

Vegetation Mapping – Peninsular Bighorn Sheep Habitat

FINAL VEGETATION MAPPING REPORT

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Prepared for
**The Coachella Valley Conservation
Commission**



Acknowledgements



Mapping vegetation within the Santa Rosa and San Jacinto Mountains Peninsular Bighorn Sheep Conservation Area proved quite a challenging effort. The study area contains over 187,000 acres of steep, mostly inaccessible terrain with a highly diverse range of plant communities over areas administered by a number of different landowners and agencies.

The project would not have been possible without funding through a Local Assistance Grant from the California Department of Fish and Wildlife (CDFW) to the Coachella Valley Conservation Commission (CVCC) for the project. Special thanks go out to Heather Pert (CDFW), Katie Barrows (CVCC), and Kathleen Brundige, from CVCC for their dedication and work in acquiring the necessary funding.

There were many people and organizations that helped make this a successful project, and to all we are grateful. We would like to acknowledge the many botanists and ecologists who offered their much-needed assistance in planning and access, in addition to their expertise in plant identification and substantial ecological knowledge of the area. Special thanks go out to Kathleen Brundige, the Management Analyst (CVCC) who provided logistical planning and field coordination throughout the duration of the project, in addition to her time and expertise in the field.

We are also grateful to work with CDFW staff, especially Todd Keeler-Wolf, Senior State Ecologist who provided his expertise on our initial field reconnaissance as well as during our mapping effort and Anne Klein, Vegetation Ecologist who aided the mapping staff with her knowledge of vegetation mapping and classification. We also want to thank Larry Wheronema and Jennifer Prado for their coordination in accessing property administered by the Friends of the Desert Mountains and for Larry's help in the field during our fall 2016 reconnaissance trip. In addition, we would like to thank the Santa Rosa Band of Cahuilla Indians for access to their lands in Palm Canyon. We appreciate all of their efforts toward this project.

Special thanks to Jon Rishi and Judy Colgero from the US Forest Service, for their concern for our safety during our reconnaissance of the Potrero and Dutch Charley Canyons this fall.

Several geospatial databases significantly aided our mapping during this project. However one that covered virtually the entire study area, stands out as a truly remarkable effort. We would not have been able to correlate image to ground relationships without help from the 216 field plot points from the 2013-2014 Santa Rosa & San Jacinto Mountains Water Study created by Cameron W. Barrows and Robert F. Johnson from the Center for Conservation Biology at the University of California, Riverside.

Finally, special thanks to all the photo interpreters and GIS staff, including John Fulton, Anne Hepburn, Arin Glass, Ed Reyes, Mike Nelson, and Ben Johnson for their time and effort in creating the Peninsular Bighorn Sheep Habitat (PBSH) Vegetation Map.

Table of Contents

I. Introduction	1
Study Area – General Overview	2
II. PBSH Vegetation Mapping Methodology	7
Project Materials.....	7
Field Reconnaissance	10
Photo Interpretation and Mapping Process	11
Second Reconnaissance/ Field Check Effort	22
Quality Control and Delivery of the Final Product.....	23
Accuracy Assessment	23
III. References.....	24
APPENDIX A: Peninsular Bighorn Sheep Mapping Classification	A-1
APPENDIX B: Attributes in the PBSH Vegetation Map	B-1
APPENDIX C: Area Report by Floristic Type	C-1
APPENDIX D: PBSH Vegetation Mapping Descriptions	D-1

I. Introduction

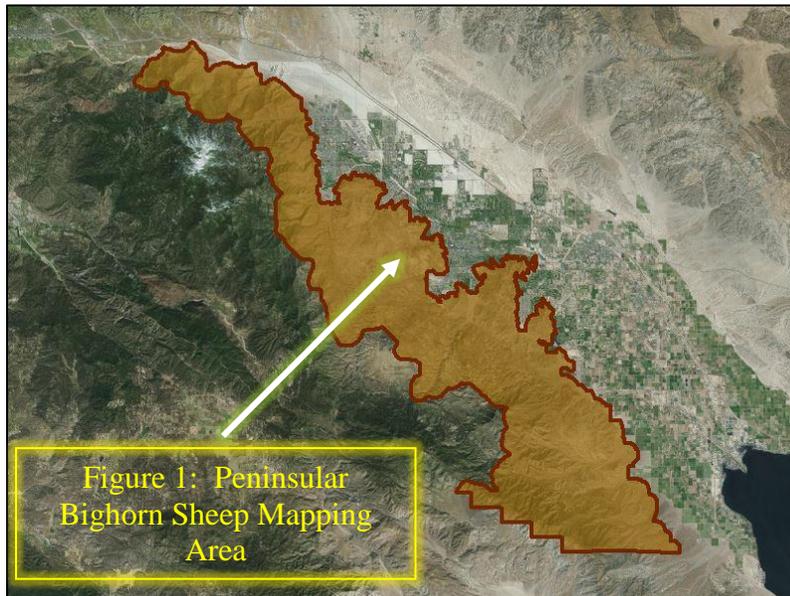
Aerial Information Systems, Inc. (AIS) was contracted by the Coachella Valley Conservation Commission (CVCC) through a Local Assistance Grant originating from the California Department of Fish & Wildlife (CDFW) to map and describe the essential habitats for bighorn sheep monitoring within the San Jacinto-Santa Rosa Mountains Conservation Area. This effort was completed in support of the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP). The completed vegetation map is consistent with the California Department of Fish & Wildlife classification methodology and mapping standards.

The mapping area covers 187,465 acres of existing and potential habitat on the northern slopes of the San Jacinto and Santa Rosa Mountains ranging from near sea level to over 6000 feet in elevation. The map was prepared over a baseline digital image created in 2014 by the US Department of Agriculture – Farm Service Agency’s National Agricultural Imagery Program (NAIP). Vegetation units were mapped using the National Vegetation Classification System (NVCS) to the Alliance (and in several incidences to the Association) level (*See Appendix A for more detail*) as described in the second edition of the Manual of California Vegetation Second Edition (Sawyer et al, 2009).

The mapping effort was supported by extensive ground-based field gathering methods using CNPS rapid assessment protocol in the adjacent areas as part of the Desert Renewable Energy Conservation Plan (DRECP) to the north and east; and by the 2012 Riverside County Multiple Species Habitat Conservation Plan vegetation map in the western portion of Riverside County adjacent to the west. These ground-based data have been classified and described for the abovementioned adjacent regions and resultant keys and descriptions for those efforts have been used in part for this project.

The Peninsular Bighorn Sheep Habitat (PBSH) Vegetation Map will help inform scientists in their effort to study fluctuations in the distribution of Peninsular bighorn sheep due to changes in vegetation due to fire, drought and climate change. Thus, the primary goals and objectives of the vegetation map are to develop a spatial geodatabase of vegetation communities deemed essential for Peninsular bighorn sheep habitat and to provide a baseline to monitor natural communities and landscape-scale vegetation change within their range. Quantification of biotic habitat variables will help assess factors that influence Peninsular bighorn sheep and other species population fluctuations. These data are key to conservation of biological diversity in the Plan area, especially given the impacts of increasing periods of drought and effects of climate change. In addition, the completed map is necessary in order to address changes in vegetation makeup due to increased fire frequency and extent throughout the mapping area.

Study Area – General Overview



The Peninsular bighorn sheep mapping effort (**Figure 1**) contains 187,465 acres of desert and desert fringe terrain lying within three unique floristic subregions (**Figure 2**), two of which, the Sonoran Desert and Peninsular Ranges subregions are located in transmontane California and the South Coast subregion, the one small area in the northwest occupying cis-montane California. Although the actual Whitewater River channel itself never enters the mapping area, the entire study area is contained within its

watershed that drains southeast, skirting along the northwest corner of the study near the town of Cabazon, and eventually terminating into the Salton Sea to the southeast of the mapping area.

The mapping area is drained by an array of north and northeasterly flowing seasonally and intermittently flooded streams. These include (from north to south) the Jenson and One Horse Creeks, occupying the small northwesternmost floristic subregion. Further south, all streams drain ultimately into arid environments including, again from north to south, Snow Creek, Blaisdell Canyon, Chino Canyon, Tachevah Canyon, Tahquitz Creek, Andreas Canyon, and Murray Canyon, all of which originate near Mt. San Jacinto, the second tallest mountain in southern California, attaining an elevation of 10,834'. East of Palm Canyon (the largest stream draining the mapping area) are Cathedral Canyon, Bradley Canyon, Magnesia Springs Canyon, and Dead Indian Creek that flow in a north trending or easterly direction toward the towns of Palm Desert and Cathedral City. Further south, extensive gently sloping areas of semi-desert chaparral and pinyon pine woodlands are drained by Deep Canyon, Guadalupe Creek, and Martinez Canyon, all originating within 10 miles of the tallest peak within the Santa Rosa Mountains, Toro Peak at 8716' elevation. Within the southernmost quarter of the mapping area, Sheep, Alamo, and Barton Canyons all drain into agricultural areas west of the Salton Sea.

Precipitation in the mapping region decreases from northwest to southeast. The southeasternmost portions of the study area receive less than 4 inches annually as measured in the city of Indio. The northwesternmost regions just barely make it into the Koppen defined "C climates" (summer dry season humid climate) receiving approximately 15" annually as measured in Cabazon according to the data from the Western Regional Climate Center.

Precipitation also tends to rise with increasing elevation, especially in the northwestern and central portions of the mapping area. In the westernmost portions of the mapping area,

precipitation at the base of Mt. San Jacinto is sufficient to support vegetation occurring in the NVCS “Central and South Coastal Californian Coastal Sage Scrub Group.” Above 3000’ in this region, precipitation both in the form of rain and snow yields some of the most mesic types of vegetation found in the PBSH mapping area. To the east, precipitation drops rapidly at lower elevations with totals falling below 6” annually at Palm Springs. Precipitation increases more gradually along gently increasing elevational gradients in the Palm Canyon watershed. In this region (roughly mid-way between the northwestern and southeastern edges of the study area), vegetation within the Warm Interior Chaparral Macrogroup (semi-desert or borderline chaparral) begins to occur on protected north trending slopes above 2500’ and broadly expand onto gently sloping areas above 3500’ in elevation. Further south, in the region of Martinez and Toro Canyons, the higher elevation band of vegetation found within the Western Mojave and Western Sonoran Desert borderland chaparral Group narrows considerably. This corresponds to a very steep slope gradient trending generally east facing as the main axis of the Santa Rosa Mountains follow a north to south direction. These topographical characteristics tend to yield a significantly more xeric setting. In the southernmost portion of the study, this ridgeline orientation changes again, as the main ridge of the Santa Rosa Mountains trends along a westerly to easterly direction. This setting generates north facing slopes resulting in extensive bands of semi-desert chaparral, especially along the eastern portions of the study area near Rabbit Peak and along the adjacent slopes.

Nearly all areas below 2500’ in elevation contain vegetation typical of the Colorado Desert, a small subsection of the larger 100,000 square mile Sonoran Desert, mainly to the east and south of the Colorado River.

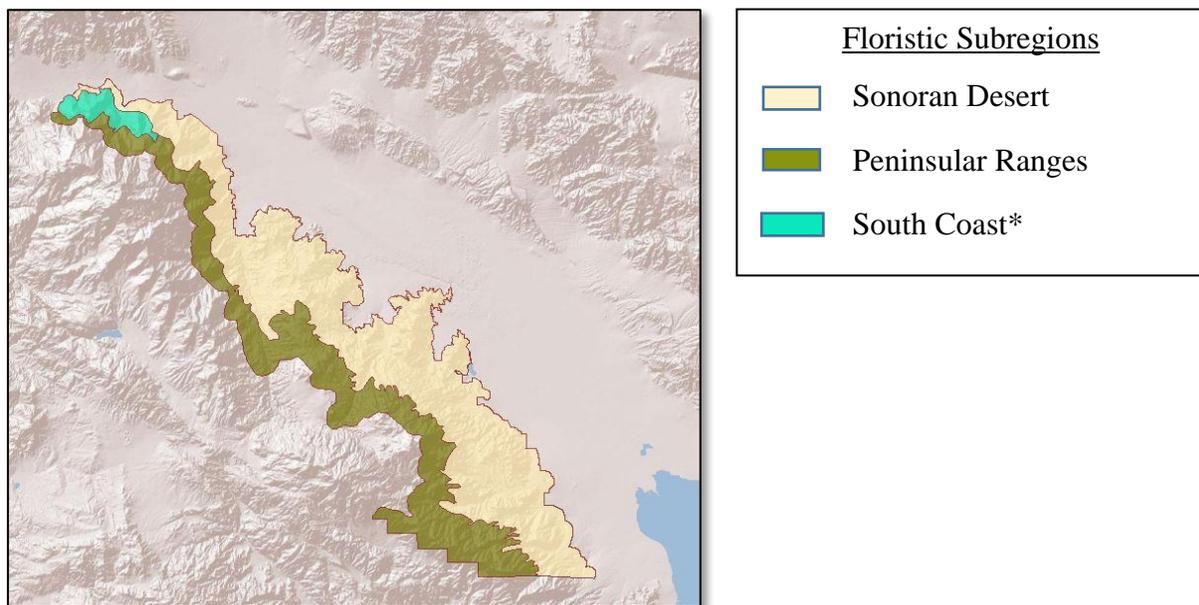
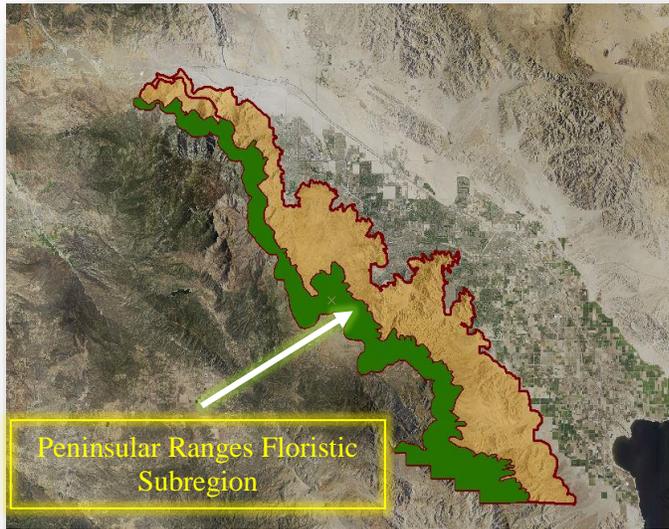


Figure 2: The three floristic subregions are adapted from the Jepson Manual: Higher Plants of California, and refined to correspond to mapped vegetation types in the PBSH study area. *Note that the South Coast Subregion has been extended several miles eastward from the Jepson Manual’s limits (at Banning Pass) based on vegetation identified in the area occurring within the California Coastal Scrub Macrogroup and nearby weather stations receiving greater than 10 inches of precipitation annually.

The Peninsular Ranges Floristic Subregion



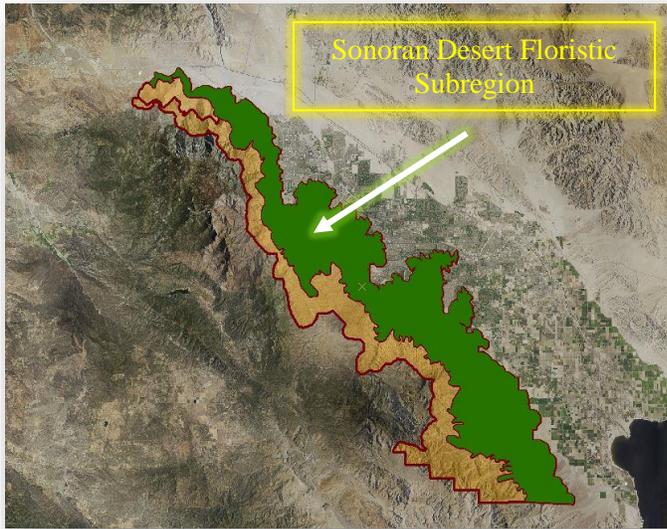
The 63,449 acres making up the Peninsular Ranges Floristic Subregion are dominated by vegetation consisting primarily of xeric sclerophyll scrub and sparse conifer woodlands. This subregion extends in varying width across the western fringes of the entire PBSH mapping area in elevations averaging between 2500 and 4500 feet. The subregion (and higher portions of the adjacent Sonoran Desert Floristic Subregion) consists of about 49,000 acres of vegetation found primarily in the Warm Interior

Chaparral, the California Forest and

Woodland, and Inter-mountain Basins Macrogroups. Conifer woodlands containing a rather low to moderate cover of *Pinus monophylla* and/or *Juniperus californica* occupy approximately 31,000 acres, most of which are co-dominated by an understory of *Quercus cornelius-mulleri*, *Rhus ovata*, and to a lesser extent, *Adenostoma sparsifolium*. Approximately 11,200 acres of vegetation are classified into alliances found within the Western Mojave and Western Sonoran Desert borderland chaparral Group often referred to as semi-desert chaparral. These stands frequently contain a very low emergent cover of *Juniperus californica*. Within this semi-desert chaparral, on protected steep northerly slopes above 3500', a sparse emergent cover of *Pinus monophylla* will share the tree canopy with *J. californica*. In the extreme western portion of the mapping area, vegetation within the Californian premontane chaparral group, in addition to stands of *Quercus chrysolepis* (an alliance within the California Woodland and Forest Macrogroup), are found on ridgelines and steep north facing slopes, generally above 2500' in elevation.

Riparian vegetation within this subregion is diverse, containing vegetation from arid floristic groups extending upslope into higher elevations, as well as native and exotic riparian scrub and woodland vegetation from the two Southwestern North American riparian groups. Nearly 90% of the vegetation within the Southwestern North American riparian evergreen and deciduous woodland Group, (mostly California sycamore, white alder, red willow and Fremont cottonwood) are found within and west of the Palm Canyon drainage. Stands of *Prosopis glandulosa* frequent the lower elevations in this subregion, and although this alliance is classified in the Sonoran-Coloradan semi-desert wash woodland/scrub Group, over half of the total area of this alliance within the study occurs in this floristic subregion. *Baccharis sergiloides* Alliance, from the Southwestern North American riparian/wash scrub Group, comprising 235 acres, frequently occurs along narrow seasonally flooded washes, mainly in the southern two thirds of this ecoregion.

The Sonoran Desert Floristic Subregion

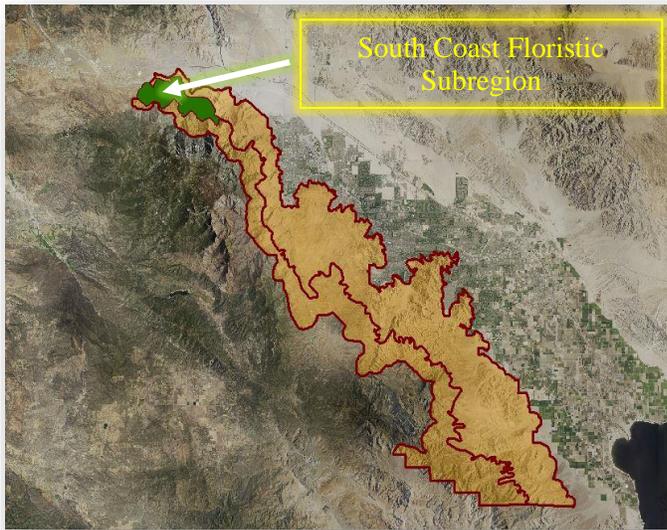


The Sonoran Desert Floristic Subregion is dominated by sparse vegetation consisting primarily of lower elevation desert scrub with a facultatively deciduous mix of microphyllous, and thorny-leaved vegetation generally 1-2 meters in height. The 117,844 acres within this subregion extends across the PBSH mapping area at elevations averaging between 500 and 2500 feet. The northern half of the subregion (along the San Jacinto Mountains) is rugged and steep, averaging only 1 to 2 miles in width.

South of Deep Canyon, along the gentler slopes of the Santa Rosa Mountains, the subregion averages closer to 4 miles in width with small areas of the southeasternmost portion approaching elevations near sea level. This subregion (and lower elevations of the adjacent Peninsular Ranges Floristic Subregion) contains over 100,000 acres (over half of the entire PBSH mapping area) of creosote bush, mixed creosote and brittlebush, and strongly dominant stands of brittlebush scrub. *Prunus fremontii* and *Viguiera parishii*, two higher elevation desert scrub alliances found within the Arizona upland Sonoran desert scrub Group, are mapped on moderately steep to very steep terrain that forms a transition between the Sonoran Desert and Peninsular Ranges Floristic Subregions. These two alliances total nearly 17,000 acres.

Riparian vegetation in this subregion is also diverse and covers significantly greater area than what is found at the higher elevations of the Peninsular Ranges Floristic Subregion. Nearly 6800 acres within the *Acacia greggii* Alliance and the *Parkinsonia florida* / *Hyptis emoryi* Association are found almost exclusively within this subregion. Nearly all of the vegetation classified within the two associations of the *Washingtonia filifera* Alliance are also found within this subregion, mainly in the Palm Canyon watershed south to Deep Canyon just east of the Palms to Pines Highway (State Route 74).

The South Coast Floristic Subregion



The South Coast Floristic Subregion is the only subregion within the PBSH mapping area where the lower elevations are not defined within the boundaries of the Koppen “B” dry climates. Over 90% of this 6170-acre subregion has been burned since 2000, nearly half since 2013. Reconnaissance surveys indicate early recovering stands of *Artemisia californica*, *Keckiella antirrhinoides* and *Eriogonum fasciculatum*, often with a high component of *Lotus scoparius* over a dense mat of Mediterranean weedy grasses.

However, none of these types were mapped because the most recent fire occurred less than one year before the baseline 2014 image acquisition date, and the vegetation at the time the imagery was flown had not recovered to the point of being discernible. Isolated small “refugia” islands that escaped the 2013 Silver Fire generally contain a low to moderate cover of *Rhus ovata*. Unburned and recovering stands of *Encelia farinosa* in a more ‘Riversidean Coastal Scrub’ setting make up slightly over 2000 acres in this subregion on moderate to steep slopes, often with a weedy annual grassy understory. Only the northernmost low elevation bajadas are mapped to alliances containing *Larrea tridentata*, generally along the fringes of the active floodplain along the Whitewater River.

Riparian vegetation in the Southern California Coastal Floristic Subregion is restricted to steep, narrow canyons including several drainages in the Snow Creek and One Horse Creek watersheds. Burned, recovering stands of California sycamore and wild grape are common in small patches along the seasonally to perennially flooded stream channels in this subregion. Small amounts of *Populus fremontii* and *Alnus rhombifolia* have been mapped along segments of both drainages.

II. PBSH Vegetation Mapping Methodology

The PBSH vegetation mapping procedures implemented for this project have been tried and substantiated during our long history of mapping vegetation throughout the state and elsewhere. These steps have been proven to insure that a successful project outcome will follow. The mapping effort began with the compilation of a preliminary mapping classification that used the classification from the adjacent DRECP efforts as its base. Then the project staff of experienced photo interpreters conducted field reconnaissance visits to prepare for the photo interpretation effort. Using geographic information system (GIS) technology, they applied their knowledge and observations of desert vegetation to create a map of vegetation types. Codes representing a suite of other attributes were assigned to the vegetation polygons. Several quality control procedures were implemented prior to finalizing the geodatabase. A more detailed discussion of these methodology components follows.

Project Materials

Baseline Imagery for Photo interpretation

Since the project commenced approximately 1.5 year after the release of the 2014 NAIP natural color imagery, it was determined to be the most recent reliable image source and would therefore be used as the basis for interpretations. NAIP imagery is widely distributed and provided at no cost to the public. Although photo interpreters had access to higher resolution imagery, it was considered important to reference the data to a source available to all agencies both local and statewide. The 2014 NAIP imagery captures conditions in the mapping area shortly after the onset of the dry season in the month of June. The imagery depicts conditions after four lower than normal rainfall seasons. The imagery is natural color with image resolution (Image Pixel Size) of 1 meter.

Although the NAIP 2014 imagery serves as the baseline dataset, other image datasets aided photo interpreters in defining floristic types and delineating vegetation stands. In addition to the NAIP 2014 photo interpreters had access to NAIP 2014 color infrared, NAIP 2012 natural color imagery, and online image sources.

Online Imagery

In nearly all instances, additional online imagery was needed to help finalize vegetation attribution decisions. On these occasions, online image sets spanning one to as many as five separate years from Google Earth (GE) were used. In addition, the World Imagery layer available through ArcGIS Online was also used where needed. The dates of the online imagery from Environmental Systems Research Institute (Esri) were May 2010. Polygon delineations could be overlain directly onto the online imagery acquired through Esri. However, GE imagery was used with a follow-along tool and viewed on an adjacent screen.

The table below shows all image datasets used in the mapping effort. Those denoted with an asterisk are accessed through on-line technology.

Image Name	Year Created	Resolution	Color
NAIP	2014	1-meter	Natural Color
NAIP	2014	1-meter	CIR
NAIP	2012	1-meter	Natural Color
*Google Earth	2008 - 2016	3-inch	Natural Color
*Esri World	2010	1-foot	Natural Color

Ancillary Data

The following is a list of other datasets used by the photo interpreter in the mapping process.

Digital Sources Provided by CVCC

- Project Study Area
 - PBS Essential Habitat (shapefile)
- Vegetation Maps and Data
 - CVCC Valley Floor Final Product Veg Map 20140530.gdb
 - 1996 Holland Vegetation Map (shapefile)
 - Vegetation Assessments – Water Sources BLM-UCR
 - SRSJMNM Water Study – BLM-UCR_ShpFile (shapefile)
 - Water Sources – SRSJNM FINAL REPORT-UCR.PDF (Assessing Climate-Related Changes in Water Resources in the Santa Rosa and San Jacinto Mountains National Monument, July 2014)
 - Rapid Assessments from BLM-UCR Water Study.xlsx
 - 2016-02-12_PalmCanyonTamarisk (shapefiles)
 - TamMapped_UTM_NAD83Copy
 - Tam_Trtd_Thru_Nov_2015
- Trails
 - BLM_All_Trails_TMS_102115 (shapefile, kmz file)
 - Trails Geodatabase and Layer Files
- Land Ownership
 - LandOwner_2015_Jan (shapefile)

Other Digital Sources

- Anza Borrego State Park Vegetation Map and Data
 - VegetationSurveys_AnzaBorrego.mdb (downloaded from CDFW website)
 - ds165.gdb (geodatabase downloaded from <https://catalog.data.gov/dataset/vegetation-anza-borrego-desert-state-park-ds165>)

- Geology
 - Geology_a_ca.gdb (Geodatabase downloaded from <http://datagateway.nrcs.usda.gov/> on 8/8/2014).
- NWI Wetlands
 - CA_wetlands.gdb (Geodatabase downloaded from <http://www.fws.gov/wetlands/Data/State-Downloads.html> on 4/2/2014).
- California Fire Perimeters
 - Fire13_2.gdb (Geodatabase downloaded from <http://frap.caf.ca.gov/data/frapgisdata-subset.php> on 10/10/2014).
- ESRI ArcGIS online
 - Topo Maps
 - USA Topography Maps

The use of USGS contour data derived from digital elevation models and supplementary information from the ancillary datasets such as the ones listed above are important sources of data for the photo interpreter. Vegetation communities have a wide range of image signature characteristics and overlapping signatures between differing vegetation communities can be extensive. It is therefore necessary for the photo interpreter to have a thorough understanding of the topographical setting (slope steepness, direction of the slope, shape of the slope, position of the vegetation stand on the slope) in addition to modal elevation in which the vegetation communities occur. These biogeographic variables along with substrate characteristics, flooding frequency and severity are but just a few of the features that help in defining where a stand of vegetation occurs in the landscape.

Mapping Classification

For this mapping effort no classification analyses were conducted. The PBSH Floristic Classification that was used represents a subset of the DRECP vegetation classification completed in 2015 (VegCAMP, 2013, 2016), which was used to derive the preliminary project vegetation descriptions, keys, and other pertinent information. After the initial field reconnaissance trips with CDFW & CVCC ecologists, the preliminary classification was adjusted to include new types encountered in the field. All added types have been verified and accepted by the CDFW. These new alliances and associations were added based on the Manual of California Vegetation Second Edition (Sawyer, Keeler-Wolf & Evens, 2009), and from the adjacent Western Riverside County (Klein & Evens, 2005) and Anza-Borrego State Park (CDFG, 1998) mapping efforts.

The vegetation classification for the DRECP and other mapping efforts were based on numerous vegetation surveys and subsequent analyses and follow Federal Geographic Data Committee (FGDC) as well as National Vegetation Classification Standards (NVCS).

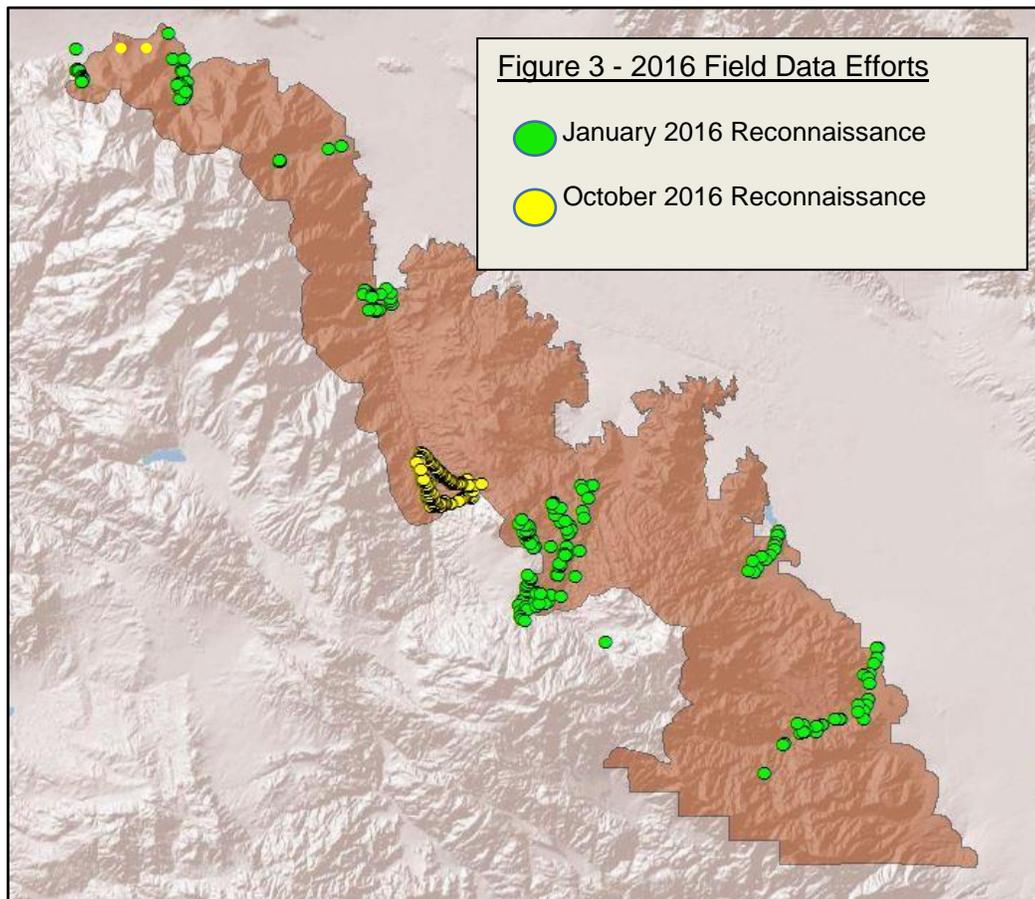
Mapped types in the PBSH study were characterized for the most part to the alliance level in the NVCS hierarchy and at times to the finer association level where possible. Photo interpreters assigned vegetation stands to more generalized categories in the classification hierarchy (e.g., group or macrogroup) when they were unable to assign vegetation to a specific alliance due to image resolution (most herbaceous types and some wetland types) or in cases of recently burned

areas. The mapping classification was updated throughout the production and final phase of the project, with the final mapping classification (see Appendix A) reflecting the finest level that the photo interpreter can identify and map from existing imagery and ancillary data.

Field Reconnaissance

Field reconnaissance efforts serve two major functions. First, they enable photo interpreters to relate the vegetation ground conditions at each observation site to the signatures on the aerial imagery. Second, with guidance from ecologists in the field, the photo interpreters become familiar with the flora, vegetation assemblages, and local ecology of the study area. At the same time, ecologists gain an understanding from the photo interpreters' perspective about assessing vegetation through the framework of map creation.

The photo interpreters review the study area for terrain and environmental features, in addition to probable vegetation types that may be found along the proposed field reconnaissance routes. Questionable photo signatures were noted so that those sites could potentially be visited during the field reconnaissance trip. After field reconnaissance, the ground data, in the form of GPS waypoints and associated ground photos were input into a GIS database and correlated with corresponding image-based photo signatures.



Prior to the first reconnaissance effort in January 2016, AIS photo interpreters reviewed imagery on-screen to identify and select potential reconnaissance sites in close proximity to roads and trails. Accessibility and regulations on differing administrative lands (Indian reservations, USFS, BLM, wilderness & private property) was ascertained prior to the effort. Sites were selected to represent different vegetation types and percent vegetative cover, as well as variations in geography, landform, and abiotic factors such as percent slope, aspect, shape of the slope, and elevation. AIS staff noted these sites within the study area to visit for observation. A set of hardcopy medium-scale maps were created encompassing all the sites; the potential site data were downloaded onto Android Tablets using Esri Collector Applications software to assist in field navigation. In all, 241 reconnaissance points (both base and distance observations) in seven unique watersheds were taken during the five-day effort. **(Figure 3)**

The field crew consisted of three photo interpreters from AIS, the Senior State Ecologist from CDFW, the Management Analyst from CVCC, and several local ecologists from the region. Data was collected from representative sites throughout the study.

During reconnaissance, the crew traversed the seven major watersheds within the study, stopping at sites that crewmembers deemed significant to study. Areas encountered in transit as well as areas of floristic or biogeographical significance were visited in the field as observation points. Additional observation points were often taken to mark the transition between vegetation types, with the intent of helping photo interpreters to determine the edges of stands. A single observation point may have contained information about more than one stand. It was also possible for a given stand to be assessed in multiple places. Some stands of vegetation were remotely observed at a distance with the aid of binoculars. The location of these remote stands was determined using a compass and laser rangefinder. The field crewmembers from AIS recorded location coordinates for each site visited into a GPS unit and logged pertinent information on field sheets.

The crew took digital color ground photos at many observation points. The photo number, direction the photographer was facing, and other information about the photo were recorded onto a field sheet and later input into computer files for easy reference during the mapping process. The field data (GPS waypoints and site descriptions) and linked ground photos were essential for correlating conditions seen on the aerial imagery to conditions on the ground.

A second reconnaissance effort was conducted in October 2016 after the initial mapping was completed, and is discussed in more detail later in the report.

Photo Interpretation and Mapping Process

Photo interpretation and mapping is a two-pronged process that occurs simultaneously while creating the vegetation database. Both processes are described in more detail below.

Photo Interpretation Process

Photo interpretation is the process of identifying map units based on their photo signature. All land cover features have a range of photo signatures. These signatures are defined by the color, texture, tone, size, and pattern exhibited on the aerial imagery. By observing the context and

extent of the photo signatures associated with specific land cover types, the photo interpreter is able to identify and delineate the boundaries between plant communities or signature units on a digital image or map. In context with the photo signature characteristics, the photo interpreters use field data, descriptions, and keys from adjacent projects (i.e. DRECP and Western Riverside County) which help identify and delineate these boundaries. In addition, existing datasets depicting topography, climate, and past vegetation data gathering efforts also aided photo interpreters in their delineations and floristic assignments during the production effort.

It should be noted that vegetation stature as well as the scale and resolution of the aerial imagery determine the visibility of individual plants. Trees and shrubs are usually visible as individuals on high-resolution digital imagery. However, grasses and forb-dominated vegetation (other than bunch grass clumps) are rarely seen as individual plants.

Environmental factors such as elevation, slope, and aspect also play an important part in the photo interpretation decision-making process. Knowledge of these factors, and how plant communities respond to them, guides a photo interpreter in choosing from among other plant types with similar photo signatures. Ultimately, such knowledge enables vegetation mappers to create biogeographical models of expected vegetation communities where the vegetation types are indistinct on the imagery. This ecological approach produces a more accurate product than would be created by relying solely on extracting information from the imagery, which is subject to variations in color, clarity and ground conditions.

The detailed descriptions of each vegetation type mapped in the study area are found in Appendix D, and include examples of the types of information the photo interpreters incorporate into their understanding of the models. Some examples of these models include how one alliance may favor broad floodplains, while another is found at the immediate fringe of narrow well-defined channels. Some alliances may flourish on disturbed sites, while others cannot tolerate multiple frequencies of high intensity disturbance events such as fire. Moreover, some alliances are ubiquitous and found in a variety of settings.

These descriptions also discuss the importance of various plant species in the alliance. However, in many cases, complicated relationships exist between the relative covers of plants, such as in alliances named for indicator species that have lower percent cover than other species present. Thus, both environmental settings and rules regarding relative cover factor into the intelligent delineation of vegetation polygons.

Mapping Process

Just as the use of biogeographical models by experienced photo interpreters contributed to the production of a high-quality vegetation map, the use of reliable procedures allowed the map to be produced in a highly efficient manner. For example, the study area was divided into six modules varying in size between 10,000 and 40,000 acres each. This facilitated project workflow by enabling several staff members to work on the mapping effort simultaneously.

Using an on-screen heads-up digitizing method, the photo interpreters had at their disposal a suite of standard and in-house customized ArcMap tools for use in the creation of polygons. The photo interpreters generally viewed the imagery at scales ranging from 1:1000 to 1:4000. They used variations in signature to draft boundaries separating areas of different vegetation types and/or distinct categories of percent cover of several stature levels. To assist in boundary placement and coding decisions, photo interpreters also referenced supplemental imagery, field reconnaissance data, and other ancillary data. These sources were displayed in the ArcMap session as needed.

Using the Vegetation Mapping Classification, the photo interpreters assigned code values to each polygon for the following attributes:

Vegetation Mapping Attributes
MapUnit
ConiferCover
TotalTreeCover
ShrubCover
HerbaceousCover
Notes
Tamarisk
FountainGrass
Mesquite
Palms
FieldCheck

The Vegetation Mapping Classification, with attributes and code values, is located in Appendix A.

The vegetation codes were entered into the database as numeric values, which are easier to input and manipulate than alphanumeric codes. Numeric code values also allow for the hierarchical grouping of like vegetation communities, assisting the mapper to know at a glance, which alliances are found in a particular hierarchical grouping. A custom menu was developed by AIS staff that enabled code values to be assigned to their corresponding spatial delineations efficiently and minimizing the possibilities for entry errors.

The six modules were edge-matched and checked for invalid codes, illogical relationships between attributes, unnecessary polygon divisions, as well as topologic and other GIS related inaccuracies. Once finished, the modules were joined into one seamless geodatabase. The geodatabase was subject to further processing and review by a senior staff member before being delivered to the client. Quality control procedures implemented during the mapping effort and before final delivery of the data improved the consistency and accuracy of the overall geodatabase.

Mapping Criteria

As discussed above, appropriate tools, reference sources, photo interpretation training, and knowledge of vegetation communities are all essential in creating a quality vegetation map. However, without the establishment and refinement of mapping criteria, a given vegetation map could be riddled with discrepancies, as different photo interpreters approach the task with different assumptions and styles. Guidelines and rules regarding exceptions, special situations, and minimum feature size are discussed and disseminated to all staff members before and during the mapping effort, which helps to create a clear and consistent product. Establishing criteria also makes the mapping process more efficient, as individual photo interpreters do not have to pause too long to consider how best to capture the more commonly occurring complicated or problematic situations that are confronted.

The specific criteria for each interpreted attribute contained in the final database are discussed in the next section below under the appropriate heading.

Mapping Attributes

MapUnit Attribute

This 4-digit code (5-digits for association level) corresponds to a vegetation type (e.g. mapping unit, alliance, association, group, or macrogroup) or miscellaneous class (e.g. urban disturbance, water) in the Vegetation Mapping Classification. The MapUnit attribute is assigned to each vegetation polygon in the geodatabase.

Each vegetation type is described in Appendix D; the Vegetation Mapping Classification is presented in Appendix A; and a summary table of vegetation acreage by map unit code is presented in Appendix C.

Vegetation Mapping Considerations – Minimum Mapping Unit

For vegetation mapping, a minimum polygon size is an important consideration when creating and viewing a vegetation geodatabase. A minimum mapping unit (MMU) is established to ensure the map contains polygons of a workable, meaningful size. The choice of a MMU is influenced by the clarity of the imagery, the detail of the mapping classification, the purpose of the data, and time and budget constraints.

The MMU can vary for different categories of features being mapped. The Statewide mapping criteria has established different MMUs depending on the area being mapped (e.g., MMUs in Desert areas are different from those in the Sierra Foothills). For this project, there were several established MMUs: 2 acres for upland types, .5 acre for special & wetland features and 5 acres for cover-class and other attribute changes.

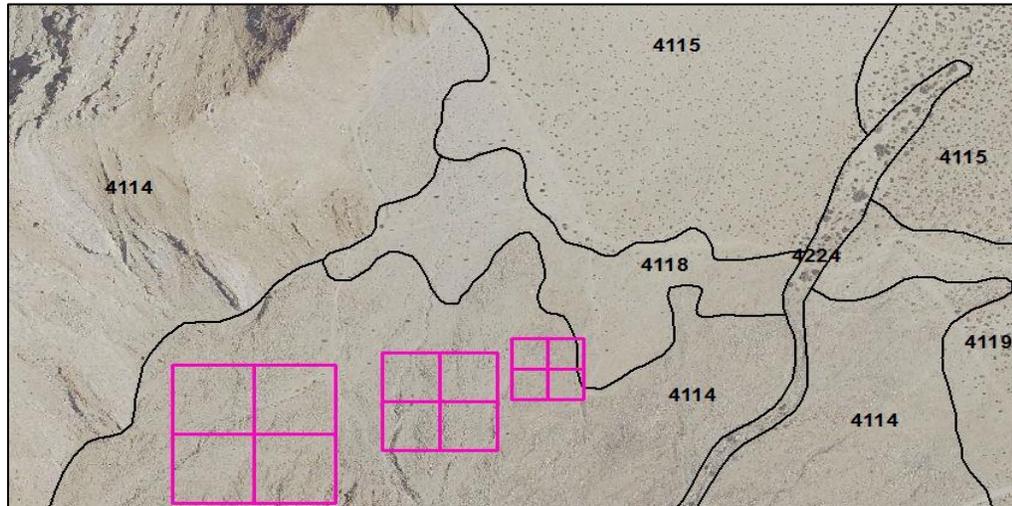


Figure 4: Stands of desert vegetation within the *Larrea tridentata* (code 4119), *Larrea tridentata* – *Ambrosia dumosa* (code 4115), *Larrea tridentata* – *Encelia farinosa* (code 4118), and *Encelia farinosa* Alliances (code 4114), normally divide into larger homogenous units, often well over 10 acres in size. Minimum unit squares denoted in pink are 10, 5 and 2 acres.

Further discussion between photo interpreters and CVCC & CDFW ecologists allowed for a 5-10 acre MMU for desert vegetation between extremely closely related types. **(Figure 4)** This was proposed in order to more closely adhere to the adjacent DRECP 10 acre upland MMU rule.

At the request of CVCC ecologists, AIS photo interpreters agreed to map wetlands that were distinct from adjacent vegetation to sizes below the project defined .5 acre MMU. CVCC ecologists also requested AIS to map stands of *Washingtonia filifera* and *Prosopis glandulosa* to the finest level possible due to the sensitive nature of palm oases and importance of mesquite as a food source for the Peninsular bighorn sheep. **(Figure 5)**

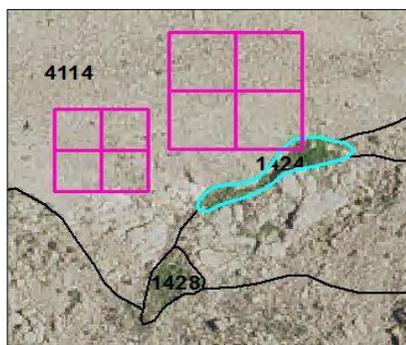


Figure 5: Stands of wetland vegetation such as the one highlighted in blue (*Salix exigua* Alliance code 1424) or the adjacent small polygon (*Vitis* Alliance code 1428) are mapped as small as possible when distinct from adjacent upland vegetation. The polygon highlighted in blue is 0.16 acres in size. MMU squares denote .5 acre and 1 acre. Note: Figures 4 & 5 are depicted at different mapping scales.

The establishment of an MMU requires the need for guidelines when aggregating vegetation that occurs below that defined MMU. In general, similar life forms are aggregated together: tree-dominated types are aggregated with other tree-dominated types, shrub types with other shrub types, and herbaceous types with other herbaceous vegetation types. However, if possible, wetland vegetation types are not aggregated with upland types, even if they are in the same life form.

Another guideline is used when a vegetation unit below MMU is aggregated with the vegetation type that surrounds it. This is known as a mapping or vegetation inclusion. Finally, if a vegetation unit that is below MMU is the same life form as two adjacent larger stands, and the adjacent stand types are very dissimilar in environment, the unit may be aggregated with the more environmentally similar adjacent type.

In addition to establishing MMU size, guidelines were established for the minimum width (MW) of a map polygon. The rule of thumb was to make the MW roughly half the width of an MMU square. For the .5 acre MMU, the MW is approximately 70 feet and for the 1-acre MMU, the MW is approximately 135 feet. This guideline did not preclude the creation of polygons where a small section fell below the minimum width, as long as the greater portion of the polygon met the stated criteria. This is most common when a narrow stream or riparian polygon was mapped and below MMU or MW portions were included in order to maintain the continuity of the stream or riparian vegetation. As mentioned above regarding overall MMU, AIS opted to map below these limitations where structural, floristic and or ecological characteristics were significantly different from the adjacent vegetation.

Another type of MMU mapping consideration pertains to sparsely vegetated or nonvegetated areas. Polygons assigned to a floristic type in the NVCS often contain small areas of unvegetated surface that are too small to delineate. These small areas are generally not separated out as unique features unless they met the minimum mapping resolution. The most common examples of these features include rock outcroppings in shrub dominated communities and small riverine flats or wash channels in riparian stands of vegetation.

Vegetation mapping to more generalized levels of the hierarchy

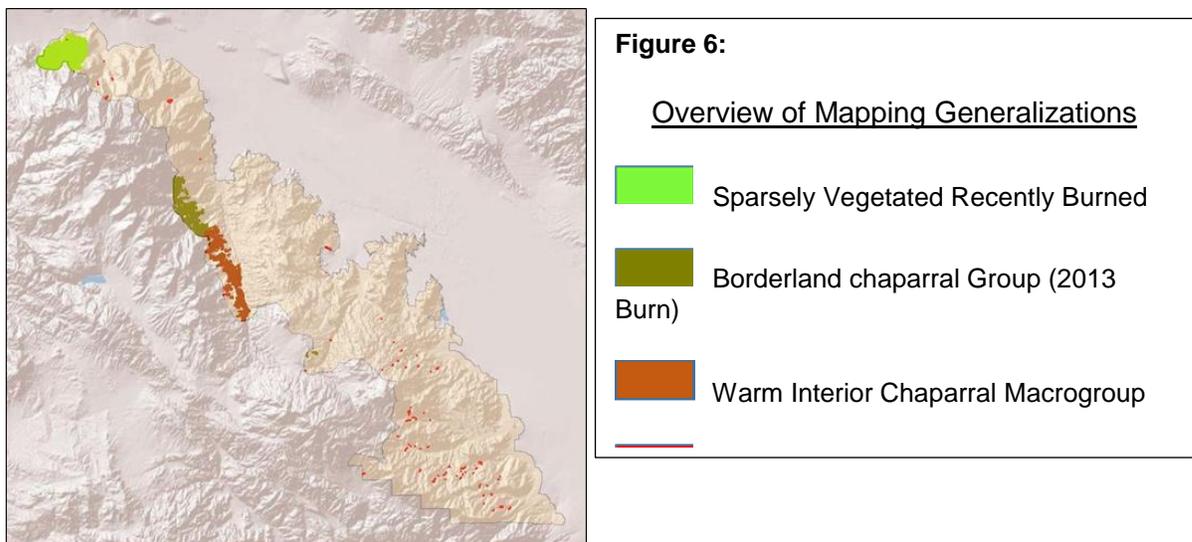
When the photo interpreter could not confidently classify a polygon at the alliance or association level, or the vegetation was a mix that did not fit into an existing described alliance, association, or mapping unit, the polygon was assigned to a more generalized (higher-level) group or macrogroup unit within the hierarchy.

Approximately 101 acres of riparian woodland or scrub have been generalized into higher levels in the hierarchy (mostly within the Southwestern North American riparian evergreen and deciduous woodland Group and the Southwestern North American riparian/wash scrub Group). For understandable reasons, it is difficult to

distinguish on imagery or ascertain any meaningful biogeographical models to help determine small thickets or woodland patches containing either red willow, arroyo willow or broom Baccharis. Within the abovementioned riparian woodland group, mappers generalized up from alliance-level calls less than 3% of the time.

Approximately 5743 acres of upland shrub dominated vegetation have been generalized into group or macrogroup categories in the hierarchy. **(Figure 6)** In all but one circumstance, these generalized assignments are due to recent or a history of multiple burns.

Approximately 1800 acres in the upper Palm Canyon watershed have been mapped to the Warm Interior Chaparral Macrogroup in areas not recently burned. The vegetation in these stands is extremely sparse, averaging about 3-10% shrub cover in very rocky settings. Field efforts could not ascertain dominance or co-dominance of the 4 or 5 shrub types consistently occurring in these stands. It was therefore necessary in these circumstances to map up to the macrogroup level.



Immediately north of the area described above, vegetation along Murray and Andreas Canyon was recently burned during the July 2013 Mountain Fire. By reviewing pre-burned imagery, photo interpreters were able to ascertain co-dominance of several shrub species within the Western Mojave and Western Sonoran Desert borderland chaparral Group. Vegetation in this area has been assigned to this group knowing that these species are basal sprouters. One cannot accurately estimate species dominance using the 2014 imagery, and therefore Alliance-level labels in this burn were not assigned. **(Figure 7)**

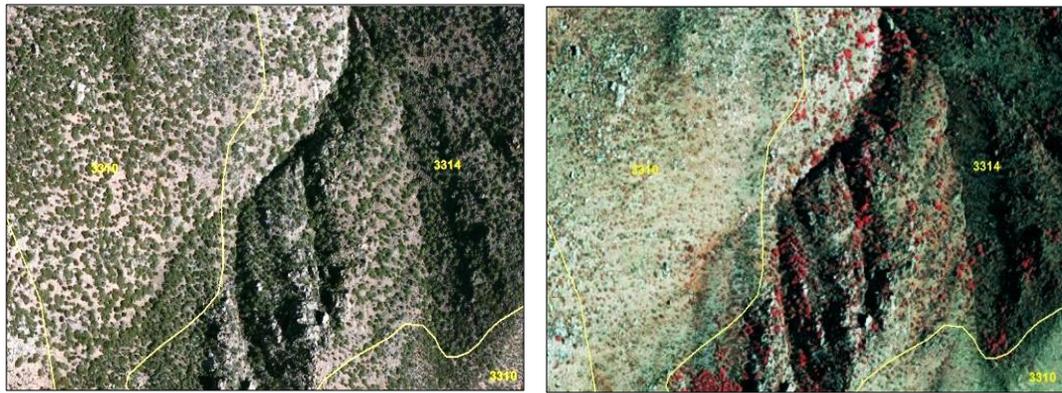


Figure 7: Image comparisons between two datasets; the one on the left is a natural color depiction of pre-burned conditions in 2006 where *Quercus cornelius-mulleri* and *Adenostoma sparsifolium* co-dominate. The infrared imagery to the right shows a post 2013 burn along the western portions of the image with an unburned portion stretching along the eastern part.

Association Level Vegetation Mapping

Although mapping to the alliance level of detail is this project's standard, photo interpreters mapped the following vegetation types to a finer level of the classification known as the floristic association. These associations are more thoroughly described in Appendix D of this report:

Within the *Washington filifera* (California fan palm oasis) Alliance

- 14151 *Washingtonia filifera* – *Platanus racemosa* / *Salix* spp. Association
- 14152 *Washingtonia filifera* / spring (*Atriplex* – *Baccharis* – *Pluchea*) Association

Within the *Parkinsonia florida* – *Olneya tesota* Alliance

- 42271 *Parkinsonia florida* / *Hyptis emoryi* Association

In addition to these three associations, photo interpreters designated in the Notes Field of the database vegetation units that could be potentially mapped to the *Pinus monophylla* / *Cercocarpus ledifolius* Association.

The following summarizes vegetation mapped to hierarchical units other than the Alliance Level:

- Riparian vegetation (101 acres – group level designations)
- Upland vegetation (5743 acres - Group & Macrogroup designations)
- Burned area (3211 acres - Sparsely Vegetated Recent Burned Areas – code 9701)
- Total generalized (~4.8% of the total mapping area)
- Association level classification (3960 acres)

- Potential association level based on Notes Field - pinyon pine / curl-leaf mountain mahogany (3934 acres)
- Total fine-scale associations mapped (~ 3.4% of the total mapping area)

Percent Cover Attributes

The percent cover attributes include the following:

- ConiferCover
- HardwoodCover
- TotalTreeCover
- ShrubCover
- HerbaceousCover

Percent cover, also referred to as cover density, is a quantitative estimate of the aerial extent of the living plants for each vegetation layer mapped within a stand. Absolute percent cover, based on a birds-eye view (what a photo interpreter can see from the sky looking down), and is the primary metric used to quantify the importance or abundance of a life form and/or species.

It should be noted that the cover of a stand could be considered a more significant attribute than the floristic assignment depending on the end use of the map. A mapped boundary dividing a break between a shrub cover density of 60% to a cover density of 10% can be more important than a boundary separating closely related floristic types (such as between a *Larrea tridentata* and a *Larrea tridentata* – *Ambrosia dumosa* Alliance).

More often than not, the cover of a stand will change following one or more severe burn events. Therefore, in studying a change that has occurred in vegetation stands between vegetation maps completed at different times, in most cases, it is more likely that the vegetative cover will drop rather than the actual vegetation type change.

The percent cover was estimated separately for conifer, hardwood, shrub and herbaceous layers. Cover was assessed and then assigned to a range category of percent cover for each layer and recorded in the database. These values are listed in Appendix B.

To determine the vegetative cover, photo interpreters assigned percentages to the different life forms visible on the imagery, including nonvegetated areas. The cover percentages were then converted into the appropriate cover category for each of the life forms being mapped. For example, if a total hardwood cover in the stand was 3-4%, then it was assigned the range of 1-5% (hardwood cover class category 2).

Photo interpreters formed separate polygons when there were changes from one cover class to another within a vegetation mapping type. A given vegetation polygon would have been subdivided due to cover differences regardless of which strata the cover difference occurred. For example, two adjacent polygons in the geodatabase may have had the same shrub vegetation type assigned but different cover categories for conifers (for example, 1-5% versus 5-15%).

Most standardized vegetation mapping efforts have a set of criteria regarding percent cover. The PBSH vegetation mapping effort follows the same criteria as those developed for the adjacent DRECP vegetation mapping effort, where a life form generally needs to account for at least 2-3 percent cover in order for an alliance of that life form to be mapped.

Percent Cover Mapping Considerations

It is important to note that the photo interpreters could only accurately quantify the vegetation that is visible on the aerial imagery. Therefore, in this project, only “bird’s eye” total cover was mapped. Thus, the cover of understory layers, which were obscured by overstory layers were not included in this analysis. For this reason, total cover of understory vegetation may be underestimated, especially if their extent was hidden under the crowns of trees, and may differ from assessments done on the ground.

Stands of riparian vegetation, along with adjacent unburned chaparral and desert scrub, often occur in dense cover over 60%. Where the overstory cover exceeded 40%, it was considered too dense to give a reliable estimate of lower tier canopy or understory percent cover. In these situations, the code assigned for percent cover for the understory life forms would be given a value of “Not applicable/Not assigned”. This same criterion has been used in numerous statewide mapping efforts. For example, if a conifer tier cover exceeded 40%, then the other tiers below (hardwood and shrub) were not evaluated for cover. If the conifer tier cover was <40% but together with the hardwood tier the combined cover was >40%, then the shrub cover was not estimated. Appendix B includes tables that present the ranges of percent cover used for each of these categories.

The date that the aerial photography mission is flown influences the percent cover assigned to vegetation types. Subsequent field reconnaissance and field verification efforts must take into consideration the following factors that can cause apparent discrepancies between the percent cover evident on the imagery and percent cover seen in the field:

- Seasonality - The percent cover of most plants is variable due to their annual growth cycle. Depending on whether the aerial imagery was taken during the wet season or the dry season, a mapped unit could show a different percent cover on the aerial imagery than is observed during an on-site visit at a different time of the year. Differences in leaf phenology (cold-season deciduous, drought deciduous, facultatively deciduous) can affect plant cover determination. Leaf-on conditions obscure the understory. Imagery of leaf-off conditions would allow photo interpretation of the understory, but make it difficult to identify the overstory species since there is no foliage present.

- Annual variability - The differences in environmental conditions at the time the imagery was captured (wet vs. drought years, flooding, etc.) vs. the timing of the on-site field visits may result in different assessments or perceptions of percent cover for the same stand.

Notes Attribute

This field is considered a catchall for significant information regarding a polygon and generally contains “value added” information that cannot be statistically quantified by the photo interpreter. An example of this “value added” information is the photo interpreter noting predominant species present in the stand other than the vegetation type being mapped. Polygons are not created or split based on this field.

Examples of important information that can be derived from this field are noted below:

- Stands assigned to the group or macrogroup levels are often denoted with the date and name of the associated burn that prevented photo interpreters from identifying species-level vegetation dominance.
- Stands of *Pinus monophylla* at high elevations were noted with a probable understory of *Cercocarpus ledifolius*. This is a described association, so with minimal post analysis, all polygons with these notes can be later cross-walked to an association level value.
- Pertinent site-specific information such as a ground assessed stand from ecologists denoting an unusual presence of *Olneya tesota* are noted near Martinez Canyon.

Tamarisk Attribute

This field identifies all polygons where photo interpreters can detect any amount of *Tamarix spp.* occurring in the stand. Stands that are assigned to a native wetland type (such as *Baccharis sergiloides* Alliance) often have Tamarisk present in the shrub layer. These polygons would be denoted with this attribute.

Fountain Grass Attribute

This field identifies all polygons where photo interpreters can detect any amount of *Pennisetum setaceum* occurring in the stand. Note that small amounts of this species is extremely difficult to detect and most likely will not be identified with this attribute.

Mesquite Attribute

This field identifies all polygons where individual mesquite trees can be detected in the stand. Every effort was made to delineate even the smallest patches as per request by CVCC field ecologists; however, individual trees cannot make a “mapped polygon” or vegetation stand. In these situations, the presence of mesquite in the polygon is denoted with this attribute.

Palms Attribute

This field identifies all polygons where individual palm trees (native *Washingtonia filifera*) can be detected in the stand. If observed, the polygon is denoted with this attribute.

The latter four specific attributes discussed above were added to the database based on discussions with CVCC ecologists pertaining to concern regarding rarity, exotic vegetation, and Peninsular bighorn sheep critical use habitats.

FieldCheck Attribute

This field identifies all polygons that were flagged for further observation in the field.

Second Reconnaissance/ Field Check Effort

The October 2016 field reconnaissance trip followed the initial draft completion of the vegetation map. For this field effort AIS photo interpreters were accompanied by an ecologist from the Friends of the Desert Mountains on the first day of the two-day effort. In all, 154 field points were collected in an area between 2000' and 4000' in elevation along the Dutch Charley, upper Palm Canyon, and Potrero trails. The area contains both upland and riparian vegetation from all three subregions and provided photo interpreters with a broad array of alliances over a relatively small and accessible area. **(Figure 3)**

During the photo interpretation process, it is common for photo interpreters to encounter areas that have questionable or confusing photo signatures. These polygons were flagged for ground observation (referred to as field checks) for the October 2016 reconnaissance effort. The difficulties photo interpreters consistently encountered during the production mapping process are listed below:

1. Difficulty separating out the *Encelia farinosa* Alliance from the higher elevation *Viguiera parishii* Alliance
2. Challenges in distinguishing some of the borderline chaparral types.
3. Distinguishing very small stands of riparian types in steep canyons.
4. Determining the species-specific cover class values in polygons mapped to the *Prunus fremontii* Alliance.
5. Validation of very small stands of *Prosopis glandulosa*.

Map Revisions Based on Field Findings

- Topographical and elevation considerations proved fairly reliable in initially separating out *Encelia* from *Viguiera*. However, there were slight corrections in areas of higher elevations where *Encelia farinosa* Alliance stands should have been mapped.
- Challenges remain in separating out small patches of riparian vegetation in steep canyons. Several of the stands have been reassigned to group-level categories in the hierarchy.
- It was discovered that stands containing a component of *Quercus cornelius-mulleri* were mapped to the *Quercus cornelius-mulleri* Alliance on low elevation slopes where the tree species *Juniperus californica* co-occurred in cover greater than 2%. In these situations, the stands should have been mapped as the *Juniperus californica* Alliance. Therefore, stands within the oak alliance were reduced in these settings to steeper more protected sites where juniper cover was below 2%.

- It was also noted that stands of the desert *Yucca schidigera* Alliance were under mapped on low toe-slopes and upper floodplain terraces adjacent to some of the broader floodplain below 3000'. This species of yucca proves quite difficult to discern using existing imagery, however with the additional topographical modeling aspects gained and further review of high-resolution GE imagery, photo interpreters added stands containing *Yucca schidigera* to the final vegetation product.
- Finer biogeographical modeling considerations were gained while observing stands of vegetation within the *Baccharis sergiloides* Alliance and used to update polygons throughout the entire map.

Quality Control and Delivery of the Final Product

Quality control steps were implemented throughout the duration of the project in order to make sure the map followed set guidelines and consistency among the photo interpreters. Once the initial photo interpretation phase was completed, a comprehensive quality control was performed by a different photo interpreter. Checks were then run for invalid attribute codes, and topology and other GIS related problems.

Quality control checks for illogical coding combinations were also run on the polygon attributes. An example of an illogical coding combination is “a creosote bush scrub polygon with a high conifer component in the conifer cover field.” After the final changes from the verification effort were implemented into the geodatabase, one last round of quality control checks were run on the geodatabase before it was delivered to the client.

Accuracy Assessment

Due to budgetary constraints, no formal accuracy assessment was performed on the vegetation database. However, given our familiarity with desert and semi-desert vegetation types and our high accuracy assessment scores from the adjacent DRECP area we are confident that the final vegetation data is of good quality and high value.

III. References

- Baldwin, B.G., D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken, editors. 2012. The Jepson Manual Vascular Plants of California, second edition. University of California Press, Berkeley.
- Barrows, Cameron W., and Robert F. Johnson. 2014. Santa Rosa San Jacinto Mountains National Monument Water Study Points 09152014 Coachella Valley Conservation Commission; Center for Conservation Biology, University of California, Riverside; U.S. Bureau of Land Management. (SRSJNMNM_Water_Study_09152014)
- Barrows, Cameron W., Kathleen D., and Robert F. Johnson., Michelle Murphy-Mariscal. 2014. Coachella Valley MSHCP Valley Floor Vegetation Map Center for Conservation Biology (CCB), University of California, Riverside. May 2014. (cv_veg_cover_20140530_Final_POLYGONS).
- California Department of Fish & Game (CDFG), Natural Heritage Division. March 1998. Vegetation Mapping of Anza-Borrego Desert State Park & Environs. A Report to the California Department of Parks and Recreation.
- Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Maps used as backdrops in this report.
- Federal Geographic Data Committee (FGDC). 2008. National Vegetation Classification Standard, Version 2 FGDC-STD-005-2008 (version 2). Vegetation Subcommittee, Federal Geographic Data Committee, FGDC Secretariat, U.S. Geological Survey. Reston, VA. 55 pp. + Appendices.
- Klein, Anne, and Julie Evens. 2005. Vegetation Alliances of Western Riverside County, California. Revised May 2006. California Native Plant Society, Sacramento, CA.
- Menke, J., E. Reyes, A. Glass, D. Johnson, and J. Reyes. 2013. 2013 California Vegetation Map in Support of the Desert Renewable Energy Conservation Plan. Final Report. Prepared for the California Department of Fish and Wildlife Renewable Energy Program and the California Energy Commission. Aerial Information Systems, Inc., Redlands CA.
- Sawyer, J.O., T. Keeler-Wolf, and J. Evens. 2009. A Manual of California Vegetation. California Native Plant Society, Sacramento, CA.
- United States Department of Agriculture, Forest Service. 2015. Palm Canyon Tamarisk Management & Removal Map. National Forests of Southern California Weed Management Strategy.
- Vegetation Classification and Mapping Program (VegCAMP). 2013. 2013 California desert vegetation map and accuracy assessment in support of the Desert Renewable Energy Conservation Plan. Final Report. Prepared for the California Department of Fish and Wildlife Renewable Energy Program and the California Energy Commission. California Department of Fish and Wildlife, Sacramento, CA.

Vegetation Classification and Mapping Program (VegCAMP). 2016. Addendum to the 2013 California desert vegetation map and accuracy assessment in support of the Desert Renewable Energy Conservation Plan. Final Report. Prepared for the California Department of Fish and Wildlife Renewable Energy Program and the California Energy Commission. California Department of Fish and Wildlife, Sacramento, CA.

Western Regional Climate Center – Cooperative Climatological Data Summaries. Southern California. Reno, Nevada. <http://www.wrcc.dri.edu/summary/Climsmsca.html>

APPENDIX A: Peninsular Bighorn Sheep Mapping Classification

NOTE: # Indicates a Macrogroup or Group level code value that was at times assigned to polygons in the final geodatabase. Yellow highlighted types indicate a .5-acre MMU. Green highlighted types indicate a 10-acre MMU desert alliance.

1000 = TEMPERATE FOREST SUBCLASS

1100 = California Forest and Woodland Macrogroup MG009

1110 = Californian broadleaf forest and woodland Group

1113 = *Quercus chrysolepis* (Canyon live oak forest) Alliance

1114 = *Quercus wislizeni* (Interior live oak woodland) Alliance

1120 = Californian evergreen coniferous forest and woodland Group

1122 = *Juniperus californica* (California juniper woodland) Alliance

1123 = *Pinus coulteri* (Coulter pine woodland) Alliance

1300 = Intermountain Basins Pinyon-Juniper Woodland Macrogroup MG026

1310 = Western Great Basin montane conifer woodland Group

1311 = *Pinus monophylla* (Singleleaf pinyon woodland) Alliance

1400 = Southwestern North American Riparian, Flooded and Swamp Forest Macrogroup MG036

#1410 = Southwestern North American riparian evergreen and deciduous woodland Group

1411 = *Populus fremontii* (Fremont cottonwood forest) Alliance

1412 = *Salix laevigata* (Red willow thickets) Alliance

1414 = *Platanus racemosa* (California sycamore woodland) Alliance

1415 = *Washingtonia filifera* (California fan palm oasis) Alliance

14151 = *Washingtonia filifera* – *Platanus racemosa* / *Salix* spp. Association

14152 = *Washingtonia filifera* / spring (*Atriplex* – *Baccharis* – *Pluchea*) Association

#1420 = Southwestern North American riparian/wash scrub Group

1423 = *Baccharis sergiloides* (Broom baccharis thickets) Alliance

1424 = *Salix exigua* (Sandbar willow thickets) Alliance

1428 = *Vitis arizonica* – *Vitis girdiana* (Arizona grape – valley grape thickets) Alliance

1430 = Southwestern North American introduced riparian scrub Group

1431 = *Arundo donax* (Giant reed breaks) Semi-natural Stands

1432 = *Tamarix* spp. (Tamarisk thickets) Semi-natural Stands

1500 = Western Cordilleran Montane-Boreal Riparian Scrub and Forest Macrogroup MG034

1510 = Vancouverian riparian deciduous forest Group

1511 = *Alnus rhombifolia* (White alder groves) Alliance

2000 = MESOMORPHIC SHRUB AND HERB CLASS

2100 = California Chaparral Macrogroup MG043

- 2110 = Californian xeric chaparral Group
 - 2112 = *Adenostoma fasciculatum* (Chamise chaparral) Alliance
- #2120 = Californian pre-montane chaparral Group
 - 2121 = *Arctostaphylos glandulosa* (Eastwood manzanita chaparral) Alliance

2200 = California Coastal Scrub Macrogroup MG044

- #2210 = Central and south coastal Californian seral scrub Group
 - 2215 = *Eriodictyon (crassifolium, trichocalyx)* (Thick leaf and hairy yerba santa scrub) Provisional Alliance
- 2220 = Central and South Coastal Californian coastal sage scrub Group
 - 2221 = *Eriogonum fasciculatum* (California buckwheat scrub) Alliance

2300 = California Annual and Perennial Grassland Macrogroup MG045

- #2330 = Mediterranean California naturalized annual and perennial grassland Group
 - 2334 = *Pennisetum setaceum* (Fountain grass swards) Semi-natural Stands

3000 = TEMPERATE AND BOREAL SHRUBLAND AND GRASSLAND SUBCLASS

#3300 = Warm Interior Chaparral Macrogroup MG051

- #3310 = Western Mojave and Western Sonoran Desert borderland chaparral Group
 - 3314 = *Quercus cornelius-mulleri* (Muller oak chaparral) Alliance
 - 3315 = *Adenostoma sparsifolium* (Redshank chaparral) Alliance
- 3320 = Mogollon Rim chaparral Group
 - 3321 = *Rhus ovata* (Sugarbush chaparral) Alliance

#3600 = Western North America Wet Meadow and Low Shrub Carr Macrogroup MG075

- 3610 = Californian warm temperate marsh/seep Group
 - 3613 = *Muhlenbergia rigens* (Deer grass beds) Alliance

3700 = Warm Semi-Desert/Mediterranean Alkali-Saline Wetland Macrogroup MG083

- 3720 = Southwestern North American salt basin and high marsh Group
 - 3722 = *Atriplex lentiformis* (Quailbush scrub) Alliance

4000 = WARM SEMI-DESERT SCRUB AND GRASSLAND SUBCLASS

#4100 = Mojavean-Sonoran Desert Scrub Macrogroup MG088

- #4110 = Lower bajada and fan Mojavean-Sonoran desert scrub Group
 - 4111 = *Ambrosia dumosa* (White bursage scrub) Alliance

4113 = *Atriplex polycarpa* (Allscale scrub) Alliance
4114 = *Encelia farinosa* (Brittle bush scrub) Alliance
4115 = *Larrea tridentata* – *Ambrosia dumosa* (Creosote bush – white bursage scrub) Alliance
4118 = *Larrea tridentata* – *Encelia farinosa* (Creosote bush – brittle bush scrub) Alliance
4119 = *Larrea tridentata* (Creosote bush scrub) Alliance

4150 = Arizonan upland Sonoran desert scrub Group
4151 = *Viguiera parishii* (Parish's goldeneye scrub) Alliance
4153 = *Prunus fremontii* (Desert apricot scrub) Alliance

4200 = Madrean Warm Semi-Desert Wash Woodland/Scrub Macrogroup MG092

#4210 = Mojavean semi-desert wash scrub Group
4211 = *Ephedra californica* (California joint fir scrub) Alliance
4212 = *Lepidospartum squamatum* (Scale broom scrub) Alliance
4213 = *Ericameria paniculata* (Blackstem rabbitbrush scrub) Alliance
4214 = *Prunus fasciculata* (Desert almond scrub) Alliance
4216 = *Ambrosia salsola* (Cheesebush scrub) Alliance
4218 = *Bebbia juncea* (Sweet-bush scrub) Provisional Alliance
4220 = Sonoran-Coloradan semi-desert wash woodland/scrub Group
4221 = *Pluchea sericea* (Arrow weed thickets) Alliance
4222 = *Prosopis glandulosa* (Mesquite bosque, mesquite thicket) Alliance
4224 = *Chilopsis linearis* (Desert willow woodland) Alliance
4225 = *Psoralea argophylla* (Smoketree woodland) Alliance
4226 = *Acacia greggii* (Catclaw acacia thorn scrub) Alliance
4227 = *Parkinsonia florida* – *Olneya tesota* (Blue palo verde – ironwood woodland) Alliance
42271 = *Parkinsonia florida* / *Hyptis emoryi* Association
4228 = *Hyptis emoryi* (Desert lavender scrub) Alliance

5000 = COOL SEMI-DESERT SCRUB AND GRASS SUBCLASS

5200 = Cool Semi-desert wash and disturbance scrub Macrogroup MG095

#5210 = Intermontane seral shrubland Group

5400 = Inter-Mountain Dry Shrubland and Grassland Macrogroup MG098

#5410 = Intermontane deep or well-drained soil scrub Group
5420 = Mojave and Great Basin upper bajada and toeslope Group
5421 = *Coleogyne ramosissima* (Black brush scrub) Alliance
5424 = *Yucca schidigera* (Mojave yucca scrub) Alliance
5440 = Intermountain shallow/calcareous soil scrub Group
5441 = *Cercocarpus ledifolius* (Curl leaf mountain mahogany scrub) Alliance

**6000 = NORTH AMERICAN WARM SEMI-DESERT CLIFF, SCREE AND ROCK
VEGETATION DIVISION**

**6100 = North American Warm Semi-Desert Cliff, Scree, and Other Rock Vegetation
Macrogroup MG117**

#6110 = North American warm desert bedrock cliff and outcrop Group

6114 = Unvegetated wash and river bottom Mapping Unit

6115 = Massive sparsely vegetated rock outcrop Mapping Unit

6120 = North American warm desert dunes and sand flats Group

6121 = Dicoria canescens – Abronia villosa (Desert dunes) Alliance

9000 = MISCELLANEOUS CLASSES

9200 = Agriculture

9210 = Woody Agriculture (orchards, vineyards)

9220 = Non-woody Row and Field Agriculture

9300 = Built-up & Urban Disturbance

9320 = Anthropogenic Areas of Little or No Vegetation

#9500 = Exotic Trees

9701 = Sparsely Vegetated Recent Burned Areas

9800 = Water

9805 = Water Impoundment Feature

APPENDIX B: Attributes in the PBSH Vegetation Map

MapUnit

The values for this attribute are found in the PBSH Vegetation Mapping Classification (Appendix A).

ConiferCover

0 = None or Not Observable

1 = 0-1%

2 = 1-5%

3 = 5-15%

4 = 15-25%

5 = 25-50%

6 = 50-75%

7 = 75-100%

9 = Not applicable/Not assigned

HardwoodCover

0 = None or Not Observable

1 = 0-1%

2 = 1-5%

3 = 5-15%

4 = 15-25%

5 = 25-50%

6 = 50-75%

7 = 75-100%

9 = Not applicable/Not assigned

TotalTreeCover

0 = None or Not Observable

1 = 0-1%

2 = 1-5%

3 = 5-15%

4 = 15-25%

5 = 25-50%

6 = 50-75%

7 = 75-100%

9 = Not applicable/Not assigned

ShrubCover

0 = None or Not Observable

1 = 0-1%

2 = 1-5%

3 = 5-15%

4 = 15-25%

5 = 25-50%

6 = 50-75%

7 = 75-100%

9 = Not applicable/Not assigned

HerbaceousCover

1 = None or Not Observable, 0-2%
2 = 2-15%
3 = 15-40%
4 = 40-100%
9 = Not applicable/Not assigned

Notes

Contains text added at discretion of photo interpreter to add extra information about the vegetation polygon as well as the results of the field checks.

Tamarisk

0 = Not present in the polygon
1 = Present in the polygon
9 = Not applicable

FountainGrass

0 = Not present in the polygon
1 = Present in the polygon
9 = Not applicable

Mesquite

0 = Not present in the polygon
1 = Present in the polygon
9 = Not applicable

Palms

0 = Not present in the polygon
1 = Present in the polygon
9 = Not applicable

FieldCheck

0 = Polygon not questioned
1 = Needs ground verification
2 = Field question answered

APPENDIX C: Area Report by Floristic Type

Frequency	Map Unit	NVCS Name	Acres
24	1113	Quercus chrysolepis (Canyon live oak forest) Alliance	462
97	1114	Quercus wislizeni (Interior live oak woodland) Alliance	3164
366	1122	Juniperus californica (California juniper woodland) Alliance	19,541
1	1123	Pinus coulteri (Coulter pine woodland) Alliance	2
138	1311	Pinus monophylla (Singleleaf pinyon woodland) Alliance	11,542
30	1410	Southwestern North American riparian evergreen and deciduous woodland Group	18
61	1411	Populus fremontii (Fremont cottonwood forest) Alliance	69
38	1412	Salix laevigata (Red willow thickets) Alliance	42
92	1414	Platanus racemosa (California sycamore woodlands) Alliance	416
4	1415	Washingtonia filifera (California fan palm oasis)	2
40	14151	Washingtonia filifera- Platanus racemosa/ Salix spp. Association	78
121	14152	Washingtonia filifera / spring (Atriplex - Baccharis - Pluchea) Association	64
101	1420	Southwestern North American riparian/wash scrub Group	63
145	1423	Baccharis sergiloides (Broom baccharis thickets) Alliance	236
27	1424	Salix exigua (Sandbar willow thickets) Alliance	13
43	1428	Vitis arizonica - Vitis girdiana (Arizona grape – valley grape thicket) Alliance	32
8	1431	Arundo donax (Giant reed breaks) Semi-natural Stands	2
109	1432	Tamarix spp. (Tamarisk thickets) Semi-natural Stands	163
10	1511	Alnus rhombifolia (White alder groves) Alliance	23
10	2112	Adenostoma fasciculatum (Chamise chaparral) Alliance	191
2	2120	Californian pre-montane chaparral Group	152
12	2121	Arctostaphylos glandulosa (Eastwood manzanita chaparral) Alliance	318
8	2210	Central and south coastal Californian seral scrub Group	550

10	2215	Eriodictyon (crassifolium, trichocalyx) (Thick leaf and hairy yerba santa scrub) Provisional Alliance	173
6	2221	Eriogonum fasciculatum (California buckwheat scrub) Alliance	27
28	2330	Mediterranean California naturalized annual and perennial grassland Group	88
12	2334	Pennisetum setaceum (Fountain grass swards) Semi-natural Stands	17
53	3300	Warm Interior Chaparral Macrogroup	1813
17	3310	Western Mojave and Western Sonoran Desert borderland chaparral Group	2221
221	3314	Quercus cornelius-mulleri (Muller oak chaparral) Alliance	6115
70	3315	Adenostoma sparsifolium (Redshank chaparral) Alliance	2844
53	3321	Rhus ovata (Sugarbush chaparral) Alliance	2230
2	3600	Western North America Wet Meadow and Low Shrub Carr Macrogroup	0
9	3613	Muhlenbergia rigens (Deer grass beds) Alliance	4
3	3722	Atriplex lentiformis (Quailbush scrub) Alliance	50
27	4100	Mojavean-Sonoran Desert Scrub Macrogroup	970
1	4110	Lower bajada and fan Mojavean-Sonoran desert scrub Group	36
4	4111	Ambrosia dumosa (White bursage scrub) Alliance	77
11	4113	Atriplex polycarpa (Allscale scrub) Alliance	181
170	4114	Encelia farinosa (Brittle bush scrub) Alliance	19,187
38	4115	Larrea tridentata - Ambrosia dumosa (Creosote bush - white bursage scrub) Alliance	2403
209	4118	Larrea tridentata - Encelia farinosa (Creosote bush - brittle bush scrub) Alliance	75,691
115	4119	Larrea tridentata (Creosote bush scrub) Alliance	3631
239	4151	Viguiera parishii (Parish's goldeneye scrub) Alliance	9705
214	4153	Prunus fremontii (Desert apricot scrub) alliance	7137
4	4210	Mojavean semi-desert wash scrub Group	20
4	4211	Ephedra californica (California joint fir scrub) Alliance	69
4	4212	Lepidospartum squamatum (Scale broom scrub) Alliance	13
2	4213	Ericameria paniculata (Blackstem rabbitbrush scrub) Alliance	3

34	4214	Prunus fasciculata (Desert almond scrub) Alliance	133
71	4216	Ambrosia salsola (Cheesebush scrub) Alliance	592
1	4218	Bebbia juncea (Sweet-bush scrub) Provisional Alliance	4
12	4221	Pluchea sericea (Arrow weed thickets) Alliance	7
448	4222	Prosopis glandulosa (Mesquite bosque, mesquite thicket) Alliance	293
49	4224	Chilopsis linearis (Desert willow woodland) Alliance	298
21	4225	Psoralea argemone (Smoke tree woodland) Alliance	153
518	4226	Acacia greggii (Catclaw acacia thorn scrub) Alliance	2961
1	4227	Parkinsonia florida - Olneya tesota (Blue palo verde - ironwood woodland) Alliance	2
169	42271	Parkinsonia florida / Hyptis emoryi (Blue palo verde / Desert lavender) Association	3818
13	4228	Hyptis emoryi (Desert lavender scrub) Alliance	81
1	5210	Intermontane seral shrubland Group	10
2	5410	Intermontane deep or well-drained soil scrub Group	31
2	5421	Coleogyne ramosissima (Black brush scrub) Alliance	9
54	5424	Yucca schidigera (Mojave yucca scrub) Alliance	2003
10	5441	Cercocarpus ledifolius (Curl leaf mountain mahogany scrub) Alliance	312
4	6110	North American warm desert bedrock cliff and outcrop Group	28
236	6114	Unvegetated wash and river bottom Mapping Unit	310
67	6115	Massive sparsely vegetated rock outcrop Mapping Unit	333
1	6121	Dicoria canescens - Abronia villosa (Desert dunes) Alliance	14
2	9200	Agriculture	26
5	9210	Woody Agriculture (orchards, vineyards)	38
171	9300	Built-up & Urban Disturbance	604
30	9320	Anthropogenic Areas of Little or No Vegetation	239
3	9500	Exotic Trees	2
7	9701	Sparsely Vegetated Recent Burned Areas	3211
5	9800	Water	7
2	9805	Water Impoundment Feature	97
4951		Total Area	187,464

APPENDIX D: PBSH Vegetation Mapping Descriptions

Explanation of the Descriptions

This section of the report contains descriptions for each of the vegetation types (Alliances, Associations, and Map Units) represented in the final geodatabase for this project.

Most vegetation types have a detailed description containing the following components:

- **Distribution Maps:** The distribution maps show the mapped polygons of the vegetation types within the study area and give the user an overall range of the species distribution in the study. Depictions of mapped types are enhanced to help the reader see the locations.
- **Aerial Image Screenshot:** These are digital images (using the 2012 or 2014 1-meter natural color NAIP imagery) showing aerial views of the vegetation stands. The screenshot give the reader a sense of the overall photo signature. Most examples display only a portion of the defined stand, depicting a representative or modal area. When the stand occupies only a portion of the imagery, an arrow denotes its location.
- **Ground photos:** These are digital pictures taken during the reconnaissance effort. They are a snapshot in time showing the plants in their landscape. They usually represent only a portion of the actual mapped stand.
- **Descriptions:** The descriptions discuss the expected locations, cover characteristics, species composition and other pertinent information. Species cover characteristics and relative abundance conforms to those presented in the second edition of *The Manual of California Vegetation* (MCV), but are also specifically tailored to the PBSH Vegetation Study. For example, where *Quercus cornelius-mulleri* is described in the MCV as occurring primarily on upper slopes and ridgetops, the descriptions in this document are more restrictive because within the mapping area, they are more likely to be found on protected mid to lower slopes that are quite steep at lower elevations and on gently sloping terrain higher up. Specific rules regarding definitive cover and floristic characteristics of the stand are derived from the Second Edition of the Manual of California Vegetation (Sawyer et al, 2009) floristic descriptions, the DRECP Final Report (Menke et al, 2013), and associated plot data and analysis. Descriptions in this section refer to common and/or likely settings within the PBSH Vegetation mapping area.
- **Photo Interpretation Signature:** These descriptions help the reader identify the vegetation from an aerial perspective. Since most of the Alliance-level assignments were interpreted from the 2014 or 2012 NAIP imagery, signature descriptions are based on these datasets, unless otherwise noted.

Some vegetation types have a very limited presence in the study area at sizes above the MMU. For these types, it was not possible to formulate the standard in-depth descriptions. Instead, they are represented only with a short description of their location within the study area. These will be noted at the end of the descriptions within this Appendix.

1113 *Quercus chrysolepis* Alliance (Canyon live oak forest)



462 Acres Mapped

The above example depicts a steep low to mid slope in Chino Canyon. The elevation here is approximately 4000'. The stand contains a *Q. chrysolepis* canopy with *Platanus racemosa* & *Alnus rhombifolia* adjacent to the drainage.

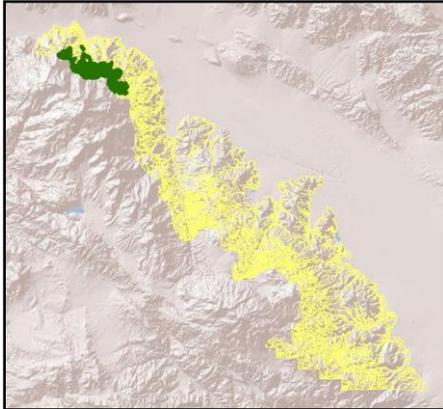
DESCRIPTION:

The *Quercus chrysolepis* Alliance is limited to several steep lower to mid canyon sideslopes mainly in upper Falls Creek and Chino Canyon. Stands generally are found upslope from riparian vegetation containing a mix of *Platanus racemosa* and *Alnus rhombifolia*. Cover is moderate to high, lower cover stands are interspersed with rocky outcroppings. *Quercus wislizeni* frequently occurs adjacent and upslope from this alliance.

PHOTO INTERPRETATION SIGNATURE:

Quercus chrysolepis forms a uniform signature within the stand except where narrow riparian vegetation occurs or where the canopy is interrupted by rock outcroppings. In all but the densest woodland settings, crowns are generally rounded and form multiple sub-crowning, especially in mature trees. Crown edges form distinct margins. Signature color ranges from medium to dark tones of green depending mainly on the leaf age and health.

1114 *Quercus wislizeni* Alliance (Interior live oak woodland)



3164 Acres Mapped

The above example depicts a moderately steep mid slope above the east fork of Snow Creek between 4000' & 5000'. The stand contains a mix of *Q. wislizeni* with other pre-montane chaparral species including *Ceanothus leucodermis*.



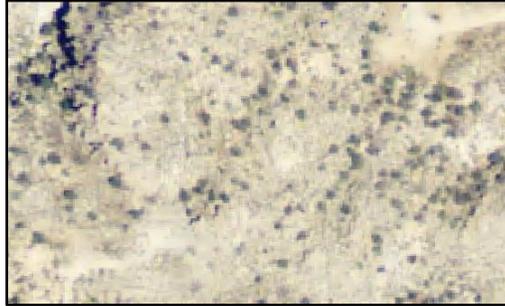
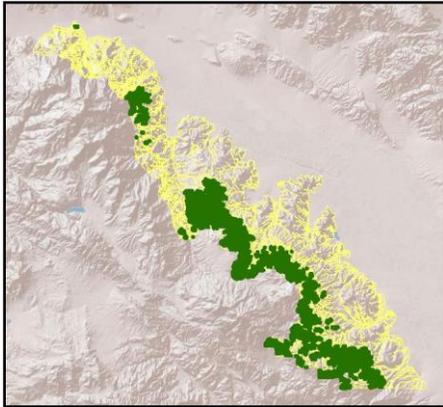
DESCRIPTION:

The *Quercus wislizeni* Alliance is limited to moderately steep to very steep canyon sideslopes mainly in upper Falls Creek, Chino Canyon, and Snow Creek. Stands in the mapping area are usually shrubby, in a variety of post fire settings making cover highly variable. Stands mix with *Ceanothus leucodermis* and on higher slopes with *Arctostaphylos glandulosa*. This species transitions to a *Q. chrysolepis* woodland downslope closer to steep sideslopes near seasonally flooded streams and upslope at higher elevations. Stands are noted in unusually low elevations adjacent to Jenson Creek and other drainages nearby due to steep cold air drainages from upper slopes.

PHOTO INTERPRETATION SIGNATURE:

Quercus wislizeni has a variable signature due to its cover density changing based on burn history in the stand. Signature variability also increases from other species mixing in the shrub layer, especially the lighter colored *C. leucodermis*. *Q. wislizeni* crowns are smaller than its canyon oak relative but, like canyon oak, tend to have a similar dark green color.

1122 *Juniperus californica* Alliance (California juniper woodland)



19,541 Acres Mapped

The above example depicts a rocky moderately steep mid to upper slope around 3400' near Dos Palmas Springs. This is a low elevation more xeric desert edge example containing an understory of *Viguiera parishii* and *Agave deserti*. Junipers in this example are under 2 meters tall.



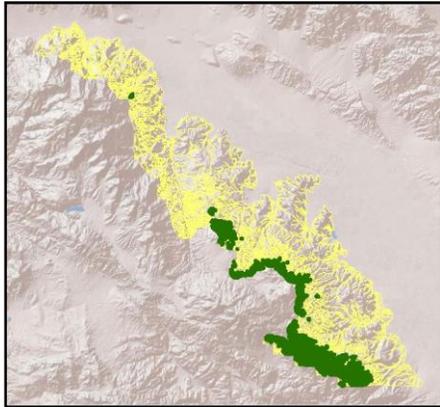
DESCRIPTION:

The *Juniperus californica* Alliance is widespread on gently sloping to moderately steep settings. It is found as low as 2200' but is more extensive above 2700' throughout the eastern third of the study area. Portions of its range have been decimated by recent burns in 2013. Stands in the mapping area are variable in size and floristic diversity. Drier sites often contain an understory of *Agave deserti* and *Viguiera parishii*, and occasionally *Yucca schidigera*. Higher elevation stands will mix with *Quercus cornelius-mulleri*, often with an emergent low cover of *Pinus monophylla*. Juniper cover can be as low as 2-3% in this alliance.

PHOTO INTERPRETATION SIGNATURE:

Juniperus californica has a reliably rounded crown, varying considerably in size. Crown color is usually brighter green than associated *Q. cornelius-mulleri*, but usually less bright than *Rhus ovata*. Look for juniper on gentler slopes than the nearby oaks, which at lower elevations will be on steeper, more protected settings.

1311 *Pinus monophylla* Alliance (Singleleaf pinyon woodland)



11,542 Acres Mapped

The above example depicts a fairly dense mix of emergent *Pinus monophylla* with juniper and oak in the understory on a fairly steep north trending rocky slope.



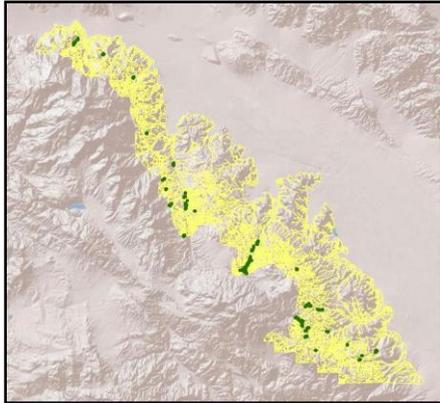
DESCRIPTION:

The *Pinus monophylla* Alliance occurs in a similar range to the juniper but is more restricted to elevations generally over 3500'. Lower elevation stands contain a high cover of *Juniperus californica* and *Quercus cornelius-mulleri*. High elevation stands are strongly dominated with pine. Stands occurring along upper slopes between Toro and Rabbit Peaks are likely to contain an open understory shrub component of *Cercocarpus ledifolius*, especially at elevations greater than 4500'. Stands are mapped with as little as 1-2% cover, even in semi-desert chaparral settings where juniper and/or oak may co-dominate with significantly higher cover.

PHOTO INTERPRETATION SIGNATURE:

Pinus monophylla has a narrow irregularly shaped crown, especially for a pine. Color trends towards a blue-grey, not as bright as juniper. In several topographical settings, the pines yield some significant shadowing on the imagery. When pines become strongly dominant, the signature becomes more distinct with extensive shadowing where the cover varies.

1411 *Populus fremontii* Alliance (Fremont cottonwood forest)



69 Acres Mapped



The above example depicts a narrow stand in upper Palm Canyon sharing dominance with *Salix exigua* & *S. laevigata*. In the adjacent ground photo, most of the riparian canopy is hidden from view.



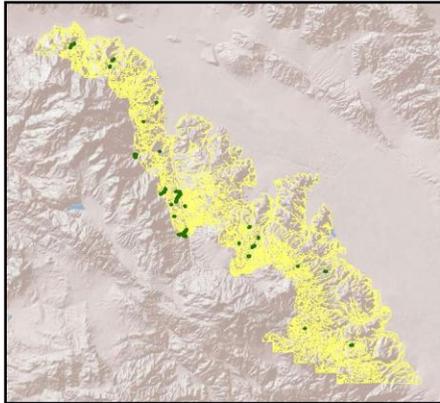
DESCRIPTION:

The *Populus fremontii* Alliance is mapped in narrow seasonally flooded major drainages with at least 5% cover. *Salix spp.* are a frequent co-dominant to the riparian canopy. Stands are quite small with most under a couple of acres in size. Several stands within the mapping area are infested with *Tamarix spp.* Lower elevation stands may contain several individuals of *Washingtonia filifera*. Stands are widely distributed, and in the northwestern portion of the mapping area, they occasionally co-dominate with *Platanus racemosa*.

PHOTO INTERPRETATION SIGNATURE:

Higher resolution ancillary imagery (GE and Esri World) are necessary to separate out riparian trees in the canyons, usually because the stands are below two acres in size. On finer resolution image datasets, cottonwood crowns tend to be more open than associated tree willows but this is only evident when stands are more extensive.

1412 *Salix laevigata* Alliance (Red willow thickets)



42 Acres Mapped

The above example depicts a low cover discontinuous stand in upper Palm Canyon.

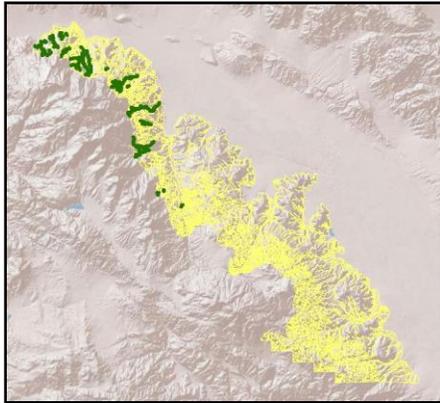
DESCRIPTION:

The *Salix laevigata* is mapped in narrow seasonally flooded major drainages with at least 5% cover. *Populus fremontii* can be present in the canopy. Stands are quite small and widely distributed throughout larger seasonally flooded streams in the study. Although this Alliance occurs in very small stands, cover tends to be higher than in the *Populus fremontii* Alliance. In the mapping area, this species is also less likely to occur as individual trees.

PHOTO INTERPRETATION SIGNATURE:

Higher resolution ancillary imagery (GE and ESRI World) are necessary to separate out riparian trees in the canyons, usually because the stands are commonly less than two acres. On finer resolution image datasets, red willow has a denser, darker green, more irregularly shaped crown than cottonwood.

1414 *Platanus racemosa* Alliance (California sycamore woodland)



416 Acres Mapped

The above example depicts a small dense patch in leaf-on conditions adjacent to *Quercus wislizeni*. The adjacent ground photo depicts leaf-off conditions. The stand occurs on an alluvial sideslope in the Snow Creek watershed.



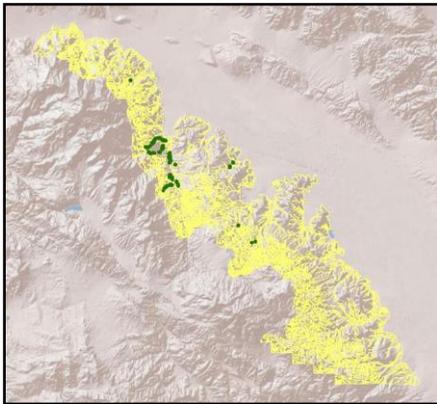
DESCRIPTION:

The *Platanus racemosa* Alliance is mapped in rather narrow temporarily to seasonally flooded canyons and on sideslope springs in the northwestern third of the study area. Stands in spring-like settings are small, but when occurring adjacent to larger seasonally flooded drainages such as Chino Canyon, they extend continuously over two miles. The alliance is mapped where *Platanus racemosa* dominates or co-dominates with at least 10% cover, at times with other riparian trees such as *Alnus rhombifolia*, or *Salix spp.* *Populus fremontii* is occasionally a component to the canopy.

PHOTO INTERPRETATION SIGNATURE:

Photo signatures in larger mature stands are distinct on a number of image datasets. Fall GE imagery depicts the brownish orange leaf color contrasting with the white trunk. Texture is coarse and leaf-on signature is lighter green than other riparian tree species. Stands are often bordered on the upland margins by the darker green *Quercus wislizeni*.

1415 *Washingtonia filifera* Alliance (California fan palm oasis)
14151 *Washingtonia filifera* – *Platanus racemosa* – *Salix spp.* Association



78 Acres Mapped

In this example, *Washingtonia filifera* co-dominates with *Platanus racemosa* along with a presence of *Alnus rhombifolia* in upper Andreas Canyon at an elevation just under 1500'.



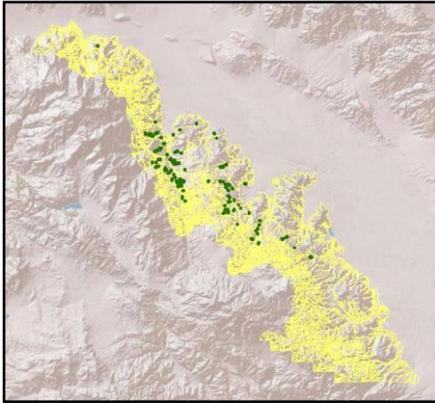
DESCRIPTION:

The *Washingtonia filifera* Alliance is mapped where the palm species dominates or co-dominates the canopy. In this Association, *Platanus racemosa*, with or without *Alnus rhombifolia* is present to co-dominant. At times *Populus fremontii* and/or *Salix spp.* is present in the stand. Stands are limited in the study area, occurring generally below 2500' in Palm Canyon, Cedar Creek, Andreas Canyon, and Murray Canyon. Note: When palms are visible in the canopy but not mapped to either of the palm associations, their presence is noted in the Palms attribute within the database.

PHOTO INTERPRETATION SIGNATURE:

Photo signature characteristics of *Washingtonia filifera* are distinct, with a consistent rounded crown, light green in color and tightly packed in dense groups. Riparian trees co-dominating the canopy do not truly mix but occur adjacent between the palm groves and are significantly darker green.

1415 *Washingtonia filifera* Alliance (California fan palm oasis)
14152 *Washingtonia filifera* / spring (*Atriplex* – *Baccharis* – *Pluchea*) Association



64 Acres Mapped

In this example, *Washingtonia filifera* strongly dominates the tree canopy. *Acacia greggii* & *Prosopis glandulosa* surround the stand.



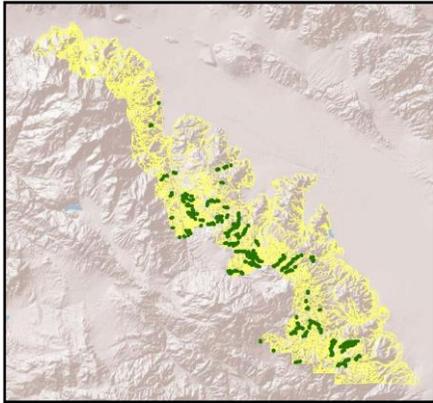
DESCRIPTION:

The *Washingtonia filifera* Alliance is mapped where the palm species dominates or co-dominates the canopy. In this association, *Washingtonia filifera* is the sole dominant, with little or no associated riparian trees. Stands may contain an understory component of *Baccharis sergiloides* or *Atriplex spp.*, at times with scattered *Tamarix spp.* This association is more widely distributed than the riparian one; however, they occur in significantly smaller stands. This association tends to occur in smaller less frequently flooded watersheds, at times in temporarily saturated conditions.

PHOTO INTERPRETATION SIGNATURE:

Photo signature characteristics of *Washingtonia filifera* are distinct, with a consistent rounded crown, light green in color and tightly packed in dense groups. In this association, there are little or no other tree species in the canopy that interrupt the signature characteristics of the palms.

1423 *Baccharis sergiloides* Alliance (Broom Baccharis thickets)



236 Acres Mapped

In this example, *Baccharis sergiloides* is seen occurring in a temporarily to seasonally flooded sandy wash with patches of *Prosopis glandulosa* along the floodplain margin.



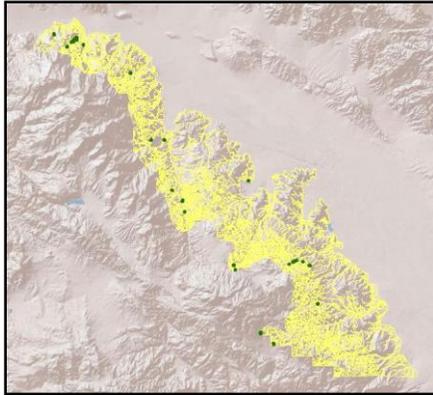
DESCRIPTION:

The *Baccharis sergiloides* Alliance is mapped within and along the immediate margins of sandy washes with a watershed large enough to sustain annual flooding in its channel. Stands are discontinuous and vary in cover, generally under 15% with as little as 2% cover. Distribution is widespread in the southern portion of the study area.

PHOTO INTERPRETATION SIGNATURE:

Photo signature characteristics often yield very small dark patches over a light colored sandy substrate. The discontinuous nature of the cover makes it difficult to obtain an adequate signature across the stand. Stands are found more often in the channel than other shrubby riparian species in the region such as *Acacia greggii*.

1424 *Salix exigua* Alliance (Sandbar willow thickets)



13 Acres Mapped

In this example at the mouth of Murray Canyon, *Salix exigua* is a strong dominant with several emergent palms. The stand is located just below a small patch of mesquite.



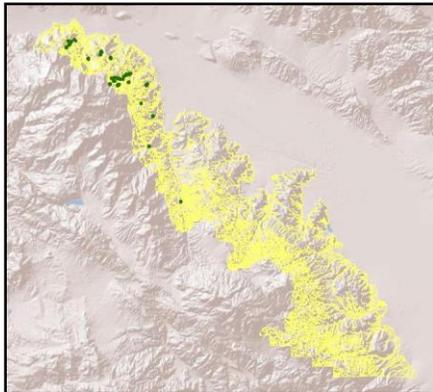
DESCRIPTION:

The *Salix exigua* Alliance is mapped in scattered locations throughout the study area in very small patches across a broad elevational gradient. Mapped where *Salix exigua* dominates or co-dominates with other riparian vegetation. This type is found in large watersheds where water is present at or near the surface most of the year. Stands are mapped where shrub cover is usually over 40%.

PHOTO INTERPRETATION SIGNATURE:

Salix exigua has a distinctive signature in healthy mature stands. Signature color is light blue to light blue-green and texture is stipple-like to smooth depending on image resolution. Less healthy stands or stands in leaf-off phenology tend to be a very light gray color.

1428 *Vitis arizonica* – *Vitis girdiana* Alliance (Arizona grape – valley grape thickets)



32 Acres Mapped

In this example, two small patches of *Vitis* are identified by the arrows adjacent to a sycamore run at the parking lot of the Palm Springs Aerial Tramway.

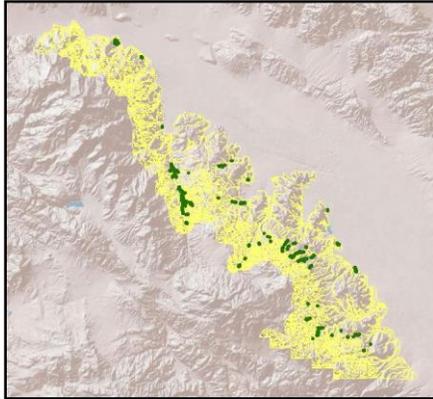
DESCRIPTION:

The *Vitis arizonica* – *Vitis girdiana* Alliance is mapped where *Vitis spp.* strongly dominates the shrub layer in cover usually over 80%. Stands are limited and often just upslope from the canyon bottom. This alliance is found in the northwest quarter of the mapping area.

PHOTO INTERPRETATION SIGNATURE:

Photo signature is uniform changing only on imagery flown in different seasons. Texture is smooth and leaf-on color is a uniform medium green. Stand edges are abrupt, especially against xeric vegetation upslope from this alliance.

1432 *Tamarix* spp. Semi-natural Stands (Tamarisk thickets)



163 Acres Mapped

In this example, *Tamarix* spp. dominates in a narrow band along upper Palm Canyon. Annual Mediterranean grasses dominate the understory. Some mesquite is visible upslope.



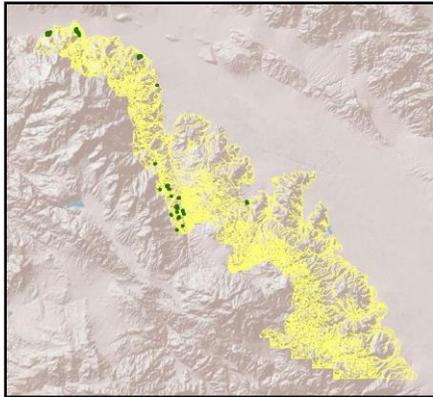
DESCRIPTION:

Tamarix spp. Semi-natural Stands are mapped where it strongly dominates the tall shrub layer in a wide range of cover. Riparian woodland species can be an emergent to the shrub layer in cover generally under 5%. *Tamarix* spp. (*Tamarix ramosissima*, *T. chinensis*, or other similar species) are frequently a significant component to riparian defined alliances and can even locally dominate portions of the stand. Mapped stands are somewhat limited in size except along Palm Canyon where portions have been treated. When *Tamarix* shrubs are visible in the stand, the polygon is denoted in the Tamarisk attribute within the database as being present.

PHOTO INTERPRETATION SIGNATURE:

Tamarisk is difficult to interpret because it has a wide variety of signature characteristics, depending on age, health and prior treatment efforts within the stand. Healthy stands are bright green with a relatively smooth texture. Stands often contain a component of native vegetation and make it difficult to estimate cover. Interpretation from one image dataset can yield a significant change from subsequent or prior imagery dates.

2330 Mediterranean California naturalized annual & perennial grasslands Group



88 Acres Mapped

In this example, annual grasses (*Bromus* spp. and *Avena fatua*) form a dense herbaceous mat with less than 5% emergent cover of coastal scrub. The area was burned in 2013



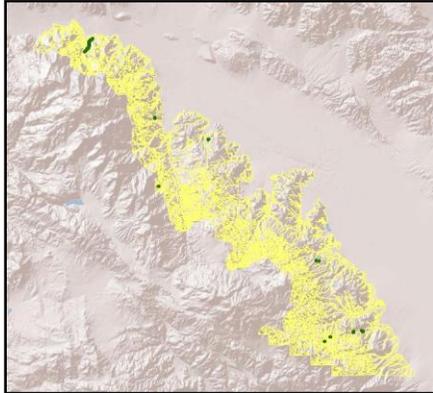
DESCRIPTION:

The Mediterranean California naturalized annual & perennial grasslands Group is mapped primarily in post burn settings in the non-desert (extreme northwest) portion of the mapping area and in an area west of Palm Canyon that underwent a burn in 1994. Stands contain less than 8-10% cover of coastal scrub (in the northwest portion) and under 5% cover of semi-desert chaparral species in the Palm Canyon burn. Annual *Bromus*, *Schismus*, *Avena*, *Brassica*, and/or other nonnative species strongly dominate.

PHOTO INTERPRETATION SIGNATURE:

As depicted in the ground photo and imagery above, annual grasses vary in color depending on season and winter precipitation. Texture is generally smooth with increasing variability depending on shrub cover, herbaceous species diversity and the presence of sparsely vegetated outcroppings.

2334 *Pennisetum setaceum* Semi-Natural Stands (Fountain grass swards)



17 Acres Mapped

In this example, the ground photo contains a high component of *Pennisetum* with *Encelia farinosa* in Snow Canyon. The 2014 imagery depicts a narrow but dense stand in Sheep Canyon at the other end of the study.



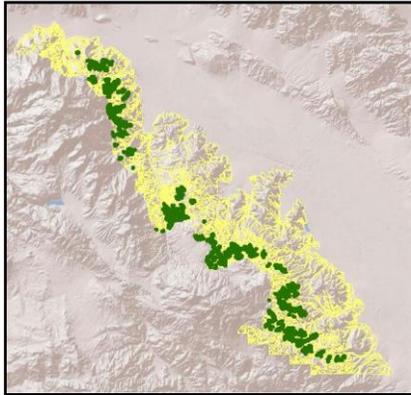
DESCRIPTION:

The *Pennisetum setaceum* Semi-natural Stands are mapped only where cover is concentrated in dense linear stands. Scattered individuals are difficult to see using even the finest imagery. If substantiated by plot or reconnaissance data, or visible on the imagery, the Fountain Grass attribute within the database is denoted as present. Mapped where this species strongly dominates and shrub cover is very low in a few scattered locations throughout the study area.

PHOTO INTERPRETATION SIGNATURE:

Stands containing this species of grass are visible on the imagery only when they strongly dominate. In these settings, they give off a tan to light green color that is stipple-like in texture.

3314 *Quercus cornelius-mulleri* Alliance (Muller oak chaparral)



6115 Acres Mapped

In this example, *Quercus cornelius-mulleri* dominates the stand with a presence of *Juniperus californica* and *Rhus ovata* at 4000' on gently sloping terrain just south of Asbestos Mountain.



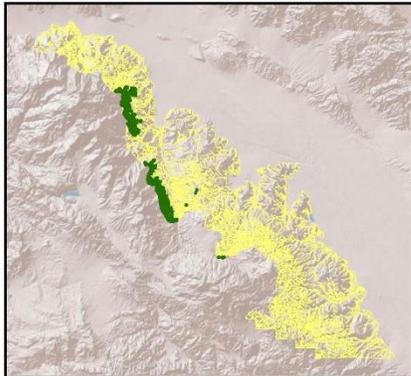
DESCRIPTION:

The *Quercus cornelius-mulleri* Alliance is mapped in two distinct settings in the study area. The higher elevation example as depicted here occurs on relatively deep, well-drained soil on gently sloping terrain, often with a component of *Juniperus californica*, *Rhus ovata* and *Pinus monophylla*. Lower elevation examples are mapped on steep north and northeast protected slopes, also with a component of *Juniperus californica*. Conifer cover in this alliance is below 2-3%. *Rhus ovata* can co-dominate the tall shrub layer. This alliance is widespread along almost the entire eastern third of the study area; best developed at elevations above 3000'.

PHOTO INTERPRETATION SIGNATURE:

Quercus cornelius-mulleri has a more blue-grey signature than juniper and has a denser more rounded crown than pinyon pine. *Rhus ovata* has a brighter green crown. Difficulty arises in estimating relative cover of oaks to conifers in accurately assigning this alliance.

3315 *Adenostoma sparsifolium* Alliance (Redshank chaparral)



2844 Acres Mapped

In this example, *Adenostoma sparsifolium* dominates the stand in high cover along the margins of the study area around 4200' in the upper portions of Deep Canyon.



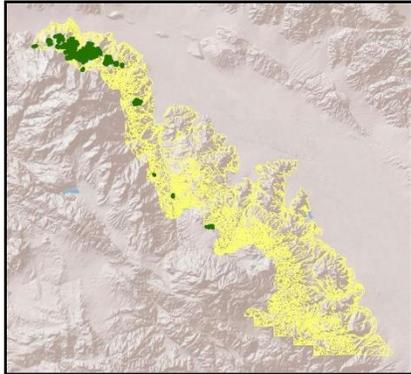
DESCRIPTION:

The *Adenostoma sparsifolium* Alliance is mapped at elevations generally over 3000' in a broad band east of upper Palm Canyon just below Pine Mountain and in a similar but less rocky environment along north-south trending ridgeline between Andreas and Tachevah Canyons. It is mapped where *Adenostoma sparsifolium* is a strong dominant in the shrub layer, generally in cover over 40%, at times significantly higher.

PHOTO INTERPRETATION SIGNATURE:

Adenostoma sparsifolium has a distinct brown-green hue representing components of the leaf canopy and the woody portion of the plant. A generally high cover in the shrub canopy yields consistency to this color across the stand and is interrupted only by the rockiness of the substrate.

3321 *Rhus ovata* Alliance (Sugarbush chaparral)



2230 Acres Mapped

In this example, *Rhus ovata* dominates the chaparral mix with an understory of *Encelia farinosa* in a rocky setting west of Snow Creek along the Pacific Crest Trail.



DESCRIPTION:

The *Rhus ovata* Alliance is mapped where it strongly dominates the chaparral in a variety post fire settings in the northwest portion of the study area. The species is a component, often co-dominating borderline chaparral alliances such as *Quercus cornelius-mulleri* further east, especially along the Palms to Pines Highway. Where the alliance is mapped, *Encelia farinosa* is a frequent understory shrub, and in rocky settings, where this alliance is found, it is low in cover.

PHOTO INTERPRETATION SIGNATURE:

Rhus ovata has distinct rounded dense crowns with definitive margins. Individual crowns are often over 3 meters in diameter. They are indistinguishable in these settings from other large shrubs including *Prunus ilicifolia* and *Quercus cornelius-mulleri* because of the low cover. Where these and other shrubs co-occur east of Palm Canyon, stands are mapped up to the Warm Interior Chaparral Macrogroup.

4114 *Encelia farinosa* Alliance (Brittle bush scrub)



19,187 Acres Mapped

In this example, *Encelia farinosa* dominates the shrub layer with low to moderate cover in the western portion of the mapping area.



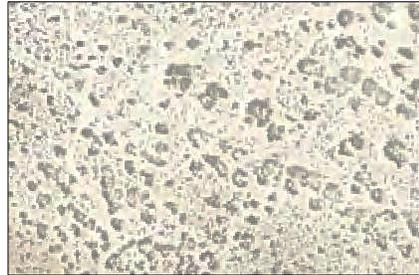
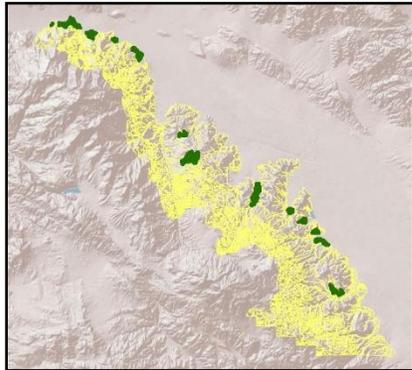
DESCRIPTION:

The *Encelia farinosa* Alliance is mapped in two distinct floristic subregions; it occurs in grassy settings on lower mountain slopes in an inland coastal scrub community within the Southern California Coastal Subregion, and in the Sonoran Desert Subregion on rocky mid and upper slopes with low cover. It is mapped where *Encelia farinosa* dominates or co-dominates the small shrub layer, in the western portion often with a component of *Eriogonum fasciculatum* and in the eastern three quarters of the study with a component of *Agave deserti* and/or *Fouquieria splendens*. This alliance is occasionally mapped on upper rocky, relatively steep alluvial fans with small rills, at times with a component of *Acacia greggii*.

PHOTO INTERPRETATION SIGNATURE:

Encelia farinosa has a fairly distinct signature for a small desert shrub, displaying a very light color with a dense well-defined crown. Distribution across the stand is generally quite variable depending on substrate soil development yielding a somewhat clumpy pattern.

4115 *Larrea tridentata* – *Ambrosia dumosa* Alliance (Creosote bush – white bursage scrub)



2403 Acres Mapped

In this example, *Larrea tridentata* dominates the tall shrub layer with an understory of *Ambrosia dumosa*. Cover is between 10 & 15%. Note some of the creosote cloning on the imagery in the upper right.



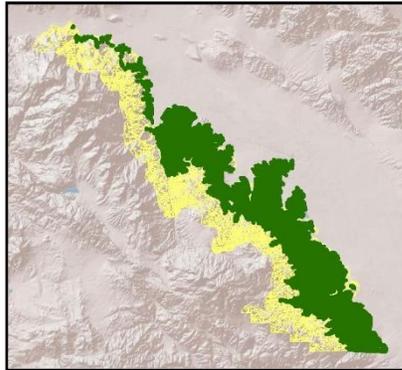
DESCRIPTION:

The *Larrea tridentata* – *Ambrosia dumosa* Alliance is mapped where *Larrea tridentata* broadly co-dominates with *Ambrosia dumosa* and both species are evenly distributed across the stand. However, mapping of this alliance takes into account areas where either species may locally not be present in situations that are patchy across the stand. Within the mapping area, *Ambrosia dumosa* can have as little as 1% cover, and still be mapped to this alliance. When *Encelia farinosa* is present, it is inconsistently distributed and less than 1% cover.

PHOTO INTERPRETATION SIGNATURE:

Larrea tridentata has an unexpectedly consistent signature for a plant that is so widely distributed across the study area. Variation in crown size is high though, with smaller plants occurring on hillslopes with minimal soil development. The associated *Ambrosia dumosa* is difficult to distinguish from other small understory shrubs; however, their distribution patterning characteristics differ from other species such as *Ambrosia salsola*.

4118 *Larrea tridentata* – *Encelia farinosa* Alliance (Creosote bush – brittle bush scrub)



75,691 Acres Mapped

In this example, *Larrea tridentata* dominates the tall shrub layer with an understory of *Encelia farinosa*. Cover is less than 5% in a cobble-dominated substrate.



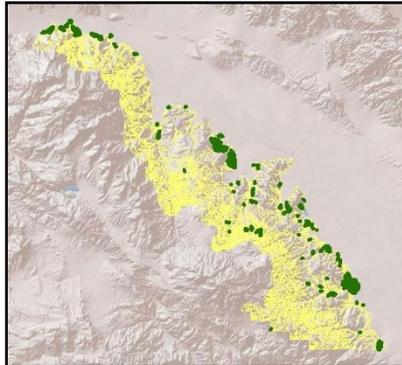
DESCRIPTION:

In this dual-species alliance, both *Larrea tridentata* and *Encelia farinosa* broadly co-dominate with both species having at least 1% cover. It is the most extensive alliance in the study area containing just about 40% of the total area mapped. Stands generally occur on low to upper slopes above the alluvial bajadas. This alliance ranges from the northwestern quarter of the study, where it is restricted to the lower easternmost slopes, all the way to the southern edge of the study, where its east-west range broadens significantly. *Agave deserti* is often a significant component to the stand throughout all but the westernmost portions of study area, especially in rockier settings where it shares the canopy with *Fouquieria splendens*.

PHOTO INTERPRETATION SIGNATURE:

Larrea tridentata has a relatively small, poorly defined crown and occurs on rocky slopes. *Encelia farinosa* has a larger and more distinct crown than *Ambrosia dumosa* and appears brighter against the generally brown to brownish orange rocky substrate. Distribution of the *Encelia* shrub is variable, with small dense patches often occurring in rills where there is somewhat more soil development.

4119 *Larrea tridentata* Alliance (Creosote bush scrub)



3631 Acres Mapped

In this example, *Larrea tridentata* strongly dominates the tall shrub layer over a cobble-strewn substrate. Cover averages 5-10% across the stand.



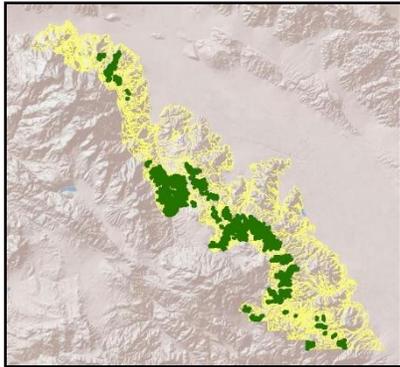
DESCRIPTION:

In this alliance, *Larrea tridentata* is the dominant shrub with at least 2% cover and is evenly distributed in the stand. Stands are mapped in a variety of settings and are widely distributed across the eastern portions of nearly the entire extent of the study area. This alliance contains significantly less area than the dual-species *Larrea tridentata* – *Encelia farinosa* Alliance. This particular *Larrea* type extends onto higher elevations than the other two dual-species alliances. It is found as high as 4000' in small stands, either on upper south trending slopes or on deep soil terraces adjacent to floodplains.

PHOTO INTERPRETATION SIGNATURE:

Larrea tridentata in this alliance usually occurs with larger than average crowns for this species. Patterning is also more consistent across the stand. As with the other two *Larrea* defined alliances, shrub color is consistent across the stand.

4151 *Viguiera parishii* Alliance (Parish's goldeneye scrub)



9705 Acres Mapped

In this example, *Viguiera parishii* co-dominates with *Eriogonum fasciculatum* and *Agave deserti* on a steep south facing mid slope.



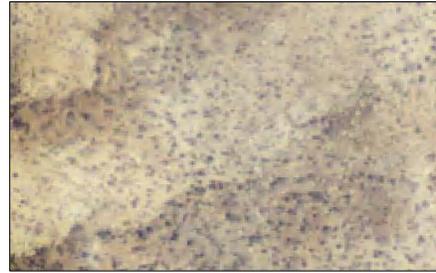
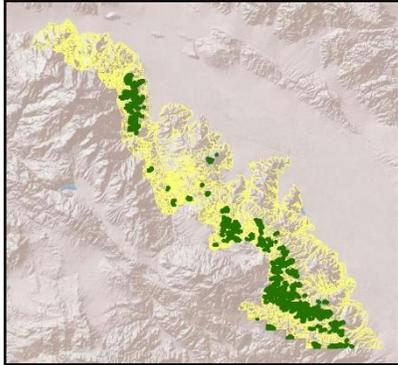
DESCRIPTION:

In this alliance, *Viguiera parishii* usually co-dominates with *Eriogonum fasciculatum* in the mapping area. Stands often contain an emergent cover of *Juniperus californica* well below 1% cover. *Agave deserti* is often a component to this alliance in rockier settings and *Prunus fremontii* can be present in low cover on lower more gently sloping terrain. This desert edge alliance is found at elevations over 2000' mostly in the southeastern half of the mapping area.

PHOTO INTERPRETATION SIGNATURE:

Both *Viguiera parishii* and *Eriogonum fasciculatum* are not reliably discernable from each other on even higher resolution data sets and therefore this alliance must be modeled from other small shrub types by their elevation and other terrain characteristics. Generally, *Encelia farinosa* is recognizable as a shrub on the imagery and the patterning is quite different. The *Viguiera* Alliance often has a small component of juniper and will never have *Larrea tridentata* in the shrub layer.

4153 *Prunus fremontii* Alliance (Desert apricot scrub)



7137 Acres Mapped

In this example, *Prunus fremontii* appears in drought stress, leaf-off conditions sharing dominance with *Cylindropuntia* spp., *Viguiera*, *Yucca schidigera* and *Eriogonum fasciculatum*.



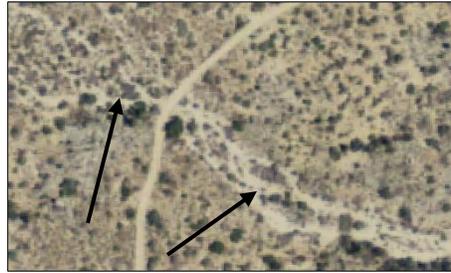
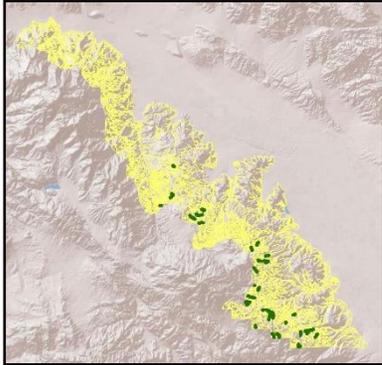
DESCRIPTION:

In this alliance, *Prunus fremontii* dominates or co-dominates the shrub layer with generally smaller shrubs such as *Eriogonum fasciculatum*, *Viguiera parishii* and others. *Yucca schidigera*, *Juniperus californica* is often present in the canopy. Overall shrub cover is generally between 10 and 20%. This alliance is found on lower to middle slopes along the desert edge borderline chaparral margins. Stands where *Yucca schidigera* is greater than 1% cover are mapped to that alliance.

PHOTO INTERPRETATION SIGNATURE:

Prunus fremontii is a dark-colored rather large shrub occurring at elevations generally over 2500'. It can be distinguished from *Juniperus californica* by its darker color and by *Quercus cornelius-mulleri* by its smaller size. This species is difficult to estimate cover relative to other species in the stand making this alliance a challenge to map.

4214 *Prunus fasciculata* Alliance (Desert almond scrub)



134 Acres Mapped

In this example, *Prunus fasciculata* dominates the tall shrub canopy in a narrow wash setting crossing a small dirt road.



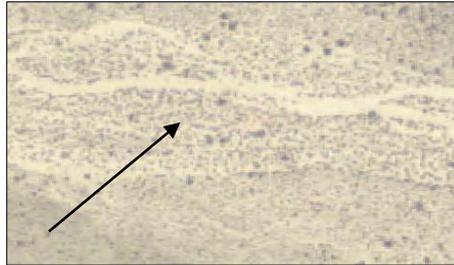
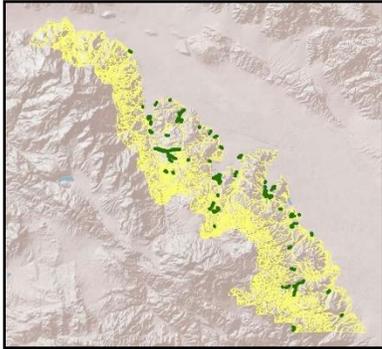
DESCRIPTION:

In this alliance, *Prunus fasciculata* dominates or co-dominates the shrub layer with relative high cover, generally over 25%. Washes are mapped to this alliance when *Prunus fasciculata* has as little as 2% cover. This alliance is for the most part mapped in washes adjacent to semi-desert chaparral or juniper woodlands.

PHOTO INTERPRETATION SIGNATURE:

Prunus fasciculata has an irregularly shaped crown, generally medium to dark gray in color. The typical sandy substrate makes the shrub stand out quite easily. This alliance is difficult to discern from the *Acacia greggii* washes, but generally occurs in higher elevations in less rocky settings.

4216 *Ambrosia salsola* Alliance (Cheesebush scrub)



592 Acres Mapped

In this example, *Ambrosia salsola* strongly dominates this large wash with a high shrub cover over 15%. Note the several braids within the wash.



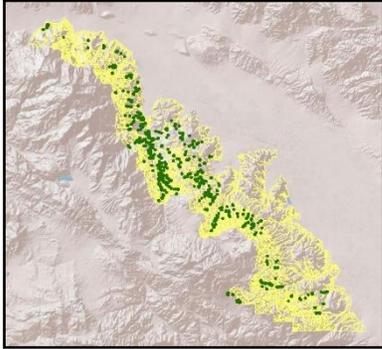
DESCRIPTION:

In this alliance, *Ambrosia salsola* strongly dominates the shrub layer, comprising over 60% of the relative cover in the canopy. Washes mapped to this alliance occur on sandy to gravelly substrate at lower elevations. Stands are occasionally mapped in disturbance settings such as cleared areas. Riparian trees, including *Parkinsonia florida* and *Psoralea argemone* can be emergent in the canopy with under 1% cover.

PHOTO INTERPRETATION SIGNATURE:

Ambrosia salsola has a gray to yellow-green color with very small rounded crowns. Smaller washes where this species dominates tend to lack much color, often trending gray to light gray. Washes dominated by *A. salsola* tend to occur at lower elevations than washes where other similar appearing types dominate such as *Baccharis sergiloides*. Washes containing *Bebbia juncea* as a dominant shrub are found in similar elevations; however, they are uncommon, and generally cover small areas.

4222 *Prosopis glandulosa* Alliance (Mesquite bosque, mesquite thicket)



293 Acres Mapped

In this example near 1000' in Palm Canyon, *Prosopis glandulosa* strongly dominates upslope from a stand of palms. Only a portion of the stand is seen on the adjacent ground photo.



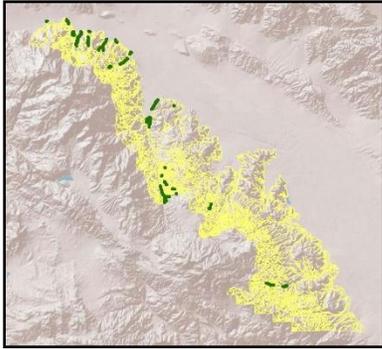
DESCRIPTION:

In this alliance, *Prosopis glandulosa* dominates the tree canopy, usually as the sole dominant in cover greater than 40%. Other microphyll shrubs when present generally have significantly less cover. Stands are generally quite small (averaging under 2 acres) and occur along the riparian fringe in very small, dense patches, usually at the slope break between the upper floodplain and adjacent sideslope. Higher elevation stands occasionally mix with semi-desert chaparral species such as *Q. cornelius-mulleri*.

PHOTO INTERPRETATION SIGNATURE:

The signature characteristics of this alliance vary only slightly, depending on the health and phenology of the trees. Patterning is clonal like and its consistent topographic setting makes this a reliable mapping type no matter how small the stand is.

4224 *Chilopsis linearis* Alliance (Desert willow woodland)



298 Acres Mapped

In this example, *Chilopsis linearis* strongly dominates this large wash with a tree cover between 10 and 15%.



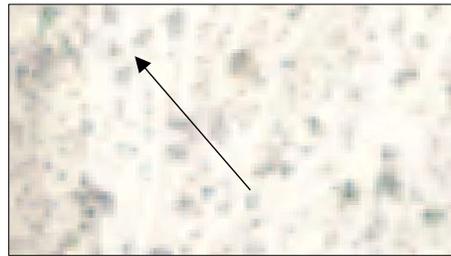
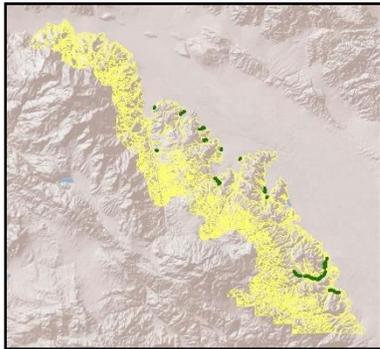
DESCRIPTION:

In this alliance, *Chilopsis linearis* dominates or co-dominates the tree canopy with as little as 1% cover when consistent along the wash. Riparian vegetation mapped to this alliance generally occurs in large watersheds, on broad sandy to gravelly washes in a wide range of elevations. Several of the mapped stands in the study area contain a significant component of *Tamarix* spp.

PHOTO INTERPRETATION SIGNATURE:

Mature individual *Chilopsis linearis* trees have large, irregularly shaped crowns, smaller ones are difficult to separate out from commonly co-occurring large shrubs, especially *Acacia greggii*. Color depends on seasonal phenology; some imagery depicts this species with a yellow to yellow-green color. Leaf-on settings yield a green to dark green color with medium intensity. Patterning of the trees in a typical large wash tends to form as parallel linear bands within the channel.

4225 *Psorothamnus spinosus* Alliance (Smoketree woodland)



153 Acres Mapped

In this example, *Psorothamnus spinosus* occupies the centermost active portion of the wash, with *Parkinsonia florida* in the background adjacent on the less active portions.



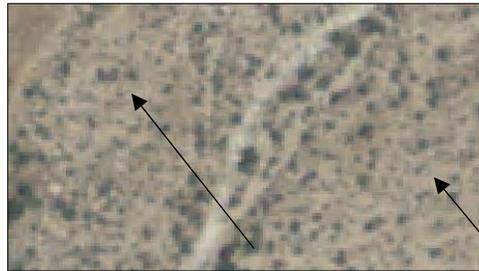
DESCRIPTION:

In this alliance, *Psorothamnus spinosus* dominates or co-dominates the tree canopy. Within the mapping area, *Parkinsonia florida* is a frequent component to the stand. Cover of *Psorothamnus* can be as low as 1% if consistent in the wash channel. Tree cover rarely exceeds 10%. Within the mapping area, stands dominated by this tree occur in more high-energy washes, often in and along the adjacent margins of the most active portion of the channel.

PHOTO INTERPRETATION SIGNATURE:

Psorothamnus spinosus has a consistent blue-grey color regardless of crown size. Crowns are irregularly shaped and feathery. Patterning of individuals in the wash is highly variable. Understory substrate is usually a very light tan to white.

4226 *Acacia greggii* Alliance (Catclaw acacia thorn scrub)



2961 Acres Mapped

In this example, *Acacia greggii* is occurring adjacent to the active channel along a broad upper floodplain in Murray Canyon.



DESCRIPTION:

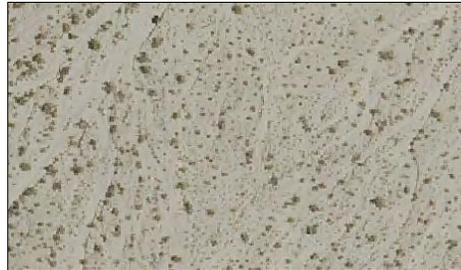
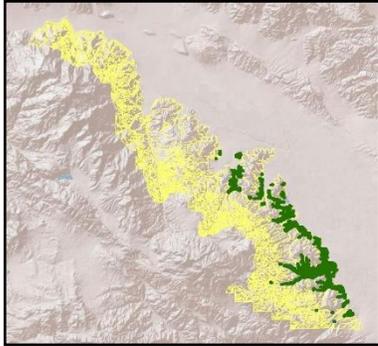
In this alliance, *Acacia greggii* is usually mapped in a wash setting, although scattered individual shrubs were observed frequently on nearby upland slopes. In the mapping area, *Acacia greggii* dominates or co-dominates the shrub layer, often with cover exceeding 20%. Stands tend to form clusters along the channel edge in medium sized watersheds. This alliance has a broad distribution where it is common in both desert and semi-desert chaparral settings.

PHOTO INTERPRETATION SIGNATURE:

Acacia greggii is a reliably dark colored medium sized shrub with minimal color variability. Patterning is inconsistent and clumpy forming linear bands along the margins of the channel. Small individual desert willows are difficult to distinguish but are more likely to be in the center of the channel. *Baccharis sergiloides* also cluster along the wash margins but are also common in the channel itself in less rocky more sandy settings.

4227 *Parkinsonia florida* – *Olneya tesota* Alliance (Blue palo verde – ironwood woodland)

42271 *Parkinsonia florida* / *Hyptis emoryi* Association



3818 Acres Mapped

This is a drier example where *Parkinsonia florida* occurs in small braids in the upper portions of a bouldery upper bajada near the mouth of Martinez Canyon.



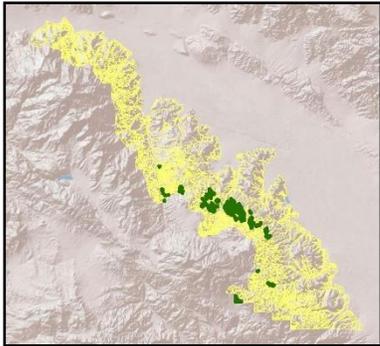
DESCRIPTION:

Although limited to the lower elevations within the southeastern portion of the mapping area, this association contains more acreage than any other riparian type. Stands are mapped as an association where *Parkinsonia florida* is the only occurring tree with at least 2-3% cover and *Hyptis emoryi* is scattered inconsistently in the shrub layer with as little as 1% cover. The association occurs in small to large watersheds and even in small rivulets between desert pavement surfaces.

PHOTO INTERPRETATION SIGNATURE:

Parkinsonia florida is a medium to large tree with a light to medium green color with a well-defined, irregularly shaped crown. Stands containing this tree form some of the broadest wash settings in the mapping area ranging from the active portion of the wash channel up to the lowest sideslopes of the adjacent mountains.

5424 *Yucca schidigera* Alliance (Mojave yucca scrub)



2003 Acres Mapped

In this example, *Yucca schidigera* co-dominates with other medium sized shrubs including *Prunus fremontii*. Scattered juniper occur in the tree layer below 1% cover. The stand is located around 3200' along State Route 74.



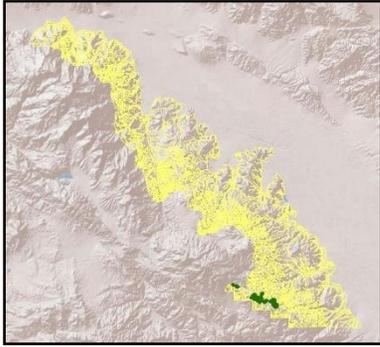
DESCRIPTION:

The *Yucca schidigera* Alliance is mapped where *Yucca schidigera* is consistent in the shrub layer with at least 1% cover. Other shrubs may often co-dominate the stand and may have higher cover. Overall shrub cover in the mapping area is high, often over 20%. Common associates include *Prunus fremontii*, *Viguiera parishii*, *Bernardia incana*, and in lower elevation stands, *Larrea tridentata*. Higher elevation stands often have an emergent cover of juniper less than 1%. The alliance is mapped in desert and desert edge environments, normally on gently sloping toe slopes and ridges between 2500 and 3500 feet.

PHOTO INTERPRETATION SIGNATURE:

Mojave yuccas are discernable only on fine-scale GE and other sub-meter image datasets, and even with these images, only larger individuals can be reliably identified. Shadowing characteristics provide somewhat more reliability of their presence. Modeling the elevational and topographic trends provides greater confidence in mapping this alliance.

5441 *Cercocarpus ledifolius* Alliance (Curl leaf mountain mahogany scrub)



312 Acres Mapped

In this example, *Cercocarpus ledifolius* occurs in dense cover on upper slopes above 5500' between Toro and Rabbit Peak in the Santa Rosa Mountains. *Note: these stands need to be substantiated with ground verification.

DESCRIPTION:

Within the study area, *Cercocarpus ledifolius* strongly dominates the shrub layer in cover greater than 30%. Emergent *Pinus monophylla* occurs in the stand with under 2-3% cover. Stands dominated by pinyon surround the mapped polygons. Note: Only several stands dominated by this species of Intermountain scrub were mapped, and only several occur within the DRECP area mapped to date. Previously documented stands occur near Rabbit and Villager Peak south of the study area. Stands within the PBSH mapping area were not visited during field reconnaissance.

PHOTO INTERPRETATION SIGNATURE:

Signature characteristics of *Cercocarpus ledifolius* vary little across the stand. Shrub size is fairly uniform and color is consistently a dark brown. Stands are found within pinyon woodlands and may be the result of burn history.

Mapped Group Level & other vegetation types and types with a limited presence in the Mapping Area

1123 – *Pinus coulteri* Alliance (Coulter pine woodland)

Mapped where *Pinus coulteri* dominates or co-dominates the stand in open woodland settings. Adjacent to the mapping area, *Arctostaphylos glandulosa* is a common understory shrub. 1 polygon (~2 acres) mapped along the boundary of the study area at the 5400' level as part of a stand in a grassy setting in the San Jacinto Wilderness. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

1410 – Southwestern North American riparian evergreen and deciduous woodland Group

30 polygons (~18 acres) mapped in scattered locations throughout the study area. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

1420 – Southwestern North American riparian/wash scrub Group

101 polygons (~63 acres) mapped throughout the study area. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

1431 – *Arundo donax* Semi-natural Stands (Giant reed breaks)

Mapped where *Arundo donax* forms dense stands as a strong dominant to the tall herbaceous layer. Emergent riparian vegetation, when present, is inconsistently distributed and sparse. 2 polygons (Less than 2 acres total) were mapped in the southern portion of the study mainly along the middle portions of Martinez Canyon. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

1511 – *Alnus rhombifolia* Alliance (White alder groves)

Mapped where *Alnus rhombifolia* dominates or co-dominates the tree canopy, generally in high cover over small areas. 10 polygons (~23 acres) mapped along the upper branches of Snow Creek and Chino Canyon. Mapped stands have a component of *Platanus racemosa*. Mapped in steep seasonally flooded streams, often down slope from canyon live oak woodlands. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

2112 – *Adenostoma fasciculata* Alliance (Chamise chaparral)

Mapped where *Adenostoma fasciculata* dominates or co-dominates the shrub layer, generally in dense cover. 10 polygons (~191 acres) mapped in the northwestern corner of the mapping area above 2500'. Most are recovering from recent fire. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

2120 – Californian pre-montane chaparral Group

2 polygons (~152 acres) mapped in higher elevations in the northwestern portion of the study area in the 2005 Blaisdell fire. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

2121 – *Arctostaphylos glandulosa* Alliance (Eastwood manzanita chaparral)

Mapped where *Arctostaphylos glandulosa* dominates, or occasionally co-dominates the stand in open to high cover. 12 polygons (~317 acres) mapped in higher elevations (above 3000') of the mapping area on upper slopes and ridges in the San Jacinto Mountains. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

2210 – Central and south coastal Californian seral scrub Group

8 polygons (~550 acres) mapped to the Group level, primarily in the 2004 Verbenia fire. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

2215 – *Eriodictyon (crassifolium, trichocalyx)* Provisional Alliance (Thick leaved and hairy yerba santa scrub)

Stands are mapped in the study area where *Eriodictyon crassifolium* is a strong dominant in moderately dense to dense cover. 10 polygons (~173 acres) mapped in post burn settings. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

2221 – *Eriogonum fasciculatum* Alliance (California buckwheat scrub)

Stands are dominated by *Eriogonum fasciculatum* in open cover. May become more common in areas recovering from the 2013 fire in the northwestern corner of the study area. 6 polygons (~27 acres) mapped in higher elevations in post burn settings. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

3300 – Warm Interior Chaparral Macrogroup

53 polygons (~1813 Acres) mapped to the Macrogroup level in very sparsely vegetated bouldery settings west of Palm Canyon, where cover is extremely low and species dominance is difficult to estimate. Species from two Groups within this Macrogroup commonly share dominance in these stands. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

3310 – Western Mojave and Western Sonoran Desert borderland chaparral Group

17 polygons (~ 2221 acres) mapped to the Group level within the 2013 Mountain fire. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

3600 – Western North America Wet Meadow and Low Shrub Carr Macrogroup

2 polygons (~.2 acres) mapped to the Group level. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

3613 – *Muhlenbergia rigens* Alliance (Deer grass beds)

Mapped along seasonal channels where *Muhlenbergia rigens* is present to co-dominant with other weedy annuals. 9 polygons (~3 ½ acres) mapped in upper Palm Canyon based on the information from a nearby SRSJMNM water study site (FID 60). Note field visited stands contained a high cover of annual grasses. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

3722 – *Atriplex lentiformis* Alliance (Quailbush scrub)

Mapped where *Atriplex lentiformis* dominates or strongly dominates the shrub layer in dense cover. 3 polygons (~ 50 acres) mapped in disturbance settings along the eastern edge of the mapping area. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4100 – Mojavean-Sonoran Desert Scrub Macrogroup

27 polygons (~970 Acres) mapped to the Macrogroup level within the 2013 Mountain fire. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

4110 – Lower bajada and fan Mojavean-Sonoran desert scrub Group

1 polygon (~36 acres) mapped to the Group level. Stand contains a component of *Psoralea spp.* Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

4111 – *Ambrosia dumosa* Alliance (White bursage scrub)

Mapped where *Ambrosia dumosa* dominates or co-dominates the stand with other small shrubs in open cover. 4 polygons (~ 77 acres) mapped along the northernmost boundary of the study area. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4113 – *Atriplex polycarpa* Alliance (Allscale scrub)

Mapped where *Atriplex polycarpa* dominates or co-dominates in open cover with other shrubs such as *Ambrosia dumosa*. 11 polygons (~181 acres) mapped in post agricultural and other disturbance settings along the eastern edge of the mapping area. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4210 – Mojavean semi-desert wash scrub Group

4 polygons (~20 acres) mapped to the Group level. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

4211 – *Ephedra californica* Alliance (California joint fir scrub)

Stands of *Ephedra californica* are mapped where it dominates or co-dominates with shrubs such as *Ambrosia dumosa* and *Psoralea spp.* in open cover over sandy substrate. 4 polygons (~69 acres) mapped along the uppermost floodplain south of the Whitewater River in the northwestern most portion of the study area. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4212 – *Lepidospartum squamatum* Alliance (Scale broom scrub)

Mapped where *Lepidospartum squamatum* is present to dominant in the shrub layer with other desert wash species including *Ambrosia salsola*. 4 polygons (~13 acres) mapped along the margins of the Whitewater River in the northwestern most portion of the study area. This alliance is better represented in the main channel just outside of the study area. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4213 – *Ericameria paniculata* Alliance (Blackstem rabbitbrush scrub)

Stands are dominated by *Ericameria paniculata* in open cover, generally in the most active portions of the wash channel. 2 polygons (2.6 acres) mapped based on a SRSJMNM water study plot (FID 106) in Bradley Canyon. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4218 – *Bebbia juncea* Provisional Alliance (Sweet-bush scrub)

Stands containing *Bebbia juncea* are mapped where the species dominates in open cover, generally in small narrow washes at lower elevations. 1 polygon (~ 4 acres) mapped along a wash near the Snow Creek Village. This stand could not be substantiated by ground reconnaissance. It is flagged in the FieldCheck attribute for verification. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4221 – *Pluchea sericea* Alliance (Arrow weed thickets)

Stands are dominated by *Pluchea sericea* in dense cover over small patches along the margins of larger seasonally flooded washes in the study area. 12 polygons (~7 acres) mapped in scattered localities mainly along Palm and Sheep Canyon. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

4227 – *Parkinsonia florida* – *Olneya tesota* Alliance (Blue palo verde – ironwood woodland)

Stands are mapped where either tree is dominant, or they both co-dominate the tree canopy in cover as low as 3-4%. 1 polygon (2½ acres) mapped based on ground verification by the Friends of the Desert Mountains, substantiating a stand of *Olneya tesota*. Note: The association under this alliance (pg. D-32) is a *Parkinsonia florida* type. This stand is referenced in the Notes attribute as being ironwood. Due to the infrequency of *Olneya tesota* within the study area, photo signature and biogeographical characteristics have not been described.

5210 – Intermontane seral shrubland Group

1 polygon (~10 acres) mapped in a post burn setting to the Group level. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

5410 – Intermontane deep or well-drained soil scrub Group

2 polygons (~31 acre) mapped to the Group level. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

5421 – *Coleogyne ramosissima* Alliance (Black brush scrub)

Stands are mapped where *Coleogyne ramosissima* dominates the shrub layer in cover often exceeding 20%. 2 polygons (~9 acres) mapped adjacent to the Anza-Borrego Desert mapping effort where it is common at higher elevations. Due to the infrequency of this Alliance within the study area, photo signature and biogeographical characteristics have not been described.

Sparsely Vegetated and Disturbance Related Categories

6110 – North American warm desert bedrock cliff and outcrop Group

4 polygons (~28 acres) mapped to the Group level. Interpreting to finer levels in the National Vegetation Classification hierarchy cannot reliably be achieved from existing imagery or by modeling based on environmental features for these polygons.

6114 – Unvegetated wash and river bottom Mapping Unit

236 polygons (~310 acres) mapped throughout the study in temporarily, intermittently, and seasonally flooded washes and stream courses containing less than 2-3% vegetative cover.

6115 – Massive sparsely vegetated rock outcrop Mapping Unit

67 polygons (~333 acres) mapped in scattered locations mostly in the northern half of the study on area of bedrock substrate with less than 2% cover.

6121 – *Dicoria canescens* – *Abronia villosa* Alliance (Desert dunes)

1 polygon (~14 acres) mapped where sand is collecting at the base of a small hill called Windy Point south of the Whitewater River. Note: the polygon is flagged in the FieldCheck attribute for post field verification to check the presence of the alliance indicator species. If these species are not present during the growing season, the polygon should be moved up to the North American warm desert dunes and sand flats Group level.

9200 – Agriculture

2 polygons (~26 acres) mapped. One area is recovering (an old pistachio farm off Dunn Road) with *Ambrosia salsola*, *Rhus ovata* and *Eriogonum fasciculatum*. The other appears to be a mixed-use area called the Lazy C Ranch below Desert Angel Peak.

9210 – Woody Agriculture (orchards, vineyards)

5 polygons (~38 acres) mapped (mainly citrus & date palm) along the southeastern edge of the study area, and a small olive farm in the Snow Creek settlement.

9300 – Built-up & Urban Disturbance

171 polygons (~604 acres) mapped along the eastern fringe of the study area and in the Pinyon Crest settlement off State Route 74.

9320 – Anthropogenic Areas of Little or No Vegetation

30 polygons (~239 acres) mapped in close proximity to built-up land use areas. These areas have been recently cleared; they do not contain any fixed structures at the time of the NAIP 2014 imagery.

9500 – Exotic Trees

3 polygons (~2 acres) mapped where non-native trees are not defined or could not be classified to an alliance level in the NVCS.



Figure 8: 1-mile section of the 2013 post fire recovery

9701 – Sparsely Vegetated Recent Burned Areas

7 polygons (~3211 acres) mapped in areas recovering from the 2013 Silver Fire Burn. **(Figure 8)** This is a mapping unit agreed upon by Todd Keeler-Wolf (CDFW Senior Vegetation Ecologist) which is used to denote stands of vegetation that have exhibited little or no recovery on the 2014 NAIP imagery. Unfortunately, much of this land is contained within the coastal sage scrub group, which represents only a small area of the study. Field reconnaissance in January of 2016 denoted annual grasses with recovering *Artemisia californica*, *Keckiella antinodes*, *Eriogonum fasciculatum*, and *Eriodictyon crassifolium* that were not present on the 2014 imagery. In these circumstances, it was agreed that photo interpreters should map to the Sparsely Vegetated

Recently Burned Areas mapping unit that most accurately represents 2014 conditions. This will in turn more accurately represent change analysis after subsequent updates to the vegetation map in the future.

9800 – Water

5 polygons (~7 acres) all water-classified features are associated with golf courses along the margins of the study area.

9805 – Water Impoundment Feature

2 polygons (~ 97 acres) South of Avenue 60 in the southeastern portion of the study area. These specific features are most likely used as flood control for the La Quinta Golf Club and surrounding development.