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Date: July 1, 2022

Subject: Vegetation Classification and Mapping Report for Carnegie SVRA, 2022


INTRODUCTION

Purpose

This report describes the vegetation mapping methods and results for Carnegie State Vehicular Recreation Area (SVRA), conducted in 2021 and 2022. This mapping effort was part of a larger project within the Off Highway Motor Vehicle Division of State Parks to create updated vegetation maps and an inventory of native plant communities for each SVRA. When mapping began in 2021, Carnegie SVRA and the adjacent Alameda-Tesla Expansion Area were sampled and analyzed together. However, results here are presented only for the Carnegie SVRA unit, in order to inform the development of an updated standalone General Plan. A full report for both areas may be found on the California Department of Fish and Wildlife Biogeographic Information and Observation System (BIOS) viewer (CDFW 1).

VegCAMP Background

In 2007, Fish and Game Code 1940 established a State Vegetation Standard which is now the industry standard from both a scientific and policy perspective and is compatible with the National Vegetation Classification System (NVCS). The California Department of Fish and Wildlife (CDFW) manages the Vegetation Classification and Mapping Program (VegCAMP) which develops and maintains a standard classification system and mapping methodology. This methodology is being employed statewide to meet the legislative goal of mapping the entire state of California. To date, approximately 60% of the state has been mapped with these methods. Data, reports, and maps may be found on the BIOS viewer (CDFW 1), the VegCAMP website (CDFW 2) and via the Manual of California Vegetation (MCV) online (CNPS 2022). The Manual of California Vegetation (MCV) is California's expression of the NVCS.

The NVCS is hierarchical, with "association" (a characteristic suite of species) at the most granular level. Associations are grouped into alliances, alliances into groups, and upward, as follows:

Formation Class
Formation Subclass
Formation
Division
Macrogroup
Group
Alliance
Association
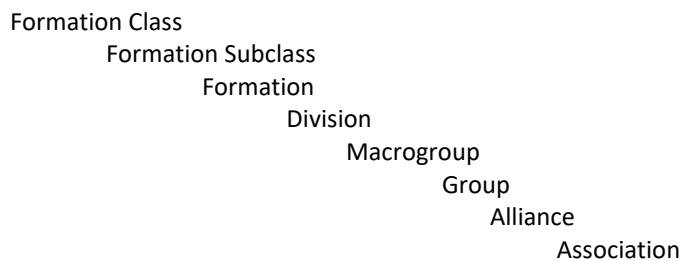
VegCAMP maps generally delineate vegetation stands at the Alliance level, but some types may be mapped at the association level, or at the group or macrogroup level, depending on what is distinguishable in the aerial imagery.

VegCAMP at Carnegie SVRA

The vegetation types in the NVCS and the MCV are defined and grouped into the hierarchy by robust statistical analysis of eco-regional vegetation sampling data. As new regions are sampled and mapped, the database is updated. The Alameda county region where Carnegie SVRA is located, has not yet been analyzed for input into the classification system. Therefore, assigning classification types to the vegetation communities at Carnegie SVRA requires referring to vegetation types that have been defined for ecologically similar areas, such as the Central Valley region. Plans for the classification of Alameda and Contra Costa counties and the Central Coast region are underway by CDFW and are expected to be completed in the next few years. The resulting updates to the MCV may create additional vegetation alliances and associations that are more specific and appropriate for Carnegie SVRA than some of the types used in this report. Future updates to this data and crosswalks from previous nomenclature will be available on the BIOS viewer (CDFW 1).

Carnegie SVRA and the Tesla-Alameda expansion area were previously mapped using VegCAMP methods in 2011-2012 (AECOM 2012), and the data is available on the BIOS viewer (CDFW 1).

METHODS

Overview

The VegCAMP mapping methods follow these general steps. Detailed standards and protocols may be found on the VegCAMP website (CDFW 2).

1. Vegetation stands are sampled in the field using standard relevé, rapid assessment, and reconnaissance protocols. Species cover and a range of environmental variables are recorded.
2. Vegetation data is analyzed and interpreted, producing a key or list of vegetation types for the project area.

3. Vegetation stands are delineated by heads-up digitizing, using high-resolution aerial photography in a Geographic Information System (GIS), which produces a map of vegetation type polygons.
4. An accuracy assessment is conducted in the field, and the map is finalized. A final accuracy of at least 80% is required.

Carnegie SVRA sampling and mapping

Field sampling was conducted in the SVRA and in the Alameda-Tesla Expansion area by State Parks staff on May 3rd-6th, 2021. A total of 16 formal samples were collected, as well as many informal photo points. Vegetation types were assigned using the membership rules of the MCV (CNPS 2022) and by consulting with CDFW staff.

A draft map was developed in Fall 2021, drawn using NAIP 2020 imagery. Mapping followed VegCAMP standards defined in the "Survey of California Vegetation Classification and Mapping Standards" document (CDFW 2020). The minimum mapping unit was 1 acre for upland vegetation types and ¼ acre for wetland vegetation types. Polygons were divided based on a change in cover class according to Braun-Blanquet categories (<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%). Breaks for the dominant overstory vegetation required a 3-acre minimum mapping unit, and breaks for understory vegetation required a 5-acre minimum mapping unit. Map attributes for the GIS database are found in Appendix B.

An accuracy assessment of the map was conducted on March 17, 2022 by confirming the mapped type for >80% of the polygons in the field.

RESULTS

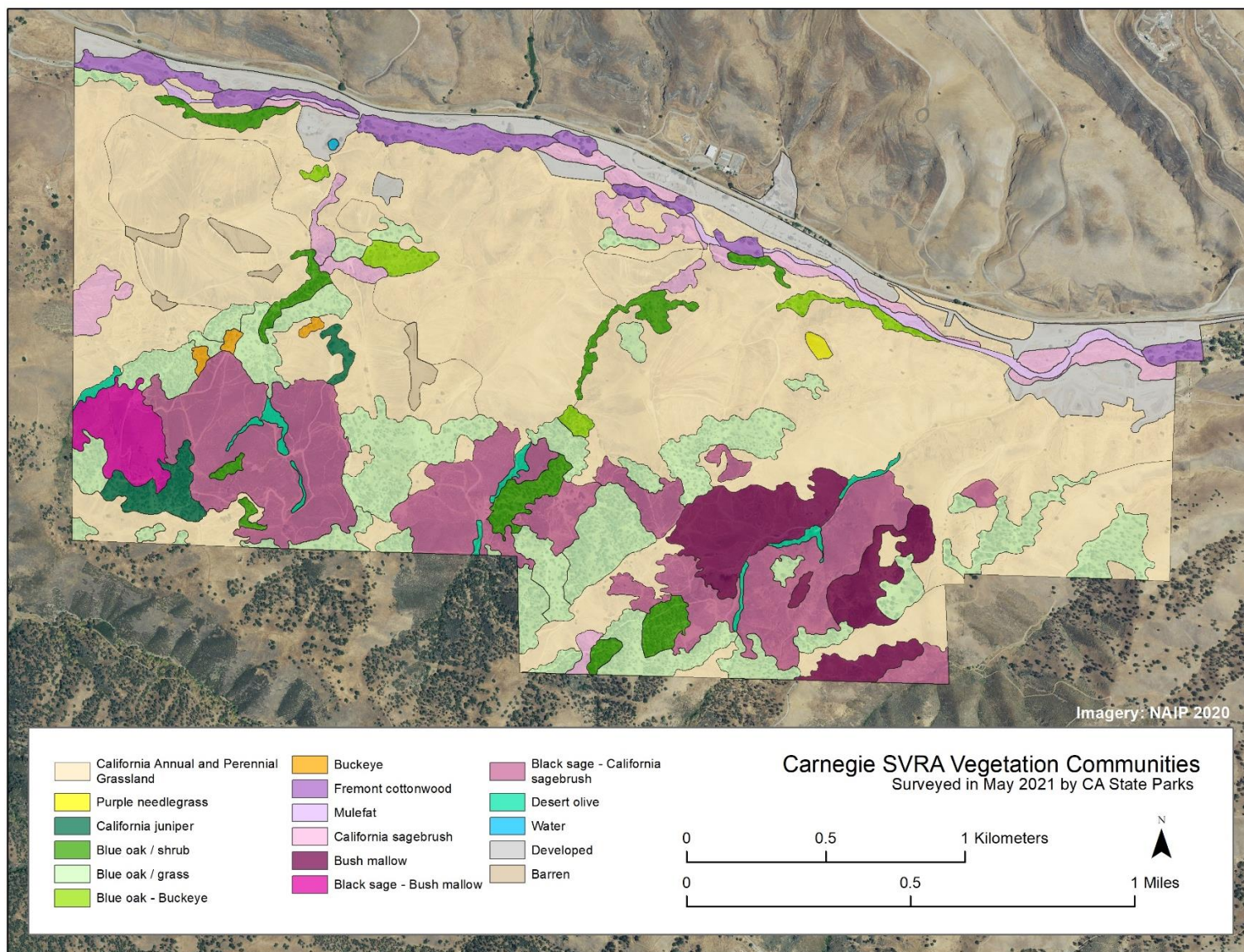Mapped vegetation types are summarized below in Figure 1 and Table 1.

Figure 1: Vegetation community map at Carnegie SVRA

Table 1: Carnegie SVRA mapped vegetation types and acreage

	NVCS Name	Rarity Ranking (if known)	Sensitive?	Common name map label	Total Acres
Tree Overstory (Woodland / Forest) Vegetation	*Juniperus californica* woodland alliance	S4	No	Juniper	13.9
	Aesculus califonica forest and woodland alliance	S3	**yes**	Buckeye	2.9
	*Quercus douglasii forest and woodland alliance				
	• *Quercus douglasii* / Mixed herbaceous association		No	Blue oak / grass	194.4
	• *Quercus douglasii - Aesculus californica* / grass association		No	Blue oak - Buckeye	13.3
	• *Quercus douglasii / Ericameria linearifolia* association		No	Blue oak / shrub	37.5
	Populus fremontii - Fraxinus velutina - Salix gooddingii Forest and woodland alliance	S3	**Yes**	Fremont cottonwood	35.4
Shrubland Vegetation	*Rhus trilobata - Crataegus rivularis - Forestiera pubescens* shrubland alliance	S3.2	**Yes**	Desert olive	9.6
	Baccharis salicifolia shrubland alliance	S4	No	Mulefat	12.3
	Malacothamnus fasciculatus – Malacothamnus spp. shrubland alliance	S4	No	Bush mallow	60.9
	Salvia mellifera – Artemisia californica alliance	S4	No	Black sage - California sagebrush	195.9
	• *Salvia mellifera – Malacothamnus fasciculatus* association	S3	**Yes**	Black sage - Bush mallow	21.1
	*Artemisia californica – (Salvia leucophylla) shrubland alliance				
	• ***Artemisia californica* association**	S4	no	California sagebrush	49.8
Herbaceous Vegetation	California annual and perennial grassland macrogroup			California annual and perennial grassland	761.8
	*Nassella spp – Melica spp. Alliance				
	• *Nassella pulchra* association	S3	**Yes**	Purple needlegrass	1.5
Non-Vegetated	Barren			Barren	11.1
	Developed			Developed	90.1
	Water			Water	0.3
				SUM	**1,512**

* Alliances with asterisk are included in the table for classification clarity, although they are not displayed as mapping units in the map.

Vegetation descriptions

The mapped vegetation types are described below. See the MCV online (CNPS 2022) for a full description of the vegetation alliances, including detailed membership rules. Below is a brief description of the vegetation types as they are observed at Carnegie SVRA, and how the membership rules were applied for this project.

Definitions:
> **Absolute cover**: The percent of the ground surface which is covered by the vertical projections of live plant material, including porousness of a tree/shrub canopy. (Imagine the cover as the shadow cast on the ground if the sun were positioned perfectly overhead)
>
> **Relative cover**: A measure of the cover of a species in relation to that of other species within a set area or sample of vegetation, within the same stratum. (Example: If the tree layer in a stand is 5% absolute cover of blue oak and 15% absolute cover of live oak, then the relative cover of blue oak is 25% and the relative cover of live oak is 75%)
>
> **Dominant:** >50% relative cover in the stratum
>
> **Strongly dominant:** >60% relative cover in the stratum
>
> **Co-Dominant**: Two or three species are each 30-60% relative cover in the stand
>
> **Tree-Overstory (Woodland/Forest) Vegetation:** Vegetation characterized by an even distribution of overstory trees. Tree canopy is generally greater than 10% absolute cover, but occasionally may be as low as 5% if evenly distributed.
>
> **Shrubland Vegetation:** Vegetation characterized by woody shrubs in the canopy. Tree species, if present, generally total less than 10% absolute cover. Herbaceous species may total higher cover than shrubs. Shrubs are usually at least 5% absolute cover.
>
> **Herbaceous vegetation:** Vegetation characterized by non-woody, herbaceous species in the canopy including grass, graminoids, and broad-leaved herbaceous species. Shrubs, if present, usually comprise <5% absolute cover. Trees, if present, generally compose <5% absolute cover.

Carnegie SVRA
Tree Overstory (Woodland/Forest) types:

Juniperus californica) woodland alliance (California juniper)
This type is mapped in areas where California juniper cover is dominant (>50% relative cover) in the tree stratum, with blue oak as the second highest cover. At Carnegie SVRA, juniper is often mixed with blue oak, but there are only a few small stands where juniper cover is higher than blue oak.

Aesculus californica (Buckeye) alliance

This type is mapped when buckeye is dominant in the tree canopy. Blue oak may also be present. The shrub layer is sparse and the herbaceous layer is generally dominated by non-native grasses, with native forbs present in the spring.

Quercus douglasii / **Mixed herbaceous association (Blue oak / grass)**
This type is mapped where blue oaks occur over a grassy or herbaceous understory. Blue oak is the dominant species in the tree stratum, but *Juniperus californica* (California juniper) and *Aesculus californica* (buckeye) are also present at low cover. If buckeye reaches >30% relative cover, see the blue oak – buckeye association. The canopy may be intermittent to continuous, or savannah-like, where tree cover is as low as 5% absolute cover, but is spatially consistent. The shrub layer is <10% (if higher, see the blue oak / shrub association), and is usually dominated by *Artemisia californica (*California sagebrush). The understory is herbaceous, generally dominated by non-native grasses with native forbs present in the spring.

Quercus douglasii – *Aesculus californica* / **grass association (Blue oak – Buckeye)**
This type is mapped when blue oaks and buckeyes are co-dominant in the tree canopy, with a similar understory as in the blue oak / grass association. If buckeye relative cover is >50%, map as the buckeye alliance.

Quercus douglasii / *Ericameria linearifolia* **association (Blue oak / shrub)**
This type is mapped when blue oaks are dominant in the tree stratum and are >10% absolute cover, and there is significant (>10%) shrub cover in the understory. At Carnegie SVRA, the shrubs in the understory for this type are most commonly *Artemisia californica* (California sagebrush), and *Salvia mellifera* (black sage). Narrow-leaf goldenbush (*Ericameria linearifolia*) is sometimes present at low cover, as is chaparral honeysuckle (*Lonicera subspicata* var. *denudata*)*.* This is the most appropriate association for this vegetation type currently defined in the MCV, although its documented occurrences usually have higher cover of *Ericameria linearifolia* than *Artemisia californica* in the shrub layer (Buck-Diaz and Evens 2011, CNPS 2022).

Populus fremontii - *Fraxinus velutina* - *Salix gooddingii* **Forest and woodland alliance (Fremont cottonwood)**
This wetland type is characterized by Fremont cottonwood (*Populus fremontii*) in the tree layer. The shrub canopy is absent or may have sparse cover of mulefat (*Baccharis salicifolia*). The herbaceous layer may be sparse to intermittent, and tends to be weedy. This type occurs along Corral Hollow Creek, which is seasonally wet. Cottonwoods must be at least 5% absolute cover in order to meet the membership rules of this alliance. The alliance is mapped in patchy stands since cottonwood cover is not consistently high enough along the entire creek corridor to qualify as a stand.

Shrubland types:

Rhus trilobata - *Crataegus rivularis* - *Forestiera pubescens* **shrubland alliance (Desert olive).**

This semi-wetland type occurs in draws and drainages at the park, often extending up adjacent slopes. At Carnegie SVRA, stands of this type are strongly dominated by desert olive (*Forestiera pubescens)*, with additional cover of elderberry (*Sambucus nigra* ssp. *caerulea*), coyotebrush (*Baccharis pilularis*), and poison oak (*Toxicodendron diversilobum*). The shrub canopy is dense and there is little herbaceous understory.

Baccharis salicifolia shrubland alliance (Mulefat)

This wetland type is mapped in Corral Hollow Creek, in between Fremont cottonwood stands. Shrub cover is sparse and patchy, and the herbaceous layer may be sparse to intermittent and tends to be weedy. Tree tobacco (*Nicotiana glauca*), a non-native invasive species, may be present in more disturbed areas. California poppy (*Eschscholzia californica*) patches are characteristic in the spring.

Malacothamnus fasciculatus - Malacothamnus spp. shrubland alliance (Bush mallow)

This shrub alliance is mapped in areas where bush mallow (*Malacothamnus fremontii*) is strongly dominant (>60% relative cover). Yerba santa (*Eriodictyon californicum*) and bush monkeyflower (*Diplacus aurantiacus*) may occur at low cover. Note that *Malacothamnus fremontii* is the species of bush mallow that occurs at Carnegie SVRA, and *Malacothamnus fasciculatus* is not present at the park. The herbaceous layer is sparse, but may include non-native grasses or fire-following forbs. At Carnegie SVRA, this type was observed on slopes that had burned in the June 2019 Hollow fire, two years prior to surveys.

Salvia mellifera - Malacothamnus fasciculatus association (Black sage – Bush mallow)

This shrub association is mapped when black sage (*Salvia mellifera*) and bush mallow (*Malacothamnus fremontii*) together add up to >60% relative cover. California sagebrush (*Artemisia californica*) may be present at lower cover. At Carnegie SVRA, this type was observed on slopes that had burned in the August 2015 Tesla fire, six years prior to surveys. The herbaceous layer is sparse and consists mostly of non-native grasses.

Salvia mellifera - Artemisia californica alliance (Black sage – California sagebrush)

This shrub alliance is mapped when black sage (*Salvia mellifera*) and California sagebrush (*Artemisia californica*) together add up to >60% cover. Bush mallow (*Malacothamnus fremontii*) may also be present at lower cover, or the three species may have nearly equal cover in the shrub canopy. Generally, more bush mallow is present in areas that burned more recently, and over time following a fire the community shifts to higher proportions of black sage and California sagebrush. The herbaceous layer is sparse and consists mostly of non-native grasses.

Artemisia californica association

This shrub association is mapped when California sagebrush is >60% relative cover in the shrub layer. Note that although this association is within the *Artemisia californica - (Salvia leucophylla)* shrubland alliance, *Salvia leucophylla* is not present at Carnegie SVRA. The herbaceous layer is sparse to dense and consists of non-native grasses and native forbs.

Herbaceous types:

Nassella spp. – Melica spp. alliance (Purple needlegrass)
This type was mapped where purple needlegrass (*Nassella pulchra*, also known as *Stipa pulchra*) was characteristic and at least 2% absolute cover, over an acre or more. This type was mapped in a restoration area where *N. pulchra* likely came from a seed mix. Information for this stand was informed by 2021 native grassland surveys (MIG 2021).

California annual and perennial grassland macrogroup
Most of the grassland at the park is mapped as this type, except for the native stand described above. Grassland species composition and abundance varies spatially and temporally, and alliances and associations assemble in small stands that are difficult to distinguish in imagery. Most of the park is dominated by non-native grasses including *Bromus* spp., and *Avena* spp., however, in less disturbed areas there are native forbs which are especially evident in the spring, including *Amsinckia* spp., *Dichelostemma capitatum*, *Triteleia laxa*, *Lupinus* spp., *Lasthenia californica*, *Plantago erecta*, and others.

Non-Vegetated types:

Barren
Polygons were designated "Barren" when there was <2% vegetation cover on native substrate across the minimum mapping unit of 1 acre.

Developed
Developed areas include roads, buildings, parking lots, tracks, and campgrounds.

Water
There are a few designated ponds in the park but only one had visible standing water in the 2020 aerial imagery. Years with more rainfall may have more water polygons.

DISCUSSION

Comparison to a previous vegetation map

A previous mapping effort conducted surveys in 2011 and digitized polygons with NAIP 2010 imagery, using VegCAMP methods to produce a map of vegetation types (from here on referred to as the 2011 map) (AECOM 2012). There are minor differences in mapping standards and project boundaries compared to the project described in this report (from here on referred to as the 2021 map), but the two maps are broadly comparable. Since 2011, there appear to have been negligible changes to the spatial extent of the blue oak woodland alliances, the grassland alliances, and the developed areas. Some grassland polygons have higher vegetation cover in

2021 compared to 2011, especially in areas that have changed from open OHV riding to trails-only riding.

For woodland vegetation, the 2021 project distinguishes between several blue oak alliances, and mapped a few small buckeye and juniper stands that are surrounded by blue oak woodland, whereas the 2011 map groups all these tree types as blue oak woodland. The 2021 project also maps the desert olive patches at a smaller minimum mapping unit since it is a wetland type (1/4 acre compared to 1 acre), which resulted in more polygons of that alliance than in the 2011 map, however, an examination of historic imagery (NAIP 2010) shows that the actual number and extent of the stands has not significantly changed in that time. Similarly for the Fremont cottonwood and mulefat corridor along Corral Hollow Creek, the 2021 project defines a smaller minimum mapping unit and follows a different membership rule for the Fremont cottonwood alliance, resulting in smaller Fremont cottonwood polygons than in the 2011 map, but there does not appear to have been significant change in cottonwood extent or density in the past decade.

The 2021 project maps four upland shrub community types (Bush mallow, bush mallow – black sage, black sage – California sagebrush, and California sagebrush), whereas the 2011 project only maps two (Bush mallow and California sagebrush – black sage). Therefore, some of the changes in the shrubland polygons are due to differences in methods and image interpretation, however, some of the changes represent true compositional shifts due to succession and response to fire. There have been two fires in the area since 2011: the Tesla fire in 2015 and the Hollow fire in 2019. The 2012 project shows bush mallow stands occurring in the area that burned in the 2009 Corral fire. The current map shows some of that area is now bush mallow-black sage. Additionally, areas that burned in the 2019 fire were mapped as California sagebrush – black sage in 2012 are now mapped as bush mallow. The shrubland community composition is dynamic and will continue to change over time.

Future mapping efforts

As mentioned in the methods section, there are expected to be additional vegetation classification projects in this region, which will define new vegetation types and add them to the MCV. Survey data from this 2021 map could potentially be re-interpreted and assigned different alliance or association names in the future, using regionally appropriate classifications. Any updated vegetation community maps of Carnegie SVRA should be made available on the BIOS viewer. Future regional maps that include the Carnegie area will also be available on the BIOS viewer, with links to relevant reports and classification keys.

REFERENCES

AECOM. 2012. Vegetation Classification and Mapping Report, Carnegie SVRA. Technical memo submitted to Clint Elsholz, CA Department of Parks and Recreation

Buck-Diaz, J., and J. Evens. 2011. Carrizo Plain National Monument vegetation classification and mapping project. California Native Plant Society, Sacramento, CA. Available: http://www.cnps.org/cnps/vegetation/pdf/carrizo-vegetation_rpt2011.pdf

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CNPS. 2022. A Manual of California Vegetation, Online Edition. Available at vegetation.cnps.org

MIG. 2021. Carnegie State Vehicular Recreation Area Rare Plant and Native Grassland Survey Report October 2021. Report submitted to Clint Elsholz, CA Department of Parks and Recreation.

NAIP (National Agriculture Imagery Program) 2010. Aerial Imagery. U.S. Department of Agriculture

NAIP (National Agriculture Imagery Program) 2020. Aerial Imagery. U.S. Department of Agriculture

APPENDIX A: MAP ATTRIBUTE DEFINITIONS

More detailed mapping attribute definitions and a geodatabase template are available at the VegCAMP website (CDFW 2).

Mapping Attributes	Definition
OBJECTID	Unique value for each polygon
ConifCover	Absolute cover of conifer tree species within the polygon. Attributed in 1% increments
HdwdCover	Absolute cover of hardwood tree species within the polygon. Attributed in 1% increments
TreeCover	Absolute cover of trees within the polygon. May be less than the sum of conifer + hardwood if there is overlap. Attributed in 1% increments
ShrubCover	Absolute cover of shrubs within the polygon, attributed in 1% increments. If the overstory tree cover is greater than 40%, shrubs would not be visible in aerial imagery and are not estimated.
HerbCover	Absolute cover of herbaceous vegetation in the polygon. May not be interpretable if shrub or tree cover is high. Cover values for herbaceous vegetation are recorded in the following cover classes: <2%, 2-9%, 10-40%, >40%
Roadedness	The cover of roads and trails in the polygon. Categories are: None visible; Low (at least 2/3 of the polygon without any roads); Moderate (1/3 to 2/3 of the polygon without any roads); High (Less than 1/3 of the polygon without any roads); Not Applicable/Not evaluated
MethodID	Attribution method: either the polygon was attributed through image interpretation, based on a field survey, or based on a less-formal field reconnaissance
Notes	Information, caveats, site history etc.
NVCS_Name	The mapping class name per NVCS. See vegetation.cnps.org to look up descriptions.
NVCS_Level	The NVCS hierarchy level of the NVCS_Name, e.g., Association, Alliance, Group, Macrogroup, etc
GlobalRank	The global rarity ranking for the vegetation alliance, from 1 (very rare and threatened) to 5 (demonstrably secure)
StateRank	The California state rarity ranking for the vegetation alliance, from 1 (very rare and threatened) to 5 (demonstrably secure). Natural communities with ranks of S1-S3 are considered Sensitive Natural Communities to be addressed in the environmental review processes of CEQA and its equivalents. More information on the VegCAMP website.
NVCSAlliance	The alliance name per NVCS. Will be null for polygons that are mapped at a higher level than alliance (group or macrogroup), or for non-vegetated polygons such as urban, developed, water etc.
NVCSGroup	The group name per NVCS. Will be null for polygons that are mapped at a higher level than group (macrogroup), or for non-vegetated polygons such as urban, developed, water etc.
NVCSMG	The macrogroup name per NVCS. Will be null for non-vegetated polygons such as urban, developed, water etc
MappingUnitName	A common name label developed specifically for this project
Field_Verified	"Yes" for polygons that have been verified in the field in sampling or during the accuracy assessment
Acres	Area in acres of the polygon

APPENDIX B: REPRESENTATIVE PHOTOS

Blue oak / grass and blue oak / shrub associations

A small buckeye stand, with California sagebrush in the foreground

California juniper

Blue oak with California sagebrush in the understory

California sagebrush (*Artemisia californica*) shrubland

Bush mallow shrubland

Black sage – Bush mallow association

Black sage, California sagebrush, and bush mallow co-dominating, which is mapped as the black sage – California sagebrush alliance.

Desert olive (*Forestiera pubescens*)

Blue oak with native forbs in the grassy understory

A riding-heavy "barren" area in the background, with California annual and perennial grassland in the foreground.

Purple needlegrass in a restoration area

Mulefat and Fremont cottonwood in the dry creek bed