0	0	0
California Annual and Perennial Grassland Macrogroup	1452	3	4	10
California Chaparral Macrogroup	1	0	0	0
California Perennial Grassland Group	7	0	0	0
Californian Evergreen Coniferous Forest and Woodland Group	2	0	0	0
Californian Maritime Chaparral Group	7	0	0	0
Californian Mesic Chaparral Group	8	0	0	0
Californian Xeric Chaparral Group	15	0	0	0
Carpobrotus edulis or Other Ice Plants Semi-natural Stands	13	0	0	0
Ceanothus crassifolius Alliance	68	2	4	6
Ceanothus megacarpus Alliance	95	2	4	6
Ceanothus tomentosus Alliance	22	1	4	5

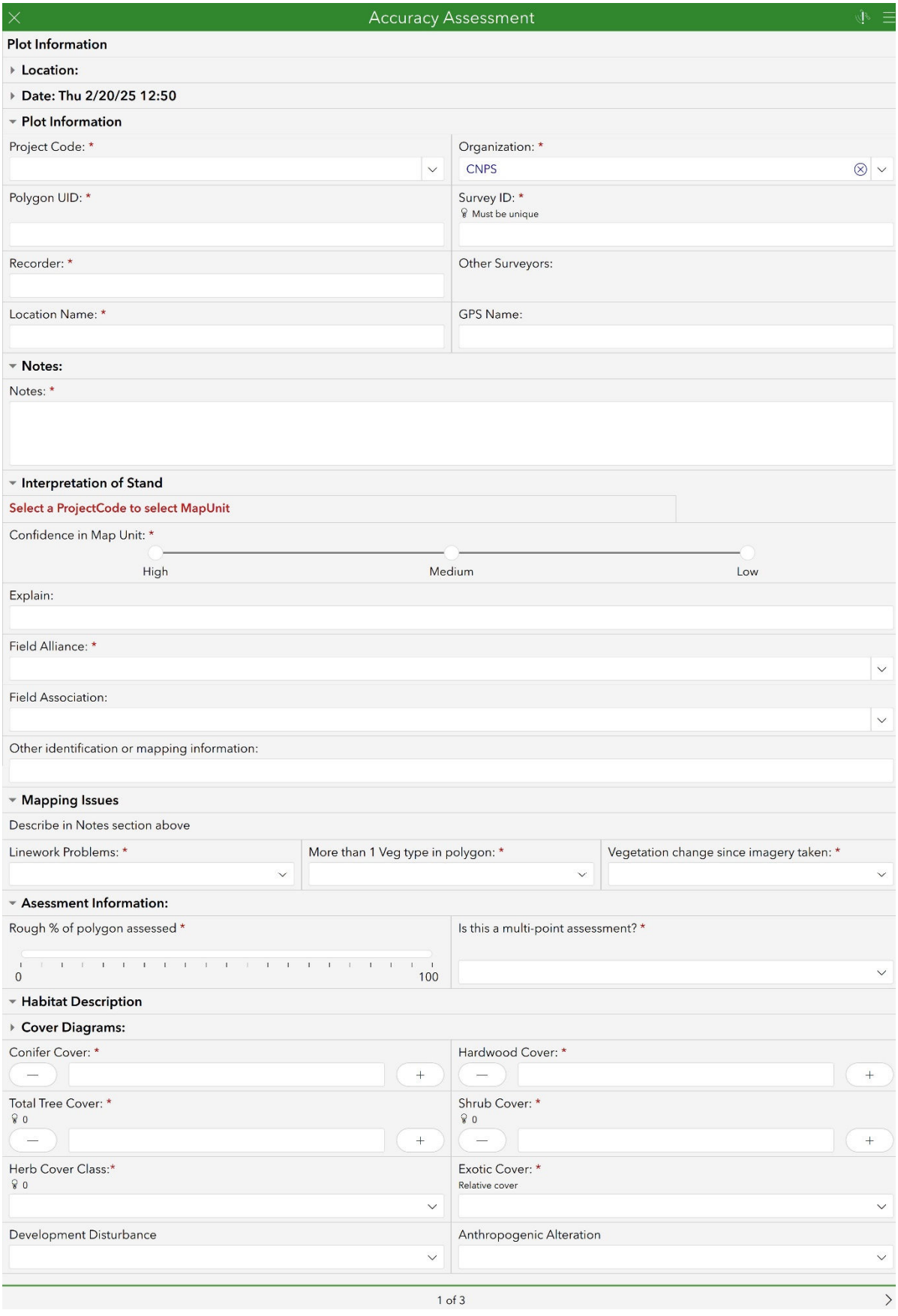
Vegetation Name	Polygon Count	Priority Rank	Goal	Number Allocated
Central and South Coastal California Seral Scrub Group	12	0	0	0
Central and South Coastal Californian Coastal Sage Scrub Group	155	0	0	0
Cercocarpus montanus Alliance	2	0	0	0
Coastal Baja California Norte Maritime Succulent Scrub Group	15	0	0	0
Cortaderia (jubata, selloana) Semi-natural Herbaceous Stands	8	0	0	0
Diplacus aurantiacus Alliance	27	1	4	6
Distichlis spicata Alliance	1	0	0	0
Encelia californica Alliance	51	2	4	5
Ericameria palmeri Alliance	22	0	0	0
Eriogonum fasciculatum - Salvia apiana Alliance	1	0	0	0
Eriogonum fasciculatum Alliance	224	2	4	6
Eucalyptus (globulus, camaldulensis) Semi-natural Woodland Stands	53	0	0	0
Fresh Water Marsh (bulrush - cattail) Mapping Unit	12	0	0	0
Hesperocyparis forbesii Alliance	52	2	4	5
Heteromeles arbutifolia Alliance	58	2	4	6
Isocoma menziesii Alliance	3	0	0	0
Juglans californica Alliance	2	0	0	0
Keckiella antirrhinoides Alliance	6	0	0	0
Lepidium latifolium Semi-natural Herbaceous Stands	5	0	0	0
Lepidospartum squamatum Alliance	35	1	0	0
Leymus condensatus Alliance	3	0	0	0
Malacothamnus fasciculatus Alliance	143	2	6	9
Malosma laurina Alliance	574	3	6	12
Meadow (Carex - Juncus - Eleocharis) Mapping Unit	4	0	0	0
Opuntia littoralis Alliance	205	2	4	6
Platanus racemosa Alliance	146	0	0	0
Populus fremontii Alliance	7	0	0	0

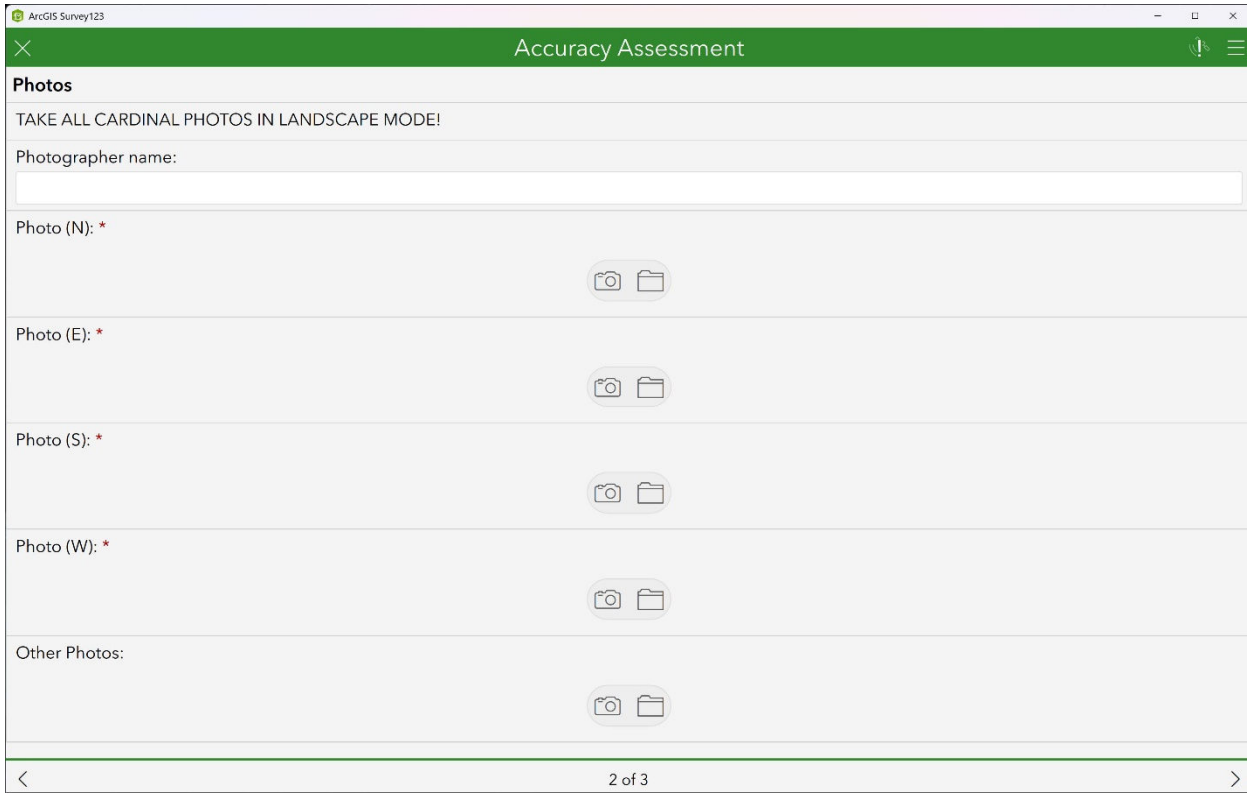
Vegetation Name	Polygon Count	Priority Rank	Goal	Number Allocated
Pseudotsuga macrocarpa Alliance	2	0	0	0
Quercus agrifolia Alliance	649	0	0	0
Quercus agrifolia Riparian	201	0	0	0
Quercus berberidifolia - Adenostoma fasciculatum Alliance	29	1	4	6
Quercus berberidifolia Alliance	300	2	4	6
Quercus dumosa Alliance	39	1	4	6
Rhus integrifolia Alliance	279	2	4	6
Salix gooddingii Alliance	70	0	0	0
Salix laevigata Alliance	34	0	0	0
Salix lasiolepis Alliance	291	0	0	0
Salvia apiana Alliance	62	2	4	6
Salvia leucophylla Alliance	48	1	4	6
Salvia mellifera Alliance	273	2	4	6
Sambucus nigra Alliance	127	2	4	6
Sarcocornia pacifica (Salicornia depressa) Alliance	11	0	0	0
Schoenoplectus acutus Alliance	3	0	0	0
Schoenoplectus californicus Alliance	7	0	0	0
Scirpus robustus Alliance	2	0	0	0
Southwestern North American Riparian Evergreen and Deciduous Woodland Group	27	0	0	0
Southwestern North American Riparian/Wash Scrub Group	22	0	0	0
Southwestern North American Salt Basin and High Marsh Group	26	0	0	0
Spartina foliosa Alliance	86	0	0	0
Stipa lepida Alliance	22	0	0	0
Stipa pulchra Alliance	184	0	0	0
Temperate and Boreal Freshwater Marsh Formation	30	0	0	0
Temperate Pacific Tidal Salt and Brackish Marsh Group	108	0	0	0
Toxicodendron diversilobum Alliance	27	0	0	0

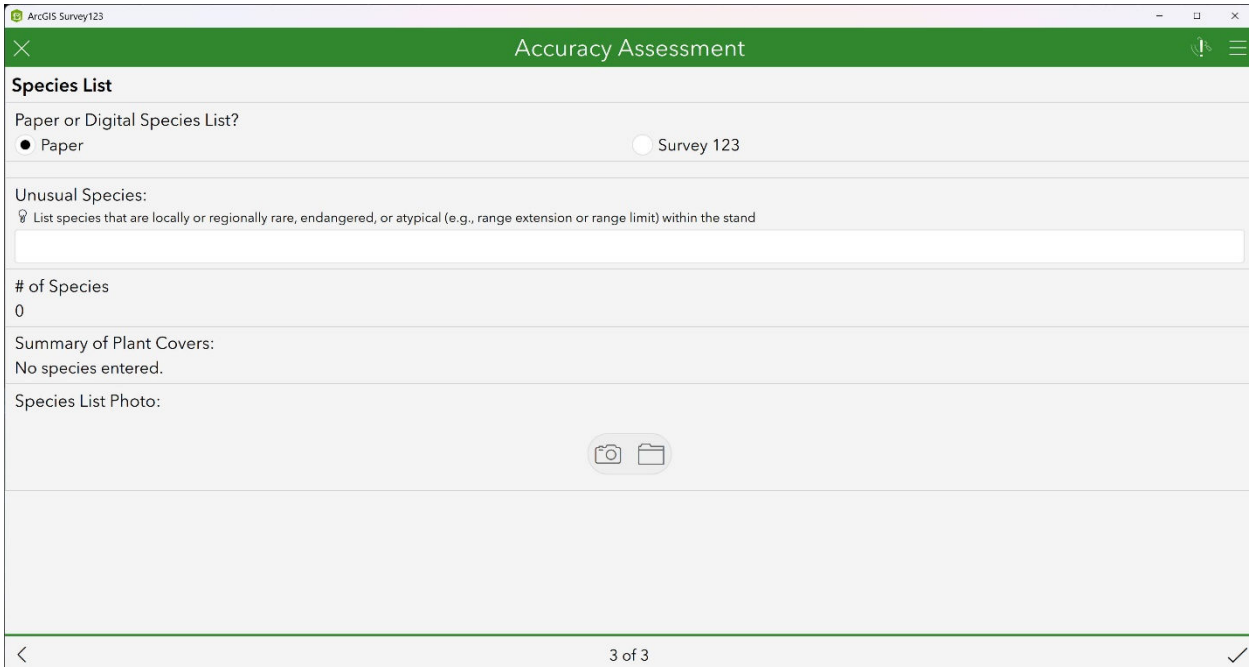
Vegetation Name	Polygon Count	Priority Rank	Goal	Number Allocated
Typha (angustifolia, domingensis, latifolia) Alliance	8	0	0	0
SUM			126	200

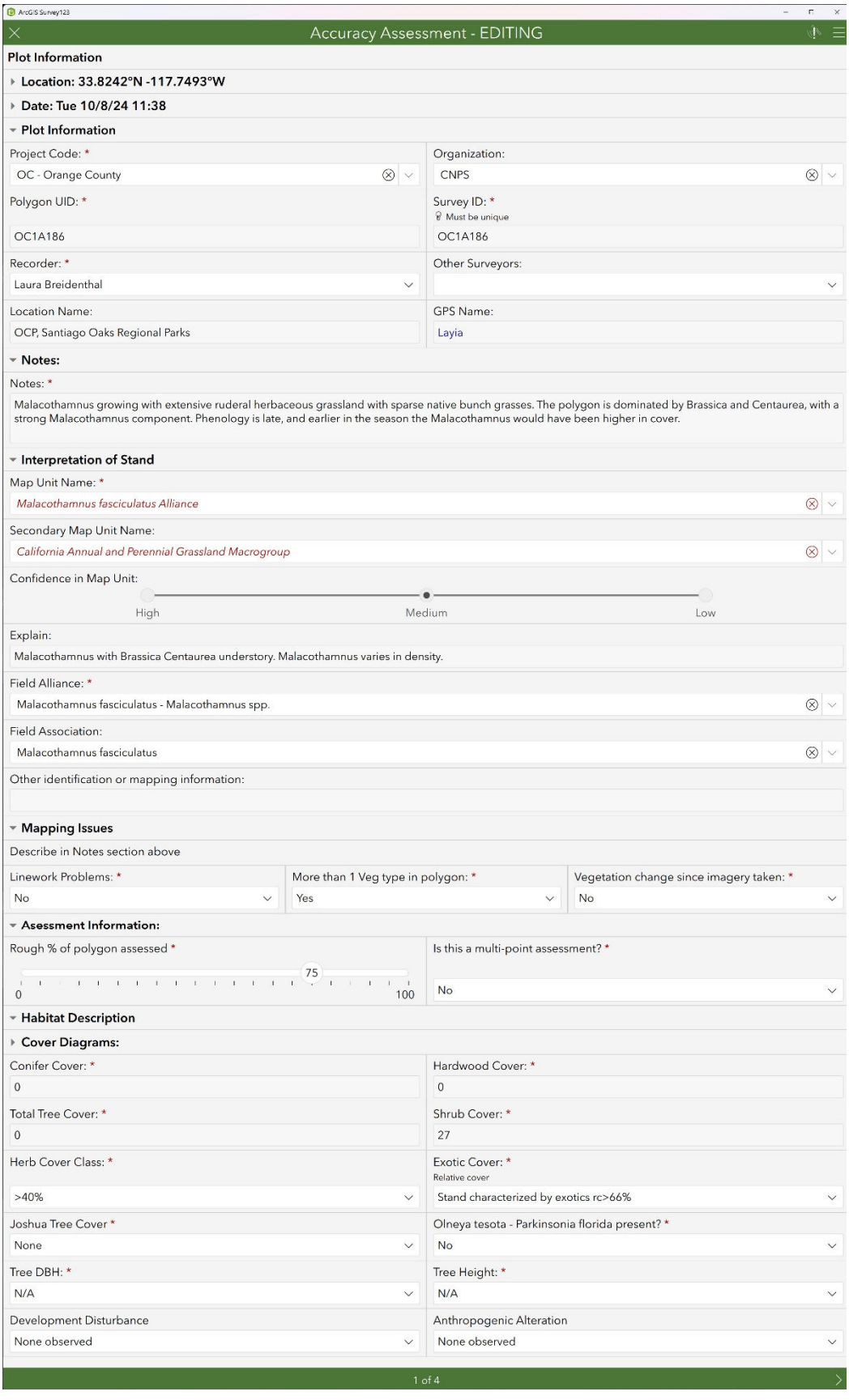
Appendix B

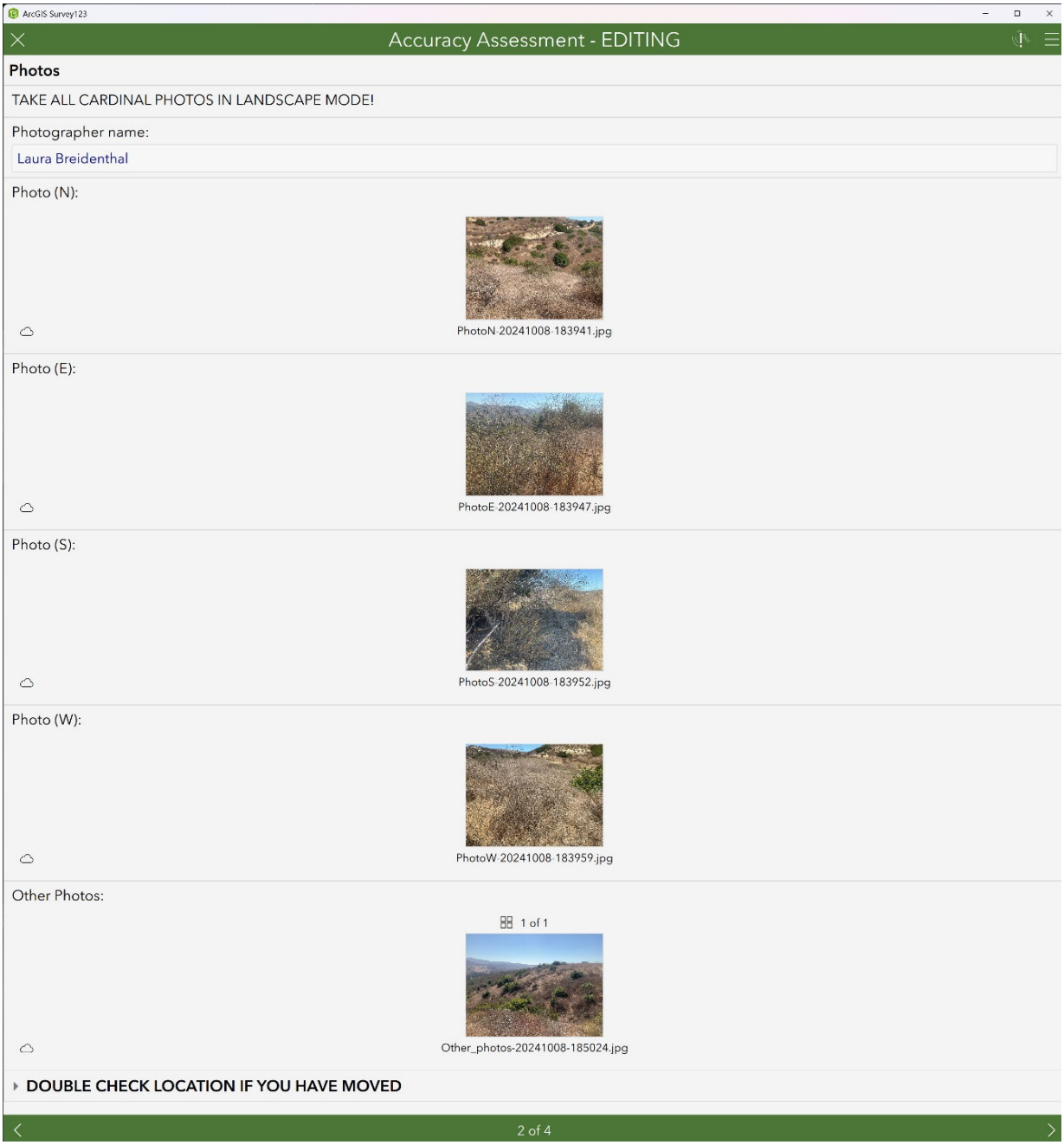
CNPS Accuracy Assessment Field Form

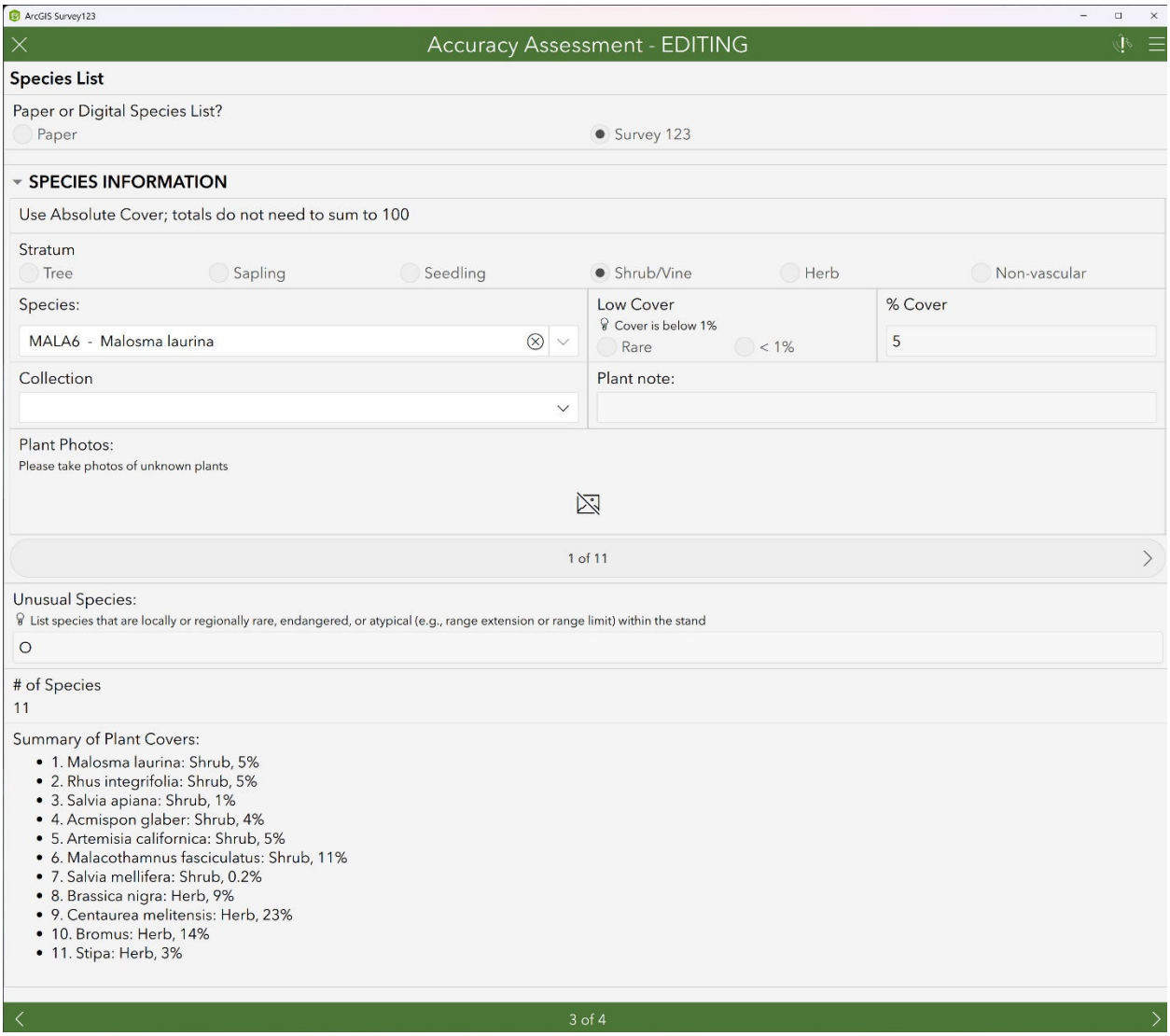

Accuracy Assessment
Plot Information
Location:
Date: Thu 2/20/25 12:50
Plot Information
Project Code: *
Organization: *
CNPS
Polygon UID: *
Survey ID: *
Must be unique
Recorder: *
Other Surveyors:
Location Name: *
GPS Name:
Notes:
Notes: *
Interpretation of Stand
Select a ProjectCode to select MapUnit
Confidence in Map Unit: *
High
Medium
Low
Explain:
Field Alliance: *
Field Association:
Other identification or mapping information:
Mapping Issues
Describe in Notes section above
Linework Problems: *
More than 1 Veg type in polygon: *
Vegetation change since imagery taken: *
Asessment Information:
Rough % of polygon assessed *
0
100
Is this a multi-point assessment? *
Habitat Description
Cover Diagrams:
Conifer Cover: *
Hardwood Cover: *
Total Tree Cover: *
0
Shrub Cover: *
0
Herb Cover Class:*
0
Exotic Cover: *
Relative cover
Development Disturbance
Anthropogenic Alteration
1 of 3


ArcGIS Survey123
Accuracy Assessment
Photos
TAKE ALL CARDINAL PHOTOS IN LANDSCAPE MODE!
Photographer name:
Photo (N): *
Photo (E): *
Photo (S): *
Photo (W): *
Other Photos:
2 of 3


ArcGIS Survey123
Accuracy Assessment
Species List
Paper or Digital Species List?
Paper
Survey 123
Unusual Species:
List species that are locally or regionally rare, endangered, or atypical (e.g., range extension or range limit) within the stand
# of Species
0
Summary of Plant Covers:
No species entered.
Species List Photo:
3 of 3


ArcGIS Survey123
Accuracy Assessment - EDITING
Plot Information
Location: 33.8242°N -117.7493°W
Date: Tue 10/8/24 11:38
Plot Information
Project Code: *
OC - Orange County
Organization:
CNPS
Polygon UID: *
OC1A186
Survey ID: *
Must be unique
OC1A186
Recorder: *
Laura Breidenthal
Other Surveyors:
Location Name:
OCP, Santiago Oaks Regional Parks
GPS Name:
Layia
Notes:
Notes: *
Malacothamnus growing with extensive ruderal herbaceous grassland with sparse native bunch grasses. The polygon is dominated by Brassica and Centaurea, with a strong Malacothamnus component. Phenology is late, and earlier in the season the Malacothamnus would have been higher in cover.
Interpretation of Stand
Map Unit Name: *
Malacothamnus fasciculatus Alliance
Secondary Map Unit Name:
California Annual and Perennial Grassland Macrogroup
Confidence in Map Unit:
High
Medium
Low
Explain:
Malacothamnus with Brassica Centaurea understory. Malacothamnus varies in density.
Field Alliance: *
Malacothamnus fasciculatus - Malacothamnus spp.
Field Association:
Malacothamnus fasciculatus
Other identification or mapping information:
Mapping Issues
Describe in Notes section above
Linework Problems: *
No
More than 1 Veg type in polygon: *
Yes
Vegetation change since imagery taken: *
No
Asessment Information:
Rough % of polygon assessed *
75
0
100
Is this a multi-point assessment? *
No
Habitat Description
Cover Diagrams:
Conifer Cover: *
0
Hardwood Cover: *
0
Total Tree Cover: *
0
Shrub Cover: *
27
Herb Cover Class: *
>40%
Exotic Cover: *
Relative cover
Stand characterized by exotics rc>66%
Joshua Tree Cover *
None
Olneya tesota - Parkinsonia florida present? *
No
Tree DBH: *
N/A
Tree Height: *
N/A
Development Disturbance
None observed
Anthropogenic Alteration
None observed
1 of 4


ArcGIS Survey123
Accuracy Assessment - EDITING
Photos
TAKE ALL CARDINAL PHOTOS IN LANDSCAPE MODE!
Photographer name:
Laura Breidenthal
Photo (N):
PhotoN 20241008 183941.jpg
Photo (E):
PhotoE 20241008 183947.jpg
Photo (S):
PhotoS 20241008 183952.jpg
Photo (W):
PhotoW 20241008 183959.jpg
Other Photos:
1 of 1
Other_photos-20241008-185024.jpg
DOUBLE CHECK LOCATION IF YOU HAVE MOVED
2 of 4


ArcGIS Survey123
Accuracy Assessment - EDITING
Species List
Paper or Digital Species List?
Paper
Survey 123
SPECIES INFORMATION
Use Absolute Cover; totals do not need to sum to 100
Stratum
Tree
Sapling
Seedling
Shrub/Vine
Herb
Non-vascular
Species:
MALA6 - Malosma laurina
Low Cover
Cover is below 1%
Rare
< 1%
% Cover
5
Collection
Plant note:
Plant Photos:
Please take photos of unknown plants
1 of 11
Unusual Species:
List species that are locally or regionally rare, endangered, or atypical (e.g., range extension or range limit) within the stand
O
# of Species
11
Summary of Plant Covers:
1. Malosma laurina: Shrub, 5%
2. Rhus integrifolia: Shrub, 5%
3. Salvia apiana: Shrub, 1%
4. Acmispon glaber: Shrub, 4%
5. Artemisia californica: Shrub, 5%
6. Malacothamnus fasciculatus: Shrub, 11%
7. Salvia mellifera: Shrub, 0.2%
8. Brassica nigra: Herb, 9%
9. Centaurea melitensis: Herb, 23%
10. Bromus: Herb, 14%
11. Stipa: Herb, 3%
3 of 4

Appendix C

Hierarchical Vegetation Field and Mapping Key

Orange County Vegetation Classification

Primary Terms and Concepts Used Throughout the Key:

Dominance by layer: Tree, shrub, and herbaceous layers are considered physiognomically distinct. A vegetation type is considered to belong to a certain physiognomic group if it is dominated by one layer. Layers are prioritized in order of height when naming the type.

Dominant: Dominance refers to the preponderance of vegetation cover in a stand of uniform composition and site history. It may refer to cover of an individual species (as in "dominated by *Quercus agrifolia*"), or it may refer to dominance by a physiognomic group, as in "dominated by shrubs." Dominance refers to the relative cover of one species or physiognomic group as compared to another species or physiognomic group.

Co-dominant: Co-dominance refers to two or more species (usually in the same physiognomic group or layer) in a stand that share dominance and have between 30 and 60 percent relative cover each.

Cover: The primary metric used to quantify the importance/abundance of a particular species or a particular vegetation layer within a stand. It is measured by estimating the aerial extent of the living plants, or the bird's-eye view looking from above, for each category. Cover in this project uses the concept of "porosity" or foliar cover rather than "opacity" or crown cover.

Relative cover: Refers to the amount of the surface of the plot or stand sampled that is covered by one species (or physiognomic group) as compared to (relative to) the amount of surface of the plot or stand covered by all species (in that group). Thus, 50 percent relative cover means that half of the total cover of all species or physiognomic groups is composed of the single species or group in question. Relative cover values are proportional numbers and, if added, total 100 percent for each stand (sample).

Absolute cover: Refers to the actual percentage of the ground (surface of the plot or stand) that is covered by a species or group of species. For example, *Artemisia californica* covers between 5 and 10 percent of the stand. Absolute cover of all species or groups if added in a stand or plot may total greater or less than 100 percent.

Characteristic/Diagnostic species: Must be present in at least 80 percent of the classification samples, with no restriction on cover, in that layer.

Often/Usually occurring species: Must be present in at least 50 percent of the classification samples, with no restriction on cover, in that layer.

Parentheses ( ): The use of ( ) in an Alliance or Association name denotes that the species in parentheses may or may not be present, if present it may act as merely an indicator with low cover (e.g. *Adenostoma fasciculatum* – (*Ceanothus crassifolius*)).

Sparse: Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is less than 8 percent absolute cover.

Trace: Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is less than 5 percent absolute cover.

Open: Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is generally less than 33 percent absolute cover.

Stand: Is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small such as wetland seeps, and some may be several square kilometers in size such as desert or forest types. A stand is defined by two main unifying characteristics:

> **a.** It has *compositional* integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or gradual.
>
> **b.** It has *structural* integrity. It has a similar history or environmental setting, affording relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest formerly dominated by the same species but has burned on the upper part of the slope and not the lower is divided into two stands. Likewise, a sparse woodland occupying a slope with shallow rocky soil is considered a different stand from an adjacent slope of a denser woodland/forest with deep, moister soil and the same species.

Tree: Is a one-stemmed woody plant that normally grows to greater than 5 meters tall. In some cases, trees may be multiple stemmed following a fire or other disturbance, but the size of mature plants is typically greater than 5 meters. Undisturbed individuals of these species are usually single stemmed.

Shrub: Is normally a multi-stemmed woody plant that is usually between 0.2 to 5 meters tall. Definitions are blurred at the low and high ends of the height scales. At the high end, shrubs may approach trees based on growth trajectories (e.g., old-growth re-sprouting chaparral species such as *Fraxinus dipetala, Heteromeles arbutifolia,* and *Prunus ilicifolia* may attain "tree size"). At the low end, woody perennial herbs or subshrubs of various species are often difficult to categorize into a consistent life-form.

Herbaceous plant: Is any species of plant that has no main woody stem development and includes grasses, forbs, and dieback perennial species.

Key to vegetation types in Orange County, California

Class A. Vegetation characterized by an even distribution of overstory trees. Tree canopy is generally greater than 10%, but occasionally may be less than 10% over a denser understory of shrub and/or herbaceous species = **Tree-Overstory (Woodland / Forest Vegetation)**

Class B. Vegetation characterized by woody shrubs in the canopy. Shrubs are usually at least 10% cover. Tree species, if present, generally total less than 10% absolute cover and herbaceous species may total higher cover than shrubs = **Shrubland Vegetation**

Class C. Vegetation characterized by non-woody, herbaceous species in the canopy including grass, graminoid, and broad-leaved herbaceous species. Shrubs, if present, usually comprise <10% of the vegetation. Trees, if present, generally compose <10% cover **= Herbaceous Vegetation**

Class A. Tree-Overstory (Woodland / Forest Vegetation)

Section I: Woodlands and forests characterized by needle or scale-leaved conifer trees (1200)

1. Vegetation dominated or co-dominated by a species of *Pinus*.

    1a. *Pinus coulteri* is co-dominant to dominant in the tree overstory, sometimes with well-developed understory shrub layers.

    ***Pinus coulteri* Alliance (1230)**
    Pinus coulteri / *Arctostaphylos glandulosa* – *Quercus wislizeni* Association
    Pinus coulteri – *Quercus wislizeni* Association

    1b. *Pinus attenuata* is co-dominant to dominant in the tree overstory. *Pinus coulteri* may be present and sub-dominant.

    ***Pinus attenuata* Alliance (1220)**
    Pinus attenuata / Arctostaphylos glandulosa Association

2. Vegetation dominated or co-dominated by *Hesperocyparis* or *Pseudotsuga*, sometimes with co-dominant *Quercus* spp.

    2a. *Pseudotsuga macrocarpa* is co-dominant to dominant in the tree overstory, usually with >30% relative cover. In Orange County, *Quercus agrifolia*, *Q. chrysolepis*, and *Q. wislizeni* may be found intermixing as co-dominant trees.

    ***Pseudotsuga macrocarpa* Alliance (1410)**
    Pseudotsuga macrocarpa – *Quercus agrifolia* Association

Pseudotsuga macrocarpa – Quercus chrysolepis Association

2b. *Hesperocyparis forbesii* has >30% relative cover in the tree overstory or is emergent above a shrub canopy, typically with at least 5% cover.

Hesperocyparis forbesii – Hesperocyparis nevadensis **Alliance**
Hesperocyparis forbesii Association **(1210)**

Section II. Woodlands, forests, and riparian shrublands characterized mainly by native and non-native broad-leaved evergreen and deciduous trees, as well as riparian shrub species. Includes *Acer*, *Alnus*, *Baccharis salicifolia, Eucalyptus, Juglans, Platanus, Quercus*, *Salix*, *Sambucus*, *Schinus*, and *Myoporum*.

3. Stands characterized by a species of *Acer, Juglans*, and/or *Quercus*.

3a. *Acer macrophyllum* is co-dominant or dominant in the tree overstory, occurring alone or with *Quercus chrysolepis.*

Acer macrophyllum – Alnus rubra **Alliance (1310)**
Acer macrophyllum Association

3b. *Juglans californica* dominates in the tree overstory or co-dominates with *Quercus agrifolia*.

Juglans californica **Alliance (1110)**
Juglans californica / annual herbaceous Association

3c. Stands not as above and with a species of *Quercus* dominating or co-dominating in the tree canopy.

3c1. *Quercus chrysolepis* dominates in the tree overstory, often with >50% relative cover. If present, *Pseudotsuga macrocarpa* is sub-dominant.

Quercus chrysolepis **(tree) Alliance (1130)**
Quercus chrysolepis Association

3c2. *Quercus agrifolia* dominates in the tree overstory, usually with >50% relative cover and >10% absolute cover.

Quercus agrifolia **Alliance (1120)**
Quercus agrifolia / Artemisia californica Association
Quercus agrifolia / grass Association
Quercus agrifolia / Quercus (berberidifolia, x *acutidens*) Association
Quercus agrifolia / *Toxicodendron diversilobum* / grass Association

4. Stands characterized by native riparian/wash trees and tall shrubs, including *Alnus, Platanus, Salix, Baccharis salicifolia*, and *Sambucus*. *Quercus agrifolia* may intermix as a sub- to co-dominant tree.

4a. Riparian/wash vegetation with an overstory characterized by trees.

4a1. *Alnus rhombifolia* dominates or co-dominates in the tree overstory. In Orange County, *Acer macrophyllum* and *Platanus racemosa* are two of the more common tree species that intermix as sub-dominant trees.

***Alnus rhombifolia* Alliance (1610)**
Alnus rhombifolia – Acer macrophyllum Association
Alnus rhombifolia – Platanus racemosa Association

4a2. *Salix gooddingii* dominates or co-dominates in the tree overstory as the sole dominant or with other tree species of *Salix*.

***Salix gooddingii – Salix laevigata* Alliance**
Salix gooddingii Association **(1720)**

4a3. *Salix laevigata* dominates in the tree overstory. *Salix lasiolepis* may intermix in the sub-canopy and sometimes can exceed *S. laevigata* in cover.

***Salix gooddingii – Salix laevigata* Alliance (1730)**
Salix laevigata Association
Salix laevigata – Salix lasiolepis Association

4a4. *Platanus racemosa* dominates in the tree overstory as the sole dominant tree or intermixes with other co-dominant species including *Quercus agrifolia, Salix* spp., or *Populus fremontii*.

***Platanus racemosa – Quercus agrifolia* Alliance (1710)**
Platanus racemosa / annual grass Association
Platanus racemosa – Quercus agrifolia Association
Quercus agrifolia / *Salix lasiolepis* Association (1121)

4a5. *Populus fremontii* dominates or co-dominates in the tree overstory with *Salix* spp., if *Platanus racemosa* is present it has <30% relative cover in the overstory.

***Populus fremontii – Fraxinus velutina – Salix gooddingii* Alliance (1740)**

4b. Riparian/wash vegetation with an overstory characterized by tall shrubs.

4b1. *Salix lasiolepis* dominates or co-dominates with *Baccharis salicifolia* in the shrub/tree canopy.

***Salix lasiolepis* Alliance (1820)**
Salix lasiolepis Association
Salix lasiolepis / Baccharis salicifolia Association

4b2. *Baccharis salicifolia* dominates or co-dominates with *Sambucus nigra* in the shrub overstory.

***Baccharis salicifolia* Alliance (1810)**
Baccharis salicifolia Association
Baccharis salicifolia – Sambucus nigra Association (not yet observed)

4b3. *Sambucus nigra* dominates or co-dominates with *Baccharis pilularis* in the shrub overstory. *Sambucus nigra* can occur in both riparian and non-riparian

settings across Orange County and is currently not differentiated in mapping efforts.

Sambucus nigra Map Unit **(1830)**

includes *Sambucus nigra* Riparian Association
within the ***Rhus trilobata – Crataegus rivularis – Forestiera pubescens*** **Alliance &**
Sambucus nigra Upland Association
within the ***Ribes quercetorum – Rhus trilobata – Frangula californica*** **Alliance**

5. Stands are characterized by high relative cover of non-native trees, including species of *Acacia, Eucalyptus, Schinus*, and *Myoporum*.

5a. A species of *Eucalyptus* dominates in the tree overstory.

Eucalyptus **spp. –** ***Ailanthus altissima – Robinia pseudoacacia*** **Semi-Natural Stands**
Eucalyptus (globulus, camaldulensis) Semi-Natural Stands **(1510)**

5b. A species of *Schinus* or *Myoporum laetum* dominates in the tree/shrub overstory, usually with >60% relative cover.

Schinus (molle, terebinthifolius) – Myoporum laetum **Semi-Natural Stands (1520)**

5c. A species of *Acacia* dominates stands, with no other native tree/shrub species having significant cover.

Acacia **spp. –** ***Grevillea*** **spp. –** ***Leptospermum laevigatum*** **Semi-Natural Stands**
Acacia (cyclops, dealbata) Semi-Natural Stands **(3410)**

Class B. Shrubland Vegetation

Section III. Shrublands dominated by sclerophyllous, evergreen shrubs in upland settings. Californian Chaparral (2000).

[Note: Throughout the study area, *Rhus integrifolia* and/or *Malosma laurina* may be present with the highest cover in shrub stands, but neither species is considered a useful diagnostic species, as they are both ubiquitous across chaparral and coastal scrub settings. *Rhus integrifolia* and *Malosma laurina* Alliances are distinguished only when either species is strongly dominant and other shrub species are trace or strongly sub-dominant.]

6. A species of scrub oak, *Quercus berberidifolia, Q. dumosa* or *Q. wislizeni*, dominates or shares dominance with other chaparral species in the shrub overstory.

6a. *Quercus berberidifolia* and *Adenostoma fasciculatum* share dominance in the shrub overstory, often co-occurring with a variety of sub-dominant chaparral and/or coastal scrub species. If *Q. berberidifolia* is sub-dominant to *A. fasciculatum*, key to the *A. fasciculatum* alliance.

Quercus berberidifolia **Alliance**

Quercus berberidifolia – Adenostoma fasciculatum Association **(2350)**

6b. *Quercus berberidifolia* intermixes with a variety of shrubs as either the dominant species or it shares dominance with *Cercocarpus montanus*, *Ceanothus* spp., *Fraxinus dipetala* or *Arctostaphylos glandulosa*. [Note: *Fraxinus dipetala* may occasionally be dominant to *Q. berberidifolia* in this alliance].

***Quercus berberidifolia* Alliance (2340)**
Quercus berberidifolia Association
Quercus berberidifolia – Ceanothus tomentosus Association
Quercus berberidifolia – Fraxinus dipetala – Heteromeles arbutifolia Association

6c. *Quercus wislizeni* occurs as the dominant shrub or may be co-dominant with *Arctostaphylos glandulosa* or *Fraxinus dipetala* in the overstory [Note: *Fraxinus dipetala* may occasionally be dominant to *Q. wislizeni* in this alliance].

***Quercus wislizeni – Quercus chrysolepis* (shrub) Alliance (2420)**
Quercus wislizeni – Arctostaphylos glandulosa Association

6d. *Quercus dumosa* occurs as the dominant shrub usually within 2 km of the coastal shore.

***Quercus dumosa – Quercus pacifica* Alliance**
Quercus dumosa Association **(2230)**

7. Vegetation not as in 6 and with a species of *Ceanothus* dominating or sharing dominance with other chaparral or disturbance following species in the shrub overstory.

7a. *Ceanothus megacarpus* is dominant in the shrub overstory (Note: Some *Ceanothus* individuals in these stands may bear similarities with *C. verrucosus* of coastal San Diego Co.).

***Ceanothus megacarpus* Alliance (2130)**
Ceanothus megacarpus Association

7b. *Ceanothus tomentosus* intermixes with a variety of shrubs as either the dominant species or sharing dominance with disturbance following species such as *Crocanthemum* (*Helianthemum*) *scoparium* or *Eriodictyon crassifolium* in the overstory.

***Ceanothus* (*oliganthus*, *tomentosus*) Alliance**
Ceanothus tomentosus Association **(2310)**

7c. *Ceanothus crassifolius* is the dominant shrub species or may be co-dominant with *Adenostoma fasciculatum* in the overstory.

***Ceanothus crassifolius* Alliance (2120)**
Ceanothus crassifolius Association
Ceanothus crassifolius – Adenostoma fasciculatum – Malosma laurina Association

8. Vegetation not as in 6 and 7 and with *Adenostoma fasciculatum* and/or *Arctostaphylos glandulosa* characterizing the shrub overstory, sometimes sharing dominance with disturbance following species.

8a. *Arctostaphylos glandulosa* is the dominant shrub species or may be co-dominant with *Adenostoma fasciculatum* in the overstory.

***Arctostaphylos glandulosa* Alliance (2410)**
Arctostaphylos glandulosa Association
Arctostaphylos glandulosa – Adenostoma fasciculatum Association

8b. *Adenostoma fasciculatum* is co-dominant with *Salvia mellifera* alone or with *S. mellifera* and a mix of other coastal sage shrubs that reach > 30% relative cover when combined in the shrub canopy.

***Adenostoma fasciculatum – Salvia* spp. Alliance (2140)**
Adenostoma fasciculatum – (*Eriogonum fasciculatum*, *Salvia mellifera*) Association

8c. *Adenostoma fasciculatum* intermixes with a variety of shrubs as either the dominant species or it shares dominance with disturbance following species such as *Helianthemum scoparium*, *Acmispon glaber* (*Lotus scoparius*), and *Eriodictyon crassifolium*. Sub-dominant shrubs may include *Arctostaphylos glandulosa, Eriogonum fasciculatum*, *Artemisia californica*, *Salvia mellifera*, *Quercus berberidifolia*, *Ceanothus crassifolius*, and others.

***Adenostoma fasciculatum* Alliance (2110)**
Adenostoma fasciculatum Association
Adenostoma fasciculatum – (*Arctostaphylos glandulosa*) Association
Adenostoma fasciculatum – (*Ceanothus crassifolius*) Association
Adenostoma fasciculatum – (Lotus scoparius – Eriodictyon spp.) Association
Adenostoma fasciculatum – Malosma laurina Association

9. Stands not as above in 6-8 and characterized by *Cercocarpus montanus*, *Fraxinus dipetala*, *Heteromeles arbutifolia*, *Malosma laurina* or *Rhus integrifolia*.

9a. *Heteromeles arbutifolia* intermixes with a variety of shrubs as either the dominant species or it shares dominance with *Baccharis pilularis*, *Encelia californica*, *Fraxinus dipetala,* or *Rhus integrifolia.* [Note: *F. dipetala* may occasionally be dominant to *H. arbutifolia* in this alliance].

***Prunus ilicifolia – Heteromeles arbutifolia – Ceanothus spinosus* Alliance**
Heteromeles arbutifolia Association **(2330)**
Heteromeles arbutifolia – Fraxinus dipetala Provisional Association

9b. *Cercocarpus montanus* is the dominant shrub species or may be co-dominant with *Adenostoma fasciculatum, Eriogonum fasciculatum* or *Fraxinus dipetala* in the overstory. [Note: *Fraxinus dipetala* may occasionally be dominant to *C. montanus* in this alliance].

***Cercocarpus montanus* Alliance (2320)**
Cercocarpus montanus var. *glaber* Association

Cercocarpus montanus – Adenostoma fasciculatum Association

9c. *Malosma laurina* is strongly dominant or may share dominance with *Acmispon glaber (Lotus scoparius)*. See note under the Section III description for guidelines on identifying the *Malosma laurina* Alliance.

***Malosma laurina* Alliance (2210)**
Malosma laurina Association
Malosma laurina – Lotus scoparius Association

9d. *Rhus integrifolia* is strongly dominant, usually with >50% relative cover. If *Heteromeles arbutifolia* is present as a co-dominant shrub, key to the *Heteromeles arbutifolia* Alliance. See note under the Section III description for guidelines on identifying the *Rhus integrifolia* Alliance.

***Rhus integrifolia* Alliance (2220)**
Rhus integrifolia Association

9e. If *Fraxinus dipetala* is dominant or co-dominant with *Heteromeles arbutifolia, Cercocarpus montanus* var. *glaber, Quercus berberidifolia* or *Q. wislizeni*, key to the most appropriate alliance of the four latter species by following the appropriate key steps above. A *Fraxinus dipetala* Alliance is not supported by data collected to date in Southern California.

Section IV. Shrublands dominated mainly by soft-leaved, deciduous, or succulent shrubs that are microphyllous or broad-leaved. This vegetation is generally considered to be part of coastal sage scrub or other more soft-leaved shrub habitats. Chaparral species may be present but are not dominant.
[Please see note regarding *Malosma laurina* and *Rhus integrifolia* under Section III description].

10. Stands characterized by *Bebbia juncea, Eriodictyon crassifolium, Lycium californicum,* or *Lepidospartum squamatum*. The latter two species may be sub-dominant to other shrubs.

10a. *Lycium californicum* is dominant, co-dominant or characteristically present with a mixture of other shrubs and herbs, including *Suaeda taxifolia, Cylindropuntia prolifera, Atriplex* spp., and others. Even if *Rhus integrifolia* has significantly higher cover than *L. californicum*, key to this alliance.

***Lycium californicum* Alliance (8110)**
Lycium californicum Association

10b. *Lepidospartum squamatum* is characteristically present (may be low cover) to dominant along washes, intermixing with variable cover (sometimes much higher) of species such as *Eriogonum fasciculatum, Artemisia californica, Baccharis salicifolia, Brickellia californica*, and others.

***Lepidospartum squamatum* Alliance (8210)**
Lepidospartum squamatum – Eriogonum fasciculatum Association

10c. *Bebbia juncea* dominates in the shrub overstory along washes or on south-facing slopes with rocky substrate. *Pennisetum setaceum* had similar cover to *Bebbia* in the one stand encountered in the study area.

***Ambrosia salsola – Bebbia juncea* Alliance**
Bebbia juncea Association (8220)

10d. *Eriodictyon crassifolium* dominates in the shrub overstory along alluvial washes or in post-burn areas.

***Lotus scoparius – Lupinus albifrons – Eriodictyon* spp. Alliance**
Eriodictyon crassifolium Provisional Association

11. Stands with *Atriplex lentiformis, Baccharis pilularis*, or *Toxicodendron diversilobum* as dominant or co-dominant species.

11a. *Baccharis pilularis* is dominant or may share dominance with *Artemisia californica* or *Isocoma menziesii*.

***Baccharis pilularis* Alliance (5310)**
Baccharis pilularis / Annual grass - herb Association
Baccharis pilularis – Artemisia californica Association

11b. *Atriplex lentiformis* is dominant in the shrub canopy.

***Atriplex lentiformis* Alliance (7210)**
Atriplex lentiformis Association

11c. *Toxicodendron diversilobum* is dominant or co-dominant with *Artemisia californica* and *Leymus condensatus*. If *Rhus integrifolia* and *Heteromeles arbutifolia* intermix with poison oak at moderate cover, key to this alliance.

***Toxicodendron diversilobum* Alliance (5210)**
Toxicodendron diversilobum – Artemisia californica / *Leymus condensatus* Association

12. A shrub species of *Salvia* is dominant or co-dominant with *Artemisia californica* or *Eriogonum fasciculatum* in the shrub overstory.

12a. *Salvia apiana* is dominant or co-dominant with *Artemisia californica* or *Diplacus aurantiacus* in the overstory.

***Salvia apiana* Alliance (3180)**
Salvia apiana Association
Salvia apiana – Artemisia californica Association

12b. *Salvia leucophylla* is dominant or co-dominant with *Artemisia californica* in the overstory.

***Artemisia californica* – (*Salvia leucophylla)* Alliance (3190)**
Salvia leucophylla Association
Salvia leucophylla – Artemisia californica Association

12c. *Salvia mellifera* is dominant or co-dominant with *Eriogonum fasciculatum* in the overstory. A variety of sub-dominant shrubs may intermix, including *Artemisia californica, Malacothamnus fasciculatus*, and others.

***Salvia mellifera* – (*Artemisia californica*) Alliance (3210)**
Salvia mellifera Association
Salvia mellifera – Eriogonum fasciculatum Association
Salvia mellifera – Malosma laurina Association

12d. *Salvia mellifera* is co-dominant with *Adenostoma fasciculatum* in the shrub canopy or *S. mellifera* occurs with a mix of other coastal sage shrubs that sum to > 30% relative cover and co-dominate with *Adenostoma fasciculatum* in the shrub canopy.

***Adenostoma fasciculatum – Salvia* spp. Alliance (2140)**

12e. *Artemisia californica* and *Salvia mellifera* occur as co-dominants in the overstory, co-occurring with a variety of sub-dominant shrubs. *Rhus integrifolia* and/or *Malosma laurina* may be present with the highest cover, but neither species is considered a useful diagnostic species, being that they are both ubiquitous across the study area, occupying both chaparral and coastal sage settings. Such stands should be types to this alliance.

***Salvia mellifera* – (*Artemisia californica*) Alliance**
Salvia mellifera – Artemisia californica Association **(3130)**

12f. *Eriogonum fasciculatum* and *Salvia apiana* share dominance, often intermixing with other shrub species such as *Artemisia californica*.

***Eriogonum fasciculatum – Salvia apiana* Alliance (3160)**
Eriogonum fasciculatum – Salvia apiana Association

13. Stands dominated by either *Keckiella antirrhinoides* or *Encelia californica* or with either species co-dominant with *Artemisia californica*.

13a. *Keckiella antirrhinoides* is dominant or co-dominant with *Artemisia californica.*

***Keckiella antirrhinoides* Alliance (3170)**
Keckiella antirrhinoides – Artemisia californica Association

13b. *Encelia californica* is dominant or co-dominant with *Artemisia californica*.

***Encelia californica – Eriogonum cinereum* Alliance (3140)**
Encelia californica Association
Encelia californica – Artemisia californica Association

14. Vegetation not as above and characterized by *Artemisia californica*, *Diplacus aurantiacus*, *Eriogonum fasciculatum, Opuntia littoralis, Opuntia oricola*, and/or *Salvia mellifera*. If *Mirabilis laevis* and/or *Salvia columbariae* characterize open stands with *E.*

fasciculatum, skip to 14g below. (Note: These are south facing hotter and well drained rocky or gravelly slopes usually inland.)

14a. *Opuntia littoralis* OR *Opuntia oricola* occurs as the dominant shrub or co-dominates with *Eriogonum fasciculatum*, which is characteristically present. If *Artemisia californica* is present, it has trace cover or is clearly sub-dominant [contrast with the similar *Artemisia californica – Eriogonum fasciculatum – Opuntia littoralis/Dudleya* (*edulis*) Association described in lead 14b below]. High cover by *Malosma laurina*, *Rhus integrifolia*, or disturbance following species such as *Acmispon glaber* should be disregarded as these species are not diagnostic in the study area unless they are sole dominants.

***Opuntia littoralis – Opuntia oricola – Cylindropuntia prolifera* Alliance (8120)**
Opuntia littoralis – Eriogonum fasciculatum – Malosma laurina Association

14b. *Artemisia californica* and *Eriogonum fasciculatum* characterize stands, either as co-dominant species, or in combination with a variety of coastal succulent species such as *Opuntia littoralis*, *Cylindropuntia prolifera* or a species of *Dudleya*. In the latter case, the combined cover of *Artemisia californica* and *E. fasciculatum* exceeds that of succulents (e.g. *Opuntia littoralis*), though succulents are clearly diagnostic. When *O. littoralis* is dominant or co-dominant with *E. fasciculatum* and *A. californica* is absent or sub-dominant, key to the *Opuntia littoralis* Alliance above.

***Artemisia californica – Eriogonum fasciculatum* Map Unit (3120)**
Artemisia californica – Eriogonum fasciculatum – Malosma laurina Association
Artemisia californica – Eriogonum fasciculatum – Opuntia littoralis/*Dudleya* (*edulis*) Association

14c. *Artemisia californica* occurs as the dominant or co-dominant with *Diplacus aurantiacus* in the overstory (*D. aurantiacus* may occasionally be dominant to *A. californica*). A variety of sub-dominant shrubs may intermix, including *Eriogonum fasciculatum*, *Acmispon glaber, Salvia mellifera, Baccharis pilularis, Toxicodendron diversilobum, Opuntia littoralis*, and others. *Nolina cismontana*, a CNPS list 1B species, has been found in stands dominated by *A. californica* in Orange County.

***Artemisia californica* Map Unit (3110)**
Artemisia californica Association
Artemisia californica – Diplacus aurantiacus Association
Artemisia californica – Opuntia littoralis Association

14d. *Diplacus aurantiacus* is dominant (>50% relative cover) in the shrub canopy; if *Artemisia californica* or *Adenostoma fasciculatum* are present as co-dominant species, then key stands to those alliances.

***Diplacus aurantiacus* Alliance (3220)**

14e. *Artemisia californica* and *Salvia mellifera* occur as co-dominant species in the overstory, co-occurring with a variety of sub-dominant shrubs. *Rhus integrifolia* and/or *Malosma laurina* may be present with the highest cover, but neither species

is considered a useful diagnostic species, being that they are both ubiquitous across the study area, occupying both chaparral and coastal sage settings.

***Salvia mellifera* – (*Artemisia californica*) Alliance (3130)**

14f. *Eriogonum fasciculatum* and *Salvia apiana* occur as co-dominants, often intermixed with other shrub species such as *Artemisia californica*.

***Eriogonum fasciculatum – Salvia apiana* Alliance (3160)**
Eriogonum fasciculatum – Salvia apiana Association

14g. *Eriogonum fasciculatum* characterizes stands by being the sole dominant shrub, and understory may include *Mirabilis laevis* and/or *Salvia columbariae* in open shrub stands.

***Eriogonum fasciculatum* Alliance (3150)**
Eriogonum fasciculatum Association
Eriogonum fasciculatum / *Salvia columbariae – Mirabilis laevis* Association

15. Vegetation open and/or with recent evidence of fire or other disturbance. Stands are dominated by *Ericameria palmeri*, *Isocoma menziesii*, *Hazardia squarrosa*, *Malacothamnus fasciculatus*, or *Acmispon glaber*. (Note: Usually higher herb than shrub cover during peak phenology, with the look of open shrublands or grassy shrublands.)

15a. *Ericameria palmeri* is dominant in the shrub overstory, with *Stipa* (*Nassella) pulchra* occurring as a characteristic grass.

***Hazardia squarrosa – Ericameria palmeri* Alliance**
Ericameria palmeri Association **(3310)**

15b. *Isocoma menziesii* is dominant in the shrub overstory, usually over a mixture of forbs and grasses.

***Isocoma menziesii* Alliance (3330)**
Isocoma menziesii Association

15c. *Hazardia squarrosa* is the dominant shrub usually over a mixture of forbs and grasses.

***Hazardia squarrosa – Ericameria palmeri* Alliance**
Hazardia squarrosa / Nassella pulchra – Deinandra fasciculata Association **(3320)**

15d. *Malacothamnus fasciculatus* is dominant or co-dominant with *Heteromeles arbutifolia* and/or *Malosma laurina* in the shrub overstory, with other co-occurring chaparral or coastal scrub species being clearly sub-dominant. *Acmispon glaber* may occasionally be present with similar cover to *M. fasciculatus*.

***Malacothamnus fasciculatus – Malacothamnus* spp. Alliance (3350)**
Malacothamnus fasciculatus Association
Malacothamnus fasciculatus **–** *Malosma laurina* Association

15e. *Acmispon glaber* (*Lotus scoparius*) is dominant in the shrub overstory, with any co-occurring chaparral or coastal scrub species being clearly sub-dominant.

***Lotus scoparius – Lupinus albifrons – Eriodictyon* spp. Alliance**
Lotus scoparius Association **(3340)**

16. *Malosma laurina* or *Rhus integrifolia* display strong dominance in the shrub overstory. If coastal scrub or other soft-leaved, deciduous shrubs are present, they are insignificant. See note under Section III description.

16a. *Malosma laurina* is strongly dominant or may share dominance with *Acmispon glaber (Lotus scoparius)*.

***Malosma laurina* Alliance (2210)**
Malosma laurina Association
Malosma laurina – Lotus scoparius Association

16b. *Rhus integrifolia* is strongly dominant, usually with >50% relative cover.

***Rhus integrifolia* Alliance (2220)**
Rhus integrifolia Association

17. A non-native *Acacia* dominates stands, with no other native shrub species having significant cover.

***Acacia* spp. – *Grevillea* spp. – *Leptospermum laevigatum* Semi-Natural Stands (3410)**

18. A species of *Schinus* or *Myoporum laetum* dominates in the tree/shrub overstory, usually with >60% relative cover.

***Schinus (molle, terebinthifolius) – Myoporum laetum* Semi-Natural Stands (1520)**

Class C. Herbaceous Vegetation

Section V. Herbaceous Vegetation

19. Vegetation is dominated or characterized by a mixture of native perennial grasses in upland settings, with the native grasses and forbs usually making up >10% relative cover of the herbaceous layer. Non-native herbaceous species may have a significant presence but are not considered diagnostic as they are ubiquitous across the study area.

Californian Annual & Perennial Grassland Macrogroup (4000)

Californian Perennial Grassland Group (4100)

19a. *Stipa* (*Nassella) pulchra* characterizes stands alone or in shared dominance with other native and non-native grasses and forbs. A variety of emergent shrubs may be present.

***Nassella* spp. – *Melica* spp. Alliance**
Nassella pulchra Association **(4130)**

19b. *Stipa (Nassella) lepida* characterizes stands alone or in shared dominance with other native and non-native grasses and forbs. A variety of emergent shrubs may be present.

***Nassella* spp. – *Melica* spp. Alliance**
Nassella lepida Association **(4120)**

19c. *Leymus condensatus* dominates herbaceous stands that may be associated with scrub or woodland vegetation.

***Leymus condensatus* Alliance (4110)**
Leymus condensatus Association

19d. *Muhlenbergia rigens*, a mid-sized tufted perennial grass, is dominant, co-dominant or characteristically present with other native and non-native grasses and forbs in moist settings. A variety of emergent shrubs may be present.

***Muhlenbergia rigens* Alliance (6210)**
Muhlenbergia rigens Association

20. Vegetation dominated, co-dominated or characterized by native annual grasses and forbs in upland settings, such as *Amsinckia*, *Croton setiger*, *Eschscholzia*, *Lasthenia*, *Holocarpha*, *Lupinus*, *Plantago erecta*, and *Festuca* (*Vulpia*) *microstachys*.

Californian Annual Grassland & Forb Meadow Group

20a. *Croton setiger* is dominant or seasonally characteristic in herbaceous stands with a variety of native and non-native forbs and grasses. Soils are often well-drained and may have high levels of bioturbation, grazing (either past/current), and/or other disturbances.

***Amsinckia (menziesii, tessellata) – Phacelia* spp. Alliance**
Croton setigerus – (Trichostema lanceolatum) Provisional Association

21. Vegetation dominated by non-native perennial or annual grasses and forbs in upland settings, with native herbaceous species being absent, having trace cover, and/or with uneven distribution.

Californian Ruderal Grassland, Meadow & Scrub Group

21a. Vegetation strongly dominated by non-native annual grasses and forbs, including *Avena* spp., *Brassica nigra* and other mustards, *Bromus* spp., *Cynara cardunculus, Euphorbia terracina*, *Festuca perennis (Lolium perenne)*, *Pennisetum* spp., *Schismus* spp., and others:

Mediterranean California naturalized annual and perennial grassland Group (4200)
Specific types listed below:

***Avena* spp. – *Bromus* spp. Semi-Natural Alliance (4210)**
Avena barbata Semi-Natural Stands

Avena barbata – Avena fatua Semi-Natural Stands

***Avena* spp. – *Bromus* spp. Semi-Natural Alliance (4230)**
Bromus diandrus Semi-Natural Stands
Bromus diandrus – Avena spp. Semi-Natural Stands

***Brassica nigra – Centaurea (solstitialis, melitensis)* Semi-Natural Alliance (4220)**
Brassica nigra – Bromus diandrus Semi-Natural Stands
Cynara cardunculus Provisional Semi-Natural Stands **(4250)**
Euphorbia terracina Semi-Natural Stands

***Bromus rubens – Schismus* (*arabicus, barbatus*) Semi-Natural Alliance (4240)**

***Lolium perenne* Semi-Natural Alliance (4280)**

***Pennisetum setaceum – Pennisetum ciliare* Semi-Natural Alliance**

21b. Vegetation dominated by medium to tall, introduced perennial herbs, including *Cortaderia, Foeniculum vulgare* and *Phalaris aquatica*:
***Cortaderia (jubata, selloana)* Semi-Natural Alliance (4260)**

***Conium maculatum – Foeniculum vulgare* Semi-Natural Alliance (4270)**
Conium maculatum Semi-Natural Stands

***Phalaris aquatica – Phalaris arundinacea* Semi-Natural Alliance (5110)**

22. Vegetation dominated by herbs, grasses, and graminoids in wet to moist meadows, seasonal ponds, in regularly to episodically flooded bottomlands or depressions, or in tidal/intertidal aquatic environments. Stands are characterized by species of *Bolboschoenus, Distichlis*, *Muhlenbergia*, *Sarcocornia*, *Schoenoplectus*, *Spartina*, or *Typha*.

22a. Vegetation characterized by halophytic species such as *Spartina foliolosa*, *Batis maritima*, *Sarcocornia pacifica*, *Distichlis spicata*, *Bolboschoenus maritimus, Juncus acutus* ssp. *leopoldii* and *Frankenia salina*.

22a1. *Spartina foliolosa* is dominant or co-dominant with *Batis maritima* or *Sarcocornia pacifica*.
***Spartina foliosa* Alliance (7120)**
Spartina foliosa Association

22a2. *Sarcocornia pacifica* characterizes stands as a dominant or co-dominant, though sometimes with much less cover than associated species *Frankenia salina*.
***Sarcocornia pacifica* (*Salicornia depressa*) Alliance (7110)**
Sarcocornia pacifica – Frankenia salina Association

22a3. *Bolboschoenus maritimus* or *Scirpus robustus* is dominant or co-dominant with other halophytic species.

***Bolboschoenus maritimus* Alliance (7130)**
Bolboschoenus maritimus Association
Scirpus robustus Provisional Association (6140)

22a4. *Distichlis spicata* is dominant in the herbaceous layer.

***Distichlis spicata – Frankenia salina* Coastal Alliance**
Distichlis spicata Association (7140)

22b. Vegetation dominated by moderately tall, emergent, wetland perennial graminoids.

Arid West interior freshwater emergent marsh Group (6100)
Specific types key as follows:

22b1. One or more species of *Schoenoplectus* dominates in the herbaceous layer.

***Schoenoplectus (acutus, californicus*) Alliance**
Schoenoplectus acutus Association (6110)
Schoenoplectus californicus Association (6130)

22b2. One or more species of *Typha* dominates in the herbaceous layer. If a species of *Schoenoplectus* is co-dominant, key to the appropriate *Schoenoplectus* type.

***Typha (angustifolia, domingensis, latifolia*) Alliance (6120)**
Typha domingensis Association

22c. *Muhlenbergia rigens*, the mid-sized tufted perennial grass, is dominant, co-dominant or characteristically present with other native and non-native grasses and forbs in moist settings. A variety of emergent shrubs may be present.

***Muhlenbergia rigens* Alliance (6210)**
Muhlenbergia rigens Association

22d. *Arundo donax* dominates, often with >60% relative cover in the herbaceous and shrub layers.

***Phragmites australis – Arundo donax* Semi-Natural Stands (1910)**

22e. *Lepidium latifolium* dominates the herbaceous layer.

***Lepidium latifolium – Lactuca serriola* Semi-Natural Stands (6310)**

23. Vegetation dominated mainly by herbs of coastal environments, including sea cliffs, dunes, rocky outcrops, and bluffs. Stands in such settings may have relatively low total vegetation cover.

23a. *Carpobrotus edulis* dominates stands, often found spreading on bluffs or dunes adjacent to the ocean.

***Mesembryanthemum* spp. – *Carpobrotus* spp. Semi-Natural Stands (5410)**

23b. Various annuals and perennials (grasses, forbs, succulents), including *Dudleya* spp., as well as shrub species (i.e. *Atriplex* spp., *Lycium californicum*) occur along steep coastal bluffs, slopes, or cliffs, usually with sparse cover (<10% total cover) and no clear diagnostic species.

Coastal Baja California Norte maritime succulent scrub Group (8100)

Appendix D

Contingency Table

User MapClass	Acmispon glaber Alliance	Adenostoma fasciculatum - Salvia mellifera Alliance	Adenostoma fasciculatum Alliance	Arctostaphylos glandulosa Alliance	Artemisia californica - Eriogonum fasciculatum Alliance	Artemisia californica - Salvia mellifera Alliance	Artemisia californica Alliance	Baccharis pilularis Alliance	California Annual and Perennial Grassland Macrogroup	Ceanothus crassifolius Alliance	Ceanothus megacarpus Alliance	Ceanothus tomentosus Alliance	Diplacus aurantiacus Alliance	Encelia californica Alliance	Eriogonum fasciculatum - Salvia apiana Alliance	Eriogonum fasciculatum Alliance	Hesperocyparis forbesii Alliance	Heteromeles arbutifolia Alliance	Isocoma menziesii Alliance	Malacothamnus fasciculatus Alliance	Malosma laurina Alliance	Opuntia littoralis Alliance	Quercus agrifolia Alliance	Quercus berberidifolia - Adenostoma fasciculatum Alliance	Quercus berberidifolia Alliance	Quercus dumosa Alliance	Rhus integrifolia Alliance	Salvia apiana Alliance	Salvia leucophylla Alliance	Salvia mellifera Alliance	Sambucus nigra Alliance	Toxicodendron diversilobum Alliance	Producer Total
Acmispon glaber Alliance	2	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	8
Adenostoma fasciculatum - Salvia mellifera Alliance	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Adenostoma fasciculatum Alliance	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Arctostaphylos glandulosa Alliance	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Artemisia californica - Eriogonum fasciculatum Alliance	0	0	0	0	5	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	10
Artemisia californica - Salvia mellifera Alliance	1	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7
Artemisia californica Alliance	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	5
Baccharis pilularis Alliance	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6
California Annual and Perennial Grassland Macrogroup	0	0	0	0	1	0	0	1	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	9
Ceanothus crassifolius Alliance	0	2	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7
Ceanothus megacarpus Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceanothus tomentosus Alliance	0	0	0	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Diplacus aurantiacus Alliance	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Encelia californica Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Eriogonum fasciculatum - Salvia apiana Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Eriogonum fasciculatum Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hesperocyparis forbesii Alliance	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Heteromeles arbutifolia Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	2	1	0	0	0	0	0	7
Isocoma menziesii Alliance	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Malacothamnus fasciculatus Alliance	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	2	0	13
Malosma laurina Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	4
Opuntia littoralis Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Quercus agrifolia Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Quercus berberidifolia - Adenostoma fasciculatum Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Quercus berberidifolia Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5
Quercus dumosa Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhus integrifolia Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	4
Salvia apiana Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Salvia leucophylla Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5
Salvia mellifera Alliance	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Sambucus nigra Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Toxicodendron diversilobum Alliance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
User Total	4	5	4	4	7	7	7	6	6	3	1	5	4	4	0	5	1	3	0	5	8	5	0	6	3	5	3	4	5	4	5	0	129

Appendix E

Vegetation Change 2012-2022

Map Unit Type	Acres 2012	Acres 2022	Net Acres	Change
Acacia (cyclops) Semi-natural Stands	267	266	-1	-1%
Acmispon glaber Alliance	1,458	1,196	-262	-18%
Adenostoma fasciculatum - Salvia mellifera Alliance	1,077	934	-143	-13%
Adenostoma fasciculatum Alliance	4,490	4,468	-23	-1%
Agriculture	883	618	-265	-30%
Alnus rhombifolia Alliance	22	22	1	2%
Anthropogenic Areas of Little or No Vegetation	541	416	-125	-23%
Arctostaphylos glandulosa Alliance	312	296	-17	-5%
Arid West Freshwater Emergent Marsh Group	89	104	15	17%
Artemisia californica - Eriogonum fasciculatum Alliance	9,330	6,780	-2,549	-27%
Artemisia californica - Salvia mellifera Alliance	8,317	5,441	-2,876	-35%
Artemisia californica Alliance	4,588	4,006	-582	-13%
Arundo donax Semi-natural Stands	79	19	-60	-76%
Atriplex lentiformis Alliance	31	32	1	5%
Baccharis pilularis Alliance	404	481	77	19%
Baccharis salicifolia Alliance	828	864	36	4%
Beach sand	119	119	0	0%
Bebbia juncea Alliance	2	0	-2	-100%
Bolboschoenus maritimus Alliance	1	1	0	0%
California Annual and Perennial Grassland Macrogroup	10,343	9,506	-837	-8%
California Chaparral Macrogroup	4	4	0	0%
California Perennial Grassland Group	53	42	-11	-21%
Californian Evergreen Coniferous Forest and Woodland Group	1	1	0	-8%
Californian Maritime Chaparral Group	39	44	4	11%
Californian Mesic Chaparral Group	43	35	-8	-18%
Californian Xeric Chaparral Group	219	72	-147	-67%
Carpobrotus edulis or Other Ice Plants Semi-natural Stands	12	15	4	32%
Ceanothus crassifolius Alliance	1,161	1,129	-32	-3%
Ceanothus megacarpus Alliance	1,223	1,196	-27	-2%
Ceanothus tomentosus Alliance	98	111	14	14%
Central and South Coastal California Seral Scrub Group	90	144	55	61%
Central and South Coastal Californian Coastal Sage Scrub Group	1,143	777	-366	-32%

Map Unit Type	Acres 2012	Acres 2022	Net Acres	Change
Cercocarpus montanus Alliance	26	26	0	0%
Cliff, bluffs, scree, and rock outcrop	313	287	-27	-8%
Coastal Baja California Norte Maritime Succulent Scrub Group	26	25	-1	-4%
Cortaderia (jubata, selloana) Semi-natural Herbaceous Stands	16	14	-2	-11%
Diplacus aurantiacus Alliance	103	93	-10	-10%
Encelia californica Alliance	191	242	50	26%
Ericameria palmeri Alliance	51	46	-4	-8%
Eriogonum fasciculatum - Salvia apiana Alliance	4	9	4	107%
Eriogonum fasciculatum Alliance	981	945	-36	-4%
Eucalyptus (globulus, camaldulensis) Semi-natural Woodland Stands	173	167	-6	-3%
Fresh Water Marsh (bulrush - cattail) Mapping Unit	33	14	-19	-59%
Fuel Mod Zone	1,149	1,257	108	9%
Hazardia squarrosa Alliance	0	2	2	0%
Hesperocyparis forbesii Alliance	34	136	103	306%
Heteromeles arbutifolia Alliance	330	353	22	7%
Introduced Trees, Shrubs (not in hierarchy)	598	555	-43	-7%
Isocoma menziesii Alliance	39	32	-7	-18%
Juglans californica Alliance	15	15	0	0%
Keckiella antirrhinoides Alliance	17	16	-2	-10%
Lepidium latifolium Semi-natural Herbaceous Stands	19	8	-11	-59%
Lepidospartum squamatum Alliance	110	141	31	28%
Leymus condensatus Alliance	3	3	0	0%
Malacothamnus fasciculatus Alliance	323	844	521	161%
Malosma laurina Alliance	2,655	2,859	205	8%
Meadow (Carex - Juncus - Eleocharis) Mapping Unit	4	3	-1	-26%
Opuntia littoralis Alliance	799	666	-133	-17%
Perennial Stream Channel	30	28	-3	-9%
Platanus racemosa Alliance	479	474	-5	-1%
Populus fremontii Alliance	30	29	-1	-2%
Pseudotsuga macrocarpa Alliance	5	5	0	0%
Quercus agrifolia Alliance	2,346	2,323	-23	-1%
Quercus agrifolia Riparian	1,170	1,170	0	0%
Quercus berberidifolia - Adenostoma fasciculatum Alliance	171	165	-6	-4%

Map Unit Type	Acres 2012	Acres 2022	Net Acres	Change
Quercus berberidifolia Alliance	1,303	1,313	10	1%
Quercus dumosa Alliance	23	23	0	-1%
Recently Burned Areas – Undetermined Vegetation Type Mapping Unit	0	6,789	6,789	0%
Reservoirs and other Artificial Water Features	875	872	-3	0%
Rhus integrifolia Alliance	1,261	1,298	37	3%
Riverine & Lacustrine	4	4	0	0%
Rocky shore	37	37	0	0%
Salix gooddingii Alliance	648	584	-65	-10%
Salix laevigata Alliance	94	115	21	22%
Salix lasiolepis Alliance	683	729	46	7%
Salt panne	9	8	-1	-8%
Salvia apiana Alliance	211	177	-34	-16%
Salvia leucophylla Alliance	410	350	-60	-15%
Salvia mellifera Alliance	2,216	1,961	-256	-12%
Sambucus nigra Alliance	410	461	50	12%
Sarcocornia pacifica (Salicornia depressa) Alliance	36	36	0	0%
Schoenoplectus acutus Alliance	10	8	-2	-19%
Schoenoplectus californicus Alliance	8	5	-3	-33%
Scirpus robustus Alliance	17	16	-1	-4%
Southwestern North American Riparian Evergreen and Deciduous Woodland Group	112	101	-11	-10%
Southwestern North American Riparian/Wash Scrub Group	30	21	-10	-31%
Southwestern North American Salt Basin and High Marsh Group	38	72	34	90%
Sparsely vegetated to non-vegetated	4	6	2	57%
Spartina foliosa Alliance	125	90	-36	-29%
Stipa lepida Alliance	83	81	-2	-2%
Stipa pulchra Alliance	594	587	-6	-1%
Streambed	234	139	-95	-40%
Temperate Pacific Tidal Salt and Brackish Marsh Group	274	317	43	16%
Temperate and Boreal Freshwater Marsh Formation	7	45	38	551%
Tidal mudflat	155	153	-2	-1%
Toxicodendron diversilobum Alliance	61	65	4	7%
Typha (angustifolia, domingensis, latifolia) Alliance	26	14	-12	-47%

Map Unit Type	Acres 2012	Acres 2022	Net Acres	Change
Urban/Disturbed	14,718	15,678	960	7%
Vegetation Restoration Areas	704	722	17	2%
Water Body	743	741	-2	0%
Xeromorphic Scrub & Herb Vegetation	33	0	-33	-100%
Sum	85,705	85,705	0	