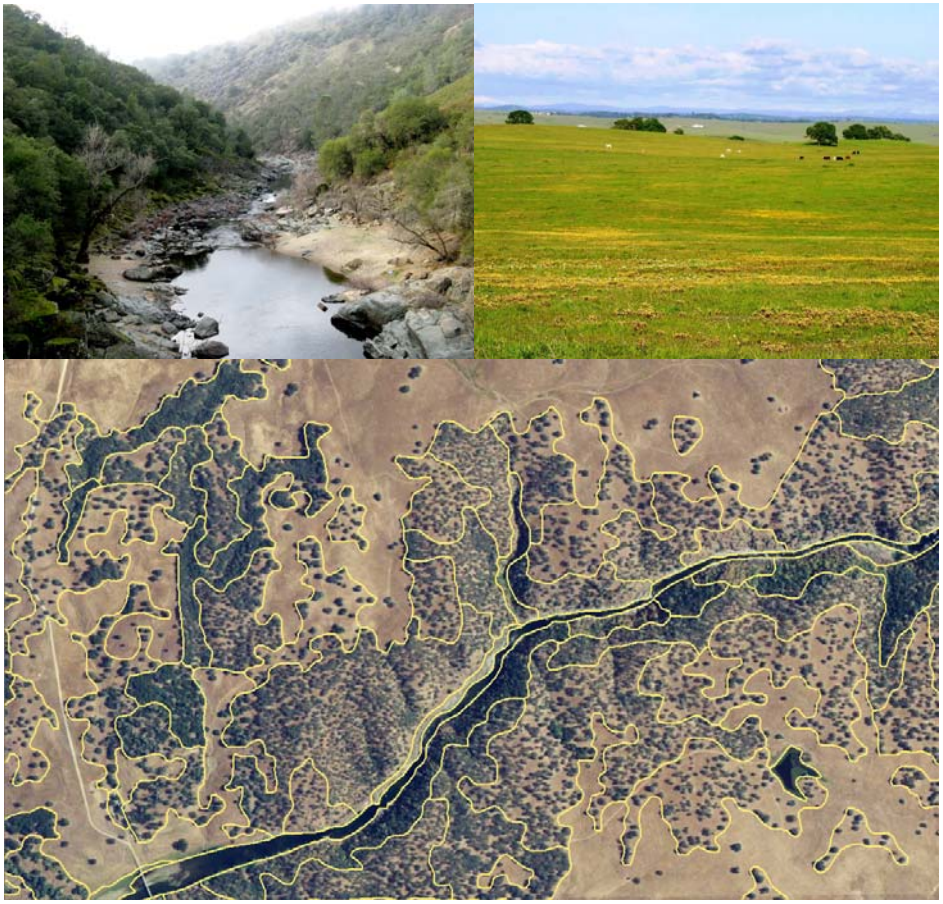
Northern Sierra Nevada Foothills Vegetation Project: Vegetation Mapping Report



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Introduction

The California Department of Fish and Game (CDFG) worked collaboratively with the California Native Plant Society (CNPS) and Aerial Information Systems (AIS) to produce a fine-scale vegetation map of the northern foothills of the Sierra Nevada, an area of approximately 2.6 million acres. This area is a biologically diverse mix of habitats including annual and perennial grasslands, oak woodlands, riparian scrub and forests, and foothill chaparral types.

The vegetation map is based upon 1-m resolution digital color aerial imagery. It includes 67 map units, of which 54 are natural vegetation map units at the floristic alliance level or higher (group) level and 13 are non-vegetation land use mapping units. The resulting vegetation map and supporting surveys provide baseline data with great floristic and ecological detail. Information from this project is being used to assess conservation and management objectives in the region, and it will enable wildlife, wildfire, and climate change modeling in the future. The project was supported by the California Wildlife Conservation Board, CDFG Vegetation Classification and Mapping Program, Sierra Nevada Conservancy, and Resources Legacy Fund Foundation.

Methods

Study Area

The northern Sierra Nevada foothills (NSNF) study area encompasses 2,618,180 acres (4,100 square miles) generally below 1,500 m (5,000 ft.) in elevation in the foothills from Shasta County east of Redding south to Madera County east of Chowchilla. It is defined by the northern two subsections of the USDA's Sierra Nevada Foothills Section (Miles and Goudey 1997). Approximately 85% is in private ownership and 15% in public ownership. Numerous major and minor watersheds are situated along the foothills and primarily drain to the southwest.

Mapping Efforts

In a separately funded project, AIS and CNPS produced a vegetation map for the Lassen Foothills subregion from 2007-08, using the National Agriculture Imagery Program's (NAIP's) true color aerial imagery from 2005. Mapping for the entire NSNF subsequently occurred from 2008-11, and used 1-meter resolution true color imagery acquired by NAIP in 2005 and 2009.

The NSNF study area was divided into 4 modules of fairly comparable size to aid in project scheduling. Module 1, at the north end, includes the foothill portions of Shasta, Tehama and Butte counties. Module 2 includes Butte, Yuba, Nevada, Placer, Sacramento and El Dorado counties. Module 3 includes Sacramento, El Dorado, Amador, and some of Calaveras, Tuolumne, and Stanislaus counties. Module 4 includes the balance of the foothill portions of Stanislaus, Calaveras, and Tuolumne counties, and Mariposa, Merced, and Madera counties (see Figure 1).

The project partners determined which vegetation alliances and higher level groups (i.e., map units) were interpretable after reviewing the available color aerial imagery along with the existing floristic classification and key to vegetation types.

Figure 1. Study area of the Northern Sierra Nevada Foothills

A full description of AIS's vegetation mapping procedures and techniques is provided in Appendix A. Classification and field keys for vegetation map units (as opposed to the floristic units) were created to enable consistent mapping of vegetation types (see Appendix B and C).

Existing Datasets for Project

Previous vegetation field surveys in the region resulted in a floristic classification and field key of vegetation types by CNPS and CDFG staff (Klein et. al. 2007, Buck et al. 2009), including 57 vegetation alliances and 8 semi-natural types. Around 2,531 vegetation rapid assessment or relevé field surveys and an additional 1,855 reconnaissance points (see Figure 2) were used as reference data for the vegetation map produced by AIS. Existing vegetation maps from AIS/CNPS (Lassen Foothills and Tuolumne Table Mountain/Peoria Wildlife Area) were also incorporated into the final map product.

Other ancillary data used for mapping included GIS layers for: protected lands, roads, railroads, and vehicular trails; vernal pools; soils; fire history; geology; and ultramafic geology. It also included National Wetlands Inventory Data, USFS CalVeg data, USGS digital raster graphics (DRGs), and 20-foot contour digital elevation models (DEMs).

Accuracy Assessment

To validate the vegetation map, an accuracy assessment (AA) effort with field verification was conducted by CNPS and CDFG staff. AA samples were allocated by CDFG for each map Module as it was received from AIS. In general, stratified random sampling (Cochran 1977, Thompson 2002) was employed to obtain a sufficient number of observations within each map unit to make a reasonably precise statement about the accuracy of each map unit. See Appendix D for a more complete description of the accuracy assessment methodology.

Using the field key to vegetation map types (Appendix C), CNPS staff collected more than a thousand field AA surveys over the entire study area. A set of digital photographs for surveys were taken and archived (in folders by survey date or polygon number). As AA surveys were collected, they were entered into a database and data quality control was performed prior to analysis. These surveys are archived in an MS Access database, including forms for entering and viewing data records. Associated survey data are contained within a series of tables, and other look-up reference tables provide functionality of the forms and data tables.

CNPS staff collected field AAs for each of the Modules without knowledge of the mappers' attributes for the polygons that were assessed. Then CDFG staff scored each Module for accuracy. See Appendix E for examples of the AA field survey forms and the AA analysis database.

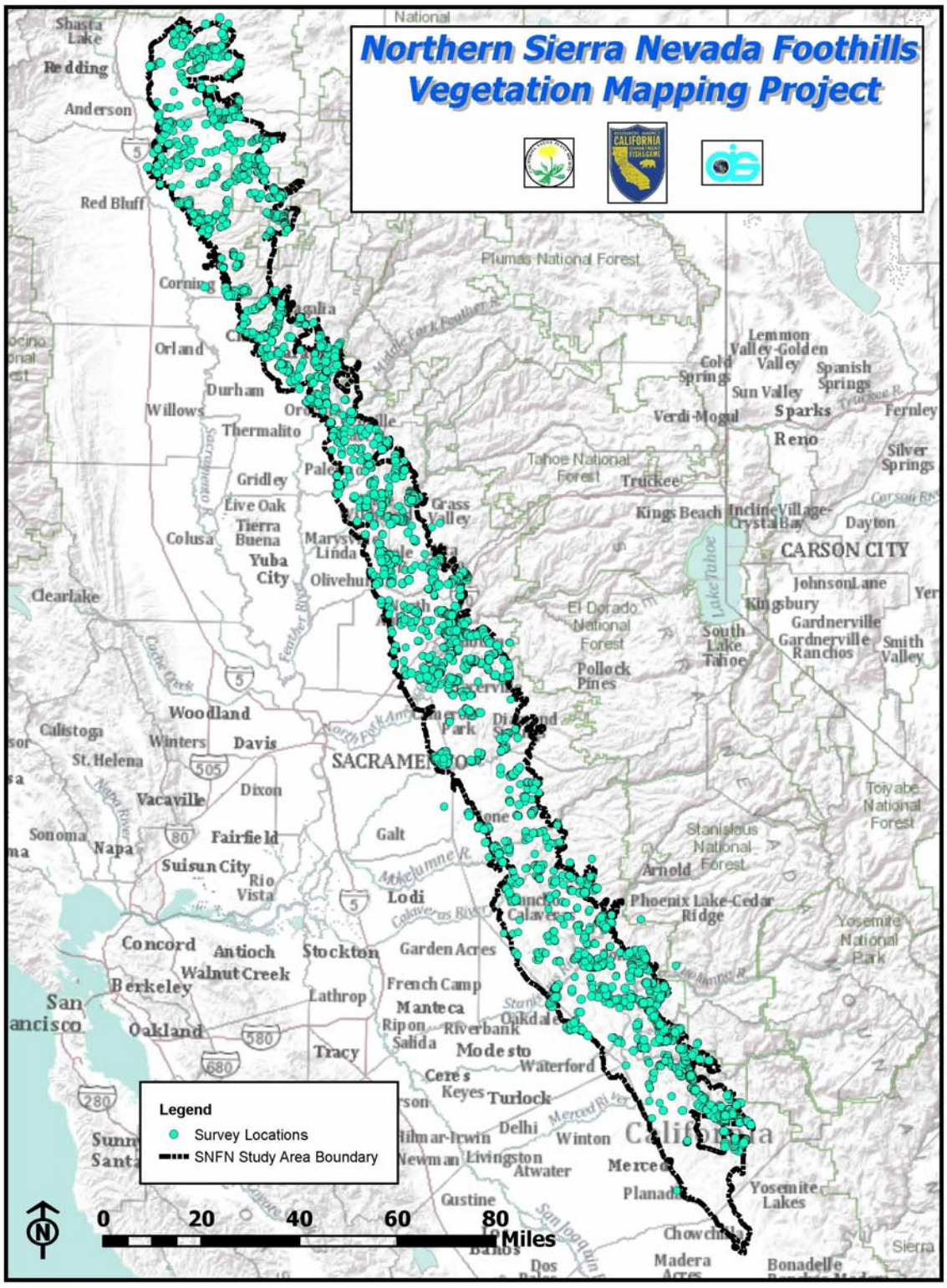

Figure 2. Location of Vegetation Rapid Assessment, Relevé, and Reconnaissance Surveys in the Study Area

An accuracy assessment analysis helps map users determine how much confidence can be assigned to each of the map units, and provides an understanding of the map's appropriateness for various applications. A fuzzy logic method was used to compare the vegetation label assigned to each polygon in the map (i.e., the photo-interpreted map unit attribute) with the label assigned through ground-truthing.

During the AA analysis process, a set of database codes were used to score polygons assessed (see table 1). Each field-verified polygon was ranked according to the set of decision rules in this scoring scale. Scores were summed for each vegetation type and then divided by the total possible score for each type, then multiplied by 100 for a percent accuracy. This calculation was done to determine the percent accuracy per type. Two forms of accuracy (users' and producers') can be estimated from the data (Story and Congalton 1986). Users' accuracy is conditional on the mapped classes and is defined as the probability that a location mapped as class i is in fact class I. This provides an estimate of how well spatial mapping data actually represents what is found on the ground; i.e., if the user goes to a location mapped as class i, what is the probability it is in fact vegetation class I? Producers' accuracy, on the other hand, is conditional on the true vegetation class in the field. The producers' accuracy for class J is the probability that a location of vegetation class J in the field is mapped as class j. Producers' accuracy may inform the producers of remotely sensed and mapped data how readily a mapping class may be detected by mapping whenever it occurs on the ground (Story and Congalton 1986, Lea and Curtis 2010).

The scores and percent accuracy were provided back to the AIS photo interpreters to reassess units and make any necessary changes. These efforts verify and increase the final accuracy of the map product beyond what is reported in the accuracy scores. The approach to AA in this project does not provide a single test of the photo-interpreters' ability to correctly interpret the vegetation. For the first and each of the successive three modules, an individual AA was completed and reported prior to undertaking the mapping of the next module. The final scores reported for all modules in the following tables are cumulative, without altering any of the original results. However, the modular approach allowed for an accumulation of knowledge, and afforded the AIS photo-interpretation team three separate sets of feedback on their ability to correctly code the vegetation polygons. Conceptually, several of the vegetation types were difficult to discern without regular feedback from the accuracy assessment and the ecologists. Scores generally improved from Module 1 through Module 4. The result is an overall higher-quality and more reliable product.

Table 1. Summary of Accuracy Assessment scoring rationale with key to coding choices in AA database

Code	Score	Reason For Score
A	5	Correct, perfectly meets key definitions for the vegetation type at the Alliance level (or other higher level map unit if not able to key at Alliance level)
B	4	Correct at secondary level in the classification (e.g., at Group or next level up in hierarchy)
C	4	Very close ecological similarity, and shares some diagnostic species, but not correct at the alliance level
D	3	Correct at a tertiary level in the classification (e.g., not correct at the Alliance and Group levels, but correct at the Macrogroup or next level up in hierarchy)
E	3	Has overlapping cover of significant and similar species
F	2	Correct at Division level, but not at lower levels in the hierarchy
G	2	Correct at life form and some floristic/ecological similarity OR somewhat different life form but shares some diagnostic species and somewhat ecologically related
H	1	Correct only at life form level, but not ecologically related (few/no diagnostic species shared)
I	0	No similarity above Formation, incorrect life form, and very low ecological similarity
J	n/a	Survey removed because of significant change in polygon
K	n/a	Survey removed because it represents ≤ 10 percent of polygon
L	n/a	Survey removed because field data is incomplete, inadequate or confusing

Results

The mapping effort resulted in approximately 150,000 polygons with an average polygon size of 17.45 acres. The mapping classification for the region includes vegetation alliances and higher level units (see Appendix B), including the Blue and Interior Live Oak *(Quercus douglasii* and *Quercus wislizeni)* Alliances and Chamise (*Adenostoma fasciculatum)* and Wedgeleaf Ceanothus (*Ceanothus cuneatus*) Chaparral Alliances. Uncommon vegetation alliances in the region include the riparian California Sycamore (*Platanus racemosa*), Fremont Cottonwood (*Populus fremontii*), White Alder (*Alnus rhombifolia*), and Valley Oak (*Quercus lobata*) Alliances. While the region contains many rare and wildflower-rich grassland types, the available imagery did not afford fine delineation for herbaceous alliances; thus, general categories for annual and perennial grasslands were assigned in the map. The most commonly mapped types are the Blue Oak Woodland Alliance, CA Annual and Perennial Grassland Macrogroup, and Interior Live Oak Forest Alliance (27.3%, 26.9% and 12.0 % of the area, respectively). See figure 3 for the resulting map displaying the vegetation at the Formation level.

Map Accuracy Assessment

From fall 2008 to fall 2010, around 60 different alliances and higher level map units were selected for field AA of the map. In all, 1,295 AA field surveys were collected to verify the map. Of these, 1,215 were included in the analysis, while 80 were removed because of incomplete information or significant change in the region/polygon per Table 1. Despite every attempt to sample adequate numbers of all mapped types, 20 different map units had a sample size of n<5, resulting in approximately 67% of all map types with reportable results. Figure 4 shows the location of the AA field surveys in the study area, and Table 2 provides a summary of the number of map units analyzed for obtaining accuracy results of the map. Both user's and producer's accuracy are displayed for those types having at least 5 polygons visited and analyzed per type. Also, see Table 3 for the contingency table for this project. The horizontal axis in this table provides columns showing how the photo interpreters (producers) mapped the polygons as compared to how the field surveyors (users) assessed their polygons on the ground. For example, the producers attributed *Umbellularia californica* to 2 polygons out of all of the polygons surveyed during AA. While the accuracy assessment results classified both those polygons as *U. californica*, the users also identified 4 other polygons as that map class.

For the assessed map units, the overall users' accuracy averaged 85.1% and producers' accuracy averaged 80.2%. The broad distribution of these AA surveys and resulting accuracy are indications of the final map's validity. Since the preferred accuracy for fine-scale vegetation mapping products is 80%, the map met or exceeded these expectations in most cases. Those vegetation map units that did not meet the 80% expectation were further reviewed by AIS and additional changes were made to improve the final map product.

Additionally, 100,000 acres were already mapped with around 275 AA field surveys collected for the Lassen Foothills area (Buck et al. 2009); thus, the map for this area was edge-matched with the surrounding northern foothills boundary to create one seamless map (see Figure 4).

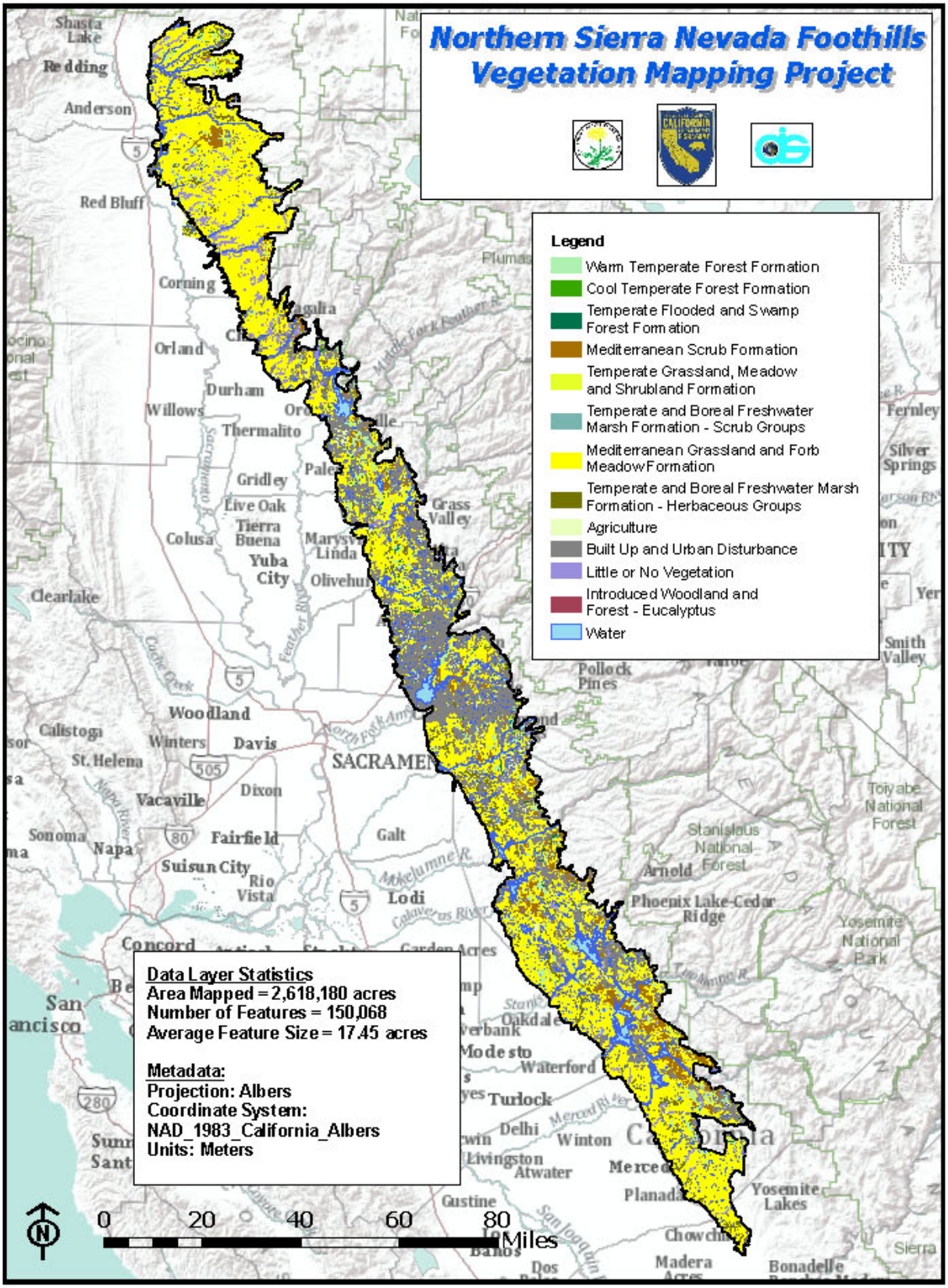

Figure 3. Resulting vegetation map of the NSNF region at the formation level.

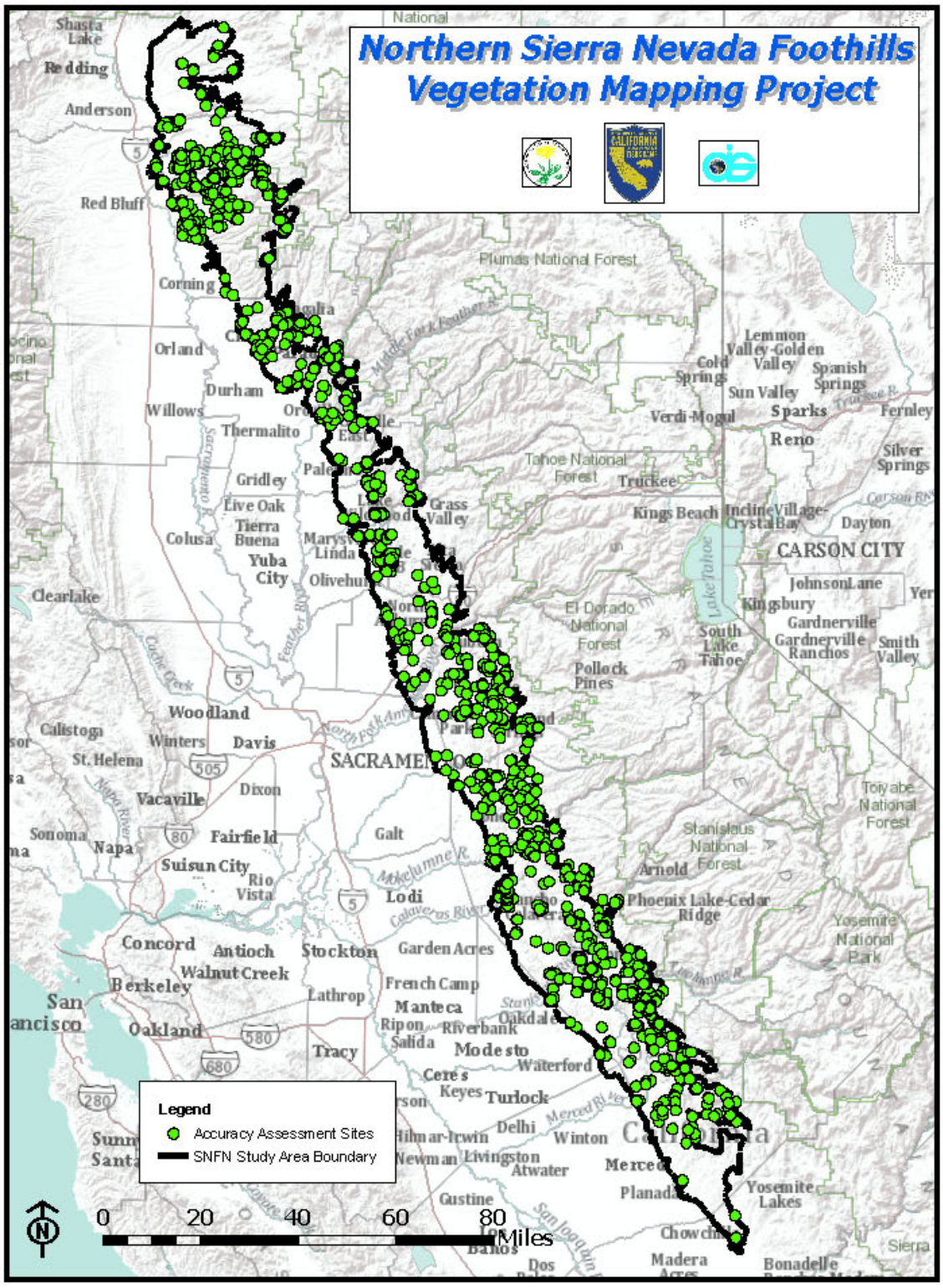

Figure 4. Distribution of the Accuracy Assessment field surveys in the study area.

Table 2. Summary of the percent accuracy assessment of the vegetation map units. Numbers in bold signify less than the 80% accuracy threshold. #Polygons mapped refers to the final map, after changes were made based on the accuracy assessment; an asterisk (*) means this type was not maintained in the final map.

Map Code	Map Unit Name (If Italicized, Alliance-level. Otherwise, Specified)	Users' Count	Users' Accuracy	Producers' Count	Producers' Accuracy	# Polygons Mapped
1110	*Umbellularia californica*	6	83.3	2	100.0	64
1111	*Quercus wislizeni*	149	84.8	79	96.2	21534
1210	*Pinus sabiniana*	42	91.0	49	89.0	1939
1310	*Aesculus californica*	15	86.7	24	85.8	691
1311	*Quercus douglasii*	81	90.9	69	96.8	42110
1312	*Quercus kelloggii*	54	**72.6**	42	88.1	6077
1313	*Quercus lobata*	72	86.4	60	91.3	2624
1410	*Quercus chrysolepis*	62	83.9	46	94.3	2252
2110	*Pseudotsuga menziesii*	24	85.8	20	93.0	149
2200	California Montane Conifer Forest	2	100.0	6	90.0	120
2210	*Pinus ponderosa*	15	92.0	15	78.7	*
2212	*Pinus ponderosa–Calocedrus decurrens*	2	100.0	9	**55.6**	37
3100	SW N.A. Riparian Broadleaf Woodland Group	1	60.0	20	75.0	*
3110	*Populus fremontii*	53	84.9	50	86.0	1185
3111	*Salix laevigata*	36	90.0	60	81.0	1659
3210	*Alnus rhombifolia*	33	**77.6**	27	83.0	569
3310	*Platanus racemosa*	10	86.0	9	80.0	84
4100	California Xeric Chaparral Group	1	100.0	11	58.2	*
4111	*Adenostoma fasciculatum*	63	89.8	43	98.6	2075
4112	*Arctostaphylos viscida*	27	84.4	41	82.4	4359
4113	*Ceanothus cuneatus*	36	79.4	35	84.0	5416
4114	*Eriodictyon californicum*	5	68.0	4	95.0	255
4115	*Arctostaphylos manzanita*	10	**76.0**	6	80.0	151
4200	California Mesic Chaparral Group	1	10.0	9	75.6	517
4210	*Quercus berberidifolia*	16	**62.5**	4	60.0	120
4211	*Cercocarpus montanus*	5	**60.0**	8	**55.0**	138
4212	*Heteromeles arbutifolia*	18	90.0	19	90.5	143
4410	*Quercus wislizeni* (shorter stature)	15	88.0	47	85.1	4879
4610	Broom (*Cytisus scoparius,* etc) Semi-natural Stands	1	20.0	7	**14.3**	32
6100	S. Vancouverian Montane Deciduous Scrub Group	0	n/a	10	**44.0**	*
6110	*Ceanothus integerrimus*	12	85.0	15	**68**	256
6111	*Quercus garryana* var. *breweri*	13	**75.4**	12	**71.7**	486
6200	SW N.A. Riparian/Wash Scrub	0	n/a	21	**55.2**	*
6211	*Salix exigua*	19	86.3	18	90.0	258
6213	*Rubus armeniacus*	28	85.0	31	85.8	752
6217	*Salix lasiolepis*	5	**76.0**	2	50.0	38
6301	*Toxicodendron diversilobum*	20	100.0	29	80.0	463
7100	CA Annual and Perennial Grassland Macrogroup	84	93.8	61	95.4	25197
7101	Medit. CA Naturalized Grassland Macrogroup	23	94.8	43	93.0	2292
7102	Naturalized Perennial Grassland Group	21	93.3	22	91.8	930
7200	Californian Warm Temperate Marsh/Seep Group	55	93.8	60	87.7	1872
7300	Arid West Freshwater Emergent Marsh Group	13	96.9	22	86.4	362
7400	Vernal Pool & Grassland Matrix Mapping Unit	22	90.0	22	94.5	915
7600	California Mixed Annual/Perennial Freshwater Vernal Pool/Swale Bottomland Group	7	100.0	11	**70.9**	99
9500	Introduced N.A. Medit. Woodland and Forest Group	6	90	6	86.7	37

Table 3. Contingency table comparing field-visited versus photo-interpreted map units for accuracy assessment of polygons. The columns along the horizontal axis show how the photo interpreters (producers) mapped the polygons and the rows along the vertical axis show how polygons were assessed by field surveyors (users) on the ground.

Mapper PI

Final Call	1100 - CA Evergreen Forests & Woodlands	1110 - Umbellularia californica	1111 - Quercus wislizeni	1210 - Pinus sabiniana	1212 - Juniperus californica	1213 - Callitropsis (Cupressus) macnabiana	1310 - Aesculus californica	1311 - Quercus douglasii	1312 - Quercus kelloggii	1313 - Quercus lobata	1410 - Quercus chrysolepis	2110 - Pseudotsuga menziesii	2111 - Acer macrophyllum	2200 - California Montane Conifer Forests	2210 - Pinus ponderosa	2212 - Pinus ponderosa, Calocedrus decurrens	2213 - Calocedrus decurrens	3100 - Southwestern North American Riparian Evergreen and Deciduous Woodlands	3110 - Populus fremontii	3111 - Salix laevigata	3112 - Salix gooddingii	3113 - Juglans hindsii	3115 - Salix lasiolepis	3210 - Alnus rhombifolia	3211 - Fraxinus latifolia	3310 - Platanus racemosa	4100 - California Xeric Chaparral	4111 - Adenostoma fasciculatum	4112 - Arctostaphylos viscida	4113 - Ceanothus cuneatus	4114 - Eriodictyon californicum	4115 - Arctostaphylos manzanita	4200 - California Mesic Chaparral	4210 - Quercus berberidifolia	4211 - Cercocarpus montanus	4212 - Heteromeles arbutifolia	4310 - Quercus durata	4410 - Quercus wislizeni shrub	4420 - Baccharis pilularis	4501 - Frangula californica (including F. c. ssp. tomentella)	4610 - Broom (Cytisus scoparius and others)	6100 - Southern Vancouverian Montane Deciduous Shrubs	6110 - Ceanothus integerrimus	6111 - Quercus garryana var. breweri	6200 - Madrean Warm-temperate Riparian Wash Scrub	6210 - Baccharis salicifolia	6211 - Salix exigua	6213 - Rubus armeniacus	6214 - Cephalanthus occidentalis	6301 - Toxicodendron diversilobum	6401 - Rosa californica	7100 - Californian Annual and Perennial Grassland Macrogroup	7101 - Mediterranean California Naturalized Annual & Perennial Grasslands & Meadow	7102 - Vancouverian & Rocky Mtn. Naturalized Perennial Grasslands (Passively irrigated pastures)	7200 - Californian Warm Temperate Marsh/Seep Group	7300 - Arid West Freshwater Emergent Marsh Group	7310 - Typha	7400 - Vernal Pool & Californian Annual and Perennial Grassland Matrix Mapping Unit	7600 - Californian Mixed Annual / Perennial Freshwater Vernal Pool / Swale Bottomland Group	9300 - Built up & Urban Disturbance	9310 - Urban Window	9500 - Introduced North American Mediterranean Woodland and Forest Group	9501 - Eucalyptus	9997 - Indeterminable	Not Used	Grand Total
1100 - California Evergreen Sclerophyll Forests & Woodlands									1	1																																																								2
1110 - Umbellularia californica		2							1		1																											1							1																					6
1111 - Quercus wislizeni			65	6			2	7	4	6	6							2	4	4				1			2		3	2					2	5		22	1						3			2		2																151
1210 - Pinus sabiniana			1	35																			1							2								1												2																42
1212 - Juniperus californica					2																																																													2
1213 - Callitropsis (Cupressus) macnabiana																																											1																							1
1310 - Aesculus californica							12																	1														1							1																					15
1311 - Quercus douglasii			4	2	1		5	58	1	3					1												1		1	2			2					1																												82
1312 - Quercus kelloggii			1	2				2	25	3	4	1			2	2													3									2			2	2	1		1					2																55
1313 - Quercus lobata			2				1	1	1	39								3	9	7	1			3		2																			2			2																		73
1410 - Quercus chrysolepis			4				2		8	5	35	1	1					1	1															1				1			1	1	1																							63
2110 - Pseudotsuga menziesii									1			18				5																																																		24
2111 - Acer macrophyllum																																																																	1	1
2200 - California Montane Conifer Forests														2																																																				2
2210 - Pinus ponderosa									1					4	10																																																			15
2212 - Pinus ponderosa, Calocedrus decurrens																2																																																		2
2213 - Calocedrus decurrens																						1																																												1
3100 - Southwestern North American Riparian Evergreen and Deciduous Woodlands																																																1																		1
3110 - Populus fremontii										2								5	26	10				3		2																			1		3															1				53
3111 - Salix laevigata																		1	4	26			1	1																							2									1										36
3112 - Salix gooddingii																			1	1																									1			1																		4
3113 - Juglans hindsii																			1					1																																										2
3115 - Salix lasiolepis																				3																									2			1																		6
3210 - Alnus rhombifolia										1	1							2	2	7				18		2																			1																					34
3211 - Fraxinus latifolia																				1				1																																										2
3310 - Platanus racemosa										1								5	1							3																																								10
4100 - California Xeric Chaparral																											1																																							1
4111 - Adenostoma fasciculatum				1			1																					40	12	2				1	3	2		1																												63
4112 - Arctostaphylos viscida															1												1	3	19	3								1					2							1																31
4113 - Ceanothus cuneatus				1																							5		1	19	1	1										3	1	1						1		2														36
4114 - Eriodictyon californicum																															3												1									1														5
4115 - Arctostaphylos manzanita				1																									2	2		3	1											1																						10
4200 - California Mesic Chaparral																																	1																																	1
4210 - Quercus berberidifolia			1	1			1																						1	1		1	3	1	2		1	2						1																						16
4211 - Cercocarpus montanus																											1		1				2											1																						5
4212 - Heteromeles arbutifolia																														2				1		12		2												1																18
4310 - Quercus durata																																																																	1	1
4410 - Quercus wislizeni shrub			1					1																														11			1		1																							15
4420 - Baccharis pilularis																																									1												1													2
4501 - Frangula californica (including F. c. ssp. tomentella)																														1																																				1
4610 - Broom (Cytisus scoparius and others)																																			1																															1
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6110 - Ceanothus integerrimus															1																							1				1	5	2																						10
6111 - Quercus garryana var. breweri																													1			1						2				3	2	6																						15
6200 - Madrean Warm-temperate Riparian Wash Scrub																																																																	1	1
6210 - Baccharis salicifolia																																													1																					1
6211 - Salix exigua																		1	1	1																									2		13									1										19
6213 - Rubus armeniacus																																													2			23							3	2										30
6214 - Cephalanthus occidentalis																																													2																					2
6301 - Toxicodendron diversilobum																																																		21																21
6401 - Rosa californica																																									1																									1
7100 - Californian Annual and Perennial Grassland Macrogroup																																					1															56	19	1	2			5	3							87
7101 - Mediterranean California Naturalized Annual & Perennial Grasslands & Meadow																																																				3	19		1											23
7102 - Irrigated Pasture (Naturalized non-native perennial grassland & Meadow Macrogroup)																																																					1													1
7102 - Vancouverian & Rocky Mtn. Naturalized Perennial Grasslands (Passively irrigated pastures)																																																					2	18	1											21
7200 - Californian Warm Temperate Marsh/Seep Group																																													1									3	48	3										55
7300 - Arid West Freshwater Emergent Marsh Group																																																							2	11										13
7310 - Typha																																																					1		1	6										8
7400 - Vernal Pool & Californian Annual and Perennial Grassland Matrix Mapping Unit																																																					1		1			18	1							21
7600 - Californian Mixed Annual / Perennial Freshwater Vernal Pool / Swale Bottomland Group																																																					1		2				7							10
9300 - Built up & Urban Disturbance																																									1																									1
9310 - Urban Window									1																																																									1
9500 - Introduced North American Mediterranean Woodland and Forest Group																				1																																										5				6
9501 - Eucalyptus																																																1															2			3
9997 - Indeterminable			1						2					1	2		1	1	1					3		1						2						2					2	1						1			2	1	1											25
Not Used	1					1																			1															1						1			1		1						1			1	1			1		11
Grand Total	1	2	83	49	3	1	24	69	48	62	48	20	1	7	17	9	1	21	52	62	1	1	2	33	1	10	11	44	46	38	4	8	9	4	9	20	2	53	1	1	7	10	20	13	21	1	18	32	1	31	1	69	47	24	63	24	1	23	11	1	1	6	2	1	4	1310

Discussion of the Ponderosa Pine in the NSNF map

Pacific Ponderosa pine (*Pinus ponderosa* ssp*. pacifica, sensu novum* as per Dr. Robert Haller, personal communication, March 2011), henceforth referred to as simply Ponderosa pine, is arguably the most obvious conifer and the principal marketable timber tree in the Sierra Nevada, although the vast majority of individuals and best developed stands of this species currently exist at elevations higher than those in the foothills region. Recently, Ponderosa pine has also figured prominently in the discussion of regional climatic changes (Thorne et al 2007, Crimmins et al. 2010), based on distributional shifts recorded in the past 75 years and based primarily on vegetation mapping and sampling conducted with the VTM survey (Wieslander 1935). With further development of the quantitative State vegetation classification system in the past decade, the role of Ponderosa pine as a pivotal diagnostic species has also changed (see page 192 Sawyer et al. 2009). In the interpretation of the classification and vegetation data from the Northern Sierra Foothills region from Yosemite, Sequoia-Kings Canyon National Parks, and from other forest areas in the Sierra, we have decided that the lower elevation expression of Ponderosa pine is generally better considered within the concept of the black oak (*Quercus kelloggii*) alliance, yet still recognized as associations between *Q. kelloggii* and *P. ponderosa*. In short, stands with any *significant* black oak in the tree layer are being considered members of the black oak alliance, even if they contain equal or higher mixtures of Ponderosa pine. Photo-interpreters for this project were advised to map to the *Q. kelloggii* Alliance when black oak was observed at any cover in the tree canopy, as long as it was regularly distributed in the stand. If they saw largely pure stands of *P. ponderosa*, they would either code to the Ponderosa pine – Incense-cedar alliance, if at high elevation or cool/mesic sites, or to California Montane Conifer Forest Group (including Managed Conifer Stands) if the Ponderosa pines appeared to be planted.

Because Ponderosa pine is such an important timber tree, it has been selectively managed through, for example, plantings of pines and thinning or elimination of black oak, to emphasize and encourage the pines. In analysis of recently collected data from many non-managed stands in the foothills, the pines tended to be much less predictable and less persistent than black oak in stands sharing the same ecological conditions. This becomes intuitively obvious when you consider the following. Ponderosa pine, although very widespread in the foothills and in similar elevations and conditions throughout the Coast, Transverse and Peninsular ranges, rarely forms zonal or large regional aggregations of stands. Vegetation of the lower elevations tends to interface with chaparral or oak woodlands with shrubby or short-tree understories. This is a very different condition than the higher elevation slopes of the Sierra, where Ponderosa pine tends to co-occur with other conifers such as incense-cedar over open understories and with much less continuous shrub or herbaceous cover. This zone experiences summer lightning and regular low intensity surface fires that tend to (at least, prior to fire-suppression) maintain dominance of older fire-scarred individuals of Ponderosa pine with periodic regeneration, usually of individuals, not large cohorts of pines.

In contrast, what tends to happen at lower elevations in the foothills today (although perhaps not when Native Americans were burning frequently hundreds of years ago) is that Ponderosa pine colonizes on more locally mesic conditions such as north facing slopes, or river and stream terraces. However, the colonization is less apt to develop into mature stands of pines for many reasons. These include the typical situation of relatively frequent but much more intense fires that are driven by the higher fuel loads of shrubs such as manzanita, chamise, shrubby oaks, and other woody species. Many of these species are very well adapted to fire, and they either recruit from a soil seed bank (e.g., manzanitas, ceanothus) or can vigorously resprout (e.g., black oak and other oaks). Ponderosa pine typically resists impact from fire only after its bark

thickens upon attaining ages of >50 years, so if high intensity fire occurs more frequently, the pines are typically killed. Thus, most Ponderosa pines in the lower elevation tend to be young (sometimes dense stands) with higher fire intensity vegetation, or the pines are more isolated individuals in fire protected areas, such as river terraces and rocky slopes.

The two associations defined for Ponderosa pine alliance in the Sierra Foothills (Klein et al. 2007) are considered provisional (<10 samples each) and are either defined by an overstory of Ponderosa pine with other hardwoods at much lower cover (e.g., *Pinus ponderosa* provisional stream terrace association, n=5) or an open overstory of usually immature Ponderosa pine over chaparral shrubs (*Pinus ponderosa* / *Arctostaphylos viscida* provisional association, n=5). However, more samples were collected of these types in the AA survey data.

Both of these conditions are relatively uncommon (hence the low sample size) and rely on their assignment to the Ponderosa pine alliance primarily through rules of strong dominance (>80% dominance of the pine compared to other trees). It remains to be seen when more samples of these types are collected and analyzed with other similar data, if these stands should remain within a rarified Ponderosa pine alliance in the region, or if they are placed in other alliances such as the *Arctostaphylos viscida* shrubland alliance, or a riparian alliance such as *Alnus rhombifolia*.

Another prominent foothill conifer, ghost pine (*Pinus sabiniana*) is somewhat parallel to Ponderosa pine in its behavior and its indicator value as a vegetation alliance. However, it is even more fire sensitive and tends to persist only in oak woodlands, or occasionally in rocky sites and ridges as pure stands with grassy understories because fuel loading is much lighter in such places. It is a more xerophytic species than Ponderosa pine so it has the ability to exist at lower elevations, and drier and hotter settings, where herbaceous or relatively low fuel producing understories persist.

Black oak occurs in the majority of stands with Ponderosa pine at these elevations, and of course it also exists in many stands without Ponderosa pine. Because quantitative vegetation classification is based on the identification of the best diagnostic or indicator species to differentiate vegetation types, we have assigned such foothill stands with black oak and Ponderosa pine to the black oak alliance. However, at the association level, Ponderosa pine may be an important differential species. Thus we have identified a Ponderosa pine–black oak/*Arctostaphylos viscida* association within the Black oak alliance, or a Ponderosa pine–black oak/*Ceanothus integerrimus* association in the same alliance, to describe settings that have Ponderosa pine in the overstory, but also contain Black oak and different shrubs defining different fire conditions.

Not defining a Ponderosa pine alliance in the NSNF vegetation map may appear at odds with the prevailing forestry practices, and also could be considered “demoting” for such a visually prominent species. This may be all the more surprising, even if scientifically warranted, since many other classification systems (CalVeg, WHR, SAF) identify a Ponderosa pine type at these lower foothill elevations in the Sierra Nevada. In order to provide a translation between this NSNF map and other mapping systems, we have implemented a polygon-by-polygon based cross-walking of map units when the visually obvious ponderosa pine has relatively high cover. This has been accomplished in the following way:

1) Use the Ponderosa pine modifier that was attributed in this product to identify if Ponderosa pine exists in a given mapping polygon.

2) Use the hardwood cover and conifer cover attribute to identify when a significant amount of conifer is present in the overstory.
3) Determine by slope position and vegetation type whether the predominant conifer element is more likely to be Ponderosa pine or some other conifer such as Foothill pine.
4) Cross-walk the polygons with dominant or co-dominant Ponderosa pine to the appropriate WHR and CalVeg types (e.g., >50% relative cover for translating to conifer type, and >25 and <50% relative cover of conifers for the mixed hardwood-conifer type for WHR).

Proper translation to WHR type requires an understanding of what hardwoods are present (e.g., black oak, canyon live oak) and in what amounts versus the conifers. Since the attributes for each polygon already include the hardwood alliance type and the percent cover of hardwood versus conifer as separate attributes, an accurate translation can be made to montane hardwood-conifer WHR type, versus the Ponderosa pine WHR type. Similarly, CALVEG ponderosa pine type versus black oak type can be reliably translated from our map attributes based on the proportion of hardwoods of various species, to Ponderosa pines in the overstory.

A similar translation has been made for other conifer-based classification types, such as blue oak alliance as defined in this map per the NVC versus and the Blue Oak and Blue Oak–Foothill Pine WHR habitat types.

Discussion of Other Accuracy Assessment Scores

Most of the map units that came in at users or producers accuracy below 80% were those types that were not sampled sufficiently for valid sample sizes based on the statistical assumptions of the allocation (see Tables 4 and 5). There are many reasons to regard those map units of *low* sample size with less credibility. Particularly insignificant are those types with fewer than 10 samples. Here we address the low scores of both producers and users accuracy with adequate or near adequate sample sizes, and evaluate the reasons and actions that have been taken to improve the scores.

Table 4: Accuracy Assessment summary table for total number of map units with high, moderate and low sample sizes.

Category	n ≥ 20	% passing AA for n ≥ 20	n ≥ 10 and < 20	% passing AA for ≥ 10 and < 20	n ≥ 1, < 10	% passing AA for >1. <10	Total by category
Users' Accuracy data	**20**	85	**11**	73	**13**	**48**	**44**
Producers' Accuracy data	**25**	92	**8**	38	**15**	**46**	**48**
All sampled types of any kind	**45**	89	**19**	56	**28**	**47**	**58**

Table 5. Summary of fuzzy logic scores for Users' and Producers' Accuracy for those map units at <80% accuracy threshold (with their scores in red).

Map Code	Map Unit Name (If *Italicized*, Alliance-level. Otherwise, Specified)	Users Count	Users' Accuracy	<20 Samples for Users	Producers Count	Producers' Accuracy	<20 Samples for Producers
1213	*Callitropsis (Cupressus) macnabiana*	1	40.0	x	0	n/a	x
1312	*Quercus kelloggii*	54	73.8		42	88.1	
2212	*Pinus ponderosa–Calocedrus decurrens*	2	100.0	x	9	55.6	x
3100	SW N.A. Riparian Broadleaf Woodland Group	1	60.0	x	21	75.0	
3112	*Salix gooddingii*	4	70.0	x	1	80.0	x
3113	*Juglans hindsii*	2	70.0	x	0	n/a	x
3210	*Alnus rhombifolia*	33	77.6		27	83.0	
4100	California Xeric Chaparral Group	1	100.0	x	11	58.2	
4113	*Ceanothus cuneatus*	36	79.4		38	84.0	
4114	*Eriodictyon californicum*	5	68.0	x	4	95.0	x
4115	*Arctostaphylos manzanita*	10	76.0	x	80	80.0	
4200	California Mesic Chaparral Group	1	100.0	x	9	75.6	x
4210	*Quercus berberidifolia*	16	62.5		4	60.0	x
4211	*Cercocarpus montanus*	5	60.0	x	9	55.0	x
4420	*Baccharis pilularis*	2	20.0	x	1	20.0	x
4501	*Frangula californica*	1	20.0	x	0	n/a	x
4610	Broom (*Cytisus scoparius* and others)	1	20.0	x	7	14.3	x
6100	S. Vancouverian Montane Deciduous Shrub Group	0	n/a	x	10	44.0	
6110	*Ceanothus integerrimus*	12	85.0	x	16	68	x
6111	*Quercus garryana* var. *breweri*	13	75.4		12	71.7	
6200	SW N.A. Riparian/Wash Scrub Group	0	n/a	x	21	55.2	
6217	*Salix lasiolepis*	5	76.0	x	2	50.0	x
6401	*Rosa californica*	1	60.0	x	0	n/a	
7600	Californian Mixed Annual/Perennial Freshwater Vernal Pool / Swale Bottomland Group	8	92.5	x	11	72.7	x

Problems with Users' Accuracy:

Of the adequately sampled vegetation map units, 23 of 25 producers' and 17 of 20 users' accuracy results met or exceeded the expected 80% accuracy standard (see tables 2 and 4). Only 3 (*Alnus rhombifolia, Quercus kelloggii,* and *Ceanothus cuneatus* alliances) came in below 80% for users' accuracy. With users' scores of from 72.6 to 79.7% accuracy, they were close to the 80% threshold expected, and their scores were above 80% for producers' accuracy.

For *Alnus rhombifolia*, the users' accuracy was 77.6% (close to the 80% threshold), so we are willing to accept this score without modification to the map. Also, a common problem with riparian mapping is the fine scale spatial heterogeneity, and every mistake for *A. rhombifolia* was another riparian woody vegetation type. Stands are typically small, relating to the fine scale flooding, deposition, and erosion patterns of fluvial processes. In addition, the principal problem with riparian mapping using NAIP 2005 imagery is that the spatial resolution isn't quite accurate enough to depict the typically narrow riparian stands in the NSNF region. Thus, generalization (or lumping of types) is a common mapping strategy, and sometimes it works, though other times, not. For example, if the photo interpreters generalized a group of stands that included both tree and shrub riparian types, depending upon what the field crews were able to assess, the producers might have been scored as correct if the field call was a shrub type or as incorrect if a tree type.

For *Quercus kelloggii*, at 73.8% users' accuracy, the issues appeared to be two-fold. In several cases, recent fires likely confounded the producers' ability to determine the difference between what was in the 2005 aerial image versus what was seen 3-5 years later by the field crews in 2008 to 2010 when AA sampling was conducted. Another issue involved subtle rules in classification of vegetation, such as *Pinus ponderosa* is allowed to be co-dominant and prominent in *Q. kelloggii* stands, and often appears more prominent than the shorter oak. This photo-interpretation issue was refined in the progressive modular approach taken in this project, so that the first module had several mistakes based on the assumption of dominant overstory of *P. ponderosa* translating to the *Pinus ponderosa* alliance, when in fact, it was often *Quercus kelloggii* alliance (see more discussion of *P. ponderosa* interpretation in a previous section). A final problem is that both *Q. chrysolepis* and *Q. kelloggii* can appear very similar on the NAIP 2005 imagery, and these species occur in similar settings and can be mistaken for each other. Although the user's accuracy was slightly less than 75%, the DFG VegCAMP staff believes the map is generally more useful as is, rather than deciding to modify all calls to a more generalized mapping unit, such as the Group - Californian broadleaf forest and woodland.

For *Ceanothus cuneatus*, the users' accuracy was 79.4% (close to the 80% threshold), and this score was accepted without modification to the map. The main problem appeared to be mistaking one shrub type for another. Common errors included the producers using different mid-level hierarchy categories – i.e., Southern Vancouverian Montane Deciduous Shrub Group, California Xeric Chaparral Group, or California Mixed Perennial and Annual Grassland and Meadow Macrogroup. The latter problem appeared to be the result of the imagery not being sharp enough to see sparse *C. cuneatus* shrublands within a context of a rocky herbaceous background.

For the three types with moderate sample sizes, the *Arctostaphylos manzanita* alliance was a type identified by the photo-interpreters, but never sampled in the prior fieldwork/classification effort. Since this type had close to 80% users' accuracy with only AA survey data and no prior field information, we have accepted this type without modification. For *Quercus berberidifolia* and *Quercus garryana* var. *breweri,* both alliances did not have acceptable users' and

producers' scores. Neither did the associated alliances (*Cercocarpus montanus* and *Ceanothus integerrimus*) within their respective higher-level Groups (California Mesic Chaparral Group and Southern Vancouverian Montane Deciduous Shrub Group). The four alliances within these two groups were difficult for photo-interpreters to discern on the imagery, and some of the AA samples for these types showed mixing (not strict dominance) of the indicator species for each of these alliance (e.g., some AA samples included mixed stands of both *Q. garryana* var. *breweri* and *C. integerrimus*, and some AA samples of *Quercus berberidifolia* included mixed stands of this species and *C. montanus*). A commonality between all these shrub alliances is the strong effect of seral stage development, including recent fire and other disturbance.

The types with *C. integerrimus* and *Q. garryana* var. *breweri* are winter deciduous shrublands, which are typically replaced by *Quercus kelloggii, Q. chrysolepis,* or other tree alliances with longer fire intervals. They tend to occur in mesic settings and often occupy a fine scale matrix with other related scrubland stands that have been affected by recent fire, thinning, or other disturbance. When these shrublands were misinterpreted, they were often mistaken for other shrublands, suggesting that the 2005 NAIP imagery was inadequate to determine the salient environmental or signature differences between the two. Since *C. integerrimus* and *Q. garryana* var. *breweri* alliances are members of the same Vancouverian Montane Deciduous Shrubland Group, displaying the polygons labeled with these alliances at the group level would increase their accuracy. Table 6 illustrates this relationship by displaying the users' calls for *Ceanothus integerrimus* compared to what they were called in the map.

If we applied the group level Southern Vancouverian Montane Deciduous Scrub, the users' score would improve from 85% to 91%. However, if we applied the group level distinction to the producers' accuracy, we would have done only slightly better (69 versus 68%). This brings up an important point about improving accuracy. Although aggregating producers' accuracy may improve an already acceptable score for producers' accuracy, it would not significantly change the users' accuracy. The real issue is the mixed and seral nature of the scrub alliances and their relatively poor discern-ability and predictability in the study area.

One expected value of the hierarchy in such situations is that, assuming similarities between alliances of the same group, common errors might be reduced if the map unit was aggregated into a larger hierarchical unit. For example, if *Q. garryana* var. *breweri* and *C. integerrimus* were regularly misinterpreted (one for another), then aggregation of these into the Group Southern Vancouverian Montane Deciduous Scrub would be helpful. However, this was not always the case. Thus, we have retained these two types in the map, even though some *C. integerrimus* polygons truly represent a co-dominance of *C. integerrimus* and *Q. g.* var. *breweri* and we have recognized a *Ceanothus integerrimus–Quercus garryana* var. *breweri* association in the region.

The problem with *Ceanothus integerrimus* alliance was the producers' accuracy. What was thought to be this alliance by the producers turned out to be other types about a third of the time. The hierarchy, as currently understood, does not appear to be useful as an aggregation tool for improving the scores of this type. The NSNF region is in a zone of overlap between montane and lower elevation scrub and woodland vegetation, which contributes to a "messy" matrix of juxtaposed foothill and lower montane vegetation made all the more confusing by many recent fires and other disturbances. In addition, imagery was not quite good enough resolved to discern signature difference between the diagnostic species.

Reviewing the problems with the low users' accuracy score for the *Quercus berberidifolia* alliance, the photo interpreters confused this type with a variety of other shrubland types. Of the 16 samples, no scores were greater than 2, except for those that were mapped more generally

as the California Mesic Chaparral Group (n=3), of which the scrub oak alliance is a member. This alliance appears to be difficult to map in the study area and could be aggregated with others, including the *Cercocarpus montanus* alliance, into the California Mesic Chaparral Group (where 9 of 16 polygons would have been correct at the group level).

A point noted throughout the sampling and accuracy assessment phases of this project was the unpredictable occurrences of *Quercus berberidifolia* (scrub oak) alliance stands, and that both this alliance and the *Cercocarpus montanus* alliance polygons have a mix of other mesic species, including *Fraxinus dipetala* and *Heteromeles arbutifolia*. Although somewhat common in the northern module 1, scrub oak stands were very rare in modules 2 and 3, and only occasionally present in module 4, usually associated with serpentine or other nutrient poor substrates. Unlike stands that regularly occur in the central and south Coast Ranges and in the mountains of south coastal California, *Q. berberidifolia* in the NSNF is sporadic in occurrence. This, in addition to its similar habitat and photo signature to scrubby interior live oak and some other mesic chaparral (or other scrub such as *Q. garryana* var. *breweri*), makes it difficult to map in this area.

If *Q. berberidifolia* and *Cercocarpus montanus* alliances were aggregated, the producer score would go from 55% to 68% accuracy for C. *montanus* and from 60 to 70% for Q. *berberidifolia*. And the user score would go from 62 to 68% for QUBE. Thus, the map would be more accurate at the group level with aggregation, and this shows some value of the NCV hierarchy.

The scrub oak alliance had a large disparity between the number of samples from the producers' (n=4) versus the users' (n=16) sample sizes (see second half of table 7), reflecting the largely unpredictable and ambiguous signature of this vegetation. In other words, the AA field crews encountered 4 times as many scrub oak stands as they were assigned during their general survey of polygons of all types assigned for assessment. Thus, we have decided to aggregate polygons to the Group level.

Table 6. AA analysis display for Southern Vancouverian Scrub Group with producers' and users' calls

Polynum	VegCode_PI	Map Unit_PI	Final Keyed Type	Final Alliance Name	Reviewers Notes	Call Justification	Score
1B07928	6110	Ceanothus integerrimus	6110	Ceanothus integerrimus	6110B. Polygon has many types within and little compositional integrity. Includes CECU, QUGA, QUKE with sections of CEIN	60 poly; cecu 15, qugab 10, cein 8; Based on the field assessment we looked at the stand table for the CEIN3-QUGAB association, this is what it is, and the key is a little difficult here	5
1B08308	6110	C. integerrimus	6111	Quercus garryana var. breweri	6110B	70 poly; qugab 35, cein 20, erca 6, cercis 7, cemo 6, cecu 5; cein <30% rel cover	4
1B08350	6110	C. integerrimus	6110	C. integerrimus		50 poly; cein 50	5
1B11833	6110	C. integerrimus	4410	Quercus wislizeni	1111 shrubby version	entire poly; quwi 20 shrub, cecu 10, erca 10, gafl 13, cein 3. Correct at life form (except QUWI is tree?). Revisit: shared species? CEIN present.	1
1B11967	6110	C. integerrimus	6110	C. integerrimus	secondary code is 1312D	60 poly; 23 cein, 12 quke (under 5 meters tall), 3 pipo,	5
1C05394	6110	C. integerrimus	4112	Arctostaphylos viscida	2210A. Pine seedlings.	entire poly; pipo 38, quke 5, cepr 35, arvi 13. PIPO seedlings don't count towards tree type.	2
1C05397	6110	C. integerrimus	4114	Eriodictyon californicum	unable to see poly - 5 hectares estimated size; '4114A	qugab 9, erca 18, cecu 7, qube 2	2
1C05397	6110	C. integerrimus	1213	Cupressus macnabiana	1213A; this is one of two GPS pts showing the extent of the Cupressus stand	20 poly; Cuma 35%, 10 erca, 4 qugab, 2 qube, 3 cecu, 0 cein, arvi 10. CUMA shrubby in this plot.	2
1C05399 B	6110	C. integerrimus	4113	C. cuneatus	4113B. Different due to CECU and little CUMA.	70 poly; cecu 18, erca 7, cemo 5.	1
2A18110	6110	C. integerrimus	6110	C. integerrimus			5
2A18112	6110	C. integerrimus	1410	Quercus chrysolepis			3
2A18132	6110	C. integerrimus	6110	C. integerrimus		Upon review, changed final call from 2110 (s. portion of poly has higher tree cover), perhaps this should be removed	5
2A18159	6110	C. integerrimus	6110	C. integerrimus			5
2A18160	6110	C. integerrimus	1312	Quercus kelloggii		QUKE is shrubby resprouts w/ 27% cover. CEIN is shrubby w/ 20%.	3
1B05501	6111	Quercus garryana var. breweri	4211	Cercocarpus montanus		80 poly; qudo 6, cecu 37, cemo 17%, qugab 0%	1
1B06620	6111	Quercus garryana var. breweri	6111	Quercus garryana var. breweri		30 poly; 20 qugab, 8 cemo	5
1B06794	6111	Quercus garryana var. breweri	4115	Arctostaphylos manzanita	In AA survey, CUMA is more consistent than ARMA and CECU (less steep slopes) but only portion of poly has CUMA, so ARMA is best call	50% poly covered; 0% qugab, 4% Cuma, 4% frca, 20% gafr, 25% arma. Since ARMA co-dominates the shrub canopy, closest in key is Arctostaphylos manzanita Alliance	1
1B08245	6111	Quercus garryana var. breweri	6111	Quercus garryana var. breweri	6111A	40 poly; qugab 19, cein 8, cemo 16, erca 7	5
1B08252	6111	Quercus garryana var. breweri	6111	Quercus garryana var. breweri		60 poly; cein 12, qugab 20, quke 12 (in clumps), cecu 15	5
1B08266	6111	Quercus garryana var. breweri	6110	Ceanothus integerrimus	6110B, 4410A	60 poly; qugab 11, cein 12, quwi 10, quke 5; quwi is in the shrub layer. Correct at group level.	4
1B08270	6111	Quercus garryana var. breweri	6110	Ceanothus integerrimus	Should be 6111A and 6110B	6110B;poly 70; qugab 40, cein 24, cecu 15	4
1C05426	6111	Quercus garryana var. breweri	4210	Quercus berberidifolia	Primary = 4210A	50% assessed; qube 31%, umca 10%, quga 8, cele 7 (under tree), gafr 9%, quga 8%	2
1C05427	6111	Quercus garryana var. breweri	6111	Quercus garryana var. breweri	6111A	20% poly assessed; qugab 26%, cein 10%, cecu 8%	5
1C05433	6111	Quercus garryana var. breweri	6111	Quercus garryana var. breweri		50% poly viewed; qugab 20%, gafr 20%, arvi 10%, cein 1%, cele 5%, umca 6% - shrubby	5
1b07168	6111	Quercus garryana var. breweri	4113	Ceanothus cuneatus	1311h pre-death, now 4113	35 poly; quke 7, cecu 24, qudo 1; mix of shrubs and young quke. Cecu is dom. is in the 2.1 acres assessed. Diff formations; same lifeform =1. Revisit?	1
1B08056	6111	Quercus garryana var. breweri	6111	Quercus garryana var. breweri	Secondary should be 4113C	60 poly; cecu 24, qugab 14, erca 7; according to key and stand tables qugab allows for high cecu cover	5

Table 7. AA analysis display for Mesic Chaparral Group with producers' and users' calls

Polynum	VegCode_PI	Map Unit_PI	Final Keyed Type	Final Alliance Name	Reviewers Notes	Call Justification	Score
414907	4210	Cercocarpus montanus	4209	Quercus berberidifolia		No CEMO, QUBE 9%, ADFA 6%, HEAR 5%	4
414926	4211	Cercocarpus montanus	4210	Quercus berberidifolia		QUBE 12%, FRDI 4%, HEAR 13%, CECU 7%	4
414946	4211	Cercocarpus montanus	4111	Adenostoma fasciculatum		ADFA 11%, HEAR 8%, FRDI 3%, UMCA 4%	4
414932	4211	Cercocarpus montanus	4111	Adenostoma fasciculatum		ADFA 16%, HEAR 2%, FRDI 2%, CEMO 2%	4
414944	4211	Cercocarpus montanus	4111	Adenostoma fasciculatum	does seem very "green" for dominant adfa, looks like more HEAR and other mesic shrubs (FRDI, etc) but leaf-off at time of AA	Macrogroup correct; close to mesic chaparral group ADFA 25%, HEAR 6%, FRDI 2%	3
414928	4211	Cercocarpus montanus	1111	Quercus wislizeni	not steep enough for CEMO, more like quwi with aeca, light yellow summer aeca seen in 2005 and 2009 imagery	No CEMO; QUWI 14%, ADFA 7%, HEAR 6%, QUBE 1%	2
414945	4211	Cercocarpus montanus	1111	Quercus wislizeni		A lot of xeric shrubs	0
2a17110	4211	Cercocarpus montanus	4610	Broom		CEMO 5%, CECU 3%, CYSC 30%, ALRH 2%	1
414888	4210	Quercus berberidifolia	4212	Heteromeles arbutifolia		HEAR 13%, QUBE 2%	4
414887	4210	Quercus berberidifolia	4111	Adenostoma fasciculatum		ADFA 8%, HEAR 5%, CECU 3%	3
1c04261	4210	Quercus berberidifolia	1410	Quercus chrysolepis		entire poly; quch 10, umca 8, aeca 4, quercus scrub 8	0
1C04260	4210	Quercus berberidifolia	4210	Quercus berberidifolia	4210a = QUBE-CECU 4112a = ARVI-QUWI	20% poly viewed; qube 30%, arma 15%, arvi 10%, qugab 15%	5
414907	4211	Cercocarpus montanus	4210	Quercus berberidifolia		No cemo, qube 9%, adfa 6%, hear 5%	4
414926	4211	Cercocarpus montanus	4210	Quercus berberidifolia		qube 12%, frdi 4%, hear 13%, cecu 7%	4
1B04064	1111	Quercus wislizen	4210	Quercus berberidifolia		80 poly assessed; qube 20, quke 7; qube is a big shrub in the photos, and highest cover far greater than trees, so should be a qube alliance stand based on field AA.	3
1B05077	4200	California Mesic Chaparral	4210	Quercus berberidifolia	4210A	60 poly; 5 qube, 7 cecu, 4 cemo. Correct at group level	4
1B05172	4200	California Mesic Chaparral	4210	Quercus berberidifolia	4210A	before only assessed 1B05172; this is other 80% of poly	4
1B05176	4310	Quercus durata	4210	Quercus berberidifolia	1210D	entire poly; 10 pisa, 9 cecu, 5 qube, 0 qudu; not qudu, looks open and shrubby in some views; tree cover not uniform	3
1B05581	4113	Ceanothus cuneatus	4210	Quercus berberidifolia	4210A	80 poly; 14 qube, 6 cecu, 5 cemo, 2 erca. Correct at macrogroup.	3
1B07869	1111	Quercus wislizen (shrub)	4210	Quercus berberidifolia	SHOULD BE 4210A	70 poly; qube 36, cecu 15, cein 6, umca 7, quwi 0.	1
1B11717	1310	Aesculus californica	4210	Quercus berberidifolia		entire poly; aeca 17, qube 14, cecu 9, quwi 2, quke 4; close, but qube can be co dom with aeca and be a qube type, not visa-versa	3

Polynum	VegCode_PI	Map Unit_PI	Final Keyed Type	Final Alliance Name	Reviewers Notes	Call Justification	Score
1B11734	4200	California Mesic Chaparral	4210	Quercus berberidifolia		entire poly; 7 cein, 7 qube, 3 cebe, 4 erca, 5 pisa, 3 quke	4
1C00465	1210	Pinus sabiniana	4210	Quercus berberidifolia		entire poly; pisa 10%, qube 10%, hear 15%, gafr 10%, arma 10%, shrub cover 38%; this is qube type based on high shrub cover and marginally sufficient tree (PISA) cover	3
1C03250	4112	Arctostaphylos viscida	4210	Quercus berberidifolia	4210a = QUBE - CECU	50% poly; arma 6%, cecu 8%, qube 9%. Correct at macrogroup	3
1C04070	4115	Arctostaphylos manzanita	4210	Quercus berberidifolia	4210a = QUBE - CECU 4410a = QUWI shrub	15% poly; pipo 3%, quwi 25%, cecu 20%, qube 25%, arma 5%; it is a qube type since qube is high and plot data for qube-cecu looks close to this, the only difference is the quwi, which doesn't show up much	3
1C04260	4210	Quercus berberidifolia	4210	Quercus berberidifolia	4210a = QUBE-CECU 4112a = ARVI-QUWI	20% poly; qube 30%, arma 15%, arvi 10%, qugab 15%	5
1C04696	1111	Quercus wislizen (shrub)	4210	Quercus berberidifolia	4210A	35% poly; pisa 8%, qube 40%, cemo 10%, cecu 8%, quwi 0%	1
1C05426	6111	Quercus garryana/ var. breweri	4210	Quercus berberidifolia	Primary = 4210A	50% poly; qube 31%, umca 10%, quga 8, cele 7 (under tree), gafr 9%, quga 8%	2

Problems with Producers' Accuracy

Only two of 25 types with high sample sizes had producers' scores of less than 80% accuracy. These were both Group level units: Southwestern North American Riparian Broadleaf Woodland, and Southwestern North American Riparian/Wash Scrub. This is a special case which we call "Problems with "back-off" groups being more likely defined by the producers than by field staff."

Because in some instances the producers could not tell which alliance comprised some mapped stands of riparian scrub, they were given the option to "back-off" to the Riparian/Wash Scrub Group, the next step up in the hierarchy. Similarly, when the producers encountered stands of riparian trees they could not differentiate at the alliance level, they "backed-off" to its Riparian Broadleaf Woodland Group. Often when the producers employed the generic group level attribute, it was because the particular polygon was delineated with inclusions of several riparian stands, all below the minimum map unit size. However, when the AA field crews encountered such stands, they were almost always able to describe them at the alliance level, and they may not have been able to see the entire mapped polygon area. Thus, field crews may see several small discrete stands of vegetation rather than a blend of a higher level group, and they would often list these or some of these individually. Comparisons of these field assessments with the generalized mapping assessment were difficult. An example of this can be seen in the following table 8, which includes all 21 samples sorted by producer's (mapper's) call.

As shown in the table for SW N.A. Riparian/Wash Scrub (Table 8), no field assessment was made at that Group level (see column "Final Alliance Name"). All final alliance calls were based on specific alliances, with one exception, where a polygon was called the Californian Warm Temperate Marsh/Seep Group. This points out a conundrum in our mapping system. If the producers are allowed to attribute a group for areas that are aggregates of multiple types, and field assessors identify the type at the alliance level, then the best score the producers can get is a 4 because the expected map unit is alliance and not group level. In many cases in the table, particular polygons had anomalous characteristics that would be difficult to map correctly at the alliance level with the resolution of the 1 m NAIP imagery. Such uncertain scores are difficult to resolve, since under these circumstances, there is little likelihood of receiving a perfect score. However, this is an indication of what can be expected from alliance level mapping in often fragmented and/or disturbed situations (as are riparian scrubs) using the available imagery.

We could have asked the photo interpreters to attribute all riparian scrub polygons using the Group level, but in many cases they could correctly attribute the riparian scrub alliances. See Table 9 as an example where *Salix exigua* alliance (a member of the SW N.A. Riparian/Wash Scrub) was mapped at 90% producer accuracy. It is more worthwhile for users to see the greatest level of map detail even if the call is wrong in a small part of map.

Table 8. Display of AA analysis for Riparian/Wash Scrub Group with producers' and users' calls

Polynum	VegCode_PI	Map Unit_PI	Final Keyed Type	Final Alliance Name	Reviewers Notes	Call Justification	Score
A18374	6200	SW N.A. Riparian/Wash Scrub	6214	*Cephalanthus occidentalis*			4
B11753	6200	SW N.A. Riparian/Wash Scrub	3210	*Alnus rhombifolia*		45 alrh, 10 rudi, 2 salas. Different Formation, same life form. Revisit: additional point for riparian-ness	1
B11798	6200	SW N.A. Riparian/Wash Scrub	1110	*Umbellularia californica*	1110B	alrh 28, pipo 2, quke 4, quch 6, umca 30. Revisit: 3.8 acres of 19 acres assessed. We had given it 1 for life form, but that's not even correct ("scrub").	3
C05456	6200	SW N.A. Riparian/Wash Scrub	6217	*Salix lasiolepis*		25 poly; pisa 5, salas 5, qudo 2, rudi 6; good at group level	4
A18166	6200	SW N.A. Riparian/Wash Scrub	3110	*Populus fremontii*			3
A18194	6200	SW N.A. Riparian/Wash Scrub	7200	Californian Warm Temperate Marsh/Seep Group	Final call changed from 3110, POFR to 4420, BAPI, and ultimately to 6200, based on patchiness and difficulty in keying. Riparian scrub is very diff't than wetland herb in NVC.	Appears mostly herbaceous dominated poly and not woody. if we back off to the macrogroup or group this becomes a SW warm temperate marsh type that is dominated by Juncus and other spp.	0
A18219	6200	SW N.A. Riparian/Wash Scrub	3112	*Salix gooddingii*			3
A18235	6200	SW N.A. Riparian/Wash Scrub	6213	*Rubus discolor*			2
A18356	6200	SW N.A. Riparian/Wash Scrub	1313	*Quercus lobata*		QULO Riparian could be considered under the Riparian Woodland Group	3
B08812	6200	SW N.A. Riparian/Wash Scrub	6210	*Baccharis salicifolia*		Entire poly assessed; 2 qulo, 1 plra, 23 basa. Correct at group level.	4
A18373	6200	SW N.A. Riparian/Wash Scrub	6214	*Cephalanthus occidentalis*			4
A18551	6200	SW N.A. Riparian/Wash Scrub	1111	*Quercus wislizeni*	Most of poly is tree type; life form incorrect. Could redraw poly so that tree and shrub types are separate.	Macrogroup is correct; but alliance is quwi (riparian association), hence why fuzzy is 3.	3
A18386	6200	SW N.A. Riparian/Wash Scrub	6211	*Salix exigua*	AIS called this 6200, but not imported from JUNO.		4
A18437	6200	SW N.A. Riparian/Wash Scrub	1111	*Quercus wislizeni*			3
A18441	6200	SW N.A. Riparian/Wash Scrub	6211	*Salix exigua*			4
A18449	6200	SW N.A. Riparian/Wash Scrub	6217	*Salix lasiolepis*			4
A18464	6200	SW N.A. Riparian/Wash Scrub	1111	*Quercus wislizeni*		this riparian quwi association, while somewhat patchy, is within bounds of expected riparian distribution of trees	3
A18509	6200	SW N.A. Riparian/Wash Scrub	1310	*Aesculus californica*		AECA riparian doesn't fit into this riparian scrub group at this time.	2
A18511	6200	SW N.A. Riparian/Wash Scrub	1312	*Quercus kelloggii*	A tree type, not a shrub type. While fragmented and choked with exotic understory, QUKE is best call.		0
A18515	6200	SW N.A. Riparian/Wash Scrub	1313	*Quercus lobata*		This is a tree type w/ 40% tree cover.	3
A18368	6200	SW N.A. Riparian/Wash Scrub	6213	*Rubus discolor*		21% Rubus cover. Only 1% cover of a shrub (SAEX).	2

Table 9. Display of AA analysis for *Salix exigua* Alliance with producers' and users' calls

Polynum	VegCode_PI	Map Unit_PI	Final Keyed Type	Final Alliance Name	Reviewers Notes	Call Justification	Score
3A13352	6211	Salix exigua	6211	Salix exigua			5
2A18597	6211	Salix exigua	6211	Salix exigua			5
2A18611	6211	Salix exigua	6211	Salix exigua			5
2A18615	6211	Salix exigua	6211	Salix exigua			5
2A18629	6211	Salix exigua	3110	Populus fremontii		Trees: POFR 12%, SAGO 10%. Shrubs: SAEX 17%	3
2A18665	6211	Salix exigua	6211	Salix exigua			5
2B24654	6211	Salix exigua	6211	Salix exigua		POFR not evenly distributed	5
1A11590	6211	Salix exigua	6211	Salix exigua			5
2B24704	6211	Salix exigua	6211	Salix exigua			5
2A18622	6211	Salix exigua	6211	Salix exigua			5
3A13360	6211	Salix exigua	3111	Salix laevigata			3
3A13368	6211	Salix exigua	3110	Populus fremontii			3
3A13374	6211	Salix exigua	6211	Salix exigua			5
3B11707	6211	Salix exigua	3110	Populus fremontii			3
415606	6211	Salix exigua	6211	Salix exigua			5
415610	6211	Salix exigua	3111	Salix laevigata			4
415611	6211	Salix exigua	6211	Salix exigua			5
2B24686	6211	Salix exigua	6211	Salix exigua		POFR not evenly distributed	5

The lesson for riparian mapping is that the producers likely should not have opted for mapping at a higher group level. Instead, they should stick with assigning alliance labels in order to avoid the always partly incorrect comparison of a generic group "back-off" with a specific alliance level attribute.

Additionally, for the five map unit types with moderate sample sizes, three types have already been discussed above since their user accuracy was also less than 80% accuracy. The other two types were mapped with Group level units: California Xeric Chaparral Group and W. North American Vernal Pools and Other Seasonally Flooded Macrogroup. For the chaparral group with 58.2% accuracy, producers were correct at the group level for six out of the 11 polygons, and all but one of these had *Ceanothus cuneatus* dominant or co-dominant. Three other polygons had trees dominant in the overstory, and shrubs present in the understory. Thus, photo-interpreters reassessed all polygons identified as this generic group-level and recoded them to appropriate chaparral or woodland alliances.

For the vernal pool macrogroup, with accuracy of 72.7%, three of the 11 polygons were identified as upland California annual and perennial grasslands, one was a vernal pool/upland grassland matrix, and the other seven were correctly mapped. Thus, photo-interpreters applied this information back into the finalized map to improve overall accuracy. However, spring field-visitation of all polygons mapped as this type would additionally improve the overall results of the map.

Summary of AA analysis

With the scores displayed and reviewed above, the DFG Vegetation Classification and Mapping Program is comfortable in reporting these as acceptable for use in most cases without modification. This is particularly true for all the types achieving sample sizes of n ≥ 20. Those users who prefer to

have units with higher accuracy can achieve these by aggregating units into their next level up (Group) in the NVC hierarchy.

One detail that we have learned from this project is that conversion to a more generalized level in the classification hierarchy is not always a remedy for low accuracy scores. Improving scores for producers' accuracy may not improve scores for users' accuracy and vice versa. Also, reducing the specific thematic resolution may decrease the general value of the map more than improving the accuracy of more generic units. Thus, our practice is to present the information in the map, with the full disclosure that some mapping classes may be less reliable from either users', producers' or both accuracy perspectives. We expect that this map product will be used for many purposes, and that the most intensive and in-depth users should be able to customize it to include more or less detail based on their own specific needs.

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Appendix A. Description of the Mapping Methods by AIS

Introduction

Aerial Information Systems (AIS) was subcontracted by the California Native Plant Society (CNPS) under contract by the California Department of Fish and Game (CDFG) to produce a vegetation map of the Northern Sierra Nevada Foothills (NSNF) using a vegetation classification based on Klein et al. (2007) and the Manual of California Vegetation (MCV). Through photo interpretation methods, AIS was tasked to use 2005 NAIP imagery, CDFG/CNPS classification plot data, other on-site field data, and ancillary datasets to produce the map using a modified version of the USGS/NPS National Vegetation Mapping Standard protocol.

Vegetation stands are delineated and digitized to a 2 acre minimum mapping unit (MMU) resolution and reflect conditions based on digital imagery produced in 2005. In addition to the MCV-based alliance vegetation type, other attributes include birds-eye percent cover for conifer, hardwood, shrubs, and herbaceous, attributes for influence by disturbance and exotics, and attribution of height and size.

Description of the Study Area

The upper elevations include *Pseudotsuga menziesii* and *Quercus chrysolepis* forests grading down to mixed conifer forests of *Pinus ponderosa*, *Calocedrus decurrens* and *Quercus kelloggii*, to *Quercus wislizeni* woodlands, *Pinus sabiniana* woodlands, and *Quercus douglasii* woodlands at the lowest elevations. Shrublands include *Ceanothus integerrimus* at higher elevations, with stands of *Arctostaphylos viscida* and *Adenostoma fasciculatum* at mid elevations, and *Ceanothus cuneatus* at lower elevations. Extensive grasslands are found at the lower elevations. Riparian corridors throughout the study area are composed of various combinations of *Populus fremontii*, *Quercus lobata*, *Alnus rhombifolia*, *Salix laevigata*, *Salix gooddingii*, and *Salix exigua*.

Urbanization throughout the study area varies from metropolitan centers of Auburn, Placerville, and Folsom, to moderate and small towns along the Gold Country corridor of State Highway 49. Rural ranches and vast open space occur throughout the area. Most of the study area is generally accessible through a network of state and local highways and roads.

Summary of the Mapping Effort

Project Setup, Data collection – March 2008

Field Reconnaissance
- Overview of Module 3 and 4 – May 5-9, 2008
- Module 1 – May 19-22, 2008
- Module 2 – October 20-24, 2008
- Stop Work Order – December 24, 2008 – March 2009
- Module 3 – January 5-7, 2010
- Module 4 – March 15-19, 2010

Classification/Criteria Meeting – May 1, 2008

Mapping Criteria, Mapping Classification – March – July 2008
Mapping Production
- Module 1 – March 2008 – October 2008

Stop Work Order December 24, 2008 – March 2009
Module 2 – September 2008 – December 2008; March 2009 – May 2009
Module 3 – March 2009 – April 2010
Module 4 – March 2010 – June 2010

CDFG Answer Field Questions
Module 1 – June-July 2008
Module 2 – April 2009
Module 3 – February-March 2010
Module 4 – May 2010

Post AA Revisions
Module 1 – April 2009
Module 2 – May – June 2009
Module 3 – January 2011
Module 4 – January 2011

Height (Modules 1-4) – January 2011

Final Documentation – February 2011

Vegetation Mapping Criteria and Methodologies

Sources

Many digital data files were available to aid in the photo interpretation, mapping, and planning for field reconnaissance.

Digital Imagery
Base Imagery – 2005 NAIP 1-meter resolution for each county
Supplemental Imagery
2009 NAIP 1-meter resolution for each county
Globe Explorer
Google Earth

Ancillary Data provided by CDFG
Protected Lands
Roads, Railroads, and Vehicular Trails Data SNFN
Vernal Pools
Soils
Fire History
Geology
Ultramafic
Relevè and Rapid Assessment Plot Data (CDFG/CNPS)

Other Ancillary Data
National Wetlands Inventory (NWI) Data
USGS DRG
USGS DEM 20 ft contour
AIS Reconnaissance Site Information

Mapping Classification and Other Attributes

A preliminary vegetation classification was provided by CDFG and CNPS. This classification was modified to reflect mapping classes that could be discerned on the aerial imagery. The final vegetation database includes the following attributes:

Photo Interpreted (PI) Vegetation Type
Conifer Cover
Hardwood Cover
Shrub Cover
Herbaceous Cover
PIPO Modifier
Disturbance
Exotics
Height
Size
Land Use

- PI vegetation type is typically mapped at the alliance level, based on the vegetation classification and keys provided by CDFG and modified by AIS for photo interpretation and mapping. The vegetation classification is based on the 2009 edition of the Manual of California Vegetation (MCV) and is in alignment with the National Vegetation Classification System (NVCS).

- The cover density for conifer, hardwood, and shrubs are based on birds-eye view for photo interpretation of the imagery. The cover density values are by one percent intervals rather than a range of values. Herbaceous cover, however, is coded as none, low (<20%), medium (20-40%), or high (>40%) value representing a range of values.

- The PIPO modifier denotes presence of Ponderosa pine in the polygon. A yes or no code is assigned.

- Disturbance is coded as none observable (up to 5%), light (5-25%), moderate (25-50%) or high (>50%) value based on percent of a mapped polygon affected by disturbance. Agriculture and urban disturbance are also coded.

- Exotics is coded as none observable (<5%), low (5-25%), medium (25-50%) or high (>50%) value based on percent of a mapped polygon impacted by non-native plants.

- Height categories are assigned to the mapped polygons based on their assigned alliance then adjusted based on visual review to the imagery. The classes are given as ranges of values.

- Size categories are assigned to mapped polygons based on their assigned alliance. The classes are given as ranges of values.

- Land use assignment is limited to Urban/Built-up and Agriculture. Land use is a separate data layer from vegetation type, so for a given polygon there can be overlap between a land use urban or agriculture code and a vegetation type and associated its vegetative attributes.

Criteria for Mapping

Minimum Mapping Unit Size

The project minimum mapping unit (MMU) follows the criteria noted below:

- Vegetation type (alliance) stands are mapped with MMU size of 2 acres.
- Cover density breaks within a vegetation type are mapped with MMU size of 5 acres.
- Emergent and Understory cover density breaks within a vegetation type are mapped with MMU size of 10 acres.
- Minimum width guidelines – extremely narrow stands (such as riparian vegetation or powerline or highway corridors less than half the width of a 1 acre square (=104 ft) are not mapped.
- Special MMU of 1 acre was used for Quercus lobata, riparian woodlands, mixed shrub riparian/wash, mesic herbaceous, marsh, cattails, vernal pools, urban land use, lithomorphic vegetation, cliffs/rock outcrops, river flats/streambeds, little or no vegetation, and water.
- The MMU size of isolated land use (urban/built-up/agriculture) polygons in a rural or natural setting is 1 acre.
- An urban core/urban window is defined as an intensely urban or built-up area that is at least 1 square mile in extent.
- Agriculture and natural vegetation within an urban core will only be mapped if >10 acres. The MMU of mapping natural vegetation within an urban core is 10 acres.

Typically, vegetation maps focus on stands of similar vegetation types. This product may contain small "patches" of vegetation that are below the MMU when the patch clearly defines an alliance. These situations often occur in wetland settings. However, photo interpreters do not normally map below the MMU since most patches of vegetation that small do not represent a vegetation type or a vegetation alliance. Normally, aggregations of similar like patches which may differ slightly based on minor floristic or structural characteristics make up a stand of vegetation large enough to be characterized as an alliance.

At times, photo interpreters found it necessary to aggregate vegetation types when patches of vegetation were too small to map. Aggregation follows two different sets of criteria that portray unique issues to the vegetation mappers:

- Issues of complexing: When a small patch of vegetation below the MMU that is clearly different from the larger adjacent vegetation is found within a mapped polygon one or more times, the mapped polygon is defined as a complex. When this occurs frequently in the polygon, the overall heterogeneity tends to be rather high.

- Issues of ecological similarities: When two species occur within a given polygon that tend to share similar ecological characteristics, and their relative abundance varies subtly within the mapped unit, the polygon is said to be transitional between two closely related vegetation types.

Cover Density

Cover density was photo interpreted separately for conifer, hardwood, shrub, and herbaceous. Density was coded to 1% intervals. However, when overstory cover for any number of canopy tiers was >40% the overstory is considered too dense to give a reliable estimation of lower tier canopy understory photo interpreted birds-eye cover, and therefore the understory cover was not evaluated and given a not applicable value. For example, if the conifer tier cover was >40% then the other tiers below (hardwood,

shrub, and herb) 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 and herb cover were not estimated.

In general, *Quercus lobata* stands with combined tree and shrub cover <40%, meadow vegetation, marsh vegetation, riparian flat grass, irrigated pasture land, and weedy grass were considered to have a high herbaceous cover. In contrast, most stream beds, vegetation on serpentine with combined tree and shrub cover of <40%, and volcanic tablelands were considered to have low herbaceous cover.

Urban/Built-up and agricultural polygons were not given cover densities unless there was >10% natural vegetation. The cover was given for the natural vegetation, not the exotics.

Disturbance

Polygons coded as vegetation types of urban/built-up, agriculture, reservoirs, and small earthen dam ponds were considered to be highly affected by disturbance.

Exotics

Polygons coded as vegetation types of urban/built-up, agriculture, *Juglans hindsii*, broom (e.g., *Genista monspessulana*), *Tamarix* spp., *Rubus armeniacus =(discolor)*, weedy grass, irrigated pasture lands, exotic trees, and eucalyptus were considered to be highly affected by exotics.

Urban and Agricultural Land Use vs. Vegetation in an Urban Land Use

The database contains a separate field or layer for PI Vegetation Type and one for Land Use. A single polygon can be coded for vegetation type as well as for land use. The majority of polygons within the study area are natural settings with a vegetation type and vacant or no land use. Other polygons are intensely built up or in agriculture and contain no natural vegetation. These are coded as urban or agriculture land use and urban or agricultural vegetation type. There are polygons, however, that contain both urban or agricultural land use as well as some natural vegetation throughout the polygon. These are coded with the urban or agriculture land use and the natural vegetation type and associated vegetation characteristics.

The general guide for urban or agricultural polygons is that if the polygon contains <10% natural trees and/or shrubs, then it is coded as urban or agriculture for its map unit. If the polygon contains >10% natural trees and/or shrubs, then it is coded as the natural vegetation type, with associated cover types.

- Urban Window Vegetation Type - The Urban Window is intensely and fully developed with built-up and disturbed use, and originates from an intensely developed urban core.
  - Agriculture is not separated out from an urban window unless it is >10 acres in size.
  - Adjacent natural vegetation can finger into the urban window from outside.
  - The urban window can finger out into the surrounding suburban and rural areas as long as it is continuous and still intensely built.
  - Intense land use of >7-10 houses per 10 acres and at least 1 square mile in size even with vegetation >10% natural cover is included in the urban window and coded as vegetation type of Urban Window rather than as its natural vegetation type.
    - Highly disturbed areas adjacent to an urban window are included in the urban window.

- Dense Urban Areas (not Urban Window)
  - Agriculture is separated out if >10 acres in size
  - Vegetation type (alliance) stands are mapped with MMU of 10 acres.
  - Cover density breaks within a vegetation type are mapped with MMU of 10 acres
  - Emergent and Understory cover density breaks within a vegetation type are mapped with MMU of 10 acres.

- Isolated Settlements
  - Agriculture is separated out if >10 acres in size.
  - Use 10 acre MMU for separating agriculture, disturbance, and built-up areas
  - Cover density breaks within a vegetation type are mapped with MMU of 10 acres
  - Emergent and Understory cover density breaks within a vegetation type are mapped with MMU of 10 acres

- Sparse Urban Areas/Rural Areas
  - All normal MMU criteria apply.

Interface with Previous CNPS/AIS Projects

The study area contains or abuts two previous projects that were mapped for CNPS. The Lassen Foothills project, conducted in 2007-08, is contained in Module 1. The Tuolumne Table Mountain project, conducted in 2003, is adjacent to Modules 3 and 4.

o Lassen Foothills (approx. 100,000 acre area)

An attempt was made to edgematch lines and equivalent vegetation types across the project boundaries. The Lassen Foothills project was mapped using a slightly different mapping classification and criteria for vegetation type and cover density. If the estimated covers did not match (see above for what "match" means), then the polygons were assessed by a qualified photo interpreter to determine if they should actually be merged. An example: If only a small portion of a vegetation polygon was within the boundary of one of the map projects, then the cover estimates might not have been accurate. The whole polygon was reassessed as one unit.

If the line work for the edge-matched polygons corresponded and obviously should be one polygon (i.e. the same vegetation and vegetation cover) and yet the map unit attributes were conflicting for the edge polygons, then the polygons were merged and a qualified photo interpreter reassessed and updated the attributes for the entire polygon.

If an edge polygon from either project contained an inclusion that was below the minimum mapping unit and was therefore not delineated, but the edge matched polygon from the other map recognized that inclusion as a separate polygon (and together they met the minimum mapping unit), then the inclusion was split from the original polygon and merged with the edge polygon with the correct attributes.

If the edge matched polygons were mapped to a different level in the hierarchy, a qualified photo interpreter determined if the polygons should remain separate, be merged at the higher lever, or merged at the finer level of the hierarchy. Few changes were made to the original Lassen Foothills database. These changes include recoding any generic riparian Lassen vegetation types of Sonoran Riparian Broadleaf Deciduous Woodlands and Madrean Warm-temperate Riparian Wash Scrub to the alliance level. In addition, height and size were also systematically coded to the polygons and adjustments to the assigned code were made through photo interpreted review of each polygon.

o Tuolumne Table Mountain (approx. 4,000 acre area)

The Table Mountain project was incorporated into the NSNF project by correlating and converting the Table Mountain vegetation types to the NSNF vegetation type criteria and codes. The Table Mountain project therefore was recoded for conifer, hardwood, shrub, and herbaceous density, and coded for disturbance, exotics, height, size, and land use. The polygon boundaries across the study area were edgematched and the study area boundary between the two projects dissolved once complete.

Methodology for Mapping

The vegetation mapping effort was interpreted throughout the study area using heads-up digitizing techniques and custom tools for use with Esri's ArcGIS 9.3 Software. All delivered geodatabase products are in this format.

The working tile system for the project was the USGS 7.5 minute quadrangle (quad). The quad units used throughout the project were joined together by Module for interim delivery to CNPS/CDFG prior to Accuracy Assessment. The final deliverable is a joined geodatabase combining Modules 1, 2, 3 and 4.

Field Reconnaissance

The field reconnaissance visit serves two major functions. First, the photo interpreter keys the signature on the aerial photos to the vegetation on the ground at each signature's field site. Second, the photo interpreter becomes familiar with the flora, vegetation assemblages and local ecology that occur in the study area. The CDFG/CNPS field ecologists who are familiar with the local vegetation and ecology of the study area are present to help the photo interpreter understand these elements and their relationship with the geography of the area.

Prior to the field reconnaissance, AIS staff performed several in-house preparations to facilitate a more organized trip. Field routes were planned to accommodate a variety of factors including: maximizing the number of vegetation types and regional zones visited addressing time constraint considerations and accessibility. Hardcopy outputs of the base imagery were plotted for navigation in the field.

The imagery was reviewed for representative signatures of different vegetation types, density and abiotic factors such as percent slope, aspect, shape of the slope, elevation, etc. Field check sites and associated notations were noted on the field overlays. Multiple sites were chosen to provide alternatives if one or more sites proved inaccessible.

Field site locations visited were recorded on a GPS unit. Field survey sheets were used to record pertinent information for each site visited. Later, these records were input into computer files for easy reference. Color ground photos were taken at selected locations and later compared to the imagery and the field site notes. Additional field sites included areas encountered in transit between initially selected sites, areas of noteworthy or unusual significance, and other vegetation types the photo interpreter or ecologist deemed important. Four photo interpretation field reconnaissance trips, one for each Module, were conducted by the photo interpretation staff from AIS and ecologist/GIS staff from CDFG/CNPS.

Mapping

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

signatures associated with specific vegetation types, the photo interpreter is able to identify and delineate the boundaries between plant communities or signature units. Environmental factors such as elevation, slope, and aspect also play an important part in the photo interpretation decision-making process. For the NSNF project, the photo interpreters also gleaned information from the field reconnaissance notes and the relevé/rapid assessment surveys Access database. The CDFG/CNPS staff attempted to answer photo interpretation questions in the field as the mapping progressed.

Photo interpretation was conducted through an on-screen 'heads-up' digitizing method using ArcGIS. The study area was divided into several modules, and further subdivided into USGS 7.5 minute quads as the working tiling system. The individual quads were interpreted using the primary and supplemental imagery, reconnaissance and relevé/rapid assessment plot data, and other ancillary data, including elevation contours, geology, and fire history. The polygon delineations were based on a number of signature characteristics including color, tone, texture, relative height, and density. Each polygon was assigned the appropriate attribute code string (mapping classification types, conifer, hardwood, shrub, and herbaceous percent cover, disturbance, exotics, and land use).

As mapping progressed for each Module, subsequent specific mapping questions were generated for investigation in the field by CDFG/CNPS. The questions with corresponding geographic coordinate locations were provided to CDFG/CNPS. After the field investigation CDFG/CNPS provided the answers in the form of digital copy of survey forms, as well as digital files, to AIS for application to the database.

The quads were subsequently edgematched and were checked for invalid codes, code correlation consistency, and errors in topology. A senior photo interpreter reviewed each quad for map unit delineation and the accuracy of the codes assigned to every polygon. Prior to delivery, each joined module was checked again for invalid codes, code correlation consistency, and topology errors, as well as completeness, and adherence to the mapping criteria and guidelines. The individual modules were then delivered to CDFG/CNPS for the Accuracy Assessment process.

Accuracy Assessment Revisions

CDFG conducted the analysis of Accuracy Assessment (AA) surveys of each Module as it was delivered. After analysis, the results were provided to AIS for application of revisions into the map geodatabase. A senior photo interpreter reviewed each Module's AA results and applied the revisions.

Height and Size

For attribution of Height and Size, these attributes were applied after the accuracy assessment revisions were done (as agreed upon at the start of the project). CDFG provided the criteria for assigning Height and WHR Size to each mapped vegetation type. Herbaceous types, other than Vernal Pools, were not given height and size categories. Height and Size classes were applied systematically by an automated mode. The photo interpreters reviewed each polygon against the imagery and adjusted the height categories as needed. Size, however, was not further photo interpreted or adjusted.

Final Delivery

The four Modules were joined together and reviewed once again for invalid codes, consistency, topological errors, and final edgematch between Modules. Once complete the final geodatabase was posted for delivery to CDFG/CNPS.

Appendix B. *Mapping Classification and Other Map Attributes for the Northern Sierra Nevada Foothills*

Mapping Classification Attributes

The classification is arranged in the following hierarchical order, beginning with the broader map class of the Formation, and ending in the finer map class of the Alliance. Formations will occasionally repeat across shrub and herbaceous life forms. Also, alliances that are in the mapping classification but not described within the existing vegetation classification report (by Klein et al. 2007) are denoted with a *. Alliances that were included in the classification report but not mapped are denoted with a †.

LEVEL 1. Formation Class

Level 2 or 3 Formation Subclass or Formation

Levels 4, 5, or 6: Divisions, Macrogroups, & Groups

California *Scientific Name* (Alliance)

Map Units & Non-hierarchy Vegetation

Level 1.A. Mesomorphic Tree Vegetation (Forest and Woodland)

Warm Temperate Forest Formation

1100, 1300 – California Broadleaf Forest and Woodland Group

1110 – *Umbellularia californica*
1111 – *Quercus wislizeni*
1310 – *Aesculus californica*
1311 – *Quercus douglasii*
1312 – *Quercus kelloggii*
1313 – *Quercus lobata*
1410 – *Quercus chrysolepis*
4410 – *Quercus wislizeni (shrub form retained for height)*

1200 – California Evergreen Coniferous Forest and Woodland Group

1210 – *Pinus sabiniana*
1211 – *Pinus attenuata*
1212 – *Juniperus californica*
1213 – *Callitropsis (Cupressus) macnabiana*

Cool Temperate Forest Formation

1400 – Vancouverian Evergreen Broadleaf and Mixed Forest Group

1411 – *Arbutus menziesii* †

2100 – Upland Vancouverian Mixed Woodland and Forest Group

2110 – *Pseudotsuga menziesii*
2111 – *Acer macrophyllum*

2200 – California Montane Conifer Forest Group (including Managed Conifer Stands)

2210 – *Pinus ponderosa*†
2212 – *Pinus ponderosa – Calocedrus decurrens*
2213 – *Calocedrus decurrens*

Temperate Flooded and Swamp Forest Formation

3100 – Southwestern North American Riparian Evergreen and Deciduous Woodland Group

3110 – *Populus fremontii*
3111 – *Salix laevigata*
3112 – *Salix gooddingii*
3310 – *Platanus racemosa*
3113 – *Juglans hindsii*

3200 – Vancouverian Riparian Deciduous Forest Group

3210 – *Alnus rhombifolia*
3211 – *Fraxinus latifolia*

Level 1.B. Mesomorphic Shrub and Herb Vegetation (Shrubland and Grassland)

Mediterranean Scrub Formation

4100 – California Xeric Chaparral Group

4111 – *Adenostoma fasciculatum*
4112 – *Arctostaphylos viscida*
4113 – *Ceanothus cuneatus*
4114 – *Eriodictyon californicum*
4115 – *Arctostaphylos manzanita**
4117 – *Arctostaphylos myrtifolia**

4200 – California Mesic Chaparral Group

4210 – *Quercus berberidifolia*
4211 – *Cercocarpus montanus*
4212 – *Heteromeles arbutifolia*

4300 – California Serpentine Chaparral Group

4310 – *Quercus durata*

4600 - Naturalized Non-native Mediterranean Scrub Group

4610 – Broom (*Cytisus scoparius* and others)*

Temperate and Boreal Scrub and Herb Coastal Vegetation Formation

4400, 4500 – California Coastal Evergreen Bluff and Dune Scrub Group

4420 – *Baccharis pilularis**
4501 – *Frangula californica (*including *F. c.* ssp*. tomentella*)

Temperate Grassland, Meadow, and Shrubland Formation

6100 – Southern Vancouverian Montane Deciduous Scrub Group
6110 – *Ceanothus integerrimus*
6111 – *Quercus garryana* var*. breweri*

6300 – Vancouverian Coastal Deciduous Scrub Group
6301 – *Toxicodendron diversilobum*

Temperate Flooded and Swamp Forest Formation

6200 – Southwestern North American Riparian/Wash Scrub Group

6210 – *Baccharis salicifolia**
6211 – *Salix exigua*
6214 – *Cephalanthus occidentalis*
6215 – *Brickellia californica* (provisional) †
6217 – *Salix lasiolepis*
6401 – *Rosa californica*†

6200b – Western Dogwood Thicket Group
6216 **–** *Cornus sericea* †

6200c – Southwestern North American Introduced Riparian Scrub Group
6212 – *Tamarix* spp.

6200d - Naturalized Non-Native Deciduous Scrub Group
6213 – *Rubus armeniacus*

Mediterranean Grassland and Forb Meadow Formation

7100 – Californian Annual and Perennial Grassland Macrogroup

7101 – Mediterranean California Naturalized Annual and Perennial Grassland Group
(Weedy grasslands with no native component)

Temperate Grassland, Meadow, and Shrubland Formation

7102 – Vancouverian and Rocky Mountain Naturalized Perennial Grassland Group
(Passively irrigated pasture lands)

Temperate and Boreal Freshwater Marsh Formation

7200 – Californian Warm Temperate Marsh/Seep Group

7300 – Arid West Freshwater Emergent Marsh Group

7310 – *Typha* (*angustifolia, latifolia, domingensis*) †

7400 – Vernal Pool & Californian Annual and Perennial Grassland Matrix Mapping Unit

7600 – Californian Mixed Annual/Perennial Freshwater Vernal Pool / Swale Bottomland Group (Including the *Eleocharis macrostachya, Lasthenia fremontii-Downingia* (*cuspidata*)*,* and *Trifolium variegatum* Herbaceous Alliances)

Level 1.C. Sparsely Vegetated, Water, & Urbanized Land Use & Land Cover Types

9200 – Agriculture (Without fallow annual grasses dominating)

9300 – Built Up & Urban Disturbance (includes development, mines and borrow pits)

9310 – Urban Window

9400 – Areas of Little or No Vegetation

9401 – Cliffs & Rock Outcroppings
9402 – River & Lacustrine Flats & Streambeds
9403 – Undefined Areas with Little or No Vegetation

9500 – Introduced North American Mediterranean Woodland and Forest Group

9501 – Eucalyptus

9800 – Water

9801 – Perennial Stream Channel
9802 – Reservoirs
9803 – Small Earthen Dam Ponds & Natural Lakes

Other Map Attributes

Percent Cover by Conifers
Percent Cover by Hardwoods (or Monocot Trees)
Percent Cover by Shrubs

The cover values for conifers, hardwoods, and shrubs are based on a birds-eye view during photo interpretation of the imagery. The cover density values are by one percent (1%) intervals rather than a range of values. However, when overstory cover for any number of canopy tiers was more than forty percent (>40%) the overstory is considered too dense to give a reliable estimation of lower tier canopy understory photo interpreted birds-eye cover, and therefore the understory cover was not evaluated and given a not applicable value. For example, if the conifer tier cover was >40% then the other tiers below (hardwood, shrub, and herb) 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 and herb cover were not estimated.

0 = Little or no cover (<1%)
NN = 1 to 100% cover
99 = Not applicable/not evaluated

Percent of Birdseye Total Cover by Herbaceous

Herbaceous cover is also based on a birds-eye view during photo interpretation, yet it is represented as a range of cover values: low (<20%), medium (20-40%), or high (>40%).

0 = Little or no cover
1 = <20% cover
2 = 20-40% cover
3 = >40% cover
9 = Not applicable/Not evaluated

Pinus ponderosa (PiPo) Modifer

The PIPO modifier denotes presence of Ponderosa pine in the polygon. A yes or no code is assigned.

0 = No observable PiPo
1 = PiPo present
9 = Not applicable

Disturbance Modifier

This modifier denotes the level of disturbance by roads, trails, disking activity (evidence of intensive agricultural use), scrapes on the landscape, or other similar land use.

0 = No Observable Disturbance: <5% of polygon affected
1 = Minimal Disturbance: 5-25% of polygon affected. Polygons adjacent to major disturbances are also placed into this category.
2 = Moderate Disturbance: 25-50% of polygon affected.
3 = High Disturbance: >50% of polygon affected
4 = Urban Disturbance: Polygon is built-up and contains associated structures
5 = Agriculture Disturbance: Polygon is under intensive agricultural use.
9 = Not applicable

Exotics Modifier

0 = No Observable Invasive Plant Component: <5% of polygon affected with invasive plants.
1 = Low Invasive Plant Content: 5-25% of polygon affected with invasive plants.
2 = Moderate Invasive Plant Content: 25-50% of polygon affected with invasive plants.
3 = High Invasive Plant Content: >50% of polygon affected with invasive plants.
9 = Not applicable

Land Use Modifier

0 = Not evaluated
1000 = Urban-Built-up
2000 = Agriculture

Appendix C. Field Key for the Vegetation Types Mapped in the Region

Class A. Vegetation with an overstory of trees (at least 5 m tall). Tree canopy is generally greater than 10%, but occasionally may be less than 10% over a denser understory of shrub and/or herbaceous species. = **Tree-Overstory (Woodland / Forest) Vegetation.**

Class B. Vegetation characterized by woody shrubs in the canopy. Tree species, if present, generally total less than 10% absolute cover and are not evenly distributed across the stand. Herbaceous species may total higher cover than shrubs. Shrubs are usually at least 10% cover = **Shrubland Vegetation.**

Class C. Vegetation characterized by non-woody, herbaceous species in the canopy including grass, graminoid, and broad-leaved herbaceous species. Shrubs, if present, usually comprise <10% of the vegetation and are not evenly distributed across the stand. Trees, if present, generally compose <5% cover: **= Herbaceous Vegetation.**

Class D. Sparsely vegetated, water, and urbanized (including agriculture and development) features **= Land Use and Land Cover Types.**

Note: Alliances with a "*" at the end of the name are types recognized during the mapping phase of the project, and not during the earlier sampling and classification phase (cf. Klein et al. 2007), while those alliances that were included in the classification report but not mapped are denoted with a †.

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

Group I. Woodlands and forests characterized mainly by broad-leaved evergreen and deciduous tree species such as oaks (*Quercus*), willows (*Salix*), etc. The broad-leaved trees may be associated with conifer trees or shrubs.

I.A. Tree overstory dominated by non-natives (for *Juglans hindsii* see step I.G) **[Introduced North American Mediterranean Woodland and Forest Group (9500)]**

I.A.1. Tree overstory dominated by *Eucalyptus* sp.

***Eucalyptus* sp. Semi-natural Stands (9501) ***

I.B. One or more oak (*Quercus* spp.) species are the primary overstory canopy tree, or oaks share dominance with conifers **[California Broadleaf Forest and Woodland Group (1100,1300)]**…

IB.1. Blue oak (*Quercus douglasii*) is the dominant oak species, with >50% relative cover in the overstory. Other trees, such as foothill pine (*Pinus sabiniana*), buckeye (*Aesculus californica*), California juniper (*Juniperus californica*), valley oak (*Quercus lobata*), interior live oak (*Quercus wislizeni*), or other oaks, may be present, but blue oak has greater cover. Shrubs that may be associated with blue oak in the understory include whiteleaf manzanita (*Arctostaphylos viscida*), common manzanita (*Arctostaphylos manzanita*), and wedgeleaf ceanothus (*Ceanothus cuneatus*)…

***Quercus douglasii* Woodland/Forest Alliance (1311)**

IB.2. Interior live oak (*Quercus wislizeni*) is dominant, or may be co-dominant, with other tree species in the overstory. Stands may occur in upland or riparian settings. Trees that associate with interior live oak include blue oak (*Quercus douglasii*), black oak (*Quercus kelloggii*), California buckeye (*Aesculus californica*), foothill pine (*Pinus sabiniana*), red willow (*Salix laevigata*), and Ponderosa pine (*Pinus ponderosa*). Shrubs that associate with interior live oak include whiteleaf manzanita (*Arctostaphylos viscida*), common manzanita

(*Arctostaphylos manzanita*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), hoary coffeeberry (*Rhamnus tomentella*), and snowdrop bush (*Styrax officinalis*). Scrub oak (*Quercus berberidifolia*) and canyon live oak (*Quercus chrysolepis*), if present, have lower cover…

***Quercus wislizeni* Woodland/Forest Alliance (1111)**

Additional Alliance Notes:

1). When blue oak (*Quercus douglasii*) forms an association with interior live oak in the Interior Live Oak Alliance, California buckeye (*Aesculus californica*) has a significant presence OR interior live oak has higher cover (may be slight) than blue oak.

2). Black oak (*Quercus kelloggii*) ranges from sub-dominant to dominant when it associates with interior live oak. The understory can have significant shrub cover with toyon (*Heteromeles arbutifolia*), manzanita (*Arctostaphylos* spp.), poison oak (*Toxicodendron diversilobum*), and others.

3). In riparian or semi-riparian settings, other indicators such as red willow (*Salix laevigata*), big-leaf maple (*Acer macrophyllum*), hoary coffeeberry (*Rhamnus tomentella*), mugwort (*Artemisia douglasiana*), Himalaya blackberry (*Rubus armeniacus*) can occur.

4). California buckeye (*Aesculus californica*) can be a conspicuous member of the canopy, forming two associations with interior live oak, and foothill pine (if present) usually has lower cover.

5). Foothill pine (*Pinus sabiniana*) may codominate the tree canopy with interior live oak in this alliance.

IB.3. Black oak (*Quercus kelloggii*) is dominant or co-dominant in the overstory. Stands may have conifers such as Douglas-fir (*Pseudotsuga menziesii*) or Ponderosa pine (*Pinus ponderosa*) with equal or higher cover than black oak. Canyon live oak (*Quercus chrysolepis*) and California bay (*Umbellularia californica*) may be present with lower cover than black oak. Shrubs that may associate with black oak in the understory include poison oak (*Toxicodendron diversilobum*), snowdrop bush (*Styrax officinalis*), toyon (*Heteromeles arbutifolia*), whiteleaf manzanita (*Arctostaphylos viscida*), and deerbrush (*Ceanothus integerrimus*)…

***Quercus kelloggii* Woodland/Forest Alliance (1312)**

Additional Alliance Notes:

When Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa pine (*Pinus ponderosa*) both occur with black oak, they may have higher combined aerial cover than black oak; however, black oak is characteristically present and at least >20% relative cover in the tree layer. California bay (*Umbellularia californica*) is often present as a mixture of hardwoods and conifers.

IB.4. Canyon live oak (*Quercus chrysolepis*) is dominant to co-dominant in the overstory in upland and semi-riparian settings. Conifers may be emergent to co-dominant…

IB4.a. Canyon live oak shares cover with Douglas-fir (*Pseudotsuga menziesii*). However, in mature stands, *P. menziesii* is the major overstory tree with *Q. chrysolepis* as the major sub-canopy tree. Both trees usually have greater than 10% cover, and either one may be sub-dominant to dominant with the other…

***Pseudotsuga menziesii* Woodland/Forest Alliance (2110)**

IB4.b. Canyon live oak is the dominant or shares cover in association with Ponderosa pine (*Pinus ponderosa*), black oak (*Quercus kelloggii*), valley oak (*Quercus lobata*), interior live oak (*Quercus wislizeni*), big-leaf maple (*Acer macrophyllum*), California bay (*Umbellularia californica*), and whiteleaf manzanita (*Arctostaphylos viscida*). These associated species are sub-dominant to co-dominant with canyon live oak…

***Quercus chrysolepis* Alliance (1410)**

IB.5. Valley oak (*Quercus lobata*) is dominant or co-dominant with other oaks (e.g. *Quercus wislizeni*), or riparian species (e.g. *Alnus rhombifolia*) may be co-dominant. Other trees, including California buckeye (*Aesculus californica*), foothill pine (*Pinus sabiniana*) and California sycamore (*Platanus racemosa*), may be

present. Blackberry (*Rubus*), California rose (*Rosa californica*), and skunkbush (*Rhus trilobata*) may occur in the shrub understory with low to high cover…

***Quercus lobata* Woodland/Forest Alliance (1313)**

I.C. California buckeye (*Aesculus californica*) is dominant as a tree or tall shrub in the overstory. Found in riparian settings [e.g., with valley oak (*Quercus lobata*) and interior live oak (*Quercus wislizeni*)] OR in upland settings on rocky substrates with poison oak (*Toxicodendron diversilobum*). If buckeye is co-dominant with an oak species, see the Blue Oak (*Quercus douglasii*) and Interior Live Oak (*Quercus wislizeni*) Alliances…

***Aesculus californica* Woodland/Forest Alliance (1310)**

I.D. California bay (*Umbellularia californica*) is typically dominant in the overstory as a tree or tall shrub; though it is sometimes co-dominant with white alder (*Alnus rhombifolia*) or interior live oak (*Quercus wislizeni*). California buckeye (*Aesculus californica*) is often present. If California sycamore (*Platanus racemosa*), Fremont cottonwood (*Populus fremontii*), and/or canyon live oak (*Quercus chrysolepis*) are present, they have trace cover…

***Umbellularia californica* Woodland/Forest Alliance (1110)**

I.E. Pacific madrone (*Arbutus menziesii*) is dominant in the overstory, usually with California bay (*Umbellularia californica*), canyon live oak (*Quercus chrysolepis*) and/or black oak (*Quercus kelloggii*). This appears to be an early seral type that may transition to the Black Oak or Canyon Live Oak Alliances without significant disturbance…

***Arbutus menziesii* Woodland/Forest Alliance (1411)** †

I.F. Big-leaf maple (*Acer macrophyllum*) is typically dominant to co-dominant with >25% relative cover and ≥10% absolute cover in the canopy. Stands may include equal or higher cover of Douglas-fir (*Pseudotsuga menziesii*) and black oak (*Quercus kelloggii*). Canyon live oak (*Quercus chrysolepis*), white alder (*Alnus rhombifolia*), California bay (*Umbellularia californica*), and other trees may be present, though are lower cover than the big-leaf maple…

***Acer macrophyllum* Woodland/Forest Alliance (2111)**

I.G. Hind's Walnut (*Juglans hindsii*) is dominant in the overstory. All stands in the foothills are planted or of hybrid origin…

***Juglans hindsii* Alliance and Semi-Natural Woodland/Forest Stands (3113)**

I.H. Stands dominated or characterized by other typical riparian winter deciduous trees or tall shrubs in the following genera: *Acer, Alnus, Fraxinus*, *Platanus*, *Populus*, and *Salix* **[Western North American Temperate Flooded and Swamp Forest Division and Western North America Warm Temperate Flooded and Swamp Forest Division]**…

IH.1. Fremont cottonwood (*Populus fremontii*) has equal or greater than 5% cover in overstory, usually as a dominant or co-dominant with willows. Other riparian trees may be present and co-dominant, including California sycamore (*Platanus racemosa*), valley oak (*Quercus lobata*), white alder (*Alnus rhombifolia*), and/or Oregon ash (*Fraxinus latifolia*). California wild grape (*Vitis californica*) is often present as a vine…

***Populus fremontii* Woodland/Forest Alliance (3110)**

IH.2. California sycamore (*Platanus racemosa*) has >5% absolute cover in the overstory. Other species may intermix in the overstory, including California buckeye (*Aesculus californica*), California bay (*Umbellularia californica*), and/or Oregon ash (*Fraxinus latifolia*)…

***Platanus racemosa* Woodland/Forest Alliance (3310)**

IH.4. Black willow (*Salix gooddingii*) has the highest cover in the canopy and is at least 10% cover. Other tall woody shrubs may be sub-dominant, and Himalaya blackberry (*Rubus armeniacus*) may have high cover in the understory…

***Salix gooddingii* Woodland/Forest Alliance (3112)**

IH.5. Red willow (*Salix laevigata*) is dominant in the overstory layer with at least 10% cover. Arroyo willow (*Salix lasiolepis*) may occur as a sub- or co-dominant in the shrub or low tree layer. Himalaya blackberry

(*Rubus armeniacus*) and mugwort (*Artemisia douglasiana*) may grow in the understory with a variety of other herbs and shrubs…

***Salix laevigata* Woodland/Forest Alliance (3111)**

IH.6. White alder (*Alnus rhombifolia*) and/or Oregon ash (*Fraxinus latifolia*) are significant members of the tree canopy **[Vancouverian Riparian Deciduous Forest Group (3200)]…**

IH.6.a. Oregon ash (*Fraxinus latifolia*) makes up at least 5% of the tree canopy. This species is a strong indicator as a dominant or a co-dominant with white alder (*Alnus rhombifolia*) and/or red willow (*Salix laevigata*)…

***Fraxinus latifolia* Alliance (3211)**

IH.6.b. White alder (*Alnus rhombifolia*) is dominant or co-dominant with other riparian species in the tree overstory. Other associated trees that may occasionally have higher cover than alder include Canyon live oak (*Quercus chrysolepis*), red willow (*Salix laevigata*), and California sycamore (*Platanus racemosa*). Narrow-leaf willow (*Salix exigua*), arroyo willow (*Salix lasiolepis*), and Himalaya blackberry (*Rubus armeniacus*) may intermix as shrubs…

***Alnus rhombifolia* Woodland/Forest Alliance (3210)**

Additional Alliance Notes:

1). When white alder associates with canyon live oak (*Quercus chrysolepis*), different combinations of California bay (*Umbellularia californica*), Ponderosa pine (*Pinus ponderosa*), incense cedar (*Calocedrus decurrens*), and big-leaf maple (*Acer macrophyllum*) intermix in the overstory. California bay may be co-dominant or have higher cover than white alder when canyon live oak is present.

2). When California sycamore (*Platanus racemosa*) and red willow (*Salix laevigata*) are present, and both trees can have at least 4% absolute cover in a mix with white alder.

3). When red willow (*Salix laevigata*) associates with white alder, it can have at least 5% cover and can co-dominate (and may have higher cover than the alder).

4). When narrow-leaf willow (*Salix exigua*) associates with white alder, it can have at least 5% cover in the shrub layer, and white alder is usually the dominant tree.

5) Fremont cottonwood (*Populus fremontii*), or Oregon ash (*Fraxinus latifolia*) are NOT usually significant in the overstory.

IH.7. Stands do not have strong dominance or co-dominance of either white alder (*Alnus rhombifolia*) or Oregon ash (*Fraxinus latifolia*), though other trees - including riparian species from above - are dominant…

Southwestern North American Riparian Evergreen and Deciduous Woodland Group (3100)

IH.8. Stands are typically composed of shrubby willow (*Salix*) or mulefat (*Baccharis*) species and trees are <10% cover **[Southwestern North American Riparian/Wash Scrub Group]…**

IH.8.a. Narrow-leaf willow (*Salix exigua*) is characteristically present as a dominant or co-dominant shrub, forming an open to continuous canopy along riparian corridors. Understory shrubs may include California brickellbush (*Brickellia californica*) and Himalaya blackberry (*Rubus armeniacus*). Other willow species may be present as sub-dominants with low cover…

***Salix exigua* Shrubland Alliance (6211)**

IH.8.b Arroyo willow (*Salix lasiolepis*) is dominant as a shrub or low tree, with at least 10% absolute cover (and >60% relative cover). Himalaya blackberry (*Rubus armeniacus*) and California rose (*Rosa californica*) may occur in the understory with a variety of wetland shrubs and herbs…

***Salix lasiolepis* Shrubland Alliance (6213)**

Group II: Conifer-dominated woodlands and forests characterized by needle or scale-leaved trees, including pine (*Pinus*), fir (*Abies*), incense cedar (*Calocedrus*), etc. The conifers may be associated with tree oaks or shrubs.

II.A. The overstory is dominated by pine (*Pinus*), cypress (*Cupressus*), or juniper (*Juniperus*) trees alone or in shared dominance with broadleaf evergreen trees or shrub **[Including the California Evergreen Coniferous Forest and Woodland Group (1200) and California Montane Forest Group (2200)]…**

IIA.1. Foothill pine (*Pinus sabiniana*) is the dominant tree in the overstory, and it is generally >10% absolute cover in overstory (but may be as low as 7%). Blue oak (*Quercus douglasii*) or interior live oak are absent or sparse in cover. *Pinus sabiniana* may form associations with chamise (*Adenostoma fasciculatum*), whiteleaf manzanita (*Arctostaphylos viscida*), hoary coffeeberry (*Rhamnus tomentella*), and wedgeleaf ceanothus (*Ceanothus cuneatus*). Found on a variety of substrates including metamorphic, ultramafic, and serpentine…

***Pinus sabiniana* Woodland/Forest Alliance (1210)**

IIA.2. Knobcone pine (*Pinus attenuata*) occurs as the dominant conifer or co-occurs with other conifers in an open to intermittent overstory…

***Pinus attenuata* Woodland/Forest Alliance (1211) ***

IIA.3. McNab cypress [*Callitropsis* (*Cupressus) macnabiana*] is the dominant in the overstory. Whiteleaf manzanita (*Arctostaphylos viscida*) and other shrubs may be present in the understory with low to high cover...

***Callitropsis (Cupressus) macnabiana* Woodland/Forest Alliance (1213)**

IIA.4. California Juniper (*Juniperus californica*) is dominant tree in the overstory. Blue oak (*Quercus douglasii*) may be present with lower cover than juniper. There may be dense herbs in the understory…

***Juniperus californica* Shrubland Alliance (1212)**

IIA.5. Incense cedar (*Calocedrus decurrens*) and/or Ponderosa pine (*Pinus ponderosa*) occurs in the tree canopy…

IIA5.a. Incense cedar (*Calocedrus decurrens*) is dominant or co-dominant in the tree overstory. Alder (*Alnus rhombifolia*) or big-leaf maple (*Acer macrophyllum*) may be present with lower cover than incense cedar…

***Calocedrus decurrens* Woodland/Forest Allliance (2213)**

IIA5.b. Ponderosa pine and incense cedar (*Calocedrus decurrens*) intermix in the conifer layer in the upper elevations of the Foothills. The two species typically co-dominate (though either species may be sub-dominant to the other) and comprise >60% relative cover of the stand...

***Pinus ponderosa-Calocedrus decurrens* Forest Alliance (2212)**

IIA5.c. Ponderosa pine (*Pinus ponderosa*) is dominant in the tree canopy with >50% relative cover, while hardwoods (such as *Quercus chrysolepis* and *Q. kelloggii*) have low cover, if present. In one association of this alliance, *Arctostaphylos viscida* dominates an intermittent shrub understory on slope convexities. In another, *Pinus ponderosa* grows along stream terraces with low cover of other trees and shrubs…

***Pinus ponderosa* Woodland/Forest Alliance (2210)** †

IIA5.d. Ponderosa pine (*Pinus ponderosa*) is dominant in the overstory, with evidence of timber management (planting or slashing/thinning/removal) of tree oaks and understory shrubs…

California Montane Conifer Forest Group (including Managed Conifer Stands) (2200)

IIA5.e. Oaks are co-dominant (with at least >30% relative cover) as understory or overstory trees in stands with Ponderosa Pine (*Pinus ponderosa*)…

IIA5.e.i Black oak (*Quercus kelloggii*) has >30% relative cover with Ponderosa pine (*Pinus ponderosa*) ranging from merely present to co-dominant. Three associations with this hardwood-conifer mix are defined…

***Quercus kelloggii* Woodland/Forest Alliance (1312)**

IIA5.e.ii Interior live oak (*Quercus wislizeni*) has >30% relative cover with Ponderosa pine (*Pinus ponderosa*) ranging from merely present to co-dominant…

***Quercus wislizeni* Woodland/Forest Alliance (1111)**

IIB. The overstory is dominated by Douglas-fir (*Pseudotsuga*) or this tree shares dominance with broadleaf evergreen trees or shrubs **[Including Upland Vancouverian Mixed Woodland and Forest Group (2100)]**…

IIB.4. Douglas-fir (*Pseudotsuga menziesii*) is dominant to co-dominant in the tree overstory…

IIB4.a. Douglas-fir occurs as the dominant in the overstory canopy, alone or with low cover of sub-canopy hardwoods…

***Pseudotsuga menziesii* Woodland/Forest Alliance (2110)**

IIB4.b. Douglas-fir (*Pseudotsuga menziesii*) is co-dominant with canyon live oak (*Quercus chrysolepis*) in the tree overstory or midstory. One association of this hardwood-conifer mix (*Pseudotsuga menziesii - Quercus chrysolepis*) is defined in the study area and classified within the ***Pseudotsuga menziesii* Woodland/Forest Alliance (2110)**

IIB4.c. Douglas-fir (*Pseudotsuga menziesii*) is co-dominant with big-leaf maple (*Acer macrophyllum*) in the tree overstory or midstory. Found in the Lassen volcanic foothills…

***Acer macrophyllum* Forest Alliance (2111)**

IIB4.d. Douglas-fir is co-dominant with black oak in the tree overstory. One association (*Quercus kelloggii - Pseudotsuga menziesii - Umbellularia californica*) of this hardwood-conifer mix is classified in the foothills region…

***Quercus kelloggii* Alliance (1312)**

Class B. Shrubland Vegetation

Group I. Shrublands dominated by sclerophyllous temperate shrubs (with leaves hardened by a waxy cuticle). They are dominated by typical chaparral shrub genera, including chamise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos*), scrub oaks (*Quercus*), and ceanothus (*Ceanothus*), etc. …

I.A. The overstory is characterized by a species of shrub oak (*Quercus*), Deerbrush (*Ceanothus integerrimus*) or Birchleaf Mountain-mahogany (*Cercocarpus montanus* = *C. betuloides*) that is dominant or that shares dominance with other chaparral species in the shrub overstory …

IA.1. Deerbrush (*Ceanothus integerrimus*) or Brewer oak (*Quercus garryana* var. *breweri*) occurs alone or with other chaparral shrub species in the overstory. Found primarily on volcanic substrates in the northern portion of the study area **[Southern Vancouverian Montane Deciduous Scrub Group (6100)]**…

IA1.a. Brewer oak is typically present as a sub-dominant shrub to deerbrush (*Ceanothus integerrimus*). Woodbalm (*Lepechinia calycina*) and California redbud (*Cercis occidentalis*) are frequently present with low to moderate cover…

***Ceanothus integerrimus* Alliance (6110)**

IA1.b. Brewer oak is dominant to co-dominant in the shrub canopy and may form an intermittent to continuous shrub canopy with other shrubs such as birchleaf Mountain-mahogany (*Cercocarpus montanus*) and poison oak (*Toxicodendron diversilobum*)…

***Quercus garryana* var. *breweri* Shrubland Alliance (Provisional) (6111)**

IA1.c. Deerbrush (*Ceanothus integerrimus*) dominates or co-dominates in the shrub canopy with other chaparral species such as toyon (*Heteromeles arbutifolia*), hoary coffeeberry (*Rhamnus tomentella*), and California yerba santa (*Eriodictyon californicum*). Other shrubs such as Brewer oak (*Quercus garryana* var. *breweri*), woodbalm (*Lepechinia calycina*), and California redbud (*Cercis occidentalis*) may be present…

***Ceanothus integerrimus* Shrubland Alliance (6110)**

IA.2. Leather oak (*Quercus durata*) is dominant or co-dominant in the shrub canopy and may intermix with chamise (*Adenostoma fasciculatum*), whiteleaf manzanita (*Arctostaphylos viscida*), and other shrubs. Foothill pine (*Pinus sabiniana*) or other trees may be emergent and creeping sage (*Salvia sonomensis*) may grow in the understory **[Californian serpentine chaparral Group (4300)]**…

***Quercus durata* Shrubland Alliance (4310)**

IA.3. Interior live oak (*Quercus wislizeni*) is dominant or co-dominant in the shrub/tree canopy …

IA3.a. Interior live oak (*Quercus wislizeni*) is dominant or co-dominant at >30% relative cover, with other species in the overstory. Scrub oak (*Quercus berberidifolia*) and canyon live oak (*Quercus chrysolepis*), if present, occur at lower cover. Interior live oak may be associated with north-slope chaparral species such as ceanothus, California yerba santa (*Eriodictyon californicum*), or holly-leaf redberry (*Rhamnus ilicifolia*)…

***Quercus wislizeni* Woodland Alliance (1111)**
Note: code 4410 in the map refers to this alliance when *Q. wislizeni* has a shrub stature

IA3.b. Interior live oak is characteristically present with >5% cover. Whiteleaf manzanita (*Arctostaphylos viscida*) is typically dominant or co-dominant with interior live oak. If chamise (*Adenostoma fasciculatum*) is present, it usually has lower relative cover than interior live oak…

***Arctostaphylos viscida* Alliance (4112)**

IA.4. Scrub oak (*Quercus berberidifolia*) and/or Birchleaf Mountain-mahogany (*Cercocarpus montanus*) is dominant or co-dominant in the shrub canopy **[California Mesic Chaparral Group (4200)]…**

IA.4.a. Scrub oak (*Quercus berberidifolia*) is dominant or co-dominant in the shrub canopy. Other shrubs that may intermix include birchleaf Mountain-mahogany (*Cercocarpus montanus*), California yerba santa (*Eriodictyon californicum*), manzanita (*Arctostaphylos*), Foothill ash (*Fraxinus dipetala*), and toyon (*Heteromeles arbutifolia*). This vegetation type is relatively localized in the northern portion of the study area …

***Quercus berberidifolia* Shrubland Alliance (4210)**

I.A.5. Birchleaf Mountain-mahogany (*Cercocarpus montanus*) characterizes the shrub overstory alone or with wedgeleaf Ceanothus (*Ceanothus cuneatus*), forming an open to intermittent canopy. Other shrubs that may intermix at low cover include California brickellbush (*Brickellia californica*), California redbud (*Cercis occidentalis*), poison oak (*Toxicodendron diversilobum*), and chaparral honeysuckle (*Lonicera interrupta*)…

***Cercocarpus montanus* Shrubland Alliance (4211)**

I.B. Wedgeleaf Ceanothus (*Ceanothus cuneatus*), chamise (*Adenostoma fasciculatum*), California yerba santa (*Eriodictyon californicum*), and/or a manzanita (*Arctostaphylos*) species is co-dominant to dominant in the shrub canopy **[primarily California Xeric Chaparral Group (4100)]**…

IB.1. California yerba santa (*Eriodictyon californicum*) dominates the shrub canopy with low to moderate cover. Wedgeleaf ceanothus (*Ceanothus cuneatus*) and chamise (*Adenostoma fasciculatum*) may intermix with low cover…

***Eriodictyon californicum* Shrubland Alliance (4114)**

IB.2. California yerba santa (*Eriodictyon californicum*) and/or deer weed (*Lotus scoparius*) form an open to continuous shrub canopy as sub- to co-dominants with chamise (*Adenostoma fasciculatum*). No other shrub species has significant cover in the overstory. The understory is comprised of non-native forbs and grasses…

***Adenostoma fasciculatum* Alliance (4111)**

IB.3. Wedgeleaf ceanothus (*Ceanothus cuneatus*) dominates the shrub canopy. It may be the sole dominant or may mix with other shrubs such as California yerba santa, toyon (*Heteromeles arbutifolia*), holly-leaf redberry (*Rhamnus ilicifolia*), California Redbud (*Cercis occidentalis*), flannelbush (*Fremontodendron californicum*), and poison oak (*Toxicodendron diversilobum*). Found especially on serpentine or volcanic substrates…

***Ceanothus cuneatus* Shrubland Alliance (4113)**

IB.4. Wedgeleaf ceanothus and chamise (*Adenostoma fasciculatum*) co-dominate in an intermittent to continuous shrub canopy with California yerba santa (*Eriodictyon californicum*), holly-leaf redberry (*Rhamnus ilicifolia*), and other chaparral species intermixing at low cover. The herb layer is sparse with silver European hairgrass (*Aira caryophyllea*) and other herbs comprising an open understory…

***Ceanothus cuneatus* Shrubland Alliance (4113)**

IB.5. Birchleaf Mountain-mahogany (*Cercocarpus montanus*) and wedgeleaf ceanothus form an open to intermittent shrub canopy, where the two species may co-dominate, or either species may be dominant. Other shrub species including poison oak (*Toxicodendron diversilobum*) and chaparral honeysuckle (*Lonicera interrupta*) may intermix at low cover. Found primarily on volcanic soils in the northern portion of the study area…

***Cercocarpus montanus* Shrubland Alliance (4211)**

IB.6. Common manzanita (*Arctostaphylos manzanita*) dominates the shrub canopy…

***Arctostaphylos manzanita* Shrubland Alliance (4115) ***

IB.7. Ione manzanita (*Arctostaphylos myrtifolia*) is dominant or co-dominant in the shrub canopy (>30% relative cover). May occur with *Adenostoma fasciculatum*, *Arctostaphylos manzanita*, *A. viscida*, *Baccharis pilularis*, *Eriodictyon californicum*, *Frangula californica* spp. *tomentella, Lotus scoparius*, *Quercus berberidifolia*, and *Q. wislizeni*.

***Arctostaphylos myrtifolia* Shrubland Alliance (4117) ***

IB.8. Whiteleaf manzanita (*Arctostaphylos viscida*) intermixes with a variety of associated shrubs in the canopy. It may be dominant or co-dominant with shrubs like chamise (*Adenostoma fasciculatum*), toyon (*Heteromeles arbutifolia*), and shrubby trees of interior live oak (*Quercus wislizeni*)…

***Arctostaphylos viscida* Shrubland Alliance (4112)**

Additional Alliance Notes:

1). When whiteleaf manzanita occurs on gabbro substrate with chamise, the manzanita may have lower (<30% relative cover) or trace cover. Creeping sage (*Salvia sonomensis*) often characterizes the understory.

2). When chamise is present with significant cover on non-gabbro soils, whiteleaf manzanita must have ≥30% relative shrub cover to be classified in this alliance (if <30% relative cover on other soils, it should be classified within the ***Adenostoma fasciculatum* Shrubland Alliance**).

IB.9. The overstory is dominated by chamise (*Adenostoma fasciculatum*) alone or in shared dominance with other chaparral species such as common manzanita (*Arctostaphylos manzanita*), toyon (*Heteromeles arbutifolia*), or California yerba santa (*Eriodictyon californicum*)…

***Adenostoma fasciculatum* Shrubland Alliance (4111)**

Additional Alliance Notes (to distinguish this from others):

1). When chamise occurs on gabbro substrate with or without whiteleaf manzanita, the vegetation is classified to the ***Arctostaphylos viscida* Shrubland Alliance (4112).** Either species may have variable cover and may not be present. Creeping sage (*Salvia sonomensis*) often characterizes the understory.

2). When whiteleaf manzanita occurs with chamise on non-gabbro substrate, the manzanita has <30% relative cover and is sub-dominant to chamise. Toyon (*Heteromeles arbutifolia*) is often present and may be similar in cover to the manzanita. Found primarily on sedimentary, volcanic, and serpentine substrates.

3). When wedgeleaf ceanothus (*Ceanothus cuneatus*) and chamise (*Adenostoma fasciculatum*) co-dominate in the overstory with other chaparral shrubs occurring as sub-dominants [e.g. California yerba santa (*Eriodictyon californicum*), holly-leaf redberry (*Rhamnus ilicifolia*)] it is classified to the ***Ceanothus cuneatus*** **Shrubland Alliance (4113)**.

Group II. Shrublands dominated by scale-like or broad-leaved species. These are generally considered to be part of desert transition, riparian, or other more soft-leaved shrub habitats; including Coyote brush (*Baccharis pilularis*), California Juniper (*Juniperus californica*), poison oak (*Toxicodendron diversilobum*), willows (*Salix* spp.), Coffeeberry (*Frangula californica*), as well as dogwood (*Cornus sericea*) and the introduced blackberry (*Rubus armeniacus*).

II.A. California Juniper (*Juniperus californica*) is the sole dominant tall shrub or tree in the overstory. In the active growing season, a variety of herbs may be abundant in the understory…

Juniperus californica **Woodland Alliance (1212)**

II.B. Upland stands dominated by shrubs that have broad-leaved, deciduous leaves **[mostly California Coastal Evergreen Scrub Group (4500) and Vancouverian Coastal Deciduous Shrubs Group (6300)]**…

IIB.1. Deerbrush (*Ceanothus integerrimus*) dominates or co-dominates in the shrub canopy with other chaparral species such as toyon (*Heteromeles arbutifolia*), hoary coffeeberry (*Rhamnus tomentella*), and California yerba santa (*Eriodictyon californicum*). Other shrubs such as Brewer oak (*Quercus garryana* var. *breweri*), woodbalm (*Lepechinia calycina*), and California redbud (*Cercis occidentalis*) may be present…

Ceanothus integerrimus **Shrubland Alliance (6110)**

IIB.2. Poison oak (*Toxicodendron diversilobum*) dominates the shrub overstory. Other shrubs such as holly-leaf redberry (*Rhamnus ilicifolia*), wedgeleaf ceanothus (*Ceanothus cuneatus*), and blue elderberry (*Sambucus mexicana*) may intermix at low cover…

Toxicodendron diversilobum **Shrubland Alliance (6301)**

IIB.3. Coyote brush (*Baccharis pilularis*) dominates the shrub overstory in disturbed areas that may have been cleared or burned. Emergent trees, additional shrub species, and a variety of forbs and grasses often intermix with low cover …

Baccharis pilularis **Shrubland Alliance (4420) ***

IIB.4. Hoary coffeeberry (*Rhamnus tomentella*) dominates the shrub canopy…

Frangula californica **ssp. *tomentella* (=*Rhamnus tomentella*) Shrubland Alliance (4501)**

IIB.5. A broom (e.g., *Cytisus scoparius, Genista monspessulana*, etc) dominates the shrub canopy to the exclusion of other shrubs/trees…

Broom (*Cytisus scoparius* and others) Semi-natural Stands (4610) *

II.C. Stands dominated by one or more riparian and/or wetland species, including California rose (*Rosa californica*), Himalaya blackberry (*Rubus armeniacus*), Button-willow, (*Cephalanthus occidentalis*), tamarisk (*Tamarix*), willow (*Salix*), or mulefat (*Baccharis salicifolia*) in the shrub layer **[Including Southwestern North American Riparian/Wash Scrub Group and Southwestern North American Introduced Riparian Scrub Group (6200)]**…

IIC.1. California rose (*Rosa californica*) characterizes the shrub overstory. *Rubus armeniacus* may be sub-dominant to co-dominant…

***Rosa californica* Shrubland Alliance (6401)** †

IIC.2. Himalaya blackberry (*Rubus armeniacus*) is the sole dominant in the shrub overstory. Other shrubs such as California wild grape (*Vitis californica*), coyote brush (*Baccharis pilularis*), and hoary coffeeberry (*Rhamnus tomentella*) may occur at low cover. Stands may occur adjacent to riparian tree or wetland herbaceous types…

***Rubus armeniacus* Herbaceous Semi-Natural Stands (6213)**

IIC.3. Button-willow (*Cephalanthus occidentalis*) forms an open to intermittent shrub canopy along exposed, sandy/cobbly streambeds. Oregon ash (*Fraxinus latifolia*) or red willow (*Salix laevigata*) may intermix in the overstory…

***Cephalanthus occidentalis* Shrubland Alliance (6214)**

IIC.4. California brickellbush (*Brickellia californica*) dominates an open shrub canopy with low cover. Typically found on gravel bars adjacent to riparian corridors. Riparian trees and/or shrubs may dominate adjacent vegetation and have low cover in these stands…

***Brickellia californica* Provisional Shrubland Stands (6215)**†

IIB.5. Red-osier dogwood (*Cornus sericea*) dominates the shrub overstory. Other shrubs such as California redbud (*Cercis occidentalis*) and poison oak (*Toxicodendron diversilobum*) may be sub-dominant in the understory…

***Cornus sericea* Shrubland Alliance** †

IIC.6. Mulefat (*Baccharis salicifolia*) is dominant in the open to intermittent shrub overstory.

***Baccharis salicifolia* Shrubland Alliance (6210) ***

IIC.7. Tamarisk (*Tamarix*) dominates in the shrub canopy. Other trees or shrubs may be present at low cover, including oaks (*Quercus* spp.), willows (*Salix* spp.) and blackberries (*Rubus* spp.)…

***Tamarix* sp. Shrubland Semi-Natural Stands (6212)**

IIC.8. One or more willow species (*Salix spp*.) dominate the shrub layer, generally considered to be 5 m or less in height. (Note: some shrub willows may be tall enough to be identified as trees in the Foothills and thus, are also included in the tree-overstory section of this key)…

IIC.8.a. Arroyo willow (*Salix lasiolepis*) is dominant as a shrub or low tree, with at least 10% absolute cover (and >60% relative cover). Himalaya blackberry (*Rubus armeniacus*) and California rose (*Rosa californica*) may occur in the understory with a variety of wetland shrubs and herbs…

***Salix lasiolepis* Shrubland Alliance (6217)**

IIC.8.b. Narrow-leaf willow (*Salix exigua*) is characteristically present as a dominant or co-dominant shrub, forming an open to continuous canopy along riparian corridors. Understory shrubs may include California brickellbush (*Brickellia californica*) and Himalaya blackberry (*Rubus armeniacus*). Other willow species may be present as sub-dominants with low cover…

***Salix exigua* Shrubland Alliance (6211)**

IIC.8.c. Red willow (*Salix laevigata*) is the sole dominant in the overstory layer with at least 10% cover. Arroyo willow (*Salix lasiolepis*) may occur as a sub- or co-dominant (with at least 10% cover) in the shrub or low tree layer. Himalaya blackberry (*Rubus armeniacus*) and mugwort (*Artemisia douglasiana*) may grow in the understory with a variety of other herbs and shrubs…

***Salix laevigata* Woodland/Forest Alliance (3111)**

Class C. Herbaceous Vegetation

Herbaceous stands found in wetland settings or in seasonally moist to dry areas. Includes marshes, meadows, upland grasslands, mesa tops, swales, and vernal pools (water or wet ground present throughout the growing season). Stand identification is contingent upon appropriate phenology…

I.A. Passively irrigated pasture lands dominated by *Agrostis, Festuca, Phalaris,* and other perennial or tall annual plants …

Vancouverian and Rocky Mountain Naturalized Perennial Grassland Group (7102)

I.B. Wetland vegetation dominated by native plants

IB.1. Wetlands dominated by species of cattail (*Typha*) or bulrush (*Schoenoplectus*)…

Arid West Freshwater Emergent Marsh Group (7300)

IB.1.a. A species of *Typha* dominates the herbaceous overstory…

***Typha* (*angustifolia, latifolia, domingensis*) Herbaceous Alliance (7310)** †

IB.2. Wetlands dominated by creeping wildrye (*Leymus triticoides*) rushes (*Juncus* spp.), sedges (*Carex* spp.), deergrass (*Muhlenbergia rigens*), monkeyflowers (*Mimulus* spp.), or other herbs …

Californian Warm Temperate Marsh/Seep Group (7200)

I.C. Non-native grasslands in moist to upland settings with absolutely no native component…

Mediterranean California Naturalized Annual and Perennial Grassland Group (7101)

I.D. Grasslands, meadows, and vernal pools comprised of native annuals and perennials along with non-natives…

ID.1. Grasslands with a native component including serpentine and volcanic tableland grasslands and the typical "California Annual Grasslands"…

Californian Annual and Perennial Grassland Macrogroup (7100)

ID.2. Wetlands or vernal pools not forming complexes with upland grasslands. Includes vegetation dominated by *Eleocharis macrostachya, Trifolium variegatum, Downingia, Lasthenia,* and *Eryngium* species…

Californian Mixed Annual/Perennial Freshwater Vernal Pool / Swale Bottomland Group (7600)

ID.3. Vernal pool and upland grassland complexes consisting of the two types listed directly above (**ID.1.** & **ID.2.**)…

Vernal Pool & Californian Annual and Perennial Grassland Matrix Mapping Unit (7400)

Class D. Sparsely Vegetated, Water, and Urbanized Land Use and Land Cover Types

Areas that have anthropogenic impacts including agricultural and urban settings, and areas that are sparsely vegetated including open and rocky uplands, streambeds, and lacustrine areas.

I.A. Areas impacted by Urban Development…

IA.1. Agriculture including orchards, hayfields without fallow annual grasses dominating, and horse ranches (including corrals, tracks, associated farm buildings)…

Agriculture (9200)

IA.2. Developed areas including urban, suburban, and isolated settlement areas with groups of houses…

Built up & Urban Disturbance (9300)

IA.2.a. Fully developed areas with build up and disturbance, originating from an intensely developed urban core, and includes large built-up areas usually composed of 7-13 houses per 8 acre and at least 1 square mile (640ac) in size …

Urban Window (9310)

I.B. Areas of Little or No Vegetation (9400)…

IB.1. Areas with rock outcrops, canyons and cliffs with sparse vegetation cover …

Cliffs & Rock Outcroppings (9401)

IB.2 Riparian and lakeshore areas with sparse vegetation cover…

Riverine & Lacustrine Flats & Streambeds (9402)

IB.3. Areas appearing sparsely vegetated such as recently cleared areas…

Undefined Areas with Little or No Vegetation (9403)

I.C. Areas with Open Water (9800)…

IC.1. Riparian stream corridors with open water and perennial flooding…

Perennial Stream Channels (9801)

IC.2. Large man-made lakes and other larger basins with water…

Reservoirs (9802)

IC.3. Smaller man-made ponds as well as natural lake basins with water…

Small Earthen Dam Ponds & Natural Lakes (9803)

Appendix D. Description of the Sampling Allocation for Map Verification

Sample Allocation - Concepts in General

For this project, we assumed that approximately 20 samples of each of the natural vegetation map units would likely be sufficient to represent the expected statistical variation in the ability of the mappers to correctly map the units. In all accuracy assessments, the statistical underpinnings relate to the properties of a binomial distribution. In summary, selection of samples must be random and should be based on the complementary relationships between the expected accuracy that the producer has for each type, and the margin of error that the user or funder of the project is willing to accept that the estimate is accurate. A more complete explanation of this concept is provided in Cochran (1977). We selected 20 individual samples for each of the mapped vegetation types based on the confidence of the mappers that they could correctly map each unit at least 80% of the time. This prediction coupled with a 0.1 margin of error yields a calculation of 20 samples from the equation used to generate sample sizes based on the binomial distribution. The expected number of samples planned for the project was 1200. Because of vagaries of access, and visual sighting of minimum portions of some of the sampled polygons, we had to eliminate about 45 samples. Thus, the final usable sample size was approximately 1215. The following section describes the GIS-based sample allocation methodology.

Stepwise Sample Allocation for the Accuracy Assessment

Sample allocation for the Northern Sierra Nevada Foothills project employed an analysis that balanced three goals: achieving the target level of samples for each module (300 samples), distributing the samples amongst the vegetated mapping classes, and locating accessible vegetation polygons—given restrictions to publicly accessible land or parcels where landowners had signed permits granting access for surveys, and the ability to reach these areas efficiently.

The first step in the analysis was generally to run the vegetation dataset through a set of tools developed in ArcGIS using model builder. The first tool would remove polygons that intersected wildfire perimeters that had occurred since the time the base imagery had been flown (summer of 2005) as per CalFire data (see http://frap.cdf.ca.gov/projects/fire_data/fire_perimeters/). The second tool seamed together road data from county sources, commercial data, and the US Forest Service, after which the tool selected polygons within a distance of 500 meters of a road. The third separated the vegetated map classes that accuracy assessment was being performed on and eliminated stands that were too small (<0.5 acres), or too large to assess well (>64 acres). The fourth tool removed polygons that had previously been surveyed during reconnaissance or during classification surveys, and the tool selected only polygons within protected areas or parcels where landowners had consented to a have their property surveyed.

The next step was to summarize the number of polygons that were in the module by map unit and set targets for allocation based on what had been previously sampled and how many accessible polygons there were. Here is an example of this process:

MUCode	MUName	assessed	1	2	3	Stand Count4	Target Mod 4	Mod4 stands after tool analysis
1110	*Umbellularia californica*	2	2					
1111	*Quercus wislizeni*	54	14	20	20	2940	12	492
1210	*Pinus sabiniana*	31	14	6	11	592	18	255
1211	*Pinus attenuata*					9	9	3
1212	*Juniperus californica*	3	3			3	3	
1310	*Aesculus californica*	13	6	3	4	198	25	47
1311	*Quercus douglasii*	48	11	19	18	8174	12	877

In this example, *Juniperus californica* alliance was a very rare type to find in the project area. Only 3 polygons had been assessed in modules 1, 2 and 3, and only 3 stands existed in module 4. The target was to get all of them, even though none of them satisfied the conditions of the tool analysis above. On the other hand, *Quercus wislizeni* alliance was one of the most common vegetation types in the area. Though the total number of stands assessed in modules 1 and 2 would have been enough to satisfy an even distribution of polygons between types, the reality is that an even distribution of vegetation types does not exist; and it is also important to have some representation of types throughout the study area.

Finally, starting with the rarest types and progressing to the most common, potential polygons were selected and examined over the base (2005) and recent (2009) imagery for accessibility. Even if rare-typed polygons did not meet the conditions of the model, they could be examined. For example, all three polygons of *Juniperus californica* alliance would have been selected and checked visually using GIS to see if it might be possible to assess them from a distance survey, or if they were in publicly accessible land, but perhaps just a bit further than 500 m from a road. Once rarer polygons were selected, then the more common ones were, and these would be selected from the model subset.

Where possible, stands of different types would be selected within reasonable proximity for walking between stands to make the work more efficient. Polygons were selected in excess of the count required for each module (for example, almost 500 polygons were selected for module 4); and polygons were assigned a priority level, based on whether they were rare, core, or back-up polygons. Field maps made use of these priority levels to help field staff select the best polygons to sample.

Appendix E. Examples of Map Accuracy Assessment Survey Forms and Database

CALIFORNIA NATIVE PLANT SOCIETY – ACCURACY ASSESSMENT FIELD FORM

(Revised March 10, 2009)

Polygon #:	Air photo #:	Date:	Name(s) of surveyors:
412388		11/17/10	(MLE) REC

GPS waypoint #: _____ GPS name: CNPS 1 GPS datum: (e.g. NAD 83) _____ Zone: (10) 11 (circle one)

UTM field reading: UTMN 4 1 8 0 7 3 0 UTME 7 3 5 1 5 1 GPS Error: 19 ft / m / (pdop)

Is GPS within stand? (Yes) / No If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(degrees)

Inclination _____ Estimated waypoint #: _____ Elevation: 244 ft / (m)

Has the vegetation changed since air photo taken? Yes / (No) If Yes, What has changed? _____

Vegetation name / map unit code:	Do you agree with the polygon delineation? (yes) no). If no, explain:
Salix laevigata Woodland / 3111 B	
Primary /	Polygon captures dense Rubus area
Secondary /	
Tertiary	
Confidence in map code ID: L M (H) Explain:	Other types within poly:
% cover Salix + Rubus	

Camera #: 812 Photograph #'s: (N) 3980 – 3983

Slope exposure: NE (NW) SE SW Flat Variable /All Slope steepness: 0° (1-5°) 5-25° >25° (circle one)

Sample size: ½ hectare / (entire) polygon / other _____(% of polygon sampled)

Site location, history, stand age, comments:

Riparian polygon adj to Marshe's Flat road, above Don Pedro Reservoir. Dense understory of R. discolor with variety of mature oaks, large Salix and Juglans trees, fenced off from grazing cows.

Disturbance: Clearing (Yes (No) Level: _____ Exotics (Yes) / No) Level: H (L = 5-25% , M =25-50%, H = >50% (absolute))

Tree DBH : T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), (T4) (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

% Cover - Tree Conifer/Hardwood: – / 12 Shrub: 42 Herbaceous: 2 Total % Vasc Veg cover: 56

Height Class - Conifer/Hardwood: – / 05 Shrub: 03 Herbaceous: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 20 major species), Stratum, and Approximate % cover. Stratum categories: T= Overstory tree, U= Low-Medium Tree, S = Shrub, H= Herb, N= Non-vascular. *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	Strata	Species	% cover
T	Quercus douglasii	2	T	Juglans regia	1
T	Quercus wislizeni	2	H	Poaceae	2
T	Quercus lobata	1			
S	Rubus discolor	40			
S	Vitis californica	3			
S	Cercis occidentale	1			
T	Juglans hindsii	4			
T	Salix laevigata	6			
T	Quercus kelloggii	1			

Rare or Unusual Species: Estimated Population Size:

Dom vegetation cover (phenology): full / (partial) Explain: Trees losing leaves

Adjacent alliance and direction: 7107 / NE /

CALIFORNIA NATIVE PLANT SOCIETY – ACCURACY ASSESSMENT FIELD FORM

(Revised March 10, 2009)

Polygon #:	Air photo #:	Date:	Name(s) of surveyors:
412681		11/23/2010	(REC) DMR

GPS waypoint #: _____ GPS name: CNPS III GPS datum: (e.g. NAD 83) _____ Zone: (10) / 11 (circle one)

UTM field reading: UTMN 4 1 6 7 2 8 8 UTME 7 4 8 0 9 7 GPS Error: 2.1 ft / m / pdop

Is GPS within stand? Yes / (No) If No, cite from GPS point to stand, the distance 62 (in meters) and bearing 222 (degrees)

Inclination ~14 Estimated waypoint #: _____ Elevation: 803 ft / m

Has the vegetation changed since air photo taken? Yes / (No.) If Yes, What has changed? _____

Vegetation name / map unit code:	Do you agree with the polygon delineation? (yes) no). If no, explain:
Arctostaphylos viscida 1 411.2	Avoided burn shrub stand to
Primary	north.
1	
Secondary	
1	
Tertiary	
Confidence in map code ID: L M (H) Explain:	Other types within poly:

Camera #: E 12 Photograph #'s: 4405 - 4408 4409 to SW

Slope exposure: NE NW (SE) SW Flat Variable /All Slope steepness: 0° 1-5° (5-25°) > 25° (circle one)

Sample size: ½ hectare / entire polygon (other) _____ (% of polygon sampled)

Site location, history, stand age, comments: Polygon accessed from hunter's valley access road from J16. Shrub cover is dense throughout the polygon with large boulders emerging from shrub canopy. Adjacent to recently burned shrubland. Polygon within concavity on hillside.

Disturbance: Clearing (Yes / (No) Level: _____ Exotics (Yes / (No) Level: _____ (L = 5-25% , M =25-50%, H = >50% (absolute))

Tree DBH : T1 (<1" dbh), T2 (1-6" dbh), (T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

% Cover - Tree Conifer/Hardwood: 1 / — Shrub: 65 Herbaceous: 1 Total % Vasc Veg cover: 67

Height Class - Conifer/Hardwood: 05 / — Shrub: 04 Herbaceous: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 20 major species), Stratum, and Approximate % cover. Stratum categories: T= Overstory tree, U= Low-Medium Tree, S = Shrub, H= Herb, N= Non-vascular. *% cover intervals for reference:* <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	Strata	Species	% cover
S	Adenostoma fasciculatum	34	N	Moss	8
S	Ceanothus cuneatus	<1	1	Poaceae	1
S	Arctostaphylos viscida	27			
T	Pinus sabiniana	1			
S	Eriodictyon californicum	<1			
S	Heteromeles arbutifolia	3			
S	Chrysothamnus	1			
U	Cersis occidentalis	<1			
N	Lichen	1			

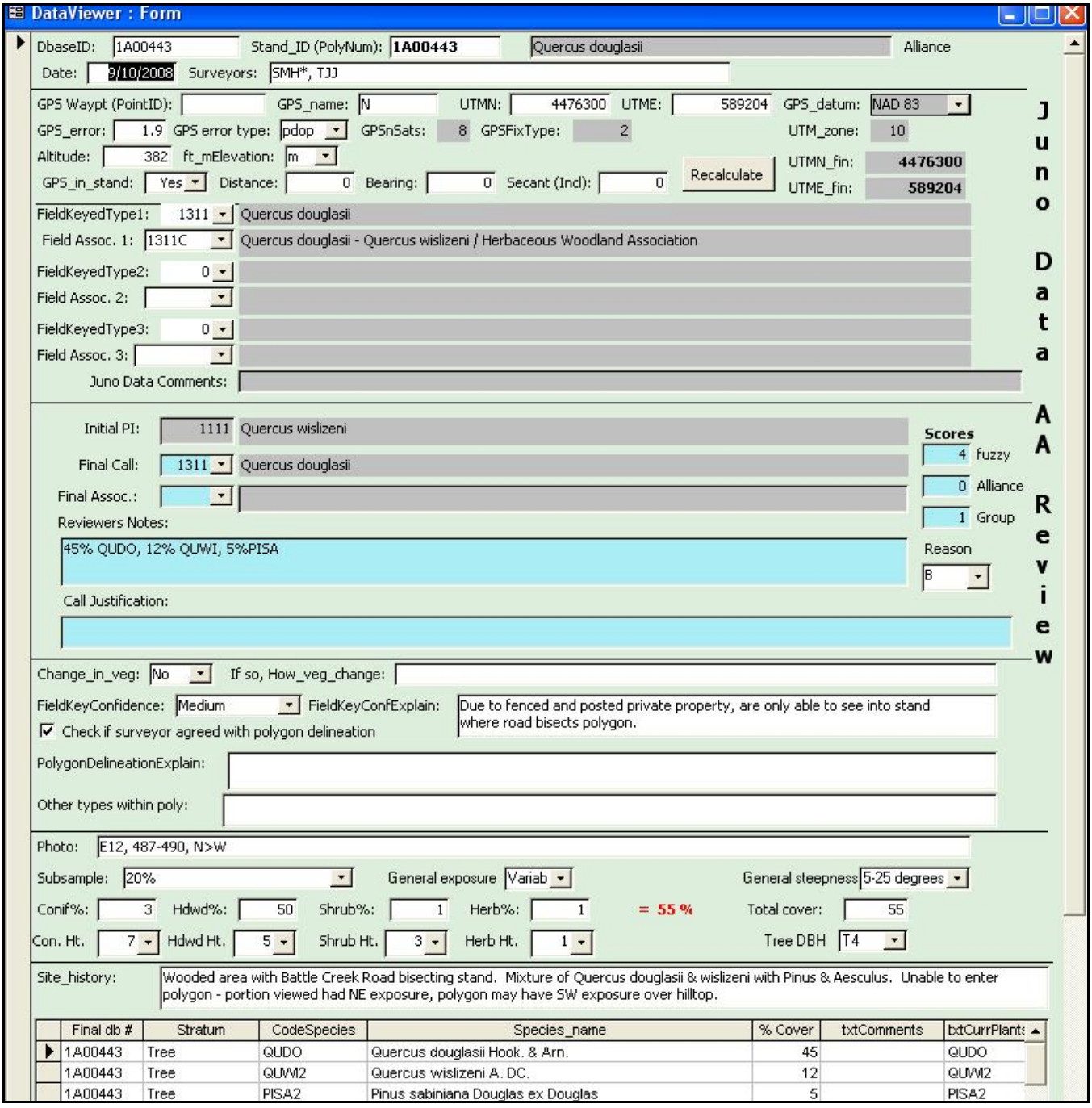
Rare or Unusual Species: Estimated Population Size:

Dom vegetation cover (phenology): (full) partial? Explain: _____

Adjacent alliance and direction: Ar vi / N Quvi-Pisa-Juniper / SW

Recently burned (within last 15yrs)

Example form view of the Accuracy Assessment Database used for recording and scoring AA for the Northern Sierra Nevada Foothills.



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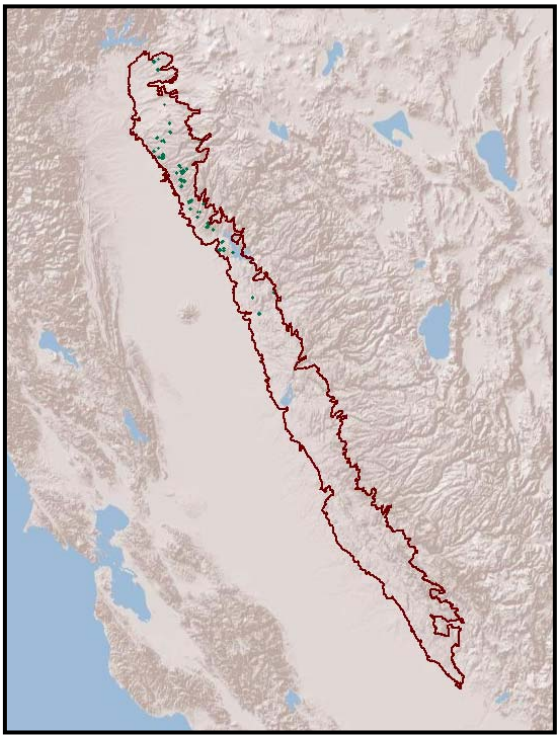
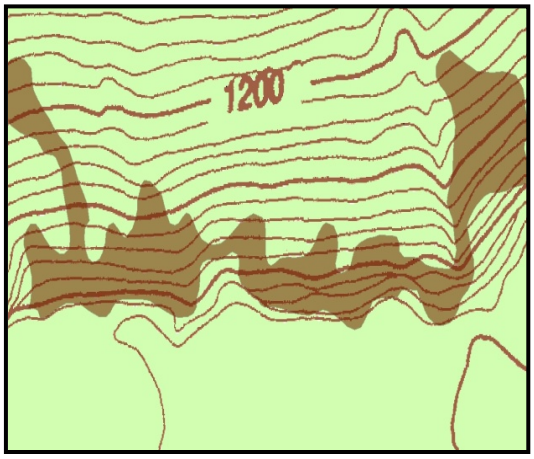
Appendix F. Descriptions of the Vegetation Map Units

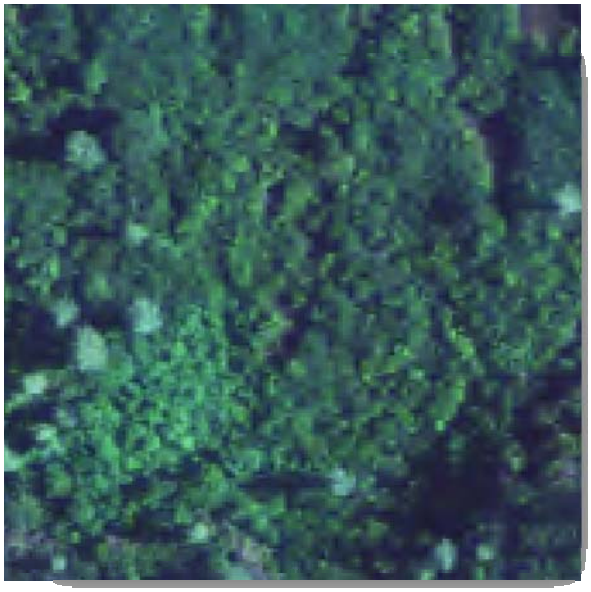
1110 – *Umbellularia californica* (California bay forest) Alliance



Regional Distribution



Topographical Characteristics
Generally steep north trending mid & upper slopes; also a component in narrow riparian corridors with white alder.



PI Signature Characteristics
Example shows brighter bay signature towards center of image with the darker tones of the interior oak along the margins with some foothill pine.

1110 – *Umbellularia californica* (California bay forest) Alliance

MAPPING DESCRIPTION:
Mapped where *Umbellularia californica* dominates or co-dominates the stand; generally in steep northerly trending slopes and often mixing with *Quercus wislizeni.* Cover is generally quite dense, often over 60% in the tree layer. Stands in riparian settings are rarely mapped since they are often a component to other riparian species making it difficult to separate from adjacent types.

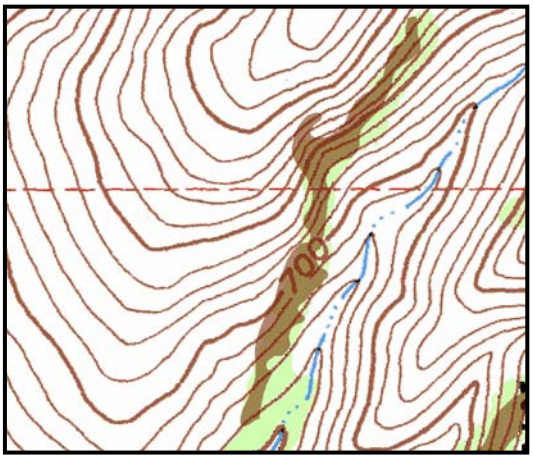
PHOTO INTERPRETATION SIGNATURE:
Narrow crowns generally consistent throughout the stand characterize this type; often with a bright green signature when adjacent to stands of dense Quercus wislizeni which often retain their leaf during longer periods of time resulting in a darker green signature.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1111 – *Quercus wislizeni* generally has a darker green signature

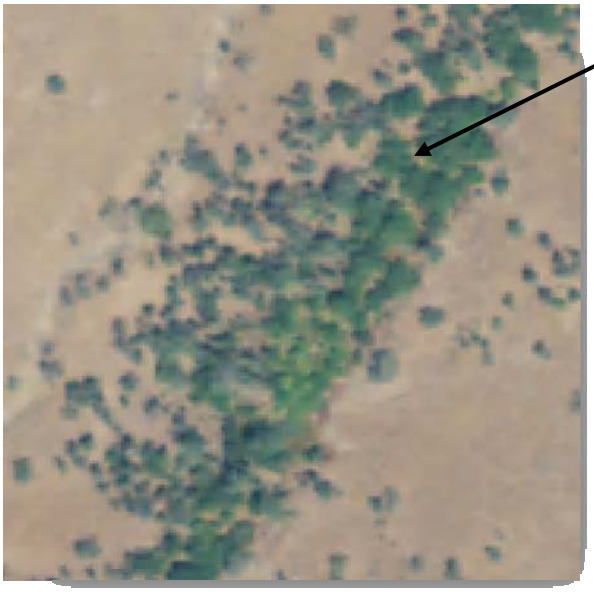
STATISTICS:
- Total Acreage: 559
- Average Polygon Size: 8.7
- Total Polygon Count: 64

1111 – *Quercus wislizeni* (Interior live oak woodland) Alliance

Regional Distribution



Topographical Characteristics
Mapped primarily on moderately steep to steep slopes in a variety of slope positions and topographical directions.



PI Signature Characteristics
Example shows interface between the brighter green signature of interior oak and the blue-gray signature of blue oak (western portion).

1111 – *Quercus wislizeni* (Interior live oak woodland) Alliance

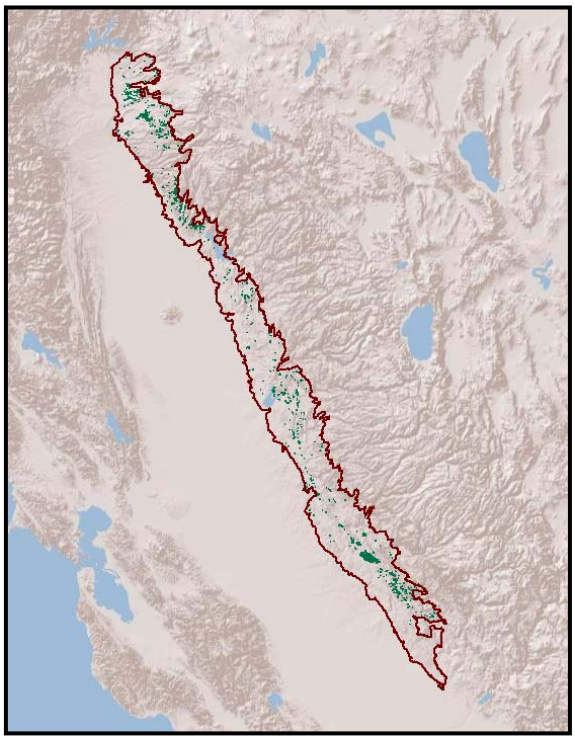
MAPPING DESCRIPTION:
Mapped where *Quercus wislizeni* dominates or at times co-dominates the stand in a variety of settings from dense woodlands to open savanna. In drier settings, *Q. douglasii* often co-dominates in the stand. In stands where other trees are important in the canopy (including *Pinus sabiniana or Aesculus californica)* and both *Q. douglasii & Q. wislizeni* co-dominate, photo interpreters generally map to this alliance. In higher elevation stands where *Q. wislizeni* co-dominates with *Q. kelloggii,* photo interpreters map to the *Q. wislizeni* alliance also. Stands can have a strong dominance of *Pinus sabiniana* in the canopy and still be mapped to the *Q. wislizeni* alliance. **Note:* Where stands take on a shrubby stature, photo interpreters originally assign a separate mapping unit denoting an overall lower height and structure to the vegetation. Stands reflecting these characteristics are probably the same sub species of interior oak; thus, they are included in this alliance with a shorter stature (due to recent fire or other disturbance).

PHOTO INTERPRETATION SIGNATURE:
Stands range from dark to medium green depending on leaf age, associate species and to a lesser degree image color variability. In open settings, crowns are large and rounded, generally larger than Q. douglasii. In dense woodland cover, crowns tend to narrow and vary considerably within the stand. In most circumstances, individual tree crowns are denser than either Q. douglasii or Q. kelloggii.

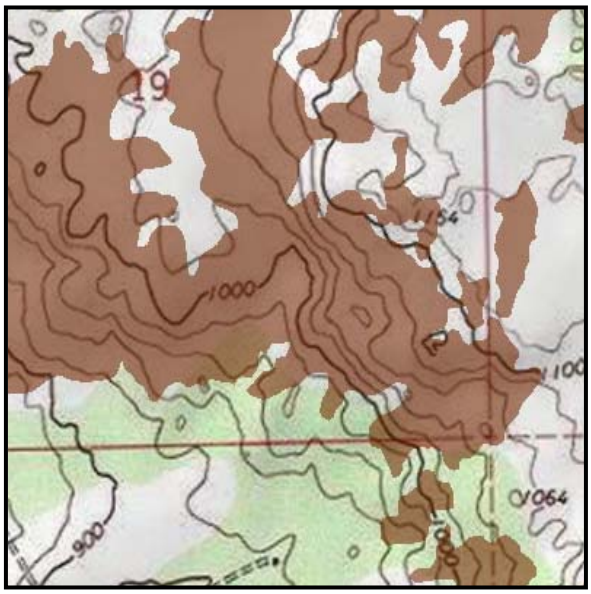
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1110 – *Umbellularia californica* generally has a brighter green signature with narrower crowns and is nearly always found in a dense cover setting.
- 1311 – Where *Q. douglasii* co-dominates the stand, look for presence of other tree species and overall cover densities. In denser more stands with a diversity of species, photo interpreters generally mapped to the *Q. wislizeni* alliance.
- 1312 – *Quercus kelloggii* generally has a brighter green signature and overlaps along the higher elevation range of *Q. wislizeni.* Where stands co-dominate, photo interpreters generally mapped to the *Q. wislizeni* alliance. Where the two stands co-occur, black oak is found on gentler upper slopes trending northerly.
- 1410 – *Quercus chrysolepis* has a brighter green color with a less rounded crown. When occurring nearby interior oak stands, *Q. chrysolepis* is found on steeper slopes closer to the canyon bottom in more protected settings, or adjacent on more northerly trending slopes.

STATISTICS:
- Total Acreage: 315,343
- Average Polygon Size: 14.6
- Total Polygon Count: 21,534

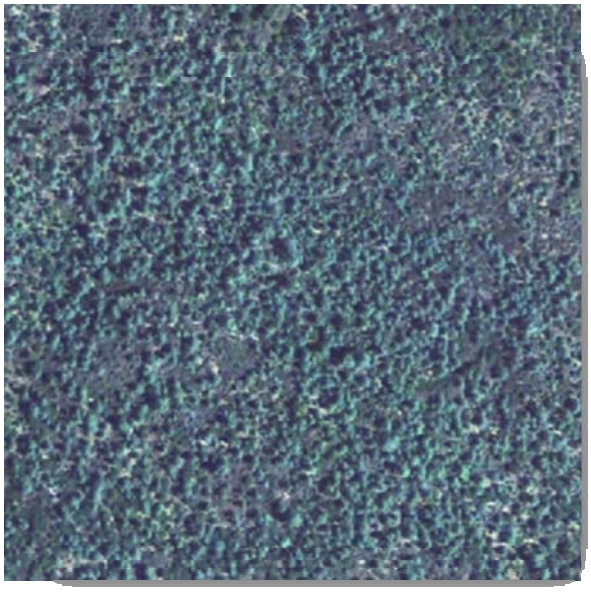
1210 – *Pinus sabiniana* (Ghost or Foothill pine woodland) Alliance



Regional Distribution



Topographical Characteristics
Topographical settings vary considerably.



PI Signature Characteristics
Example depicts dense *Pinus sabiniana* over *Arctostaphylos.*

1210 – *Pinus sabiniana* (Ghost or Foothill pine woodland) Alliance

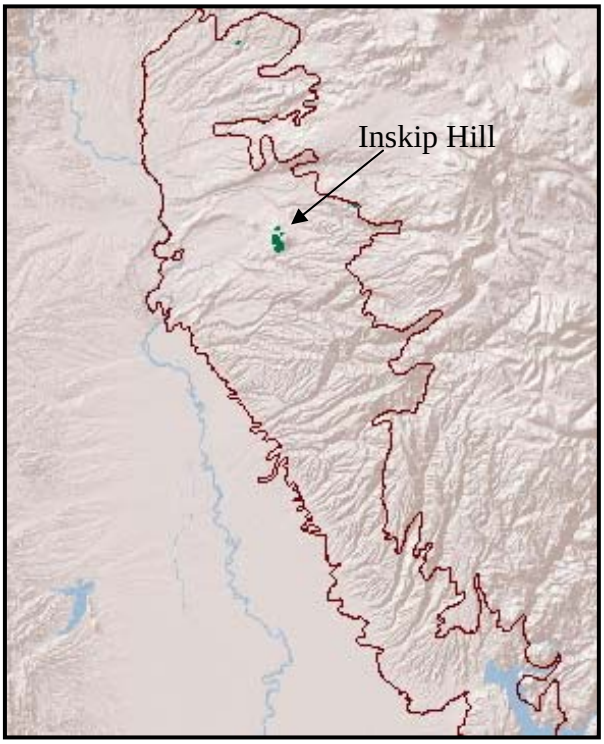
MAPPING DESCRIPTIONS:
Mapped where *Pinus sabiniana* strongly dominates the canopy in open to dense cover. In ultramafic settings, *P. sabiniana* is mapped as a sparse emergent from about 8% to 25% cover over an open to intermittent shrub understory. In woodland settings, this alliance is mapped where oaks are a very minor component to the canopy. In these settings, pines often form a dense cover in a structurally diverse canopy of tall and medium size trees where oaks are often adjacent to the stand.

PHOTO INTERPRETATION SIGNATURE:
Pinus sabiniana is easily recognizable using 1-meter NAIP imagery. The species yields a blue to gray color with an irregularly shaped medium sized crown. Emergent trees are easier to quantify than trees that are approximately the same height as the adjacent oak woodlands. Cover values of very young trees in either oak woodlands or sparse chaparral are difficult to estimate.

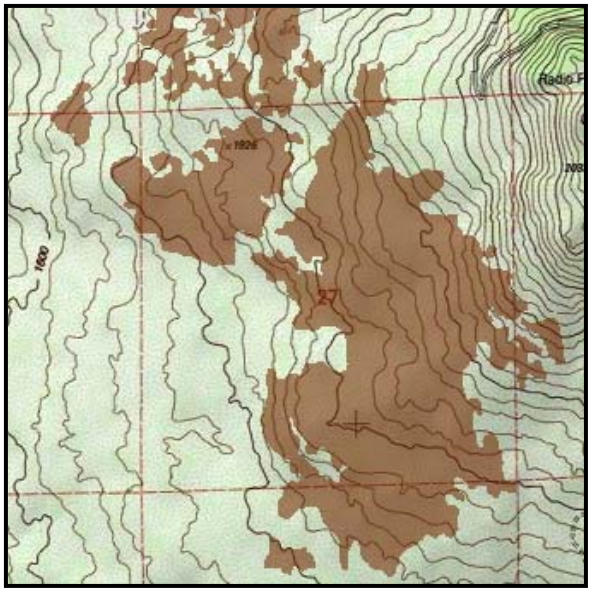
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
Photo interpreters can at times underestimate the oak component in dense stands of *Pinus sabiniana*, especially when oaks are hidden in the sub canopy. In these situations, photo interpreters may classify the stand as *Pinus sabiniana* where ground based assessments may classify the stand as an oak type.

STATISTICS:
- Total Acreage: 18,724
- Average Polygon Size: 9.7
- Total Polygon Count: 1939

1211 – *Pinus attenuata* (Knobcone pine forest) Alliance



Regional Distribution
Isolated patches along eastern NSNF – Most extensive example shown here.



Topographical Characteristics
Generally found on upper slopes and ridges.

PI Signature Characteristics
Dense *P. attenuata* with *P. sabiniana* over *Arctostaphylos* to west.

1211 – *Pinus attenuata* (Knobcone pine forest) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Pinus attenuata* dominates the tree layer in open to dense cover in most cases over a dense understory of chaparral (usually *Arctostaphylos*). Dense stands are often adjacent to chaparral as well. Stands can be adjacent to *Quercus chrysolepis* or *Q. wislizeni* woodlands and oaks were at times mapped as a component to this type.

PHOTO INTERPRETATION SIGNATURE:
Very narrow crowns characterize this species of pine; the usually dense cover forms a stipple like texture which is unique to this type. Image signature generally yields a dark brown color, which is distinct from other pine species. Stands are almost always mapped on upper slopes, spurs and ridgelines.

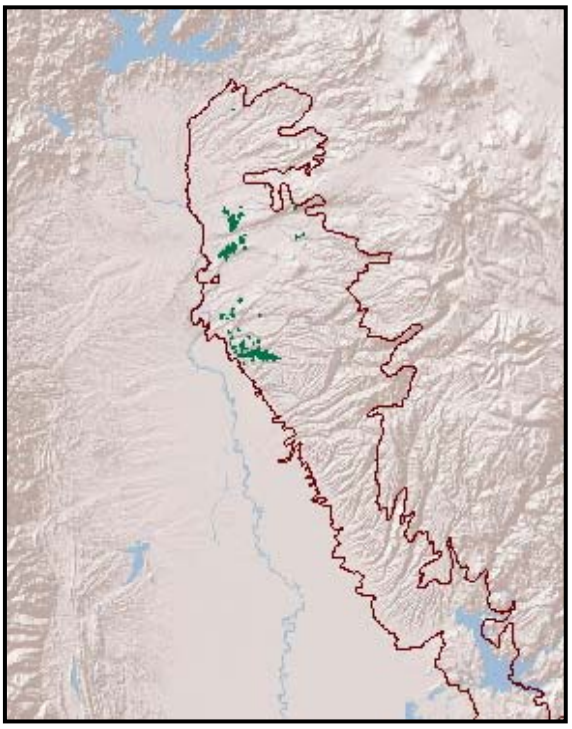
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:

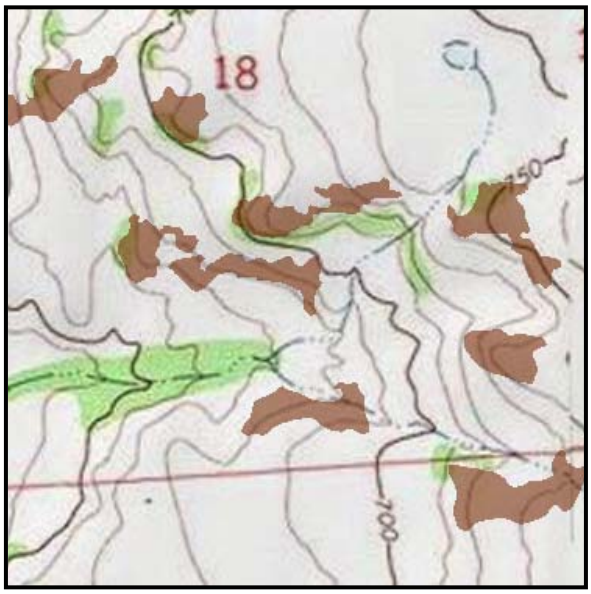
- 2212 – *Pinus ponderosa – Calocedrus decurrens* has a much higher variability in both stand color and texture and is generally greener. Stands of type 2212 are also found in much more mesic settings and at slightly higher elevations.

STATISTICS:

- Total Acreage: 546
- Average Polygon Size: 18.2
- Total Polygon Count: 30

1212 – *Juniperus californica* (California juniper woodland) Alliance





Topographical Characteristics
Found on steep side slopes upslope from dry ravines.

Regional Distribution
Most stands are limited to northern most portion of the study near Ash Creek.

PI Signature Characteristics
Example depicts a fairly dense stand of *J. californica* with sparse *Q. douglasii & P. sabiniana.*

1212 – *Juniperus californica* (California juniper woodland) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Juniperus californica* dominates the stand, generally in open settings. Where *Quercus douglasii* and *J. californica* co-dominate, photo interpreters assigned the stand to the *Q. douglasii* alliance. In stands where *Pinus sabiniana* co-dominates the conifer layer, stands were mapped to the *J. californica* alliance. Some stands were mapped on ultramafic substrate.

PHOTO INTERPRETATION SIGNATURE:
Juniperus californica yields a medium green signature; crowns are rounded with minimal deviation from that shape. Crown density is high and transparency is minimal in all but the least healthy individuals. Stress to the stand dulls the signature color and tone making it sometimes difficult to discern individuals, especially in their characteristically open setting.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:

- 1311 – *Quercus douglasii* with juniper as a co-dominant are mapped to type 1311. In open woodland settings where the two species co-occur, it is often difficult to ascertain relative cover. Thin soil cover can offer some ecological insight in erring with the juniper alliance. Where the two species co-occur, juniper will often occupy the somewhat steeper side slopes of small ravines.
- 1111 – *Quercus wislizeni* often forms denser cover, has a somewhat less rounded more irregular shaped and larger crown, especially in open settings. *Q. wislizeni* generally is found in more mesic environments and rarely on ultramafic soils where juniper can occur.

STATISTICS:

- Total Acreage: 2,334
- Average Polygon Size: 13.2
- Total Polygon Count: 177

1213 – *Callitropsis (Cupressus) macnabiana* (McNab cypress woodland) Alliance

MAPPING DESCRIPTIONS:
Mapped sparingly in open to dense cover in ultramafic settings either in pure stands or with other serpentine endemic shrubs. Most stands mapped are open containing less than 30% cover. Mapped primarily based on plot or reconnaissance data, with a total of five polygons mapped within the study area.

PHOTO INTERPRETATION SIGNATURE:
No reliable photo signature has been established for this type due to its uncommon occurrence in the study area. Stands in other portions of the state yield a signature that varies little from stand to stand and is determined almost exclusively on cover and associated shrub species.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1212 – *Juniperus californica* in ultramafic settings has been difficult to distinguish from *Cupressus macnabiana* in other parts of the state.

STATISTICS:
- Total Acreage: 21
- Average Polygon Size: 4.2
- Total Polygon Count: 5

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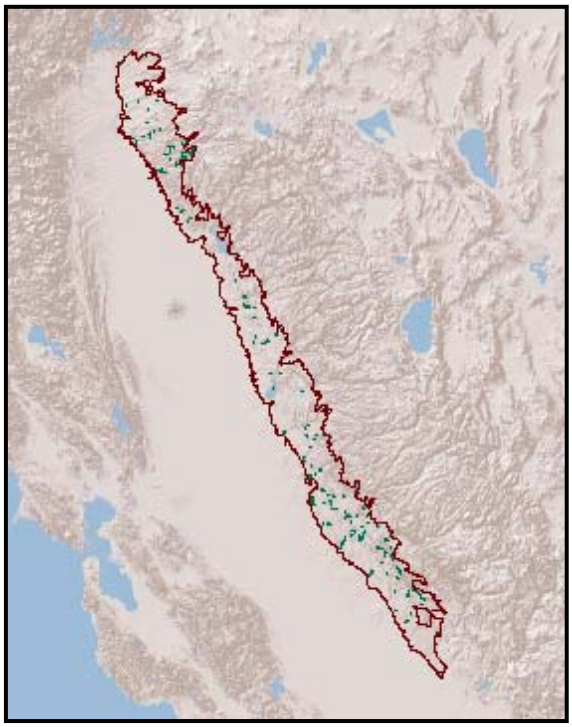
1310 – *Aesculus californica* (California buckeye groves) Alliance



Regional Distribution

Topographical Characteristics
Noted in very steep rocky canyons and on side slopes usually trending north.

PI Signature Characteristics
Example depicts individual trees in early summer leaf stress conditions; interior oak seen in dense patches adjacent to the stand.

1310 – *Aesculus californica* (California buckeye groves) Alliance

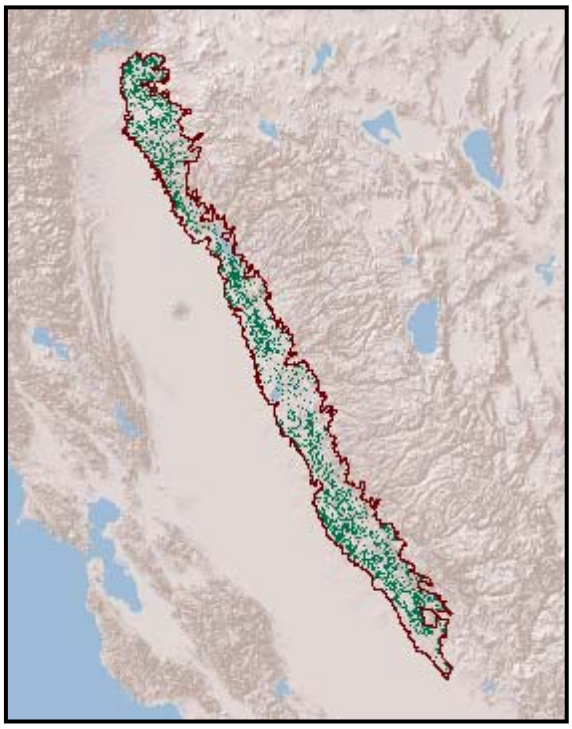
MAPPING DESCRIPTIONS:
Mapped where *Aesculus californica* strongly dominates the tree canopy, generally in open settings, sometimes up to 30% cover. Where *Quercus douglasii* and/or *Q. wislizeni* are a component to the canopy, stands are generally mapped to either of the oak alliances. *A. californica* is also noted in chaparral stands where it mixes with a shrubby *Quercus wislizeni* in a post fire setting. In these settings, the stands are mapped to the *Q. wislizeni* alliance. In stands where *A. californica* strongly dominates, *Q. wislizeni* is often found adjacent in somewhat less severe settings. *A. californica* in generally mapped in very steep north trending, rocky settings.

PHOTO INTERPRETATION SIGNATURE:
A. californica is both drought and cold-season deciduous. In most settings, early summer NAIP imagery reflects the stressing (yellow color) of the leaf before it falls off the plant. At higher elevations where it becomes less common, individual plants tend to be greener, but some stress is still noted. Relatively dense stands are easily recognizable, but it is difficult to ascertain the relative cover of *A. californica* where *Q. wislizeni* becomes a component to the stand.

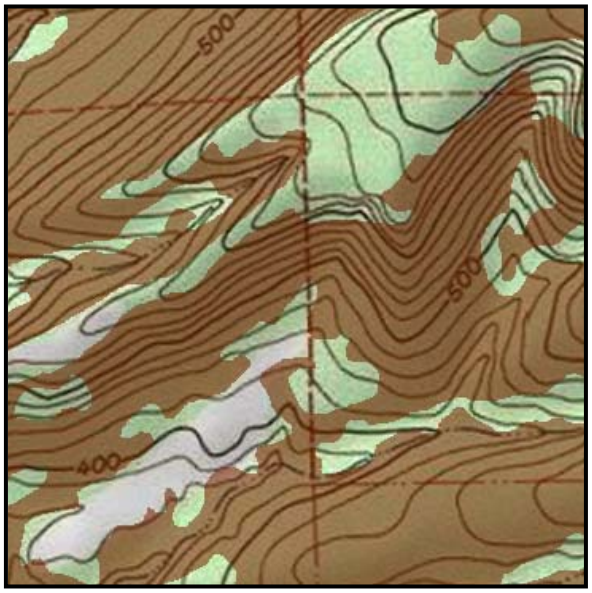
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1111 – *Quercus wislizeni* has a distinct signature when juxtaposed to *Aesculus californica;* however in open settings it is difficult to quantify relative abundance. Generally, photo interpreters map to the *Aesculus californica* alliance more often in a somewhat denser cover where it is easier to see overwhelming dominance of the buckeye.

STATISTICS:
- Total Acreage: 3,466
- Average Polygon Size: 5.01
- Total Polygon Count: 691

1311 – *Quercus douglasii* (Blue oak woodland) Alliance



Regional Distribution



Topographical Characteristics
Found in a variety of topographic settings throughout most of its distribution; restricted to south facing slopes at the higher portion of its range.

PI Signature Characteristics
Example shows open stands of *Quercus douglasii* with about 20-30% cover.

1311 – *Quercus douglasii* (Blue oak woodland) Alliance

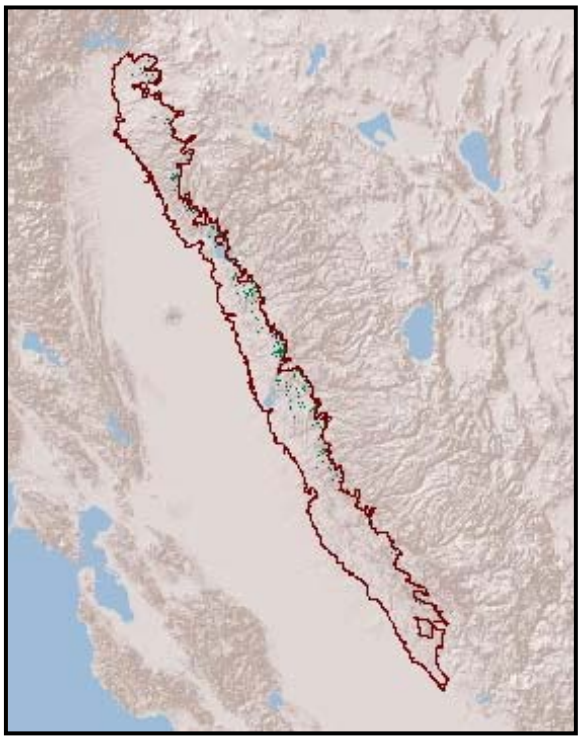
MAPPING DESCRIPTIONS:
Mapped where *Quercus douglasii* dominates or at times co-dominates the stand in open to relatively dense settings, usually with a dense herbaceous understory. *Quercus wislizeni* occasionally co-dominates the stand and in these settings photo interpreters in most cases mapped to the interior oak alliance. In stands where *Aesculus californica* co-dominates, photo interpreters mapped to the *Q. douglasii* alliance. Emergent stands of *Pinus sabiniana* are common especially in denser woodlands where combined cover occasionally is mapped over 60%. Most blue oak woodlands are mapped with covers below 35%. In more open settings, photo interpreters occasionally mapped *Quercus douglasii* with an understory of *Ceanothus cuneatus* and with an herbaceous understory. At higher elevations on upper gentle slopes, *Quercus kelloggii* occasionally mixed with blue oak, usually in a narrow gradient zone. Several polygons in these areas contain both oak species and photo interpreters generally assigned the type depending on which species dominated the stand.

PHOTO INTERPRETATION SIGNATURE:
Quercus douglasii has a characteristic blue-gray signature with a diffuse, irregularly shaped crown varying considerably in size. Stands in more xeric environments trend more to the blue-gray color while stands in mesic settings have a more blue-green signature. *Quercus douglasii* shows leaf stress conditions in late summer and imagery flown early in the season yields less of the characteristic blue signature noted on summer and early fall imagery.

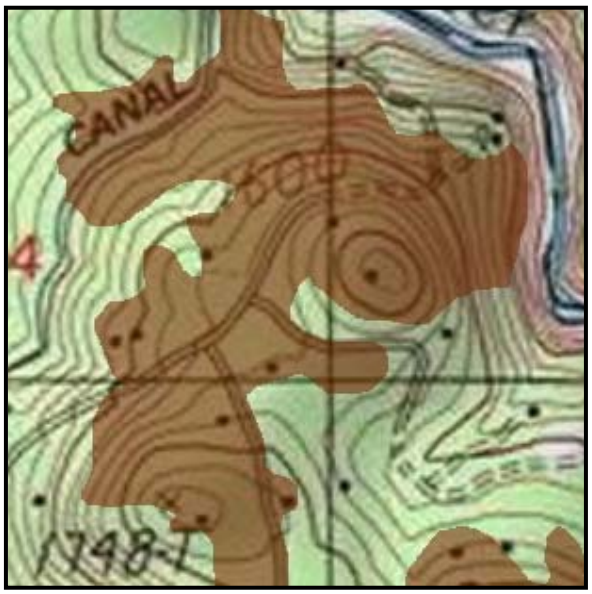
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1111 – *Quercus wislizeni* in xeric settings where it mixes with blue oak is still noticeably greener with a denser crown.
- 1210 – *Pinus sabiniana* has a similar color but the crown shape is more irregular. Overall growth characteristics of the foothill pine yield a significantly different appearance than that of blue oak despite similar color and environment. Where the two species co-occur, *Pinus sabiniana* is often an emergent to the oak canopy.

STATISTICS:
- Total Acreage: 714,904
- Average Polygon Size: 17
- Total Polygon Count: 42,110

1312 – *Quercus kelloggii* (California black oak forest) Alliance



Regional Distribution



Topographical Characteristics
Throughout most of its range, *Q. kelloggii* follows gentle upper slopes and continues downslope on north trending aspects as in the example above.

PI Signature Characteristics
Example shows *Q. kelloggii* in dense woodland with increasing emergent *P. ponderosa* towards the southern portion of the image.

1312 – *Quercus kelloggii* (California black oak forest) Alliance

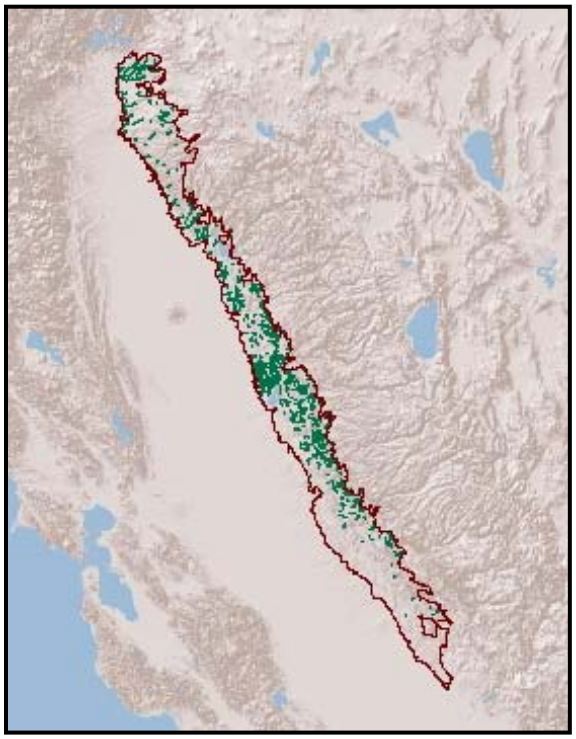
MAPPING DESCRIPTIONS:
Mapped where *Quercus kelloggii* dominates, co-dominates or is a subordinate species in the canopy layer, generally in dense settings. In stands where it mixes with *Q. wislizeni,* photo interpreters generally mapped to the interior live oak alliance. In stands where *Pinus ponderosa* occurs, black oak need only be present and regularly occurring throughout the stand to be mapped to the *Quercus kelloggii* type. In stands where *Q. kelloggii* mixes with *Q. chrysolepis*, photo interpreters generally mapped to the canyon live oak alliance.

PHOTO INTERPRETATION SIGNATURE:
Quercus kelloggii generally yields a brighter green signature than other species of oaks; when mixing in the stand with *Quercus wislizeni*, it is usually somewhat taller with a more diffuse irregularly shaped crown. Higher elevation stands often contain a strong emergent canopy of *Pinus ponderosa* significantly altering the typical hardwood signature. Early spring (April) imagery yields a unique leaf flush condition that is typically a bright blue-green color, much brighter than that of blue oak.

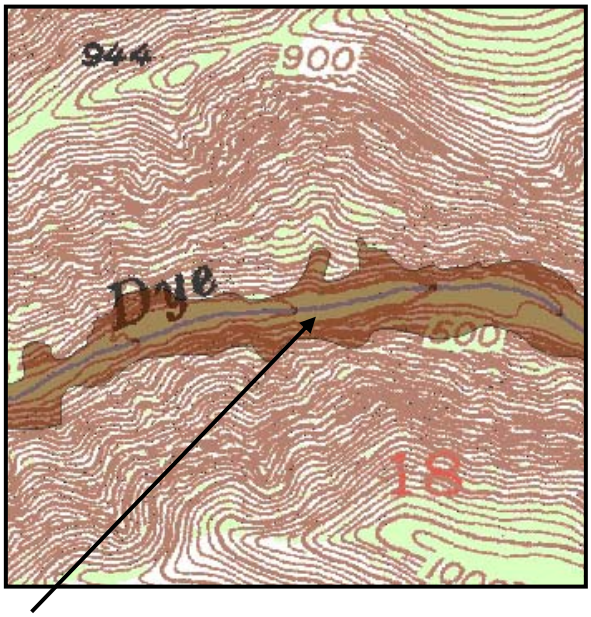
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1111 – *Quercus wislizeni* has a more rounded denser crown and is generally darker green. When the two species co-occur, photo interpreters usually mapped to type 1111. In lower elevation stands, black, interior and blue oak often occur in close proximity to one another. In these settings, black oak will often occupy gentle upper north trending slopes, interior oak will be found on the steeper side slopes and blue oak on gentle to moderately steep south trending slopes.
- 1410 – *Quercus chrysolepis* overlaps in color but has a denser more well defined crown margin even in dense cover.
- Where conifers strongly dominate the stand, photo interpreters look for diversity in the conifer component with minimal amounts of black oak. In these situations, photo interpreters will map to a mixed conifer type (*Pinus ponderosa – Calocedrus decurrens).*

STATISTICS:
- Total Acreage: 98,809
- Average Polygon Size: 16.3
- Total Polygon Count: 6077

1313 – *Quercus lobata* (Valley oak woodland) Alliance



Regional Distribution



Topographical Characteristics
Most extensive stands observed at lowest elevations in very deep soil on broad upper floodplains adjacent to large streams & rivers.

PI Signature Characteristics
Example depicts an extensive gallery forest along Auburn Ravine; note brighter green more diffuse crown with the bluer grey color of *Quercus douglasii* along the northern margins of the image.

1313 – *Quercus lobata* (Valley oak woodland) Alliance

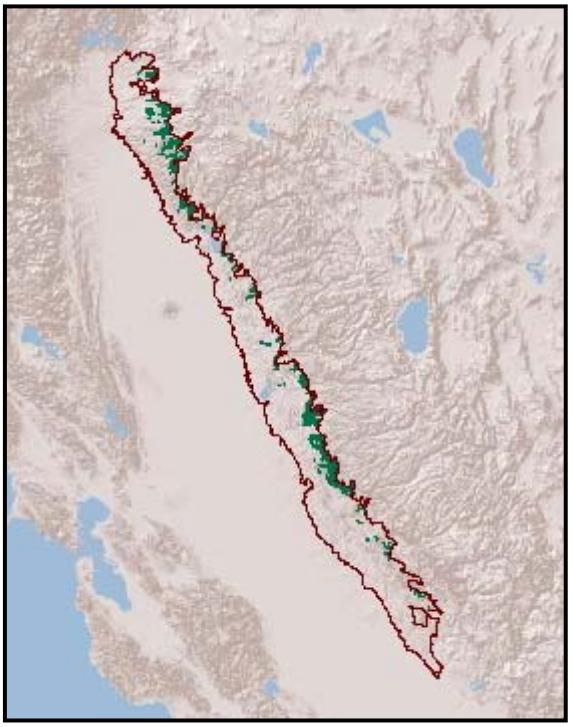
MAPPING DESCRIPTIONS:
Mapped where *Quercus lobata* dominates or co-dominates the stand, either in riparian settings where it generally has at least 30% relative cover or in savanna like environments where it dominates the canopy. Photo interpreters mapped stands ranging in cover from open to dense woodlands and in gallery forest environments along large riparian corridors. In drier settings where valley oak graded into stands of blue oak, photo interpreters mapped the co-dominating species into the blue oak alliance, although these situations were infrequently encountered. In larger riparian settings, photo interpreters were able to separate out higher less frequently flooded stands of valley oak from the true riparian species adjacent but closer to the stream channel. Valley oak stands were noted where soils appeared deep, usually where annual grasses were denser and had a significant weedy component. Irregularly occurring patches of *Rubus* spp. were a common understory component to more open stands of valley oak woodlands especially near streams.

PHOTO INTERPRETATION SIGNATURE:
Quercus lobata has a blue green color and is easily recognizable on early (spring) season imagery in leaf flush conditions. Crowns are often very large and more diffuse than that of interior live oak. Subtle differences in environmental settings aided photo interpreters in separating out small patches of valley oak where *Quercus douglasii* and *Q. wislizeni* occurred nearby. Photo interpreters noted soil depth as a more important indicator of valley oak presence than proximity to stream channel, especially in smaller watershed environments. Valley oak is mapped in broad open woodlands more frequently at lower elevations and is more commonly found in riparian settings at higher elevations. Mid elevations tended to have the least amount of valley oak.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1111 – *Quercus wislizeni* has a smaller, denser more rounded crown, even when occurring in similar deep soil environments where valley oak is expected.
- 1311 – *Quercus douglasii* shares the diffuse nature of the valley oak crown but is usually much smaller. Photo interpreters rarely noted overlap between the two species.
- 1312 – *Quercus kelloggii* can have a similar color and both species have openings in the crown structure; however crowns are usually smaller and less rounded. Stands of black oak tend to occur just upslope from valley oak on north trending slopes. Co-occurrence of the two species tends to overlap in very narrow zones often below the MMU.

STATISTICS:
- Total Acreage: 21,355
- Average Polygon Size: 8.1
- Total Polygon Count: 2,624

1410 – *Quercus chrysolepis* (Canyon live oak forest) Alliance



Regional Distribution

Topographical Characteristics
In most of its range, *Quercus chrysolepis* is found on steep north trending slopes, more commonly in low to mid positions.

PI Signature Characteristics
Example shows a small patch of *Q. chrysolepis* with *Q. wislizeni* along the margins of the image. Canyon oak has larger crowns and more "flush" conditions in the leaf.

1410 – *Quercus chrysolepis* (Canyon live oak forest) Alliance

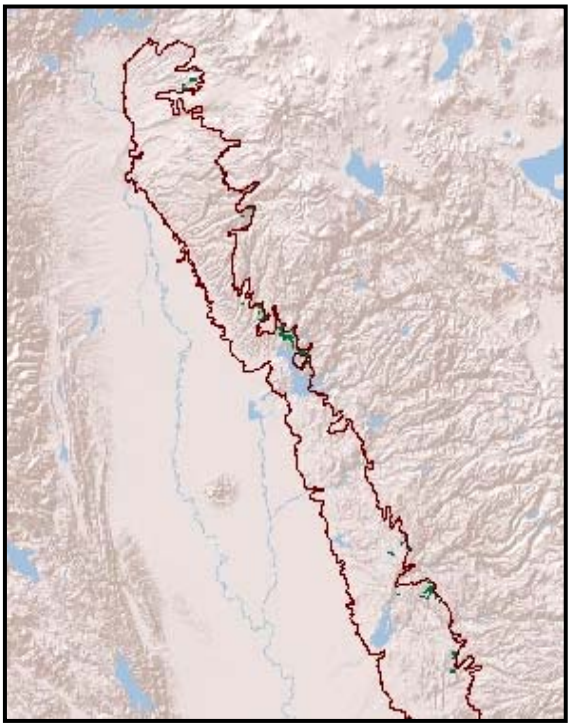
MAPPING DESCRIPTIONS:
Mapped where *Quercus chrysolepis* dominates or co-dominates the stand in dense settings; most frequently as a strong dominant but occasionally with a co-dominance of *Quercus kelloggii* or *Q. wislizeni.* When noted as a co-dominant with either of those species, photo interpreters generally mapped to the canyon oak alliance. Emergent conifers were generally sparse except in higher elevation stands.

PHOTO INTERPRETATION SIGNATURE:
Quercus chrysolepis tends to have a brighter green signature than the often adjacently occurring *Q. wislizeni.* This is most likely due to early growing season (late spring) NAIP imagery yielding leaf flush conditions in canyon oak that are usually not as prevalent in interior live oak at the time. April imagery makes it possible to separate out *Quercus kelloggii* from *Q. chrysolepis* with the former yielding a blue-green signature. Modeling the two species on topographical setting is also a fairly reliable tool; canyon oak occupies the steeper mid slopes and canyon bottoms while black oak favors adjacent gentle upper slopes and spurs.

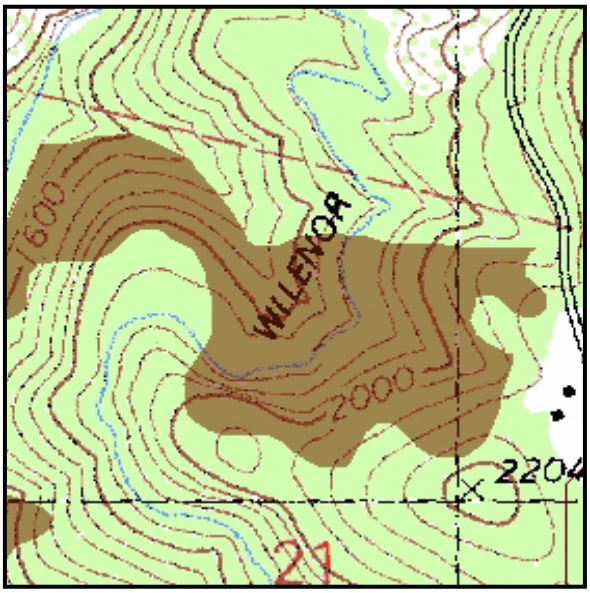
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1111 – *Quercus wislizeni* yields a darker green signature and when adjacent to *Q. chrysolepis* is found in more xeric topographical settings.
- 1312 – *Quercus kelloggii* has a more diffuse crown and the overall appearance of the stand is more open. *Q. kelloggii* is generally found upslope of canyon oak when the two species are nearby.

STATISTICS:
- Total Acreage: 44,584
- Average Polygon Size: 19.8
- Total Polygon Count: 2,252

2110 – *Pseudotsuga menziesii – Calocedrus decurrens* (Douglas-fir – Incense cedar forest) Alliance



Regional Distribution



Topographical Characteristics
Found in higher elevations of the study area on low to mid north trending aspects; usually quite steep.

PI Signature Characteristics
Dense *Pseudotsuga menziesii* with some *P. ponderosa* (lighter green) – note blue-green color & more diffuse crowns of *P. menziesii*.

2110 – *Pseudotsuga menziesii – Calocedrus decurrens* (Douglas-fir – Incense cedar forest) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Pseudotsuga menziesii* dominates or co-dominates the canopy in dense forest environments. Mapped in two settings, one containing a co-dominance of *Q. chrysolepis* on steep northerly facing mid and lower slopes, another much less commonly occurring, in higher elevation mixed conifer settings with *Pinus ponderosa* and *Calocedrus decurrens. Pseudotsuga menziesii* is the dominant conifer in all stands but at times canyon live oak can have a higher relative cover in stands where oak and Douglas-fir co-occur.

PHOTO INTERPRETATION SIGNATURE:
Quercus chrysolepis is often a strong component to this type and in the typically steep northerly settings canyon live oak yields a darker green to gray color. Emergent *Pseudotsuga* can be distinguished from *Pinus ponderosa* by its broad radial spreading branches especially noteworthy on larger individuals. Quantifying relative cover can be difficult at times due to the steep northerly trending slopes which can create severe shadowing on the NAIP imagery.

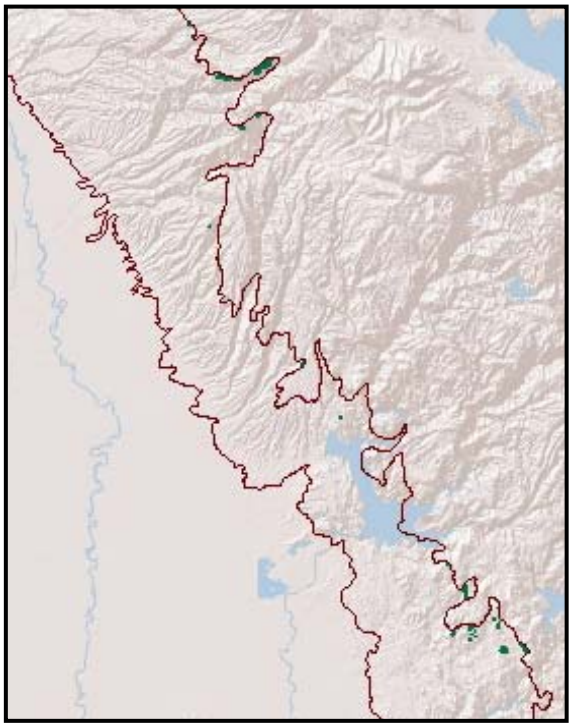
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1410 – *Quercus chrysolepis* with emergent *Pinus ponderosa* occurs in somewhat less steep settings. *P. ponderosa* tends to have a rounded fuller crown than *Pseudotsuga menziesii.*
- 2212 – *Pinus ponderosa – Calocedrus decurrens* may have Douglas-fir as a component to the conifer layer. Type 2212 however is found only within the highest elevations of the mapping area, usually not on the steep topography that is more indicative to the *Pseudotsuga menziesii.*

STATISTICS:
- Total Acreage: 3,299
- Average Polygon Size: 22.1
- Total Polygon Count: 149

2111– *Acer macrophyllum* (Bigleaf maple forest) Alliance

Mapped sparingly; only a few polygons were mapped based primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable mapping this type with a high confidence.

2200 – Plantation – (California Montane Conifer Forests Group)



Regional Distribution
Scattered locations along the eastern margins of the mapping area

Topographical Characteristics
Plantation pines are often found on upper slopes along broad ridges.

2200 – Plantation – (California Montane Conifer Forests Group)

MAPPING DESCRIPTIONS:
Mapped in post logging and replanting settings where conifers overwhelmingly dominate the canopy. Stands are for the most part even-age, varying in density and usually a single species. In most cases, *Pinus ponderosa* is the conifer in the stand. Other conifers may represent the dominant species for a mapped polygon. In most cases, logging and other roads are visible in and adjacent to the plantation stand. *Note: This type is also mapped in the land use field as code 9502.*

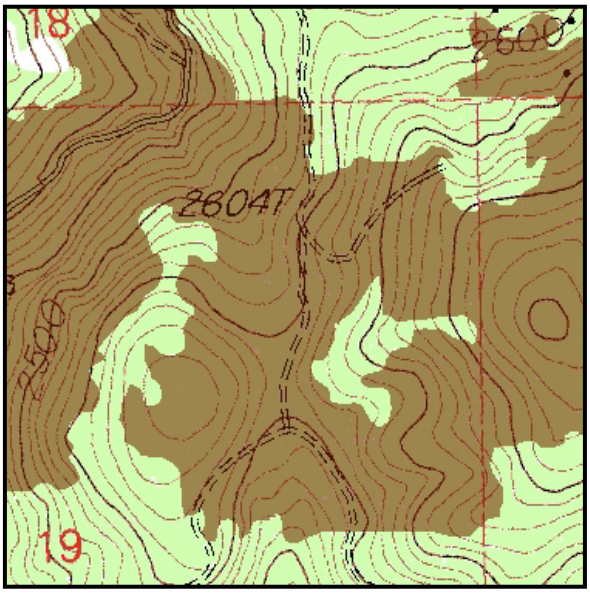
PHOTO INTERPRETATION SIGNATURE:
Stands are overwhelmingly dominated by conifer species; therefore crowns are narrow and cylindrical. Signature variability is minimal within the stand. Hardwoods, when present are most frequently noticeable in small patches especially toward the margins of the stand.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 2212 – *Pinus ponderosa – Calocedrus decurrens* has significantly higher signature variability within the stand (multiple tree sizes & canopy openings and cover variability). Signature color varies more due to the mixing of at least two conifer species in the overstory and at times as much as four species may be important in the overstory canopy.

STATISTICS:
- Total Acreage: 2,101
- Average Polygon Size: 17.5
- Total Polygon Count: 120

2212 – *Pinus ponderosa – Calocedrus decurrens* (Mixed conifer forest) Alliance

Regional Distribution
Found along eastern margins of the mapping area in most cases north of Oroville Reservoir.



Topographical Characteristics
Found in the highest elevations of the mapping area on upper slopes and north trending aspects.

PI Signature Characteristics
Large multiple size crowns, dense cover and a variety of conifer signature characteristics typify this mixed conifer type.

2212 – *Pinus ponderosa – Calocedrus decurrens* (Ponderosa pine – Incense cedar forest) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Pinus ponderosa* dominates the canopy with an important and regularly occurring component of *Calocedrus decurrens.* Other conifer species are often significant in the canopy and may include *Pinus lambertiana, Abies concolor* and *Pseudotsuga menziesii.* Cover is generally quite high and crown size and height is diverse in most stands.

PHOTO INTERPRETATION SIGNATURE:
Stands typify a mixed conifer signature with conical crowns of varying sizes dominating the canopy. The presence of *Calocedrus decurrens* is not detectable on the imagery but can be fairly reliably modeled as an important component in a multi crown sized conifer forest over 3000' in the mapping area. Other conifers such as *Pinus lambertiana* have typical "white-pine" radial crowning which can be detected on the NAIP 1-meter imagery.

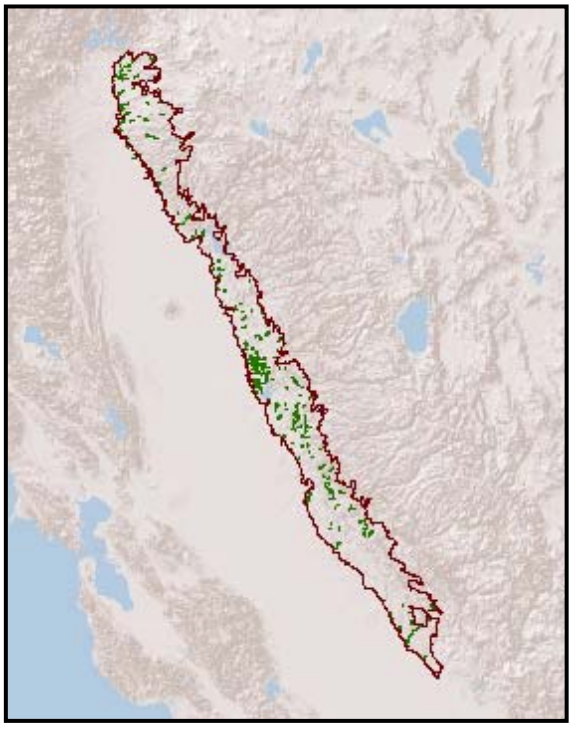
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 1312 – *Quercus kelloggii* stands at higher elevations often contain a strong dominant *Pinus ponderosa* component but in most stands *Q. kelloggii* is scattered regularly throughout the canopy.

STATISTICS:
- Total Acreage: 1321
- Average Polygon Size: 35.7
- Total Polygon Count: 37

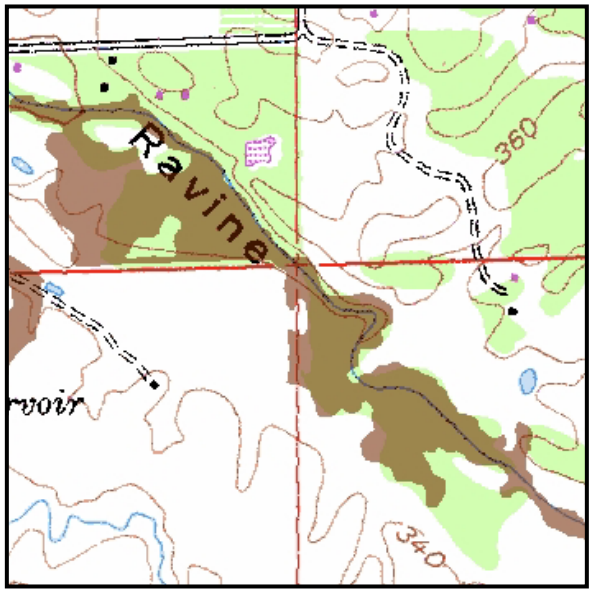
2213 – *Calocedrus decurrens* (Incense-cedar forest) Alliance

Mapped sparingly, only a few polygons mapped base primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable mapping this type with a high confidence.

3110 – *Populus fremontii* (Fremont cottonwood forest) Alliance



Regional Distribution



Topographical Characteristics
Common on broad well drained floodplains with sandy substrate; most extensive polygons are in low elevations in the western portion of the study.

PI Signature Characteristics
Large diffuse crowns with a dull green signature characterize *Populus fremontii*; most stands have a component of *Salix laevigata.*

3110 – *Populus fremontii* (Fremont cottonwood forest) Alliance

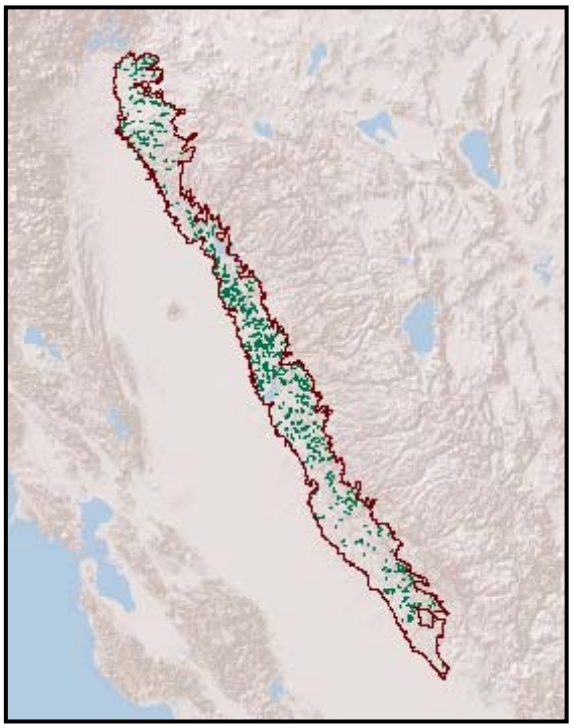
MAPPING DESCRIPTIONS:
Mapped where *Populus fremontii* dominates or co-dominates with other riparian species in open to dense cover usually with a component of *Salix laevigata.* In drier settings, stands tend to be relatively open along broad floodplains. In streamside environments, *Populus fremontii* is often mapped with a higher cover of *Salix* spp. or inclusions of *Alnus rhombifolia.*

PHOTO INTERPRETATION SIGNATURE:
Mature stands of *Populus fremontii* can be separated out fairly reliably from other riparian species by its large and open crown and dull green color. Fremont cottonwoods tend to have light gray to white branching and can be identified from other riparian species fairly easily using early season leaf off imagery.

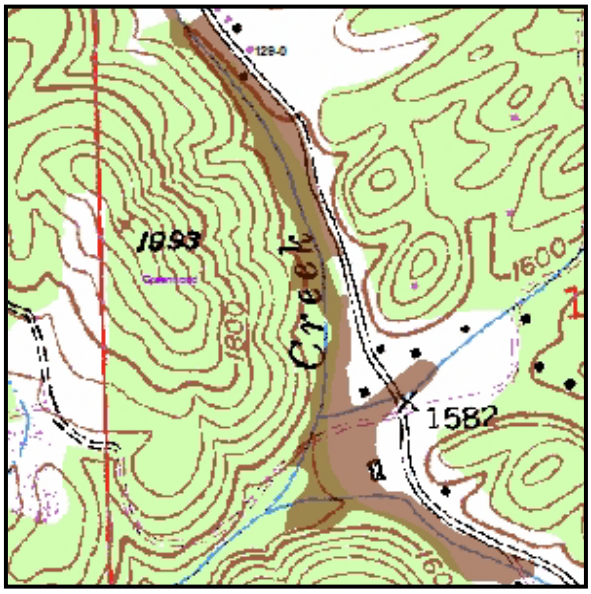
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 3111 – *Salix laevigata* has a smaller crown and can display multiple crowning in larger individuals. This species also yields a brighter and lighter green color and the crowns are less diffuse than the cottonwood. It is extremely difficult for photo interpreters however to ascertain relative abundance of the two species in a stand and to therefore at times make a determination between the two alliances.
- 1313 – *Quercus lobata* has a similar sized crown and is also fairly open. Colors tend to be a bit brighter and early season leaf flush conditions in the valley oak are distinctly blue-green. *Quercus lobata* also prefers less well drained very deep soils and will therefore often have a dense herbaceous understory composed often of weedy annuals. *Rubus discolor* also is a common understory associate to valley oak.
- 3210 – *Alnus rhombifolia* has a much smaller crown, usually occurs in dense narrow stands and is often much closer to the edge of the active stream channel. *Alnus rhombifolia* also occurs as smaller narrow stands and canopy tends to be more uniform throughout.
- 3310 – *Platanus racemosa* has a large crown but is generally not as rounded as a mature cottonwood, lacking distinct crown margins. Stands of sycamore are much less common in the mapping area and tend to occur in slightly less flooded environments or in drier narrow canyons upslope from cottonwoods.

STATISTICS:
- Total Acreage: 8,558
- Average Polygon Size: 7.2
- Total Polygon Count: 1,185

3111 – *Salix laevigata* (Red willow thickets) Alliance



Regional Distribution



Topographical Characteristics
Frequently mapped immediately adjacent to larger slower moving perennial streams.

PI Signature Characteristics
Narrow multiple crowning, quite dense with a bright green color; a few larger crown cottonwoods are noted in this example.

3111 – *Salix laevigata* (Red willow thickets) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Salix laevigata* dominates or strongly dominates the stand in open to dense woodlands or dense young shrubby thickets. Young stands of thicket-like vegetation may have other riparian species and can be difficult to distinguish, in these settings photo interpreters look for adjacent mature trees to aid in their call. Noted most frequently in close proximity to the stream edge, some larger trees noted in drier settings on adjacent floodplains in association with cottonwoods.

PHOTO INTERPRETATION SIGNATURE:
Mature *Salix laevigata* trees have a bright yellow-green color; younger thickets trend darker green. Where cover is dense, crowns tend to be small; multiple crowning is also noted in individuals, especially in open stands.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 3110 – *Populus fremontii* tends to have larger more open crowns and overall has a duller green color. Both species often occur together in a stand, in these settings, photo interpreters mapped to the *Populus fremontii* alliance.
- 6217 – *Salix lasiolepis* in most instances cannot be separated out from *S. laevigata.* Arroyo willow generally does not grow to large tree; red willow stands can be quite tall, in these circumstances, photo interpreters can identify to the alliance level with greater confidence.

STATISTICS:
- Total Acreage: 8,054
- Average Polygon Size: 4.9
- Total Polygon Count: 1,659

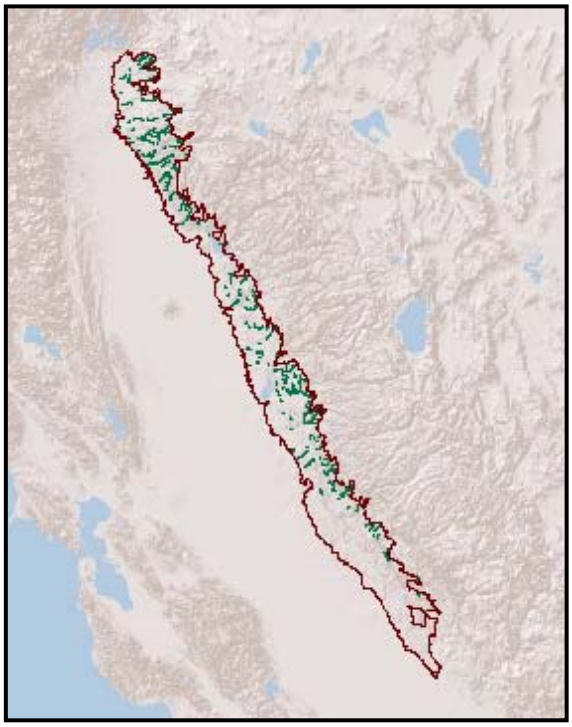
3112 – *Salix gooddingii* (Black willow thickets) Alliance

Mapped sparingly in riparian settings at lower elevations in the mapping area. Only a few polygons mapped base primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable mapping this type with a high confidence.

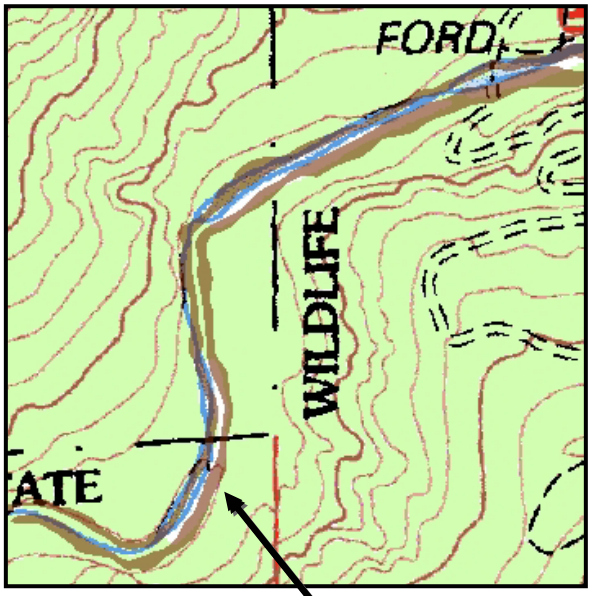
3113 – *Juglans hindsii* (California walnut groves) Alliance

Mapped sparingly in riparian settings at lower elevations in the mapping area. Only a few polygons mapped base primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area which would enable mapping this type with a high confidence.

3210 – *Alnus rhombifolia* (White alder groves) Alliance



Regional Distribution



Topographical Characteristics
Example above shows typical setting of *Alnus rhombifolia* occurring in narrow bands immediately adjacent to the stream.

PI Signature Characteristics
Typical example where *Alnus rhombifolia* forms narrow bands of even-age stands along the margins of the water.

3210 – *Alnus rhombifolia* (White alder groves) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Alnus rhombifolia* dominates the canopy in dense settings, often as narrow bands immediately adjacent to perennial stream courses. *Salix laevigata* often is a component where stands widen on broader flats. In these settings, it becomes more difficult to estimate relative cover.

PHOTO INTERPRETATION SIGNATURE:
Alnus rhombifolia is a small tree occurring in dense settings that tend to yield a consistent signature throughout the stand. Variability in stand height is minimal except when stands widen on broader stream flats. Signature color trends medium green, tree crowns are narrow but form a dense canopy with minimal crown openings within the stand.

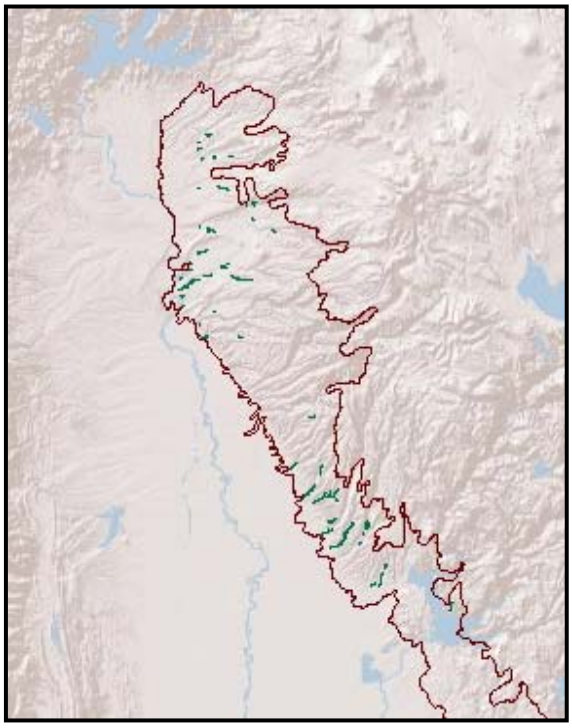
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 3111 – *Salix laevigata* often co-occurs in stands which broaden away from the immediate stream banks. *Salix laevigata* has larger crowns and yields a slightly lighter yellow-green color in most settings. In typical settings, *Alnus rhombifolia* occurs along narrow stream sides with fairly steep sides-slopes close to the channel.

STATISTICS:
- Total Acreage: 6,117
- Average Polygon Size: 10.8
- Total Polygon Count: 569

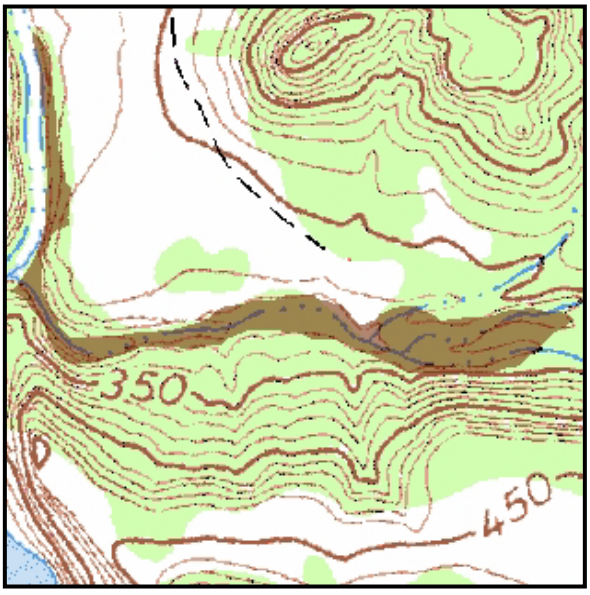
3211 – *Fraxinus latifolia* (Oregon ash groves) Alliance

Mapped sparingly in riparian settings at lower elevations in the mapping area. Only a few polygons mapped based primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable mapping this type with a high confidence.

3310 – *Platanus racemosa* (California sycamore woodlands) Alliance



Regional Distribution



Topographical Characteristics
Example above is where *Platanus racemosa* occurs in smaller narrow canyons upslope from larger watersheds.

PI Signature Characteristics
In this example, *Platanus racemosa* follows a small watershed adjacent to the stream; *Quercus douglasii* occurs immediately adjacent upslope.

3310 – *Platanus racemosa* (California sycamore woodlands) Alliance

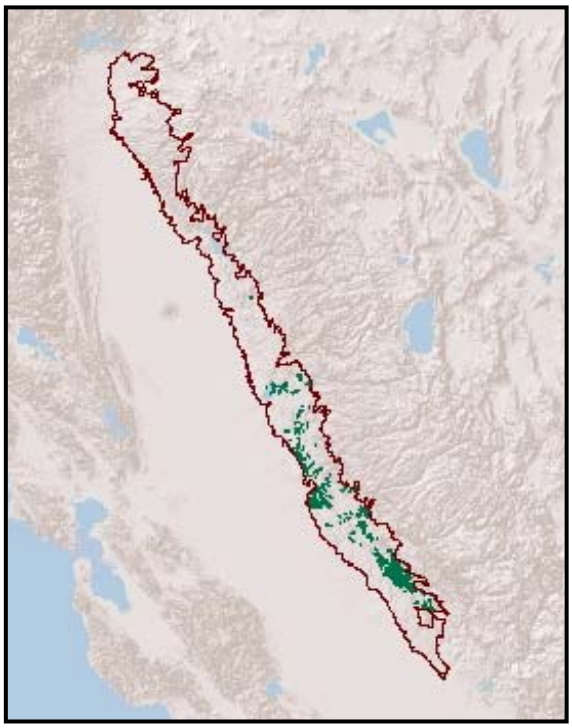
MAPPING DESCRIPTIONS:
Mapped where *Platanus racemosa* dominates the riparian canopy in dense settings at lower elevations of the mapping area and in smaller less frequently flooded watersheds in irregularly distributed patches adjacent to the stream edge. Stands in lower elevations are also patchy and can be considered part of a diverse riparian woodland where dominance alters between *Platanus, Populus & Quercus lobata.* Mixing in these settings is common and it can be quite challenging for the photo interpreter to determine relative cover of the individual species using the 1-meter imagery.

PHOTO INTERPRETATION SIGNATURE:
Platanus racemosa yields a signature similar to that of *Populus fremontii* and can be difficult to separate out where the two species co-occur. *Platanus racemosa* tends to have a smaller less rounded and lighter green crown and is found either in wetter settings along the stream margin or in dry infrequently flooded margins of the floodplain where understory annuals grasses can form dense cover.

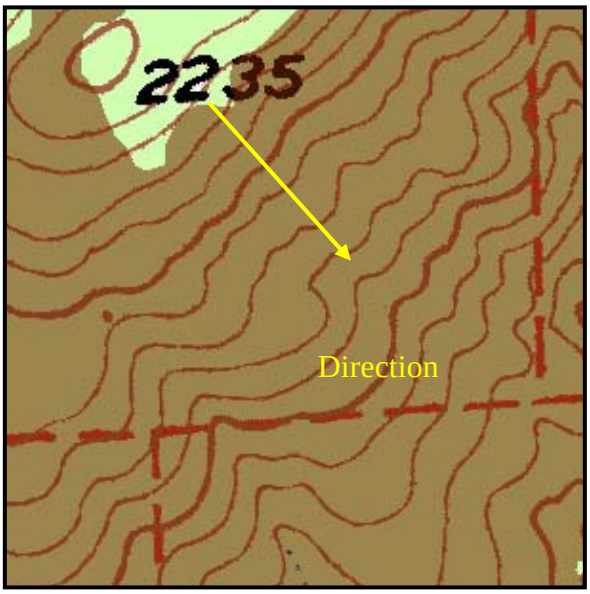
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 3110 – *Populus fremontii* tends to have larger more rounded crowns and overall has a duller green color. Both species can occur together in a stand in larger riparian woodlands, in these circumstances, photo interpreters classify to the *Populus fremontii* alliance.

STATISTICS:
- Total Acreage: 1,016
- Average Polygon Size: 12.1
- Total Polygon Count: 84

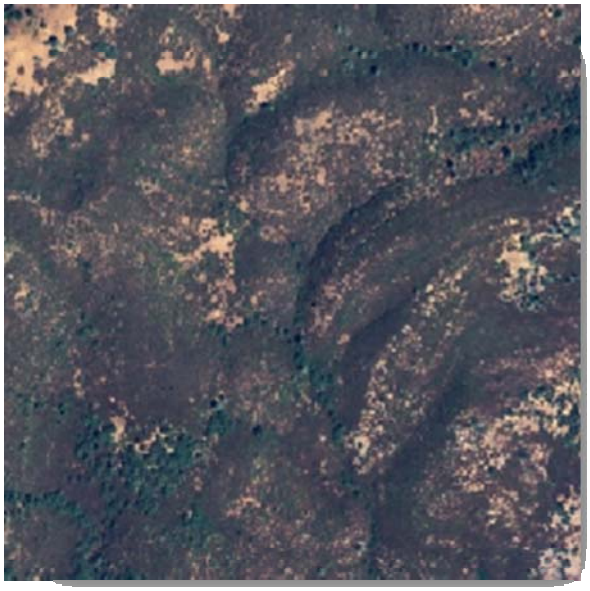
4111 – *Adenostoma fasciculatum* (Chamise chaparral) Alliance



Regional Distribution
Adenostoma fasciculatum occurs throughout the mapping area, but as an alliance type is found almost exclusively south of the American River



Topographical Characteristics
Typical setting for *Adenostoma fasciculatum* occurs on steep south trending slopes.



PI Signature Characteristics
Example depicts very large stand of *Adenostoma fasciculatum* near Halleck Hill. *Q. wislizeni* is noted in narrow canyons throughout stand (green signature).

4111 – *Adenostoma fasciculatum* (Chamise chaparral) Alliance

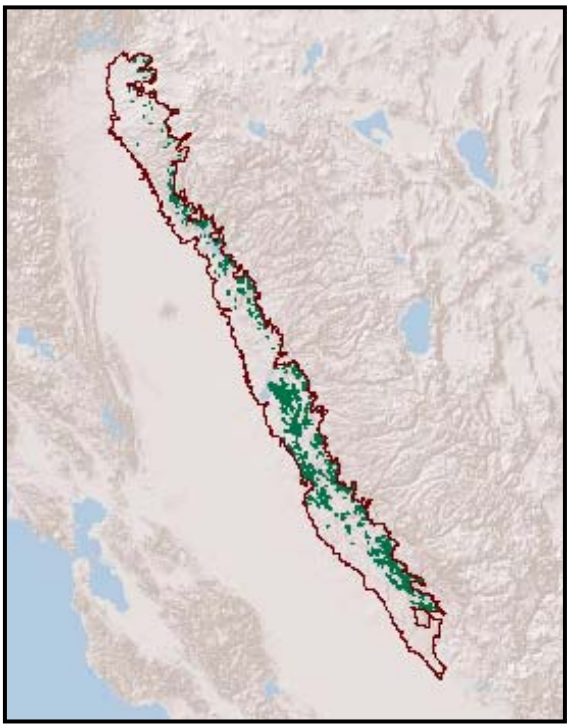
MAPPING DESCRIPTIONS:
Mapped where *Adenostoma fasciculatum* dominates the stand; usually in dense cover except in post fire and other disturbance settings where it can be quite open. On ultramafic soils (especially gabbro), photo interpreters mapped to this alliance only when overwhelmingly dominant with no visible presence of *Arctostaphylos* in the stand.

PHOTO INTERPRETATION SIGNATURE:
Adenostoma fasciculatum tends to form extensive stands where signature variability varies minimally throughout the stand. Stand cover is the primary factor in affecting image signature in most settings. Chamise has a characteristic signature in most seasons; in early summer, signature color trends a dark brown with a slightly reddish hue due in part to the numerous dead inflorescence characteristic to the post flower season.

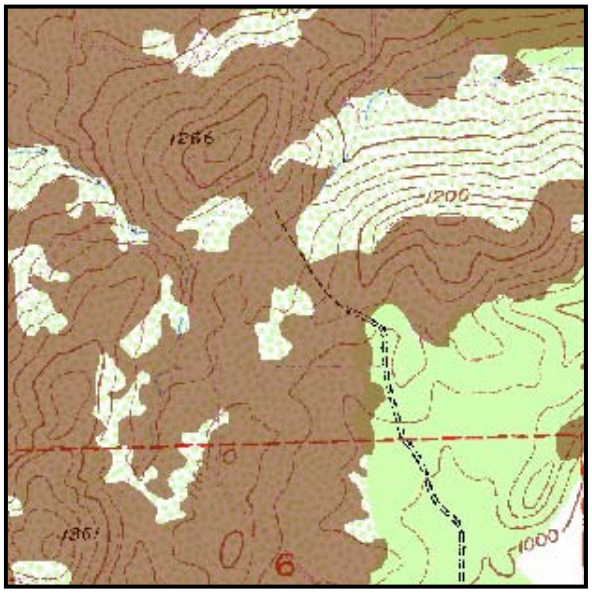
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 4112 – *Arctostaphylos viscida* tends to have a slightly brighter signature with a more dark gray overall color. Manzanita crown cover is generally less diffuse with well defined crown margins. Color infrared imagery often yields a lighter pink which may reflect how the manzanita leaf grows at perpendicular angles to the sun. This characteristic also makes it extremely difficult to discern manzanita, especially when it exhibits less cover and chamise is dense.

STATISTICS:
- Total Acreage: 38,117
- Average Polygon Size: 18.3
- Total Polygon Count: 2,075

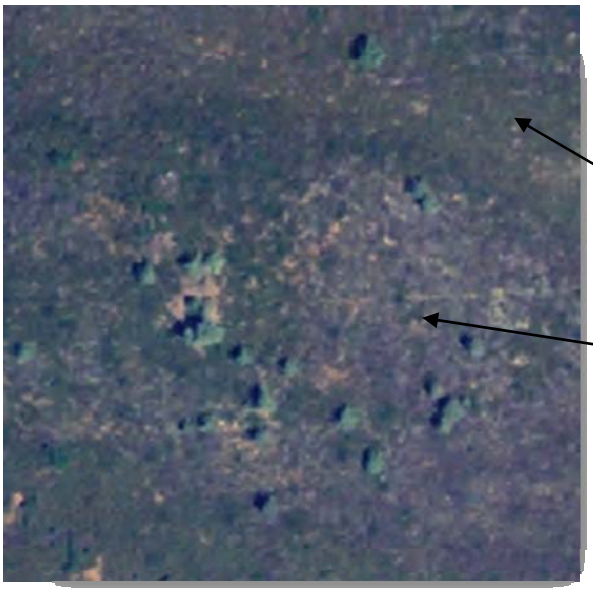
4112 – *Arctostaphylos viscida* (White leaf manzanita chaparral) Alliance



Regional Distribution



Topographical Characteristics
Arctostaphylos viscida as in most all manzanita species, tend to favor ridges and adjacent spur slopes as depicted in the above example.



PI Signature Characteristics
Example depicts the interface between *Arctostaphylos & Adenostoma*, which yields a somewhat greener signature.

Adenostoma fasciculatum

Arctostaphylos viscida

4112 – *Arctostaphylos viscida* (White leaf manzanita chaparral) Alliance

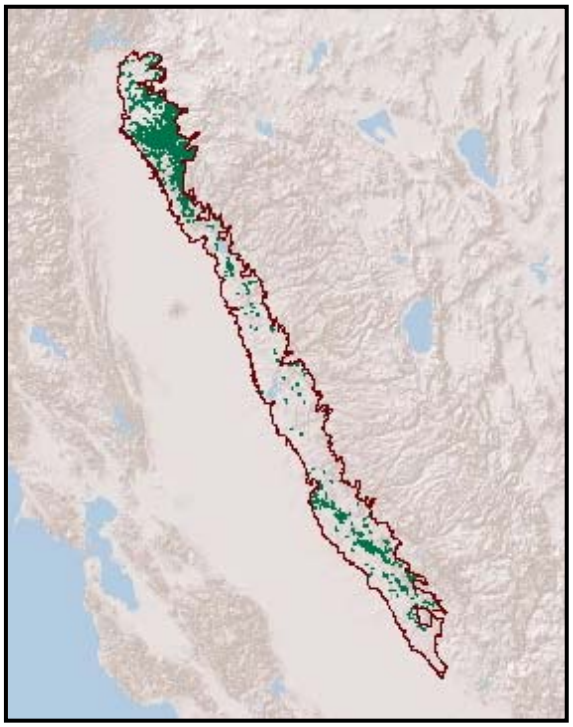
MAPPING DESCRIPTIONS:
Mapped where *Arctostaphylos viscida dominates, co-dominates* or at times is only a minor but regular occurring component to *Adenostoma fasciculatum.* Stand cover varies considerably, but in most undisturbed settings it is usually greater than 60%. Stands are mapped primarily on gentle upper slopes and ridges, often upslope from steeper settings where chamise tends to dominate on south facing aspects.

PHOTO INTERPRETATION SIGNATURE:
Arctostaphylos viscida where it dominates the stand in dense cover has a characteristic steel blue-gray signature that can appear hummocky over the stand. Crown edges are well defined in more open settings. *Arctostaphylos* stems tend to play a significant role in image signature due to the nature of the leaf which is held somewhat perpendicular to the sun.

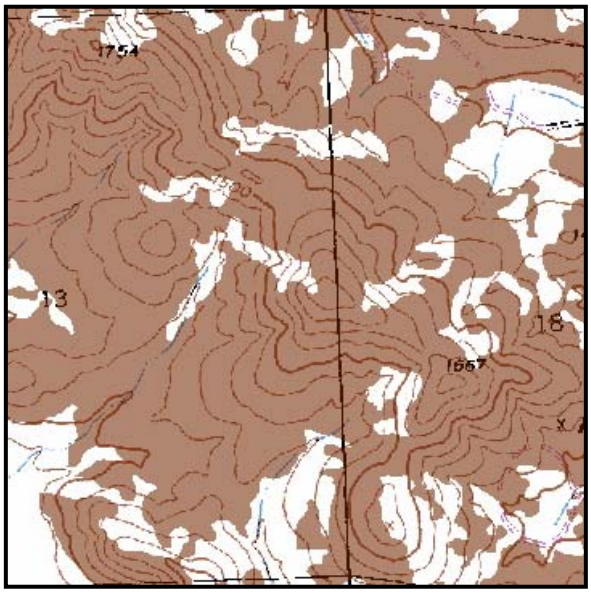
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 4111 – *Adenostoma fasciculatum* – See preceding page on type 4112 under this section

STATISTICS:
- Total Acreage: 67,346
- Average Polygon Size: 15.4
- Total Polygon Count: 4,359

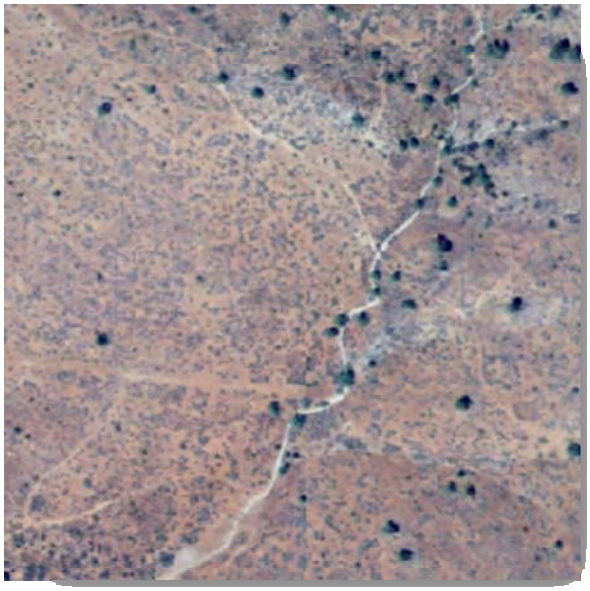
4113 – *Ceanothus cuneatus* (Wedge leaf ceanothus Chaparral) Alliance



Regional Distribution



Topographical Characteristics
Topographic settings for *Ceanothus cuneatus* vary, but most stands tend to be found off steeper side slopes. Above example is on ultramafic soil.



PI Signature Characteristics
Example shows *Ceanothus cuneatus* occurring in sparse cover on ultramafic soil. Signature is characteristic light gray; light tan background signature is formed by sparse annual grasses.

4113 – *Ceanothus cuneatus* (Wedge leaf ceanothus Chaparral) Alliance

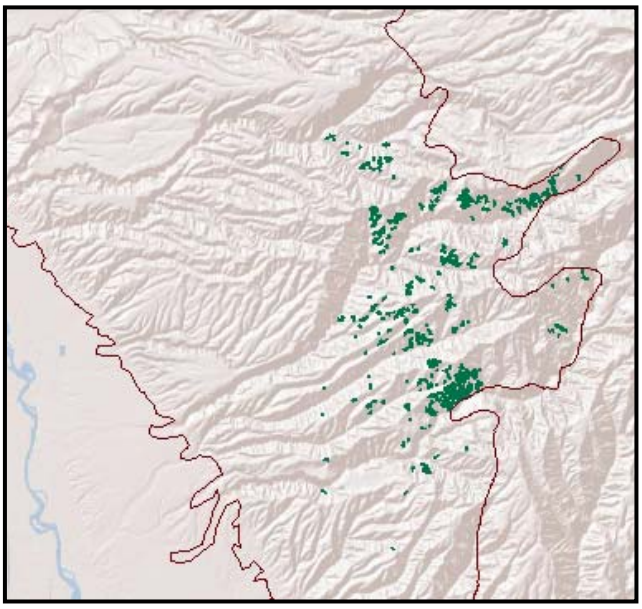
MAPPING DESCRIPTIONS:
Mapped where *Ceanothus cuneatus* dominates or is an important component of chaparral in a variety of settings in open to dense cover. On ultramafic soils, *C. cuneatus* forms more open cover often with an even sparser cover of emergent *Pinus sabiniana.* In the northern section of the study area, it is mapped extensively on recently burned slopes where it co-dominates with *Eriodictyon californicum.* In the southern portion, it is mapped often with *Adenostoma fasciculatum.*

PHOTO INTERPRETATION SIGNATURE:
Ceanothus cuneatus yields a light to dark gray color both on and off ultramafic soils. In post burn environments, it forms a dense low cover which is highly variable depending on the presence of other seral shrubs including *Eriodictyon & Toxicodendron.* On ultramafic soils, the color is reliably light gray. When occurring with *Adenostoma fasciculatum,* it is extremely difficult to separate out, but can often be found forming small bands around denser chaparral down slope where it transitions into annual gasses.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 4111 – *Adenostoma fasciculatum* in open settings is not as gray and usually has a less well defined crown. In dense cover it is almost impossible to distinguish except to note that a well mixed stand will yield a somewhat more complex signature than pure stands of chamise.
- 4112 – *Arctostaphylos viscida* generally occurs on upper gentle slopes while *C. cuneatus* will be more likely on mid and lower slopes, also gently sloping. *A. viscida* usually yields a darker gray color and has denser crown & branching.
- 4114 – *Eriodictyon californicum* in post burn settings often co-dominates with *C. cuneatus* with *Eriodictyon* yielding a greener color.

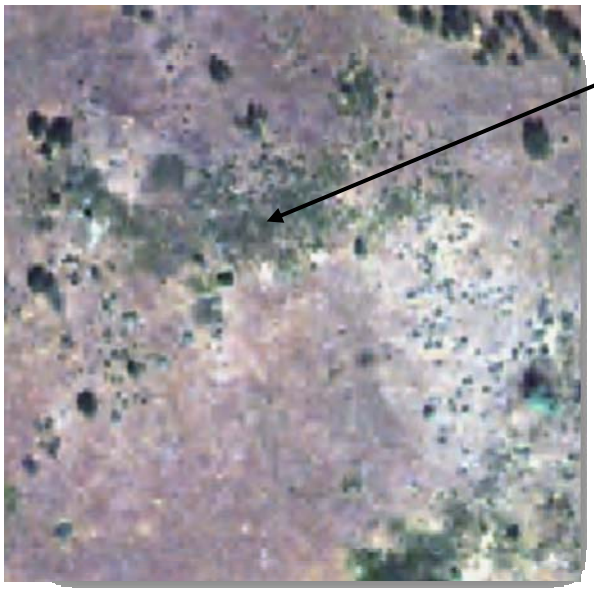
STATISTICS:
- Total Acreage: 48,599
- Average Polygon Size: 9.0
- Total Polygon Count: 5,416

4114 – *Eriodictyon californicum* (California yerba santa scrub) Alliance



Topographical Characteristics
No topographical relationships observed with this post burn type, slightly more predominant on gentle ridges

Regional Distribution
As a mapped alliance, noted almost exclusively in the Ishi Wilderness from Antelope creek in the north to Singer creek in the south as a result of 3 overlapping regional burns from 1994-1997



PI Signature Characteristics
Denser stands of *Eriodictyon californicum* tends to have a blue-green signature with a smooth texture that appears like a smear on the imagery. Scattered individuals of *C. cuneatus* are pictured here with well defined crowns in and adjacent to the stand.

4114 – *Eriodictyon californicum* (California yerba santa scrub) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Eriodictyon californicum* dominates the shrub layer in open to moderately dense cover, usually with a minor component of *Ceanothus cuneatus.* Stands were almost exclusively noted in regions repeatedly burned in 1994 (Barkley Fire), 1997 (Campbell Fire) and 1999 (Gun Fire).

PHOTO INTERPRETATION SIGNATURE:
Eriodictyon californicum tends to have a green to grayish signature with a smooth texture; individual crowns are indistinguishable.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 4113 – *Ceanothus cuneatus* even in post burn settings tend to have a defined crown even when co-occurring with *Eriodictyon californicum.*
- 6301 – *Toxicodendron diversilobum* has a similar texture but normally yields a significantly greener color

STATISTICS:
- Total Acreage: 2,485
- Average Polygon Size: 9.7
- Total Polygon Count: 255

4115 – *Arctostaphylos manzanita* (Common manzanita chaparral) Alliance

Mapped sparingly in the northern portion (primarily adjacent to Inskip Hill) of the study area on the Tuscan formation. Approximately 150 polygons mapped based primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable mapping this type with a high confidence. Separation from *Arctostaphylos viscida* is not possible.

4117 – *Arctostaphylos myrtifolia* (Ione manzanita chaparral) Alliance

Mapped sparingly (several polygons north of Irish Hill just within the mapping area). Polygons are mapped based primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable mapping this type with a high confidence. Most acreage covering this community occurs west of the study area.

4200 – California Mesic Chaparral Alliance

Mapped exclusively in the 2007 Lassen Foothills (Dye Creek & Tehama State Wildlife Area) as a group level type. No effort as of yet has been undertaken to classify these polygons to an alliance level.

4210 – *Quercus berberidifolia* (Scrub oak chaparral) Alliance

Mapped sparingly in the northern portions of the study area, primarily in the Little Chico Creek watershed northwest of Paradise, in the Ishi Wilderness, and in the Tehama State Wildlife Area. Polygons are mapped based primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area that would enable separating out this type from *Quercus wislizeni*.

4211 – *Cercocarpus montanus* (Birch leaf mountain mahogany chaparral) Alliance

Mapped primarily in the Ishi Wilderness on north trending slopes in post burn environments. No photo interpretative signature or reliable ecological correlates have been developed for the project that would enable separating out this type from stands containing a component of *Quercus wislizeni.* Mapped polygons were extrapolated on minimal amounts of reconnaissance data in nearby areas. Stands thought to have contained *C. montanus* which were mapped in the southern portion of the study were later assessed as mesic stands of *Adenostoma fasciculatum* with a component of *fraxinus dipetala.*

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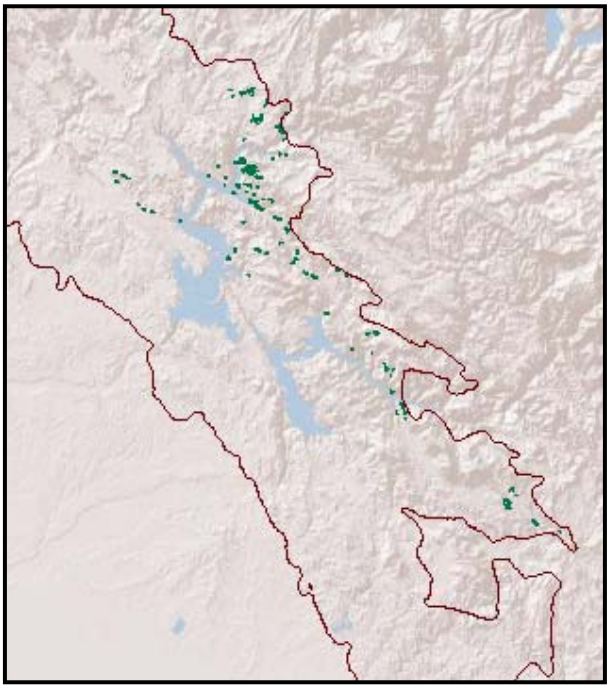
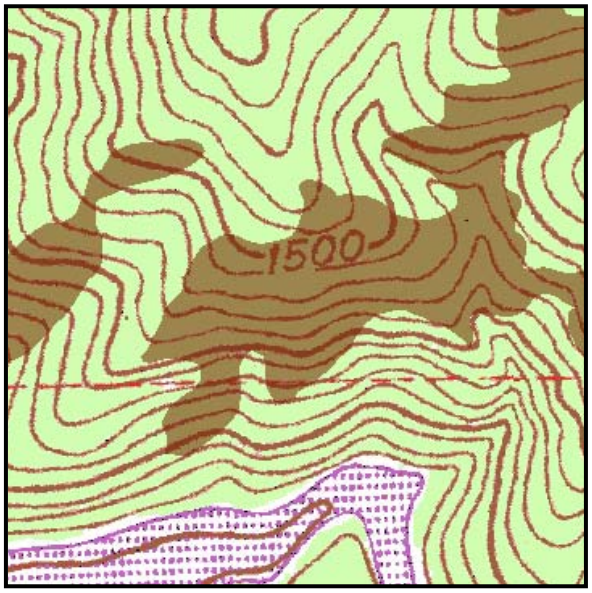
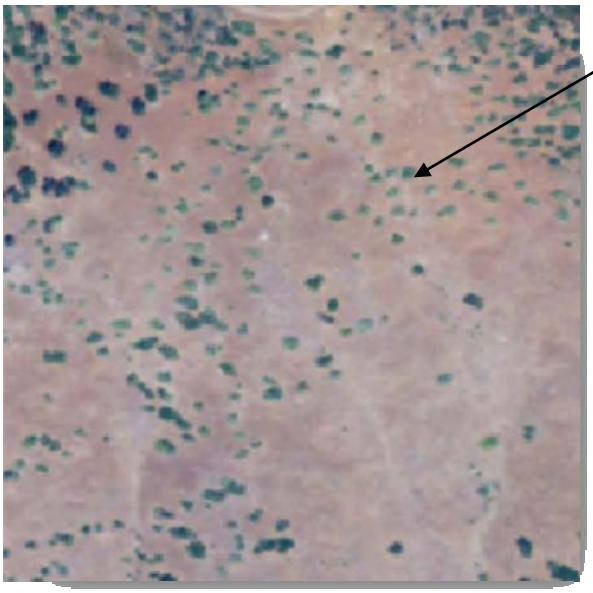
4212 – *Heteromeles arbutifolia* (Toyon chaparral) Alliance



Regional Distribution
East of Don Pedro Reservoir



Topographical Characteristics
Very xeric steep south trending slopes at lower elevations; some stands mapped on serpentine substrate



PI Signature Characteristics
Example depicts sparse *Heteromeles arbutifolia* in a sparse setting on a steep south facing slope. Crowns are distinct with a light green color; darker greens are *Q. wislizeni* mainly to the south. This example is on non ultramafic substrate.

4212 – *Heteromeles arbutifolia* (Toyon chaparral) Alliance

MAPPING DESCRIPTION:
Mapped where *Heteromeles arbutifolia* dominates the shrub layer usually with open cover. Mapped primarily off serpentine on steep south trending slopes in lower elevations. Serpentine stands generally have a co-dominance of *Ceanothus cuneatus* and were mapped to that alliance.

PHOTO INTERPRETATION SIGNATURE:
Heteromeles arbutifolia has a light green signature and a well defined crown. Stands occur often in open grassy settings with a typical annual grass signature in the herbaceous layer.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 4410 *Quercus wislizeni* shrubs have a darker green signature and usually form a denser shrub cover. Type 4410 is found in more mesic settings.

STATISTICS:
- Total Acreage: 1,307
- Average Polygon Size: 9.1
- Total Polygon Count: 143

4310 – *Quercus durata* (Leather oak chaparral) Alliance

Several polygons mapped on serpentine substrate east of Folsom Lake and near the town of Garden Valley. This type is mapped primarily on reconnaissance data from the California Department of Fish & Game in addition to some existing plot data. No reliable photo signature has been developed for this type due to the oak's typically lower cover in relation to other shrubs. Shrubs on serpentine tend to be difficult to separate on the NAIP imagery due to the severe environment limiting the variability in leaf color between species.

4410 – *Quercus wislizeni* Shrub – See descriptions for type 1111 – *Quercus wislizeni*

4420 – *Baccharis pilularis* (Coyote brush scrub) Alliance

Only 13 polygons mapped in grassy settings – several mapped based on reconnaissance in the western portion of the study area near the town of Ione.

4501 – *Frangula californica* (including F. c. ssp. *tomentella*) (California coffee berry scrub) Alliance

Two polygons mapped based on PI signature from plot data in a different part of the study area.

4610 – *Cytisus* spp., *Genista* spp., and others (Broom) Shrubland Stand

Approximately 50 polygons mapped, mainly in the eastern portion of the study, primarily in forest canopy openings. Several polygons were evaluated in the post accuracy assessment and *Genista* was not found. This could be the result of clearing efforts or mapping to 2005 imagery where a significant change has occurred. *Genista* signatures have been extrapolated from previous mapping efforts near the central coast; no reconnaissance or plot data exists for broom in the study area.

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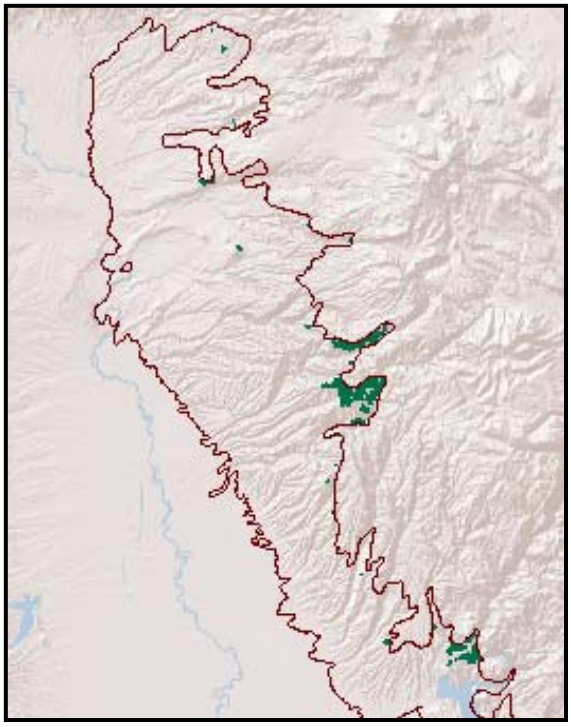
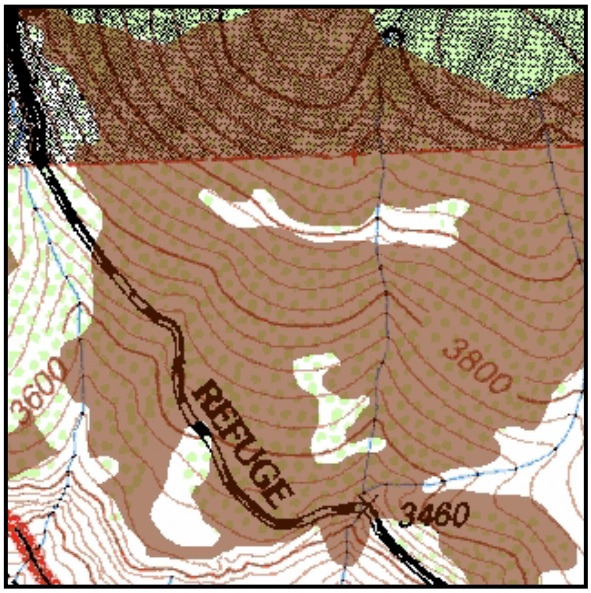
6110 – *Ceanothus integerrimus* (Deer brush chaparral) Alliance



Regional Distribution
Best developed stands in a post fire setting north of Mill Creek near Black Rock.



Topographical Characteristics
Occurs on a variety of topographic positions at higher elevations in post burn environments.

PI Signature Characteristics
Typical signature varies considerably as it does in many post burn types. Brighter greens distinguish *Ceanothus integerrimus* in dense stands; other species are often important in the shrub layer including *Quercus breweri* represented in this image by the darker linear greens in the canyons near the road.

6110 – *Ceanothus integerrimus* (Deer brush chaparral) Alliance

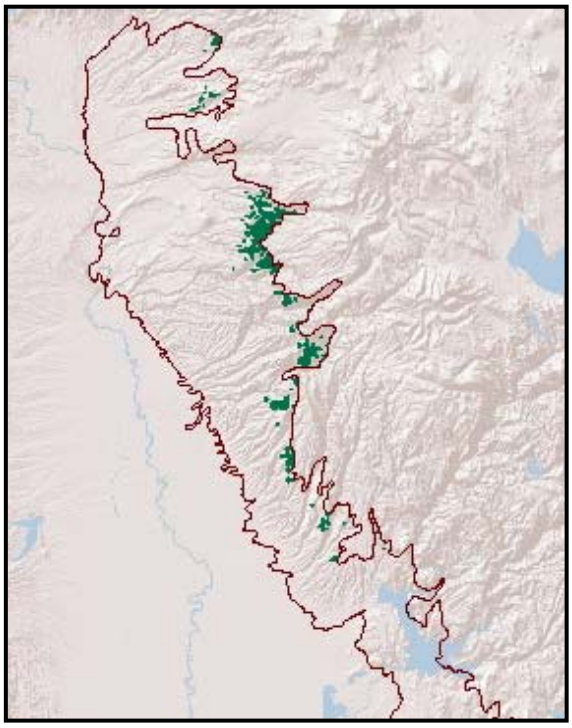
MAPPING DESCRIPTIONS:
Mapped where *Ceanothus integerrimus* dominates the shrub layer, usually in a dense cover and often with a significant component of other shrub species including *Quercus breweri.* Most stands mapped are over 3000' with *Quercus kelloggii* and *Pinus ponderosa* occurring adjacent to the stand.

PHOTO INTERPRETATION SIGNATURE:
Ceanothus integerrimus yields a fairly bright green color with a typical post burn smooth texture. Signature variability within the stand is high due in part to cover variability and other component species to the shrub layer. Individual shrub crowns are indistinct and overall crown appearance is somewhat transparent.

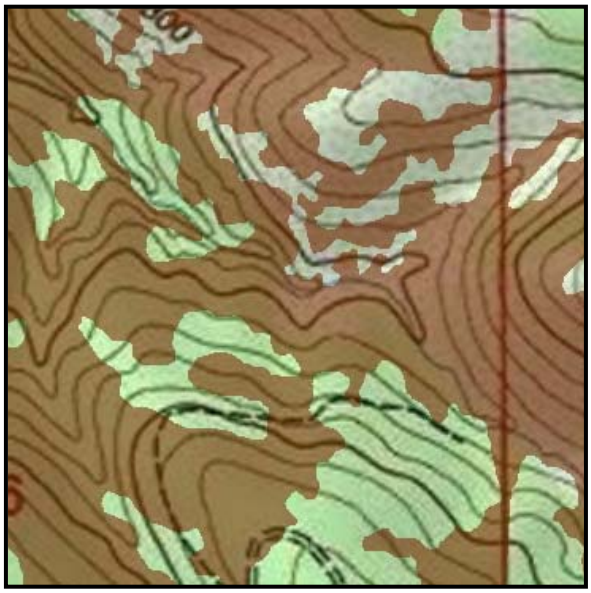
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 6111 – *Quercus breweri* has a similar color but a much denser crown with distinct margins to the stand edge. *Quercus breweri* often occurs adjacent to higher elevation stands of *Q. kelloggii* also in post burn environments but in later seral environments.
- 6301 – *Toxicodendron diversilobum* has a similar signature but occurs in different settings usually at lower elevations.

STATISTICS:
- Total Acreage: 4,463
- Average Polygon Size: 17.4
- Total Polygon Count: 256

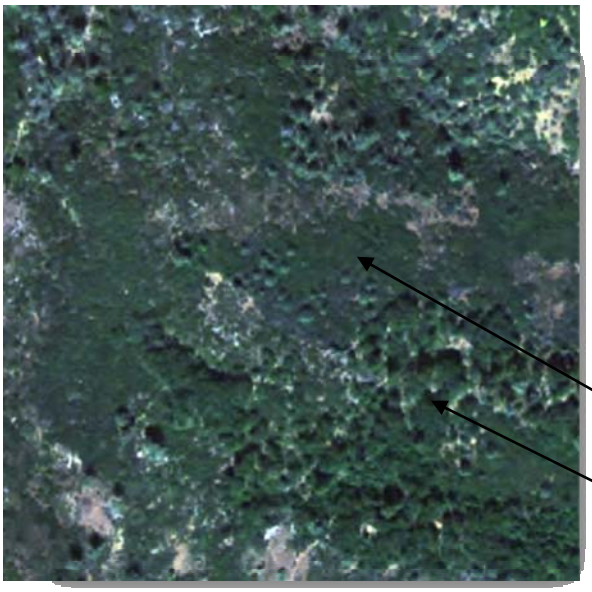
6111 – *Quercus garryana/ var. breweri* (Brewer oak scrub) Alliance



Regional Distribution
Mapped exclusively on the Tuscan Formation in the northern portion of the study area.



Topographical Characteristics
Mapped in a fairly wide range of topographic settings in higher elevations of the study area but somewhat more common in concavities on north trending aspects.



PI Signature Characteristics
Example depicts *Quercus garryana/ var. breweri* in a post burn setting with emergent *P. sabiniana.* Taller *Q. kelloggii* appears in the southeast portion of the image. *Arctostaphylos* spp. appears as a grayer signature along the drier margins.

6111 – *Quercus garryanal* var. *breweri* (Brewer oak scrub) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Quercus garryana/ var. breweri* dominates or co-dominates the shrub layer in dense cover, generally in post burn settings. Photo interpreters often noted the presence of *Ceanothus integerrimus, C. cuneatus,* or *Arctostaphylos* spp. co-dominating the stand. In these situations, photo interpreters mapped to the *Q. garryana/ var. breweri* Alliance.

PHOTO INTERPRETATION SIGNATURE:
Quercus garryana/ var. breweri has a medium green signature with a fairly smooth texture; crown densities are high and stand margins are usually distinct. Numerous small patches of other shrub species *(C. cuneatus, Arctostaphylos* spp. especially) often occur the stand at times creating minimum mapping and complexing issues for the photo interpreters.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 6110 – *Ceanothus integerrimus* usually yields a brighter green signature; crowns are also less distinct lacking definitive crown edges.
- 1312 – *Quercus kelloggii* often occurs adjacent to the stand but a clear height difference is usually noticeable.
- 4410 – *Quercus wislizeni* shrubs usually occur in lower elevations and has a slighter darker green color.

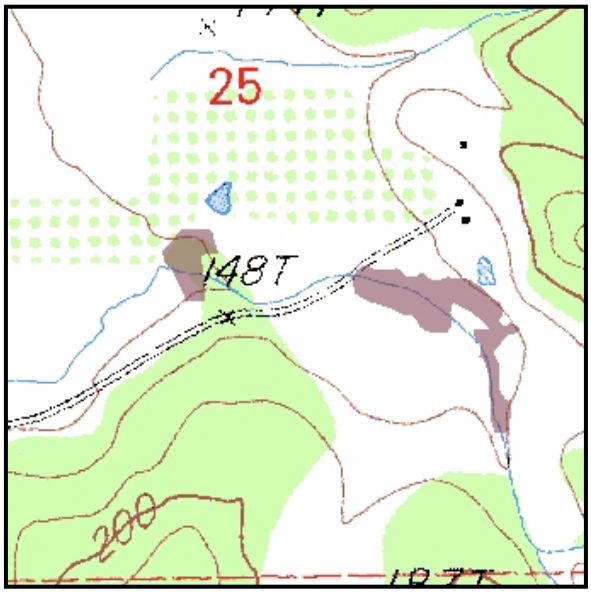
STATISTICS:
- Total Acreage: 5,911
- Average Polygon Size: 12.2
- Total Polygon Count: 486

6210 – *Baccharis salicifolia* Alliance

Only several polygons mapped in the study area based primarily on reconnaissance data and signature development from other mapping projects. Noted as a component species somewhat more frequently in other riparian environments throughout the mapping area. Other patches were below the minimum mapping unit.

6211 – *Salix exigua* (Sandbar willow thickets) Alliance

Regional Distribution
Mapped throughout the study area in a variety of riparian settings, generally as small narrow polygons adjacent to taller riparian woodland communities.



Topographical Characteristics
Generally found close to the edge of perennial streams; stands tend to be more extensive on broader floodplains.

PI Signature Characteristics
Salix exigua is a narrow crowned willow shrub that almost always yields a blue signature. In this example, *Rubus discolor* occurs along the outer margins of the stand; *Quercus wislizeni* occurs adjacent to the south of the stand.

6211 – *Salix exigua* (Sandbar willow thickets) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Salix exigua* dominates or strongly dominates the riparian shrub layer, usually in dense cover settings. At times, photo interpreters mapped willow "thickets" where *S. exigua* was a component but most of the stand signature appeared green. In these settings the type was usually mapped to the *Salix laevigata* alliance.

PHOTO INTERPRETATION SIGNATURE:
Salix exigua has a distinct signature during the majority of the growing season yielding a blue color with stippled texture due to the dense cover of fairly well defined small crowns. Most stands contain *S. exigua* as a strongly dominant species; however the stand size is usually quite small and other riparian species occur frequently along the margins of the stand.

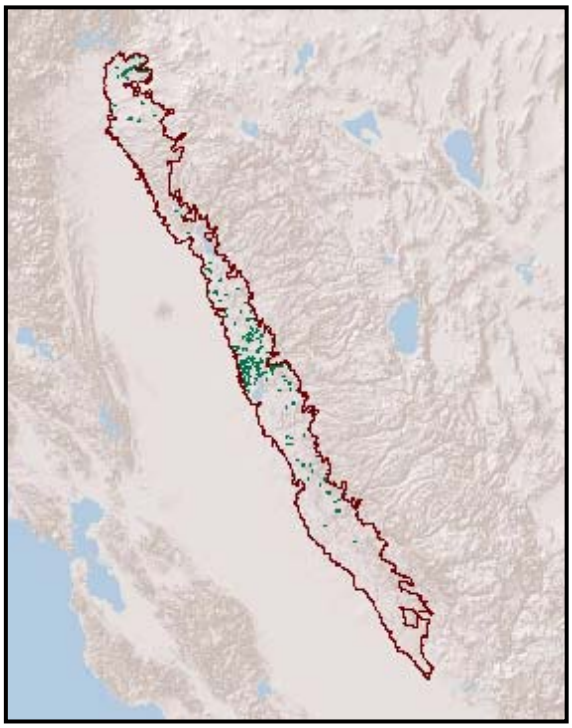
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 3111 – Young stands of *Salix laevigata* in willow thickets lack the characteristic blue color of *S. exigua.*

STATISTICS:
- Total Acreage: 708
- Average Polygon Size: 2.7
- Total Polygon Count: 258

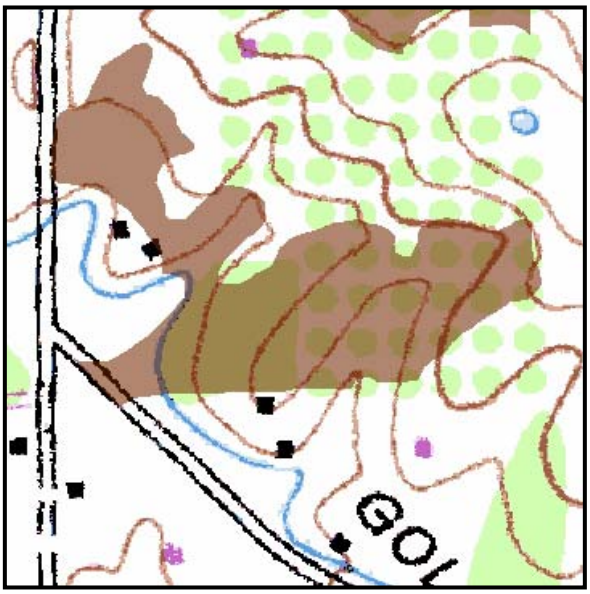
6212 – *Tamarix* spp. (Tamarisk) Semi-Natural Stands

Three polygons mapped based on reconnaissance data. Several other locations were observed by photo interpreters where *Tamarix* was a component to a riparian alliance.

6213 – *Rubus armeniacus* or *Rubus discolor* (Himalayan black berry brambles) Semi-Natural Stands



Regional Distribution



Topographic Characteristics

No unique topographic settings appear to define this type; adjacent land use and riparian vegetation however is a common setting where *Rubus discolor* occurs.

PI Signature Characteristics

Rubus discolor has a fairly uniform green color varying little except where portions of the stand may be dying. Stand edges are highly irregular, often interrupted by annual grasses or other weedy vegetation.

6213 – *Rubus armeniacus* or *Rubus discolor* (Himalayan black berry brambles) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Rubus discolor* strongly dominates the shrub layer in dense but patchy cover complexing at times over large areas with other vegetation such as annual grasses or meadows.

PHOTO INTERPRETATION SIGNATURE:
Rubus discolor has a smooth green signature with minimal variation within the patch or stand. Complexing with other vegetation types occurs frequently, especially with meadows and annual grasslands with a high weedy component.

TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 6301 – *Toxicodendron diversilobum* has a similar signature (both color & texture) but usually has a less definitive edge to the patch or stand. *T. diversilobum* also occurs in slightly drier environments, often in a post burn setting rather than an anthropogenic related disturbance environment.
- 3111 – Young willow thickets containing a dominance of *Salix laevigata* have a similar signature but occur in much wetter settings.

STATISTICS:
- Total Acreage: 3,242
- Average Polygon Size: 4.3
- Total Polygon Count: 752

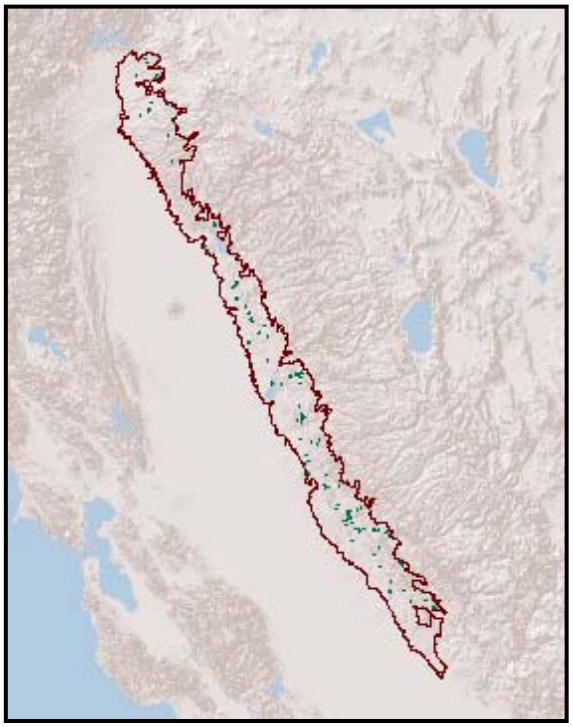
6214 – *Cephalanthus occidentalis* (Button willow thickets)

Eleven polygons mapped based on CADFG and CNPS plot data. Extrapolating mapped polygons beyond the plot data was minimal due to the open cover of this type and poorly defined and unreliable signature correlations.

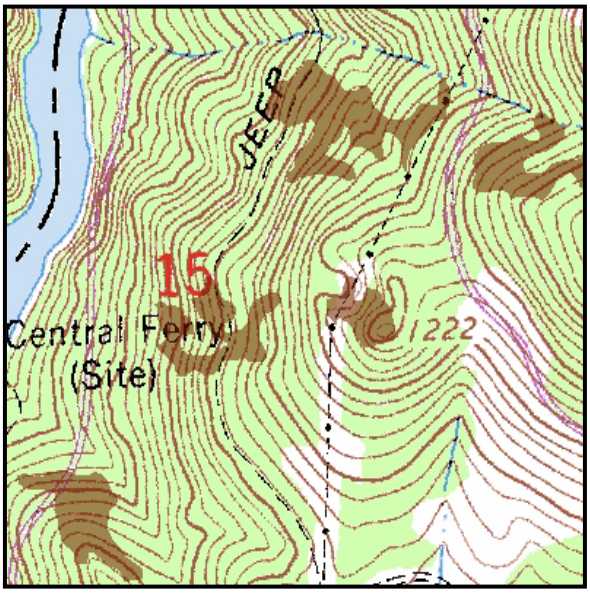
6217 – *Salix lasiolepis* (Arroyo willow thickets) Alliance

Mapped sparingly in riparian settings in the mapping area. Only a few polygons mapped base primarily on plot and reconnaissance data. No photo interpretative signature or reliable ecological correlates have been developed for the project study area which would enable mapping this type with a high confidence.

6301 – *Toxicodendron diversilobum* (Poison oak scrub) Alliance



Regional Distribution



Topographic Characteristics
Toxicodendron diversilobum occurs on a wide range of topography in a variety of settings.

PI Signature Characteristics
Example shows *T. diversilobum* occurring in and adjacent to stands of *Quercus douglasii*. Signature ranges from green to yellow-green depending on summer leaf drought stress.

6301 – *Toxicodendron diversilobum* (Poison oak scrub) Alliance

MAPPING DESCRIPTIONS:
Mapped where *Toxicodendron diversilobum* strongly dominates the shrub layer in open to dense cover. Minor components of other shrub species are included in mapped polygons but at minimal cover; emergent tree cover is below 8-10%. Mapped frequently adjacent to *Quercus douglasii stands* and in small to medium patches in a number of settings.

PHOTO INTERPRETATION SIGNATURE:
Toxicodendron diversilobum has a range of greenness to the color depending on the dominant structure of the plant (shrubby or vine like), the stress of the leaf in early season drought conditions which can be determined by topographic settings and the cover density of the stand. Stand cover generally feathers out from dense to more open cover towards the edges of the stand making it at times difficult for photo interpreters to separate from other adjacent types.

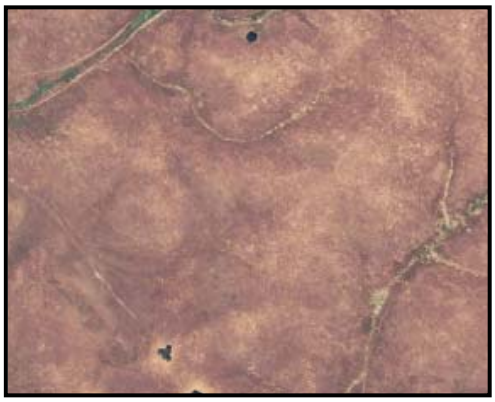
TYPES WITH SIMILAR PHOTO INTERPRETATION SIGNATURES:
- 6213 – *Rubus discolor* occurs in wetter environments – see PI signature for that type.
- 4410 – Young stands of *Quercus wislizeni* in leaf flush conditions can be similar to this type; there is usually more texture in the signature however.
- 6110 – *Ceanothus integerrimus* usually is found in higher elevations.

STATISTICS:
- Total Acreage: 3,020
- Average Polygon Size: 6.5
- Total Polygon Count: 463

HERBACEOUS VEGETATION

Note: Photo interpreters are generally unable to distinguish herbaceous alliances or species dominance using the 1-meter NAIP imagery. Herbaceous mapping categories are for the most part distinguished at group or macrogroup level hierarchy by a series of signature and environmental characteristics unique to that type.

7100 – California Annual and Perennial Grasslands Macrogroup



Mapped where native perennial grasses make up at least 10% relative cover to the herbaceous layer. Photo interpreters are unable to distinguish native species from the Mediterranean annuals and must model based on edaphic and topographical characteristics. Certain combinations of these features will reduce the overall cover of the herbaceous layer and it is in these settings that photo interpreters map to this type. The best examples occur in areas with thin soils on table top mesas of the Tuscan Formation in the northern portions of the study area. Other examples include all annual grasses on hill slopes, although the ratio of annuals to natives may not be as high as on the mesa tops. Photo interpreters also evaluate concentrations of land use types and their proximity to herbaceous vegetation in deciding which macrogroup to assign.

7101 – Mediterranean California Naturalized Annual and Perennial Grassland Group

Mapped where photo interpreters denote herbaceous vegetation with a wide variation in signature color patterns over the stand, often with varying shades of green still apparent on the early summer imagery. Mapped frequently in settings adjacent to land use features and on deep mesic soils with sparser *Rubus discolor.* Includes strong dominance of non-native species such as *Lolium spp., Centaurea spp., Phalaris aquatica,* or minor components of *Rubus discolor.* Noted by photo interpreters as a weedy herbaceous type.

7102 – Vancouverian and Rocky Mountain Naturalized Perennial Grassland Group

Mapped by photo interpreters in irrigated pasture settings and at times down slope from flumes and irrigation ditches. This type may include components of temporarily flooded meadows such as *Juncus* or other perennial species including *Phalaris, Agrostis,* or *Festuca.*

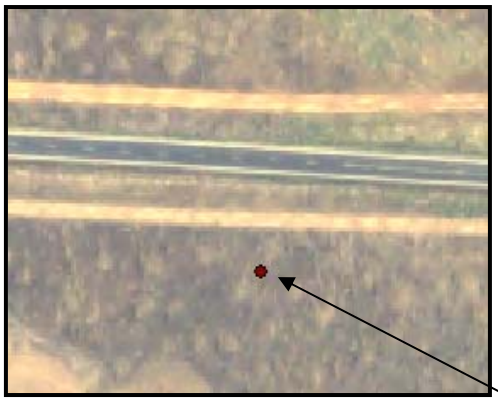
7200 – Californian Warm Temperate Marsh/Seep Group

Mapped in temporarily to seasonally flooded settings where meadow vegetation such as *Juncus spp., Carex spp.* or in wetter settings *Eleocharis* spp. dominates the herbaceous cover.

7300 – Arid West Freshwater Emergent Marsh Group

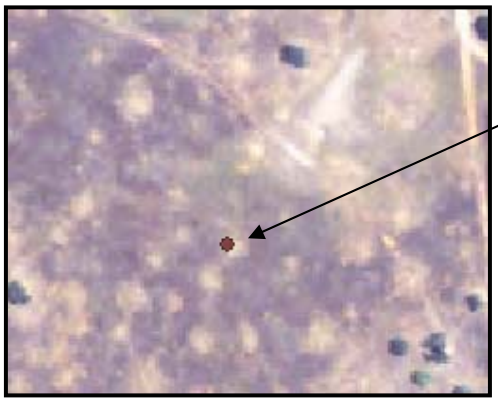
Mapped in semipermanently or permanently flooded settings where *Typha* spp. or *Schoenoplectus* spp. dominates the herbaceous layer in clumped or continuous cover. *Eleocharis* spp. can be a component to a complexing of several alliances in one mapped polygon. Photo interpreters mapped most of these stands around the margins of larger farm ponds and on the upper reaches of reservoirs. When both marsh and meadow vegetation occur adjacent to one another, and one or both do not meet the MMU criteria, they are aggregated into one unit and classified as to the majority of the mapping complex.

7400 – Vernal Pool & Californian Annual and Perennial Grassland Matrix Mapping Unit



Mapped where photo interpreters can see topography that *potentially* yields floristics that are associated with vernal pools. These micro-topographic highs and lows (sometimes called hog wallows) form pool/upland grassland complexes, which are aggregated at times into extremely large polygons that cover many acres of herbaceous dominated vegetation. Users should be cautioned that these edaphic & topographic conditions have not in all cases been classified on accuracy assessment evaluations as containing vernal pool floristics.

Area Previously Mapped as 7400; Accuracy Assessment Evaluation = 7100



Area Mapped as 7400; Accuracy Assessment Evaluation = 7400

7600 – Western North American Vernal Pool and Other Seasonally Flooded Macrogroup

Mapped by photo interpreters when vernal pools and other similar winter-wet, summer dry pools meet MMU guidelines of at least 1 acre in size.

Sparsely Vegetated, Water, & Urbanized Land Use & Land Cover Types

9200 – Agriculture

Includes irrigated row crops, orchards, and vineyards and in some cases, dry land farming of intensively planted grains. Pasture lands (irrigated and dry) are not included in this category and mapped to floristic types as described above. Fallow land which has not been altered for more than one complete growing season generally will have a component of annual grasses and therefore will be mapped to an herbaceous type, most likely type 7101 or 7100.

9300 – Built Up & Urban Disturbance

Includes land use related types not related to agricultural practices and include residential, commercial, industrial and extractive uses in addition to areas cleared for potential future land use related development.

9310 – Urban Window

Intensively and fully developed built up areas of at least 1 square mile. See methodology section for mapping criteria.

9401 – Cliffs & Rock Outcroppings

Mapped as natural features in the landscape with little or no vegetation (generally below 5-10% total cover) on rocky substrates.

9402 – Riverine & Lacustrine Flats & Streambeds

Mapped as natural features in the landscape with little or no vegetation (generally below 5-10% total cover). Note: Baseline interpretation date is late spring to early summer 2005, using NAIP 1-meter imagery. Changes in vegetation or flooding regimes either seasonally or on a year to year basis is often noted with this mapping category.

9403 – Undefined Areas with Little or No Vegetation

Mapped as natural features in the landscape with little or no vegetation. This category is used when photo interpreters are unable to reliably assign a correct landform type to the image signature.

9500 – Introduced North American Mediterranean Woodland and Forest

Mapped when photo interpreters can separate out non native trees that are not associated with built up areas.

9501 – *Eucalyptus*

Mapped when photo interpreters are able to separate out species of *Eucalyptus* not associated with built up areas.

9800 – Water

Note: Baseline interpretation date is late spring to early summer 2005, using NAIP 1-meter imagery. Changes in vegetation or flooding regimes either seasonally or on a year to year basis is often noted with water features, especially along lake & reservoir margins and flowing water in larger streams and rivers. Included in this category are the following:

- **9801** – Perennial Stream Channels
- **9802** – Reservoirs
- **9803** – Small Earthen Dam Ponds & Natural Lakes