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Sequoia and Kings Canyon National Parks Vegetation Classification and Mapping Project Report

Natural Resource Report NPS/SIEN/NRR—2020/2101



ON THE COVER
Photograph of the Great Western Divide from Alta Meadow, Sequoia National Park
Photograph courtesy of Rick Sanger, National Park Service.

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Natural Resource Report NPS/SIEN/NRR—2020/2101

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Executive Summary

The Vegetation Mapping Inventory is a cooperative effort by the Inventory and Monitoring Division of the National Park Service and the Biological Resource Division of the U.S. Geological Survey to classify, describe, and map vegetation communities in the national park units across the United States. As one of 12 inventories critical to the management of natural resources within the national park system, this information fills a wide variety of park management and stewardship needs.

The Vegetation Map of Sequoia and Kings Canyon National Parks was produced over a nine-year period (1999–2007) to describe and map the vegetation of the two southern Sierra Nevada national parks. Over 80,000 individual vegetation polygons were mapped to 166 vegetation classes. Vegetation delineations were based on photo interpretation of 1:15,840 scaled copy color infrared photography acquired during 2000 and 2001. Photo interpretation and automation were performed by Aerial Information Systems under subcontract to Environmental Systems Research Institute, who provided project management and final cartographic products. Development of the National Vegetation Classification Standard compliant mapping classification and accuracy assessment of the final map products, along with all associated field sampling, were performed by NPS ecologists at Sequoia and Kings Canyon National Parks. In order to maintain consistency among mapping products developed for the Sierra Nevada Network parks, we leveraged the floristic and mapping classifications developed for Yosemite National Park and Devils Postpile National Monument (Keeler-Wolf et al. 2012). Spatial accuracy of the resulting map products is equivalent to 1:24000 National Map Accuracy Standards. Overall map accuracy is 80% at the association level and 86% at the alliance level (based on 2,409 field assessments). The final version is cross walked to the USFS CALVEG classification to facilitate regional data sharing and synthesis.

The final products include:

- Vegetation map of Sequoia and Kings Canyon National Parks, including adjacent lands located in the East Fork of the Kaweah River watershed
- Descriptions of each vegetation type
- Key to vegetation types
- Source imagery
- Ecological field plot data
- Photographs of ecological field plots and accuracy assessment plots
- Related data and metadata files
- Table relating mapped types to the floristic classification developed for Yosemite National Park
- Summary of mapping accuracy by type
- Annotated list of type names and codes used over the course of the project in Kings Canyon, Sequoia, and Yosemite National Parks

Final products are available at the NPS Vegetation Inventory Program website and through the NPS IRMA system.

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Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

List of Acronyms

AA:	Accuracy Assessment
AIS:	Aerial Information Systems
BRD:	Biological Resources Division, U.S. Geological Survey
BPUs:	Biophysical Units
CDFW:	California Department of Fish and Wildlife
CWHR:	California Wildlife Habitat Relationship
CIR:	Color Infra-red
DBH:	Diameter at Breast Height (standard tree measurement)
DOQQs:	Digital Orthophoto Quarter Quadrangles
DRGs:	Digital Raster Graphs
ESRI:	Environmental Systems Research Institute
FGDC:	Federal Geographic Data Committee
GIS:	Geographic Information Systems
IMD:	Inventory & Monitoring Division
KICA:	Kings Canyon National Park
NPS:	National Park Service
NRI:	Natural Resource Inventory
NVC:	National Vegetation Classification
NVCS:	National Vegetation Classification Standard
PI:	Photointerpreter/Photointerpretation
SEKI:	Sequoia and Kings Canyon National Parks
SEQU:	Sequoia National Park
SIEN:	Sierra Nevada Network
TNC:	The Nature Conservancy
USGS:	U.S. Geological Survey
USNVC:	U.S. National Vegetation Classification
USNVCS:	U.S. National Vegetation Classification Standard
UTM:	Universal Transverse Mercator
YOSE:	Yosemite National Park

1. Introduction

1.1 The National Park Service Vegetation Mapping Inventory

The Vegetation Mapping Inventory (VMI) is a cooperative effort by the Inventory and Monitoring Division (IMD) of the National Park Service (NPS) and the Biological Resource Division of the U.S. Geological Survey to classify, describe, and map detailed vegetation communities in more than 270 national park units across the United States. The primary objective of the VMI is to produce high-quality, standardized maps and associated data sets of vegetation and other land-cover occurring within parks. As one of 12 baseline inventories identified as critical to the management of natural resources within units of the national park system, this information fills and complements a wide variety of resource assessment, park management, and conservation needs. The VMI adheres to the National Vegetation Classification (NVC) Standard (NVCS), a Federal Geographic Data Committee (FGDC) standard that allows federal agencies to produce uniform statistics about vegetation resources across the nation. Each VMI project contributes to the development of the NVCS by making available data sets and vegetation descriptions resulting from the inventory. Maps are produced in Universal Transverse Mercator (UTM), NAD83 datum with a minimum mapping unit of 0.5 hectares. The vegetation maps must meet the National Map Accuracy Standards for positional accuracy and the minimum class accuracy goal across all vegetation and land cover classes of 80%.

Goals of the NPS mapping projects include providing baseline ecological information to resource managers in the parks; putting these data into regional and national contexts; and providing opportunities for future inventory, monitoring, and research activities. Each park developing a vegetation map follows a standardized field sampling protocol to document the various vegetation types found in a given park. The final products include a vegetation map in digital format, descriptions of each vegetation type, a key to the types, source data (e.g., imagery), ecological field data, and all related data and metadata files (e.g., original field forms, plot database, and accuracy assessment data) (Keeler-Wolf et al. 2012).

Several parks, representing different regions, environmental conditions, and vegetation types, were chosen to be part of the prototype phase of the vegetation mapping program. The initial goal of the prototype phase was to "develop, test, refine, and finalize the standards and protocols" to be used during the production phase of the project. This included the development of a standardized vegetation classification system for each park and the establishment of photointerpretation (PI), field, and accuracy assessment (AA) procedures (Keeler-Wolf et al. 2012). In the Sierra Nevada Network, Yosemite National Park (YOSE) was selected as a prototype large western wilderness park. Sequoia and Kings Canyon National Parks (SEKI, parks) were selected as a post-prototype Inventory and Monitoring Program (IMP) mapping project.

This report documents the development of the vegetation mapping products for Sequoia and Kings Canyon National Parks, which occurred over a nine-year period between 1999 and 2007.

All final Vegetation Mapping Inventory products are made available at the NPS Vegetation Mapping Inventory Products webpage as well as through the NPS IRMA system.

1.2 Vegetation Mapping Program Standards

For its Vegetation Inventory program, the NPS Inventory and Monitoring program, in close cooperation with the USGS, has adopted standards established by the Federal Geographic Data Committee (FGDC 1997, 2008) for vegetation mapping on federal lands. The FGDC is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the Federal government. Under the FGDC, the first U.S. National Vegetation Classification Standard and resulting national classification was adopted in 1997 (FGDC 1997). The standard was established in order to enable federal agencies to produce uniform statistics about vegetation resources, facilitate interagency cooperation on vegetation management issues, and encourage non-Federal partners to use and contribute to a common system of vegetation description and mapping. This standard has continued to evolve into a dynamic system that allows for the incorporation of new information; further information about the development of the classification standards currently in use for mapping and classifying vegetation can be accessed at the U.S. National Vegetation Classification website.

The program standards dictate the scale (1:24,000), minimum mapping unit (0.5 hectares, or 1.2 acres), target positional accuracy (within 12.2 meters [40 feet] of actual location), and thematic accuracy (overall map as well as individual map classes attain 80% accuracy) for NPS vegetation mapping products. Additional information on vegetation mapping in national parks can be found at the NPS Vegetation Mapping Inventory Program website.

The vegetation classification applied in this project is based on the U.S. National Vegetation Classification (USNVC). The USNVC is a physiognomic-floristic system developed by NatureServe (formerly part of The Nature Conservancy) in partnership with the network of State Natural Heritage Programs.

In order to best meet the needs of land managers and ecologists, the USNVC was designed to:

- be vegetation-based,
- use a systematic approach to classifying a continuum,
- emphasize natural and existing vegetation,
- use a combined physiognomic-floristic hierarchy, and
- identify vegetation units based on both qualitative and quantitative data at a scale that is practical both for conservation and for mapping at multiple scales (Grossman et al. 1998.).

The resulting classification system incorporated seven physiognomic-floristic levels for terrestrial vegetation (Table 1). Upper physiognomic levels reflected growth form (e.g., woodland vs. shrubland), structure, leaf phenology, and leaf types. Lower levels incorporated floristic composition as the primary basis for classification. An alliance is a lower level unit in the classification hierarchy and is defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species. Examples in the Sierra Nevada parks include California red fir (*Abies magnifica*) forest alliance, greenleaf manzanita (*Arctostaphylos patula*) shrubland alliance, and shorthair reed grass (*Calamagrostis breweri*) herbaceous alliance. Associations form the lowest level of the

hierarchy, and are defined by a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy. Examples include California red fir-western white pine/pinemat manzanita forest (*Abies magnifica–Pinus monticola/Arctostaphylos nevadensis*) association and Sierran false needlegrass *(Ptilagrostis kingii)* association. Alliances and associations both reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes that underlie the distribution of vegetation types.

Table 1. The U.S. National Vegetation Classification physiognomic-floristic hierarchy for terrestrial vegetation (Grossman et al. 1998) with examples from Sequoia and Kings Canyon National Parks.

Level	Primary Basis for Classification	Example (Colloquial Name)
Class	Growth form and structure of vegetation	Forest
Subclass	Growth form characteristics (e.g., leaf phenology)	Evergreen forest
Group	Leaf types, corresponding to climate	Temperate or subpolar needle-leaved evergreen forest
Subgroup	Relative human impact (natural/semi-natural, or cultural)	Natural/Semi-natural
Formation	Additional physiognomic and environmental factors, including hydrology	Conical-crowned temperate or subpolar needle-leaved evergreen forest
Alliance	Dominant/diagnostic species of uppermost or dominant stratum	California Red Fir Forest Alliance
Association	Additional dominant/diagnostic species from any strata	Red fir–Lodgepole Pine /Whiteflower Hawkweed Forest Association

The SEKI mapping project relied on the 1997 version of the hierarchy and classification (Grossman et al. 1998) as it was applied in YOSE, and the subsequent floristic classification developed for the YOSE project by Keeler-Wolf et al. (2003, 2012). It is important to note that subsequent changes to the USNVC have not been incorporated into this report or data products.

Image interpretation, field sampling and vegetation classification were conducted in concert so that vegetation pattern and classification could inform each other to produce the highest quality map. Canopy density was assigned to each polygon along with vegetation class, and where applicable, land use. Where it was not possible to map to the alliance or association level, mapping units (aggregations of alliances and/or associations that could not be individually distinguished on the photography) were created.

1.3 Project Area Information

Sequoia and Kings Canyon National Parks together form a contiguous reserve of 865,964 acres (350,443 ha) located on the western slope of the south-central Sierra Nevada of California. The reserve ranges in elevation from 1,370 feet (418 m) in the low western foothills to 14,494 feet (4,418 m) on the crest of the mountain range. This section of the Sierra is composed largely of rugged, mountainous terrain; over 70% of park lands are above 8,200 feet (2,500 m) elevation. Like Yosemite National Park to the north, the crest of the range defines the eastern boundary of the parks and the beginning of the steep escarpment which drops precipitously to the Owens Valley to the east.

In addition to the lands within the park boundaries, the project area was extended to include the entire East Fork of the Kaweah watershed, bringing the total number of acres mapped to 872,013 (352,891 ha); (Figure 1.)

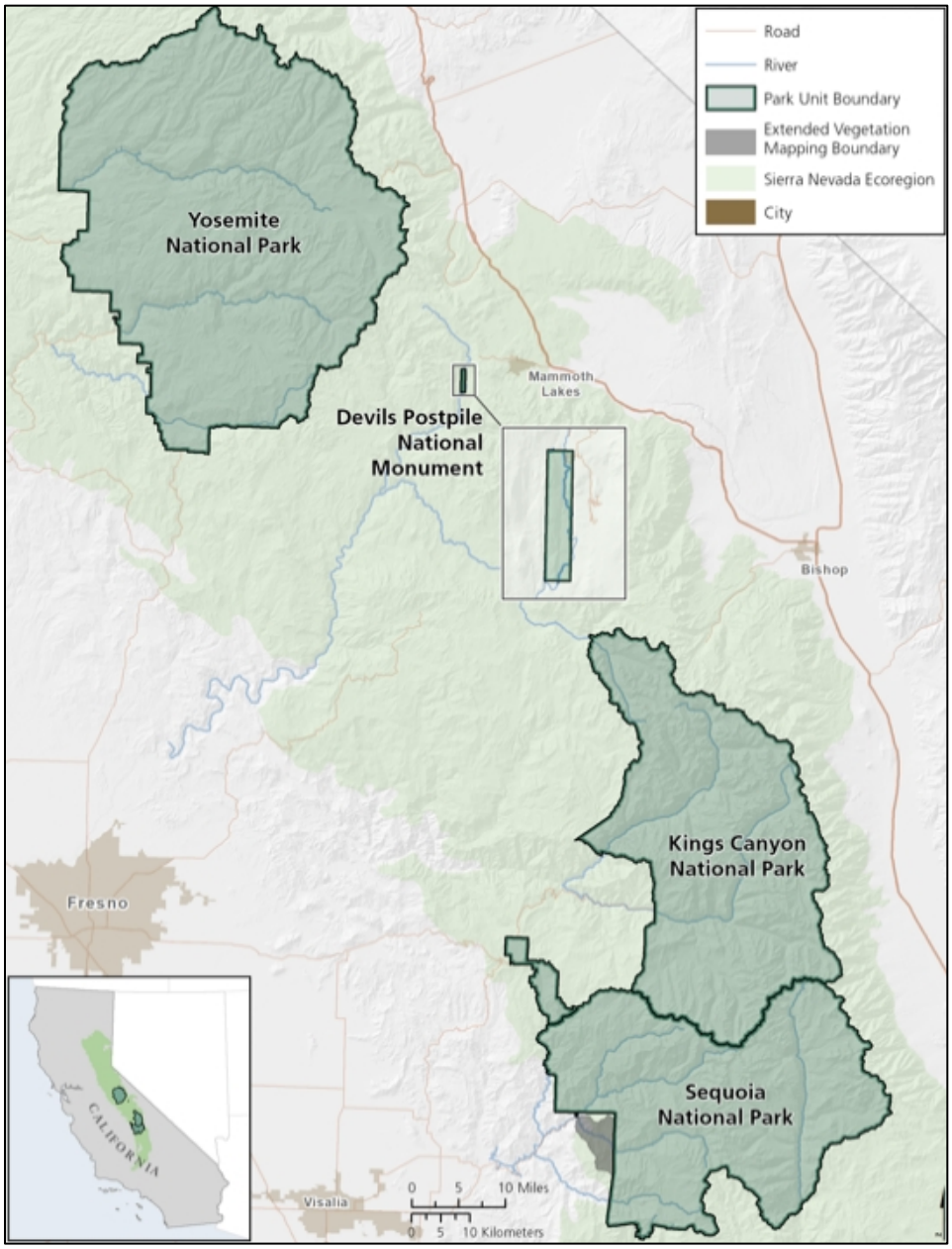


Figure 1. The mapping area for Sequoia and Kings Canyon National Parks, including the East Fork Kaweah River Pilot, which extended beyond the park boundaries.

Sequoia National Park (SEQU) was established in September of 1890 to protect the giant sequoias from logging, and was the first national park established to protect a living organism. Later expansions of the park added the Sierra Crest (1926), the Mineral King Valley (1978), and the Dillonwood Grove of giant sequoias (2000). Kings Canyon National Park (KICA) was created in

1940. It absorbed the much smaller General Grant National Park created in 1890 to protect the Grant Grove of giant sequoias and includes the remote, glacially formed high country at the headwaters of the Kings River and South Fork of the San Joaquin River. Congress created the Sequoia-Kings Canyon Wilderness to preserve (among other values) the highest, most rugged portion of the "High Sierra", including the highest mountain (Mt. Whitney) and largest contiguous alpine environment in the lower 48 states. While SEKI is technically composed of two separate national parks, they are managed as one entity. Over 97 percent of the parks are either designated or managed as wilderness.

In the broadest sense, the landscape and vegetation communities of the two parks are shaped by two defining characteristics. The first is a lengthy elevation gradient, with high species diversity and turnover reflecting the corresponding decrease in temperature with increasing elevation. The second is the inclusion of the headwaters of three major watersheds, which generate regional orographic weather patterns and strongly influence local climate through the creation of rain shadows. As a result, the ecosystems of the parks include the full range of foothill, montane, subalpine, and alpine environments, including permanent snowfields and glaciers at the highest elevations. The vegetation reflects this environmental variability, and includes riverine woodlands, wetlands, chaparral, evergreen and deciduous hardwood and coniferous forests, subalpine woodlands, meadows and grasslands, and alpine vegetation.

West of the crest, the lowest, or foothill, elevations of the two parks support drought tolerant oak woodlands, annual grasslands, and chaparral. Above the rain-snow transition, the forests of the montane zone are composed of a mix of coniferous tree species. With roughly a third of the park area falling between 5,000 and 9,000 feet in elevation, this comprises some of the most extensive stands of old-growth coniferous forest in California. Above 9,000 feet, the subalpine woodlands of Kings Canyon National Park are characterized by whitebark pine; as one travels southward into Sequoia National Park, these windswept trees give way to stands of ancient, gnarled foxtail pine. Above treeline the rocky alpine environment supports a suite of low-growing, largely perennial herbs and forbs that are adapted to the harsh winter environment and short growing season of the highest elevations.

Geology and topography. Sequoia and Kings Canyon National Parks occupy the southern portion of the Sierra Nevada's suite of batholiths, which form nearly continuous blocks of Mesozoic granite uplifted by the collision of the Pacific and North American tectonic plates (Norris and Webb 1976). The southern end of the range is higher and more rugged than the northern, with many peaks above 13,000 feet (3,962 m).

Scattered throughout the parks are roof pendants—layers of older, metamorphic rock which lie above and between the younger granitic plutons. These pendants are largely composed of metavolcanic rocks derived from silicic volcanic tuffs, breccias, and lava flows, and they overlap the plutonic granites in both age and composition (Moore and Sisson 1987). A band of such metavolcanic rock trends roughly north-northwest through the center of the parks, including the Mt. Goddard, Mt. Kaweah, and Mineral King pendants. This band is in turn flanked on either side by metasedimentary rocks, which consist primarily of mica schist, but also include marble and quartzite (Moore and Sisson 1987).

The two parks differ topographically in several ways. In the north, Kings Canyon National Park is largely defined by the watershed of the Kings River, an extensive system of rugged river canyons that drains the Sierra Nevada crest westward to the central valley of California; it also includes a small portion of the headwaters of the San Joaquin River. To the south, the Kings-Kern Divide serves as a natural east-west trending boundary between the two parks. Sequoia National Park is drained by two major river systems, the Kaweah and the Kern, and a small portion of the Tule River. The two primary watersheds are separated by the Great Western Divide, a northeast-to-southwest trending range of 4,000 m peaks lying west of and parallel to the Sierra Nevada crest. To the west, the Divide is drained by the five forks of the Kaweah River, whose U-shaped headwaters show signs of recent glaciation, while the lower reaches retain a classic unglaciated V-shape.

The massive Kern River Canyon lies between the Great Western Divide and the Sierra Nevada crest. Unlike most Sierra Nevada rivers which drain perpendicular to the crest, the Kern River flows south along a fault line, and hence runs parallel to the main crest. The canyon shows evidence of being heavily glaciated, forming a profound and rounded trench while the immediate surrounding uplands are composed of a series of lightly glaciated and unglaciated terraces. During the Late Cenozoic these ancient erosional surfaces apparently did not accumulate enough snow to form glaciers, and are believed to correspond in age to the major periods of Sierra Nevada uplift (Matthes 1950). These old surfaces remain as gently sloping plateaus characterized by relatively deep granitic soils. Above these plateaus, the cirques and upper canyons of the Divide and the crest are glaciated, with the exception of the summits of the highest peaks (e.g., Mt. Whitney and Mt. Langley) which are hypothesized to be remnants of the oldest erosional surface (Matthes 1950).

Climate (adapted from Davey et al. 2007). At the lower elevations, the climate of the southern Sierra Nevada is characterized as Mediterranean, with warm, dry summers, while the high elevation climate, with cold, moist winters, is considered boreal. Throughout the parks summers are dry and precipitation falls almost entirely during the cool winter season, with snow possible at all elevations (although infrequent at the lowest elevations). Nearly 70 percent of precipitation falls from December through March. Annual precipitation along the mountain range increases with latitude, with a marked difference between the southernmost portion of the range (the Kern watershed) and the northern portions in the watersheds of the Kings and San Joaquin rivers. The majority of annual precipitation at the middle and high elevations of the parks falls as snow. The rain/snow transition, above which precipitation falls primarily as snow rather than rain, ranges from 4,920–5,900 feet (1,500–1,798 m) and coincides with the transition from hardwood to coniferous forest. The warmest temperatures occur during the driest season, between June and September. Plant growth during these warm, dry months is dependent upon sufficient soil moisture from surface and groundwater, re-supplied by the spring and early summer snowmelt. Stephenson (1988) calculated that at high elevations in the southern Sierra Nevada, 80–90% of the annual water supply is released from melting snow between April and July.

Throughout the parks, local climatic conditions are significantly influenced by topography. The ancient erosional surfaces which characterize the Kern Canyon and the high peaks of the crest are subject to high winds which prevent the deposition of deep snow. The Great Western Divide acts as a

rain shadow on the Kern drainage, resulting in less precipitation than the Kaweah drainage to the west. For an excellent description of the climate of Sequoia National Park and its relationship to vegetation, the reader is referred to (Stephenson 1988).

1.4 Project Overview

Vegetation mapping in the Sierra Nevada Inventory & Monitoring network was initiated in 1996 when NatureServe, Environmental Systems Research Institute (ESRI), Aerial Information Systems, Inc. (AIS), NPS, and USGS ecologists met to discuss the use of Yosemite National Park as a pilot for the recently formed USGS-NPS Vegetation Mapping Program. Yosemite was to become the first large national park (defined as any park over 60,700 ha [150,000 acres]) (USGS 1994) to be mapped. AIS had been subcontracted by the prime contractor, ESRI, to perform the vegetation photointerpretation and automation for YOSE and its environs, including DEPO. Planning for the mapping project in Sequoia and Kings Canyon National Parks followed in 1998, with an interagency scoping meeting held in June of 1999. The need for a comprehensive, accurate vegetation map for resource planning, management, and research applications had long been recognized by SEKI managers and scientists. This was especially true for the fire management program, which relies on accurate vegetation data to drive predictive fuels models and assess program priorities and needs. The National Interagency Fire Center (NIFC) agreed to initiate the vegetation mapping effort at SEKI by providing two years of support, with subsequent years of funding provided by the IMD.

Development of the SEKI vegetation map was guided by the following goal: to develop a highly accurate geographic information system (GIS) based vegetation map that meets scientific and FGDC standards, is based on a hierarchical classification scheme consistent with the National Vegetation Classification, and has a level of detail that is useful to park managers, scientists, and cooperators.

Adapting the processes established in Yosemite, guiding principles for the Sequoia and Kings Canyon mapping project included the following:

- To integrate the vegetation sampling process with the photointerpretation process so a seamless, mutually beneficial feedback loop would develop with the field crews providing information to the mappers while, at the same time, the mappers supporting decisions by the field crews about where and what to sample.
- To integrate a large amount of existing vegetation data with new field data to be collected during this project into a unified vegetation classification that would be used for the final products.
- To develop products that would allow for the comparison of vegetation between the Sierra Nevada Network parks, and thus provide a common baseline for regional vegetation analyses.

To ensure compatibility across the SEKI, YOSE, and Devils Postpile (DEPO) mapping products, ESRI was selected as the prime contractor, and AIS subcontracted to perform the vegetation photointerpretation and automation. As in Yosemite, the map layer is based on 1:15,840 color infrared aerial photography, and reflects the National Vegetation Classification Standard (NVCS) developed by The Nature Conservancy (TNC) and Ecological Society of America (ESA) as well as

the floristic classification completed for Yosemite (Keeler-Wolf et al. 2003). Vegetation ecologists at the California State Heritage Program at California Department of Fish and Wildlife (CDFW) played a key role in the development of the YOSE floristic classification and the mapping classifications for YOSE and SEKI. Ecologists at Sequoia and Kings Canyon National Parks supervised the field sampling effort to support development of the classification, provide feedback for the photointerpreters, and to assess the accuracy of the cartographic map products.

Aerial photography of the project area was first acquired in July of 2000. When the original imagery failed to meet the specified 1:15,840 scale, a second set of images of the park lands were re-flown in late summer of 2001. This delay in acquisition of photographic products, and the inability of the contractor to produce images of quality comparable to those in use in Yosemite, was to influence the timeline (Appendix A) and resulting products throughout the term of the project. Field data collection occurred from 2000 through 2004. Mirroring the YOSE mapping process, the early field data collection phase included four week-long reconnaissance trips involving photointerpreters and ecologists in order to facilitate field identification of preliminary photo signatures and delineations.

Photointerpretation and automation for the Sequoia and Kings Canyon project occurred in three sequential phases. Initial efforts were focused on the East Fork of the Kaweah River (phase one, or East Fork pilot; 2001–2003), which allowed photointerpreters to evaluate both the imagery and classification along a topographic and elevation gradient representative of the broader project area. Mapping the full extent of this drainage also provided managers in the NPS and the Bureau of Land Management with a seamless map of the vegetation in a key watershed abutting the western edge of Sequoia National Park. Phase 2 (2003–2004) involved mapping the rest of Sequoia National Park, with the mapping of Kings Canyon National Park comprising phase 3 (2004–2006). Plot data collection for the development of the mapping classification and to inform the photointerpretation process took place concurrently during 2000–2003.

Data collection for accuracy assessment also took place concurrently with photointerpretation during the 2002–2004 field seasons. These data were analyzed and the map finalized in 2007 with a draft report completed in 2008.

2. Methods

Reflecting the similarity in vegetation types found within the three large Sierra Nevada parks, both the floristic and mapping classifications for the Sequoia and Kings Canyon mapping project were derived from the classifications developed for the Yosemite project. In order to maximize efficiency and to facilitate the launch of the photointerpretation process, initial efforts were focused on developing a draft mapping classification that could then be tested both in the field and during the photointerpretation phases. Using the Yosemite classifications as a starting point, we integrated information from existing data sets, published treatments, and local knowledge into a draft classification that was consistent with the Yosemite treatment of shared types, incorporated types unique to SEKI, and reflected the particular strengths and weaknesses of the SEKI imagery. The mapping classification was then refined over the course of the project through an iterative process informed by the analysis of new plot data, close consultation between CDFW, USGS and NPS ecologists and the AIS photointerpreters.

Sampling locations to augment existing data sources were identified using a combination of local expert knowledge of gaps in existing plot data, and spatial data provided by an informal GRADSECT analysis (Austin and Heyligers 1989). Using work completed in Yosemite as a guide, the GRADSECT approach was used to develop an initial stratification of the landscape according to the primary environmental variables believed to drive the distribution of Sierran vegetation (coarse geologic substrate, topography, elevation), which then provided a way of assessing both the geographic and ecological completeness of existing legacy data sets. The first full year of the project (2000) was dedicated in large part to the development of an initial classification based on existing plot data, and augmented with a season of intensive field sampling to increase its robustness. The second full year of field sampling (2001) continued the effort to characterize known types. Sample location was driven both by gaps in coverage and accessibility of recognized types.

When it became apparent that the photography acquired for this project was inferior to that used in YOSE, it was decided to carry out a pilot project on one watershed from start to finish before proceeding with development of a parks-wide map. The East Fork of the Kaweah River watershed (from the headwaters in the Mineral King Valley to the confluence with the Middle Fork of the Kaweah River just below park headquarters) was chosen for this effort, as it includes a wide range of types along a long elevation gradient and is more accessible than other areas of the parks. In 2002, AIS mapped the East Fork watershed and SEKI field crews collected AA points to evaluate its success. Because the results of the AA effort were needed in order to evaluate the pilot map, AA points were collected without the benefit of having delineations in hand. Field crews identified polygons using DOQQs (Appendix B) and field observations, and established nearly 700 0.5 ha plots across the watershed. Accuracy of the pilot map was assessed before the digital product was delivered by comparing field data with delineated overlays. After the entire mapping process—from field reconnaissance to accuracy assessment—was completed for the pilot area, project procedures were reviewed and revised by park staff and AIS prior to mapping the rest of SEKI. The East Fork pilot mapping products were ultimately incorporated into the final SEKI map.

The results of this pilot provided the team with the confidence to move forward with mapping the rest of the parks, and in 2003 the NPS contracted with ESRI/AIS to complete the map of SEQU. At the same time, field crews collected AA plots throughout the rest of SEQU, and provided the photo-interpreters with plot-based feedback on specific questions.

Reflecting the issues with the acquired imagery, and the remote nature of much of the two parks, vegetation sampling and classification, delineation of vegetation polygons, and accuracy assessment all occurred iteratively in phases throughout the project. This was in contrast to the more traditional approach of conducting each task in sequence. Accuracy assessment data were collected in the rest of the project area during 2003 and 2004.

A total of 1,228 photos were delineated for the project. Delineations were then converted to georeferenced digital format, which were then rectified to digital orthophoto quarter quads (DOQQ). Accuracy of the delineations and their attributes was conducted in stages, with the final parks-wide assessment completed in 2006.

2.1 Vegetation Sampling and Classification

2.1.1 Development of the Preliminary Classifications

The SEKI vegetation mapping project relied heavily on both the floristic and mapping classifications that were in development for YOSE at the time mapping in SEKI was initiated. Reflecting the objective of developing a classification and map that were consistent with those developed for YOSE, emphasis was placed on describing types not found in YOSE and that had not been formally described in Sierra Nevada. Plots were established in representative stands of vegetation and evaluated along with existing data in order to confirm known types and to describe new associations.

2.1.2 Integration of Existing Data Sets

Systematic surveys have been undertaken to describe the distribution of vascular plants in Sequoia and Kings Canyon since the 1980s. Prior to the vegetation mapping project, the most wide-ranging surveys, in terms of both geographic and floristic coverage, included the Natural Resource Inventory (NRI), the Stephenson Gradient Analysis study, and the Vankat/Roy studies of vegetation change in Sequoia National Park. These data were used to develop the mapping classification, and were also provided to the photointerpreters as training points. The following briefly describes these three data sets.

Natural Resources Inventory Data

In 1985, research biologists at Sequoia and Kings Canyon National Parks initiated a plot-based parkwide survey of vascular plants using a randomized systematic sampling design based on 1 km grid intersections (Graber et al. 1993). The resulting data set of 628 plots (established between 1985 and 1996) distributed throughout the two parks is well suited for describing the distribution of plant species along environmental gradients. A detailed discussion of the sampling rationale and methodology may be found in Graber et al. (1993).

One-tenth ha circular plots were located at 1 km Universal Transverse Mercator (UTM) intersections, with plot center randomly placed with a 100 m radius of the intersection. Unlike traditional

approaches to vegetation sampling, no effort was made to place the plots in either homogeneous vegetation or environment. Clusters of points were sampled throughout the study area in order to maximize sampling efficiency.

Canopy cover was determined differently according to life form. Cover of herbaceous species was estimated through the placement of six 1-m^2 quadrats at increasing intervals along two 17.83 m transects describing the north and east radii of the plot. A line-intercept technique was used to estimate shrub canopy cover along the length of the two transects. Tree dominance was estimated by measuring diameter at breast height (dbh) for all trees greater than 1.4 m high within the plot, and by a tally of saplings >10 cm high and less than 1.4 m high. A list of all additional plant species present was generated by a thorough search of the plot.

Although plots were established without reference to homogeneity of vegetation, each site was assigned to one or more of the vegetation types described by Holland (1986). Anticipating the need to assess the accuracy of future vegetation mapping efforts, up to four Holland types adjoining the plots were also noted.

Stephenson Gradient Analysis Study

Gradient analysis data were collected from 1982 to 1984 primarily to describe the distribution of forest trees along environmental gradients in Sequoia National Park (Stephenson 1988). Plot locations were not chosen with regard to vegetation type, but were located to sample a wide range of environmental gradients including elevation, slope steepness, slope aspect and soil depth, and also to cover an extensive geographic range of the park. Plot locations were selected subjectively to ensure homogeneity of slope steepness, slope aspect, and soil type. Vascular species composition (including both woody and herbaceous taxa), cover, tree dbh, tree canopy cover and abiotic plot attribute data were recorded for 228 0.1 hectare Whittaker-type rectangular plots (Stephenson 1988).

Vankat/Roy Vegetation Change Study

As part of an effort to characterize post-settlement changes in woody vegetation, in 1969 John Vankat established 110 belt transects in forest and woodland types throughout Sequoia National Park. Data collected from these 50 m by 2 m transects included cover of all woody species, dbh of rooted trees, and basal area of all trees as determined by Bitterlich wedge prisms at both ends of the transect. Environmental parameters recorded include slope steepness, slope aspect, and elevation (by altimeter and topographic map). Vankat used these data as the basis for the first detailed classification of forest vegetation in Sequoia National Park (Vankat 1970, 1982). Many of these transects were revisited in 1996 by Graham Roy, who evaluated change in vegetation between the two sampling periods. Vegetation observations from these plots were limited to woody species only (Roy and Vankat 1999).

Ancillary Data and Maps

In addition to the three data sets described above, the NPS provided a number of hardcopy and digital files to assist in the photointerpretation process. In addition to the materials described below, a complete list of products provided for this purpose can be found in Appendices B and C.

Vegetative-type survey of Sequoia National Park (1933–1934). The earliest detailed map of the vegetation of Sequoia National Park was developed as part of a vegetative-type survey of the State of California under the direction of the California Forest Experiment Station (Frost 1935, Wieslander 1935). This effort resulted in a hand-drawn map showing the distribution of tree and shrub dominated types as viewed and delineated from ground-based vantage points. In addition to dominant taxa, polygons were annotated with species deemed of distributional or ecological importance. The Sequoia map was scanned by ESRI and a digital file provided to AIS to aid in the photointerpretation process; although the type mapping effort also included the collection of plot data, these were not available for use in this project. All map products, plot data, and photographs associated with the Vegetation Type Mapping survey were subsequently compiled and digitized and made available through the U. C. Berkeley Department of Science, Policy, and Management.

Timber type maps (1964–1974). Traditional timber type maps of the parks were produced by contractors for Kings Canyon National Park in 1968 (Hammon, Jensen and Wallen) and for Sequoia National Park in 1974 (Natural Resources Management). Based on aerial photography and field checking, these maps were drawn at a scale of 1:15,840 and focused primarily on forest types. Forest types included dominant and subdominant species, stand size, cover class, and decadence rating. Treatment of other vegetation was cursory, and in remote areas, such as the Kern Canyon, issues with accuracy were encountered by users of the maps.

Giant sequoia groves (1964–1977). Of special interest to the parks was the detection and accurate delineation of all existing giant sequoia groves, including any small groves not captured during early mapping efforts. To identify known locations of giant sequoia and to assist in training to recognize the signature of this important type, a digital coverage showing the location of giant sequoia groves was provided. This coverage was based on the original Sequoia Tree Inventory, conducted under contract between 1964 and 1977, which produced a series of 1:62,500 scale stem maps of all known mature giant sequoia trees. In 1979, grove boundaries derived from these maps were transferred to 15’ USGS quad maps by NPS staff, and subsequently digitized in 1995 (National Park Service 1995).

White pine blister rust project polygon and point data (1995–1999). This extensive ground survey of the white pine species in Sequoia and Kings Canyon National Parks was guided by a model of white pine distribution, including sugar pine (*Pinus lambertiana),* whitebark pine *(Pinus albicaulis),* foxtail pine (*Pinus balfouriana),* limber pine *(Pinus flexilis)*, and western white pine (*Pinus monticola*). One hundred fifty-four (154) permanent monitoring plots were established using a stratified random sampling design which encompassed the entire known range of these species within the parks. Within each plot, white pines greater than one meter tall were measured, mapped, and evaluated for white pine blister rust (*Cronartium ribicola*) infection. Vegetation sampling in these plots included trees associated with white pine blister rust and shrub species in the genus *Ribes*, which serves as the alternate host for white pine blister rust (Duriscoe and Duriscoe 2002).

Dead foxtail pine stands. Another area of special interest was the location of stands of dead foxtail pine, which serve as an indicator of changing climatic conditions. A digital coverage identifying previously mapped dead foxtail pine areas was provided for reference during the photointerpretation

effort. A separate mapping class was added to the SEKI classification to capture standing dead and/or downed foxtail pine, sometimes referred to as “ghost forests”.

In addition to the existing data (Figure 2), the Park also provided AIS with plot information gathered by the SEKI field teams over the course of the project. This included SEKI Accuracy Assessment (AA) plots and waypoint observations (WP) obtained during the Mineral King pilot study (2000–2001), Rapid Assessment (RA) plots (established specifically to answer photointerpreters questions about vegetation signatures seen on the aerial photography), AA plots collected in 2002 and 2003, and waypoint observations from 2002 and 2003.

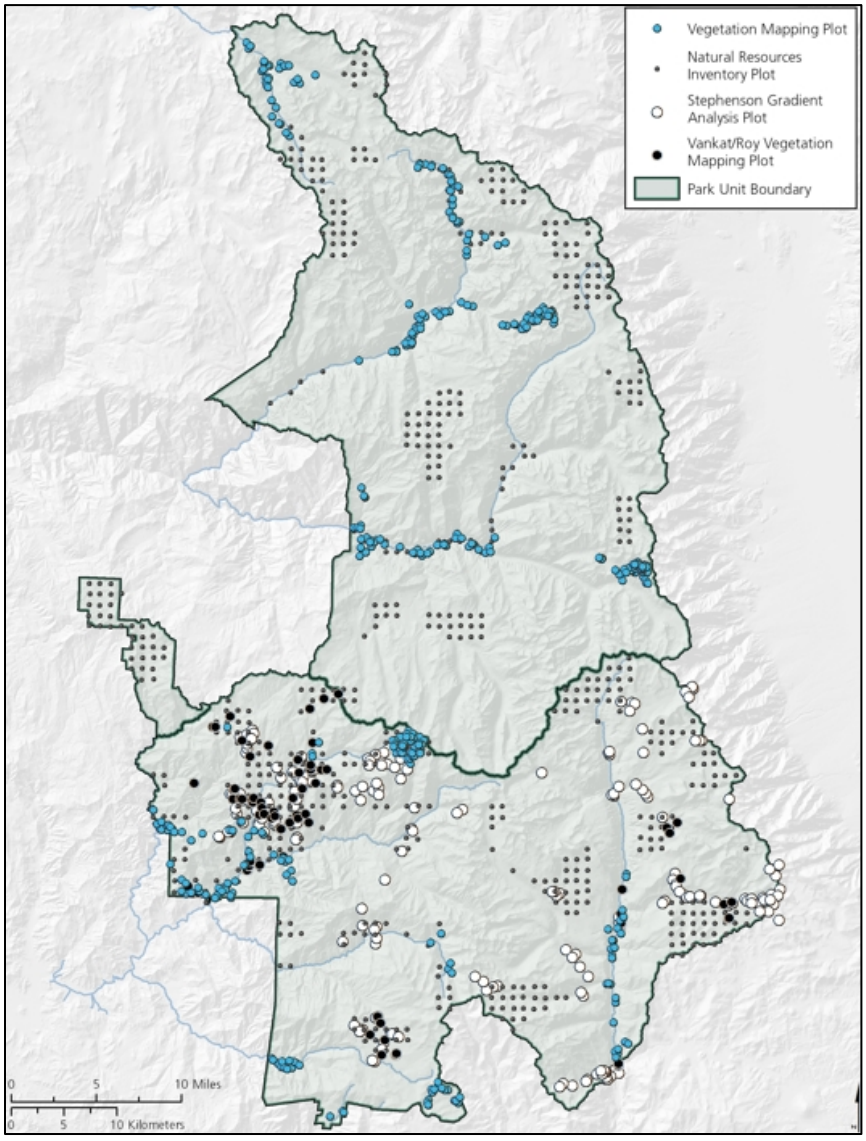


Figure 2. Locations of vegetation plots, in Kings Canyon and Sequoia National Parks, that were used to inform the development of the mapping classification.

2.1.3 Sample Allocation

Sample allocation was driven by the need to ensure crew safety, maximize efficiency and to fill known gaps in existing vegetation data sets. It was developed using a terrain model overlain by existing plot data, which then used local expert knowledge to identify locations to concentrate the sampling effort. Remote areas and steep, inaccessible terrain were largely excluded. Also emphasized were types and areas in response to questions raised by the photointerpreters.

2.1.4 Field Data Collection

Field data in support of classification development, photointerpretation, and accuracy assessment were collected by NPS crews between the years 2000 and 2004. Field observations fell into five categories:

- Plot-based vegetation data to inform classification development (Figure 2) were collected using the standardized relevé-based protocols developed for the USGS-NPS Vegetation Mapping Program by The Nature Conservancy (Grossman et al. 1998). Cover of trees, shrubs, and herbaceous species was estimated in 423 plots of variable size reflecting the physiognomy of the vegetation being sampled. In general, herb-dominated plots were 100 m^2 in size, shrubland plots were 400 m^2, and large stands of wooded/tree dominated vegetation were sampled with 1,000 m^2 plots (Keeler-Wolf et al. 2012.) A standard set of environmental variables was documented for each plot. These plots were established in the years 2000 and 2001.
- Rapid assessments (RA, n=123) (Figure 3) were conducted in 2001 and 2002 in response to specific questions raised by photo-interpreters, following the vegetation rapid assessment protocol developed by the California Native Plant Society in 2002 (CNPS 2002). These plots also varied in size depending on the physiognomy of vegetation.
- Waypoint (WP) observations (Figure 3) were rapid descriptions of vegetation developed while traveling between sample points, or in response to a specific question for the photointerpreters. In general, waypoints characterized an area equal to the minimum mapping unit of 0.5 ha, but in some cases size varied reflecting location and vegetation. Of the 433 waypoints characterized between 2000 and 2004, 248 were provided to AIS as training points and the rest retained for accuracy assessment.
- Accuracy Assessment (AA) plots were established to assess the accuracy of delivered map products. Dominant species were recorded according to stratum in 2,821 0.5 ha plots established between 2002 and 2004. Of these, 738 plots were viewed from a distance and 99 plots were provided to AIS as training points.
- Fuels were characterized on 227 plots established in the years 2000–2003 according to protocols developed as part of the YOSE vegetation mapping effort. This ancillary data set was provided to the park fire program in order to enhance the utility of the final map for fire and fuel modeling efforts.

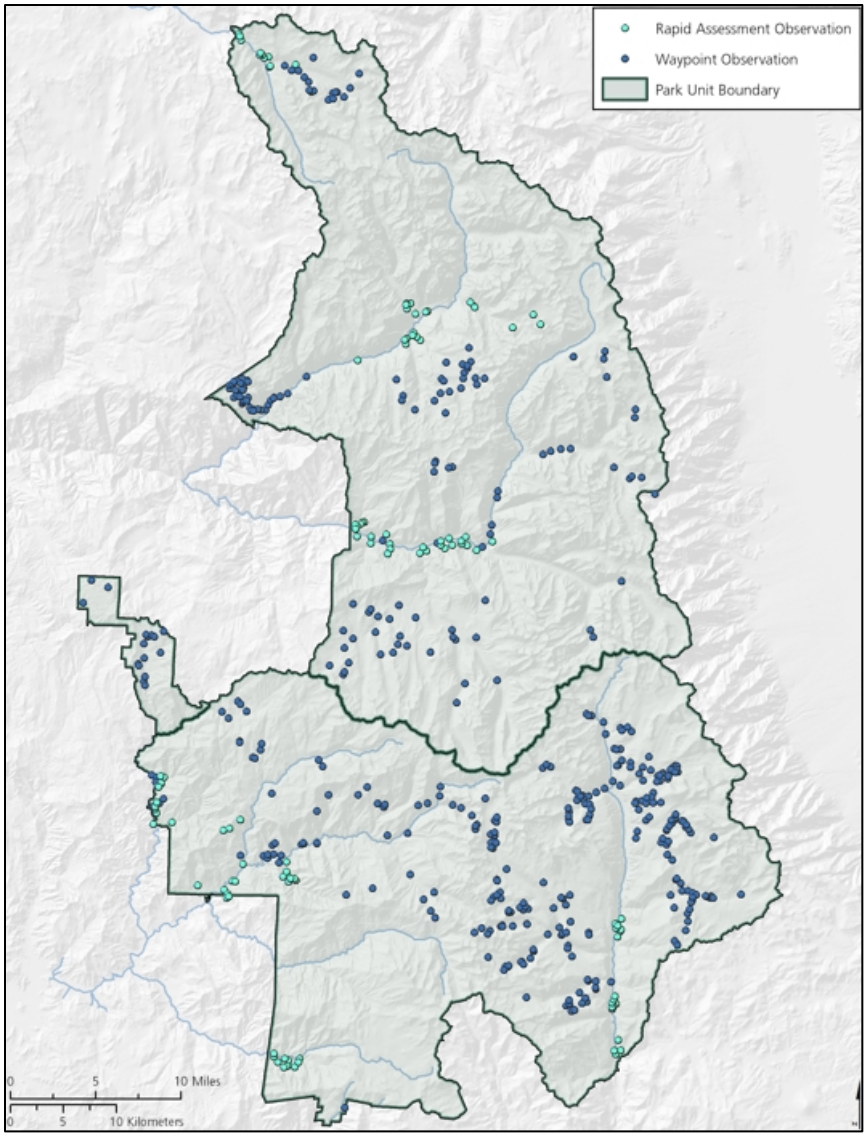


Figure 3. Locations of Rapid Assessment (RA) and Waypoint (WP) observations provided to photo interpreters during the mapping process, in Kings Canyon and Sequoia National Parks.

Plots were located using Garmin model GPS III+global positioning devices. When satellite coverage was inadequate to capture location data, coordinates were derived from 1:24,000 scale USGS topographic quadrangle maps. Plot photographs were captured using Kodak DC265 (GPS-linked), Olympus D-340R, Nikon CoolPix2000, and Canon PowerShot S40 digital cameras. A complete description of the field sampling protocol and the field datasheets and code lists are provided in Field Sampling Protocols and Datasheets for Sequoia and Kings Canyon National Parks Vegetation Mapping Program (NPS 2003).

Copies of CIR photographs were provided to field crews before each field tour. These photographs were annotated by the photointerpreters prior to the tour with specific questions pertaining to signatures and/or polygon breaks. At the end of each tour, the field crews would provide the

photointerpreters with responses to these questions along with a summary narrative describing the vegetation of the area visited during the tour.

Archiving of Data

The NatureServe–NPS PLOTS database (NatureServe, 1997), based on MS Access 2.0 software, was used to enter all field data collected in the sampling seasons of 2000 through 2004. This database was developed specifically for the NPS mapping projects, and data entry mirrored the field forms used in the project (see NPS 2003 for field forms and field protocols). When this software became incompatible with NPS-approved operating systems, the data tables from the plots database system were exported and transformed into an Access database, *SEKI_VM_Plotdata.mdb*. In 2003, PDA technology was used to record a subset of the field data. Digital data entry forms were created for Handspring VisorPro PDAs using Pendragon Forms software version 3.2, and these were electronically linked to the access tables used to store the field data. When the database was restructured, the digital forms no longer mapped to the plot data tables and their use was discontinued. Data were entered and quality controlled by NPS field staff and ecologists at the end of each field season. Field datasheets and digital photographs taken of each plot were archived at SEKI and made available through the NPS Data Store. In 2009, the plot data were reformatted by the Colorado Natural Heritage Program/Colorado State University to match the current revision of the NPS PLOTS database, PLOTS v. 3.0, thus allowing us to maintain consistency with comparable NPS vegetation mapping datasets.

The Natural Resource Inventory data set, Stephenson Gradient Analysis data set, Vankat/Roy transect data, and white pine blister rust project data were all entered individually into Microsoft Access databases and archived at SEKI.

2.1.5 Mapping Classification, Description Writing, and Key Development

The mapping classification (Appendix D) and key to types (Appendix E) developed for SEKI were in large part derived from the floristic and mapping classifications and key developed for YOSE. For a detailed description of the development of the YOSE classifications, see Appendix F of Keeler-Wolf et al. (2012). Standard classification software (e.g., Two-way Indicator Analysis, TWINSPAN) was used to detect patterns in the SEKI plot data and we worked closely with ecologists working in the Sierra Nevada parks to determine which types were consistent between the park units, and which were not. Ecologists at SEKI used subject matter expertise and local knowledge to test the keys using SEKI plot data. Types not present in YOSE but occurring in SEKI were inserted into the SEKI version of the key post hoc.

Descriptions of each mapping type (Appendix F) were written based on all available plot data and reflect the distribution of each type as mapped by the photointerpreters within the two parks. The descriptions are meant to provide the map user with an understanding of the species composition, structure, and environmental characteristics for each type. Each description includes:

- The photointerpretation (PI) code, the type name in English, and the type name using species' scientific names;

- A brief introductory description that includes habitat characteristics, elevation range and areal extent of the vegetation type, and important taxa occurring in the type;
- A range map for each vegetation class;
- Producer's and User's Accuracy that estimate classification and mapping accuracy;
- Photo Interpretation Signature description, which includes notes on key features of the photo signature of each mapping class;
- An air photo image showing a representative signature for each map class;
- Environmental characteristics of the mapping class which may include microclimate, elevation range, shape, slope position and steepness, and aspect;
- A scatterplot showing the distribution of the mapping class across slope aspects;
- A listing of types that can be mistaken for the present class during photointerpretation.
- Detailed floristic descriptions for types shared with YOSE can be found in Appendix K of Keeler-Wolf et al. (2012).

2.1.6 Vegetation Type Naming Conventions

In order to maintain consistency between the vegetation mapping products produced for the Sierra Nevada Network Parks, we adopted the type naming conventions used during the YOSE and DEPO mapping projects for the SEKI project. The following section describing naming conventions is taken from Keeler-Wolf et al. 2012.

Nomenclatural conventions follow, to the extent possible, the 2008 NVCS of the Federal Geographic Data Committee (FGDC 2008:38). This standard includes the following:

- Community nomenclature must contain both scientific and English common names.
- Nomenclature for vascular plant taxa used in scientific type names should follow the accepted name in USDA Plants Database or the Integrated Taxonomic Information System (ITIS).
- Among the taxa that are chosen to name the type, those occurring in the same stratum or growth form (tree, shrub, herb, nonvascular, floating, submerged) are separated by a hyphen (–), and those occurring in different strata are separated by a slash (/). Diagnostic taxa occurring in the uppermost stratum are listed first, followed successively by those in lower strata. The order of taxon names within a stratum or growth form generally reflects decreasing levels of dominance, constancy, or other measures of diagnostic value.
- Association or alliance names include the name of the level of the hierarchy in which the unit is placed, e.g., *Pinus ponderosa* Forest Alliance in headings or *Pinus ponderosa* forest alliance within text.
- In cases where diagnostic taxa are unknown or in question, a more general term is currently allowed as a "placeholder" (Jennings et al. 2009) (e.g., *Cephalanthus occidentalis* / *Carex* spp. northern shrubland).

In this report and classification, the source used for English as well as scientific names of species is the ITIS. Synonyms from Hickman (1993) are shown parenthetically where they differ.

In addition, capitalization rules for describing vegetation have been adopted as follows:

- When a common name for a vegetation type is being used in a table, heading, or list, each word is capitalized (except for the second word in a hyphenated word, such as Incense-cedar), e.g., Sierra Lodgepole Pine Woodland.
- When a Latin name for a vegetation type is being used as a heading or a label, each word is capitalized except for the specific epithet of Latin names, e.g., *Pinus contorta* var. *murrayana* Woodland, and the rank (e.g., ssp., var., or forma). Latin names in a vegetation type are italicized in print to follow normal rules of style.
- When a common or Latin name of a vegetation type is being used in a sentence, as in the description of the type, only the Latin names of genera and proper or place names are capitalized (as in standard conventions for Latin and common names of plants), e.g., *Pinus contorta* var. *murrayana* woodland …, or Sierra lodgepole pine woodland ….

2.1.7 Relationship between Floristic Vegetation Classification and Mapping Classification

Project ecologists at SEKI worked closely with vegetation ecologists from the CDFW, Natural Heritage program, USGS field station in YOSE, the California Native Plant Society, and the photointerpreters from AIS working on the Sierra Nevada Network (SIEN) park mapping projects to develop a mapping classification consistent with both the floristic vegetation and mapping classifications prepared for YOSE.

As in YOSE, the mapping classification for SEKI represents photo interpretable classes which for the most part fall within the hierarchy of the YOSE floristic classification. The mapping classification contains floristically and ecologically defined types, which are listed under the following categories (from Keeler-Wolf et al. 2012):

- Phases: Several mapping types represent higher levels of detail than are described in the association level definitions described in the USNVC.
- Associations: Direct correlation to associations in the USNVC.
- Superassociations: Groups of associations within an alliance which share floristic and environmental similarities such as the Sierra lodgepole pine forest mesic superassociation (mapping code 3048).
- Alliances: Direct correlation to alliances in the USNVC.
- Superalliances: Created when two or more alliances occupying similar environments are grouped together because they are not separable on the aerial photography. In SEKI, foxtail pine–sierra lodgepole pine woodland (mapping code 3540) is an example of a mapping Superalliance.
- Mapping Units: These are types that range in detail and do not nest perfectly between any of the categories defined in the USNVC. One example of a mapping unit may include species from two different associations, which technically fall in separate alliances but hold together through similar ecological and floristic characteristics. Sierra lodgepole pine–quaking aspen/(Kentucky bluegrass) forest mapping unit (mapping code 3012) is an example of a mapping unit applied in SEKI. Other examples of mapping units include aggregations of

meadow vegetation defined by their flooding regimes. Willow aggregations comprising several species in one stand also fits the definition of a mapping unit and is separated out at SEKI based on habitat (meadow, talus, or riparian).

2.2 Photointerpretation and Mapping

2.2.1 Project Materials

The following materials were used for the photointerpretation and mapping phases of the SEKI vegetation mapping project.

Project imagery

SEKI was unique in that two sets of color-infrared stereo-imagery were produced for the project. The first set, acquired in late July 2000, was rejected when it failed to meet the 1:15,860 scale standard and exhibited extremely variable tonal differences and poor color balance. A second overflight was performed in July 2001. The 2001 overflight produced photography of acceptable quality but due to variable climatic conditions, failed to capture the entire study area. Approximately 5% of the study area, concentrated in the western edge of Kings Canyon National Park and in the vicinity south of Grant Grove, was missing photo coverage. Imagery acquired in 2000 was used to fill in for areas of missing photo coverage from the 2001 overflight.

Aerial Imagery (hardcopy stereo-pair diapositives and prints):

As noted above, aerial imagery was initially flown in July of 2000 and again in July of 2001 at a scale of approximately 1:15,860. The 2001 images served the primary base for the vegetation photointerpretation and attribute coding. A total of 1,228 23 cm x 23 cm (9 in x 9 in) photos were photointerpreted.

Digital Orthophoto Quarter Quadrangle (DOQQ) Basemap:

Digital orthophoto quarter quadrangles (DOQQs) served as the base for the data rectification task. Data rectification is discussed further under the topic of Data Conversion. As the park did not have a full set of DOQQs that covered the study area, two different sets of DOQQ imagery were used. The dates of the DOQQs ranged from 1987 to 2003 and they were in either a color infra-red (CIR) or black and white format. For a complete list of the DOQQs used, refer to Appendix B.

- Total Number of DOQQs: 129 (all or in part)
- Total Number of DOQQ Full Module Equivalents (FME): 91
- Total Number of USGS 7.5 Quads: 41

2.2.2 Photointerpretation Mapping Procedures

There were six major tasks associated with the photointerpretation phase of the SEKI vegetation mapping project:

- Field reconnaissance
- Field plot sampling and mapping classification development
- Photointerpretation of vegetation
- Data conversion (rectification of vegetation delineations to the map base)
- Field verification

- Accuracy assessment

AIS conducted the photointerpretation and data conversion efforts. Field reconnaissance was performed by AIS photointerpreters along with NPS and CDFW ecologists. NPS ecologists conducted the field plot sampling, and worked closely with YOSE USGS and CDFW ecologists to develop the SEKI mapping classification. Field verification was incorporated with the field sampling effort. Park staff collected accuracy assessment data, created the final accuracy assessment database, and analyzed the data to determine the accuracy of the final map products.

Field Reconnaissance

Four week-long reconnaissance trips were conducted during the 2001 field season in order to familiarize the photointerpreters with the project area, and to assist in developing the preliminary mapping classification. The intensive field trips began in the foothills in early April and continued through late August, when the team visited two areas along the Sierra Crest. Ecologists from CDFW, USGS Biological Resources Division, and the SEKI division of Natural Resources assisted with each of the field reconnaissance trips. In 2003, an additional three-day orientation was conducted to introduce new photointerpreters to the project area.

To aid in trip planning and the orientation process, the study area was divided into five broad zones reflecting the influence of elevation on the distribution of vegetation in the Sierra Nevada. These five zones are roughly comparable to Zones 1–5 identified for the YOSE project, with differences in elevation accounted for by the effect of latitude as well as the inclusion of lower-elevation foothill types into Sequoia National Park.

- Zone I: Lower west slope woodland and chaparral
    - 1,000 to 3,000 feet (305–914 m)
- Zone II: Middle west slope chaparral and mixed hardwoods
    - 3,000 to 5,000 feet (914–1,524 m)
- Zone III: Mixed conifer
    - 5,000 to 7,000 feet (1,524–2,134 m)
- Zone IV: Upper montane/subalpine
    - 7,000 to 10,000 feet (2,134–3,048 m)
- Zone V: Alpine
    - above 10,000 feet (3,048 m)

The field reconnaissance visits served two major functions. First, they allowed the photointerpreters to key the signature on the aerial photos to the vegetation on the ground. Second, the photointerpreters became familiar with the flora, vegetation communities, and local ecology of the study area. Ecologists that are familiar with the local vegetation and ecology were present to interpret these elements and their relationship with the environmental gradients underlying the distribution of vegetation in the parks. The field trips at SEKI involved driving, hiking, horseback riding, backpacking, and in one instance helicopter transport to view a wide variety of vegetation types.

Prior to each trip, field routes were planned to maximize the number of vegetation communities and elevation zones visited, while taking into account time constraints and accessibility. The selected routes were then prepared onto a frosted Mylar field overlay adhered to the 9 inch x 9 inch aerial photo prints. Location features such as trails and place names were added to the overlays to aid in navigation.

Each photo was then reviewed under a stereoscope to identify representative signatures of different vegetation types, correlated environmental variables (% slope, aspect, slope shape, elevation), and other landscape features noted on the photography. The field photographs (CIR aerial photograph prints), annotated overlays and associated topographic sheets were arranged in packets for the field team.

Each photo field overlay was annotated with field site numbers, which tied the field site to a specific location and photo signature. Canopy dominance, understory species, abiotic features, and disturbance history for each site visited was recorded in a field notebook. Color ground photos (35mm) were taken at selected locations and later compared to the aerial photographs and the field site notes. Additional field sites included noteworthy areas and vegetation types encountered in transit.

Photointerpretation of Vegetation

The process of photointerpretation (PI), or the study of ground objects and patterns visible on aerial photographs, was used to identify map units based on their photo signature. These unique land cover signatures were defined by the color, texture, tone and pattern visible on the aerial photography. By observing the context and extent of the photo signatures associated with specific vegetation types, the photointerpreters were able to identify and delineate boundaries between plant communities or signature units. Environmental factors such as elevation, slope, and aspect also informed the photointerpretation decision-making process. Working with the photointerpretation team tasked with developing the YOSE and DEPO products ensured that the network vegetation maps would be comparable with regard to signature recognition, scale, and production.

Each photo was prepared with a 9”x 9” (23 cm x 23 cm) frosted Mylar overlay for the photo signature delineations. Overlays were pin-registered to the photos and project labels affixed to each overlay identifying the photo number, status of work, and photointerpreter responsible for that task. Study area boundaries were drafted onto each photo overlay, defining the area within the photograph to be interpreted. The study area boundaries were edge matched to adjacent photos to ensure complete coverage.

To aid the photointerpreters in understanding the relationship between the vegetation units and the environmental context in which they appeared, ancillary data sources (e.g., existing vegetation maps, supplemental photography, soil data, and plot data) were provided. Prior to the PI effort on each photo, these ancillary data were reviewed and pertinent information added to the Mylar overlay by photointerpreters in order to document the locations of available information within the study area on each aerial photograph. Photointerpreters also relied on their familiarity with the YOSE vegetation

signatures to inform this process. A list of ancillary data used by AIS during the SEKI project is provided in Appendix C.

Using a mirrored stereoscope with a 3X and sometimes 6X lens, photo signature units were delineated onto the Mylar overlays. These initial photo delineations were based on a number of signature characteristics including color, tone, texture, relative height, and density. Attribute codes (mapping classification types and canopy density) were assigned to each polygon and annotated onto the Mylar overlay. The map units and codes were edge matched to the adjoining photo overlays.

Land use activities within the park units were also identified during the mapping of the vegetation units, and are nested within the 900 series within the mapping classification, with a modified Anderson et al. (1976) level 3 classification assigned to the land use attribute field. For the SEKI classification, the only land use code used was 990, Urban-developed.

Minimum Mapping Unit

Every effort was made to conform to the 0.5 ha minimum mapping unit standard and, in areas of special concern, such as stands of giant sequoia, to exceed it by mapping at a finer scale. In some settings where extensive gradients existed between two vegetation types, it was not possible to adhere to the minimum mapping unit and therefore larger inclusions of very similar types may be found within mapped polygons.

Aggregation

Aggregation of multiple vegetative classes became necessary when vegetation types present within a polygon fell below the resolution of the minimum mapping unit of 0.5 ha. The following aggregation rules were followed when mapping vegetation for this project:

- Similar life forms were aggregated together; tree dominated types were aggregated with other tree dominated types, shrub types with other shrub types and herbaceous types with other herbaceous vegetation types.
- If possible, wetland vegetation types generally were not aggregated with upland types, even if they were in the same life form.
- If a unit that was below minimum mapping resolution was completely surrounded by another vegetation type, the unit was aggregated with the surrounding vegetation.

Density

Density, also referred to as vegetative cover, is a quantitative estimate of plant cover derived from viewing the aerial photography in stereo magnification. Photointerpreters assessed the total density of vegetation associated with the life form of the alliance being assigned to that polygon. For example, if the polygon was defined as a Jeffrey pine/greenleaf manzanita association, only the tree cover was evaluated in calculating a density value. If the polygon was defined as a greenleaf manzanita alliance, only the shrub cover was evaluated, not any emergent tree layer.

Six categories were used to define density or vegetative cover:

1 = Continuous to nearly continuous; > 60%

Canopies overlapping, touching or nearly touching in most of the mapping unit. Herbaceous cover in this class often takes the form of wet meadows or low elevation annual grasslands.

2 = Discontinuous; 40–60%

Canopies rarely touching, however spacing is fairly minimal, especially when plants are not evenly distributed throughout the polygon. Herbaceous cover generally takes the form of dry meadows.

3 = Dispersed; 25–40%

An open setting where large spaces occur between trees and shrubs, or where grasses are fairly sparse throughout the mapping unit such as in dry meadows interspersed with rock or scree.

4 = Sparse; 10–25%

Trees or shrubs are widely spaced, scattered throughout the polygon, or are clumped in very small areas making up a small percentage of the entire vegetative cover within the polygon. Herbaceous cover is often irregularly dispersed over large areas such as fell fields.

5 = Rare; 2–10%

Trees or shrubs occur only occasionally and usually do not make up enough percentage to be considered evenly dispersed. Herbaceous coverage in this class is hard to detect on small scale aerial photography.

6 = Trace amounts less than 2%

Used for talus & scree where no vegetation is visible on the photography

9 = Not applicable to polygon

It is important to note that photointerpreters could only accurately quantify the vegetation visible on the aerial photography. Using aerial photography at scales smaller than about 1:12,000 (the SEKI aerial photography scale is approximately 1:15,860), photointerpreters generally cannot see the amount of vegetation which is obscured by a higher canopy, regardless of its life form; therefore, total vegetative cover may differ from assessments done on the ground by field crews. Understory vegetation that is not visible on the aerial photograph cannot be quantified when assigning the total cover of vegetation for that polygon.

Density Mapping Criteria

- Separate polygons were formed when changes from one density class to another within a vegetation type or mapping unit at a scale greater than the minimum mapping unit of 0.5 ha occurred. For example, two adjacent polygons may have the same vegetation type assigned (e.g., 1022, canyon live oak/whiteleaf manzanita forest) but different density categories (e.g., 25–40% versus 10–25%). Subtle density changes that occurred near the break between two classes, however, were evaluated over a larger scale.
- Densities represent absolute values determined for the dominant life form (tree, shrub or herbaceous) assigned to that polygon. A polygon classified with a tree-type alliance will have a density reflecting the absolute tree cover of that polygon.

- In the event that a species exhibited multiple life forms within a single polygon, (e.g., a stand including both tree and shrub form of aspen), density was calculated on the species (aspen) for both shrub and tree. Smaller stature shrubs present in the polygon (such as sagebrush) would not contribute to the density class.
- Standing dead vegetation was not included in the density calculations.
- To determine the density or vegetative cover, photointerpreters assigned percentages to the different life forms visible on the aerial photo, including non-vegetated areas. The total percent cover of trees, shrubs, herbaceous and non-vegetated should add up to 100%. The density percentages were then converted into the appropriate density category.
- Non-vegetated areas were not coded in the database unless they met the minimum mapping resolution for the park and could be mapped as stand-alone polygons. Otherwise, it was assumed that all vegetation polygons contained non-vegetated areas.
- Vegetation stature and the scale of the aerial photography determine the visibility of individual plants. Trees are usually visible as individuals, and, with larger scale photography, so are shrubs. However, grasses are rarely seen as individual plants, regardless of the scale of the photography.
- In the case of trees and shrubs, the percent cover at a density break was adjusted downward. If the percent cover was at about 25%, the polygon was assigned a density category of sparse (10–25%) instead of dispersed (25–40%).
- Dry grasses tend to be less dense than they appear on the aerial photography. To more accurately depict the densities, the percent cover for dry grasses was adjusted downward. In particular, if the percent cover fell at the lower end of a density class, the polygon was assigned the next density class down. For example, if the percent cover was 25%, the polygon was assigned a density category of sparse (10–25%) instead of dispersed (25–40%).
- The date that the aerial photography is acquired also influences the density assigned to vegetation types, particularly for herbaceous dominated vegetation types. These factors can cause apparent discrepancies between the densities evident on the photo and those visible in the field:
    - Seasonality – The density of most herbaceous plants varies due to their annual growth cycle. Depending on the season the aerial photography was taken, a mapped unit could show a different density on the aerial photographs than is observed during an on-site visit at a different time of the year. Another effect of seasonality is leaf on/off conditions. Photos of forest or woodland areas with leaf on conditions can obscure the understory. Photos of leaf off conditions would allow photointerpretation of the understory, but make it difficult to identify the overstory species and density since there is no foliage present.
    - Annual variability – The environmental conditions at the time of the photography (wet vs. drought years, flooding, etc.) may affect the densities seen during the on-site field visits.

Quality Control of the Photointerpretations

A separate quality control step was performed for each photo upon completion of the photointerpretation. Each photo was reviewed by a senior photointerpreter for map unit delineation, PI signature code, and canopy density code accuracy. Each photo overlay was checked for completeness, consistency, and adherence to the mapping criteria and guidelines. Photos were also reviewed for edge consistency both along and between the flight lines.

Field Verification for the East Fork Kaweah Watershed Pilot Study Area: A Park Based Interim Data Verification Effort

In order to verify that the imagery and methodology being applied were of high enough quality to proceed with mapping the rest of the project area, accuracy was assessed for the East Fork of the Kaweah watershed as soon as draft photointerpretation products were available. A description of this process, which involved extensive consultation between the photointerpreters and ecologists, is described in Section 2.3.

2.2.3 Data Conversion

Once it had been verified that the East Fork pilot study area was of high enough accuracy to continue with the overall map development, data automation took place. The following section outlines the data automation procedures used to convert the hand-drafted vegetation map units to a digital format rectified to the DOQQ base. For a list of the digital orthophoto quadrangle names, see Appendix B.

Data Automation

Data automation was conducted using Mono Digitizing Stereo Digitizing (MDSD, Carto Instruments Incorporated, Seattle, WA) software. The MDSD software was used to capture the vegetation linework and automatically georeference the data into real-world coordinates. The first step of the procedure involved the creation of control points. Control points are corresponding locational points identified both on the DOQQ imagery and the aerial photography and input into an ARC/INFO (Environmental Systems Research Institute, Inc., Redlands, CA) point coverage.

By using the control points generated in the previous step, each photo was registered to the DOQQ. Once each photo was georeferenced, the lines were then digitized. The digitized lines were stored in a MDSD outfile format that were then converted to a coverage using ARC/INFO.

Data Rectification

Coverage linework from each aerial photo was rectified to the corresponding DOQQ such that the DOQQs served as the base imagery for positional accuracy of interpreted vegetation polygons. The coverage, containing polygons and codes, was checked for open polygons, data registration, and any spatial edge match problems among photos. Registration quality depended on the accuracy, quantity, and distribution of the control points. Spatial refinement was performed in ARCEDIT sessions using various user-defined tools. Lines depicting boundaries representing minimal ecotones (for example – land use interface, water bodies, life-form interface) were refined.

Positional Accuracy

Photointerpreted line work was registered and rectified to published USGS digital orthophoto quadrangles (DOQs) to match the positional accuracy of the DOQs. USGS DOQs are designed to meet national map accuracy standards for 1:12,000-scale products.

Polygon Attribute Assignment

During the data rectification step, label points were created and coded for each map unit. The vegetation mapping type, density, and land use attribute codes were input for each polygon (see Appendix D for mapping classification including codes for vegetation mapping types). Automated quality control measures created by AIS, such as Codecheck and code frequency programs, were run to confirm code validity.

Code Verification and Edit Plot Quality Assurance

A hard copy edit plot of the converted spatial data was produced for each DOQQ and compared to the aerial photo overlays. Each edit plot was checked for cartographic quality of the arcs defining the polygon features and the accuracy of the label assignments. Line and code corrections were noted directly on the edit plot. All plots were edge matched to verify line and code accuracy across map sheets, and corrections to the coverages were made during interactive ARCEDIT sessions.

Final Quality Assurance of the Vegetation Map

The individual coverages created for each DOQQ were then joined into a single seamless vegetation coverage for the park unit. This final vegetation layer was examined by a senior photointerpreter. Final checks were conducted to test for invalid codes, missing or extra lines, or edge match problems; to verify the registration of linework to the DOQQ base; and to review the distribution of species mapped within the park.

2.3 Accuracy Assessment

Accuracy assessment (AA), or the comparison of how well polygon mapping class assignments represent vegetation observed on the ground, is an essential part of the vegetation mapping process. Results of AA allow the map user to evaluate the utility of the vegetation mapping products for specific applications. The SEKI AA process was informed by guidance provided in *Final Draft Accuracy Assessment Procedures* prepared for the NPS Vegetation Mapping program by ESRI, the National Center for Geographic Information and Analysis at the University of California, Santa Barbara, and TNC (ESRI and TNC 1994.) AA plot data were collected by park field crews for the East Fork pilot project during the 2002 field season, for the rest of Sequoia National Park during 2002 and 2003, and for Kings Canyon National Park in 2004.

2.3.1 Accuracy Assessment Sample Allocation

Optimally, the collection of AA data is initiated after the photointerpretation process has been completed, which allows AA sample sizes to reflect both the number of delineated polygons of a given type and the distribution of types across the landscape. The availability of digital delineations also allows for the random selection of polygons for assessment. Because the collection of SEKI AA data was essentially carried out in tandem with photointerpretation and delineation, preliminary map products were not available to inform the sample selection process. Instead, targets were set in order

to acquire a minimum number of samples of each mapped type that would also reflect the abundance of the type in the parks.

Faced with a large number of mapping classes to be assessed (169) in a limited amount of time, coupled with the inherent challenges of accessing remote wilderness locations, in some cases these targets were not met. As in YOSE, some classes, which typically included non-vegetated or sparsely vegetated, and planted vegetation types, were not assessed for mapping accuracy (Keeler-Wolf et al. 2012). In SEKI these included domes, rock outcrops, urban/developed areas, conifer plantations, sparsely vegetated riverine flats, alpine snow patch communities, and California grape. Widespread types, and those identified by NPS staff as important from a management perspective, were emphasized. Types with the highest number of assessment points included Foxtail pine–Sierra Lodgepole pine Woodlands, Whitebark pine-dominated woodlands, Sierra Lodgepole Pine dominated associations, Jeffrey Pine Woodlands, Canyon Live Oak Forests, California Black Oak Forests, and Intermittently to Seasonally Flooded Meadows.

2.3.2 AA Field Data Collection

Efficiency (e.g., areas which had a large number of types, and which were readily accessible with regard to travel time) and safety of the field crews (especially with regard to terrain and remoteness) informed the selection of areas to be visited for AA sampling. Field tours were planned to maximize the number of polygons that could be assessed and/or plots established in a given area of the parks. Every effort was made to establish assessment plots away from polygon boundaries, although this often proved difficult to assess on the ground. Aerial photographs were carried into the field to assist in this process. Once the apparent boundaries of a polygon were identified, the center of a 0.5 ha AA plot was randomly selected. In some instances, safety concerns led to the assessment of polygons from a distance; binoculars were then used to aid in identification of dominant vegetation.

For each plot, cover of dominant species was estimated and recorded according to vegetation stratum. In 2002, these estimates were recorded in six cover classes; during the 2003 and 2004 field seasons, absolute cover was estimated and placed into classes *post hoc*. Environmental variables including slope, aspect, elevation, topographic position, and micro topography were recorded. Location coordinates were captured by Garmin model III+ GPS units. If a plot was viewed from a distance, UTM coordinates were derived in the field from the USGS 7.5 minute quadrangle, or in some cases from within ArcView or ArcGIS application upon return to the office. Each plot was assigned to a provisional mapping class by the field observers; plots were later assigned a mapping code by an ecologist using available keys and references.

2.3.3 Accuracy Assessment Data Analysis

Although the AA for the SEKI project was in large part based on plot data, the accuracy assessment process at SEKI used a polygon-centric approach. That is, the basic unit of assessment was the polygon, with each polygon carrying an equal weight regardless of size or how many assessment points were located in the polygon. In some cases, more than one AA point was used to assess a given polygon; conversely, in other cases the assessment of more than one polygon was informed by a single AA point. Because the data included elements of mechanical and human error, and were

usually gathered without the benefit of the map linework, points were not always included digitally within the boundaries of the polygon they were used to assess.

In addition to plots specifically established for AA, the AA process was also informed by the following sources of data:

- Plots – Vegetation mapping plot observations, including identification of all species within the plot area, used for vegetation classification and PI training.
- RA observations – Rapid Assessment plots to capture rapid vegetation observations and answer photointerpreter questions about the vegetation in specific areas.
- WP observations – Waypoint plots to capture rapid vegetation parameters. Used to answer photointerpreter questions about the vegetation or capture a snapshot of an area while traveling between sample points
- NRI plots (vegetation plots provided to AIS as training points) and Stephenson Gradient Analysis plots (also provided to AIS as training points) were also available for AA. These data sets provided context and filled in spatial gaps in the contemporary vegetation information.
- Other data included hard-copy maps from AA missions with rough delineations of vegetation types created by field crews. Digital photos from WP and AA plots were also used to assess the vegetation of a given area.

Assessment data were gathered into an ArcGIS environment for comparison with the preliminary map layer delivered by AIS. All available data (maps, plot data, photos, etc.) were considered in the context of the larger landscape in order to determine whether polygons were correctly mapped and coded. Sometimes information about the polygon was gleaned from aerial or satellite photography or topographic maps. Finally, an NPS ecologist assigned a final PI code from the mapping classification to each assessed polygon using all of the data available. The information used and rationale for each polygon assessment was recorded.

Mapping Aggregations and Map Revision

Following completion of each phase of the map (East Fork Kaweah Pilot, SEQU NP, and KICA NP) preliminary accuracy assessment scores were delivered to AIS. The scoring scheme used to categorize each polygon assessed during this process is shown in Table 2. The photointerpreters evaluated the scores and sent comments regarding scores they questioned back to the NPS ecologists for review. These comments were reviewed by NPS ecologists and where appropriate, scoring on individual polygons was revised. Following each project phase, NPS ecologists spent several days working alongside the photointerpreters to review and discuss the remaining questions. During these sessions, decisions were made about how to best aggregate types which did not pass AA and where changes in linework were required. Following the example set by YOSE, we agreed to accept all types that met a minimum of 70% accuracy. Types with less than 5 samples were discussed but not formally evaluated, as the sample size was deemed too small to be informative. For those types with at least 5 samples which fell below the 70% standard, aggregations were agreed upon. Final products include both the original PI code and a separate code for the revised or aggregated code for each

mapped polygon. This allows the user to choose which level of map detail and accuracy is required for a particular map application, while taking into account the increased error rate associated with the more detailed map.

Table 2. Scoring scheme for SEKI Accuracy Assessment. Scores applied to vegetation mapping polygons during the accuracy assessment process. All scores used throughout the project are shown here, with notes indicating changes made during the final accuracy assessment.

Score	Value
0	Cannot determine if polygon correctly coded.
1	Polygon correctly coded.
2	Polygon correctly coded to alliance but association or map unit is incorrect.
3	Polygon correct to superalliance.
4	Polygon probably correctly coded, but assessment is inconclusive. *In the final assessment, all uncertain assessments were coded as "0", unable to determine.*
5	Polygon needs NPS discussion before scoring. *In the final assessment, all polygons requiring discussion between NPS and AIS were also coded "5".*
6	Polygon has significant linework issue (inclusions or imprecise boundaries). *In the final assessment, polygons with linework issues were flagged using a "yes/no" field and assigned another score for the classification.*
7	Polygon needs AIS and NPS discussion before scoring. *In the final assessment, all polygons requiring discussion were coded as "5".*
8	Polygon probably incorrectly coded, but assessment inconclusive. *In the final assessment, all uncertain assessments were coded as "0".*
9	Polygon incorrectly coded.

Two levels of accuracy were calculated using the assessment data. Association or mapping unit accuracy reflected the accuracy of the finest level of detail in the mapping classification assigned by the photointerpreters. Alliance level accuracy was based on a more inclusive (higher) level in the classification hierarchy. Individual assessments were grouped together based on alliance, superalliance, or map unit to determine alliance level accuracy.

Accuracy is conventionally reported in terms of either *producer's accuracy* or *user's accuracy*. *User's accuracy* is the number of samples classified correctly divided by the total number of AA points mapped as that class. User errors are errors of commission and user's accuracy is the probability that a sample from the classified data actually represents that category on the ground. *Producer's accuracy* is the number of samples classified correctly divided by the total number of AA points in that class that were visited in the field. Producer errors are errors of omission and producer's accuracy is the probability that a reference sample has been classified correctly. Producer's and user's accuracy were calculated for each of the three map phases and aggregated into a final accuracy assessment for the final SEKI map.

3. Results

3.1 Vegetation Classification and Key

3.1.1 The Vegetation within Sequoia and Kings Canyon National Parks

Within the two parks, 29% of the total acreage was mapped as forest, 25.3% as woodland, 9.3% as shrubland, and 2.4% as herbaceous vegetation types (Table 3). Sparsely vegetated types (which include both alpine and non-alpine talus and scree, alpine fell-fields, and exposed rock) were mapped over 32% of the parks. Although evergreen and deciduous forest types covered nearly a third of the area, only a small fraction (2.3%) of the parks were mapped as deciduous forest. Similarly, shrublands were also dominated by evergreen types.

Table 3. Abundance of mapped vegetation within Sequoia and Kings Canyon National Parks by NatureServe (2007) Formation Class and Formation Subclass. Evergreen Forest and Evergreen Woodland include needle-leaved and broad-leaved evergreen types.

Formation (Subclass / Class)	Area (acres)	Area (hectares)	Percent of Park
Evergreen Forest	230,630	93,333	26.7%
Deciduous Forest	20,258	8,198	2.3%
Forest Total	***250,888***	***101,531***	***29.00%***
Evergreen Woodland	214,788	86,922	24.8%
Deciduous Woodland	3,957	1,601	0.5%
Woodland Total	***218,745***	***88,523***	***25.30%***
Evergreen Shrubland	57,058	23,091	6.6%
Deciduous Shrubland	23,758	9,615	2.7%
Shrubland Total	***80,816***	***32,706***	***9.30%***
Perennial Graminoid or Forb Vegetation	21,091	8,535	2.4%
Annual Graminoid or Forb vegetation	413	167	0.0%
Herbaceous Total	***21,504***	***8,702***	***2.40%***
Sparse Vegetation Total	***277,209***	***112,183***	***32.0%***
Other (Snow, Water, Developed)	***11,675***	***4,725***	***1.3%***

Herbaceous vegetation types were the least commonly mapped, covering only 21,504 acres or 2.4% of the park area. Annual herbaceous vegetation is represented by a single type (California annual grassland/herbland superalliance) which is found primarily in the lower elevations. Perennial herbaceous types were more frequently mapped, and occur in both wetland (15,744 acres) and upland (5,347 acres) environments, primarily in the montane, subalpine and alpine zones. The most frequently mapped upland perennial herbaceous vegetation type is the Shorthair sedge herbaceous alliance, which is found throughout the subalpine and alpine and has a distinctive signature on CIR photography. Meadow types (intermittently to seasonally flooded and semi-permanently to permanently flooded), a relatively rare but ecologically important component of the montane and subalpine environments, totaled 15,744 acres, or less than 2% of the parks.

The final map layer for Sequoia and Kings Canyon National Parks includes over 80,000 individual vegetation polygons, which at the finest scale are mapped to 166 classes at various levels of the classification hierarchy (Appendix D). At the level of vegetation alliance or higher (e.g., superalliances and mapping units), there are 16 forest types, 17 woodlands, 27 shrublands, and five herbaceous types (Table 4).

As in Yosemite National Park, Sierra lodgepole pine forest alliance occupies the greatest area of any single mapped alliance, or 5.8% of SEKI (Table 4). Alliances dominated by red fir, white fir or a combination of the two, however, total over 81,000 acres, with an additional 32,043 acres mapped as California red fir-white fir forest alliance where the two fir species co-occur. The white fir–sugar pine forest alliance adds another 39,384 acres, illustrating the importance of evergreen coniferous forests in the montane elevations of the two parks. In the lower elevations, the only evergreen broadleaf forest alliance (canyon live oak forest alliance) occupies 28,981 acres. With the exception of the black oak forest alliance, which is mapped in lower montane uplands, deciduous forest alliances (quaking aspen, black cottonwood, white alder, and bigleaf maple) are predominantly found in mesic environments. Evergreen woodlands are also important, with 43,822 acres mapped as Jeffrey pine woodland alliance, 36,359 acres as whitebark pine woodland alliance, 33,874 acres as foxtail pine woodland alliance, and 20,984 acres as Sierra juniper woodland alliance. An additional 61,610 acres are mapped as evergreen woodlands at the superassociation, superalliance, or mapping unit level [e.g., foxtail pine–Sierra lodgepole pine superalliance, 26,593 acres; and western white pine–Sierra lodgepole pine–(California red fir) woodland superassociation, 25,333 acres]. Deciduous woodlands included 2,180 acres of blue oak woodland alliance and 1,468 acres of California buckeye woodland alliance, both of which are restricted to the foothills of the parks.

Table 4. Abundance by mapping unit at the alliance or higher level of classification within Sequoia and Kings Canyon National Parks. Alliances and mapping units are grouped by NatureServe (2007) Formation Class (Forest, Woodland, etc.) and by Formation Subclass (Evergreen Forest, Deciduous Forest, etc.).

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Area (hectares)	Percent of Park
Forest – Evergreen Forest	1020	Canyon Live Oak Forest Alliance	*Quercus chrysolepis* Forest Alliance	28,981	11,728	3.3%
	3010	Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance	*Pinus contorta var. murrayana–Populus tremuloides–(Pinus jeffreyi)* Forest Alliance	521	211	0.1%
	3020	Sierra Lodgepole Pine Forest Alliance	*Pinus contorta* var. *murrayana* Forest Alliance	50,602	20,477	5.8%
	3060	Ponderosa Pine–Incense-cedar Forest Alliance	*Pinus ponderosa–Calocedrus decurrens* Forest Alliance	12,683	5,132	1.5%
	4020	Giant Sequoia Forest Alliance	*Sequoiadendron giganteum* Forest Alliance	11,102	4,493	1.3%
	4030	Mountain Hemlock Forest Alliance	*Tsuga mertensiana* Forest Alliance	1,387	561	0.2%
	4050	California Red Fir Forest Alliance	*Abies magnifica* Forest Alliance	49,354	19,973	5.7%
	4070	California Red Fir–White Fir Forest Alliance	*Abies magnifica–Abies concolor* Forest Alliance	32,043	12,967	3.7%
	4080	White Fir–Sugar Pine Forest Alliance	*Abies concolor–Pinus lambertiana* Forest Alliance	39,384	15,938	4.6%
	4110	Incense-cedar Forest Alliance	*Calocedrus decurrens* Forest Alliance	277	112	<0.1%
	910	Conifer Reproduction	Conifer Reproduction	4,296	1,738	0.5%
Forest – Deciduous Forest	2010	Quaking Aspen Forest Alliance	*Populus tremuloides* Forest Alliance	6,159	2,492	0.7%
	2020	California Black Oak Forest Alliance	*Quercus kelloggii* Forest Alliance	12,050	4,877	1.4%
	2050	Black Cottonwood Temporarily Flooded Forest Alliance	*Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Forest Alliance	1,333	540	0.2%
	2060	White Alder Temporarily Flooded Forest Alliance	*Alnus rhombifolia* Temporarily Flooded Forest Alliance	530	214	0.1%
	2080	Bigleaf Maple Forest Alliance	*Acer macrophyllum* Forest Alliance	186	75	<0.1%

Table 4 (continued). Abundance by mapping unit at the alliance or higher level of classification within Sequoia and Kings Canyon National Parks. Alliances and mapping units are grouped by NatureServe (2007) Formation Class (Forest, Woodland, etc.) and by Formation Subclass (Evergreen Forest, Deciduous Forest, etc.).

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Area (hectares)	Percent of Park
Woodland – Evergreen Woodland	1040	Interior Live Oak Woodland Alliance	*Quercus wislizeni* var. *wislizeni* Woodland Alliance	5,190	2,100	0.6%
	3050	Ponderosa Pine Woodland Alliance	*Pinus ponderosa* Woodland Alliance	448	181	0.1%
	3070	Jeffrey Pine Woodland Alliance	*Pinus jeffreyi* Woodland Alliance	43,822	17,734	5.1%
	3110	Singleleaf Pinyon Pine Woodland Alliance	*Pinus monophylla* Woodland Alliance	7,653	3,097	0.9%
	3130	Western White Pine Woodland Alliance	*Pinus monticola* Woodland Alliance	4,301	1,741	0.5%
	3140	Whitebark Pine Woodland Alliance	*Pinus albicaulis* Woodland Alliance	36,359	14,714	4.2%
	3150	Limber Pine Woodland Alliance	*Pinus flexilis* Woodland Alliance	547	221	0.1%
	3200	Foxtail Pine Woodland Alliance	*Pinus balfouriana* ssp. *austrina* Woodland Alliance	33,874	13,708	3.9%
	3520	(Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland Mapping Unit	*(Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana–Pinus albicaulis)* Krummholz Woodland Mapping Unit	792	321	0.1%
	3530	Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance	*Pinus albicaulis–Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana* Woodland Superalliance	8,892	3,598	1.0%
	3540	Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance	*Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana* Woodland Superalliance	26,593	10,762	3.1%
	4100	Sierra Juniper Woodland Alliance	*Juniperus occidentalis* var. *australis* Woodland Alliance	20,984	8,492	2.4%
	4540	Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland Superassociation	*Pinus monticola–Pinus contorta* var. *murrayana–(Abies magnifica)* Woodland Superassociation	25,333	10,252	2.9%

Table 4 (continued). Abundance by mapping unit at the alliance or higher level of classification within Sequoia and Kings Canyon National Parks. Alliances and mapping units are grouped by NatureServe (2007) Formation Class (Forest, Woodland, etc.) and by Formation Subclass (Evergreen Forest, Deciduous Forest, etc.).

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Area (hectares)	Percent of Park
Woodland – Deciduous Woodland	2030	Blue Oak Woodland Alliance	*Quercus douglasii* Woodland Alliance	2,180	882	0.3%
	2100	California Sycamore Temporarily Flooded Woodland Alliance	*Platanus racemosa* Temporarily Flooded Woodland Alliance	303	123	<0.1%
	2110	California Buckeye Woodland Alliance	*Aesculus californica* Woodland Alliance	1,468	594	0.2%
	2530	Montane Broadleaf Deciduous Trees Mapping Unit	Montane Broadleaf Deciduous Trees Mapping Unit	6	3	<0.1%
Shrubland – Evergreen Shrubland	5010	Birchleaf Mountain Mahogany Shrubland Alliance	*Cercocarpus betuloides* Shrubland Alliance	3,093	1,252	0.4%
	5020	Chamise Shrubland Alliance	*Adenostoma fasciculatum* Shrubland Alliance	8,675	3,510	1.0%
	5030	Chamise–Buckbrush Shrubland Alliance	*Adenostoma fasciculatum–Ceanothus cuneatus* Shrubland Alliance	139	56	<0.1%
	5050	Buckbrush Shrubland Alliance	*Ceanothus cuneatus* Shrubland Alliance	5	2	<0.1%
	5060	Chaparral Whitethorn Shrubland Alliance	*Ceanothus leucodermis* Shrubland Alliance	186	75	<0.1%
	5070	Whiteleaf Manzanita Shrubland Alliance	*Arctostaphylos viscida* Shrubland Alliance	362	146	<0.1%
	5090	Greenleaf Manzanita Shrubland Alliance	*Arctostaphylos patula* Shrubland Alliance	2,184	884	0.3%
	5130	Mountain Misery Dwarf-shrubland Alliance	*Chamaebatia foliolosa* Dwarf-shrubland Alliance	287	116	<0.1%
	5140	Indian Manzanita Shrubland Alliance	*Arctostaphylos mewukka* Shrubland Alliance	653	264	0.1%
	5160	Mountain Big Sagebrush Shrubland Alliance	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	3,154	1,276	0.4%
	5200	Timberline Sagebrush Shrubland Alliance	*Artemisia rothrockii* Shrubland Alliance	255	103	<0.1%
	5230	Curl-leaf Mountain Mahogany Woodland Alliance	*Cercocarpus ledifolius* Woodland Alliance	674	273	0.1%
	5270	Chaparral Yucca Shrubland Alliance	*Yucca whipplei* Shrubland Alliance	401	162	<0.1%
	5280	Pinemat Manzanita Shrubland Alliance	*Arctostaphylos nevadensis* Shrubland Alliance	306	124	<0.1%

Table 4 (continued). Abundance by mapping unit at the alliance or higher level of classification within Sequoia and Kings Canyon National Parks. Alliances and mapping units are grouped by NatureServe (2007) Formation Class (Forest, Woodland, etc.) and by Formation Subclass (Evergreen Forest, Deciduous Forest, etc.).

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Area (hectares)	Percent of Park
Shrubland – Evergreen Shrubland (continued)	5300	Water Birch Shrubland Alliance	*Betula occidentalis* Shrubland Alliance	157	64	<0.1%
	5510	Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance	*Artemisia tridentata* ssp. *vaseyana* & *Artemisia rothrockii* & *Holodiscus discolor* & *Phyllodoce breweri* Shrubland Superalliance	12,298	4,977	1.4%
	5530	Bitter Cherry–Gooseberry spp.–(Mountain Maple)–Shrubland Mapping Unit	*Prunus emarginata–Ribes* spp.*–(Acer glabrum)* Shrubland Mapping Unit	3,252	1,316	0.4%
	5550	Red Mountainheather Dwarf-shrubland Alliance	*Phyllodoce breweri* Dwarf-shrubland Alliance	1,015	411	0.1%
	5590	Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance	*Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* Shrubland Superalliance	19,962	8,078	2.3%
Shrubland – Deciduous Shrubland	6010	Deerbrush Shrubland Alliance	*Ceanothus integerrimus* Shrubland Alliance	793	321	0.1%
	6020	Oregon White Oak Shrubland Alliance	*Quercus garryana* var. *breweri* Shrubland Alliance	2,391	968	0.3%
	6110	Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance	*Salix orestera*/*Allium validum* Seasonally Flooded Shrubland Alliance	8,325	3,369	1.0%
	6210	Oceanspray Shrubland Alliance	*Holodiscus discolor* Shrubland Alliance	395	160	<0.1%
	6300	Bitter Cherry Shrubland Alliance	*Prunus emarginata* Shrubland Alliance	810	328	0.1%
	6500	Willow spp./Meadow Shrubland Mapping Unit	*Salix* spp./Meadow Shrubland Mapping Unit	2,023	819	0.2%
	6600	Willow spp. Riparian Shrubland Mapping Unit	*Salix* spp. Riparian Shrubland Mapping Unit	5,191	2,101	0.6%
	6700	Willow spp. Talus Shrubland Mapping Unit	*Salix* spp. Talus Shrubland Mapping Unit	3,830	1,550	0.4%
Herbaceous Vegetation	7260	California Annual Grassland/Herbland Superalliance	California Annual Grassland/Herbland Superalliance	413	7	<0.1%
	7120	Shorthair Sedge Herbaceous Alliance	*Carex exserta* Herbaceous Alliance	4,194	1,697	0.5%
	7702	Mesic Post Fire Herbaceous Mapping Unit	Mesic Post Fire Herbaceous Mapping Unit	525	212	0.1%

Table 4 (continued). Abundance by mapping unit at the alliance or higher level of classification within Sequoia and Kings Canyon National Parks. Alliances and mapping units are grouped by NatureServe (2007) Formation Class (Forest, Woodland, etc.) and by Formation Subclass (Evergreen Forest, Deciduous Forest, etc.).

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Area (hectares)	Percent of Park
Herbaceous Vegetation (continued)	7703	Post Fire Shrub/Herbaceous Mapping Unit	Post Fire Shrub/Herbaceous Mapping Unit	628	254	0.1%
	8000	Intermittently to Seasonally Flooded Meadow	Intermittently to Seasonally Flooded Meadow	13,953	5,646	1.6%
	9000	Semi-permanently to Permanently Flooded Meadow	Semi-permanently to Permanently Flooded Meadow	1,791	725	0.2%
Sparse Vegetation/ Unvegetated	–	Rock and Sparsely Vegetated	–	277,209	112,180	32.0%
	0980	Water	–	11,604	4,696	1.3%
	0990	Urban/Developed	–	71	29	<0.1%

3.1.2 Species Added to the Sequoia and Kings Canyon Flora

A total of sixteen vascular plant species previously undocumented on the checklist of the SEKI flora were collected, vouchered, and added to the park herbarium during the course of the vegetation mapping fieldwork. These include:

- *Achnatherum parishii* (Vasey) Barkworth (Parish's needlegrass)
- *Agrostis humilis* Vasey (mountain bent grass)
- *Cymopterus terebinthinus* (Hook.) M.E. Jones var. *petraeus* (M.E. Jones) Goodrich
- *Elymus trachycaulus* (Link) Shinn. ssp. *subsecundus* (Link) Gould (slender wheatgrass)
- *Erigeron multiceps* Greene (Kern River daisy)
- *Festuca idahoensis* Elmer (Idaho fescue, blue bunchgrass)
- *Gentiana newberryi* A. Gray var. *tiogana* (A. Heller) J. Pringle (Tioga gentian)
- *Hesperostipa comata* (Trin. & Rupr.) Barkworth ssp. *intermedia* (Scribner & Tweedy) Barkworth (needle-and-thread)
- *Juncus effusus* L. var. *pacificus* Fernald & Wiegand (Pacific rush)
- *Juncus longistylis* Torr. (longstyle rush)
- *Keckiella breviflora* (Lindl.) Straw var. *glabrisepala* (D.D. Keck) N.H. Holmgren (bush beardtongue)
- *Lemna minor* L. (common duckweed)
- *Lupinus lepidus* Douglas var. *sellulus* (Kellogg) Barneby (dwarf lupine)
- *Platanthera hyperborea* (L.) Lindl. (green-flowered bog-orchid)
- *Tellima grandiflora* (Pursh) Lindl. (fringe cups)
- *Trifolium breweri* S. Watson (forest clover)

3.2 Accuracy Assessment

3.2.1 Thematic Map Accuracy

By convention, thematic map accuracy is summarized in tabular format using an error, or misclassification matrix. Also referred to as a contingency or confusion matrix, the resulting table allows the map user to visualize both *producer's accuracy* and *user's accuracy* for each mapping class in one place. The matrix also illuminates which types were confused with a given type during the mapping process. The confusion matrix showing both producer's and user's map accuracy estimates by association and by alliance for the SEKI vegetation map is available online through the NPS Data Store.

In the sample misclassification matrix shown in Table 5, one can see that although Class D is often confused with Class A, it has a user's accuracy of 81.2%, meaning that 81.2% of the polygons mapped as Class D can be expected to be in that class when visited on the ground. User's accuracy is considered the measure of greatest interest to users of map products, as it provides a measure of map reliability. In contrast, producer's accuracy reflects the accuracy of the map from the perspective of the map maker, e.g., how often features on the ground are correctly shown on the map. In this case

Class D has a producer's accuracy of 65.7%. Overall accuracy (the number of correctly classified points, summed along the diagonal and divided by the total number of assessment points) of the hypothetical product assessed in this example is 68.7%.

Table 5. Sample misclassification/confusion matrix for five hypothetical map classes (adapted from ESRI and TNC 1994).*

Vegetation Map Class	Map class A	Map class B	Map class C	Map class D	Map class E	Total	User's Accuracy
Map class A	80	4	0	15	7	106	75.5% (80/106)
Map class B	2	17	0	9	2	30	56.7% (17/30)
Map class C	12	5	9	4	8	38	23.7% (9/38)
Map class D	7	8	0	65	0	80	81.2% (65/80)
Map class E	3	2	1	6	38	50	76% (38/50)
Total	104	36	10	99	55	**304**	–
Producer's Accuracy	76.9% (80/104)	47.2% (17/36)	90% (9/10)	65.7% (64/99)	69.1% (38/55)	–	**Overall accuracy 68.7%**

* The rows in the table represent the map, and the columns represent the field AA points.

Of the 2,821 0.5 ha AA plots collected during the field seasons of 2002, 2003 and 2004 in support of the SEKI mapping project (Figure 4), 2,409 were used to calculate accuracy of the map products. Of these, 637 points fell within the boundary of the East Fork Kaweah watershed pilot area, and were used to calculate the accuracy of the pilot map area prior to commencing with mapping the rest of the parks. As these data were then provided to the photointerpreters as training points, accuracy results are reported separately for the East Fork Kaweah watershed (which also includes acreage outside of the park boundary) and the rest of SEKI. Accuracy of the SEKI map exclusive of the East Fork Kaweah drainage was calculated using the 1,772 points distributed across the rest of SEKI.

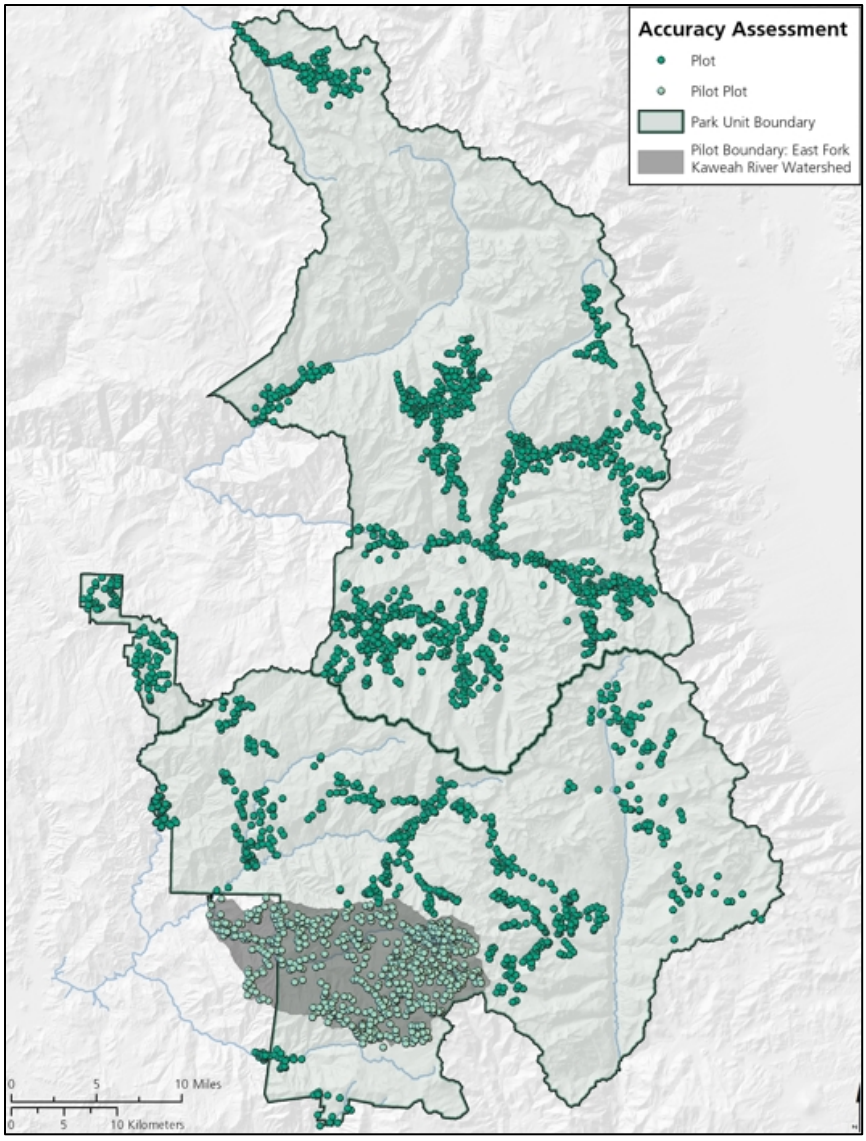


Figure 4. Accuracy Assessment plots collected in support of the SEKI mapping project.

East Fork Kaweah Watershed Pilot Map Accuracy

Of the 117 mapping classes delineated in the East Fork Kaweah pilot area, 87 were represented by at least one AA point, and 45 types had five or more. At the association level, global accuracy of the assessed types was 76.6%, with 488 correct out of 637 assessments. At the alliance level or above, global accuracy of assessed types was 83.5%, with 532 correct out of 637 assessments. Estimated map accuracy at the alliance level or above is shown in Table 6.

Table 6. Estimated map accuracy at the alliance level or above for the East Fork of the Kaweah watershed. Global accuracy was 83% with 532 correct out of 637 assessments. Types labeled not applicable (n/a) were not assessed; interim map codes applied during the pilot mapping phase shown in parenthesis.

Mapping Unit	PI Code	Common Name	Scientific Name	Polygons Mapped	Area (acres)	Total Number AA Points	Percent Correct (User's)
Forest – Evergreen Forest	1020	Canyon Live Oak Forest Alliance	*Quercus chrysolepis* Forest Alliance	330	5,555	35	94
	3020	Sierra Lodgepole Pine Forest Alliance	*Pinus contorta* var. *murrayana* Forest Alliance	95	1,265	17	100
	3060	Ponderosa Pine–Incense-cedar Forest Alliance	*Pinus ponderosa–Calocedrus decurrens* Forest Alliance	133	2,790	27	93
	4020	Giant Sequoia Forest Alliance	*Sequoiadendron giganteum* Forest Alliance	39	2,819	22	95
	4050	California Red Fir Forest Alliance	*Abies magnifica* Forest Alliance	358	8,828	97	93
	4070	California Red Fir–White Fir Forest Alliance	*Abies magnifica–Abies concolor* Forest Alliance	115	3,947	34	59
	4080	White Fir–Sugar Pine Forest Alliance	*Abies concolor–Pinus lambertiana* Forest Alliance	108	5,031	36	81
	4110	Incense-cedar Forest Alliance	*Calocedrus decurrens* Forest Alliance	4	33	–	n/a
	910	Conifer Reproduction	Conifer Reproduction	72	419	5	100
Forest – Deciduous Forest	2010	Quaking Aspen Forest Alliance	*Populus tremuloides* Forest Alliance	3	25	1	100
	2020	California Black Oak Forest Alliance	*Quercus kelloggii* Forest Alliance	283	2,179	14	71
	2050	Black Cottonwood Temporarily Flooded Forest Alliance	*Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Forest Alliance	10	53	8	88
	2060	White Alder Temporarily Flooded Forest Alliance	*Alnus rhombifolia* Temporarily Flooded Forest Alliance	14	123	–	n/a
	2080	Bigleaf Maple Forest Alliance	*Acer macrophyllum* Forest Alliance	5	21	–	n/a
Woodland – Evergreen Woodland	1040	Interior Live Oak Woodland Alliance	*Quercus wislizeni* var. *wislizeni* Woodland Alliance	312	1,643	14	79
	3050	Ponderosa Pine Woodland Alliance	*Pinus ponderosa* Woodland Alliance	133	2,790	3	0
	3070	Jeffrey Pine Woodland Alliance	*Pinus jeffreyi* Woodland Alliance	198	3,067	38	79

Table 6 (continued). Estimated map accuracy at the alliance level or above for the East Fork of the Kaweah watershed. Global accuracy was 83% with 532 correct out of 637 assessments. Types labeled not applicable (n/a) were not assessed; interim map codes applied during the pilot mapping phase shown in parenthesis.

Mapping Unit	PI Code	Common Name	Scientific Name	Polygons Mapped	Area (acres)	Total Number AA Points	Percent Correct (User's)
Woodland – Evergreen Woodland (continued)	3130	Western White Pine Woodland Alliance	*Pinus monticola* Woodland Alliance	73	970	8	50
	3200	Foxtail Pine Woodland Alliance	*Pinus balfouriana* ssp. *austrina* Woodland Alliance	202	2,126	57	79
	4100	Sierra Juniper Woodland Alliance	*Juniperus occidentalis* var. *australis* Woodland Alliance	26	322	10	100
Woodland – Deciduous Woodland	2030	Blue Oak Woodland Alliance	*Quercus douglasii* Woodland Alliance	37	438	7	86
	2100	California Sycamore Temporarily Flooded Woodland Alliance	*Platanus racemosa* Temporarily Flooded Woodland Alliance	8	40	2	50
	2110	California Buckeye Woodland Alliance	*Aesculus californica* Woodland Alliance	15	86	2	50
Shrubland – Evergreen Shrubland	5010	Birchleaf Mountain Mahogany Shrubland Alliance	*Cercocarpus betuloides* Shrubland Alliance	259	1,993	24	88
	5020	Chamise Shrubland Alliance	*Adenostoma fasciculatum* Shrubland Alliance	175	1,748	17	88
	5050	Buckbrush Shrubland Alliance	*Ceanothus cuneatus* Shrubland Alliance	15	130	–	n/a
	5070	Whiteleaf Manzanita Shrubland Alliance	*Arctostaphylos viscida* Shrubland Alliance	28	263	7	86
	5080	Bush Chinquapin Shrubland Alliance	*Chrysolepis sempervirens* Shrubland Alliance	130	615	9	89
	5090	Greenleaf Manzanita Shrubland Alliance	*Arctostaphylos patula* Shrubland Alliance	79	380	12	58
	5110	Mountain Whitethorn Shrubland Alliance	*Ceanothus cordulatus* Shrubland Alliance	18	63	2	100
	5130	Mountain Misery Dwarf-shrubland Alliance	*Chamaebatia foliolosa* Dwarf-shrubland Alliance	16	95	4	75
	5140	Indian Manzanita Shrubland Alliance	*Arctostaphylos mewukka* Shrubland Alliance	80	377	12	83
	5160	Mountain Big Sagebrush Shrubland Alliance	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	45	593	16	100

Table 6 (continued). Estimated map accuracy at the alliance level or above for the East Fork of the Kaweah watershed. Global accuracy was 83% with 532 correct out of 637 assessments. Types labeled not applicable (n/a) were not assessed; interim map codes applied during the pilot mapping phase shown in parenthesis.

Mapping Unit	PI Code	Common Name	Scientific Name	Polygons Mapped	Area (acres)	Total Number AA Points	Percent Correct (User's)
Shrubland – Evergreen Shrubland (continued)	5270	Chaparral Yucca Shrubland Alliance	*Yucca whipplei* Shrubland Alliance	20	110	–	n/a
	5250	Silverbush Lupine Shrubland Alliance	*Lupinus albifrons* Shrubland Alliance	1	2	1	0
	5280	Pinemat Manzanita Shrubland Alliance	*Arctostaphylos nevadensis* Shrubland Alliance	28	96	5	40
	5510 (5501)	Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance	*Artemisia tridentata* ssp. *vaseyana* & *Artemisia rothrockii* & *Holodiscus discolor* & *Phyllodoce breweri* Shrubland Superalliance	55	379	2	100
	5530 (5503)	Bitter Cherry–Gooseberry spp.–(Mountain Maple)–Shrubland Mapping Unit	*Prunus emarginata–Ribes* spp.*–(Acer glabrum)* Shrubland Mapping Unit	21	153	5	100
	5590 (5502)	Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance	*Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* Shrubland Superalliance	101	838	17	82
Shrubland – Deciduous Shrubland	6010	Deerbrush Shrubland Alliance	*Ceanothus integerrimus* Shrubland Alliance	60	482	4	100
	6020	Oregon White Oak (Brewer's Oak) Shrubland Alliance	*Quercus garryana* var. *breweri* Shrubland Alliance	130	908	4	100
	6030	California Grape Mapping Unit	*Vitis california* Mapping Unit	1	<1	–	n/a
	6110	Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance	*Salix orestera*/*Allium validum* Seasonally Flooded Shrubland Alliance	60	368	12	92
	6300 (5220)	Bitter Cherry Shrubland Alliance	*Prunus emarginata* Shrubland Alliance	7	33	2	0
	6500	Willow spp./Meadow Shrubland Mapping Unit	*Salix* spp./Meadow Shrubland Mapping Unit	46	231	9	89

Table 6 (continued). Estimated map accuracy at the alliance level or above for the East Fork of the Kaweah watershed. Global accuracy was 83% with 532 correct out of 637 assessments. Types labeled not applicable (n/a) were not assessed; interim map codes applied during the pilot mapping phase shown in parenthesis.

Mapping Unit	PI Code	Common Name	Scientific Name	Polygons Mapped	Area (acres)	Total Number AA Points	Percent Correct (User's)
Shrubland – Deciduous Shrubland (continued)	6600	Willow spp. Riparian Shrubland Mapping Unit	*Salix* spp. Riparian Shrubland Mapping Unit	50	329	6	100
	6700	Willow spp. Talus Shrubland Mapping Unit	*Salix* spp. Talus Shrubland Mapping Unit	41	205	6	33
Herbaceous Vegetation – Annual	7260	California Annual Grassland/Herbland Superalliance	California Annual Grassland/Herbland Superalliance	23	97	1	100
Herbaceous Vegetation – Perennial	7000	Upland Herbaceous	Upland Herbaceous	44	203	6	57
	7120	Shorthair Sedge Herbaceous Alliance	*Carex exserta* Herbaceous Alliance	13	65	1	100
	7702	Mesic Post Fire Herbaceous Mapping Unit	Mesic Post Fire Herbaceous Mapping Unit	7	33	–	n/a
	7703	Post Fire Shrub/Herbaceous Mapping Unit	Post Fire Shrub/Herbaceous Mapping Unit	16	117	1	100
	8000	Intermittently to Seasonally Flooded Meadow	Intermittently to Seasonally Flooded Meadow	194	575	13	92
	9000	Semi-permanently to Permanently Flooded Meadow	Semi-permanently to Permanently Flooded Meadow	13	21	–	n/a
Sparse Vegetation/ Unvegetated	200 500 950	Rock and Sparsely Vegetated	Talus, Scree, and Rock Outcrops	292	2,821	5	100
	0980	Water	–	39	253	1	100

Results from the East Fork Kaweah pilot map were used to inform the mapping of the vegetation of the rest of SEKI. Table 7 shows the ten types with the highest and lowest accuracies, demonstrating that associations characterized by mixtures of conifers (e.g., foxtail pine and lodgepole pine, foxtail pine and western white pine, and red fir and white fir) proved the most challenging to the photointerpreters. Stands dominated by a single species (e.g., foxtail pine, Sierra juniper, or lodgepole pine) had the highest levels of user's accuracy.

Table 7. Types at the association, alliance or mapping unit level with the highest and lowest accuracies estimated from 637 accuracy assessment points within the East Fork Kaweah Watershed Pilot vegetation map. Types with 5 or fewer assessment points excluded.

Group	PI Code	Alliance/Map Unit Name	Number Polygons Mapped	Number Acres Mapped	Total Number AA Points	% Correct (User's)
Map Classes with the Highest Estimated Accuracies	1024	Canyon Live Oak–California Laurel Association	152	3,539	26	100
	3038	Lodgepole Pine Woodland Association	22	268	7	100
	3072	Jeffrey Pine/Greenleaf Manzanita Association	124	1,329	14	100
	4054	Red Fir/Mixed Shrub Mapping Unit	27	309	10	100
	4108	Sierra Juniper Association	26	322	10	100
	5070	Whiteleaf Manzanita Shrubland Alliance	18	221	6	100
	5160	Big Sagebrush Shrubland Alliance	45	593	16	100
	6010	Deerbrush Shrubland Alliance	60	482	6	100
	6600	Shrub Willow Riparian Setting Mapping Unit	50	329	8	100
	3203	Foxtail Pine Association	89	831	25	96
Map Classes with the Lowest Estimated Accuracies	3201	Foxtail Pine–Lodgepole Mapping Unit	23	390	7	40
	3204	Foxtail Pine–Western White Pine Association	38	511	10	44
	4063	Red Fir–Lodgepole Pine/White-Flowered Hawkweed Association	49	1,287	11	54
	4071	Red Fir–White Fir Association	50	2,322	16	57
	5090	Greenleaf Manzanita Shrubland Alliance	79	380	8	58
	3086	Jeffrey Pine–White Fir & White Fir–Sugar Pine–Jeffrey Pine Mapping Unit	53	1,438	12	60
	4072	Red Fir–White Fir–Jeffrey Pine Association	45	973	7	60
	4051	Red Fir Association	76	2,746	23	62
	2020	Black Oak Forest Alliance	194	1,638	7	70
	4055	Red Fir–Western White Pine–Lodgepole Pine Association	37	605	12	70

Of the 30 types not sampled for accuracy assessment in the East Fork Kaweah watershed, nine had more than 100 acres mapped; the rest ranged from less than one to 97 acres (Table 8). The two most

widespread types that were not assessed for accuracy were deliberately excluded from field sampling as they were unvegetated (exposed rock and alpine talus slopes).

Table 8. Number of polygons and acres mapped of classes within the East Fork Kaweah watershed not assessed for accuracy during the pilot phase.

PI Code	Mapping Class Name	No. of Polygons mapped	Area (acres)
961	Exposed Rock	437	2,750
100	Alpine Talus Slope	164	1,301
5027	Chamise–Wedgeleaf Ceanothus Association	30	317
1043	Interior Live Oak–Canyon Live Oak Association	220	242
700	Boulder Field	15	142
400	Alpine Fell-field	12	132
5050	Wedgeleaf Ceanothus Shrubland Alliance	15	130
4095	White Fir–Sugar Pine/Mixed Shrub Mapping Unit	5	118
3053	Ponderosa Pine/Whiteleaf Manzanita Association	13	110
3060	Ponderosa Pine–Incense cedar Forest Alliance	1	97
2027	Black Oak/herbaceous Mapping Unit	6	62
5074	Whiteleaf Manzanita–Bush Poppy Association	10	42
2102	California Sycamore/Canyon Live Oak–(Interior Live Oak) Association	7	37
4111	Incense-Cedar–White Alder Association	4	33
5220	Bitter Cherry Shrubland Alliance	7	33
7702	Post-fire Herbaceous Vegetation in mesic swales	7	33
965	Sparsely Vegetated Rocky Streambed	11	32
1029	Canyon Live Oak/Greenleaf Manzanita Association	5	31
4080	White Fir Forest Alliance	1	30
2080	Bigleaf Maple Forest Alliance	5	21
9000	Seasonally to Permanently Flooded Meadow	13	21
3042	Lodgepole Pine/Shorthair Sedge Association	4	15
970	Permanent Snowfield/Glacier	4	12
2114	California Buckeye/Canyon Live Oak Association	1	9
920	Plantation	1	8
3073	Jeffrey Pine/Mountain Whitethorn Association	1	6
2110	California Buckeye Woodland Alliance	1	3
5250	Silverbush Lupine Shrubland Alliance	1	2
990	Urban/Built Up	2	2
6030	California Grape Mapping Unit	1	<1

Despite its diversity of terrain, elevation, and vegetation, the East Fork Watershed pilot area did not include all of the vegetation types found within the parks. Reflecting the distribution of several

important species, the following alliances were notably absent from the pilot area: Mountain Hemlock Forest Alliance, Singleleaf Pinyon Pine Woodland Alliance, Whitebark Pine Woodland Alliance, Limber Pine Woodland Alliance, Timberline Sagebrush Shrubland Alliance, Curl-leaf Mountain Mahogany Woodland Alliance, and Water Birch Shrubland Alliance. Conversely, there were no types found within the East Fork Kaweah watershed that did not occur elsewhere in SEKI.

Sequoia and Kings Canyon National Parks Map Accuracy (exclusive of East Fork Kaweah Watershed)

Pre-aggregation accuracy

Of the 162 mapping classes delineated on the SEKI map, 137 types were represented by at least one AA point, and 86 types had five or more. Fifty-six types had ten or more AA points. At the association level, global accuracy of the assessed types was 79.8%, with 1,414 correct out of 1,772 assessments. At the alliance level or above, global accuracy of assessed types was 85.9%, with 1,523 correct out of 1,772 assessments.

Post-aggregation results

In order to improve the accuracy of the final map product, a number of types that fell below an acceptable threshold were combined, or aggregated with other types in order to meet accuracy targets. Through this process the mapping classification was reduced from 162 to 154 types. Of the 154 mapping classes delineated on the final SEKI map, 119 types were represented by at least one AA point, and 75 types had five or more. Forty-nine types had 10 or more AA points. At the association level, global accuracy of the assessed types increased to 81.9%, with 1,451 correct out of 1,772 assessments.

At the alliance level or above, global accuracy of assessed types was 86.2%, with 1,523 correct out of 1,772 assessments. Estimated map accuracy at the alliance level or above is shown in Table 9. Of 43 alliance-level types with assessments based on more than 5 AA points, 10 fell below the 80% user's accuracy target.

Table 9. Estimated map accuracy at the alliance level or above within Sequoia and Kings Canyon, exclusive of the East Fork of the Kaweah watershed. Global accuracy was 86.2% with 1523 correct out of 1772 assessments. Types labeled not applicable (n/a) were not assessed.

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Total Number AA Points	Percent Correct (User's)
Forest – Evergreen Forest	1020	Canyon Live Oak Forest Alliance	*Quercus chrysolepis* Forest Alliance	28,981	77	95
	3010	Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance	*Pinus contorta var. murrayana–Populus tremuloides–(Pinus jeffreyi)* Forest Alliance	521	11	91
	3020	Sierra Lodgepole Pine Forest Alliance	*Pinus contorta* var. *murrayana* Forest Alliance	50,602	315	92
	3060	Ponderosa Pine–Incense-cedar Forest Alliance	*Pinus ponderosa–Calocedrus decurrens* Forest Alliance	12,683	0	n/a
	4020	Giant Sequoia Forest Alliance	*Sequoiadendron giganteum* Forest Alliance	11,102	8	100
	4030	Mountain Hemlock Forest Alliance	*Tsuga mertensiana* Forest Alliance	1,387	8	88
	4050	California Red Fir Forest Alliance	*Abies magnifica* Forest Alliance	49,354	87	79
	4070	California Red Fir–White Fir Forest Alliance	*Abies magnifica–Abies concolor* Forest Alliance	32,043	40	60
	4080	White Fir–Sugar Pine Forest Alliance	*Abies concolor–Pinus lambertiana* Forest Alliance	39,384	72	88
	4110	Incense-cedar Forest Alliance	*Calocedrus decurrens* Forest Alliance	277	2	100
	910	Conifer Reproduction	Conifer Reproduction	4,296	33	94
Forest – Deciduous Forest	2010	Quaking Aspen Forest Alliance	*Populus tremuloides* Forest Alliance	6,159	45	100
	2020	California Black Oak Forest Alliance	*Quercus kelloggii* Forest Alliance	12,050	51	88
	2050	Black Cottonwood Temporarily Flooded Forest Alliance	*Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Forest Alliance	1,333	13	85
	2060	White Alder Temporarily Flooded Forest Alliance	*Alnus rhombifolia* Temporarily Flooded Forest Alliance	530	8	100
	2080	Bigleaf Maple Forest Alliance	*Acer macrophyllum* Forest Alliance	186	1	0

Table 9 (continued). Estimated map accuracy at the alliance level or above within Sequoia and Kings Canyon, exclusive of the East Fork of the Kaweah watershed. Global accuracy was 86.2% with 1523 correct out of 1772 assessments. Types labeled not applicable (n/a) were not assessed.

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Total Number AA Points	Percent Correct (User's)
Woodland – Evergreen Woodland	1040	Interior Live Oak Woodland Alliance	*Quercus wislizeni* var. *wislizeni* Woodland Alliance	5,190	18	94
	3050	Ponderosa Pine Woodland Alliance	*Pinus ponderosa* Woodland Alliance	448	0	n/a
	3070	Jeffrey Pine Woodland Alliance	*Pinus jeffreyi* Woodland Alliance	43,822	129	83
	3110	Singleleaf Pinyon Pine Woodland Alliance	*Pinus monophylla* Woodland Alliance	7,653	23	100
	3130	Western White Pine Woodland Alliance	*Pinus monticola* Woodland Alliance	4,301	9	67
	3140	Whitebark Pine Woodland Alliance	*Pinus albicaulis* Woodland Alliance	36,359	74	92
	3150	Limber Pine Woodland Alliance	*Pinus flexilis* Woodland Alliance	547	0	n/a
	3200	Foxtail Pine Woodland Alliance	*Pinus balfouriana* ssp. *austrina* Woodland Alliance	33,874	59	88
	3520	(Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland Mapping Unit	*(Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana–Pinus albicaulis)* Krummholz Woodland Mapping Unit	792	2	100
	3530	Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance	*Pinus albicaulis–Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana* Woodland Superalliance	8,892	34	88
	3540	Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance	*Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana* Woodland Superalliance	26,593	61	67
	4100	Sierra Juniper Woodland Alliance	*Juniperus occidentalis* var. *australis* Woodland Alliance	20,984	58	91
	4540	Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland Superassociation	*Pinus monticola–Pinus contorta* var. *murrayana–(Abies magnifica)* Woodland Superassociation	25,333	44	73

Table 9 (continued). Estimated map accuracy at the alliance level or above within Sequoia and Kings Canyon, exclusive of the East Fork of the Kaweah watershed. Global accuracy was 86.2% with 1523 correct out of 1772 assessments. Types labeled not applicable (n/a) were not assessed.

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Total Number AA Points	Percent Correct (User's)
Woodland – Deciduous Woodland	2030	Blue Oak Woodland Alliance	*Quercus douglasii* Woodland Alliance	2,180	14	100
	2100	California Sycamore Temporarily Flooded Woodland Alliance	*Platanus racemosa* Temporarily Flooded Woodland Alliance	303	1	100
	2110	California Buckeye Woodland Alliance	*Aesculus californica* Woodland Alliance	1,468	2	50
	2530	Montane Broadleaf Deciduous Trees Mapping Unit	Montane Broadleaf Deciduous Trees Mapping Unit	6	0	n/a
Shrubland – Evergreen Shrubland	5010	Birchleaf Mountain Mahogany Shrubland Alliance	*Cercocarpus betuloides* Shrubland Alliance	3,093	5	80
	5020	Chamise Shrubland Alliance	*Adenostoma fasciculatum* Shrubland Alliance	8,675	14	93
	5030	Chamise–Buckbrush Shrubland Alliance	*Adenostoma fasciculatum–Ceanothus cuneatus* Shrubland Alliance	139	1	0
	5050	Buckbrush Shrubland Alliance	*Ceanothus cuneatus* Shrubland Alliance	5	0	n/a
	5060	Chaparral Whitethorn Shrubland Alliance	*Ceanothus leucodermis* Shrubland Alliance	186	0	n/a
	5070	Whiteleaf Manzanita Shrubland Alliance	*Arctostaphylos viscida* Shrubland Alliance	362	1	100
	5090	Greenleaf Manzanita Shrubland Alliance	*Arctostaphylos patula* Shrubland Alliance	2,184	20	90
	5130	Mountain Misery Dwarf-shrubland Alliance	*Chamaebatia foliolosa* Dwarf-shrubland Alliance	287	0	n/a
	5140	Indian Manzanita Shrubland Alliance	*Arctostaphylos mewukka* Shrubland Alliance	653	0	n/a
	5160	Mountain Big Sagebrush Shrubland Alliance	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	3,154	12	92
	5200	Timberline Sagebrush Shrubland Alliance	*Artemisia rothrockii* Shrubland Alliance	255	4	50
	5230	Curl-leaf Mountain Mahogany Woodland Alliance	*Cercocarpus ledifolius* Woodland Alliance	674	0	n/a
	5270	Chaparral Yucca Shrubland Alliance	*Yucca whipplei* Shrubland Alliance	401	4	100

Table 9 (continued). Estimated map accuracy at the alliance level or above within Sequoia and Kings Canyon, exclusive of the East Fork of the Kaweah watershed. Global accuracy was 86.2% with 1523 correct out of 1772 assessments. Types labeled not applicable (n/a) were not assessed.

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Total Number AA Points	Percent Correct (User's)
Shrubland – Evergreen Shrubland (continued)	5280	Pinemat Manzanita Shrubland Alliance	*Arctostaphylos nevadensis* Shrubland Alliance	306	1	0
	5300	Water Birch Shrubland Alliance	*Betula occidentalis* Shrubland Alliance	157	0	n/a
	5510	Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance	*Artemisia tridentata* ssp. *vaseyana* & *Artemisia rothrockii* & *Holodiscus discolor* & *Phyllodoce breweri* Shrubland Superalliance	12,298	23	91
	5530	Bitter Cherry–Gooseberry spp.–(Mountain Maple)–Shrubland Mapping Unit	*Prunus emarginata–Ribes* spp.*–(Acer glabrum)* Shrubland Mapping Unit	3,252	26	31
	5550	Red Mountainheather Dwarf-shrubland Alliance	*Phyllodoce breweri* Dwarf-shrubland Alliance	1,015	1	100
	5590	Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance	*Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* Shrubland Superalliance	19,962	74	81
Shrubland – Deciduous Shrubland	6010	Deerbrush Shrubland Alliance	*Ceanothus integerrimus* Shrubland Alliance	793	5	100
	6020	Oregon White Oak Shrubland Alliance	*Quercus garryana* var. *breweri* Shrubland Alliance	2,391	3	100
	6110	Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance	*Salix orestera*/*Allium validum* Seasonally Flooded Shrubland Alliance	8,325	24	100
	6210	Oceanspray Shrubland Alliance	*Holodiscus discolor* Shrubland Alliance	395	0	n/a
	6300	Bitter Cherry Shrubland Alliance	*Prunus emarginata* Shrubland Alliance	810	3	100
	6500	Willow spp./Meadow Shrubland Mapping Unit	*Salix* spp./Meadow Shrubland Mapping Unit	2,023	17	71
	6600	Willow spp. Riparian Shrubland Mapping Unit	*Salix* spp. Riparian Shrubland Mapping Unit	5,191	23	100
	6700	Willow spp. Talus Shrubland Mapping Unit	*Salix* spp. Talus Shrubland Mapping Unit	3,830	18	83

Table 9 (continued). Estimated map accuracy at the alliance level or above within Sequoia and Kings Canyon, exclusive of the East Fork of the Kaweah watershed. Global accuracy was 86.2% with 1523 correct out of 1772 assessments. Types labeled not applicable (n/a) were not assessed.

Mapping Unit	PI Code	Common Name	Scientific Name	Area (acres)	Total Number AA Points	Percent Correct (User's)
Herbaceous Vegetation – Annual	7260	California Annual Grassland/Herbland Superalliance	California Annual Grassland/Herbland Superalliance	413	7	100
Herbaceous Vegetation – Perennial	7000	Upland Herbaceous	Upland Herbaceous	2,215	26	54
	7120	Shorthair Sedge Herbaceous Alliance	*Carex exserta* Herbaceous Alliance	4,194	16	94
	7702	Mesic Post Fire Herbaceous Mapping Unit	Mesic Post Fire Herbaceous Mapping Unit	525	3	100
	7703	Post Fire Shrub/Herbaceous Mapping Unit	Post Fire Shrub/Herbaceous Mapping Unit	628	4	100
	8000	Intermittently to Seasonally Flooded Meadow	Intermittently to Seasonally Flooded Meadow	13,953	37	95
	9000	Semi-permanently to Permanently Flooded Meadow	Semi-permanently to Permanently Flooded Meadow	1,791	5	100
Sparse Vegetation/ Unvegetated	961, 963, 965	Rock and Sparsely Vegetated	–	277,209	19	68
	0980	Water	–	11,604	2	100
	0990	Urban/Developed	–	71	0	n/a

Table 10 shows the ten types with the highest and lowest accuracies, demonstrating that alliances and superalliances characterized by mixtures of conifers (e.g., foxtail pine and lodgepole pine, red fir and white fir) continued to prove challenging to the photointerpreters. Forests and woodlands dominated by a single species (e.g., quaking aspen, blue oak, white alder, single-leaf pinyon, giant sequoia, and canyon live oak) had the highest levels of user's accuracy, although the western white pine alliance fell below 70% accuracy (note, however, the relatively low sample size this assessment is based upon).

Table 10. Types at the alliance or mapping unit level with the highest and lowest accuracies estimated from 1772 accuracy assessment points within SEKI, exclusive of the East Fork Kaweah Watershed. Types with 5 or fewer assessment points excluded.

Group	PI Code	Alliance/Map Unit Name	# Polygons	Area (acres)	Total Number AA Points	% Correct (User's)
Alliances/ Mapping Units with the Highest Estimated Accuracies	2010	Quaking Aspen Forest Alliance	274	6,159	45	100
	2030	Blue Oak Woodland Alliance	1	2,180	14	100
	2060	White Alder Temporarily Flooded Forest Alliance	61	530	8	100
	3110	Single-leaf Pinyon Pine Woodland Alliance	13	7,653	23	100
	4020	Giant Sequoia Forest Alliance	11	11,102	8	100
	6110	Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance	1,954	8,325	24	100
	6600	Willow spp. Riparian Shrubland Mapping Unit	1,030	5,191	23	100
	7260	California Annual Grassland/Herbland Superalliance	117	413	7	100
	1020	Canyon Live Oak Forest Alliance	722	28,981	77	95
	8000	Intermittently to Seasonally Flooded Meadow	4,566	13,953	37	95
Alliances/ Mapping Units with the Lowest Estimated Accuracies	5530	Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit	603	3,252	26	31
	7000	Upland Herbaceous	757	2,215	26	54
	4070	California Red Fir–White Fir Forest Alliance	889	32,043	40	60
	3130	Western White Pine Woodland Alliance	260	4,301	9	67
	3540	Foxtail Pine–Lodgepole Pine Woodland Superalliance	1,087	26,593	61	67
	960	Rock Outcrop Undifferentiated	10,467	118,431	19	68
	400	Alpine Fell-field	1,453	27,408	7	71
	6500	Willow spp./Meadow Shrubland Mapping Unit	669	2,023	17	71
	4540	Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland Superassociation	933	25,333	44	73
	4050	California Red Fir Forest Alliance	3	49,354	87	79

3.2.2 Post Accuracy Assessment Modifications to the Mapping Classification

In order to meet the accepted standard for mapping class accuracy, related classes that did not meet the accuracy standards were aggregated to form superassociations (one or more associations within the same alliance), superalliances (mapping classes that occurred in two or more alliances), or mapping units that could meet an accepted standard. In some cases, associations that could not be mapped at an accepted level of accuracy were instead "rolled up", or mapped at the alliance level. The resulting combined types are reflected in the mapping classification (Appendix D) and summarized in Table 11.

Table 11. Summary of modifications made to the mapping classification post accuracy assessment.

Original PI Code	**Original Mapping Unit Name** ***Post accuracy assessment modification***
2021	California Black Oak/Greenleaf Manzanita Forest *Mapped at alliance level, California Black Oak Forest Alliance (2020)*
2026	California Black Oak/Indian Manzanita–Mountain Misery Forest *Mapped at alliance level, California Black Oak Forest Alliance (2020)*
3021	Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation
3038	Sierra Lodgepole Pine Woodland
3042	Sierra Lodgepole Pine /Shorthair Sedge Woodland *Aggregated 3021, 3038, and 3042 together to form Sierra Lodgepole Pine Woodlands Superassociation (3026)*
3033	Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association
3041	Sierra Lodgepole Pine / Ross Sedge Forest
3043	Sierra Lodgepole Pine–Whitebark Pine /Shorthair Sedge Forest Association *Aggregated 3033, 3041, and 3043 into Lodgepole Pine (Whitebark Pine)/(Ross Sedge) – (Shorthair Sedge) Forest Superassociation (3028)*
3132	Western White Pine–Sierra Lodgepole Pine Woodland
4055	California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest *Aggregated 3132 and 4055 into Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland Superassociation (4540)*
4054	California Red Fir/Mixed Shrub Mapping Unit
4069	California Red Fir–Western White Pine/Mixed Shrub Mapping Unit *Aggregated 4054 and 4069 into California Red Fir–(Western White Pine)/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4064)*
4071	California Red Fir–White Fir Forest
4072	California Red Fir–White Fir–Jeffrey Pine Forest
4073	California Red Fir–White Fir–Sugar Pine Forest *Aggregated 4071, 4072, and 4073 and mapped at alliance level California Red Fire–White Fir Forest Alliance (4070)*

Table 11 (continued). Summary of modifications made to the mapping classification post accuracy assessment.

Original PI Code	Original Mapping Unit Name ***Post accuracy assessment modification***
5021	Chamise Shrubland *Mapped at alliance level, Chamise Shrubland Alliance (5020)*
5080	Bush Chinquapin Shrubland Alliance
5110	Whitethorn Ceanothus Shrubland Alliance
5520	Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Montane Chaparral Mapping Unit *Aggregated 5080, 5110 and 5502 to form the Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)*

3.2.3 Post-delivery Translation to Regional Classification Systems

Following delivery of the final map products, ecologists at SEKI determined that in order to share the products across agency platforms within California (primarily the US Forest Service and the California State Department of Fish and Wildlife) the mapping classification would need to be translated (e.g., "cross-walked") to the coarser systems in use by those agencies. The SEKI Fire GIS Specialist (K. Folger) took the lead on this process, and worked closely with vegetation specialists within the USFS to attribute the SEKI map polygons with both Calveg and California Wildlife Habitat Relationships systems. Appendix G provides additional information on these systems.

3.2.4 Positional Accuracy

Accuracy assessment for the SEKI vegetation mapping projects addressed thematic accuracy only. Estimated positional accuracies of the base digital ortho images, to which photointerpretation products were rectified, are not available. Assuming that the DOQs meet USGS standards, horizontal map accuracy should approach the standard which is 90% for all vectors and accurate within 0.05 cm (1/50th of an inch) on the map. At the 1:24000 scale, 1/50th of an inch is 40 ft (12.2 m).

3.3 The Final Vegetation Map for Sequoia and Kings Canyon National Parks

The final vegetation map is available as a portable document format (pdf) file and as a spatial data coverage through the NPS Vegetation Inventory and Map for Sequoia & Kings Canyon National Parks. Map unit descriptions, including details on distribution within the mapping area, environmental setting and species composition are provided in Appendix F. Appendix E provides a key to mapping classes and Appendix H provides a crosswalk between the mapping classification and the YOSE floristic classification. Complete metadata are packaged with the digital map, and field definitions can be found in Appendix I.

Figures 5 through 8 show a portion of the final vegetation map of Sequoia and Kings Canyon National Parks in the Kern Canyon of Sequoia National Park. These illustrate four different classification levels, from the association level (Figure 5) to the more general alliance level (Figure 6) and finally, the California Wildlife Habitat Relationship (CWHR, Figure 7) and the CALVEG classifications (Figure 8), which provide a coarser level compatible with regional map layers.

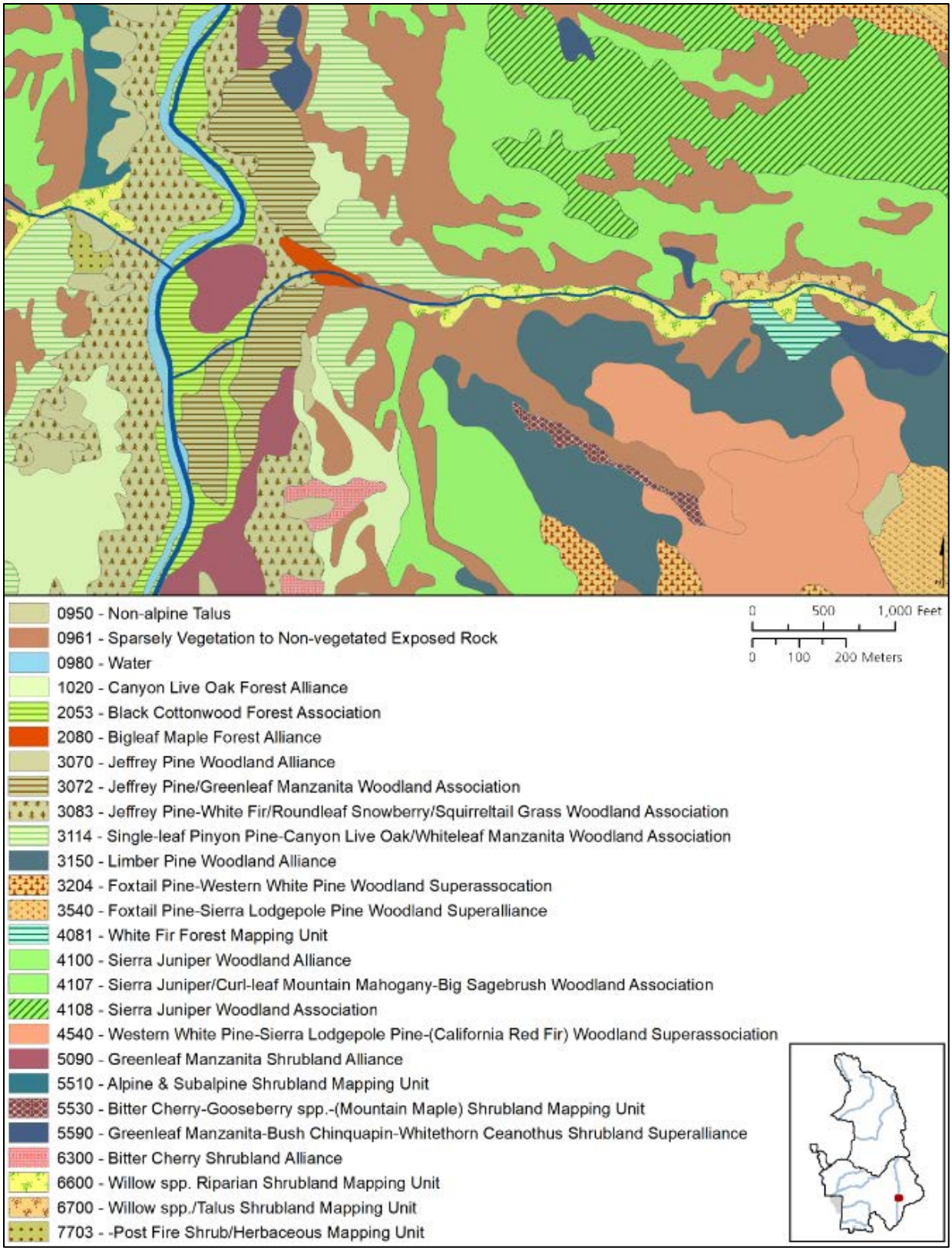


Figure 5. Association-level portion of the final vegetation map of Sequoia and Kings Canyon National Parks in the Kern Canyon of Sequoia National Park.

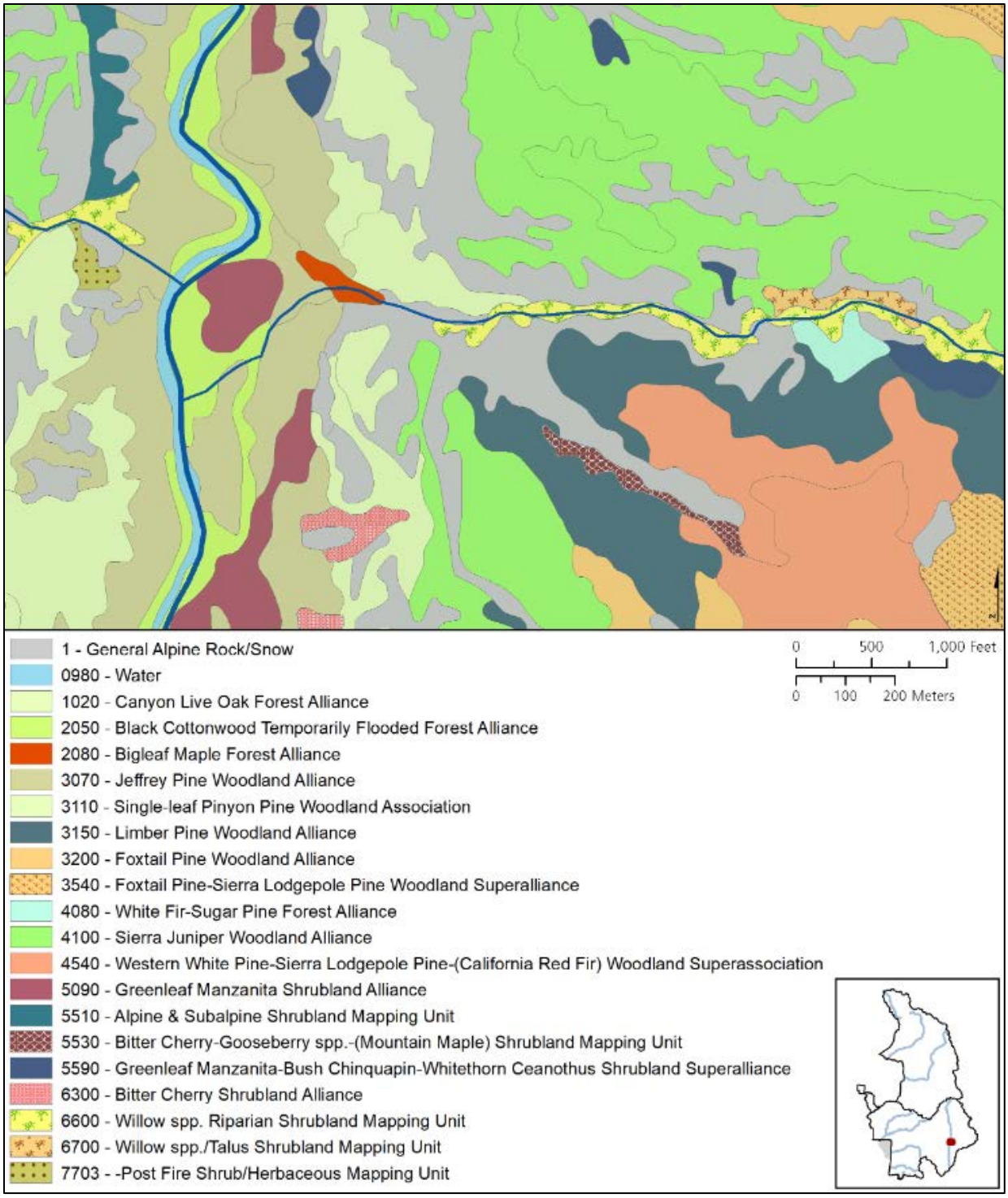


Figure 6. Alliance-level portion of the final vegetation map of Sequoia and Kings Canyon National Parks in the Kern Canyon of Sequoia National Park.

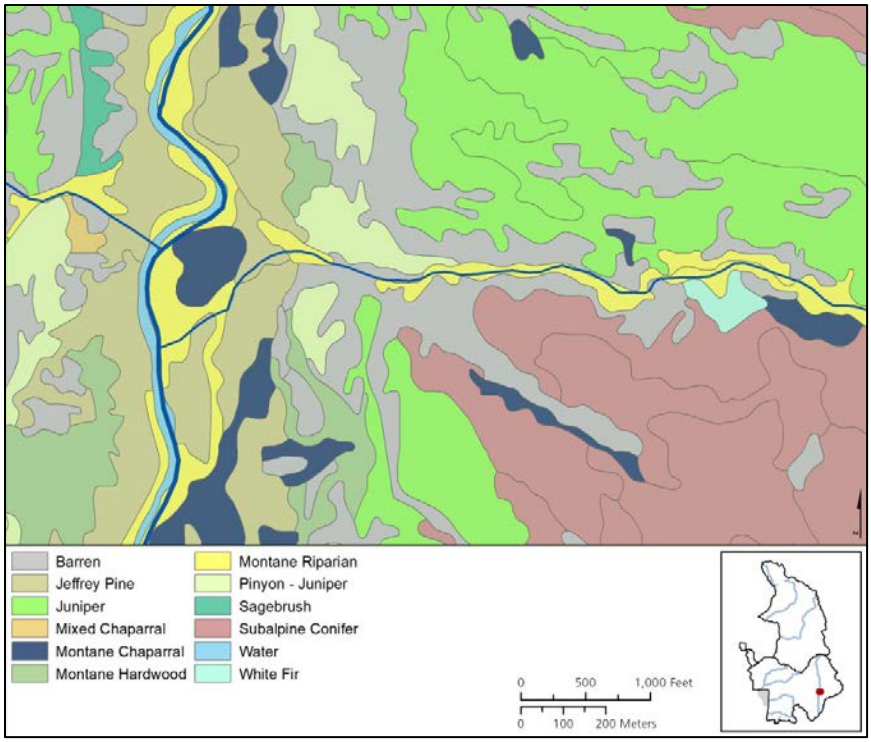


Figure 7. CWHR vegetation map of Sequoia and Kings Canyon National Parks in the Kern Canyon of Sequoia National Park.

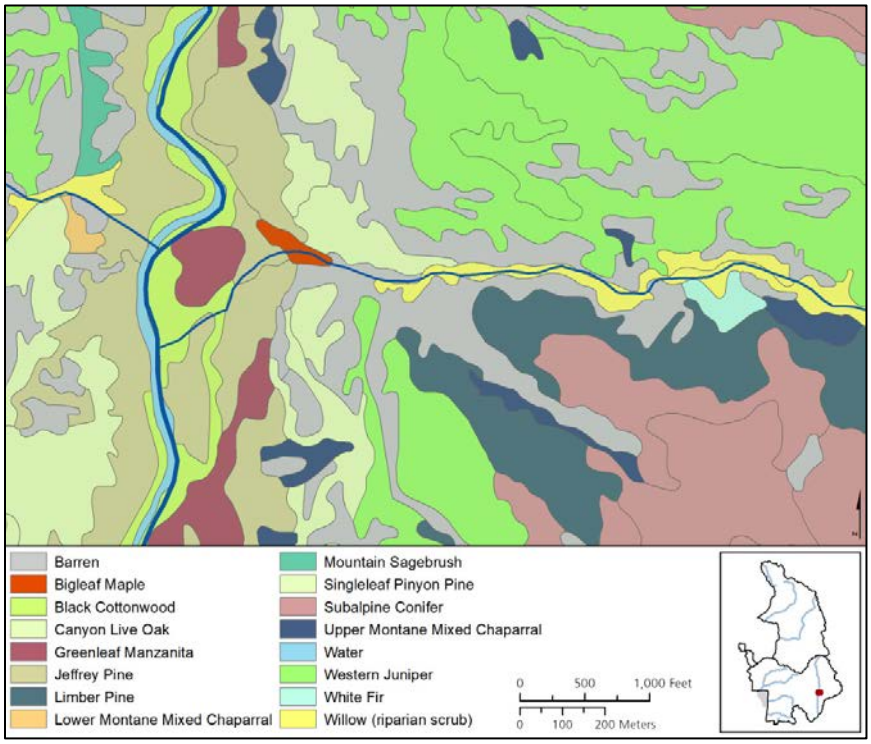


Figure 8. Cal Veg vegetation map of Sequoia and Kings Canyon National Parks in the Kern Canyon of Sequoia National Park.

4. Discussion

4.1 Considerations when using the SEKI vegetation mapping products

It is important to note that photointerpreters can only accurately quantify the vegetation that is visible on the aerial photography. Using aerial photography at scales smaller than about 1:12,000 (the SEKI aerial photography scale is approximately 1:15,860), photointerpreters generally cannot see the amount of vegetation which is obscured by a higher canopy, regardless of its life form; therefore, total vegetative cover may differ from assessments done on the ground by field crews. Understory vegetation that is not visible on the aerial photograph cannot be quantified when assigning the total cover of vegetation for that polygon. The visibility of individual plants is influenced by vegetation stature and the scale of the aerial photography. Trees are usually visible as individuals, and with larger scale photography, so are shrubs. However, grasses are rarely seen as individual plants, regardless of the scale of the photography. These constraints have important consequences for map users.

The map products described in the report should be used only as a starting point when deriving distribution maps for individual species. Because coarser levels of the mapping classification (e.g., superassociations, superalliances, and mapping units) may or may not include a taxon that appears in the name of the class, it is important to base species distribution maps on actual plot data. An example of this can be found in the distribution of whitebark pine. Because the krummholz form of lodgepole pine, foxtail pine and whitebark pine are indistinguishable on the aerial photography used for this project, polygons of windswept alpine conifers are mapped as the (foxtail pine–Sierra lodgepole pine–whitebark pine) krummolz mapping unit. The parenthesis in the type name indicate that the vegetation may include any one or more, but not necessarily all, of the three species. Thus including this type to map the distribution of whitebark pine results in overestimating the abundance of the species on the landscape. Validating the vegetation map polygons with known occurrences of whitebark pine from plot data was necessary to create an accurate distribution map of the species.

Users of vegetation type maps can be frustrated when the vegetation found in a particular location on the ground does not agree with the type it is identified as on the map. In some cases this can reflect inaccuracies in the map, but it is important to consider both the scale of underlying photography and the minimum map unit applied during the mapping process when assessing whether this is the case. Small stands of types recognizable on the ground may have been treated as inclusions within a larger polygon, and thus will not appear as distinct units on the map.

4.2 Lessons Learned During the Mapping Process

It cannot be overstated that a PI-based vegetation map is only as good as the underlying photography. Issues with both deliveries of imagery for the SEKI project, which included problems with color saturation and scale, influenced the course of the project and the quality of the final products. Consequently, the mapping process was significantly delayed as the imagery was subjected to a lengthy evaluation process, and the provider agreed to conduct a second overflight. This meant that stages in the mapping process that optimally would have occurred in sequence (classification development, photointerpretation, followed by accuracy assessment) were instead conducted in

tandem. We recognize that this may be the case for mapping in large wilderness parks regardless of the quality of imagery, as remote terrain requires that sample collection be conducted for multiple purposes concurrently.

Although this likely had a positive effect on final map accuracy due to the need for intense interaction between photointerpreters and ecologists, it also meant that field sampling was less efficient, especially with regard to the establishment of AA points. Another cost of committing to imagery that did not compare favorably to that used for the YOSE project was a reduced ability to map to the association level. In order to keep the project within budget, and to ensure that accuracy standards were met, this meant that the original plan to map a buffer around the boundary of the parks was dropped in favor of increased effort by the photointerpreters within the parks. With subsequent modification to the park boundary, the vegetation polygons are now out of sync in the Dillonwood area of Sequoia National Park; this would have been more easily rectified had a buffer been mapped. In hindsight, it may have been advantageous in terms of map accuracy and level of detail to select a new provider for the second overflight, despite the additional cost that this would have incurred.

Although the quality of the underlying photography is crucial to map development, the resulting map reflects the skill of the photointerpreters. This project benefitted from the years of experience and deep understanding of vegetation pattern and process brought by the PI team at AIS. The decision to use the same photointerpreters as were involved in the development of the YOSE map was key to creating a final product with not only park-specific but network and regional applicability. Their willingness to work closely with the ecologists throughout the term of the project brought a level of professional collaboration to the development of final map products that meet the needs of park managers and scientists alike.

The SEKI project benefitted from intensive work done in YOSE to develop a fine scale floristic classification that in the end proved to be largely transferrable to SEKI. Leveraging this product allowed us to focus our efforts on development of a mapping classification that reflected the ability of the photointerpreters to recognize types and patterns visible on the imagery. Early efforts to develop a stand-alone floristic classification for SEKI, however, took time away from development of a robust mapping classification, and as was the case in YOSE, resulted in the development of two classifications that have proven challenging to communicate to users. As a consequence, work remains to be done to finalize a floristic classification for SEKI. Again, in hindsight, we would have elected to shift the focus to the development of highly relevant map products earlier in the process.

As in YOSE, we found that fine-scale mapping to the association level proved challenging for a project of this scale. Although the resulting map has extraordinary detail, in many cases individual associations failed to meet accuracy standards. This level of detail can also be overwhelming to the user. Most users of the SEKI map have elected to use either the alliance level classification or the even coarser CWHR or CALVEG classification for parks-wide applications. Despite the challenges inherent in using a fine-scale, association-level map, we elected to retain as much detail as possible in the final map products, including even those types that failed accuracy assessment, so that the user can choose which level of the classification is most applicable to a particular application.

Although the methodology underlying the SEKI vegetation map would be difficult (if not impossible) to repeat for monitoring purposes, having a detailed map based on expert assessment of vegetation types and patterns establishes a powerful baseline for training new technologies to recognize type signatures.

4.3 Utility of the Map

Since its completion in 2007, the Sequoia and Kings Canyon National Parks vegetation map has proven to be an invaluable resource for managers and research scientists working in the Sierra Nevada. It served as the basis for a number of important species distribution maps, including whitebark pine, which is currently being considered for listing by the US Fish and Wildlife Service. It provided the base maps used to create sample frames for the High Elevation Forest and Wetland Ecological Integrity vital signs monitoring protocols being implemented by the Sierra Nevada Network Inventory & Monitoring program (McKinney et al. 2012; Gage et al. 2018).

Four significant parks-wide planning processes completed in the last decade have relied heavily on the vegetation map. As part of the SEKI Wilderness Stewardship Plan (WSP, National Park Service 2015) managers used the mapped distribution of foxtail pine types to establish campfire restrictions aimed at protecting both standing and downed ancient wood from this slow growing, high elevation endemic tree. The distribution of wet meadow vegetation documented by the map established the location of grazing resources for recreational and administrative pack stock within the wilderness of the two parks, and provided landscape scale context for the analysis of grazing impacts on meadow ecosystems. The Natural Resource Condition Assessment (NRCA; National Park Service 2013) for the two parks relied on the vegetation map for describing the extent and condition of several focal resources, including high elevation forests, oak woodlands, meadows and wetlands, and giant sequoia groves. The NRCA in turn informed the development of the Resource Stewardship Strategy (RSS) (National Park Service 2017), which established stewardship goals for key resources in the parks in the coming decades. Habitat for two sensitive species addressed in the WSP, NRCA, RSS, and subsequent Aquatic Restoration Strategy (Yosemite toad and mountain yellow-legged frog) was identified using the vegetation map in concert with observational data from targeted field studies. Wildlife biologists have also used the map to identify food resources used by black bears, resulting in a better understanding of the importance of sugar pine as an important component of their fall diet, especially in years when acorn crops falter (Mazur et al. 2013). Knowing this allows managers to better predict where bears may concentrate during the fall period of foraging and thus anticipate bear-human interactions.

The vegetation plot and accuracy assessment data sets collected in support of the development of the map have also proven useful, informing sample designs for wetland studies, establishment of oak woodland monitoring, and the distribution of both rare and common plant species. The NRCA combined these data with previous legacy data sets to describe patterns of vascular plant biodiversity in the parks (National Park Service 2013).

The translation of the SEKI map to the CWHR classification system, and subsequent integration with the CALVEG vegetation layer maintained by the USFS, has made the vegetation data accessible for regional query and analysis. Data produced by this project is now easily discoverable and provided at

a scale useful for regional analyses through the USFS web portal. This has become increasingly valuable over time, as scientists strive to develop predictive models to anticipate the impacts of climate change, including widespread high-intensity wildfires, across the broader Sierra Nevada eco-region.

Initial support for the vegetation map was provided by the national fire management program, and fire managers have used the resulting products to model fuels, fire spread, and to inform the calculation of fire return intervals. The underlying data integrated into the USFS CALVEG layer continues to be used for regional fire modeling and analysis.

5. Conclusions

In the first comprehensive assessment of research needs for Sequoia and Kings Canyon National Parks, Sumner et al. (1966) identified the need for a comprehensive map of the vegetation of the two parks:

Although vegetation maps of some park forest types, made 30 years ago, do exist, a more complete and detailed description of each vegetation type is required. The need is for a map which shows each type, whether successional or climax, supported by sufficient research... Such a map with attendant ecological studies would furnish basic information essential to wildlife surveys and studies, to the planning of fire prevention or utilization programs, to construction programs, and to the interpretive program.

Over sixty years later, we are confident that the products described in this report serve to meet this need.

SEKI's vegetation map was created from aerial photography captured in 2000 and 2001. For the past dozen years, this map has proven to be an invaluable resource for managers and scientists both within and outside of the NPS. However, in the year 2021 the map will be 20 years old. Even before the final map had been delivered, park managers expressed concern over how best to incorporate updates to the spatial data. Initially this reflected a desire to correct the map to reflect local inconsistencies and errors encountered through field use. In recent years, unprecedented broad-scale changes in vegetation have emerged as a greater concern, driven by a multi-year severe drought that has resulted in significant mortality in forests and woodlands, and the increased frequency of large, high intensity wildfires occurring throughout the west. From the outset we recognized that it would not be possible (nor desirable) to recreate the map using the traditional photo interpretation methods employed for the development of this map. With new, more powerful sources of imagery now available such as from the National Agriculture Imagery Program (NAIP) or Light Detection and Ranging (LiDAR), changes to the photointerpretation process, i.e. heads up digitizing, and over ten years of additional field observations in hand, it is time to identify current and future mapping needs and how best to update the products.

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Appendix A. Project Timeline

Table A-1. Vegetation Inventory and Type Mapping Project, Sequoia & Kings Canyon National Parks.

Year	Period	Task
1999	June	Interagency scoping meeting held at SEKI
	August	YOSE site visit with mapping team to observe PI methodology in the field
2000	July	Color infrared aerial photographs flown of SEKI and environs
	September	CIR aerial photographs delivered to AIS
2001	February	Plot data delivered to AIS: • Natural Resource Inventory • Stephenson Gradient Analysis • Vegetation Mapping (2000) • Vankat/Roy • USGS/BRD Demography Plots
	April	AIS field reconnaissance trip 1
	May	AIS field reconnaissance trip 2. Weislander maps scanned by ESRI and hard copies made for AIS to aid in the mapping process
	June	SEKI Preliminary Mapping Classification Short List created
	Summer	Field crew collected plot data and answered photo interpreter's mapping questions for Sequoia
	July	AIS field reconnaissance trip 3
	July–August	Newly commissioned CIR aerial photos flown of SEKI (excluding environs)
	August	AIS field reconnaissance trip 4
	September	Received first shipment of July 2001 CIR aerial photos
2002	June	Received last shipment of July 2001 CIR aerial photos
	Summer	SEKI field crew collected plot data and answered photo interpreter's questions from preliminary photo interpretation delineations
	October	Photo interpretation of the East Fork of the Kaweah (Mineral King) pilot project began
	Fall	SEKI field crew answered photo interpreter's mapping questions for the East Fork pilot area
2003	January	Automation for the East Fork pilot completed by AIS
	February	Meeting held at AIS to discuss the East Fork pilot accuracy assessment results
	June	Photo interpretation began on Sequoia (SEQU)
	Summer	Field crew collected data and answered photo interpreter's mapping questions for SEQU
	July	SEKI field crew conducted a "mini" field reconnaissance with the photo interpreters at Sequoia. SEKI delivered the White Pine Blister Rust report and coverage to AIS to aid in mapping.

Table A-1 (continued). Vegetation Inventory and Type Mapping Project, Sequoia & Kings Canyon National Parks.

Year	Period	Task
2003 (cont'd)	September	Photo interpreters and field crew held a face-to-face meeting at AIS to summarize and wrap up the 2003 field season
	October	The East Fork pilot was finalized with post AA changes and delivered to park staff
2004	May	SEQU final coverage delivered to park staff
	Summer	Field crew collected data and answered photo interpreter's mapping questions for Kings Canyon (KICA)
	July	Photo interpretation on KICA began
	September	Photo interpreters and field crew held a face-to-face meeting at AIS to summarize and wrap up the 2004 field season
	November	AIS received plot data from SEKI that included: • Selected plots from KICA that addressed specific questions from the photo interpreters • SEQU AA plots • Waypoints from SEQU and KICA
2005	March	AIS received "historical" plot data from SEKI (hand-drawn field maps created by SEKI NRI field crews in the 1990s)
2006	June	Meeting between SEKI ecologist and photo interpreters held at AIS to discuss SEQU AA
	August	KICA final coverage delivered to park staff
	November	Meeting between SEKI ecologist and photo interpreters held at AIS to discuss KICA AA and overall AA for SEKI
2007	January	Final AA results delivered to AIS; SEKI final coverage delivered along with the AIS Photo Interpretation Report to park staff

Appendix B. Digital Orthophoto Quarter Quadrangles (DOQQ) Used in Georectification

Table B-1. Published USGS digital orthophoto quarter quadrangles used in the Sequoia and Kings Canyon National Parks Vegetation Mapping Project to rectify photo interpreted line work. The purpose of the rectification was to match the positional accuracy of the DOQQs. The 7.5 minute quadrangles are listed by name and the DOQQs used for rectification are listed by code corresponding to the northwest, northeast, southwest, or southeast quarter. The abbreviations for the DOQQ comprise the DOQ abbreviation, an underscore and the corresponding ordinal direction. An example of the DOQQ abbreviation is MUGR_NE for the northeast section of the Muir Grove DOQ.

DOQ Name	DOQ Abbreviation	DOQQ Abbreviation (includes ordinal directions)
Aberdeen	ABER	ABER_NW, ABER_NE, ABER_SW, ABER_SE
Blackcap Mountain	BLMT	BLMT_NW, BLMT_NE, BLMT_SW, BLMT_SE
Case Mountain	CAMT	CAMT_NW, CAMT_NE, CAMT_SW, CAMT_SE
Cedar Grove	CEGR	CEGR_NW, CEGR_NE, CEGR_SW, CEGR_SE
Chagoopa Falls	CHFA	CHFA_NW, CHFA_NE, CHFA_SW, CHFA_SE
Chickencoop Canyon	CHCA	CHCA _NW, CHCA _NE, CHCA _SW, CHCA _SE
Cirque Peak	CIPE	CIPE _NW, CIPE _NE, CIPE _SW, CIPE _SE
Dennison Peak	DEPE	DEPE _NW, DEPE _NE, DEPE _SW, DEPE _SE
General Grant Grove	GEGR	GEGR _NW, GEGR _NE, GEGR _SW, GEGR _SE
Giant Forest	GIFO	GIFO _NW, GIFO _NE, GIFO _SW, GIFO _SE
Hume	HUME	HUME _NW, HUME _NE, HUME _SW, HUME _SE
Johnson Peak	JOPE	JOPE _NW, JOPE _NE, JOPE _SW, JOPE _SE
Kaweah	KAWE	KAWE _NW, KAWE _NE, KAWE _SW, KAWE _SE
Kearsarge Peak	KEPE	KEPE _NW, KEPE _NE, KEPE _SW, KEPE _SE
Kern Lake	KELA	KELA _NW, KELA _NE, KELA _SW, KELA _SE
Kern Peak	KEPE	KEPE _NW, KEPE _NE, KEPE _SW, KEPE _SE
Lodgepole	LODG	LODG _NW, LODG _NE, LODG _SW, LODG _SE
Marion Peak	MAPE	MAPE _NW, MAPE _NE, MAPE _SW, MAPE _SE
Mineral King	MIKI	MIKI _NW, MIKI _NE, MIKI _SW, MIKI _SE
Moses Mountain	MOMT	MOMT _NW, MOMT _NE, MOMT _SW, MOMT _SE
Mount Brewer	MTBR	MTBR _NW, MTBR _NE, MTBR _SW, MTBR _SE
Mount Clarence King	MTCL	MTCL _NW, MTCL _NE, MTCL _SW, MTCL _SE
Mount Darwin	MTDA	MTDA _NW, MTDA _NE, MTDA _SW, MTDA _SE
Mount Goddard	MTGO	MTGO _NW, MTGO _NE, MTGO _SW, MTGO _SE
Mount Henry	MTHE	MTHE _NW, MTHE _NE, MTHE _SW,MTHE _SE
Mount Kaweah	MTKA	MTKA _NW, MTKA _NE, MTKA _SW, MTKA _SE

Table B-1 (continued). Published USGS digital orthophoto quarter quadrangles used in the Sequoia and Kings Canyon National Parks Vegetation Mapping Project to rectify photo interpreted line work. The purpose of the rectification was to match the positional accuracy of the DOQQs. The 7.5 minute quadrangles are listed by name and the DOQQs used for rectification are listed by code corresponding to the northwest, northeast, southwest, or southeast quarter. The abbreviations for the DOQQ comprise the DOQ abbreviation, an underscore and the corresponding ordinal direction. An example of the DOQQ abbreviation is MUGR_NE for the northeast section of the Muir Grove DOQ.

DOQ Name	DOQ Abbreviation	DOQQ Abbreviation (includes ordinal directions)
Mount Langley	MTLA	MTLA _NW, MTLA _NE, MTLA _SW, MTLA _SE
Mount Pinchot	MTPI	MTPI _NW, MTPI _NE, MTPI _SW, MTPI _SE
Mount Silliman	MTSI	MTSI _NW, MTSI _NE, MTSI _SW, MTSI _SE
Mount Thompson	MTTH	MTTH _NW, MTTH _NE, MTTH _SW, MTTH _SE
Mount Whitney	MTWH	MTWH _NW, MTWH _NE, MTWH _SW, MTWH _SE
Mount Williamson	MTWI	MTWI _NW, MTWI _NE, MTWI _SW, MTWI _SE
Muir Grove	MUGR	MUGR _NW, MUGR _NE, MUGR _SW, MUGR _SE
North Palisade	NOPA	NOPA _NW, NOPA _NE, NOPA _SW, NOPA _SE
Quinn Peak	QUPE	QUPE _NW, QUPE _NE, QUPE _SW, QUPE _SE
Rough Spur	ROSP	ROSP _NW, ROSP _NE, ROSP _SW, ROSP _SE
Shadequarter Mountain	SHMT	SHMT _NW, SHMT _NE, SHMT _SW, SHMT _SE
Silver City	SICI	SICI _NW, SICI _NE, SICI _SW, SICI _SE
Slide Bluffs	SLBL	SLBL _NW, SLBL _NE, SLBL _SW, SLBL _SE
Sphinx Lakes	SPLA	SPLA _NW, SPLA _NE, SPLA _SW, SPLA _SE
Split Mountain	SPMT	SPMT _NW, SPMT _NE, SPMT _SW, SPMT _SE
Tehipite Dome	TEDO	TEDO _NW, TEDO _NE, TEDO _SW, TEDO _SE
The Sphinx	THSP	THSP _NW, THSP _NE, THSP _SW, THSP _SE
Triple Divide Peak	TRDI	TRDI _NW, TRDI _NE, TRDI _SW, TRDI _SE
Wren Peak	WRPE	WRPE _NW, WRPE _NE, WRPE _SW, WRPE _SE

Appendix C. List of Data Layers and Products Provided to Photointerpreters

The following list represents ancillary data layers and products provided to AIS by the NPS for use during the photointerpretation process.

Plot data

- White Pine Blister Rust Data (Polygons and Points)
- Limber Pine Accuracy Assessment
- Vankat-Roy Transects
- Stephenson Gradient Analysis plots
- Natural Resource Inventory Plots (with Holland codes and preliminary vegetation types coded by SEKI staff)
- Fire Effects Monitoring Plots (FMH)
- Fire History (FH) (pilot area only)
- Permanent Fuel Plots (PFP) (pilot area only)

Spatial data

- Frost VTM (Weislander) Maps (scanned)
- Dead Foxtail Pines (Points)
- Sequoia Grove Coverage (Polygons)
- Chagoopa Plateau Fire History

Narrative descriptions

- Area Descriptions of field trips taken by vegetation mapping project field crews
- Narrative responses to area-specific questions raised by photointerpreters

Appendix D. Sequoia and Kings Canyon National Parks Mapping Classification

Note: Codes in bold were used to label polygons in the final map in the PICODE field; other codes are included to provide hierarchical context. An annotated listing of codes and names used throughout the history of the projects in the Sierra Nevada Parks is provided as an ancillary digital data product through the NPS IRMA system.

0000 = Sparsely Vegetated/Miscellaneous Classes
0100 = Alpine Talus Slope (assign density)
0200 = Alpine Scree Slope (assign density)
0300 = Alpine Snow Patch Communities (no density)
0400 = Alpine Fell-field (assign density)
0500 = Mesic Rock Outcrop (no density)
0700 = Boulder Field (no density)
0900 = Sparsely Vegetated/Miscellaneous Classes (continued)
0910 = Conifer Reproduction (assign density)
0920 = Conifer Plantation (assign density)
0940 = Sparsely Vegetated Undifferentiated (no density)
0941 = Sparsely Vegetated Riverine Flat (no density)
0950 = Non-alpine Talus
0960 = Rock Outcrop Undifferentiated
0961 = Sparsely Vegetated to Non-vegetated Exposed Rock
0963 = Dome
0965 = Sparsely Vegetated Rocky Streambed
0970 = Alpine Permanent Snowfield/Glacier
0980 = Water
0990 = Urban/Developed (assign Land Use code)
1000 = Broadleaf Evergreen Trees
1020 = Canyon Live Oak Forest Alliance
1021 = Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit
1022 = Canyon Live Oak/Whiteleaf Manzanita Forest Association
1023 = Canyon Live Oak–(Ponderosa Pine–Incense-cedar) Forest Superassociation
1024 = Canyon Live Oak–California Laurel Forest Superassociation
1029 = Canyon Live Oak/Greenleaf Manzanita Forest Association
1040 = Interior Live Oak Woodland Alliance
1043 = Interior Live Oak–Canyon Live Oak Woodland Association
1044 = Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany–California Redbud Forest Association
2000 = Broadleaf Deciduous Trees
2010 = Quaking Aspen Forest Alliance
2013 = Quaking Aspen/Willow spp. Forest Mapping Unit

2014 = Quaking Aspen/Willow spp. Talus Mapping Unit
2016 = Quaking Aspen/Big Sagebrush Forest Superassociation
2017 = Quaking Aspen/Meadow Mapping Unit
2020 = California Black Oak Forest Alliance (includes 2021 and 2026)
2021 = California Black Oak/Greenleaf Manzanita Forest Association (see 2020)
2025 = California Black Oak/(Bracken Fern) Forest Mapping Unit
2026 = California Black Oak/Indian Manzanita–Mountain Misery Forest Association (see 2020)
2030 = Blue Oak Woodland Alliance
2033 = Blue Oak/Brome spp.–American Wild Carrot Woodland Association
2034 = Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland Association
2038 = Blue Oak–California Buckeye–(Interior Live Oak) Woodland Mapping Unit
2050 = Black Cottonwood Temporarily Flooded Forest Alliance
2053 = Black Cottonwood Forest Association
2060 = White Alder Temporarily Flooded Forest Alliance
2061 = White Alder–Red Willow–California Sycamore Forest Association
2080 = Bigleaf Maple Forest Alliance
2100 = California Sycamore Temporarily Flooded Woodland Alliance
2102 = California Sycamore–(Canyon Live Oak–Interior Live Oak) Forest Mapping Unit
2110 = California Buckeye Woodland Alliance
2114 = California Buckeye–Canyon Live Oak Woodland Association
2500 = Superalliances and Alliance-level Mapping Units
2530 = Montane Broadleaf Deciduous Trees Mapping Unit
3000 = Needleleaf Evergreen Pine Trees
3010 = Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance
3012 = Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit
3020 = Sierra Lodgepole Pine Forest Alliance
3021 = Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (see 3026)
3022 = Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit
3026 = Sierra Lodgepole Pine Woodlands Superassociation (includes 3021, 3038 and 3042)
3028 = Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge) Forest Superassociation (includes 3033, 3041, and 3043)
3030 = Sierra Lodgepole Pine Forest Alliance (continued)
3033 = Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (see 3028)
3034 = Sierra Lodgepole Pine/Big Sagebrush Forest Association

3038 = Sierra Lodgepole Pine Woodland Association (see 3026)

3040 = Sierra Lodgepole Pine Forest Alliance (continued)

3041 = Sierra Lodgepole Pine/Ross Sedge Forest Association (see 3028)

3042 = Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (see 3026)

3043 = Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (see 3028)

3048 = Sierra Lodgepole Pine Mesic Forest Superassociation

3049 = Sierra Lodgepole Pine Xeric Forest Superassociation

3050 = Ponderosa Pine Woodland Alliance

3053 = Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association

3060 = Ponderosa Pine–Incense-cedar Forest Alliance

3061 = Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association

3062 = Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association

3063 = Ponderosa Pine–Incense-cedar–California Black Oak Forest Association

3070 = Jeffrey Pine Woodland Alliance (includes 3550)

3072 = Jeffrey Pine/Greenleaf Manzanita Woodland Association

3073 = Jeffrey Pine/Whitethorn Ceanothus Woodland Association

3080 = Jeffrey Pine Woodland Alliance (continued)

3083 = Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Woodland Association

3084 = Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association

3085 = Jeffrey Pine–California Red Fir Woodland Association

3110 = Singleleaf Pinyon Pine Woodland Alliance

3114 = Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association

3130 = Western White Pine Woodland Alliance

3132 = Western White Pine–Sierra Lodgepole Pine Woodland Association (see 4540)

3133 = Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit

3140 = Whitebark Pine Woodland Alliance

3142 = Whitebark Pine/Davidson's Penstemon Woodland Association

3144 = Whitebark Pine/Shorthair Sedge Woodland Association

3148 = Whitebark Pine–Mountain Hemlock Woodland Association

3150 = Limber Pine Woodland Alliance

3200 = Foxtail Pine Woodland Alliance

3202 = Foxtail Pine/Bush Chinquapin Woodland Association

3203 = Foxtail Pine Woodland Superassociation

3204 = Foxtail Pine–Western White Pine Woodland Superassociation

3205 = Dead Foxtail Pine Mapping Unit

3500 = Superalliances and Alliance-level Mapping Units

3520 = (Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland Mapping Unit

3530 = Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance

3540 = Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance

3550 = White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (see 3070)

4000 = Needleleaf Evergreen Conical-form

4020 = Giant Sequoia Forest Alliance

4021 = Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association

4023 = Giant Sequoia–White Fir–California Red Fir Forest Association

4030 = Mountain Hemlock Forest Alliance

4033 = Mountain Hemlock–Western White Pine Forest Association

4040 = Mountain Hemlock Forest Alliance (continued)

4041 = Mountain Hemlock–Sierra Lodgepole Pine Forest Association

4042 = Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest Mapping Unit

4043 = Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association

4050 = California Red Fir Forest Alliance

4051 = California Red Fir Forest Association

4054 = California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita Whitethorn Ceanothus) Forest Mapping Unit (see 4064)

4055 = California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (see 4540)

4057 = California Red Fir–Western White Pine Forest Association

4060 = California Red Fir Forest Alliance (continued)

4063 = California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit

4064 = California Red Fir–(Western White Pine)/(Pinemat Manzanita Bush Chinquapin) Forest Mapping Unit (includes 4054 and 4069)

4065 = California Red Fir–Western White Pine/(Pinemat Manzanita Bush Chinquapin) Forest Mapping Unit (see 4064)

4070 = California Red Fir–White Fir Forest Alliance (includes 4071, 4072, and 4073)

4071 = California Red Fir–White Fir Forest Association (see 4070)

4072 = California Red Fir–White Fir–Jeffrey Pine Forest Association (see 4070)

4073 = California Red Fir–White Fir–Sugar Pine Forest Association (see 4070)

4080 = White Fir–Sugar Pine Forest Alliance

4081 = White Fir Forest Mapping Unit
4082 = White Fir Mature Even-age Stands Mapping Unit
4084 = White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit

4090 = White Fir–Sugar Pine Forest Alliance (continued)

4094 = White Fir–Sugar Pine–Incense-cedar Forest Superassociation
4095 = White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit

4100 = Sierra Juniper Woodland Alliance

4107 = Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association
4108 = Sierra Juniper Woodland Association
4109 = Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation

4110 = Incense-cedar Forest Alliance

4111 = Incense-cedar–White Alder Forest Association

4500 = Superalliances and Alliance-level Mapping Units

4540 = Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland Superassociation (includes 3132 and 4055)

5000 = Evergreen Shrubs

5010 = Birchleaf Mountain Mahogany Shrubland Alliance

5011 = Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association
5012 = Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association

5020 = Chamise Shrubland Alliance (includes 5021)

5021 = Chamise Shrubland Association (see 5020)
5022 = Chamise/Whiteleaf Manzanita Shrubland Association
5023 = Chamise–Chaparral Yucca Shrubland Association
5025 = Chamise–California Yerba Santa Shrubland Association

5030 = Chamise–Buckbrush Shrubland Alliance

5031 = Chamise–Buckbrush Shrubland Association

5050 = Buckbrush Shrubland Alliance
5060 = Chaparral Whitethorn Shrubland Alliance
5070 = Whiteleaf Manzanita Shrubland Alliance
5080 = Bush Chinquapin Shrubland Alliance (see 5590)
5090 = Greenleaf Manzanita Shrubland Alliance
5110 = Whitethorn Ceanothus Shrubland Alliance (see 5590)
5130 = Mountain Misery Dwarf-shrubland Alliance
5140 = Indian Manzanita Shrubland Alliance
5160 = Big Sagebrush Shrubland Alliance
5200 = Timberline Sagebrush Shrubland Alliance
5230 = Curl-leaf Mountain Mahogany Woodland Alliance

5270 = Chaparral Yucca Shrubland Alliance
5280 = Pinemat Manzanita Dwarf-shrubland Alliance
5300 = Water Birch Shrubland Alliance
5500 = Superalliances and Alliance-level Mapping Units
5510 = Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance
5520 = Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (see 5590)
5530 = Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit
5550 = Red Mountainheather Dwarf-shrubland Alliance
5590 = Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (includes 5080, 5110 and 5520)
6000 = Deciduous Shrubs
6010 = Deerbrush Shrubland Alliance
6020 = Oregon White Oak Shrubland Alliance
6022 = Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association
6030 = California Grape Association
6110 = Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance
6210 = Oceanspray Shrubland Alliance
6300 = Bitter Cherry Shrubland Alliance
6500–6990 = Superalliances and Alliance-level Mapping Units
6500 = Willow spp./Meadow Shrubland Mapping Unit
6600 = Willow spp. Riparian Shrubland Mapping Unit
6700 = Willow spp. Talus Shrubland Mapping Unit
7000 = Upland Herbaceous
7120 = Shorthair Sedge Herbaceous Alliance
7260 = California Annual Grassland/Herbland Superalliance
7702 = Mesic Post Fire Herbaceous Mapping Unit
7703 = Post Fire Shrub/Herbaceous Mapping Unit
8000 = Intermittently to Seasonally Flooded Meadow
9000 = Semi-permanently to Permanently Flooded Meadow

Appendix E. Key to Vegetation Alliances and Associations of Sequoia & Kings Canyon National Parks, Based On Floristics

The following key to vegetation alliances and select associations mapped within Sequoia and Kings Canyon National Parks is adapted from the key developed for alliances and associations documented in Yosemite National Park (see Appendix G in Keeler-Wolf et al. 2012). The key has been modified to include only those types mapped within Sequoia and Kings Canyon National Parks, which in many cases were only discernable to the alliance level. The mapping code (PI code) is shown in parenthesis following each type mapped in SEKI. In rare cases types known to occur in SEKI, but not mapped due to lack of resolution on the CIR photography, are retained in key to aid the identifying a particular association.

The key is designed to assist the user in placing vegetation associations observed on the ground into the context of the floristic classification used for mapping vegetation in Sequoia and Kings Canyon National Parks. For those interested in identifying types present but not mapped, e.g. either because they do not meet the minimum mapping unit or due to a lack of resolution on the photography underlying the map (this is particularly true for herbaceous associations) the reader is referred to Appendix J in Keeler-Wolf et al. 2012. The table provided in Appendix H of this report may also prove helpful in translated between the floristic and mapping classifications.

Instructions for following key (from Keeler-Wolf et al. 2012): This is not a strictly dichotomous key, as there are not couplets for each option. Instead, there are a set of characteristics with choices nested beneath each of these. The key first leads the user to the general options, and the individual selections for the vegetation associations are listed beneath these options. To arrive at the correct choice, simply work through the numbered list of types that lead you from the more general to the most specific options until the best fit is reached. Each of the choices is identified by a combination of alphanumeric codes, using numerals, capital letters, lowercase letters, and decimal points to distinguish different key levels. The most basic general levels in the key are on the left side of the alphanumeric code, and the most specific are on the right side. The coding system for each item in the key relates to a series of left indentations. Thus, by training your eyes down the left-hand side of the pages, you will note the major groupings and nested within them the subgroupings that will lead you to the correct answer. The preliminary key will direct you to the major groups, such as forest/woodland, shrubland, and herbaceous, with the more specific choice beneath them. **S**ince there may be more than two alternatives in a group, it is important to work through all of the options in a list before selecting the best choice for a stand. For detailed descriptions of the vegetation types, see Appendix F of this report, or Appendix K of Keeler-Wolf et al. (2012).

Woodlands versus forest: Because many Sierra Nevada tree-dominated alliances range from forest to woodland or even sparsely wooded shrubland or herbland, keys to both forest and woodland segments under 100A Evergreen Forest and 100B Winter Deciduous Forests and Woodlands are included.

Definitions

Dominance (dominated, dominant, strongly dominated by): This term refers to the preponderance of the vegetation cover in a stand of uniform composition and site history. It may refer to cover of an individual plant (as in dominated by *Pinus contorta* var. *murrayana,* or it may refer to dominance by a physiognomic type as in "stand dominated by shrubs." In the strict sense, dominance refers to the relative cover of one species or physiognomic type as compared to another species or physiognomic type. Anything over 50 percent relative cover is said to dominate a stand. Those species or physiognomic types that do not strongly dominate (considered to be 60% or greater relative cover) are treated in alternate keys so precise estimation is not necessary to arrive at the correct determination in the key.

Importance (important): A species is considered "important" in a stand or a vegetation type if it is greater than 1 percent absolute cover. However, in general, importance is a relative term with the proportion of the important species contrasted to the total cover of all species in the same layer. If there is a specific relative percentage identified for a vegetation type then it is mentioned in the key. This term is usually contrasted with "dominant" to mean that the species referenced is always present in the vegetation and always greater than 1 percent cover but not always dominant (> 50% relative cover).

Open: This is the term ascribed to individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is generally less than 30 percent absolute cover.

Intermittent: This is the term ascribed to individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is generally between about 30 percent and 60 percent absolute cover.

Continuous: This is the term ascribed to individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is generally greater than 60 percent absolute cover.

Conspicuous: Statements containing "conspicuous" are relative in meaning. For example, "conspicuous in canopy" means that in every stand a "conspicuous" species should be easily observed without a thorough searching of the stand. This is in contrast with **"inconspicuous,"** which implies that although the species may be present, it is not usually easily found without a thorough search of the stand. A conspicuous species is not necessarily dominant, but it is "important" (at least 1% cover).

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

Absolute cover: This is the actual percentage of the ground (surface of the plot or stand) that is covered by a species or group of species, for example, *Pinus ponderosa* covers between 5 percent and 10 percent of the stand. Absolute cover of all species or groups if added in a stand or plot may total greater or less than 100 percent because it is not a proportional number.

Shrubs: A shrub is a multi-stemmed woody plant that is between 0.2 meters and 5 meters tall. Definitions are blurred at the low and the high ends of the height scales. Small multi-stemmed trees approximately 4 meters tall and large woody herbaceous species less than 0.5 meters tall are individually treated in the keys and distinguished from shrubs.

Subshrubs: Subshrubs are considered multi-stemmed woody plants less than 0.5 meter tall on average.

Sparse: This is a generic term relating to low widely spaced cover of individuals of a species or physiognomic group. Sparsely vegetated is defined as less than 2 percent cover of vegetation, sparse canopy is less than 10 percent (see Emergent).

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

1. Composition. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or gradual.
2. Structure. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes, but not the lower, would be divided into two stands. Likewise, a sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called *homogeneity*. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous.

Emergent: This is a structural layer of vegetation that rises above the main canopy layer. It may be large trees over mid-sized or short trees, or large shrubs over denser subshrubs or herbaceous layers. Generally emergents are less than 10 percent absolute cover and are underlain by a denser subcanopy or understory.

Woody plant: Any species of plant that has woody stems. It does not include herbaceous species with woody underground portions such as tubers, roots, or rhizomes.

Forest: A tree-dominated stand of vegetation with 60 percent or greater cover of trees.

Woodland: A tree-dominated stand of vegetation with between 25 percent and 60 percent cover of trees.

Sparsely wooded: Stands with trees conspicuous, but less than 25 percent cover which may occur over shrubs as the dominant canopy (sparsely wooded shrubland) or herbaceous cover (sparsely wooded herbaceous).

Key to Main Vegetation Divisions

I. Trees (at least 5 meters tall) evenly distributed and conspicuous throughout stand. In areas where vegetation covers greater than ca. 20 percent, tree canopy may be as low as 10 percent over denser subcanopies of shrub and herbaceous species. In areas where vegetation is less than 20 percent total cover, trees may cover less than 10 percent, but are at least 50 percent relative cover and evenly distributed across the stand = **Division 100, Tree Vegetation**

II. Vegetation dominated by woody shrubs or subshrubs. When total vegetation cover is over ca. 20 percent trees, if present, generally less than 10 percent cover in stand, herbaceous species may total higher cover than shrubs but are shorter in stature. Shrubs are always at least 10 percent cover. In areas where vegetation is less than 20 percent total cover, shrubs may cover less than 10 percent but are at least 50 percent relative cover and evenly distributed across the stand = **Division 200, Shrub Vegetation**

III. Vegetation dominated by nonwoody herbaceous species including grasses, graminoids, and broad-leaved herbaceous species. When total vegetation cover is greater than ca. 20 percent, shrub and subshrub species and trees, if present, of lower cover than herbs and less than 10 percent. If total vegetation cover is less than ca. 20 percent, shrubs, subshrubs, and/or trees may be present but are less than 50 percent relative cover with herbaceous species predominating **= Division 300, Herbaceous Vegetation**

IV. Total plant cover generally less than 2 percent includes boulder, gravel, cobble, or talus sparse vegetation. Sparsely vegetated sand accumulations, high mountain talus/scree, intermittently flooded mudflats, and recent soil slumps or landslides = **Division 400, Sparsely Vegetated to Nonvegetated.** Not specifically treated further in this key.

DIVISION 100: VEGETATION CHARACTERIZED BY TREES

100 Three main groups are individuated in the key: evergreen forests and woodlands, deciduous forests and woodlands, and mixed evergreen and deciduous forests and woodlands.

100A Evergreen forest. Evergreen species generally contribute greater than 75 percent of the total (relative) tree cover. Most alliances are modally considered forest, but canopy cover of trees may range down into woodland (25%–60% tree cover), or even sparsely wooded shrubland or herbaceous (< 25% cover of trees) class for some alliances.

100A.1 Canopy usually dominated by sclerophyllous broad-leaved evergreen species. Occasionally, conifers and broad-leaved evergreen species are codominant, but usually the conifers form a more open emergent layer over a denser canopy of broad-leaved trees.

100A.1A Canopy typically with greater than 50 percent relative cover of *Quercus chrysolepis* (canyon live oak) sometimes with emergent conifers I.A.6.N.b.2 = ***QUERCUS CHRYSOLEPIS* FOREST ALLIANCE (1020)**

100A.1Aa *Umbellularia californica* (California Laurel) present in stand; usually moderate to steep rocky slopes, often concave; the shrub *Keckiella antirrhinoides* frequently (> = 50% of plots) present in the understory; *Toxicodendron diversilobum* (poison oak) present in virtually all plots may include up to 25 percent cover of California black oak (*Quercus kelloggii*) in tree layer **= Canyon Live Oak–California Laurel/(*Keckiella*) Forest [*Quercus chrysolepis–Umbellularia californica/(Keckiella antirrhinoides)* Forest] (1024;** mapped in SEKI as superassociation)

100A.1Ab *Arctostaphylos viscida* (whiteleaf manzanita) a conspicuous (from 2%–50% cover) understory shrub = **Canyon Live Oak/Whiteleaf Manzanita Forest [*Quercus chrysolepis/Arctostaphylos viscida* Forest] (1022)**

100A.1Ac *Arctostaphylos patula* (greenleaf manzanita) present as principal understory shrub; *Q. chrysolepis* may be shrubby = **Canyon Live Oak/Greenleaf Manzanita Forest [*Quercus chrysolepis/Arctostaphylos patula* Forest] (1029)**

100A.1Ad *Cercocarpus montanus var. glaber* (*C. betuloides* sensu Hickman 1993, birchleaf mountain mahogany) present as principal understory shrub; *Arctostaphylos viscida* or *A. patula* may also be present = **Canyon Live Oak–Birchleaf Mountain Mahogany Forest [*Quercus chrysolepis–Cercocarpus montanus var. glaber* Forest Mapping Unit] (1021)**

100A.1Ae *Pinus ponderosa* (ponderosa pine) forms a usually sparse emergent overstory over intermittent to continuous canopy of *Q. chrysolepis* = **Canyon Live Oak–Ponderosa Pine Forest [*Quercus chrysolepis–Pinus ponderosa* Forest] (1023;** mapped in SEKI as Canyon Live Oak–(Ponderosa Pine–Incense-cedar) Forest Superassociation)

100A.1Af *Calocedrus decurrens* (incense cedar) may form emergent layer or be present in main canopy with *Quercus chrysolepis;* typically riparian or semiriparian lower slope settings = **Canyon Live Oak–Incense Cedar Forest [*Quercus chrysolepis–Calocedrus decurrens* Forest] (1023** mapped in SEKI as Canyon Live Oak–(Ponderosa Pine–Incense-cedar) Forest Superassociation)

100A.1B Another oak or broad-leaved evergreen tree dominant; either *Quercus wislizeni* (interior live oak), *Cercocarpus ledifolius* (curl-leaf mountain mahogany) or *Cercocarpus betuloides* (birchleaf mountain mahogany). All of these species may take shrub or tree forms depending on disturbance history, site productivity, and other factors.

100A.1Ba Canopy dominated by the small tree or large shrub, *Cercocarpus ledifolius*. = **II.A.5.N.a.1 *CERCOCARPUS LEDIFOLIUS* WOODLAND ALLIANCE. (5230)**

100A.1Bb A short woodland or tall scrub of the west side of the Sierra Nevada foothills with *Cercocarpus montanus* var. *glaber* (*C. betuloides* var. *betuloides,* Hickman 1993) as the dominant overstory species; may mix with lesser cover of other chaparral shrubs including *Arctostaphylos viscida*, *Cercis canadensis* var. *texenus* (*C. occidentalis sensu* Hickman 1993), *Ceanothus cuneatus*, and/or *Fremontodendron californicum* var. *californicum; may also include Aesculus californica, Quercus wizlisenii, or Q. chrysolepis as tree associates* = **II.A.5.N.a.2 *CERCOCARPUS MONTANUS* VAR. *GLABER* (*C. betuloides* var. *betuloides*, Hickman 1993 nomenclature) SHRUBLAND ALLIANCE (5010)**

100A.1Bb.1 Dense species-rich mesic shrubland dominated by birchleaf mountain mahogany (*C. montanus* var. *glaber, C. betuloides sensu* Hickman 1993*)*; associated tree species may include *Aesculus californica, Umbellularia californica, Quercus wislizenii*, and/or *Q. chrysolepis*. Associated shrubs include *Adenostoma fasciculatum*, *Cercis canadensis* var. *texensis* (*C. occidentalis sensu* Hickman 1993), *Fremontodendron californicum* ssp. *californicum*, *Arctostaphylos* spp. = Birchlead Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association **[*Cercocarpus montanus* var. *glaber–Cercis canadensis* var. *texensis–Fremontodendron californicum* ssp. californicum Shrubland (*Cercocarpus betuloides* var. *betuloides*, *Cercis occidentalis sensu* Hickman 1993)](5011; see also 1044)**

100A.1Bb.2 Overstory of large birchleaf mountain mahogany with whiteleaf manzanita (*Arctostaphylos viscida*) characterizing the understory. Emergent ponderosa pine (*Pinus ponderosa*), canyon live oak (*Quercus chrysolepis*), black oak (*Q. kelloggii*) or California bay laurel (*Umbellularia californica*) may be present = **Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland [*Cercocarpus montanus* var. *glaber* (*C. betuloides sensu* Hickman 1993)/*Arctostaphylos viscida* Shrubland] (5012)**

100A.1Bc Interior live oak (*Quercus wislizeni*) dominant or important in the canopy. If *Q. wislizeni* not dominant, *Q. wislizeni* may share dominance with *Q. chrysolepis* (canyon live oak) = **II.A.5.N.a.6 *QUERCUS WISLIZENI* WOODLAND ALLIANCE (1040)**

100A.1Bc.1 Either interior live oak or canyon live oak may dominate the canopy, but both are important (> 30% relative cover). Stands are typically in low slope or ravine settings in ecological Zone I = **Interior Live Oak–Canyon Live Oak Woodland [*Quercus wislizeni–Quercus chrysolepis* Woodland] (1043)**

100A.1Bc.2 Dominated by *Quercus wislizeni* and *Aesculus californica* in a moderately open to closed overstory layer; *Cercocarpus montanus var. glaber (C. betuloides sensu Hickman 1993) and Cercis canadensis* var. *texensis (C. occidentalis sensu Hickman 1993)* **= Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany–California Redbud Forest [*Quercus wislizeni–Aesculus californica/Cercocarpus montanus* var. *glaber–Cercic canadensis* var. *texensis Forest /*] (1044)**

100A.2 Canopy dominated by needle-leaved or scale-leaved coniferous trees

100A.2A Emergent layer or canopy of *Sequoiadendron giganteum* present, typically over denser canopy or subcanopy of other conifers. *S. giganteum* must at least occur as a regular emergent and not as an isolated single tree to fit definition = **I.A.8.N.a.1 SEQUOIADENDRON GIGANTEUM FOREST ALLIANCE (4020)**

100A.2Aa *S. giganteum* emergent over second tier of conifers with *Pinus lambertiana* (sugar pine) present and a subcanopy containing *Cornus nuttalli* (Pacific dogwood) = **Giant Sequoia–Sugar Pine/Pacific Dogwood Forest [*Sequoiadendron giganteum–Pinus lambertiana/Cornus nuttalli* Forest] (4021)**

100A.2Ab Tree canopy dominated by a mixture of *Sequoiadendron giganteum* (giant sequoia), *Abies concolor* (white fir), and *A. magnifica* (red fir), over a sparse shrub layer that may include patches of *Chrysolepis sempervirens* (chinquapin), *Corylus cornuta* var. *californica* (beaked hazelnut) and/or *Symphoricarpos rotundifolius* (roundleaf snowberry) = **Giant Sequoia–White Fir–Red Fir Forest [*Sequoiadendron giganteum–Abies concolor–Abies magnifica* Forest] (4023)**

100A.2B No emergent *Sequoiadendron*, canopy composed of needle-leaved conifers with rounded or conical crowns; may include relatively open woodlands and denser forest types

100A.2Ba Pines (*Pinus* spp.) are the dominant and/or one of the characteristic conifer species of the tree canopy forming forests, woodlands, or sparsely wooded stands. Some stands may be mixed with scale-leaved conifers, deciduous and/or broad-leaved evergreen tree species. However, pines are always conspicuous. (Note: This is a long list of individual pine groups; those not familiar with the flora should work through the list to eliminate all possibilities.)

100A.2Ba.1 *Pinus contorta* ssp. *murrayana* (Sierra lodgepole pine) dominates or is an important constituent of canopy; usually greater than 50 percent relative canopy cover, but it may mix with *Pinus albicaulis* (whitebark pine) in subalpine stands where either species may be dominant (see Sierra lodgepole pine–whitebark pine/Ross sedge Forest). (Also see Quaking Aspen–Sierra lodgepole pine/Big sagebrush/Kentucky bluegrass Forest of *Populus tremuloides* alliance and *Tsuga mertensiana* Forest Alliance where *Tsuga* >30% relative cover.) **= I.A.8.N.b.4 *PINUS CONTORTA* FOREST ALLIANCE 3020)**.

100A.2 Ba.1a *Pinus albicaulis* (whitebark pine) present in canopy or shrub layer, usually at less than 50 percent relative cover (if greater than 50%, also see *Pinus albicaulis* Woodland Alliance), typically herbaceous species sparse to moderate cover.

100A.2Ba.1a.1 *Carex rossii* (Ross sedge) present in understory in at least 1 percent cover, typically intermittent to well developed forest cover in subalpine uplands, *Carex exserta* (shorthair sedge) absent or inconspicuous and of lower relative cover than *Carex rossii* **= Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest [*Pinus contorta* var. *murrayana–Pinus albicaulis/Carex rossii* Forest (3033)**

100A.2Ba.1a.2 *P. contorta* and *P. albicaulis* may be more commonly considered to be forming a woodland than a forest; *Carex exserta* (shorthair sedge) conspicuous, generally on more open rocky stands than above or slopes with at least some fine grained substrate such as decomposed granite = **Sierra Lodgepole Pine–Whitebark Pine/Shorthair Sedge Forest [*Pinus contorta* var. *murrayana–Pinus albicaulis/Carex exserta* Forest] (3043)**

100A.2Ba.1b. Understory well developed with herbaceous and/or mesic shrub or subshrub species; *Pinus albicaulis* not important in canopy.

100A.2Ba.1b.1. *Populus tremuloides* (quaking aspen) important or even marginally dominant in stands, usually mesic understory including *Poa pratensis* and scattered *Artemisia tridentata*. Meadows and low gradient creek banks = **Quaking Aspen–Sierra Lodgepole Pine/ /(Kentucky Bluegrass) Forest Mapping Unit [*Populus tremuloides–Pinus contorta/ tridentate(Poa pratensis)* Forest Mapping Unit] (3012)**

100A.2Ba.1b.2. A type of mesic to subhydric conditions along streams and meadow edges; the shrub *Ledum (Rhododendron) glandulosum* and/or *Vaccinium uliginosum* conspicuous in understory **= Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit [*Pinus contorta* var. *murrayana*/(*Vaccinium uliginosum)* Forest Mapping Unit] (3022)**

100A.2.Ba.1c Understory with either xerophytic shrubs or poorly developed with scattered herbs and shrubs except for the first association listed (100A.2Ba.1c.1); *Pinus contorta* usually in open or even sparse stands

100A.2Ba.1c.1 *Pinus contorta* forms intermittent to continuous canopy (generally > 50% cover) over sparsely developed understory (< 10%), with no species characteristic. *Abies magnifica* (California red fir) is present in canopy and understory. (Note: This is part of Potter's (1998) description. Because he did not sample the full range of variability of *Pinus contorta* woodland and forest, Keeler-Wolf et al. (2012) restricts this definition to include stands with at least 1 percent *Abies magnifica*. This would equate to the lower and warmer stands of Sierra lodgepole pine where the tree absolute cover is greater than 35 percent, widespread on slopes and flats with few rock outcrops **= Sierra Lodgepole Pine Forest [*Pinus contorta* var. *murrayana* Forest] (Potter, 1998 in part) (3020)**

100A.2Ba.1c.2 *Artemisia tridentata* (primarily ssp. *vaseyana*) conspicuous in understory, tree canopy generally intermittent to open, may have *Pinus jeffreyi, Abies magnifica* in moderate cover, generally of middle or lower slopes **= Sierra Lodgepole Pine/Big Sagebrush Forest Alliance [*Pinus contorta* var. *murrayana/Artemisia tridentata* Forest] (Potter, 1998) (3034)**

100A.2Ba.1c.3 *Pinus contorta* var. *murrayana* forms open stands (> 10% and < 50% absolute tree cover), with sparse herbaceous and shrub understory. *Carex exserta* (shorthair sedge), if present, less than 5 percent absolute cover. Substrate is rocky with frequent outcrops and poorly developed soil. Note: This is part of Potter's (1998) description. Because he did not sample the full range of variability of *Pinus contorta* woodland and forest, we restrict this definition to include stands with at least 1 percent *Abies magnifica,* and/or stands that *do not* have a significant *Carex exserta* understory. **= Sierra Lodgepole Pine Woodland [*Pinus contorta* var. *murrayana* Woodland] (Potter, 1998 in part) (3038)**

100A.2Ba.1c.4 *Pinus contorta* var. *murrayana* conspicuous emergent tree or shrubby krummholz over scattered herbaceous understory with mountain pride (*Penstemon newberryi* ssp. new*berryi*), or other rock outcrop species such as *Streptanthus tortuosus, Holodiscus discolor, or Spiraea densiflora*; usually rocky outcrops with poor soil development. Trees usually greater than 2 percent and less than 10 percent absolute cover **= Sierra Lodgepole Pine /Mountain Pride Woodland [*Pinus contorta* var. *murrayana*/*Penstemon newberryi* Woodland] (3026; mapped as part of superassociation in SEKI)**

100A.2Ba.1c.5 Intermittent to continuous cover of *P. contorta* ssp. *murrayana* over relatively sparse to moderate, largely herbaceous understory with *Carex rossii* present and characteristic, generally of upland and slopes. Note: This is analogous to the upward extension of Potter's (1998) Sierra lodgepole pine

forest (see above) where *Abies magnifica* is not present **= Sierra Lodgepole Pine/Ross Sedge Forest [*Pinus contorta* var. *murrayana/Carex rossii* Forest] (3028; mapped as part of superassociation in SEKI)**

100A.2Ba.1c.6 Open to intermittent cover of *P. contorta* over variable sparse to moderate cover of *Carex exserta* (shorthair sedge) generally covering greater than 5 percent of the understory. May occur in slightly moister and lower slope position than previous *P. contorta/Carex rossii* Forest, but also may be on upper slopes in settings with intermittent rock outcrops and gravelly benches and slopes, where *C. exserta* may colonize **= Sierra Lodgepole Pine/Shorthair Sedge Forest [*Pinus contorta* var. *murrayana*/ *Carex exserta* Forest] (3042; in final SEKI map as 3026 superassociation)**

100A.2Ba.1c.7 *Pinus contorta* var. *murrayana* is joined by *Pinus monticola* with more than 30% relative cover of *Pinus monticola*. Generally on upper slopes and ridges at moderate to high elevations = **Western White Pine–Sierra Lodgepole Pine/Western Needlegrass Woodland [*Pinus monticola–Pinus contorta* var. *murrayanaAchnatherum occidentale* Woodland] (3132; aggregated in SEKI map as 4540 superassociation)**

100A.2.Ba.2 Vegetation primarily subalpine. *Pinus albicaulis* (whitebark pine) either dominant or conspicuous species in the canopy (if *Pinus albicaulis* <50% relative cover, see *Pinus contorta* var. *murrayana* Alliance). *Tsuga mertensiana* and/or *P. contorta* may be present (usually <1% but may codominate), generally open to intermittent cover of trees = **II.A.4.N.a.33 *PINUS ALBICAULIS* WOODLAND ALLIANCE (3140)**

These associations are arranged in order from mesic to xeric.

100A.2Ba.2a An open to intermittent woodland association of high elevation snow accumulation sites usually below ridgelines and upper slopes on northerly exposures (may occur in sheltered microclimates on southerly exposures).

Always has *Tsuga mertensiana* greater than 1 percent, though cover is variable, sometimes patchy; either species may dominate, may have some *Pinus contorta,* though generally less important than the other two conifers. This category includes all mixes of *P. albicaulis* and *T. mertensiana,* where both species are conspicuous = **Whitebark Pine–Mountain Hemlock Forest [*Pinus albicaulis Tsuga mertensiana* Forest] (3148)**

100A.2Ba.2b Generally on gradual slopes at mid or lower positions adjacent to meadows and bench/rock outcrop systems, *Tsuga mertensiana* absent or inconspicuous, trees may be krummholz or erect. (See Sierra lodgepole pine–Whitebark pine/Shorthair sedge for comparison.) = **Whitebark Pine/Shorthair Sedge Woodland [*Pinus albicaulis/Carex exserta* Woodland] (3144)**

100A.2Ba.2e Xeric rocky upper slope krummholz association with scattered or clumped *Pinus albicaulis* over a sparse understory including *Penstemon davidsonii.* This is the dominant tree line association in much of Kings Canyon National Park. *P. davidsonii* is generally in low cover and only in rockier more sheltered settings, further sampling required to clarify other potential tree line associations = **Whitebark Pine/Davidson's Penstemon Woodland [*Pinus albicaulis/Penstemon davidsonii* Woodland] (Taylor, 1984) (3142)**

100A.2.Ba.3 *Pinus balfouriana* (foxtail pine) dominant canopy tree ***PINUS BALFOURIANA* SSP. *AUSTRINA* WOODLANDALLIANCE (Provisional) (3200)1**

00A.2Ba.3a *Pinus balfouriana* ssp. *austrina* dominates an open canopy over a well-developed shrub layer characterized by the presence of *Chrysolepis sempervirens* (chinquapin); *Juniperus occidentalis* (western juniper), *Pinus contorta* var. *murrayana* (lodgepole pine), *P. jeffreyi* (Jeffrey pine) or P. *monticola* (western white pine) may also be present = **Foxtail Pine/Chinquapin Woodland [*Pinus balfouriana* ssp. *austrina/Chrysolepis sempervirens* Woodland] (3202)**

100A.2Ba.3b Open tree canopy dominated by *Pinus balfouriana ssp. austrina,* with *P. albicaulis* (whitebark pine), *P. contorta* var. *murrayana* (lodgepole pine), and/or *P.*

monticola (western white pine) contributing low amounts of cover over scattered shrubs and a sparse herb layer = **Foxtail Pine Woodland [*Pinus balfouriana* ssp. *austrina* Woodland] (provisional, mapped as superassocation; 3203)**

100A.2Ba.3c *Pinus balfouriana* ssp. *austrina* shares an open canopy with *P. monticola* (western white pine); *P. contorta* var. *murrayana* and *Abies magnifica* (red fir) may contribute low to moderate amounts of cover. Shrub layer may be absent or important; most frequently dominated by patches of *Chrysolepis sempervirens* (chinquapin) = **Foxtail Pine–Western White Pine Woodland [*Pinus balfouriana* ssp. *austrina*–*Pinus monticola* Woodland] (provisional, mapped as superassociation; 3204)**

100A.2Ba.3d Open woodlands of standing dead or down *Pinus balfouriana* ssp. *austrina,* usually adjacent to living stands of foxtail pine. Shrub layer is absent and herbaceous layer characteristically sparse = **Dead Foxtail Pine Mapping Unit [Dead *Pinus balfouriana* ssp. *austrina* Mapping Unit] (3205)**

100A.2Ba.4 *Pinus flexilis* (limber pine) dominant canopy tree. In Sequoia National Park, known primarily from limited number of small stands in the subalpine of the Kern Canyon = **II.A.4.N.a.42 *PINUS FLEXILIS* WOODLAND ALLIANCE (3150)**

100A.2Ba.5 Stands dominated by the widespread and common middle and upper montane xerophytic *Pinus jeffreyi* (Jeffrey pine), or in some cases, *P. jeffreyi* may be an important codominant with other tree species including *Abies concolor, A. magnifica,* and *Juniperus occidentalis* ssp. *australis*. **= II.A.4.N.a.43 *PINUS JEFFREYI* WOODLAND ALLIANCE (3070)**

100A.2Ba.5a.1 *Pinus jeffreyi* dominant with sclerophyllous shrubs (chaparral and montane chaparral species) or smaller trees (*Quercus chrysolepis*) in the understory (*Abies concolor* may contribute up to approximately 15% relative cover and *Abies magnifica* may contribute up to about 20% relative cover. If Abies concolor and *Pinus lambertiana* are both important, see *Abies concolor–Pinus lambertiana* Alliance)

100A.2Ba.5a.1a *Pinus jeffreyi* in the overstory with *Quercus chrysolepis* (canyon live oak) as a subcanopy tree and *Arctostaphylos viscida* (whiteleaf manzanita) as a conspicuous shrub, often on glaciated granitic slopes with outcrops = **Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland [*Pinus jeffreyi–Quercus chrysolepis/ Arctostaphylos viscida* Woodland] (3084)**

100A.2Ba.5a.1b *Pinus jeffreyi* over *Arctostaphylos patula* (greenleaf manzanita). **= Jeffrey Pine/Greenleaf Manzanita Woodland [*Pinus jeffreyi/Arctostaphylos patula* Woodland] (Potter, 1998) (3072)**

100A.2Ba.5a.1c *Pinus jeffreyi* over *Ceanothus cordulatus* (whitethorn ceanothus). = **Jeffrey Pine/Whitethorn Ceanothus Woodland [*Pinus jeffreyi/Ceanothus cordulatus* Woodland] (Potter, 1998) (3073)**

100A.2Ba.5a.2 *Pinus jeffreyi* mixes with either *Abies concolor* (white fir) (greater than 15% relative cover) or *A. magnifica* (California red fir) (greater than 20% relative cover) in canopy, generally open to intermittent canopy woodlands, if either fir species dominates or codominate and canopy is relatively dense, go to California red fir–White fir alliance (100A.2Bb.3c)

100A.2Ba.5a.2a *Abies magnifica* and *P. jeffreyi* form mixed canopy stands, typically *P. jeffreyi* dominates the stand **= Jeffrey Pine–California Red Fir Woodland [*Pinus jeffreyi–Abies magnifica* Woodland] (Potter, 1998) (3085)**

100A.2Ba.5a.2b *Abies concolor* and *P. jeffreyi* form mixed canopy stands, typically *P. jeffreyi* dominates the stand **= Jeffrey Pine–White Fir Woodland] [*Pinus jeffreyi–Abies concolor* Woodland] (3083)**

100A.2Ba.6 Stands dominated in the short tree layer by *Pinus monophylla* (singleleaf pinyon pine), often with Quercus chrysolepis (canyon live oak) present. If *Pinus jeffreyi* or *Juniperus occidentalis* ssp. *australis* is important, go to 100A.2Ba.5a.1a (Jeffrey pine alliance) or 100A.2Bc.2 (Sierra juniper alliance). = **II.A.4.N.a.45 *PINUS MONOPHYLLA* WOODLAND ALLIANCE (3110)**

100A.2Ba6a *Pinus monophylla* shares canopy or forms slightly taller layer over tall shrubs of Quercus chrysolepis (canyon live oak). Well-developed shrub layer is dominated by *Arcostaphylos viscida* (whiteleaf manzanita); *Garrya flavescens* (silk-tassel) may also be present = **Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland [*Pinus monophylla–Quercus chrysolepis/Arctostaphylos viscida* Woodland] (3114)**

100A.2Ba.7 Stands dominated (>60% relative cover) in tree layer by *Pinus monticola* (western white pine) or at least 30% relative cover *P. monticola* with other pines. If other conifers are present in greater than 30 percent relative cover, look in lodgepole, California red fir, or mountain hemlock alliances. Woodlands of the subalpine and montane, generally local and not extensive = **II.A.4.N.a.34 *PINUS MONTICOLA* WOODLAND ALLIANCE (3130)**

100A.2Ba.7a Only one association formally defined with *Pinus monticola* and *Pinus contorta var. murrayana* (Sierra lodgepole pine) forming an open canopy over typically sparse ground cover; shrub layer sparse or well-developed = **Western White Pine–Sierra Lodgepole Pine Woodland [*Pinus monticola–Pinus contorta* var. *murrayana* Woodland] (3132)**

100A.2Ba.7b Open tree canopy dominated by *Pinus monticola,* with other subalpine conifers (*Abies magnifica*, *P. balfouriana* ssp. *austrina*, and/or *P. contorta* var *murrayana)* sometimes contributing low amounts of cover. Well-developed shrub layer may include dense patches of *Arctostaphylos nevadensis*, *A. patula*, *Chrysolepis sempervirens*, and/or *Holodiscus microphyllus* **= Western White Pine/(Greenleaf Manzantia–Bush Chinquapin–Oceanspray) Woodland Mapping Unit [*Pinus monticola/(Arctostaphylos patula–Chrysolepis***

***sempervirens–Holodiscus microphyllus* Woodland Mapping Unit] (3132)**

100A.2Ba.8 *Pinus ponderosa* (ponderosa pine) the principal canopy species usually greater than 10 percent cover. Locally, *Quercus kelloggii* (California black oak) is present, but usually substantially lower cover than *P. ponderosa.* Usually forms open woodlands over shrubs and grasses in the lower montane. If *Calocedrus* is present greater than 1 percent, then go to 100A.2Ba.9 = **II.A.4.N.a.32 *PINUS PONDEROSA* WOODLAND ALLIANCE (3050)**

Only one association formally defined with *Pinus ponderosa* and *Quercus kelloggii* forming an open canopy over open to relatively dense *Arctostaphylos viscida* (whiteleaf manzanita) along with other shrubs and herbaceous species of the lower montane. May have *Quercus wislizeni* and *Pinus lambertiana,* in small amounts in canopy and *Chamaebatia foliolosa* (mountain misery) and annual *Bromus* sp. in understory = **Ponderosa Pine/California Black Oak/Whiteleaf Manzanita Woodland [*Pinus ponderosa/Quercus kelloggii/ Arctostaphylos viscida* Woodland] (3053)**

100A.2Ba.9 *Pinus ponderosa* (ponderosa pine) and *Calocedrus decurrens* (incense cedar) both important (> 1% cover) in canopy and/or regeneration layers. Other conifers such as *Abies concolor* and *Pinus lambertiana* may be present, but combined, *P. ponderosa* and *C. decurrens* comprise the most cover = **I.A.8.N.b.?? *PINUS PONDEROSA–CALOCEDRUS DECURRENS* FOREST ALLIANCE (3060)**

100A.2 Ba.9a. *Quercus chrysolepis* (canyon live oak) conspicuous in stand. May or may not have *Quercus kelloggii* in tree layer.

100A.2 Ba.9a.1 Stands defined by overstory of *Pinus ponderosa* and *Calocedrus decurrens* with presence of *Quercus chrysolepis* and sparse to dense understory of *Chamaebatia foliolosa*. May have other shrubs such as *Arctostaphylos patula* **= Ponderosa Pine–Incense Cedar–Canyon Live Oak/Mountain Misery Woodlands [*Pinus ponderosa–Calocedrus decurrens–Quercus chrysolepis/Chamaebatia foliolosa* Woodland] (3061)**

100A.2Ba.9b *Quercus chrysolepis* absent or unimportant (< 1%), *Quercus kelloggii* (California black oak) or no oaks conspicuous in stand

100A.2Ba.9b.1 *Pinus ponderosa* and *Calocedrus decurrens* are dominant and average about 60 percent crown cover; *Quercus kelloggii* present, generally in low cover, throughout stand; may include some *Pinus lambertiana* (sugar pine) at upper elevation extents of type. *Chamaebatia foliolosa* usually absent or inconspicuous **= Ponderosa Pine–Incense Cedar-California Black Oak Woodland [*Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii* Woodland] (3063)**

100A.2Ba.9b.2 Stands are generally more open than above with scattered to dense understory of *Chamaebatia foliolosa;* may have conspicuous scattered shrubs of *Arctostaphylos patula*, or scattered low herbs of *Galium bolanderi*; may have significant *Pinus lambertiana* in canopy along with other two conifers, generally at coolest (high elevation) extreme of this alliance **= Ponderosa Pine–Incense Cedar/Mountain Misery Woodland [*Pinus ponderosa–Calocedrus decurrens/Chamaebatia foliolosa* Woodland] (3062)**

100A.2Bb One or more fir species (*Abies* spp.) is important in the coniferous canopy.

100A.2Bb.1 *Abies concolor* (white fir) strongly dominant (> 60% relative cover) in canopy and most common tree species in reproduction layers; may be mixed with other conifer species, but if *Pinus lambertiana* (sugar pine) present it covers less than 1 percent = I.A.8.N.b.?? *ABIES CONCOLOR* FOREST ALLIANCE (Note: This alliance has been defined for other parts of California, but all plots with white fir dominant in Sequoia and Kings Canyon National Parks and Yosemite environs also have sugar pine and are probably best considered in White fir–Sugar pine alliance [see 100A.2Bb.2].)

100A.2Bb.2 *Abies concolor* (white fir) usually dominant, but mixed in canopy with sugar pine (*Pinus lambertiana*) at least 5 percent cover. Incense cedar may also be present in high cover. Ponderosa pine and/or Jeffrey pine may be present but usually with lower cover

than the previous species = I.A.8.N.b.?? ***ABIES CONCOLOR–PINUS LAMBERTIANA*** **ALLIANCE (4080)**

100A.2Bb.2a Canopy dominated by *Abies concolor,* with *Pinus lambertiana, P. jeffreyi* and *Calocedrus decurrens* sometimes co-occuring. A subcanopy of *Cornus nuttallii*, *Corylus cornuta*, or *Quercus kelloggii* may also be present. Shrub layer may be sparse to dense with *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ribes* ssp., and *Symphoricarpos* most frequently encountered=**White Fir Forest Mapping Unit [*Abies concolor* Forest Mapping Unit] (4081)**

100A.2Bb.2a.1 Understory with both *Corylus cornuta* (California hazel) and *Cornus nuttalli* (mountain dogwood), may have *Adenocaulon bicolor* (American trail plant). Generally mesic lower slope settings, some stands are semiriparian with scattered *Alnus rhombifolia* (white alder) = **White Fir–Sugar Pine–Incense Cedar/Pacific Dogwood/ California Hazel Forest [*Abies concolor–Pinus lambertiana–Calocedrus decurrens/Cornus nuttalli/Corylus cornuta* var. *californica* Forest] (4094; mapped in SEKI as superassociation)**

100A.2Bb.2a.2 Understory without regular occurrence of *Corylus* or *Cornus* but with scattered clusters of *Adenocaulon bicolor* (American trail plant). Canopy cover relatively high, soil usually moderately deep. Generally less mesic (mid slope or less sheltered positions) than previous type = **White Fir–Sugar Pine–Incense Cedar/American Trail Plant Forest [*Abies concolor–Pinus lambertiana–Calocedrus decurrens/Adenocaulon bicolor* Forest] (=Fites 1993 ABCO-MCN/ADBI) (4094; mapped in SEKI as superassociation)**

100A.2Bb.2a.3 Generally moderately open forest in mid or lower slope positions with understory characterized by the creeping viny shrub *Symphoricarpos mollis* and the low herb *Kelloggia galloides*. Moisture conditions usually somewhat drier than previous associations **= White Fir–Sugar Pine–Incense Cedar /Creeping Snowberry/Milky**

Kelloggia Forest [*Abies concolor–Pinus lambertiana–Calocedrus decurrens/ Symphoricarpos mollis/Kelloggia galloides* Forest] (=Fites 1993 ABCO-MCN/SYMO/KEGA) (4094; mapped in SEKI as superassociation)

100A.2Bb.2a.4 A moderately open forest in relatively dry settings (upper slopes or southerly exposures) understory with regular occurrence of *Chrysolepis sempervirens* (bush chinquapin) and scattered clumps of *Carex multicaulis* (multistemmed sedge) = **White Fir–Sugar Pine–Incense Cedar/Bush Chinquapin/ Multistemmed Sedge Forest [*Abies concolor–Pinus lambertiana–Calocedrus decurrens/Chrysolepis sempervirens/Carex multicaulis* Forest] (=Fites 1993 ABCO-MCN/CHSE2) (4094; mapped in SEKI as superassociation)**

100A.2Bb.2b *Abies concolor* and *Pinus lambertiana* principal canopy species. Without significant cover of *Calocedrus* (less than 5 percent in canopy or understory) but may have other conifers such as *Pinus jeffreyi.* These associations are arranged from mesic to xeric.

100A.2Bb.2b.1 *Abies concolor* dominant in dense forest with lower cover of *Pinus lambertiana.* Mesic sparse understory includes presence of *Disporum hookeri* and *Maianthemum racemose;* as in Yosemite, not particularly common in area and may locally reflect mesic phase of the *Abies concolor–Pinus lambertiana–Calocedrus decurrens/Adenocaulon bicolor* Forest (100A.2Bb.2a.2) **= White Fir–Sugar Pine/False Solomon's-seal-Drops of Gold Forest [*Abies concolor–Pinus lambertiana/ Maianthemum racemosa–Disporum hookeri* Forest] (Fites, 1993) (4094; mapped in SEKI as superassociation)**

100A.2Bb.2b.2 *Abies concolor* and *Pinus lambertiana* are sole dominants in overstory, either may be the major species, both are usually over 20 percent relative cover. Canopy can also have lesser amounts of *Pinus ponderosa* and *Quercus kelloggii*. Forests are typically dense and are midslope or more mesic upper slope positions, with little distinction in understory =

White Fir–Sugar Pine Forest [*Abies concolor–Pinus lambertiana* Forest] (4080; mapped in SEKI as alliance)

100A.2Bb.2b.3 *Abies concolor* dominant in the canopy including young trees over dense to open shrub layer dominated by *Ceanothus cordulatus* (whitethorn ceanothus). *Pinus lambertiana* is present (either in regeneration layer, canopy, or both) but usually much less important than *A. concolor.* Generally a recent post disturbance association = **White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit [*Abies concolor–Pinus lambertiana/Arctostaphylos patula–Ceanothus cordulatus* Forest Mapping Unit] (4095)**

100A.2Bb.2b.4 *Abies concolor, Pinus lambertiana,* and *Pinus jeffreyi* are all significant components of the canopy (*P. jeffreyi* may range from 2% to 25%). Stands can have shrubby understory including *Ceanothus cordulatus* and *Chrysolepis sempervirens*. Generally open forests of upper slopes or relatively dry exposures = **White Fir–Sugar Pine–Jeffrey Pine Forest [*Abies concolor–Pinus lambertiana–Pinus jeffreyi* Forest] (4084; in SEKI included within White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Pinemat Manzanita Forest Mapping Unit)**

100A.2Bb.3 *Abies magnifica* (California red fir) and *Abies concolor* (white fir) conspicuous, both greater than 15 percent relative cover in canopy, either may dominate. Stands generally occur in cooler and/or more mesic settings than White fir or White fir-sugar pine alliances = **I.A.8.N.c. ?? CALIFORNIA RED FIR–WHITE FIR ALLIANCE (Parker, 1984; Parker, 1982) (4070)**

Associations are arranged from mesic to xeric.

100A.2Bb.3a *Abies concolor, Pinus lambertiana,* and *Abies magnifica* are present, usually with the first two species dominant. Typically located upward in elevation from slightly warmer *Abies concolor–Pinus lambertiana* Forest **= White Fir–Sugar Pine–California Red Fir Forest [*Abies***

***concolor–Pinus lambertiana–Abies magnifica* Forest (Potter, 1998) (Note: Potter's name retained for this association in the California Red Fir–White Fir Alliance) (4073)**

100A.2Bb.3b *Abies magnifica* and *Abies concolor* typically only canopy species, either may dominate (both at least 10% relative cover). Ranges over a variety of slope positions and exposures depending on elevation. Typically largest stands are on midslopes in somewhat mesic settings = **California Red Fir–White Fir Forest [*Abies magnifica–Abies concolor* Forest] (Potter, 1998) (4071)**

100A.2Bb.3c Either *Abies magnifica* or *A. concolor* may be dominant, with *Pinus jeffreyi* important (> 5 percent relative cover) in stand. Relatively xeric locations (shallow soils on upper slopes or on sunny slope exposures) **= California Red Fir–White Fir–Jeffrey Pine Forest [*Abies magnifica–Abies concolor–Pinus jeffreyi* Forest] (Potter, 1998) (4072)**

100A.2Bb.4 *Abies magnifica* dominant overstory tree and present in reproduction layers. May include several other tree conifers in stand, but white fir, sugar pine, and other warmer climate species (typically from lower elevations) are unimportant (< 5% relative cover) = **I.A.8.N.c.26 *ABIES MAGNIFICA* FOREST ALLIANCE (4050)**

100A.2Bb.4a *Abies magnifica* and *Pinus monticola* (western white pine) only trees in canopy, both important (> 1 % cover) in canopy, generally with *A. magnifica* dominant. The following associations are arranged in order of mesic to xeric.

100A.2Bb.4a.1 *A. magnifica* and *P. monticola* form moderately closed forest with no characteristic understory species. Usually on relatively mesic and shaded mid and upper slopes **= California Red Fir–Western White Pine Forest [*Abies magnifica–Pinus monticola* Forest] (Potter, 1998) (4057)**

100A.2Bb.4a.2 *A. magnifica* and *P. monticola* form a more open canopy than previous type, with small to moderately large light gaps having understory of *Arctostaphylos nevadensis* (pinemat manzanita) or *Chrysolepis sempervirens* (bush chinquapin). Usually on upper slopes and ridges, but somewhat less

exposed or xeric than following association = **California Red Fir–(Western White Pine)/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit [*Abies magnifica–Pinus monticola/(Arctostaphylos nevadensis–Chrysolepis sempervirens)* Forest Mapping Unit] (after Potter, 1998) (4064);**

100A.2Bb.4b *Abies magnifica*, *Pinus monticola*, and/or *Pinus contorta* var. *murrayana* present in canopy.

100A.2Bb.4b.1 *Abies magnifica, P. monticola*, and *P. contorta* var. *murrayana* present in the canopy throughout the stand, generally with *A. magnifica* as major dominant and two pines as subordinate. Found on lower slopes and on protected midslopes throughout much of the California red fir belt = **California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest [*Abies magnifica–Pinus monticola–Pinus contorta* var. *murrayana* Forest] (Potter, 1998) (4055)**

100A.2Bb.4b.2 *A. magnifica* and *P. contorta* are principal canopy species, *Pinus monticola* absent or of very low importance (< 1% cover). Forest moderately dense and productive with insignificant shrub layer and scattered individuals of *Hieracium albiflorum* (whiteflower hawkweed) and a few other herbs; shrubs unimportant. Widespread often adjacent to and immediately upslope from more mesic associations of the mapping area within the upper red fir belt = **California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit [*Abies magnifica–Pinus contorta* var. *murrayana/Hieracium albiflorum* Forest Mapping Unit] (after Potter, 1998) (4063)**

100A.2Bb.4c *Abies magnifica* sole species in canopy or other trees species other than above (such as *Juniperus occidentalis* ssp. *australis*) may be present in small numbers, particularly in understory. These associations are ordered from mesic to xeric.

100A.2Bb.4c.1 *A. magnifica* is sole dominant and forms moderately dense to dense forests. Usually with deep litter and very little understory vegetation. May occur on many slope exposures depending on elevation, usually on fairly well developed soil = **California Red Fir Forest [*Abies magnifica* Forest] (Potter, 1998) (4051)**

100A.2Bb.4c.2 *A. magnifica* sole dominant over relatively open understory with *Arctostaphylos nevadensis* (pinemat manzanita) characteristic; *A. patula* (Greenleaf manzanita) or *Ceanothus cordulatus* (whitethorn ceanothus) may also be present in the shrub layer. Usually on shallow soils of upper slopes and ridges = **California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus)Forest Mapping Unit [*Abies magnifica/Arctostaphylos nevadensis*–(*Arctostaphylos patula–Ceanothus cordulatus*)Forest Mapping Unit] (after Potter, 1998) (4054);**

100A.2Bc A species in the cypress family (*Calocedrus decurrens, Juniperus occidentalis* ssp. *australis*) is dominant or conspicuous conifer in the canopy. Note that *Juniperus* is a strong indicator of xeric and rocky settings. Other conifers such as *Pinus jeffreyi, Abies magnifica,* and *A. concolor* may be present in near equal amounts to *J occidentalis*. However, *J. occidentalis* alliance criteria are still met when it is only a codominant.

100A.2Bc.1 *Calocedrus decurrens* dominant and/or conspicuous conifer in canopy. The winter deciduous tree *Alnus rhombifolia* is often present in local stands and may dominate immediately adjacent to streams and seeps; typically stands occur in riparian or semiriparian settings on the west side of the crest within ecological Zones II and III **= I.A.8.N.c. ?? *CALOCEDRUS DECURRENS* FOREST ALLIANCE (4110)**

100A.2Bc.1a *Calocedrus* and *Alnus* are principal trees in the stand; may also include scattered *Abies concolor*. Understory may include *Cornus nuttalli* and *Rhododendron occidentalis*. Stands occupy bottoms and terraces adjacent to streams or other wetlands = **Incense Cedar–White Alder Forest [*Calocedrus decurrens–Alnus rhombifolia* Forest] (Potter, 2000 ms) (4111)**

100A.2Bc.2 *Juniperus occidentalis* ssp. *australis* (Mountain or Sierra juniper) conspicuous tree; usually covers less than 30 percent (and down to 2% absolute cover when its relative cover is high) of the stand over sparse to intermittent shrubby or herbaceous understory; associated with rocky slopes and outcrops.. May occur with additional conifers in low cover, particularly *Pinus jeffreyi, Abies concolor,* and/or *Abies magnifica* = **II.A.4.N.a.37 *JUNIPERUS OCCIDENTALIS* ssp. *AUSTRALIS* WOODLAND ALLIANCE (4100)**

100A.2Bc.2a Stands without *Cercocarpus ledifolius* as significant component. Widespread on sunny, exposed granitic (usually high bedrock %) slopes and ridges **= Sierra Juniper Woodland [*Juniperus occidentalis* ssp. *australis* Woodland] (Potter, 1998) (4108)**

100A.2Bc.2b *Juniperus occidentalis* ssp. *australis* and *Cercocarpus ledifolius* (curl-leaf mountain mahogany) both conspicuous, on relatively steep rocky slopes = **Sierra Juniper–Curl-leaf Mountain Mahogany/Big Sagebrush Woodland [*Juniperus occidentalis* ssp. *australis*–*Cercocarpus ledifolius/Artemisia tridentata* Woodland] (4107)**

100A.2Bc.2c *Juniperus occidentalis* ssp. *australis* forms open canopy over *Artemisia tridentata* (big sagebrush) and/or *Holodiscus discolor* (oceanspray) dominating a well-developed shrublayer. *Arctostaphylos patula* (greenleaf manzanita), *Chrysolepis sempervirens* (chinquapin), and *Eriogonum wrightii* (Wright's buckwheat) may also be present in the shrublayer **= Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation[*Juniperus occidentalis* ssp. *australis/(Holodiscus discolor–Artemisia tridentate*) Woodland Superassociation] (4109)**

100A.2Be *Tsuga mertensiana* (mountain hemlock) important conifer in canopy.

100A.2Be.1 *Tsuga mertensiana* (mountain hemlock) is either dominant or important and conspicuous tree. Forests or woodlands of mesic subalpine zone. May include up to equal or higher cover of other trees such as *Abies magnifica, Pinus contorta* var. *murrayana,* or *Pinus monticola* but does not include significant cover of *Pinus*

albicaulis (see *Pinus albicaulis* alliance) **= I.A.8.N.c.11 TSUGA MERTENSIANA FOREST ALLIANCE (4030)**

The following associations are arranged in order of increasing coolness of environments (e.g., all other things being equal, increasing elevation)

100A.2Be.1a *Tsuga mertensiana* common and conspicuous, may have equal or even higher cover of *Abies magnifica* in canopy, soil generally better developed (e.g., on lower slopes) and less steep (usually < 30% slope) than following association; may have *Pinus contorta* in low to moderate cover, usually less important than previous two species of conifers = **Mountain Hemlock Forest [*Tsuga mertensiana* Forest] (Potter, 1998) (mapped in SEKI at alliance level; 4030)**

100A.2Be.1b *Tsuga mertensiana* and *Pinus monticola* both important in canopy and understory; generally northerly facing slopes of moderate steepness or on upper slopes or ridges; tree cover is moderately dense, soils moderate to shallow = **Mountain Hemlock–Western White Pine Forest [*Tsuga mertensiana–Pinus monticola* Forest] (n=19)** Note: This is renamed and includes Potter's (1998) mountain hemlock/steep association. **(4033)**

100A.2Be.1c *Tsuga mertensiana* and *Pinus contorta* var. *murrayana* are the only tree species of significant cover; either may be dominant. Understory species are generally low cover and uncharacteristic. Stands occur at lower, middle, and upper slope positions and may have open to relatively continuous overstories = **Mountain Hemlock–Sierra Lodgepole Pine Forest [*Tsuga mertensiana–Pinus contorta* var. *murrayana* Forest] (4041)**

100A.2Be.1d *Tsuga mertensiana* and *P. contorta* var. *murrayana* are joined by *Pinus monticola* as important in the canopy. Generally rockier and more exposed than the previous three associations, upper or midslope locations = **Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest [*Tsuga mertensiana–Pinus contorta* var. *murrayana–Pinus monticola* Forest] (Parker, 1988) (4043)**

100A.2Be.1e *Tsuga mertensiana* is joined by *Pinus albicaulis and* Pinus contorta. Generally occurs in highest elevations and coolest sites, though stands may vary; some quite open and others with relatively high cover. These stands occur on ridges or on upper thirds of slopes, typically on northerly exposures = **Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest Mapping Unit [*Tsuga mertensiana–Pinus contorta ssp. murrayana–Pinus albicaulis* Forest Mapping Unit (4042)**

100B Winter deciduous forests and woodlands. Winter deciduous species generally contribute greater than 50 percent of the total tree (relative) cover. However, some stands in this group are characterized by the deciduous tree being of high importance but not dominant. Some alliances are modally considered forest, but others may range down into woodland (25–60% tree cover), or even sparsely wooded shrubland or herbaceous (< 25% cover of trees). Note: If forest is codominated by both evergreen and deciduous species, go to 100C (mixed evergreen and deciduous forest).

100B.1. Deciduous forests (or woodlands) of uplands or marginal wetlands. Major deciduous tree species are *Populus tremuloides* or the oaks *Quercus kelloggii* or *Q. douglasii.* Dominant species typically not with roots or stems immediately adjacent to year-round flowing water (but see some quaking aspen stands).

100B.1A Relatively dense to open forest or woodland with *Populus tremuloides* (quaking aspen) usually dominant (> 50% relative cover) or in the case of the quaking aspen–Jeffrey pine, or quaking aspen–Sierra lodgepole pine associations, important tree. May have mixtures of other conifers in canopy including *Abies concolor, A. magnifica, Pinus jeffreyi, P. contorta* var. *murrayana* = **I.B.2.N.b.10 *POPULUS TREMULOIDES* FOREST ALLIANCE (2010) Note that in SEKI, vegetation within this alliance is mapped either at the alliance level or as mapping units or a superassociation which largely reflect environment context rather than floristic composition.**

100B.1Aa *Populus tremuloides* in upland settings generally away from immediate influence of saturated soil or flowing water (upland quaking aspen), although talus sites may be temporarily to seasonally flooded. May include up to 15% cover of *Pinus monticola*, *P. contorta*, *P. jeffreyi*, or *Juniperus occidentalis* or other conifers

100B.1Aa.1 Understory largely xeric shrubs and herbs including relatively high cover of *Artemisia tridentata*. Primarily east of Sierra Nevada crest **= Quaking Aspen/Big Sagebrush Forest Superassociation [*Populus tremuloides/Artemisia tridentata* Forest Superassociation] (2016)**

100B.1Aa.2 Stands of shrubby *Populus tremuloides* with at least 5% of *Salix* ssp. (willow) on steep talus slopes; can also include *Chrysolepis sempervirens* (chinquapin) and *Artemisia tridentata* (big sagebrush) = **Quaking Aspen/Willow Spp. Talus Mapping Unit [*Populus tremuloides/Salix ssp.* Talus Mapping Unit] (2014)**

100B.1Ab. *Populus tremuloides* in moist stands with mesic to hydric understory species, adjacent to riparian or meadow settings.

100B.1Ab.1 At least 30% cover of *Populus tremuloides* (quaking aspen) emergent over dense, localized patches of at least 30% cover of *Salix* (willow) ssp. overtopping a diverse understory of mesic herbs. *Populus balsamifera* (black cottonwood) often present in the tree layer **= Quaking Aspen/Willow Spp. Forest Mapping Unit [*Populus tremuloides*/*Salix* Spp. Forest Mapping Unit] (2013)**

100B.1Ab.2 Open to closed canopy of *Populus tremuloides* (quaking aspen) over a dense layer of wetland graminoids, adjacent to meadows and low gradient creek banks = **Quaking Aspen/Meadow Mapping Unit [*Populus tremuloides* /Meadow Mapping Unit] (2017)**

100B.1B A deciduous oak (*Quercus* sp.) the important canopy tree, may include conifers such as*, Pinus ponderosa* or *Calocedrus decurrens*.

100B.1Ba *Quercus kelloggii* (California black oak) major tree in canopy, may have emergent (< 10%) conifers, but *Q. kelloggii* is the dominant (> 50% relative cover) throughout the stand **= I.B.2.N.b?? *QUERCUS KELLOGGII* FOREST ALLIANCE (2020)**

100B.1Ba.1 *Calocedrus decurrens* (incense cedar) present in either sapling/seedling or tree layer. May be on all slope exposures of lower montane depending on elevation = **California Black Oak–Incense Cedar Forest [*Quercus kelloggii–Calocedrus decurrens* Forest] (in SEKI mapped as alliance; 2020)**

100B.1Ba.2 Understory with *Arctostaphylos mewukka* (Mewuk manzanita) and the subshrub *Chamaebatia foliolosa* (mountain misery), generally somewhat xeric exposures (southerly facing slopes and ridges) = **California Black Oak/Mewuk Manzanita–Mountain Misery Forest [*Quercus kelloggii/ Arctostaphylos mewukka–Chamaebatia foliolosa* Forest] (2026)**

100B.1Ba.3 Generally xeric stands on shallow rocky soil of upper elevation extent of the alliance, may have scattered *Pinus jeffreyi*

(Jeffrey pine) or other mid-elevation conifers. *Arctostaphylos patula* variable, but usually greater than 5 percent; may have *Ceanothus cordulatus, Prunus emarginata,* and other montane chaparral shrubs = **California Black Oak/Greenleaf Manzanita Forest [*Quercus kelloggii/Arctostaphylos patula* Forest] (Allen et al., 1991) (2021)**

100B.1Ba.4 Open stands of *Q. kelloggii* with a grassy or herbaceous understory with *Pteridium aquilinum* common or conspicuous. Insufficient plots for association description, but photo signature discernable and treated as a mapping unit in SEKI and YOSE = **California Black Oak/(Bracken Fern) Forest Mapping Unit [*Quercus kelloggii/(Pteridium aquilinum)* Forest Mapping Unit] (2025)**

100B.1Bb *Quercus douglasii* (blue oak) dominant or conspicuous in canopy, may include *Quercus wislizeni* (interior live oak) or *Aesculus californica* (California buckeye) in lesser numbers. Of xeric low elevation foothills = **II.B.2.N.a.14 *QUERCUS DOUGLASII* WOODLAND ALLIANCE (2030)**

100B.1Bb.1 *Quercus douglasii* sole important tree, forming a layer over a grassy understory including *Bromus* sp. and *Daucus pusillus* = **Blue Oak/Brome Species–American Wild Carrot Woodland [*Quercus douglasii*/*Bromus spp.–Daucus pusillus*] Woodland (2033)**.

100B.1Bb.2 *Quercus douglasii* mixes in canopy with *Quercus wislizeni,* over an annual dominated herbaceous understory. = **Blue Oak–Interior Live Oak/Brome Species–American Wild Carrot Woodland [*Quercus douglasii–Quercus wislizeni/Bromus* spp.–*Daucus pusillus* Woodland] (Allen et al., 1991) (2034)**.

100B.1Bb.3 Tree canopy dominated by a mixture of *Quercus douglasii*, *Aesculus californica*, and in some stands, *Q. wislizeni* over a rich understory of primarily non-native annual grasses; alternate expression exhibits a generally more closed canopy over a well-developed shrub layer that may include *Rhamnus ilicifolia*, *Ceanothus cuneatus*, *Toxicodendron diversilobum*, and other mesic shrubs = **Blue Oak–California Buckeye–(Interiror Live Oak) Woodland Mapping Unit [*Quercus douglasii–Aesculus californica–*(*Quercus wislizeni* var. *wislizeni* Woodland Mapping Unit (2038)**

100B.1C *Aesculus californica* (California buckeye) dominant or conspicuous tree in small stands in somewhat mesic concavities on steep lower to mid slopes . Often associated with *Quercus wislizeni* or *Q. chrysolepis.* =

II.B.2.N.a.2 *AESCULUS CALIFORNICA* WOODLAND ALLIANCE (2110)

100B.1Ca Moderately dense to closed canopy co-dominated by *A. californica* and *Q. chrysolepis*, on low to mid-slope settings at the upper elevational limit of *A. californica* = **California Buckeye–Canyon Live Oak Woodland Association [*Aesculus californica–Quercus chrysolepis* Woodland Association] (2114) (***Provisional type retained in classification for mapping purposes; additional plot data needed to describe***)**

100B.1D *Acer macrophyllum* (bigleaf maple) dominates the tree canopy; *Calocedrus decurrens*, *Quercus chrysolepis*, and/or *Torreya californica* may be present **=BIGLEAF MAPLE FOREST ALLIANCE [ACER MACROPHYLLUM FOREST ALLIANCE] (2080)**

100B.1E *Platanus racemosa* (California sycamore) dominates the riparian woodland tree canopy; *Quercus wislizeni* var. *wislizeni*, *Q. chrysolepis*, or *Umbellularia californica* also important. *Alnus rhombifolia* may contribute low cover **= CALIFORNIA SYCAMORE TEMPORARILY FLOODED WOODLAND ALLIANCE [*PLATANUS RACEMOSA* TEMPORARILY FLOODED WOODLAND ALLIANCE] (2100)**

100B.1Ea Closed riparian forest stands co-dominated by *Platanus racemosa* and either *Quercus chrysolepis or Q. wislizeni*, with *Calocedrus decurrens* and *Umbellularia californica* (California bay) occasionally contributing lower amounts of cover = **California Sycamore–(Canyon Live Oak–Interior Live Oak) Forest Mapping Unit [*Platanus racemosa*–(*Quercus chrysolepis–Quercus wislizeni*) Forest Mapping Unit] (2102)**

100B.2. Deciduous forests or woodlands of wetlands, typically temporarily flooded by flowing waters of streams or rivers with major deciduous species being *Alnus rhombifolia*, *Populus balsamifera*, *P. fremontii*, *Salix laevigata*, or *Fraxinus latifolia* = **I.B.2.N.d. Temporarily flooded cold deciduous forest**

100B.2A *Alnus rhombifolia* dominant or important tree = **I.B.2.N.d.31 *ALNUS RHOMBIFOLIA* TEMPORARILY FLOODED FOREST ALLIANCE (2060)**

100B.2Aa *Alnus* occurs along large westside streams and river terraces with *Salix laevigata* (red willow) and *Platanus racemosa* (California sycamore). Frequenltly encountered shrubs in the understory of these riparian stands include *Baccharis salicifolia* (mulefat), *Salix lasiolepis* (arroyo willow), *Toxicodendron diversilobum* (poison oak) and *Vitis californica* (California grape). **= White Alder–Red Willow–California Sycamore Forest [*Alnus***

***rhombifolia–Salix laevigata–Platanus racemosa*Forest] [Potter 2005] (2061)**

100B.2Ab *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) conspicuous and often dominant. Typically riparian stands adjacent to standing or flowing water = **I.B.2.N.d.36 *POPULUS BALSAMIFERA* SSP. *TRICHOCARPA* TEMPORARILY FLOODED FOREST ALLIANCE (2050)**

100B.2Ab.1 *P. balsamifera* occurs in riparian stands on west side of Sierra Crest typically mixed with willows such as *Salix lasiolepis* = **Black Cottonwood Forest [*Populus balsamifera* ssp. *trichocarpa* Forest] (2053)**

100C Mixed evergreen deciduous forest. Evergreen and deciduous species generally contribute 25–75 percent of total tree cover.

100C.1 Stands are relatively even mixes of coniferous evergreen and cold deciduous trees.

100C.1A *Calocedrus* and *Alnus* are principal trees in stand, may also include scattered *Abies concolor*. Understory may include *Cornus nuttallii* and *Rhododendron occidentalis*. Stands occupy bottoms and terraces adjacent to streams or other wetlands = **Incense Cedar–White Alder Forest [*Calocedrus decurrens–Alnus rhombifolia* Forest] (Potter 2000 ms) (4111)**

100C.1C *Pinus ponderosa* and *Quercus kelloggii* (California black oak) are both conspicuous in overstory, may have *Calocedrus*.

100C.1Ca *Pinus ponderosa* and *Calocedrus decurrens* are dominant and average about 60 percent crown cover. *Quercus kelloggii* present, generally in low to moderate cover, throughout stand, may include some *Pinus lambertiana* (sugar pine) at upper elevation extents of type. *Chamaebatia foliolosa* usually absent or inconspicuous **= Ponderosa Pine–Incense Cedar–California Black Oak Forest [*Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii* Forest] (3063)** (see also 100A.2Ba.9b.1)

100C.1Cb *Pinus ponderosa* and *Calocedrus decurrens* are dominant. Stands are generally more open than above with scattered *Chamaebatia foliolosa*, may have conspicuous scattered shrubs of *Arctostaphylos patula* or scattered low herbs of *Galium bolanderi*; may have significant *Pinus lambertiana* in canopy along with other two conifers, generally at coolest (high elevation) extreme of this alliance = **Ponderosa Pine–Incense Cedar/Mountain Misery Forest [*Pinus ponderosa–Calocedrus decurrens/Chamaebatia foliolosa* Forest] (3062)** (see also 100A.2Ba.9b.2)

100C.1Cc. *Calocedrus* usually absent. *Pinus ponderosa* and *Quercus kelloggii* forming an open to intermittent canopy over open to relatively dense *Arctostaphylos viscida* (whiteleaf manzanita) along with other shrubs of the chaparral belt. May have *Quercus wislizeni* and/or *Pinus lambertiana*in small amounts in canopy and *Chamaebatia foliolosa* (mountain misery) and annual *Bromus* sp. in understory **= Ponderosa Pine/California Black Oak/Whiteleaf Manzanita Forest [*Pinus ponderosa/Quercus kelloggii/Arctostaphylos viscida* Forest] (3053)** (see also 100A.2Ba.8)

DIVISION 200: VEGETATION CHARACTERIZED BY SHRUBS AND SUBSHRUBS

200A. Shrubs the dominant canopy species, may have denser herbaceous understory, but shrubs typically at least 10 percent cover in most stands. Shrubs usually 0.5 to five meters tall with individuals or clumps not touching to interlocking (generally forming > 25% canopy cover, but see 200A.1A). For scrubs averaging under 0.5 meter in canopy height see dwarf-shrubland section (200B).

200A.1 Evergreen shrubland. Evergreen species generally contribute greater than 75 percent of the total shrub and/or tree cover.

200A.1A Leaves not hardened by a waxy cuticle (sclerophyllous), soft and pliant. Locally represented by a single alliance characterized by the palmately leaved, short-lived *Lupinus albifrons* in Zones I and II. Cover may be sparse (< 25% cover of shrubs) over herbaceous or sparsely herbaceous (or rocky) understory. Another short-lived perennial broad-leafed shrub, *Eriodictyon californica* (Yerba santa) may codominate the shrub layer in some stands. III.A.2.N.a. Temperate broad-leaved evergreen shrubland

Generally seral in recently burned or otherwise disturbed rocky areas in Zones I and II on southerly exposures = **III.A.2.N.a.?? *LUPINUS ALBIFRONS* SHRUBLAND ALLIANCE.** Only one undifferentiated type identified **= *Lupinus albifrons* Herbaceous Vegetation (present but not mapped in SEKI, below MMU)**

200A.1B Leaves hardened by a waxy cuticle; sclerophyllous-leaved shrubs the principal canopy species. This includes all chaparral and evergreen montane chaparral scrubs and, by tradition, the needle-leaved *Adenostoma fasciculatum*) = III.A.2.N.c Sclerophyllous temperate broad-leaved evergreen shrubland.

200A.1Ba Chaparral with *Adenostoma fasciculatum* dominant or important.

200A.1Ba.1 Chaparral dominated by *Adenostoma fasciculatum* (chamise) with no other species equaling or exceeding it in cover =

III.A.2.N.c.2 *ADENOSTOMA FASCICULATUM* SHRUBLAND ALLIANCE (5020)

200A.1Ba.1a Chamise and whiteleaf manzanita (*Arctostaphylos viscida*) co-occur, but the manzanita is always less than 30 percent relative cover **= Chamise–Whiteleaf Manzanita Shrubland [*Adenostoma fasciculatum–Arctostaphylos viscida* Shrubland] (5022**)

200A.1Ba.1b Chamise either sole dominant or other shrub species such as *Ceanothus cuneatus* (Buckbrush) may co-occur, but these at low cover below 30 percent relative cover = **Chamise Shrubland [*Adenostoma fasciculatum* Shrubland] (5021)**

200A.1Ba1c *Yucca whipplei* (chaparral yucca) occurs in opening in chamise dominated shrubland = **Chamise Chaparral–Yucca Shrubland [*Adenostoma fasciculatum–Yucca whipplei* Shrubland] (5023)**

200A.1Ba.1d Chaparral dominated by *Adenostoma fasciculatum* and co-occuring with a variable mix of fire-following shrubs, including *Arctostaphylos viscida*, *Ceanothus cuneatus*, *Dendromecon rigida*, *Eriodictyon californicum*, *Lotus scoparius*, and/or *Malacothamnus fremontii* = **Chamise–California Yerba Santa Shrubland [*Adenostoma fasciculatum–Eriodictyon californicum* Shrubland] (5025)**

= A.2.N.c ?? *ADENOSTOMA FASCICULATUM–CEANOTHUS CUNEATUS* ALLIANCE (Gordon & White, 1994). **(5030)**

Only one association in the mapping area = **Chamise–Buckbrush Shrubland [*Adenostoma fasciculatum–Ceanothus cuneatus* Shrubland] (5031)**

200A.1Ba.2 Chaparral with both *Adenostoma* important and *Ceanothus cuneatus* important (each > 30% relative cover)= **A.2.N.c ?? *ADENOSTOMA FASCICULATUM–CEANOTHUS CUNEATUS* ALLIANCE** (Gordon & White, 1994). **(5030)**

Only one association in the mapping area = **Chamise–Buckbrush Shrubland [*Adenostoma fasciculatum–Ceanothus cuneatus* Shrubland] (5031)**

200A.1Bb Chaparral with an *Arctostaphylos* species (manzanita) dominant

200A.1Bb.1 Chaparral dominated by *Arctostaphylos patula* (greenleaf manzanita) **= III.A.2.N.c.35 *ARCTOSTAPHYLOS PATULA* SHRUBLAND ALLIANCE (5090)**

200A.1Bb.2 Chaparral dominated by *Arctostaphylos viscida* (whiteleaf manzanita) with variable mixtures of associated shrubs all covering less than 30 percent of the total shrub cover **= III.A.2.N.c.37 *ARCTOSTAPHYLOS VISCIDA* SHRUBLAND ALLIANCE (5070)**

200A.1Bb.3 Chaparral dominated by *Arctostaphylos mewukka* (Mewuk, or Indian manzanita) (provisional type) **= *ARCTOSTAPHYLOS MEWUKKA* SHRUBLAND ALLIANCE (5140)**

200A.1Bc Scrubs with evergreen sclerophyllous *Ceanothus* species dominant or important.

200A.1Bc.1 Scrub with *Ceanothus cordulatus* (whitethorn ceanothus or snowbush) as the dominant. Generally occurs in disturbed openings in coniferous forest = **III.A.2.N.c.10 *CEANOTHUS CORDULATUS* SHRUBLAND ALLIANCE (5110)**

200A.1Bc.2 Scrub with *Ceanothus cuneatus* (buckbrush) dominant = **III.A.2.N.c.12 *CEANOTHUS CUNEATUS* SHRUBLAND ALLIANCE (5050)**

200A.1Bc.3 Scrub with *Ceanothus leucodermis* (chaparral whitethorn) dominant or conspicuous. Often mixed with shrubby *Quercus wislizeni, Aesculus californica,* and *Toxicodendron diversilobum* **= III.A.2.N.c.14 *CEANOTHUS LEUCODERMIS* SHRUBLAND ALLIANCE (5060)**

200A.1Bd Scrubs with *Chrysolepis sempervirens* (bush chinquapin) dominant = III.A.2.N.c.9 *CHRYSOLEPIS SEMPERVIRENS* SHRUBLAND ALLIANCE (aka *Castanopsis sempervirens* alliance) (5080)

200A.1Be Scrubs with *Cercocarpus* spp. (mountain mahogany species) predominant. Not typically considered scrub (see tree-dominated keys) but included here to reduce ambiguity about short stature stands.

200A.1Be.1 Canopy dominated by the small tree or large shrub *Cercocarpus ledifolius*. = **II.A.5.N.a.1 *CERCOCARPUS LEDIFOLIUS* WOODLAND ALLIANCE (5230)**

200A.1Be.2 A short woodland or tall scrub of the foothills and lower montane with *Cercocarpus montanus* var. *glaber* (aka *C. betuloides* var. *betuloides*) as the dominant overstory species; may mix with lesser cover of other chaparral shrubs including *Arctostaphylos viscida* and *Ceanothus cuneatus* = **II.A.5.N.a.2 *CERCOCARPUS MONTANUS* VAR. *GLABER* [*C. betuloides* var. *betuloides*, Hickman, 1993] SHRUBLAND ALLIANCE (5010)**

200A.1Bf Sparse shrub canopy of low elevations dominated by *Yucca whipplei* (chaparral yucca) = **CHAPARRAL YUCCA SHRUBLAND ALLIANCE (5270)**

200A.1C Microphyllous (leaf surface area generally smaller than 1 cm^2) evergreen soft-leaved species of shrubs comprise the largest proportion of shrub canopy. III.A.4.N.a Microphyllous evergreen shrubland

200A.1Ca *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) is dominant, usually occurs in subalpine to alpine zone = **III.A.4.N.a.19 *ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (5160)**

200A.2 Temperate cold deciduous shrubland. Deciduous species generally contribute greater than 75 percent of the total shrub and/or tree cover.

200A.2A Willows (*Salix* sp.) are not important in the shrub canopy.

200A.2Aa The winter deciduous deerbrush (*Ceanothus integerrimus*) is the dominant shrub, usually in recently burned openings in ecological Zone II = **III.B.2.N.a.2 *CEANOTHUS INTEGERRIMUS* SHRUBLAND ALLIANCE (6010)**

200A.2Ab.1 *Ceanothus integerrimus* dominates with *Arctostaphylos viscida* as the principal subordinate shrub. In some stands *Arctostaphylos mewukka* (Mewuk manzanita) may be present = **Deerbrush–Whiteleaf Manzanita Shrubland [*Ceanothus integerrimus–Arctostaphylos viscida–(Arctostaphylos mewukka*) Shrubland] (n=2)**

200A.2Ab.2 *Ceanothus integerrimus* dominates with *Ceanothus cordulatus* (whitethorn ceanothus) as the major subordinate species. = Deerbrush–Whitethorn Ceanothus Stands [*Ceanothus integerrimus–Ceanothus cordulatus* Stands] (n=2)

200A.2Ab Oceanspray or rock spiraea (*Holodiscus discolor*) dominates. Usually sparse to moderately open shrublands of rocky outcrops in ecological

Zones III, IV, VII, and VIII = **III.B.2.N.a.8 *HOLODISCUS DISCOLOR* SHRUBLAND ALLIANCE (6210)**

200A.2Ac Bitter cherry (*Prunus emarginata*) is the dominant shrub. Stands occur primarily in ecological Zones II, III, and VII = **III.B.2.N.a ?? *PRUNUS EMARGINATA* SHRUBLAND ALLIANCE (6300)**

200A.2Ad Water birch (*Betula occidentalis*) is the dominant shrub, frequently co-occuring with red-osier dogwood (*Cornus sericea*) and/or *Salix* spp. along watercourses and on spring-fed mesic montane and subalpine slopes = ***BETULA OCCIDENTALIS* SHRUBLAND ALLIANCE (5300)**

200A.2Ae The winter deciduous shrub oak *Quercus garryana* var. *breweri* [Oregon white oak (Brewer oak)] dominates usually on northerly slopes in the interface foothills and lower montane. = **III.B.2.N.a.12 *QUERCUS GARRYANA* SHRUBLAND ALLIANCE (6020)**

200A.2Ae.1 *Quercus garryana* var. *breweri* co-dominant with *Cercocarpus montanus* var. *glaber* (birchleaf mountain mahogany) = *Quercus garryana* var. *breweri–Cercocarpus montanus* var. *glaber* Shrubland [Oregon white oak-birchleaf mountain mahogany Shrubland] (6022)

200A.2Af *Vitis californica* (California grape) forms large draping patches either over other woody vegetation or as sole constituent = **California Grape Association [*Vitis californica* Association (provisional)] (6030)**

200A.2B Stands with a willow (*Salix*) species as the dominant shrub; in SEKI, primarily distinguished by environmental setting and classified as mapping units

200A.2Ba Willow (*Salix* spp.) dominated shrubland over wet meadow vegetation **WILLOW SPP./MEADOW SHRUBLAND MAPPING UNIT (6500)**

200A.2Bb Willow (*Salix* spp.) dominated shrubland occurring alongside rivers and streams **=WILLOW SPP. RIPARIAN SHRUBLAND MAPPING UNIT (6600)**

200A.2Bc Willow (*Salix* spp.) dominated shrubland associated with talus fields **=WILLOW SPP. TALUS SHRUBLAND MAPPING UNIT (6700)**

200A.2Bd Stands dominated by the Sierra willow (*Salix orestera*). Upper elevation meadows and streamsides **= III.B.2.N.e ?? *SALIX ORESTERA* SEASONALLY FLOODED SHRUBLAND ALLIANCE (Taylor, 1984). (6110)**

The following three associations are defined by Taylor (1984) from YOSE and are arranged in order from wet to moist. All occur in SEKI, but as indistinguishable on the photography are mapped to the alliance level ***(6110)***

200A.2Bf.1 Sierra willow dominant shrub with swamp onion (*Allium validum*) conspicuous in understory =Sierra Willow/Swamp Onion Shrubland [*Salix orestera/Allium validum* Shrubland] (Taylor, 1984)

200A.2Bf.2 Sierra willow dominant shrub with arrowleaf groundsel conspicuous tall herb = Sierra Willow/Arrowleaf Groundsel Shrubland [*Salix orestera/Senecio triangularis* Shrubland] (Taylor and Major & Taylor, 1977)

200A.2Bf.3 Sierra willow dominant shrub with shorthair reedgrass (*Calamagrostis breweri*) as the major understory associate = Sierra Willow/Shorthair Reedgrass Shrubland [*Salix orestera/Calamagrostis breweri* Shrubland] (Taylor, 1984) (n=3)

200B Dwarf-shrubland. Low-growing shrubs and/or trees usually under 0.5 meter tall, individuals or clumps not touching to interlocking (generally forming greater than 25% cover). Note: If you encounter unusually low shrubs of typically tall species, first try to key these in the shrub key (200A).

200B.1 Evergreen dwarf-shrubland. Evergreen species generally contribute greater than 75 percent of the total dwarf-shrub and/or tree cover.

200B.1A For stands with an *Artemisia* species as the dominant subshrub also see 200A under microphyllous scrubland for *Artemisa tridentata* over 0.5 meter in height.

200B.1Aa Low scrub dominated by Rothrock sagebrush (*Artemisia rothrockii*). **= IV.A.2.N.a.2 *ARTEMISIA ROTHROCKII* DWARF–SHRUBLAND ALLIANCE (5200)**

200B.1B Stands of subshrubs without *Artemisia* present or dominant

200B.1Ba Stands dominated by mountain misery (*Chamaebatia foliolosa*). Usually occupies small openings that have clearly been recently disturbed by fire or logging within forest and woodland alliances of lower to mid montane. = **IV.A.1.N.a.?? *CHAMAEBATIA FOLIOLOSA* DWARF–SHRUBLAND ALLIANCE (5130)**

200B1Bb Stands dominated by pinemat manzanita (*Arctostaphylos nevadensis*); usually occupies small openings in upper montane forest = ***ARCTOSTAPHYLOS NEVADENSIS* DWARF–SHRUBLAND ALLIANCE (5280)**

DIVISION 300: VEGETATION CHARACTERIZED BY HERBACEOUS SPECIES

300A Herbaceous Vegetation. Graminoids and/or forbs (including ferns) generally forming greater than 10 percent cover with woody cover usually less than 10 percent. This division is broken into perennial graminoid, perennial herb/forb, and annual grass/herb/forb groups.

300A.1 Vegetation dominated by perennial grasses or grass-like species (including *Carex*, *Juncus*, *Typha*, or *Scirpus*). Graminoids, generally contributing to greater than 50 percent of relative cover. Reflecting the limitations imposed by the SEKI CIR photography, mapping of herbaceous vegetation in SEKI is limited to three primary mapping units.

300A.1A Upland herbaceous group. Types mapped on uplands across all elevations, although most frequently in the foothills (annual grasslands) and subalpine to alpine. **UPLAND HERBACEOUS (7000)**

300A.1Aa Grasses may be present but sedges (*Carex* sp.), rushes (*Juncus*), or spikerushes (*Eleocharis*) herbaceous forbs or subshrubs are dominant or conspicuous.

300A.1Bb.1 A *Carex* (sedge) dominant or conspicuous. Note: In YOSE this group includes 12 alliances that are characterized by the dominance or conspicuousness of different species of *Carex*. Although these types are also present in SEKI, all but one proved indistinquishable on the photography.

Carex exserta (shorthair sedge) dominant or conspicuous cespitose sedge often forming large stands in dry to moist meadows, benches, and gently sloping areas in the subalpine and alpine zones throughout; common and conspicuous = **V.A.5.N.g.2 *CAREX* (*FILIFOLIA, EXSERTA*) HERBACEOUS ALLIANCE (7120)**

300A.1Ab Annual vegetation dominated by nonnative annual grasses and both native and non-native forbs. **CALIFORNIA ANNUAL GRASSLAND/HERBLAND HERBACEOUS SUPERALLIANCE (7260)**

300A.1Ac Post fire herbaceous vegetation which may have a sparse shrub component made up of *Ribes* or *Ceanothus*; species composition dependent on elevation and adjacent vegetation type=**Mesic Post Fire Herbaceous Mapping Unit (7702)**

300A.1Ad Post fire herbaceous vegetation with a with a well-developed shrub layer, usually dominated by *Ceanothus* ssp. = **Post Fire Shrub/Herbaceous Mapping Unit (7703)**

300A.1B Wetland herbaceous group. Two wetland types reflecting degree of saturation mapped across all elevations, although most frequently in the montane, subalpine, and alpine areas of the parks.

300A.1Ba Wetland types with standing water present during the early part of the growing season, but generally exhibit some drying during the latter part of the season =**Intermittently to Seasonally Flooded Meadow (8000)**

300A.1Bb Wetland types that generally have standing water present for the duration of the growing season =**Semi-permanently to Permanently Flooded Meadow (9000)**

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Appendix F. Sequoia and Kings Canyon National Parks Mapping Class Descriptions

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Introduction

This appendix describes the vegetation classes mapped for the Sequoia and Kings Canyon National Parks Vegetation Inventory (Classification and Mapping) Project. These classes are defined mainly by vegetation structure (physiognomy). Unlike the vegetation associations, which are defined by vegetation species composition, the map classes are recognizable and mappable on air photo imagery.

The following descriptions of mapping classes include:

- The photointerpretation (PI) code, the type name in English, and the type name using species' scientific names;
- A brief introductory description that includes habitat characteristics, elevation range and areal extent of the vegetation type, and important taxa occurring in the type;
- A range map for each vegetation class;
- Producer's and User's Accuracy that estimate classification and mapping accuracy (see formal definitions below);
- Photo Interpretation Signature description, which includes notes on key features of the photo signature of each mapping class (see signature definition below);
- An air photo image showing a representative signature for each map class;
- Environmental characteristics of the mapping class which may include microclimate, elevation range, shape, slope position and steepness, and aspect;
- A scatterplot showing the distribution of the mapping class across slope aspects;
- A listing of types that can be mistaken for the present class during photointerpretation.

Definitions of Terms

Producer's accuracy – The probability that a reference sample (the ground data) has been classified correctly, also known as error of omission. This quantity is computed by dividing the number of samples that have been classified correctly by the total number of reference samples in that class (Story and Congalton 1986).

Signature – The unique combination of color, texture, pattern, height, physiognomy, and position in the landscape used by photo interpreters to identify map classes on an aerial photograph.

User's accuracy – The probability that a sample from the mapped data actually represents that category on the ground, also known as error of commission. This quantity is computed by dividing the number of correctly classified samples by the total number of samples that were classified as belonging to that category (Story and Congalton 1986).

0000 Sparsely Vegetated/Miscellaneous Classes



Davis Lake, Kings Canyon National Park.

0100 – Alpine Talus Slope

Description:

Alpine talus slopes are mapped on moderate to steep alpine slopes of varying aspect between 2546–4375 m (8354–14354 ft) across 72,363 acres in Sequoia and Kings Canyon National Parks (Figure 0100-1). Talus habitats are characterized by sloping, unsorted masses of medium to large unstable blocks of rock, which are usually found at the base of cliffs. Although usually sparsely vegetated, mesic sites can support surprisingly high richness of perennial alpine herbaceous species. Included in this category are rock glaciers, which are masses of poorly sorted, angular boulders cemented with interstitial ice.

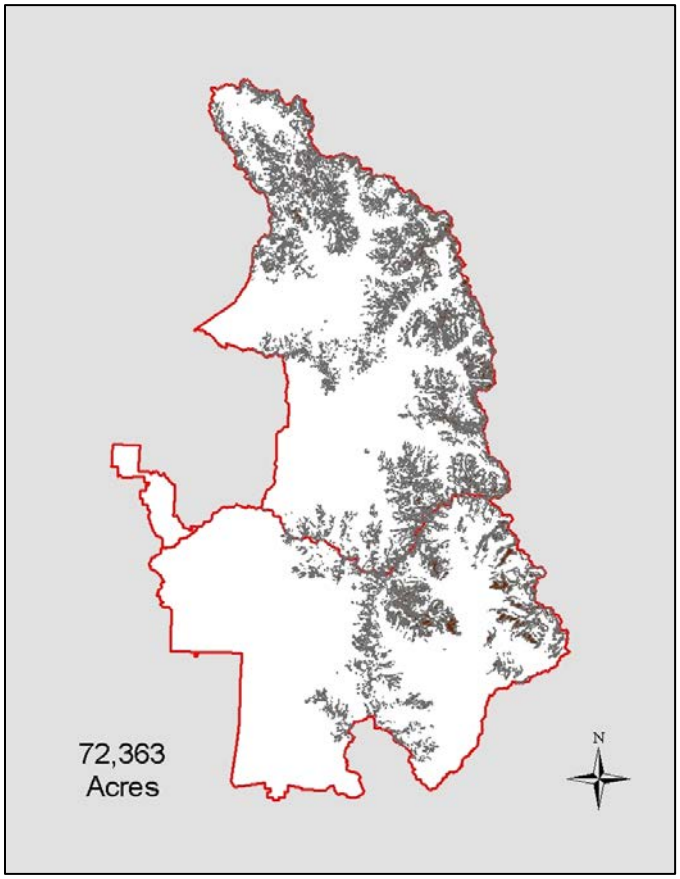


Figure 0100-1. Distribution of Alpine Talus Slopes.

Accuracy:

Producer's accuracy: 100% (n=6)

User's accuracy: 100% (n=6)

Photo Interpretation Signature:

The use of texture and color (reflectance) are the main guidelines in differentiating alpine talus (0100), alpine scree (0200), and boulder fields (0700). The photo signature may be influenced by a number of variables including soil/rock color, geologic rock type, rock size/shape, amount of

vegetation, overall aspect, and proximity to edge of photo. Alpine talus has a moderately coarse texture, while the color signature varies greatly. Since vegetation densities range from extremely sparse (<2% cover) to discontinuous (~50% cover), the signature ranges from white or gray in a sparse area to pink in areas with a denser vegetative cover (Figure 0100-2).

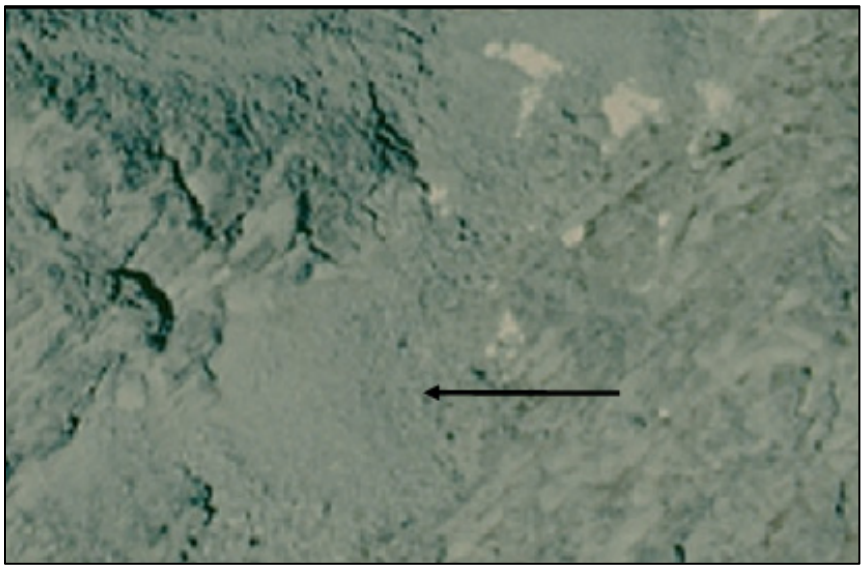


Figure 0100-2. Alpine Talus Slope signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – variable
Elevation – 2546–4375 m (8354–14354 ft)
Shape – convex to concave
Slope position – mid and low
Steepness – fairly steep to moderate
Aspect – See Figure 0100-3.

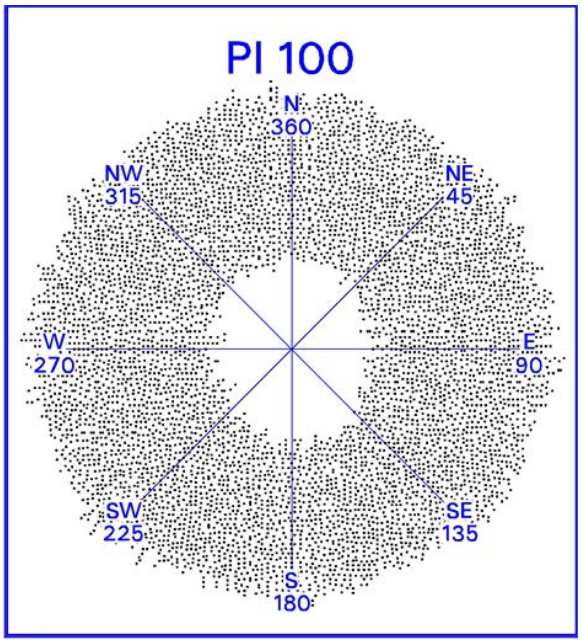


Figure 0100-3. Scatterplot shows Alpine Talus Slopes well-distributed across aspects.

Types with Similar Photo Interpretation Signatures:

- Alpine Scree Slope (0200)
- Alpine Fell-field (0400)
- Boulder Field (0700)
- Non-alpine Talus (0950)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Alpine Permanent Snowfield/Glacier (970)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)

0200 – Alpine Scree Slope

Description:

Alpine scree slopes are mapped on moderate to steep alpine slopes of varying aspect between 2428–4316 m (7967–14159 ft) across 18,813 acres in Sequoia and Kings Canyon National Parks (Figure 0200-1). Scree habitats consist of unstable rock fragments covering the exposed summits of mountains or accumulating on slopes below cliffs. Although sparsely vegetated, mesic sites can support surprisingly high richness of perennial alpine herbaceous species. Soils are poorly developed, often with areas of coarse decomposed granites or sands. The hydrology is upland.

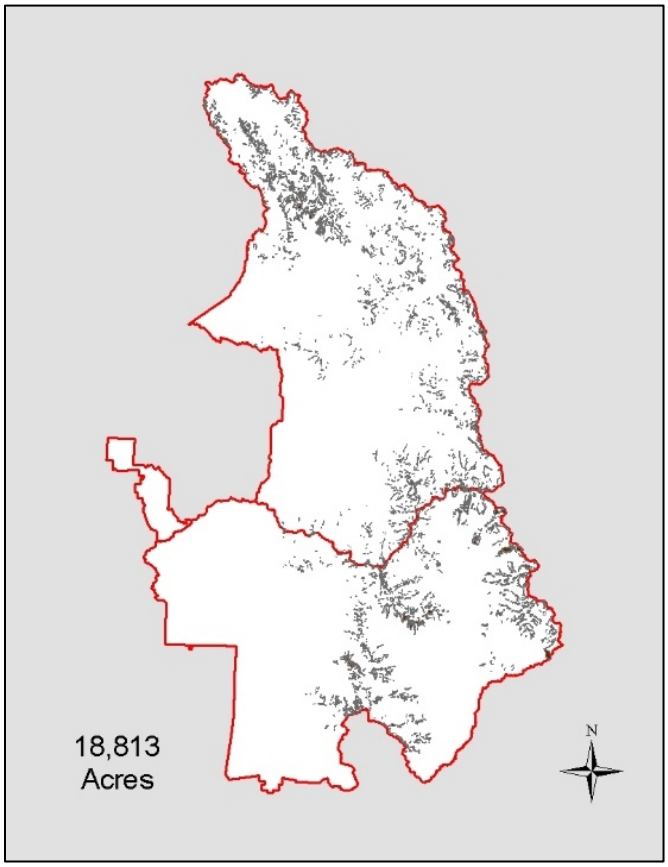


Figure 0200-1. Distribution of Alpine Scree Slopes.

Accuracy:

Producer's accuracy: 100% (n=3)

User's accuracy: 75% (n=4)

Photo Interpretation Signature:

The use of texture and color (reflectance) are the main guidelines in differentiating alpine talus (0100), alpine scree (0200), and boulder fields (0700). Scree slopes are mapped where the texture is smooth to the point that individual rocks generally cannot be observed. Photo signature may be influenced by a number of variables, including soil/rock color, geologic rock type, rock size/shape, amount of vegetation, overall aspect and proximity to edge of photo. Alpine scree has a fine texture,

and the color signature varies from light gray or white to pink (Figure 0200-2). The color signature depends on the density of vegetation present. A pink color indicates a denser vegetation cover than an area where the signature is light gray or white.

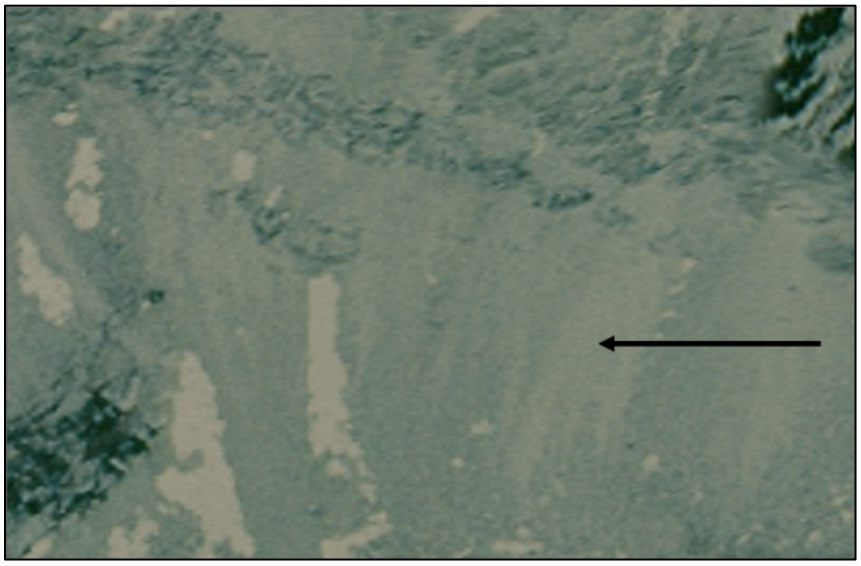


Figure 0200-2. Alpine Scree Slope signature. Photo reference: MOBR_NE.

Environmental Characteristics:
Microclimate – variable
Elevation – 2428–4316 m (7967–14159 ft)
Shape – convex to concave
Slope position – mid to low
Steepness – fairly steep to moderate
Aspect – See Figure 0200-3.

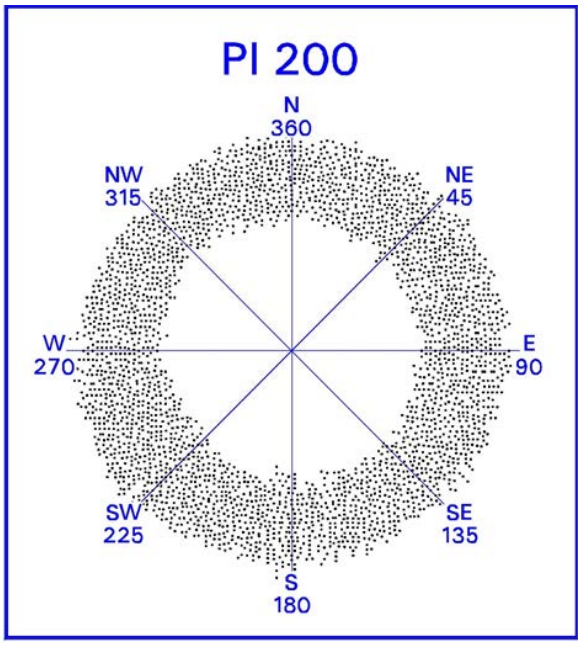


Figure 0200-3. Scatterplot of Alpine Scree Slope in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Alpine Fell-field (0400)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Alpine Permanent Snowfield/Glacier (970)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)

0300 – Alpine Snow Patch Communities

Description:

Alpine snow patches are mapped adjacent to areas of late lying snow on moderately steep, northerly facing slopes between 3230–3771 m (10598–12371 ft) across 35 acres in Sequoia and Kings Canyon National Parks (Figure 0300-1). Fed by melting snow, these habitats remain saturated well into the growing season and support a generally sparse mixture of mesic high alpine species such as *Caltha leptosepala ssp. howellii* and *Ranunculus eschscholtzii var. oxynotus*. Soils are typically poorly developed sands, and the sites are seasonally saturated.

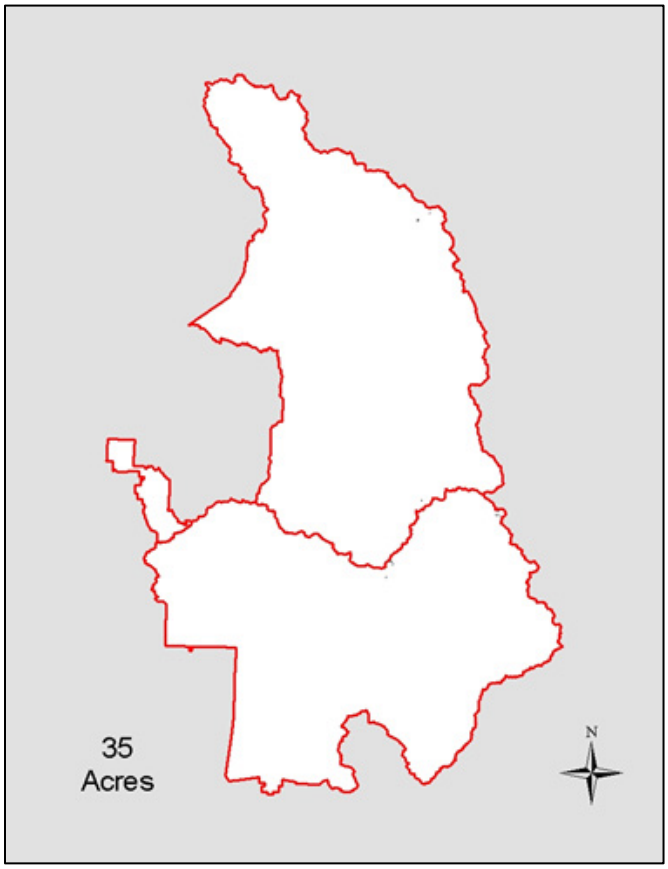


Figure 0300-1. Distribution of Alpine Snow Patch Communities.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:

The photo signature of the alpine snow patch community is very similar to the permanent snowfields/glaciers (0970) class. The USGS 7.5 minute topographic quadrangles are used to differentiate alpine snow patch communities from the snowfields/glaciers. Alpine snow patch polygons also include saturated conditions downslope from the snow that are visible on the color

infrared aerial photography, often in the form of small linear rivulets that trail below the snow patch itself (Figure 0300-2). Vegetation densities are not assigned to these polygons.

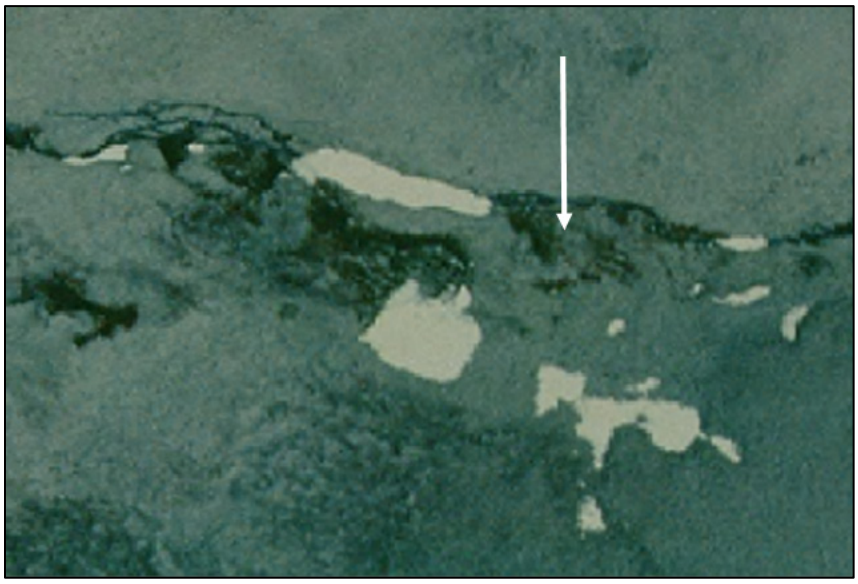


Figure 0300-2. Alpine Snowpatch Communities signature. Photo reference: MOWI_SW.

Environmental Characteristics:
Microclimate – mesic
Elevation – 3230–3771 m (10598–12371 ft)
Shape – convex
Slope position – mid and lower
Steepness – moderately steep slopes
Aspect – See Figure 0300-3.

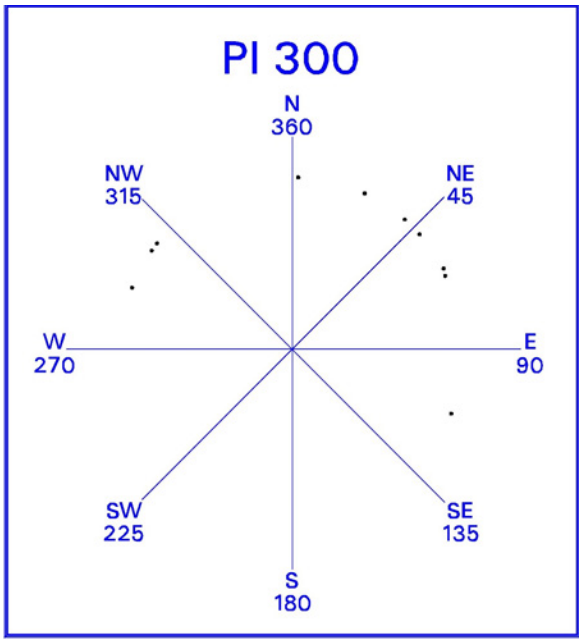


Figure 0300-3. Scatterplot of Alpine Snowpatch Communities in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Intermittently to Seasonally Flooded Meadow (8000)
- Semi-permanently to Permanently Flooded Meadow (9000)

0400 – Alpine Fell-Field

Description:

Alpine fell-fields are mapped on gentle to moderate sloping, exposed alpine flats of varying aspect between 2811–4413 m (9222–14478 ft) across 27,433 acres in Sequoia and Kings Canyon National Parks (Figure 0400-1). These communities are found on rocky flats or plateaus that are often exposed to winter winds. Fell-field vegetation is composed of scattered perennial herbs or dwarf shrubs less than 0.5 m tall, which can form a low turf on favorable sites but more often is scattered among the broken rocks, exposed outcrops and gravel which are typical of these sites (Holland 1986). Frequently encountered species include *Erigeron spp., Draba spp., Eriogonum incanum, Eriogonum ovalifolium ssp. nivale, Koeleria macrantha, Festuca brachyphylla, Juncus parryi, Lupinus breweri,* and *Oreonana clementis*. Some examples of mapped fell-fields are the areas of or around Table Mountain, Boreal Plateau, Diamond Mesa, and Martha Lake.

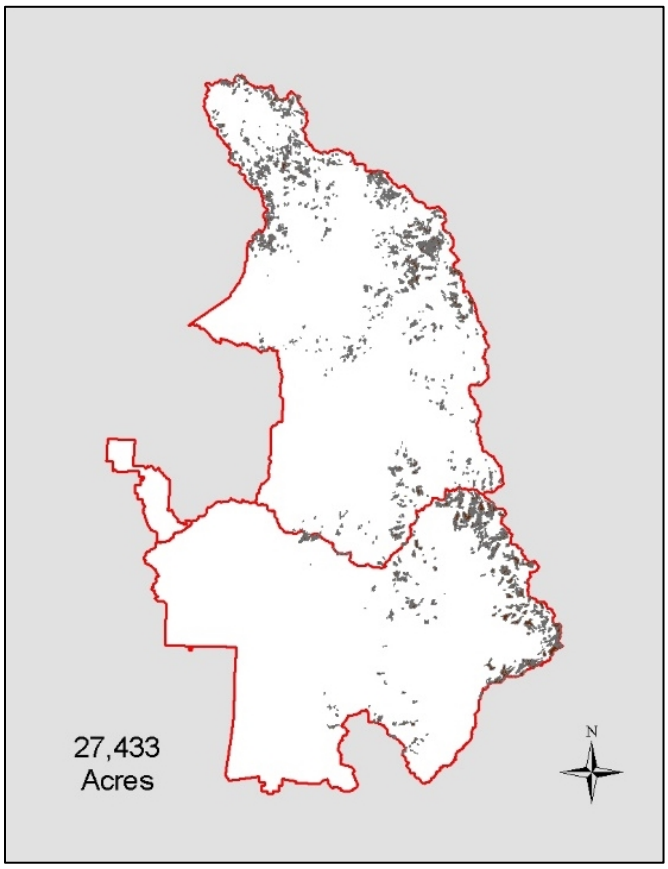


Figure 0400-1. Distribution of Alpine Fell-Fields.

Accuracy:

Producer's accuracy: 83% (n=6)

User's accuracy: 71% (n=7)

Photo interpretation signature:
The alpine fell field photo signature is dependent on several variables including the vegetative cover and density, rock composition, slope and aspect. The color evident on the color infrared imagery ranges from white to gray to light brown (Figure 0400-2).

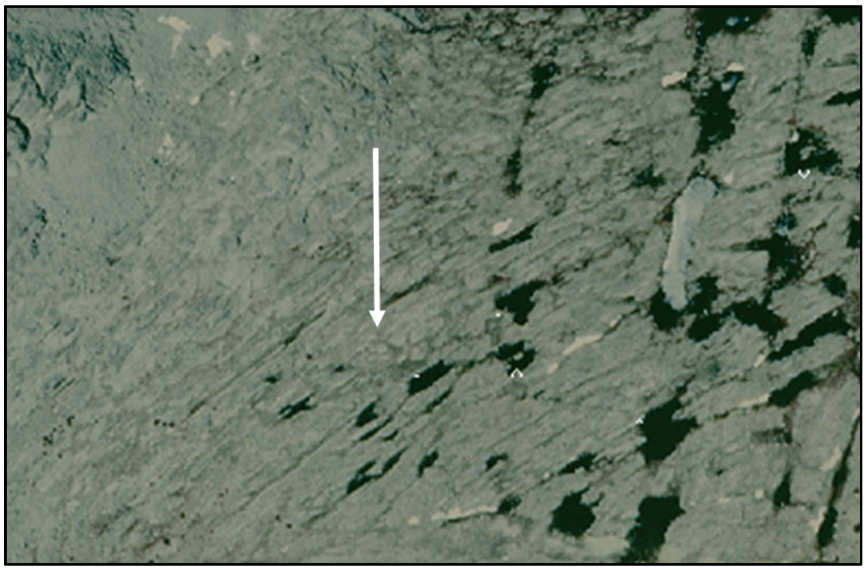


Figure 0400-2. Alpine Fell-Field signature. Photo reference: MOBR_SE

Environmental characteristics:
Microclimate – seasonally mesic (during snowmelt) to xeric
Elevation – 2811–4413 m (9222–14478 ft)
Shape – variable
Slope position – variable
Steepness – gentle to moderate
Aspect: See Figure 0400-3

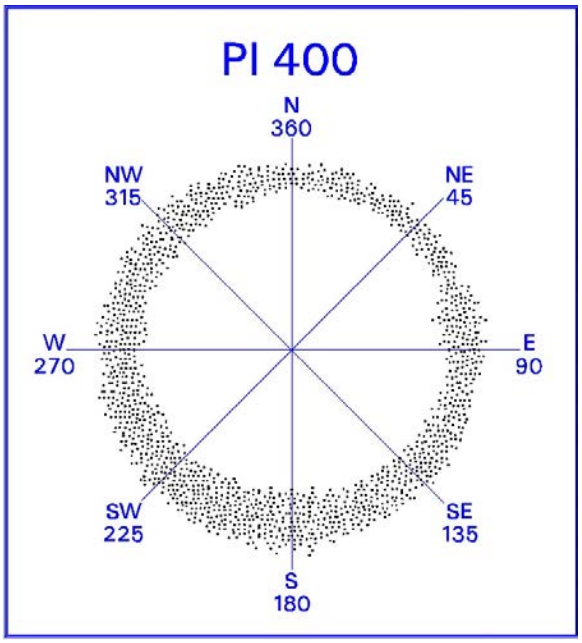


Figure 0400-3. Scatterplot of Alpine Fell-Fields in relation to aspect.

Types with similar photo interpretation signatures:

- Alpine Talus Slope (0100)
- Alpine Scree Slope (0200)
- Mesic Rock Outcrop (0500)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Upland Herbaceous (7000)
- Shorthair Sedge Herbaceous Alliance (7120)

0500 – Mesic Rock Outcrop

Description:

Mesic rock outcrops are mapped on primarily north and east facing, moderate to steep rock outcrops between 2364–3983 m (7756–13067 ft) across 22,865 acres in Sequoia and Kings Canyon National Parks (Figure 0500-1). These sparsely vegetated habitats are dominated by rock and support less than 10% absolute vegetative cover. Species composition varies according to elevation and local site conditions, but may include relatively mesic species in small, protected pockets of soil. Sites are characterized by upland hydrology and little to no soil development.

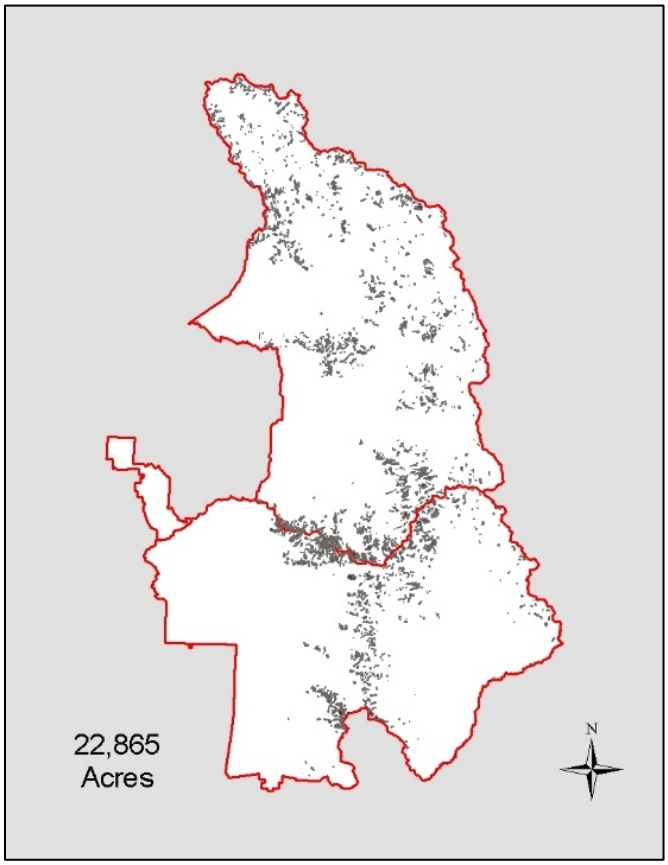


Figure 0500-1. Distribution of Mesic Rock Outcrops.

Accuracy:

Producer's accuracy: 100% (n=2)

User's accuracy: 67% (n=3)

Photo interpretation signature:

Mesic rock outcrops generally contain less than 10% absolute vegetative cover. These map units are usually northerly trending, but may be southerly where the vegetation appears clearly mesic or wet (brighter pink to red signature) on the aerial photography (Figure 0500-2). Mesic rock outcrops are usually found on rock where there are numerous breaks and cracks, which tend to accumulate small amounts of soil and pool water. Steep cliffs generally don't allow for extensive mappable mesic

vegetation; most mesic rocks are mapped on gentle to moderate slopes. Outcroppings that usually trend south and that contain a vegetation signature that tends to be brown or tan (possibly *Holodiscus* or *Dasiphora floribunda*) are lumped into the more general sparsely vegetated to non-vegetated exposed rock (0961) type. Vegetation densities are not assigned to mesic rock outcrop polygons.

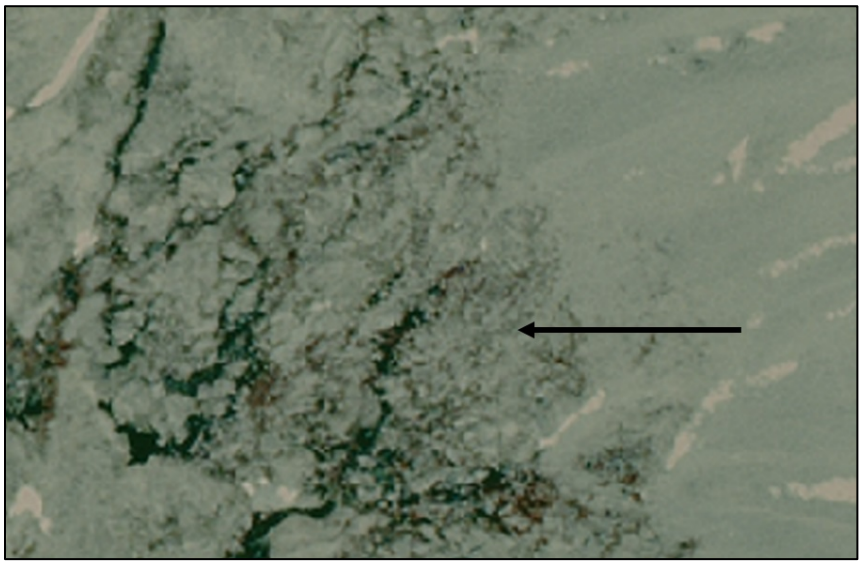


Figure 0500-2. Mesic Rock Outcrop signature. Photo reference: MOBR_SE

Environmental characteristics:
Microclimate – variable
Elevation – 2364–3983 m (7756–13067 ft)
Shape – neutral
Slope position – variable
Steepness – moderate to steep
Aspect: See Figure 0500-3

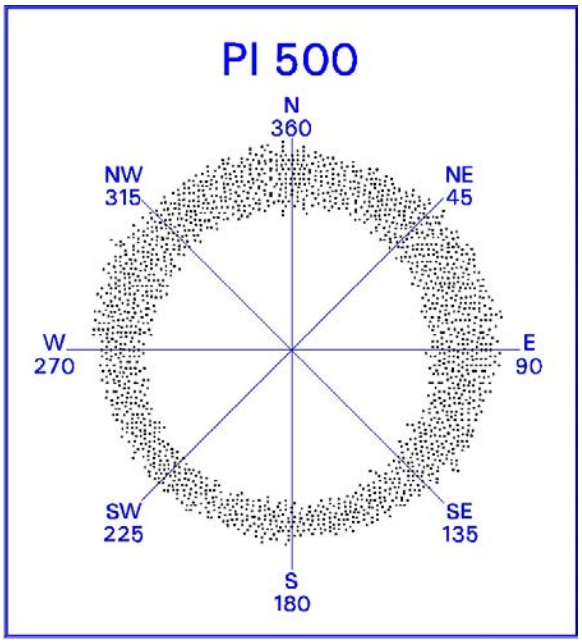


Figure 0500-3. Scatterplot of Mesic Rock Outcrops in relation to aspect.

Types with similar photo interpretation signatures:

- Alpine Fell-field (0400)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Upland Herbaceous (7000)
- Shorthair Sedge Herbaceous Alliance (7120)
- Intermittently to Seasonally Flooded Meadow (8000)

0700 – Boulder Field

Description:

Boulder fields are mapped in flat to moderately sloping areas of varying aspect between 1286–4016 m (4218–13177 ft) across 8,245 acres in Sequoia and Kings Canyon National Parks (Figure 0700-1). The habitat is characterized by large coarse rock fragments averaging 1–2 m in size or greater. Vegetation is extremely sparse and varies according to elevation and local site conditions. Sites are characterized by upland hydrology and little to no soil development.

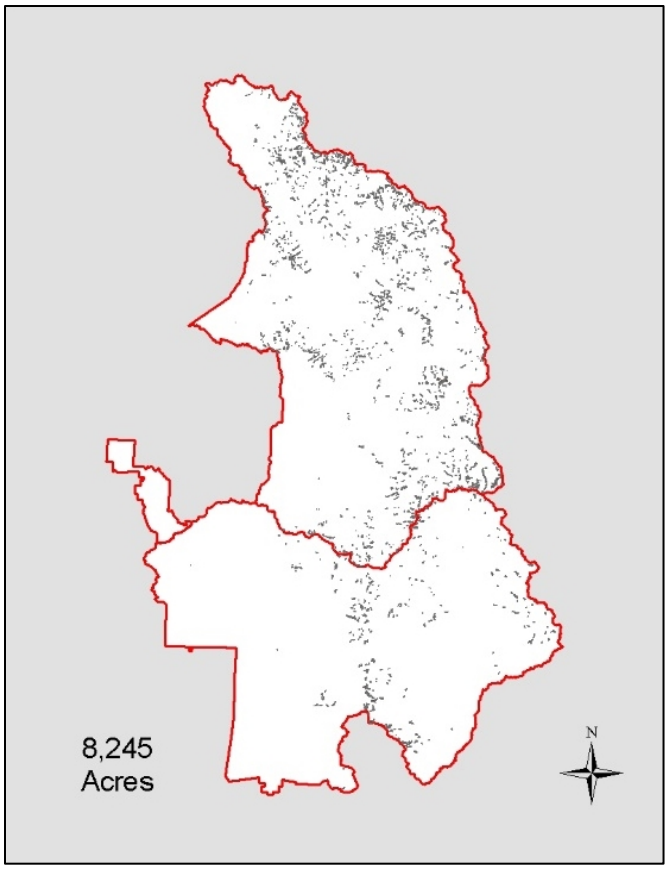


Figure 0700-1. Distributiion of Boulder Fields.

Accuracy:

Producer's accuracy: 100% (n=2)

User's accuracy: 100% (n=2)

Photo interpretation signature:

Boulder fields are mapped when the rock size averages 1–2 meters or greater. The use of photo signature texture and color (reflectance) are the main variables used in differentiating boulder fields from alpine talus (0100) and alpine scree (0200). A boulder field photo signature has an extremely coarse texture and dark gray color, and may include areas of snow that are not identified on the topographic map as permanent snowfield/glacier (Figure 0700-2).

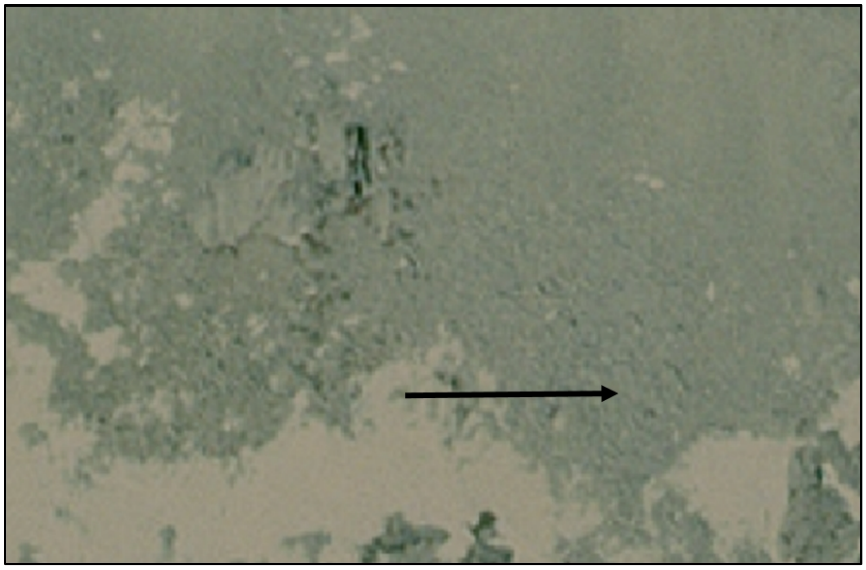


Figure 0700-2. Boulder Field signature. Photo reference: MOBR_SW

Environmental characteristics:
Microclimate – xeric
Elevation – 1286–4016 m (4218–13177 ft)
Shape – variable
Slope position – middle to lower slopes
Steepness – flat to moderate
Aspect: See Figure 0700-3

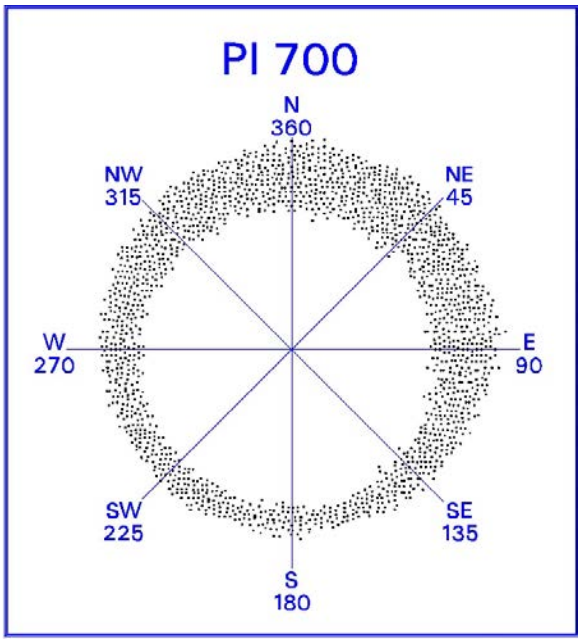


Figure 0700-3. Scatterplot of Boulder Fields in relation to aspect.

Types with similar photo interpretation signatures:

- Alpine Talus Slope (0100)
- Non-alpine Talus (0950)

0900 – Sparsely Vegetated/Miscellaneous Classes (continued)

0910 – Conifer Reproduction

Description:

The post avalanche, fire, flood, and/or mass movement conifer reproduction is mapped on gentle to steep slopes of varying aspect between 1454–3714 m (4770–12184 ft) across 6,601 acres of Sequoia and Kings Canyon National Parks (Figure 0910-1). These stands are characterized by post-disturbance (avalanche, fire, flood or mass movement) conifer reproduction, where the trees are too young to identify to species based on photo-signature.

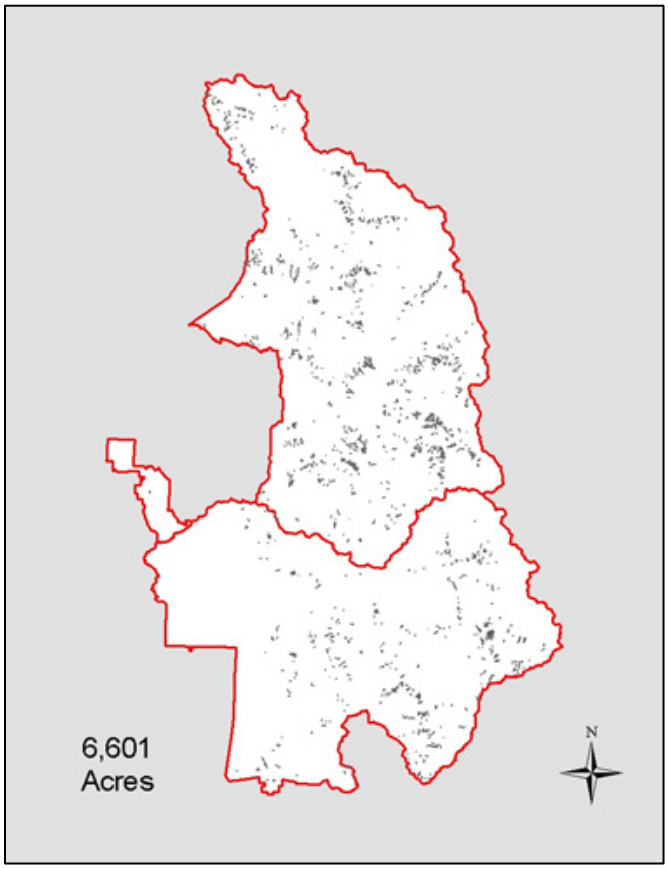


Figure 0910-1. Distribution of Conifer Reproduction.

Accuracy:

Producer's accuracy: 100% (n=31)
User's accuracy: 94% (n=33)

Photo Interpretation Signature:

Young conifers yield a stipple-like signature due to the narrow crowns of the individual plants (Figure 0910-2). Stand continuity depends on density throughout the mapped polygon; signatures generally remain constant throughout where density change is minimal.Color and tones vary little between conifer species and depend more on age, health and overall density of the stand.

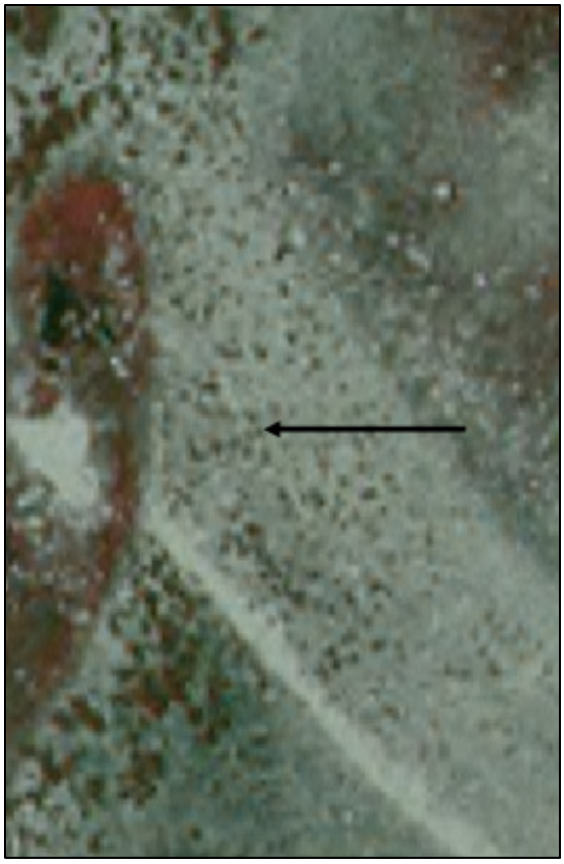


Figure 0910-2. Conifer Reproduction signature. Photo reference: MOWH_NW.

Environmental Characteristics:

Microclimate – variable
Elevation – 1454–3714 m (4770–12184 ft)
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 0910-3.

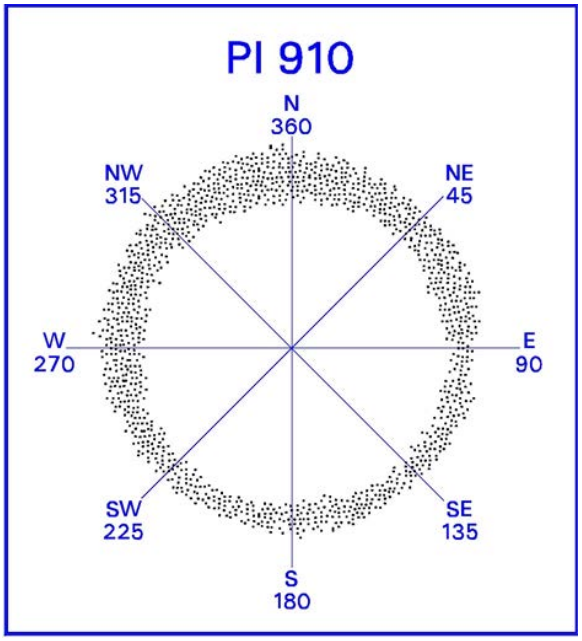


Figure 0910-3. Scatterplot of Conifer Reproduction in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Conifer Plantation (0920)
- Quaking Aspen Forest Alliance (2010)
- Giant Sequoia Forest Alliance (4020)
- White Fir Mature Even-age Stands Mapping Unit (4082)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)

0920 – Conifer Plantation

Description:

Plantations are mapped on gentle to moderate slopes of varying aspect between 1950–2068 m (6397–6784 ft) on 18 acres in the parks (Figure 0920-1). These monospecific stands are composed of a group of planted trees, often either *Pinus jeffreyi* or *Pinus ponderosa*. A pattern of evenly spaced rows may be evident, and access roads are often visible in the vicinity. Sites have well-developed soils and upland hydrology.

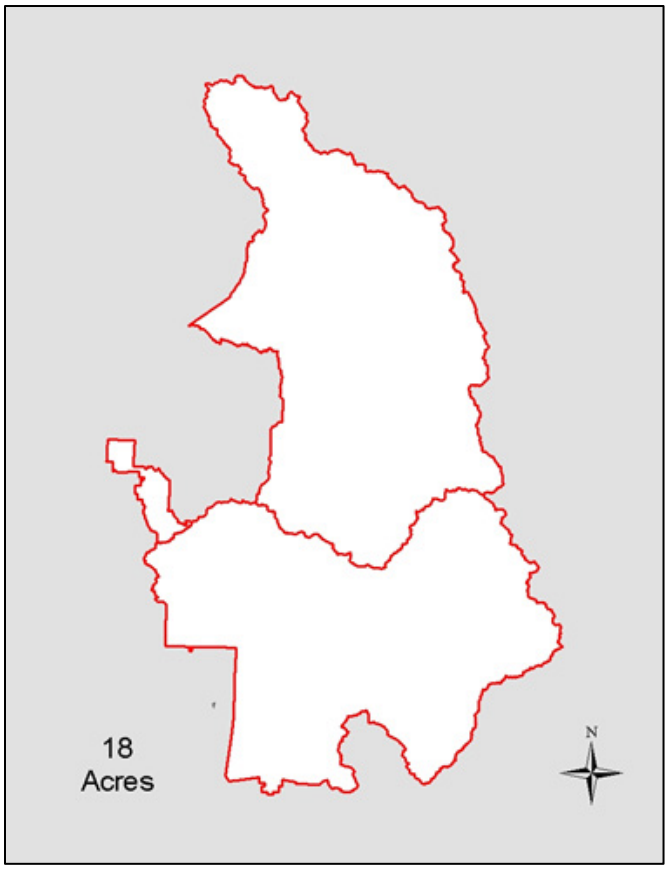


Figure 0920-1. Distribution of Conifer Plantations.

Accuracy:

Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:

Conifer plantations show up on the color infrared imagery as small red trees arranged in a pattern of evenly spaced rows (Figure 0920-2). Access roads are usually present in the vicinity.

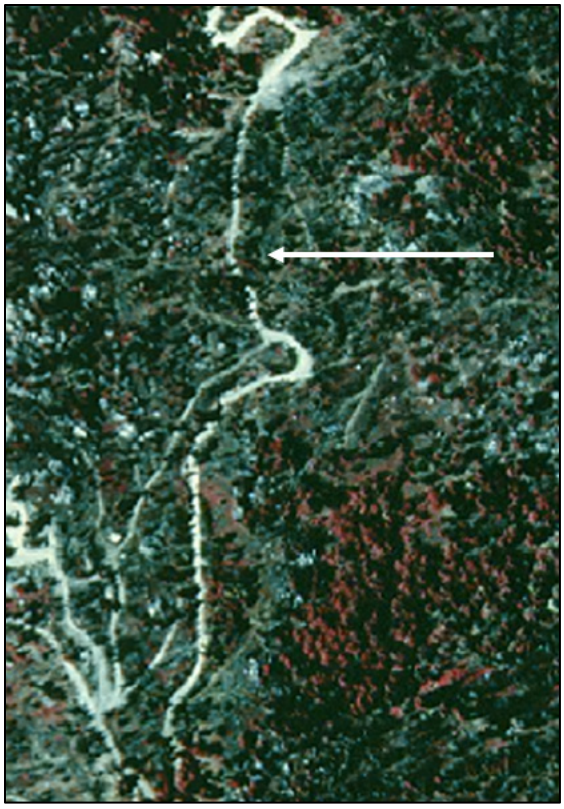


Figure 0920-2. Conifer Plantation signature. Photo reference: CAMO_SE.

Environmental Characteristics:
Microclimate – submesic to xeric
Elevation – 1950–2068 m (6397–6784 ft)
Shape – variable
Slope position – variable
Steepness – gentle to moderate
Aspect – See Figure 0920-3.

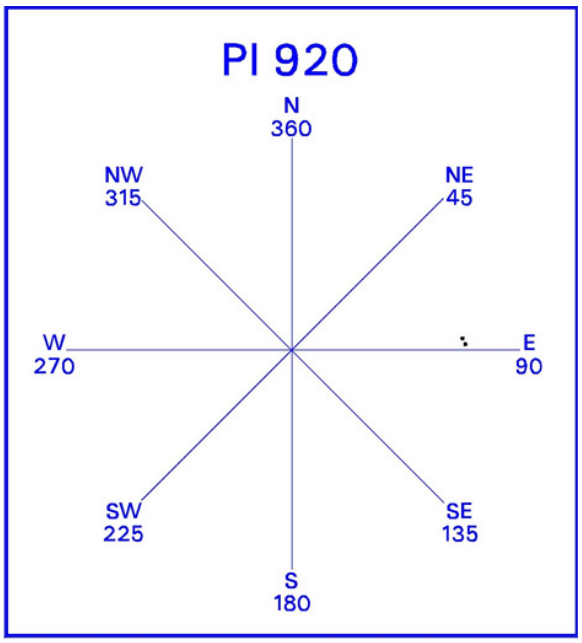


Figure 0920-3. Scatterplot of Conifer Plantations in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Conifer Reproduction (0910)

0940 – Sparsely Vegetated Undifferentiated

Description:

The sparsely vegetated undifferentiated category is mapped in naturally sparse to barren areas of varying slope and aspect between 1389–3781 m (4558–12405 ft) across 256 acres in Sequoia and Kings Canyon National Parks (Figure 0940-1). Vegetative cover is less than 2%, with species composition varying according to local site conditions.

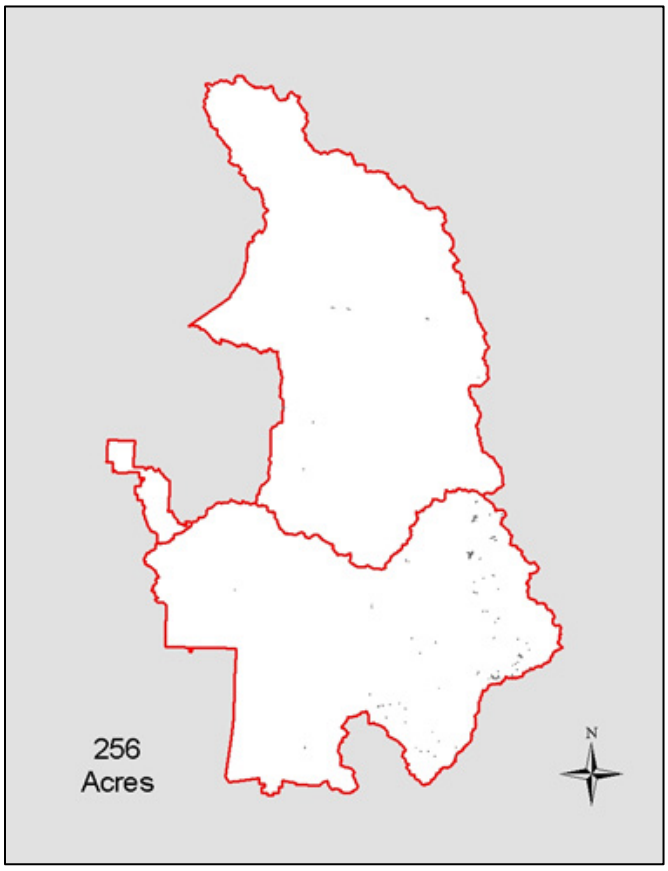


Figure 0940-1. Distribution of Sparsely Vegetated Undifferentiated.

Accuracy:

Producer's accuracy: 0% (n=1)
User's accuracy: % (n=0)

Photo Interpretation Signature:

The photo signature for sparsely vegetated undifferentiated areas typically appears white on the color infrared aerial photos (Figure 0940-2).

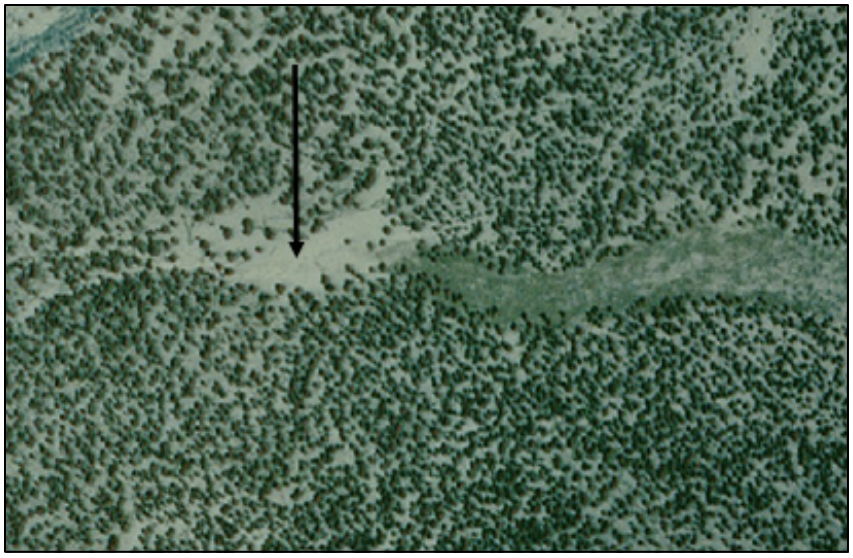


Figure 0940-2. Sparsely Vegetated Undifferentiated signature. Photo reference: MOWH_SW.

Environmental Characteristics:

Microclimate – variable
Elevation – 1389–3781 m (4558–12405 ft)
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 0940-3.

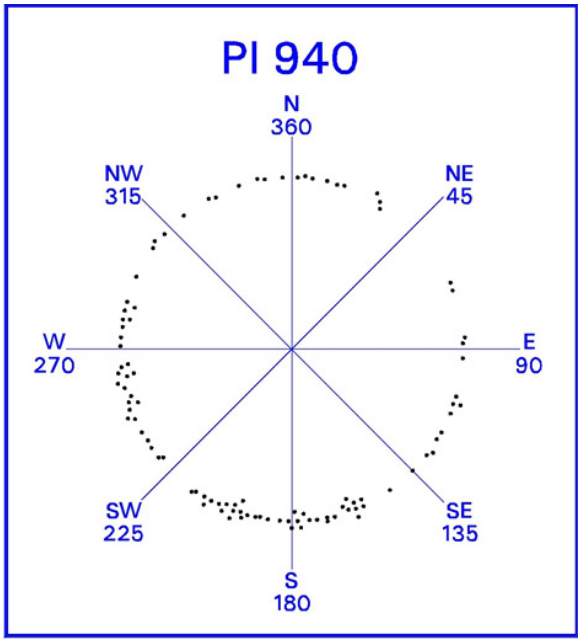


Figure 0940-3. Scatterplot of Sparsely Vegetated Undifferentiated in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated Riverine Flat (0941)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Upland Herbaceous (7000)

0941 Sparsely Vegetated Riverine Flat

Description:

The sparsely vegetated riverine flat category is mapped in naturally sparse to barren areas along the margins of rivers and streams between 566–3209 m (1857–10527 ft) across 164 acres in Sequoia and Kings Canyon National Parks (Figure 0941-1). Vegetative cover is generally less than 2%, with species composition varying according to elevation and local site conditions.

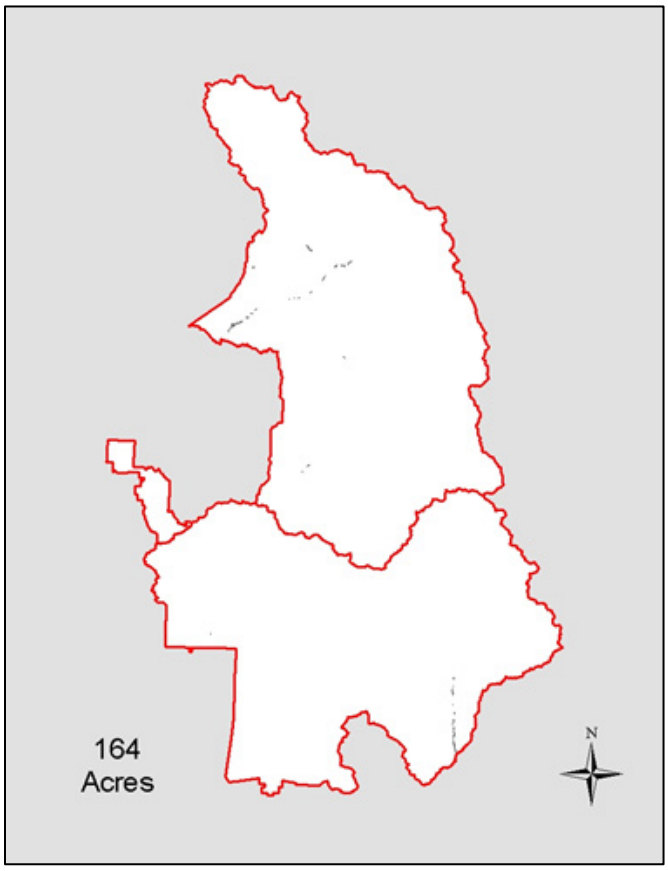


Figure 0941-1. Distribution of Sparsely Vegetated Riverine Flats.

Accuracy:

Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:

The sparsely vegetated riverine flats appear white on the color infrared photos and have less than 2% vegetation cover (Figure 0941-2).

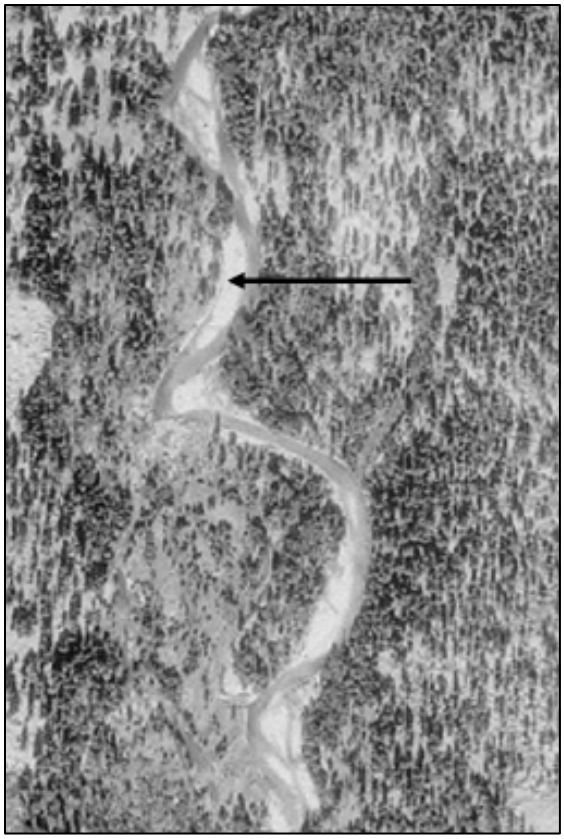


Figure 0941-2. Sparsely Vegetated Riverine Flat signature. Photo reference: CHFA_SE.

Environmental Characteristics:

Microclimate – wetland or riparian
Elevation – 566–3209 m (1857–10527 ft)
Shape – neutral
Slope position – valley and canyon bottoms
Steepness – gentle to moderate
Aspect – See Figure 0941-3.

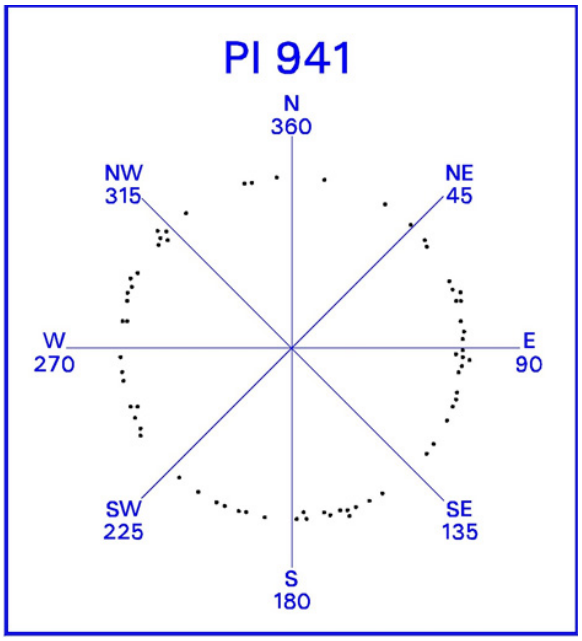


Figure 0941-3. Scatterplot of Sparsely Vegetated Riparian Flats in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated Undifferentiated (0940)

0950 – Non-alpine Talus

Description:

The non-alpine talus category is mapped on moderate to steep slopes of varying aspect between 993–3460 m (3258–11353 ft) across 7,285 acres of Sequoia and Kings Canyon National Parks (Figure 0950-1). Talus fields are characterized by sloping, unsorted masses of medium to large, unstable blocks of rock, which are usually found at the base of cliffs or steep slopes. Non-alpine talus is applied in areas below treeline. Although sparsely vegetated (less than 2% cover), mesic sites can support relatively high species richness.

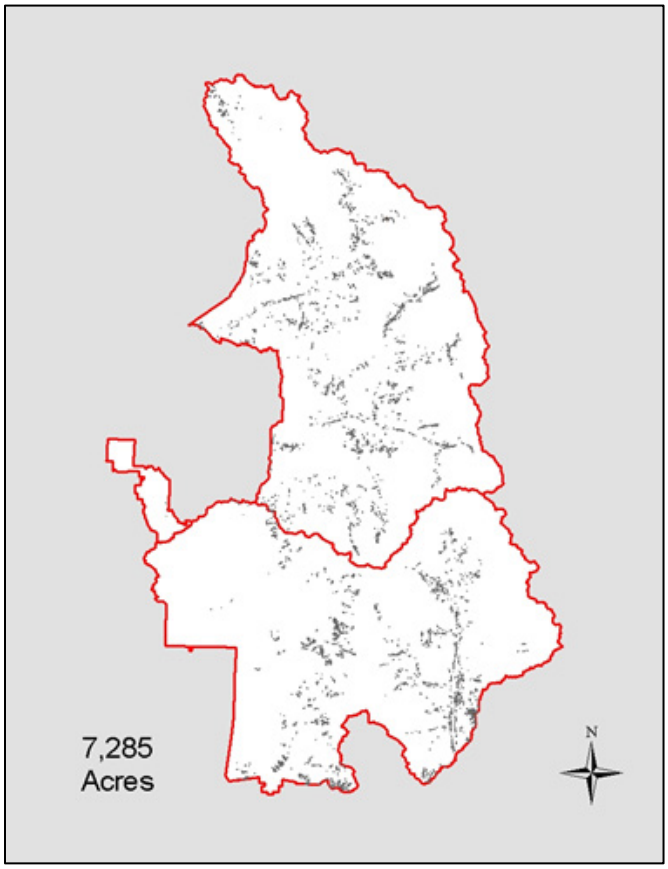


Figure 0950-1. Distribution of Non-alpine Talus.

Accuracy:

Producer's accuracy: 100% (n=7)
User's accuracy: 100% (n=7)

Photo Interpretation Signature:

The signature for non-alpine talus ranges from white to gray (Figure 0950-2). In the alpine zone (generally above 10,000 ft), talus areas are mapped using the alpine type classes (see codes 0100 through 0400). For rocks that average 1–2 meters in size or greater, the boulder field (700) code is used.

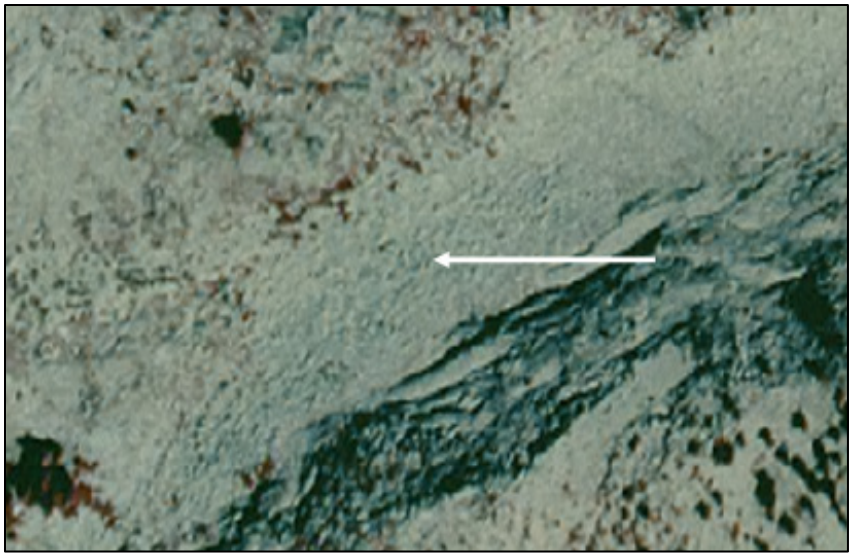


Figure 0950-2. Non-alpine Talus signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – variable
Elevation – 993–3460 m (3258–11353 ft)
Soil – variable
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 0950-3.

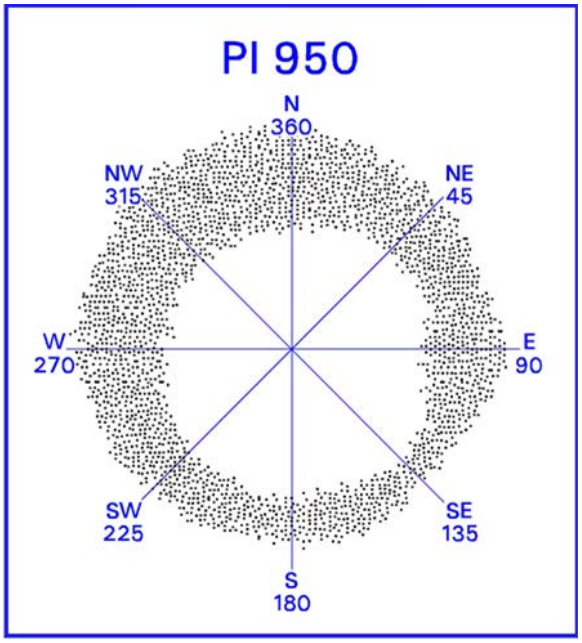


Figure 0950-3. Scatterplot of Non-alpine Talus in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Boulder Field (0700)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)

0960 – Rock Outcrop Undifferentiated

0961 – Sparsely Vegetated to Non-vegetated Exposed Rock

Description:

The sparsely vegetated to non-vegetated exposed rock category is applied to rock outcrops and cliffs across a wide range of slope positions and steepness between 421–4412 m (1381–14474 ft) across 117,758 acres in Sequoia and Kings Canyon National Parks (Figure 0961-1). These sites are naturally sparsely vegetated or barren, with less than 5% absolute vegetative cover on a substrate of exposed rock.

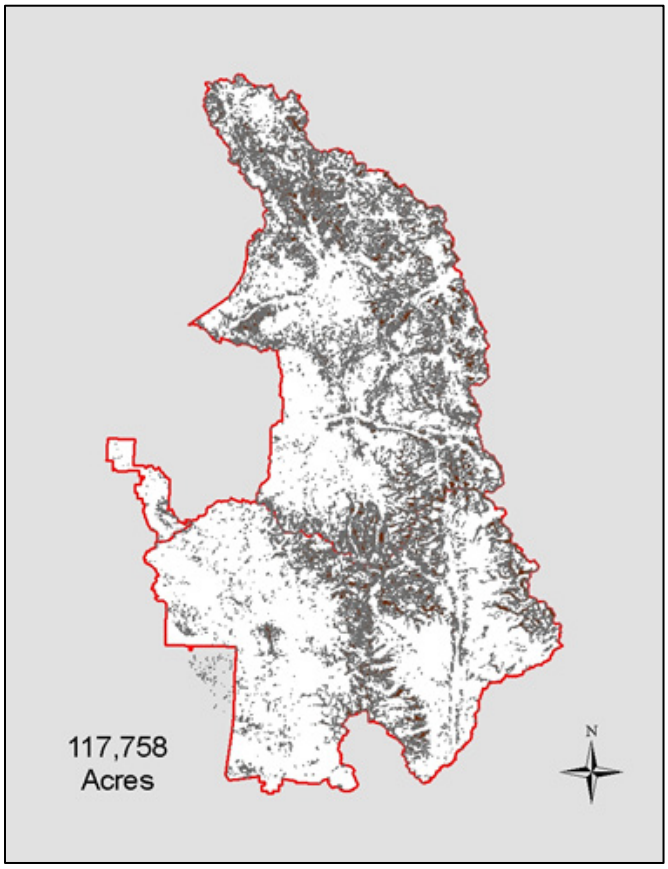


Figure 0961-1. Distribution of Vegetated to Non-vegetated Exposed Rock.

Accuracy:

Producer's accuracy: 100% (n=12)
User's accuracy: 67% (n=18)

Photo Interpretation Signature:

The photo signature for sparsely vegetated to non-vegetated exposed rock varies from white to dark gray (Figure 0961-2). Exposed rock outcrops displaying a visibly bright infrared signature are mapped as mesic rock outcrops (0500).

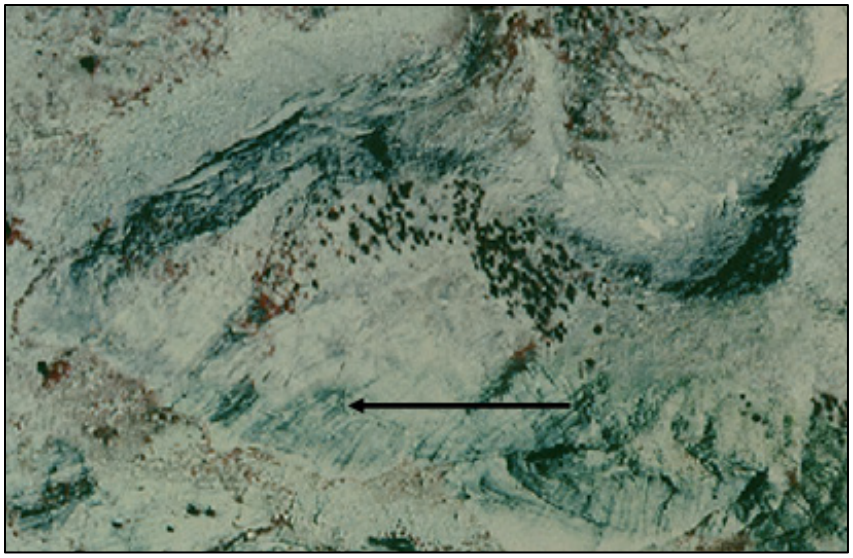


Figure 0961-2. Sparsely Vegetated to Non-vegetated Exposed Rock signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – variable
Elevation – 993–3460 m (3258–11353 ft)
Soil – variable
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 0961-3.

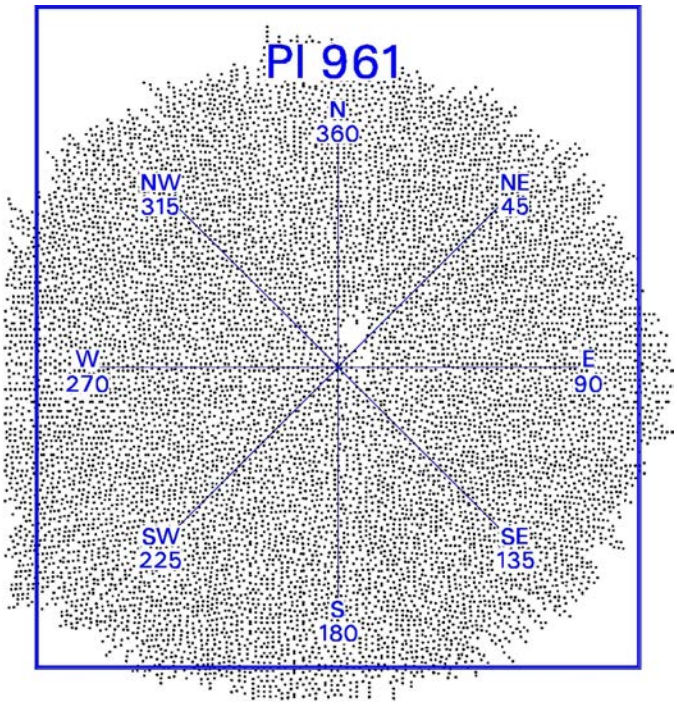


Figure 0961-3. Scatterplot of Sparsely Vegetated to Non-vegetated Exposed Rock in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Alpine Scree Slope (0200)
- Alpine Fell-field (0400)
- Mesic Rock Outcrop (0500)
- Sparsely Vegetated Undifferentiated (0940)
- Non-alpine Talus (0950)
- Dome (0963)
- Sparsely Vegetated Rocky Streambed (0965)
- Alpine Permanent Snowfield/Glacier (970)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)
- Chaparral Yucca Shrubland Alliance (5270)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)
- Oceanspray Shrubland Alliance (6210)
- Upland Herbaceous (7000)

- Shorthair Sedge Herbaceous Alliance (7120)

0963 – Dome

Description:

The dome category is applied to smooth rounded rock features that by definition generally slope in all directions from a central point. These classic topographic features are mapped between 1907–3549 m (6258–11644 ft) across 230 acres in Sequoia and Kings Canyon National Parks (Figure 0963-1), and are sparsely vegetated to barren (less than 2% absolute cover). Notable examples include Tehipite Dome, Moro Rock, and Homer's Nose.

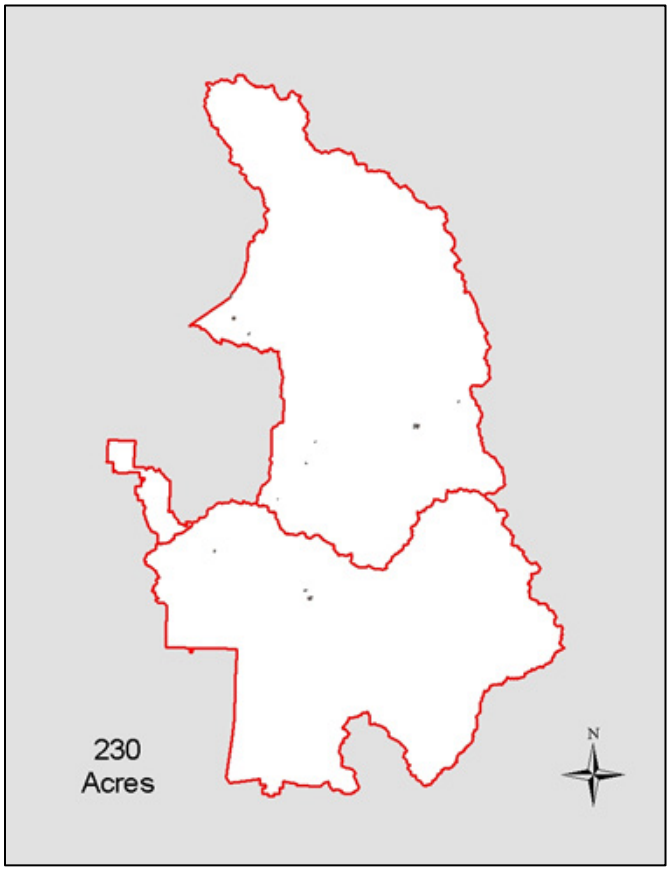


Figure 0963-1. Distribution of Domes.

Accuracy:

Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:

The signature for a dome is typically white to light gray (Figure 0963-2).

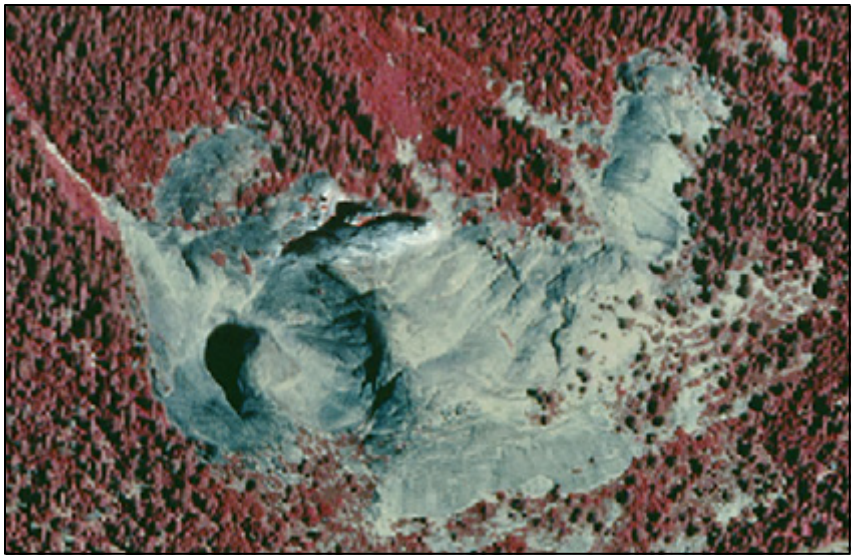


Figure 0963-2. Dome signature – Sugar Bowl Dome. Photo reference: LODG_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1907–3549 m (6258–11644 ft)
Shape – variable
Slope position – variable
Steepness – steep
Aspect – See Figure 0963-3.

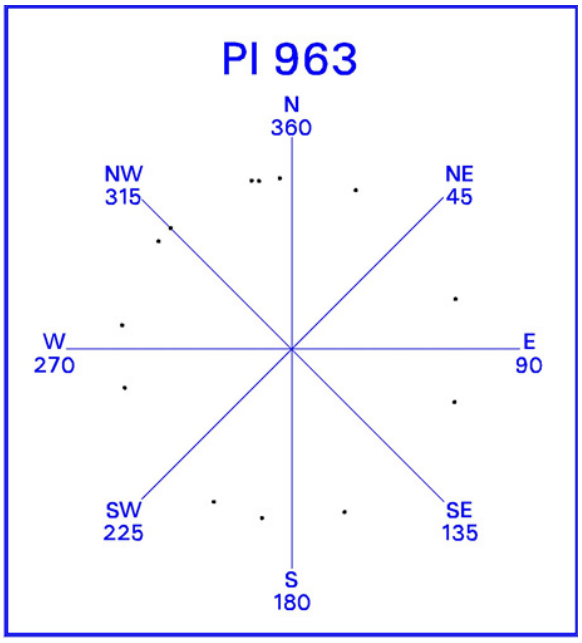


Figure 0963-3. Scatterplot of Domes in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)

0965 – Sparsely Vegetated Rocky Streambed

Description:

The sparsely vegetated rocky streambed category is applied to streambeds occurring on rock outcrops where there is little or no unconsolidated material within the stream channel. Often characterized by steep waterfalls and a lack of vegetation, this type is mapped on moderate to steep slopes of varying aspect between 606–3595 m (1987–11795 ft) across 747 acres of Sequoia and Kings Canyon National Parks (Figure 0963-1).

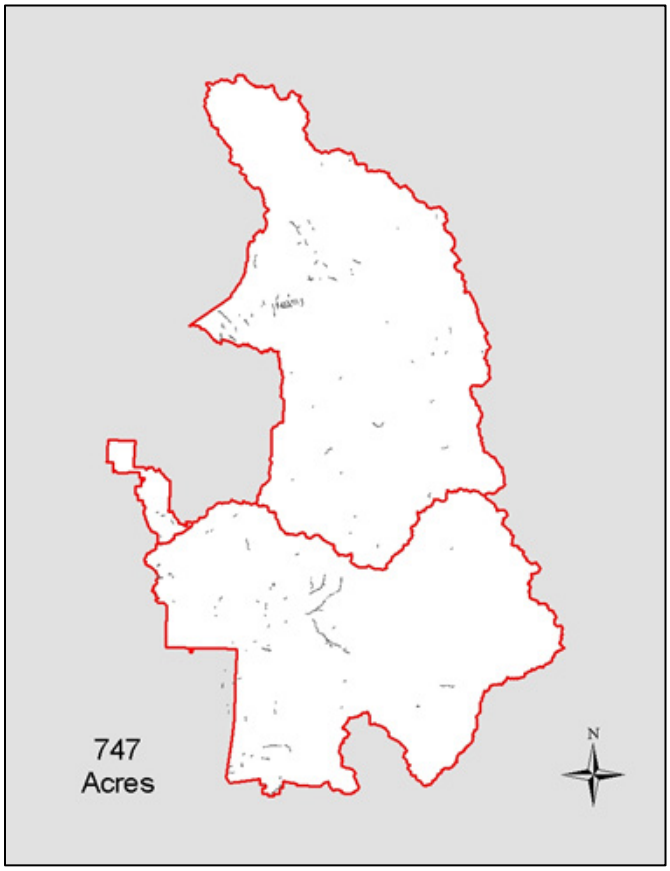


Figure 0963-1. Distribution of Vegetated Rocky Streambeds.

Accuracy:

Producer's accuracy: 100% (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:

The photo signature for sparsely vegetated rocky streambeds is light gray or white (Figure 0965-2).

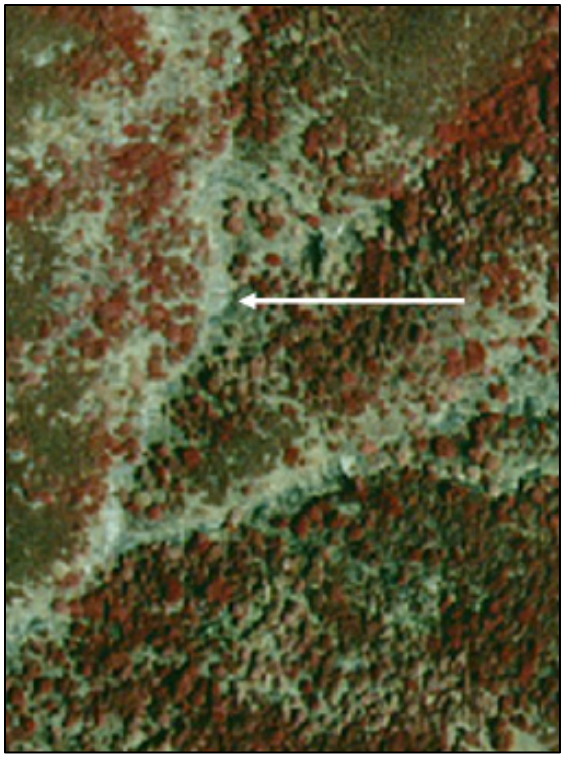


Figure 0965-2. Sparsely Vegetated Rocky Streambed signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – variable
Elevation – 606–3595 m (1987–11795 ft)
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 0965-3.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)

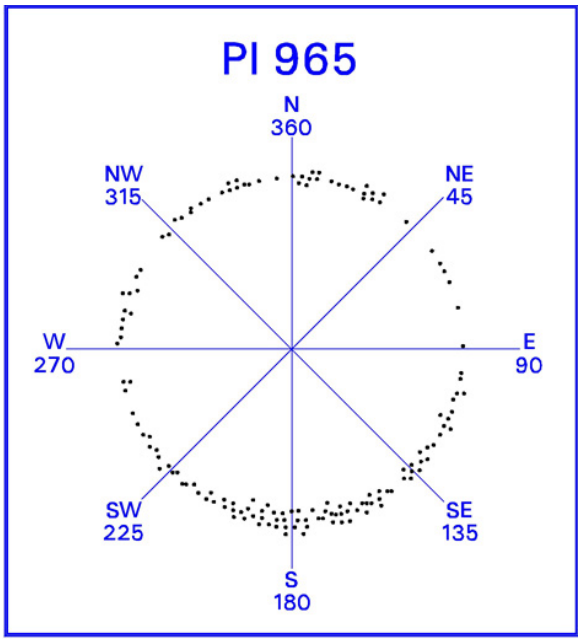


Figure 0965-3. Scatterplot of Sparsely Vegetated Rocky Streambed in relation to aspect.

0970 – Alpine Permanent Snowfield/Glacier

Description:

The alpine permanent snowfield/glacier category is applied to permanent snow and ice fields on steep, generally north-facing alpine slopes between 3136–4289 m (10290–14072 ft) across 1,211 acres in Sequoia and Kings Canyon National Parks. Locations of snowfields and glaciers are mapped from the USGS 1:24,000 scale topographic sheets (1983–1994). Polygon boundaries are then rectified to the aerial photography. Finally, polygons are readjusted to the digital orthophoto quarter quads (DOQQs) (1987–2003) to ensure that no portion of a polygon extends beyond the most recent snow line as depicted on the DOQQ image.

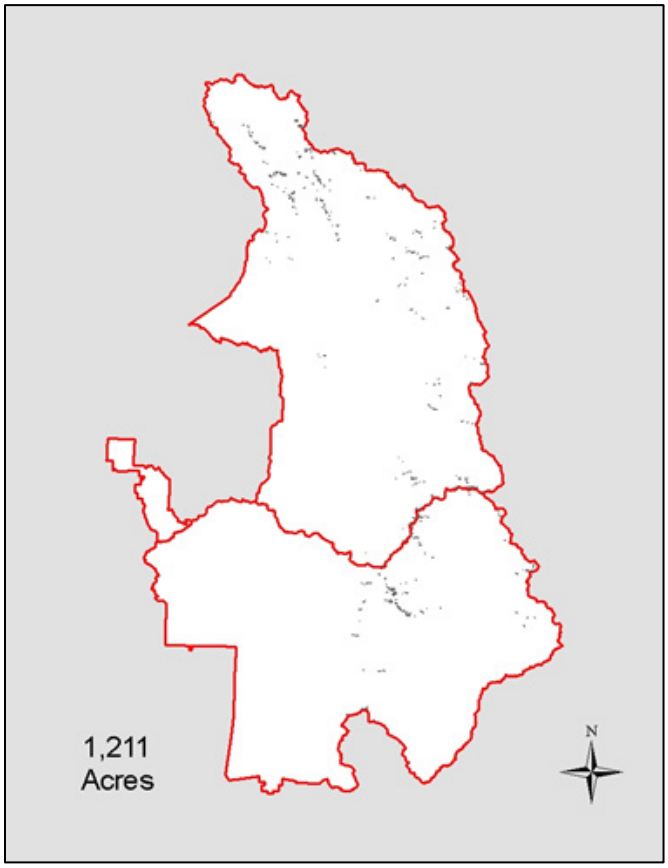


Figure 0970-1. Distribution of Alpine Permanent Snowfields/Glaciers.

Accuracy:

Producer's accuracy: 100% (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:

The permanent snowfield/glacier class is mapped using the snowfield and glacier map units found on the USGS 7.5 minute topographic quadrangles. Polygon boundaries are rectified to the color infrared photography and then readjusted to the DOQQs to ensure that no portion of the polygon goes beyond the most recent snow line as depicted on the DOQQ image (Figure 0970-2). In order to maintain

consistency, the following two rules are applied to 0970 polygons in the database: (1) if the permanent snowfield/glacier is less extensive on the DOQQ, then the polygon is shrunk to match the DOQQ; (2) if the permanent snowfield/glacier is more extensive on the DOQQ, then the polygon is drawn as originally interpreted on the color infrared imagery.

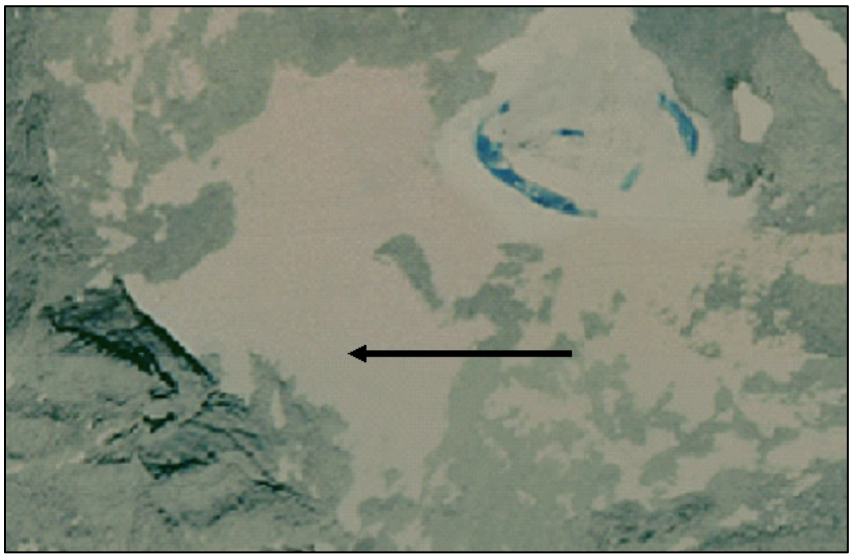


Figure 0970-2. Alpine Permanent Snowfield/Glacier signature. Photo reference: MOBR_NE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 3136–4289 m (10290–14072 ft)
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 0970-3.

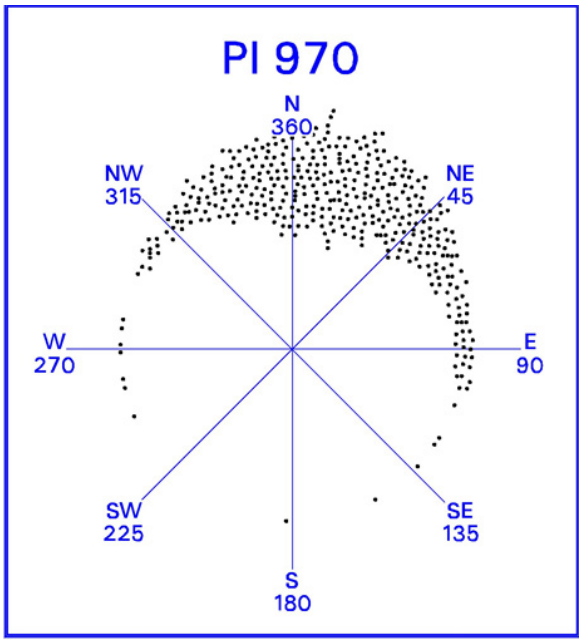


Figure 0970-3. Scatterplot of Alpine Permanent Snowfields/Glaciers in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Alpine Scree Slope (0200)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)

0980 – Water

Description:

The water category encompasses all water bodies, including lakes, ponds, streams, and rivers, and is mapped across a wide range of slope steepness and aspects between 401–3966 m (1315–13012 ft) over 11,659 acres of Sequoia and Kings Canyon National Parks (Figure 0980-1).

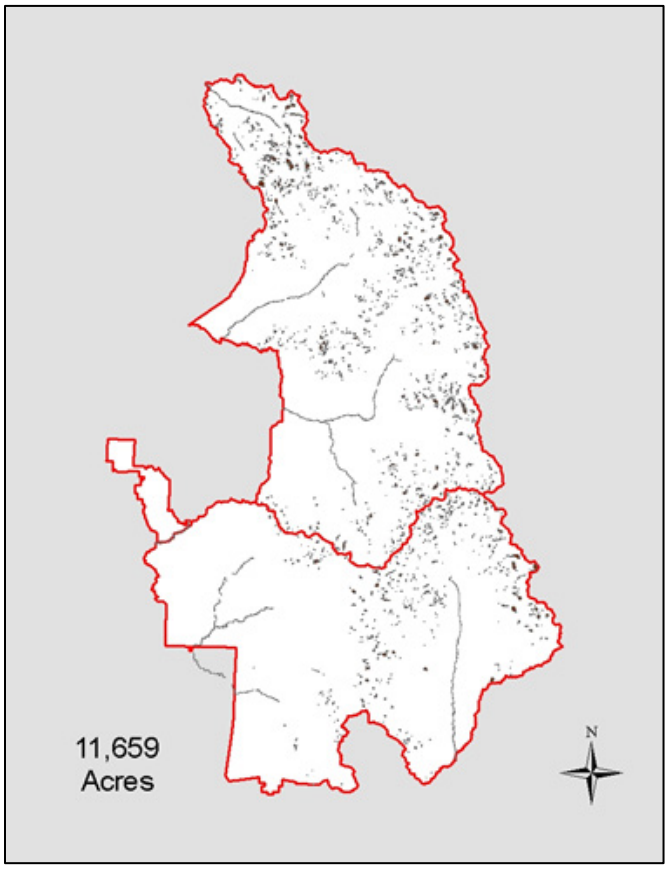


Figure 0980-1. Distribution of Water.

Accuracy:

Producer's accuracy: 100% (n=2)
User's accuracy: 100% (n=2)

Photo Interpretation Signature:

Water bodies and rivers typically have a dark blue to black signature on the aerial photography (Figure 0980-2). Portions of the rivers may appear dry (white to gray signature) due to the mid-summer dry conditions of the aerial photography.

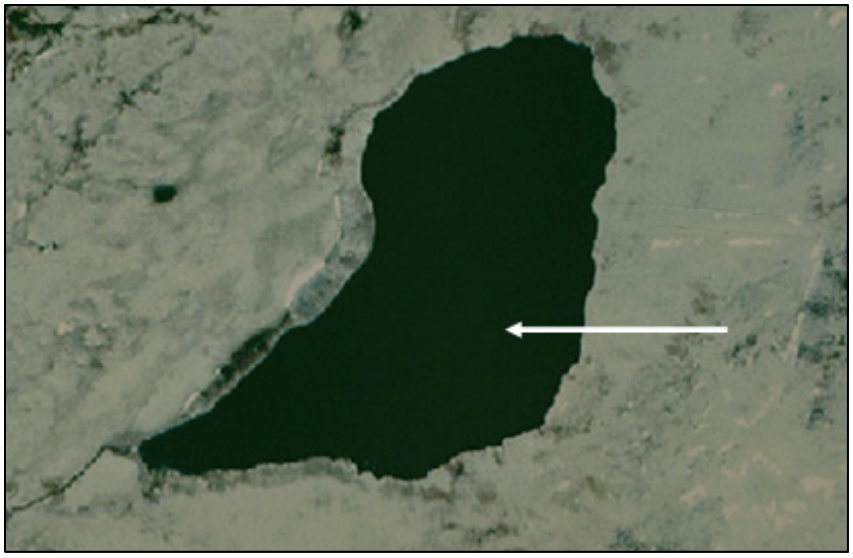


Figure 0980-2. Water signature – Lake South America. Photo reference: MOBR_SE.

Environmental Characteristics:

Elevation – 401–3966 m (1315–13012 ft)

Aspect – See Figure 0980-3.

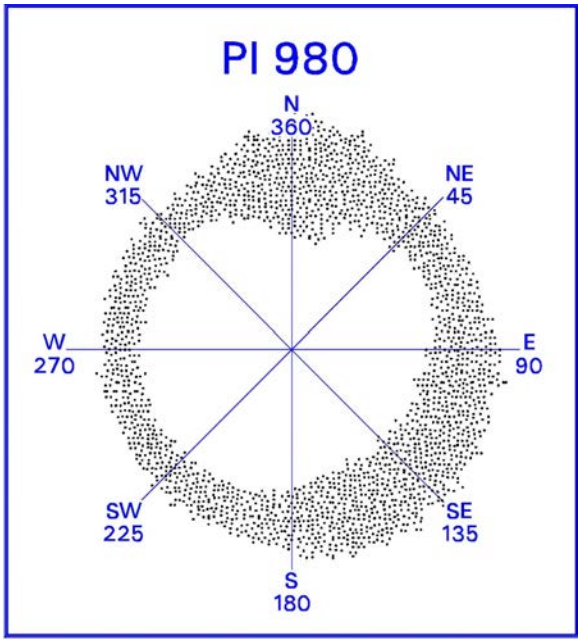


Figure 0980-3. Scatterplot of Water in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Semi-permanently to Permanently Flooded Meadow (9000)

0990 – Urban/Developed

Description:

All urban/developed or human-disturbed areas with less than 2% absolute vegetative cover are mapped in this class and total 73 acres in Sequoia and Kings Canyon National Parks (Figure 0990-1). Vacant areas created by human activity, such as road cuts and cleared areas, are included here. Refer to the following list of land use codes or see the land use layer for more detailed land use designations of built-up features. *Note: This is a complete list of land use codes, but not all of these land use types are mapped at SEKI.*

100 = Urban/Built Up (Outside of the Park and Private In-Holdings)
- 110 = Residential
- 120 = Commercial
- 130 = Industrial
- 140 = Transportation/Utility/Communication

150 = Recreation

200 = Agriculture (Outside of the Park and Private In-Holdings)
- 210 = Plantations
- 220 = Other Agricultural Land

300 = Mining (Outside of the Park and Private In-Holdings)

400 = National Park Facilities (Within the Park Except Private In-Holdings)
- 410 = Residential
- 420 = Commercial
  - 421 = Hotels/Lodges
  - 422 = Commercial/Concessions (including shops, restaurants, visitor center)
- 430 = Administration/Offices
  - 431 = Administrative Offices/Research Facilities/Other Services
  - 432 = Park Entrance
  - 433 = Restoration
  - 434 = Museum
- 440 = Industrial
  - 441 = Maintenance Shops
- 450 = Transportation/Utility/Communication
  - 451 = Sewage Treatment Facilities
  - 452 = Water Storage Facilities
  - 453 = Water Treatment Facilities
  - 454 = Electrical Power Facilities
  - 455 = Communication Facilities
  - 456 = Major Day Use Parking Areas
  - 457 = Dams
- 460 = Recreation
  - 461 = Ski Areas
  - 462 = Picnic Areas and Associated Parking
  - 463 = Campgrounds (non-primitive) and Associated Parking
  - 464 = Tent Cabins and Associated Parking
  - 465 = Golf Course
  - 466 = View Point Area and Associated Parking
  - 467 = Stables and Associated Facilities
  - 468 = Ice Rink and Associated Parking
  - 469 = Firing Range
- 470 = Mining/Borrow Pits

800 = Open Water

900 = Vacant

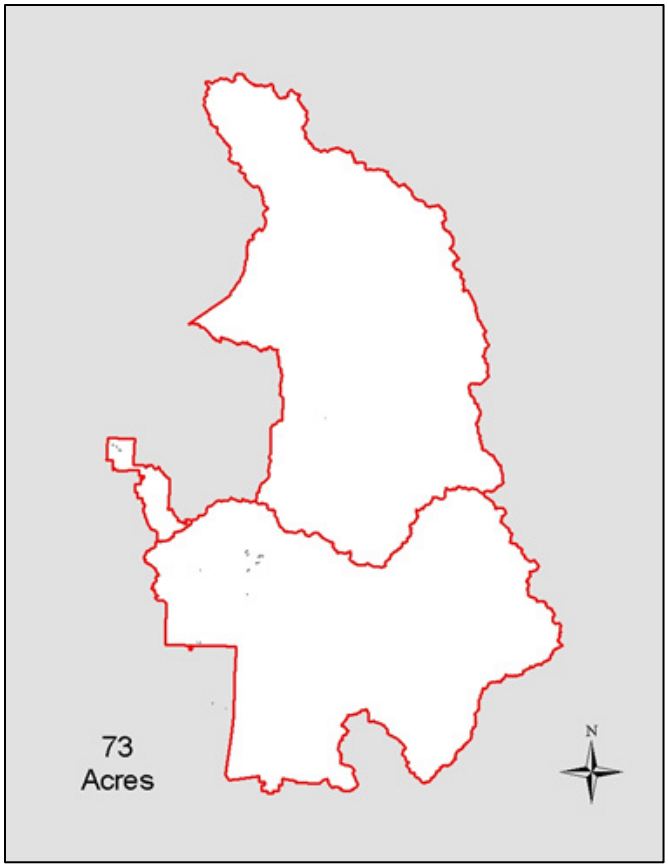


Figure 0990-1. Distribution of Urban/Developed.

Accuracy:

Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:

Unnatural non-vegetated areas or stands of unnatural altered vegetation, usually as a result of human disturbance, generally identify the photo interpretation signature for the Urban/Developed mapping unit (Figure 0990-2). The boundaries for this type are usually straight.

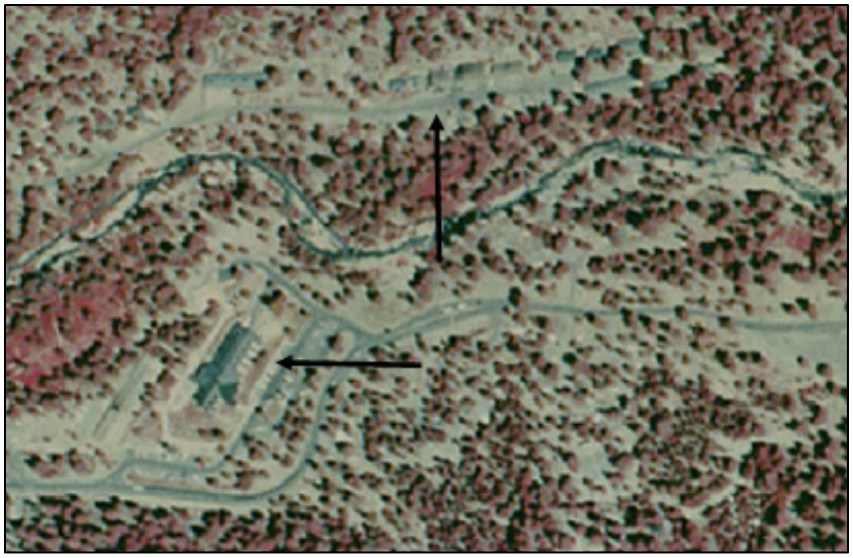


Figure 0990-2. Urban/Developed signature – Lodgepole area, Sequoia National Park. Photo reference: LODG_NW.

Environmental Characteristics:

Aspect – See Figure 0990-3.

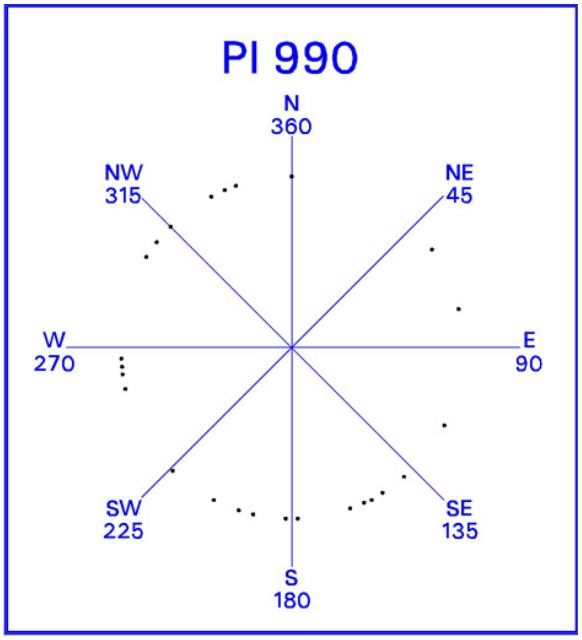


Figure 0990-3. Scatterplot of Urban/Developed in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- None

1000 Broadleaf Evergreen Trees



Canyon Live Oak – California Laurel Forest. SEKI.215_222.

1020 Canyon Live Oak Forest Alliance
Quercus chrysolepis Forest Alliance

Description:
The *Quercus chrysolepis* forest alliance is mapped on gentle to steep slopes of varying aspect between 600–2800 m (1970–9236 ft) across 31,319 acres of Sequoia and Kings Canyon National Parks (Figure 1020-1). At lower elevations, stands are often found on north- to northeast-facing slopes, while at higher elevations they are found on south- to southwest-facing slopes. Soils are generally shallow and well drained. Stands occurring on low slopes are often characterized by large talus blocks. Although not a riparian type, stands of canyon live oak are frequently found immediately adjacent to riparian corridors. The hydrology ranges from upland settings to drier fringes of riparian areas. The overstory is dominated by *Quercus chrysolepis* but also may include *Umbellularia californica* (frequently as a co-dominant), *Acer macrophyllum, Torreya californica, Pinus monophylla,* or *Juniperus occidentalis var. australis.* Emergent conifers may include *Calocedrus decurrens, Abies concolor, Pinus lambertiana, Pinus ponderosa* or *Pinus jeffreyi*. The shrub layer is characteristically sparse but may include *Arctostaphylos viscida, A. mewukka, A. patula, Cercocarpus montanus var. glaber, Garrya flavescens, Keckiella breviflora,* or *Rhamnus tomentella*. (NatureServe October 2006).

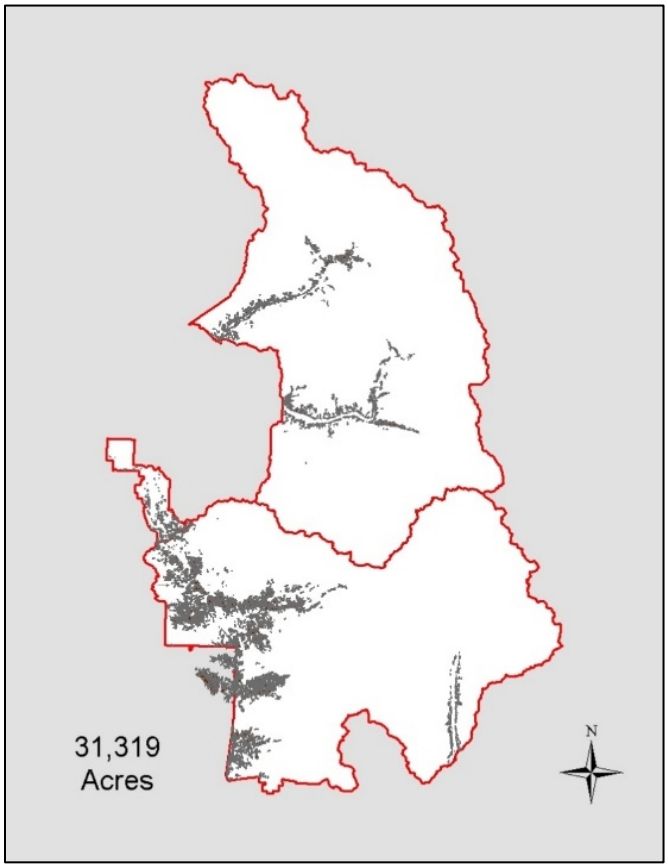


Figure 1020-1. Distribution of Canyon Live Oak Forest Alliance.

Accuracy:
Producer's accuracy: 85 % (n=33)
User's accuracy: 93% (n=30)

Photo Interpretation Signature:
The *Quercus chrysolepis* photo signature appears pink or red. The crowns of the trees are broad and round while the texture varies from smooth to slightly uneven (Figure 1020-2). *Juniperus occidentalis var. australis* is only occasionally noted as a minor component in the highest stands in rocky areas adjacent to *J. occidentalis var. australis* types.

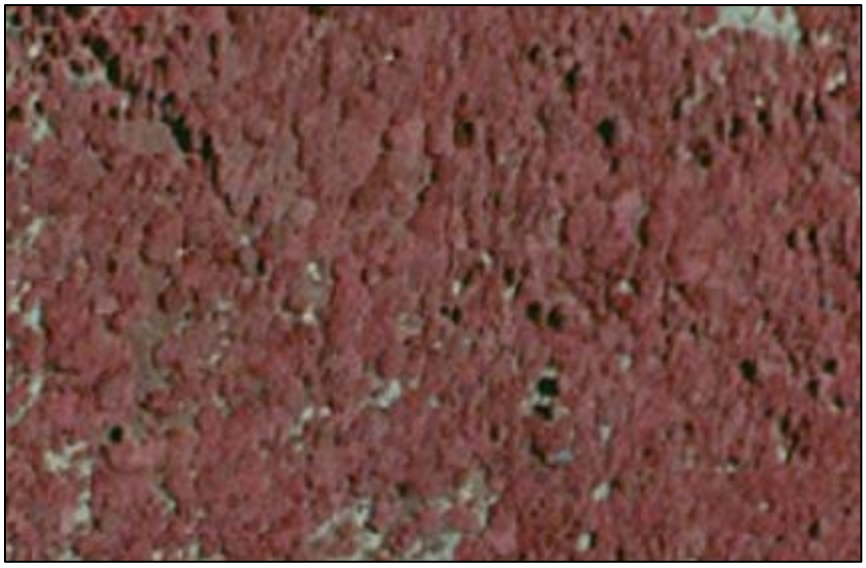


Figure 1020-2. Canyon Live Oak signature. Photo reference: LODG_NW.

Environmental Characteristics:
Microclimate – xeric
Elevation – 600–2800 m (1970–9236 ft)
Shape – flat to concave or convex
Slope position – canyon bottoms and slopes
Steepness – gentle to very steep
Aspect – See Figure 1020-3.

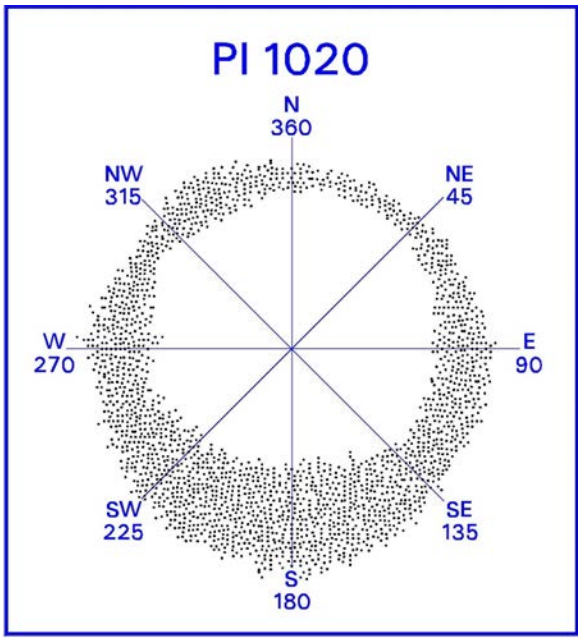


Figure 1020-3. Scatterplot of Canyon Live Oak in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak–California Laurel Forest Superassociation (1024)
- Interior Live Oak Woodland Alliance (1040)
- Interior Live Oak – Canyon Live Oak Woodland Association (1043)
- California Black Oak Forest Alliance (2020)
- Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association (3114)

1021 – Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit
Quercus chrysolepis/Cercocarpus montanus var. *glaber* Forest Mapping Unit

Description:

The *Quercus chrysolepis/Cercocarpus montanus var. glaber* mapping unit is mapped on gentle to steep southeast to southwest trending slopes between 601–2100 m (1971–6891 ft) across 2,482 acres in Sequoia and Kings Canyon National Parks (Figure 1021-1). *Quercus chrysolepis* dominates the overstory of these sparse to moderately dense stands. The shrub layer is characterized by *Cercocarpus montanus var. glaber (C. betuloides sensu* Hickman 1993*)*, with *Arctostaphylos viscida* or *A. mewukka* also often present. Stands of the *Quercus chrysolepis/ Cercocarpus montanus var. glaber* mapping unit are generally found at slightly higher elevations than the *Quercus chrysolepis / Arctostaphylos viscida* mapping unit, and in rockier and steeper settings than the *Quercus chrysolepis / Arctostaphylos* mapping unit.

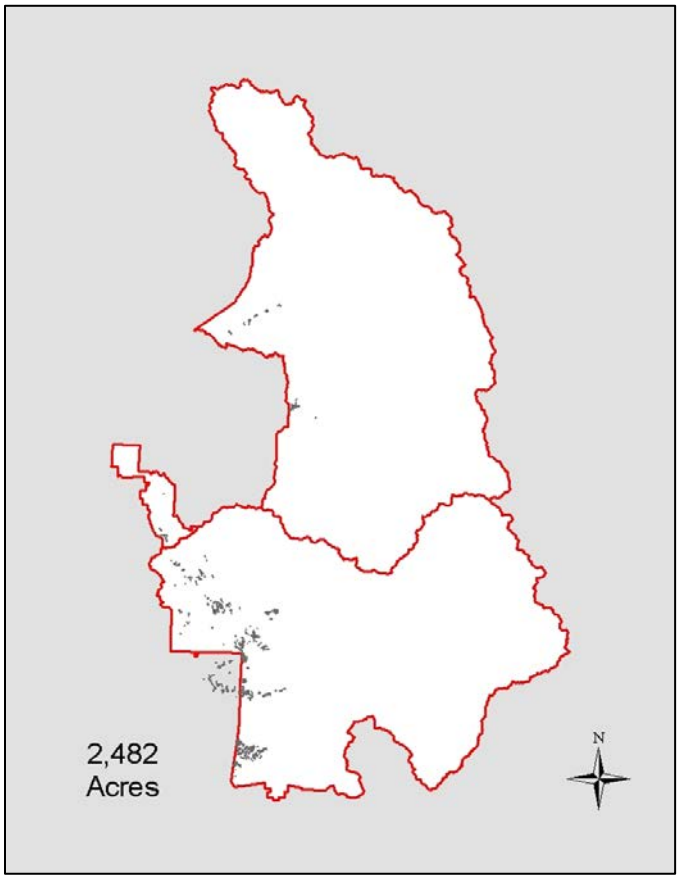


Figure 1021-1. Distribution of Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit.

Accuracy:

Producer's accuracy: 100 % (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:

The *Quercus chrysolepis* signature appears pink or red with smooth, extensive round crowns while the *Cercocarpus montanus var. glaber* signature looks coarse in texture and tan or brown in color (Figure 1021-2). There are openings in the *Quercus chrysolepis* canopy that contain sparse to dense *C. montanus var. glaber* understory.



Figure 1021-2. Canyon Live Oak / Birchleaf Mountain Mahogany Forest signature. Photo reference: LODG_NW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 601–2100 m (1971–6891 ft)
Shape – neutral to convex
Slope position – generally southeast to southwest trending
Steepness – generally steep
Aspect – See Figure 1021-3.

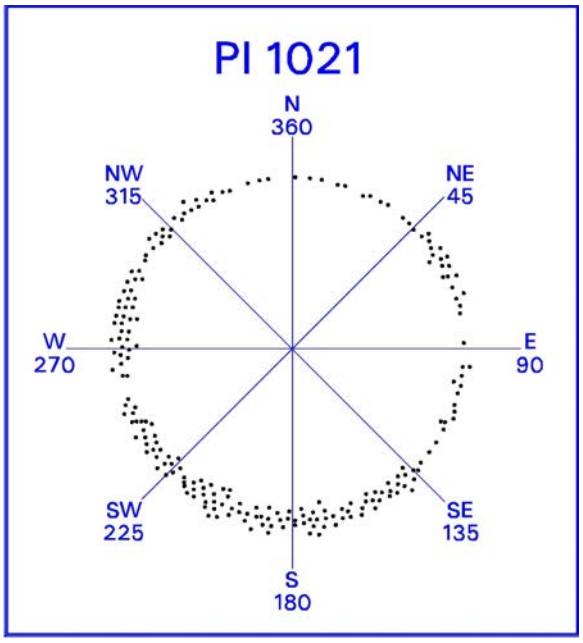


Figure 1021-3. Scatterplot of Canyon Live Oak / Birchleaf Mountain Mahogany Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Whiteleaf Manzanita Forest Association (1022)
- Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany – California Redbud Forest Association (1044)
- Birchleaf Mountain Mahogany Shrubland Alliance (5010)
- Birchleaf Mountain Mahogany /California Redbud–California Flannelbush Shrubland Association (5011)
- Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association (5012)
- Chaparral Yucca Shrubland Alliance (5270)
- Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association (6022)

1022 – Canyon Live Oak/Whiteleaf Manzanita Forest Association
Quercus chrysolepis/Arctostaphylos viscida Forest Association

Description:

The *Quercus chrysolepis*/*Arctostaphylos viscida* forest association is mapped on moderate to steep southwest facing slopes at elevations between 853–2030 m (2800–6661 ft) on 2,457 acres at Sequoia and Kings Canyon National Parks (Figure 1022-1). This association is characterized by open stands of *Quercus chrysolepis* at a minimum of 5–10% as an emergent to *Arctostaphylos viscida* or *A. mewukka*, which have proven indistinguishable through photo interpretation. Emergent conifers may also include *Abies concolor*, *Calocedrus decurrens*, *Pinus lambertiana*, or *Pinus ponderosa*. The shrub layer may also include *Ceanothus integerrimus* or *Chamaebatia foliolosa*. Soils are poorly developed to rocky, often on coarse decomposed granite. The hydrology for this mapping unit is upland.

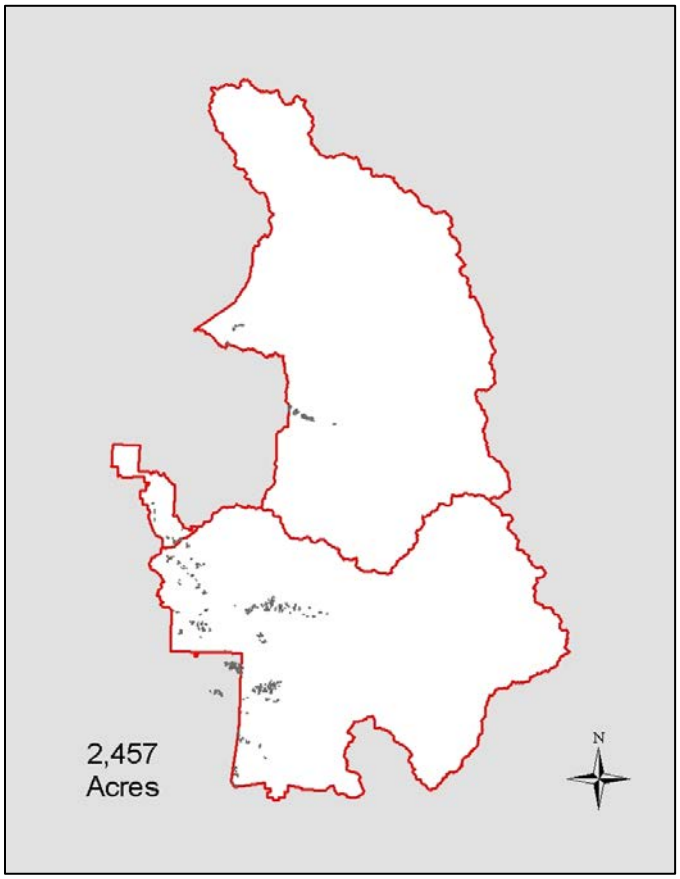


Figure 1022-1. Distribution of Canyon Live Oak/Whiteleaf Manzanita Forest Association.

Accuracy:

Producer's accuracy: 50% (n=6)
User's accuracy: 100% (n=3)

Photo Interpretation Signature:

The *Quercus chrysolepis* signature appears pink or red with smooth, broad, round crowns while the understory of the coarse whiteleaf manzanita (*Arctostaphylos viscida* or *A. mewukka)* looks light brown. There are openings in the *Quercus chrysolepis* that contain sparse to dense whiteleaf manzanita. Photo interpreters generally do not note significant conifer presence in this association.

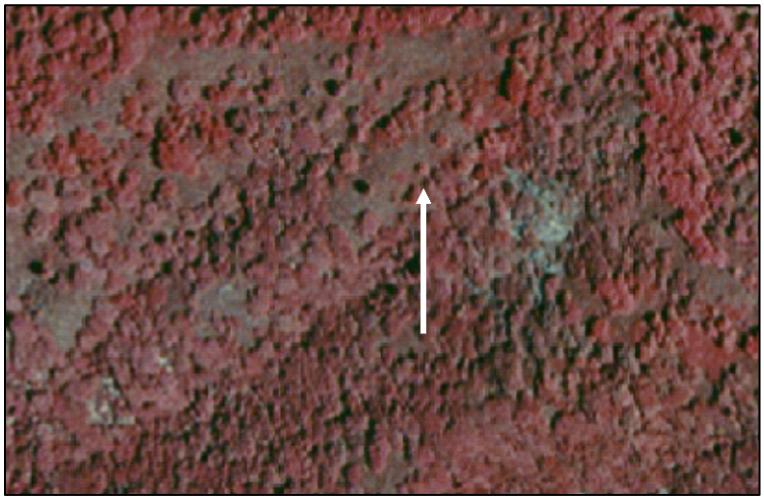


Figure 1022-2. Canyon Live Oak / Whiteleaf Manzanita Forest signature. Photo reference: LODG_NW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 853–2030 m (2800–6661 ft)
Shape – convex
Slope position – middle and upper
Steepness – fairly steep slopes and shallower slopes with exposed bedrock
Aspect – See Figure 1022-3.

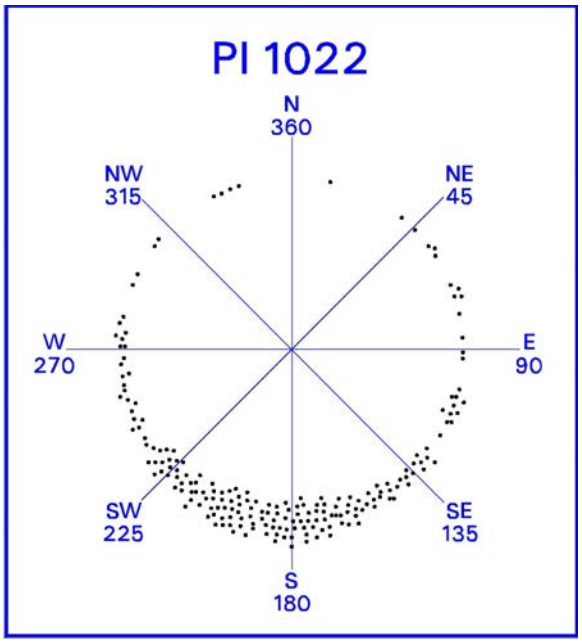


Figure 1022-3. Scatterplot of Canyon Live Oak /Whiteleaf Manzanita Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- Canyon Live Oak–California Laurel Forest Superassociation (1024)
- Canyon Live Oak/Greenleaf Manzanita Forest Association (1029)
- California Black Oak/Greenleaf Manzanita Forest Association (2021)
- California Black Oak/Indian Manzanita – Mountain Misery Forest Association (2026)

1023 – Canyon Live Oak (Ponderosa Pine–Incense-cedar) Forest Superassociation
Quercus chrysolepis (*Pinus ponderosa–Calocedrus decurrens*) Forest Superassociation

Description:

The *Quercus chrysolepis–(Pinus ponderosa–Calocedrus decurrens)* forest superassociation is mapped on gentle to steep slopes of variable aspect between 704–2064 m (2309–6773 ft) across 2,020 acres of Sequoia and Kings Canyon National Parks (Figure 1023-1). Stands are characterized by a dense (>75% crown cover) canopy of *Quercus chrysolepis* with emergent *Pinus ponderosa* or *Calocedrus decurrens* contributing at least 3–5% relative cover. The two associations making up this superassociation appear to be transitional between the *Quercus chrysolepis* forest alliance, *Pinus ponderosa* woodland alliance, and the *Calocedrus decurrens* forest alliance. The tree layer is dominated by *Quercus chrysolepis* and *Pinus ponderosa* or *Calocedrus decurrens* although *Quercus kelloggii, Abies concolor* and *Pinus lambertiana* may also be important. Although not usually discernible on the aerial photography, the shrub layer is generally open with *Chamaebatia foliolosa* and *Toxicodendron diversilobum* most frequently encountered. The sparse herb layer is characterized primarily by the presence of *Galium bolanderi* and *Asarum hartwegii*; however, a variety of other understory species may contribute minor cover. Soils are moderately to well drained loamy sands and the hydrology is upland.

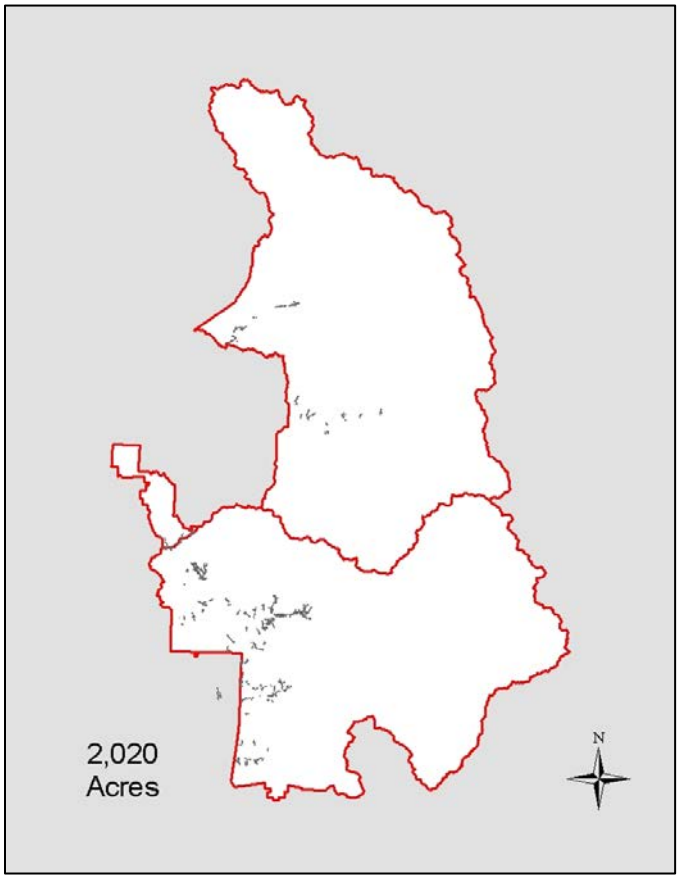


Figure 1023-1. Distribution of Canyon Live Oak (Ponderosa Pine–Incense-cedar) Forest.

Accuracy:

Producer's accuracy: 67% (n=6)
User's accuracy: 100% (n=4)

Photo Interpretation Signature:

The dense stands of broad, round-crowned *Quercus chrysolepis* in mesic settings generally yield a dark red signature. The narrow crowned, bright red *Calocedrus decurrens* is often difficult to see in this stand. Sparse emergent *Pinus ponderosa* with rounded crowns appear taller and lighter in color than the *Q. chrysolepis* (Figure 1023-2). The overall texture of the stand is smooth to slightly uneven with tall emergent trees interspersed throughout. Photo interpreters generally do not detect the presence of *Chamaebatia foliolosa* as an understory component of this class.

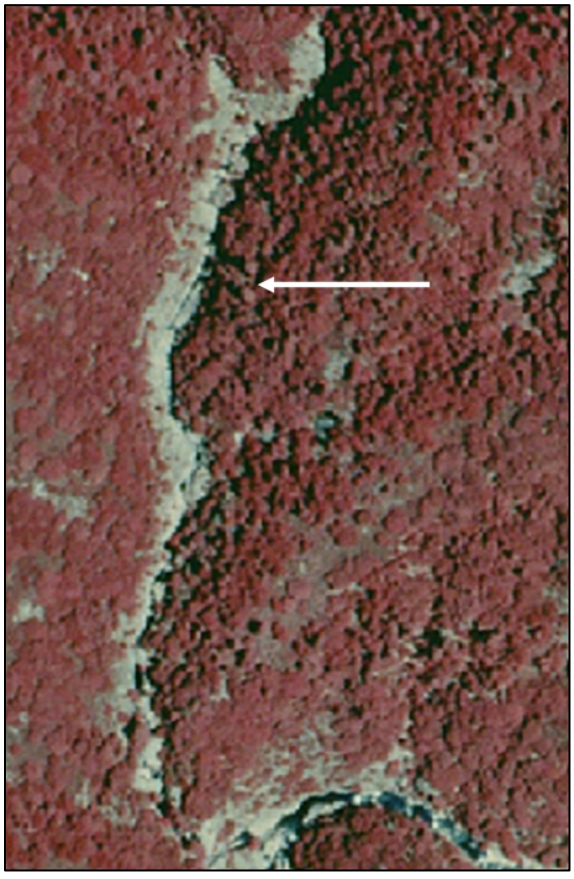


Figure 1023-2. Canyon Live Oak (Ponderosa Pine–Incense-cedar) signature. Photo reference: LODG_SW.

Environmental Characteristics:

Microclimate – mesic
Elevation – 704–2064 m (2309–6773 ft)
Shape – concave when adjacent to riparian environments and convex on side slopes
Slope position – canyon bottoms; low to midslopes
Steepness – gentle to steep

Aspect – See Figure 1023-3.

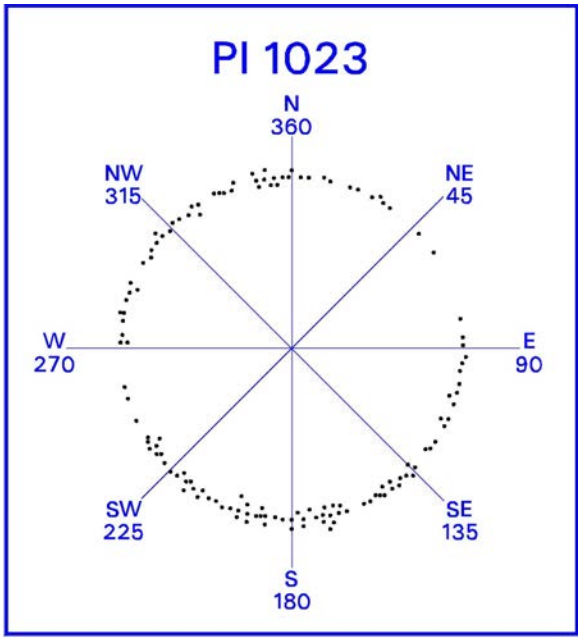


Figure 1023-3. Scatterplot of Canyon Live Oak (Ponderosa Pine–Incense-cedar) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak–California Laurel Forest Superassociation (1024)
- Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association (3061)
- Ponderosa Pine–Incense-cedar–California Black Oak Forest Association (3063)

1024 – Canyon Live Oak–California Laurel Forest Superassociation
Quercus chrysolepis–Umbellularia californica Forest Superassociation

Description:
The *Quercus chrysolepis–Umbellularia californica* forest superassociation is mapped on moderate to steep slopes of varying aspects between 611–2236 m (2005–7337 ft) across 12,327 acres of Sequoia and Kings Canyon National Parks. At lower elevations stands are often found on north- to northeast-facing slopes, while at higher elevations they can be found on south- to southwest-facing slopes. The tree canopy is closed, with >75% crown cover of *Quercus chrysolepis* and a minimum of 1–5% cover of *Umbellularia californica. Aesculus californica, Quercus wislizeni var. wislizeni, Q. kelloggii, Calocedrus decurrens* and/or *Torreya californica* may also be present. The shrub layer is characteristically sparse, and may include *Toxicodendron diversilobum, Symphoricarpos mollis*, or *Rhamnus ilicifolia*. The herbaceous layer is characteristically sparse to absent. Soils are moderately well drained sandy to silty loams. The hydrology for this superassociation is upland. (NatureServe October 2006).

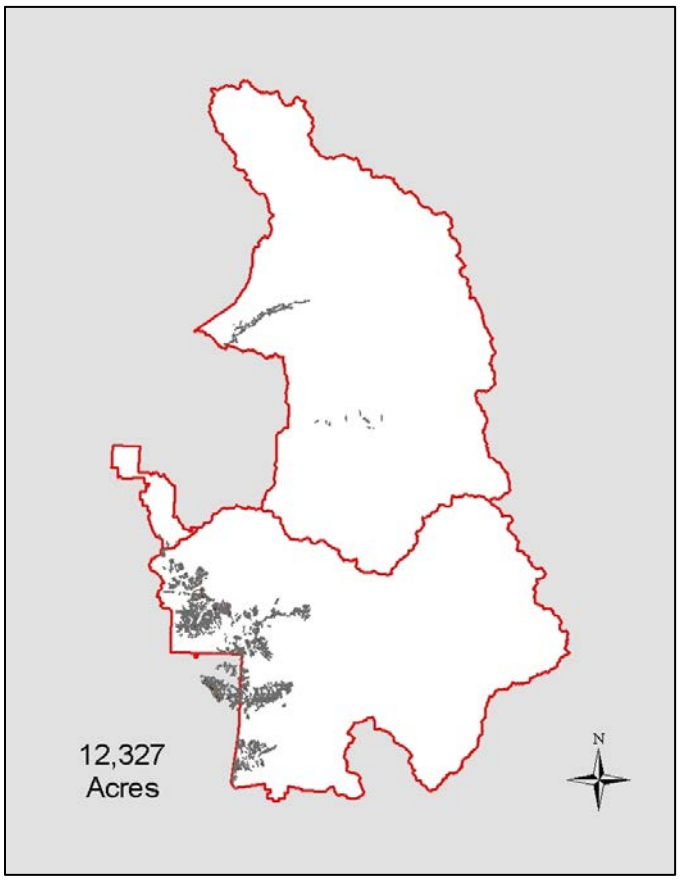


Figure 1024-1. Distribution of Canyon Live Oak–California Laurel Forest.

Accuracy:
Producer's accuracy: 89% (n=19)
User's accuracy: 77% (n=22)

Photo Interpretation Signature:

The photo signature of the large, round crowns of the *Quercus chrysolepis* appears dark red. *Umbellularia californica* can be a very minor component in the canopy and is indiscernible on the aerial photos. The stand is usually dense and the crown texture is generally smooth with some variability throughout. Photo interpreters generally do not detect presence of *Arctostaphylos viscida* in mapped stands.

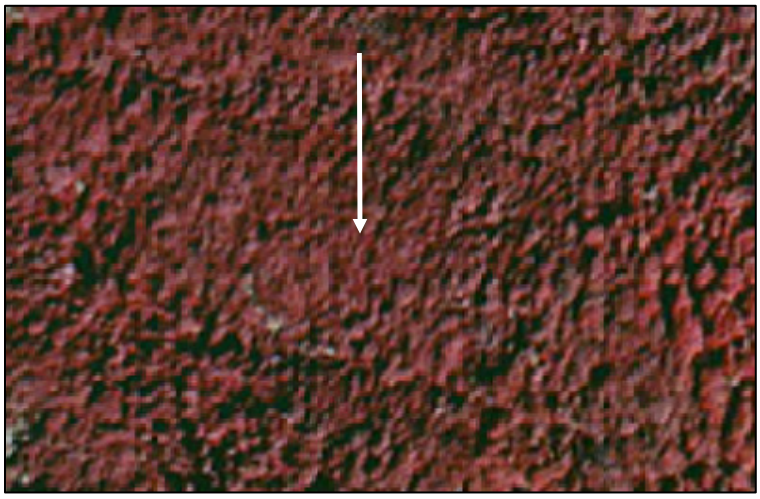


Figure 1024-2. Canyon Live Oak–California Laurel Forest signature. Photo reference: GIFO_NW.

Environmental Characteristics:

Microclimate – mesic
Elevation – 611–2236 m (2005–7337 ft)
Shape – flat to concave or convex
Slope position – variable; low to midslope
Steepness – moderate to steep
Aspect – See Figure 1024-3.

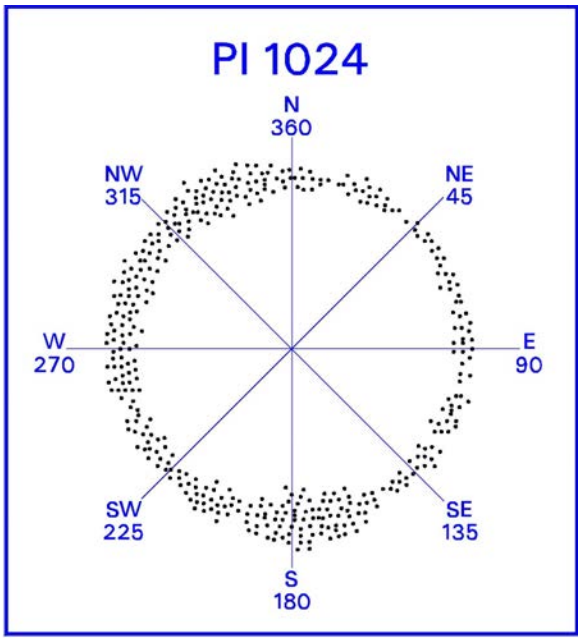


Figure 1024-3. Scatterplot of Canyon Live Oak–California Laurel Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak Forest Alliance (1020)
- Canyon Live Oak/Whiteleaf Manzanita Forest Association (1022)
- Canyon Live Oak–(Ponderosa Pine–Incense-cedar) Forest Superassociation (1023)
- Interior Live Oak – Canyon Live Oak Woodland Association (1043)
- California Black Oak Forest Alliance (2020)

1029 – Canyon Live Oak/Greenleaf Manzanita Forest Association
Quercus chrysolepis/Arctostaphylos patula Forest Association

Description:

Stands of *Quercus chrysolepis/Arctostaphylos patula* forest association are generally found at mid-elevations 1415–2815 m (4641–9236 ft) on the mid to upper portions of linear to convex-shaped slopes across 4,554 acres of Sequoia and Kings Canyon National Parks (Figure 1029-1). These sites tend to be on moderate to steep south- to southwest-facing slopes. Soils are well drained sandy loams of granitic parent material and the hydrology is upland. These are open stands of 10–40% canyon live oak over a sparse to dense understory of *Arctostaphylos patula*, shrubby *Quercus chrysolepis*, and *Chamaebatia foliolosa*. *Quercus kelloggii, Calocedrus decurrens, Pinus ponderosa,* and *Ceanothus* species can also be present. The herbaceous layer is characteristically sparse (NatureServe October 2006).

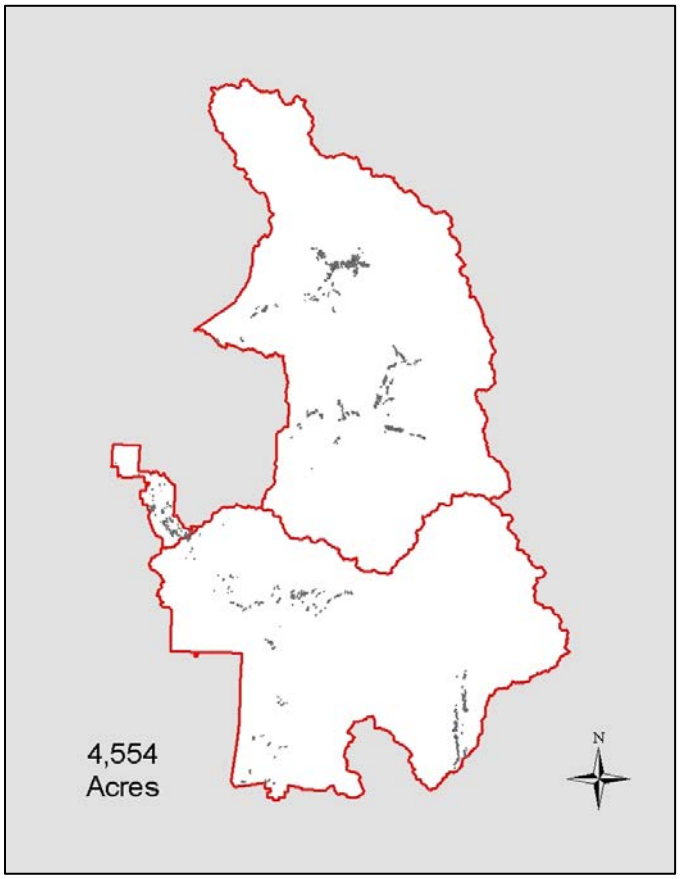


Figure 1029-1. Distribution of Canyon Live Oak/Greenleaf Manzanita Forest.

Accuracy:

Producer's accuracy: 93% (n=15)
User's accuracy: 82% (n=17)

Photo Interpretation Signature:

The photo signature of the *Quercus chrysolepis* looks red or pink, with expansive round crowns. The *Arctostaphylos patula* appears orange or orange-brown with a coarse crown. The *Quercus chrysolepis* forms a moderately open canopy with a sparse to dense understory of *Arctostaphylos patula* (Figure 1029-2). Other montane chaparral species may be present.

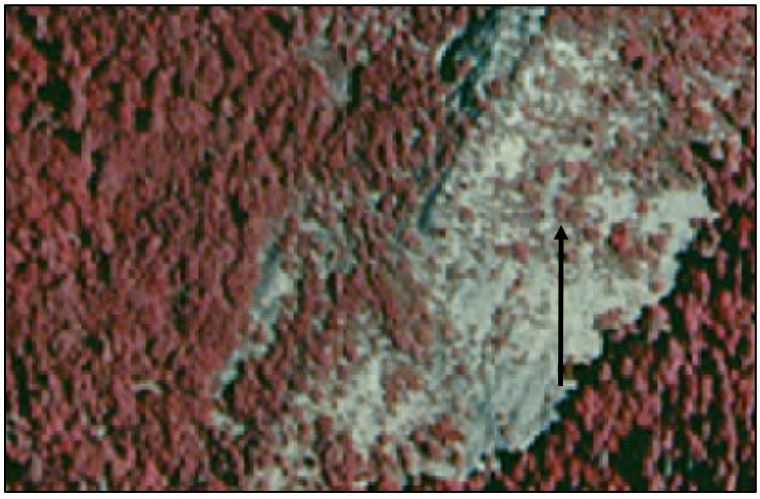


Figure 1029-2. Canyon Live Oak/Greenleaf Manzanita Forest signature. Photo reference: LODG_SW.

Environmental Characteristics:

Microclimate – subxeric
Elevation – 1415–2815 m (4641–9236 ft)
Shape – convex
Slope position – low, middle to upper
Steepness – moderate to steep
Aspect – See Figure 1029-3.

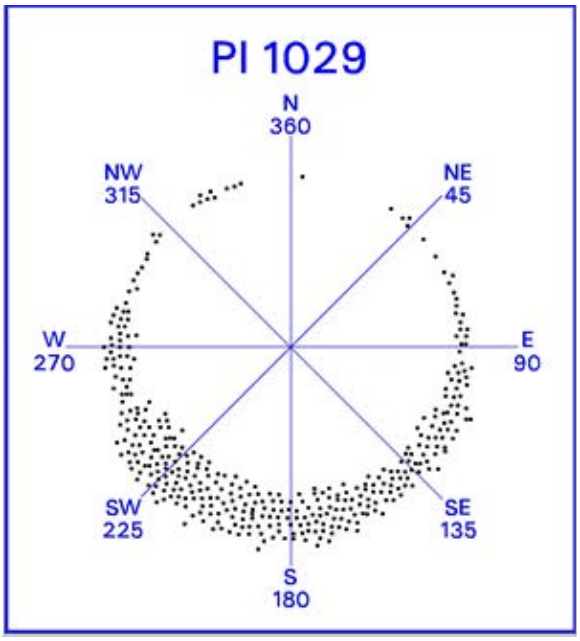


Figure 1029-3. Scatterplot of Canyon Live Oak/Greenleaf Manzanita Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Whiteleaf Manzanita Forest Association (1022)
- California Black Oak/Greenleaf Manzanita Forest Association (2021)
- California Black Oak/Indian Manzanita – Mountain Misery Forest Association (2026)

1040 – Interior Live Oak Woodland Alliance



Interior Live Oak–California Buckeye / Birchleaf Mountain Mahogany–California Redbud Forest. Photo reference: SEKI-AA.0042_659.

1040 – Interior Live Oak Woodland Alliance

Quercus wislizeni var. *wislizeni* Woodland Alliance

Description:

The *Quercus wislizeni var. wislizeni* woodland alliance is mapped on gentle to steep slopes of varying aspect between 389–1901 m (1275–6238 ft) across 6,906 acres of Sequoia and Kings Canyon National Parks (Figure 1040-1). Soils are generally shallow and well drained sandy loams. The hydrology is upland. This alliance is characterized by *Quercus wislizeni var. wislizeni* as the sole or co-dominant tree in the canopy. Other trees may include *Aesculus californica, Quercus chrysolepis,* or *Umbellularia californica*. Shrubs may be either infrequent or common and may include a diverse mixture of *Adenostoma fasciculatum, Arctostaphylos viscida, Cercis canadensis var. texensis, Cercocarpus montanus var. glaber,* or *Toxicodendron diversilobum.* The herbaceous layer is often sparse, but may include exotic annual species such as *Bromus diandrus* or *Hypochaeris glabra*; moister sites often support a diverse herbaceous layer. (NatureServe October 2006).

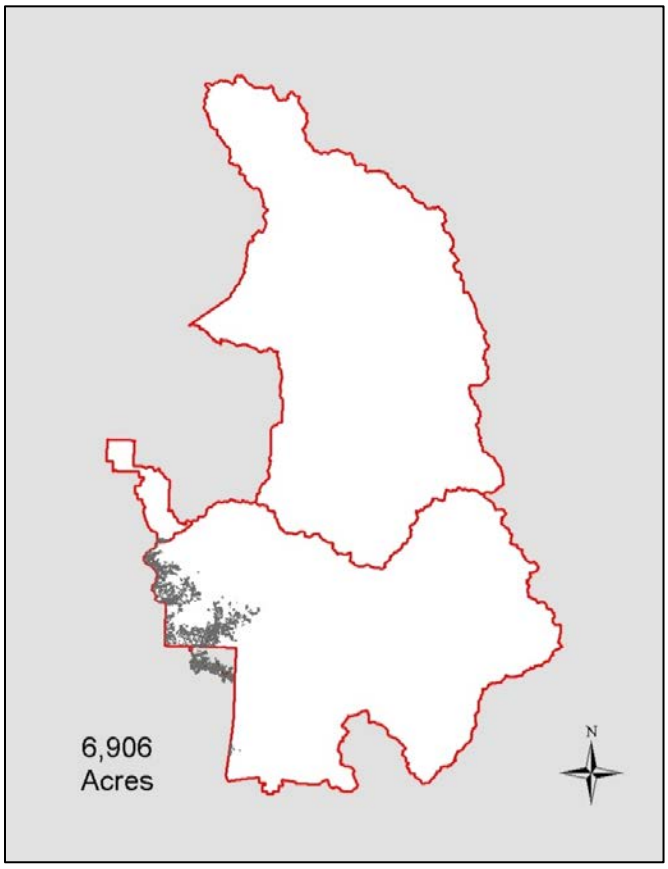


Figure 1040-1. Distribution of Interior Live Oak Woodland.

Accuracy:

Producer's accuracy: 100 % (n=5)

User's accuracy: 71% (n=7)

Photo Interpretation Signature:
The photo signature of *Quercus wislizeni var. wislizeni* varies from dark to dull red with a smooth texture and a small rounded crown (Figure 1040-2).

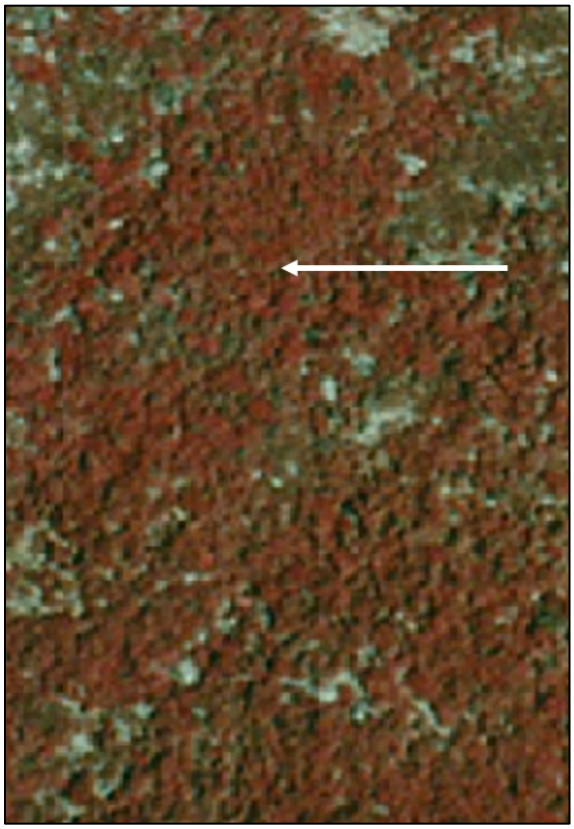


Figure 1040-2. Interior Live Oak Woodland signature. Photo reference: SHMO_NE.

Environmental Characteristics:
Microclimate – variable
Elevation – 389–1901 m (1275–6238 ft)
Shape – concave to convex
Slope position – low to midslope
Steepness – gentle to steep
Aspect – See Figure 1040-3.

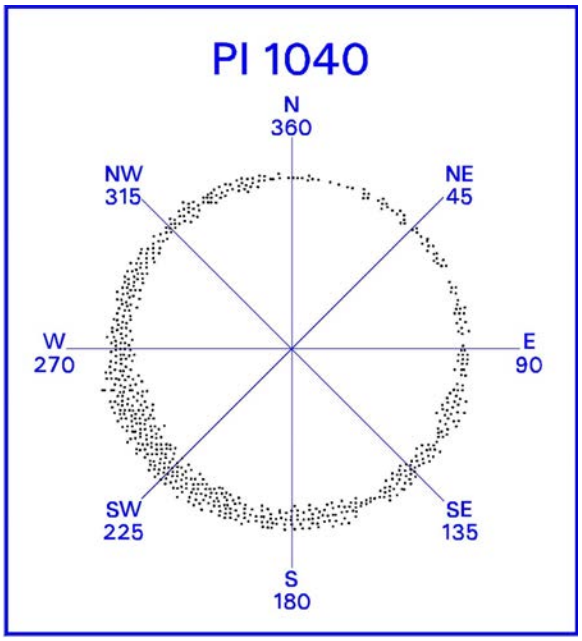


Figure 1040-3. Scatterplot of Interior Live Oak Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak Forest Alliance (1020)
- Canyon Live Oak–California Laurel Forest Superassociation (1024)
- Interior Live Oak – Canyon Live Oak Woodland Association (1043)
- Interior Live Oak – California Buckeye/Birchleaf Mountain Mahogany – California Redbud Forest Association (1044)
- California Black Oak Forest Alliance (2020)
- Blue Oak–Interior Live Oak/Brome spp–American Wild Carrot Woodland Association (2034)

1043 – Interior Live Oak–Canyon Live Oak Woodland Association
Quercus wislizeni var. *wislizeni–Quercus chrysolepis* Woodland Association

Description:
The *Quercus wislizeni var. wislizeni–Quercus chrysolepis* woodland association is mapped on gentle to steep slopes of varying aspect between 591–1608 m (1939–5277 ft) across 1,603 acres of Sequoia and Kings Canyon National Parks (Figure 1043-1). The open to closed stands are dominated by an even mix of *Quercus wislizeni var. wislizeni* and *Q. chrysolepis* over an understory of scattered shrubs and patches of annual grasses and herbs. Total tree canopy cover generally ranges from 30–60%. Other tree species may include *Umbellularia californica, Aesculus californica,* and *Pinus ponderosa*. When present, the shrub layer may include *Adenostoma fasciculatum, Arctostaphylos viscida, Cercocarpus montanus var. glaber Rhamnus tomentella* or *Toxicodendron diversilobum*. This upland association is often found adjacent to riparian corridors (NatureServe October 2006).

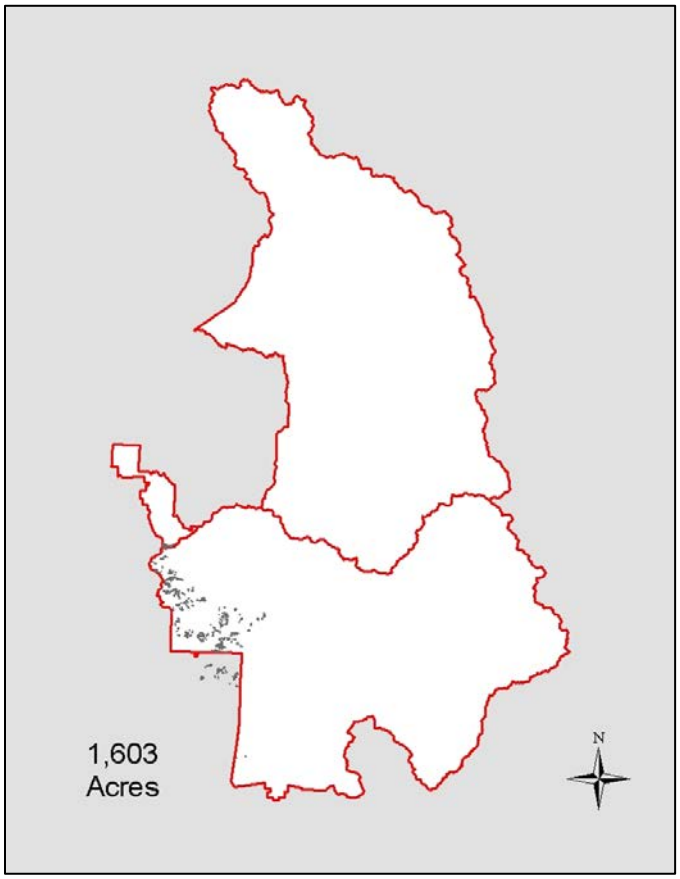


Figure 1043-1. Distribution of Interior Live Oak–Canyon Live Oak Woodland.

Accuracy:
Producer's accuracy: 100% (n=6)
User's accuracy: 100% (n=6)

Photo Interpretation Signature:

Generally the *Quercus chrysolepis* yields a redder signature and has a slightly larger round crown than the *Q. wislizeni var. wislizeni*. The stand texture appears smooth with some jaggedness throughout (Figure 1043-2).

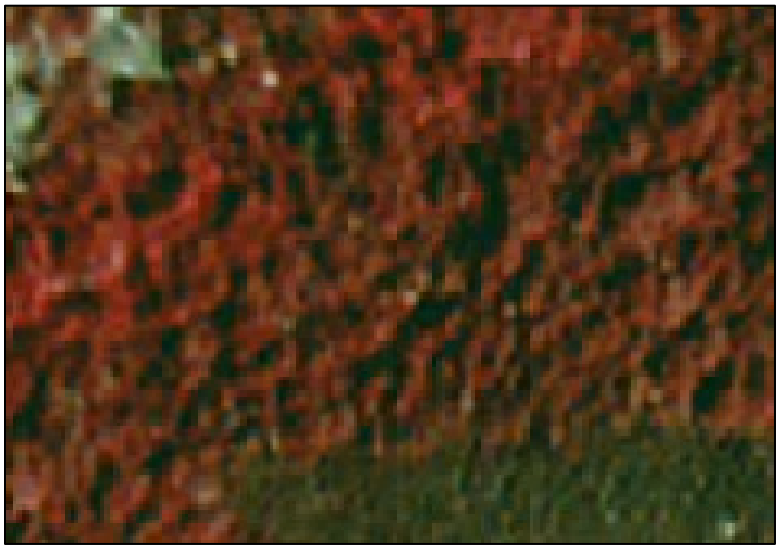


Figure 1043-2. Interior Live Oak–Canyon Live Oak Woodland signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – submesic
Elevation – 591–1608 m (1939–5277 ft)
Shape – concave to convex
Slope position – low slopes
Steepness – gentle to steep
Aspect – See Figure 1043-3.

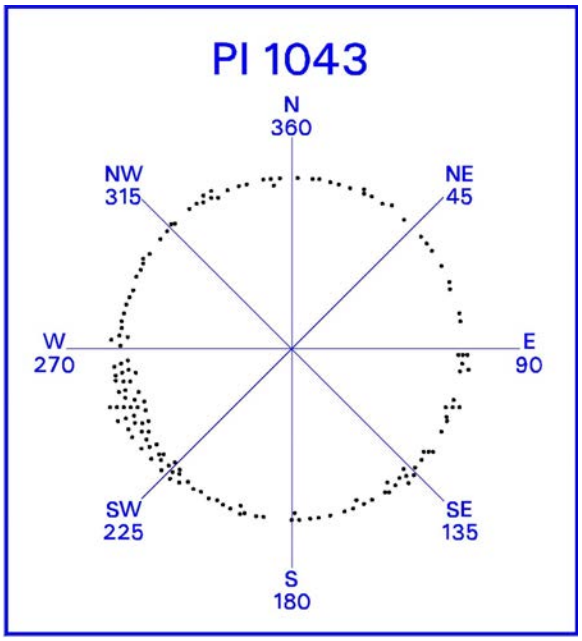


Figure 1043-3. Scatterplot of Interior Live Oak–Canyon Live Oak Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak Forest Alliance (1020)
- Canyon Live Oak–California Laurel Forest Superassociation (1024)
- Interior Live Oak Woodland Alliance (1040)
- Interior Live Oak – California Buckeye/Birchleaf Mountain Mahogany – (California Redbud) mapping unit (1044)
- California Black Oak Forest Alliance (2020)

1044 – Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany–California Redbud Forest Association

Quercus wislizeni var. *wislizeni–Aesculus californica/Cercocarpus montanus* var. *glaber–Cercis canadensis* var. *texensis* Forest Association

Description:

The *Quercus wislizeni var. wislizeni–Aesculus californica/Cercocarpus montanus var. glaber–* (*Cercis canadensis var. texensis*) mapping unit is mapped on gentle to steep slopes of varying aspects between 389–1523 m (1275–4997 ft) across 4,311 acres at Sequoia National Park (Figure 1044-1). Stands of this moderately open to closed canopy type occur on low to midslopes of the Kaweah River drainages, where it often forms extensive patches. The tree canopy is dominated by *Quercus wislizeni var. wislizeni* and *Aesculus californica*, with *Quercus chrysolepis* and *Umbellularia californica* often present. The shrub layer is characterized by *Cercocarpus montanus var. glaber* (*C. betuloides sensu* Hickman 1993) and *Cercis canadensis var. texensis (C. occidentalis sensu* Hickman 1993), but often includes varying amounts of *Fraxinus dipetala, Fremontodendron californicum,* and *Toxicodendron diversilobum*. Soils are moderately to well drained sandy loams. The hydrology of this vegetation type is upland.

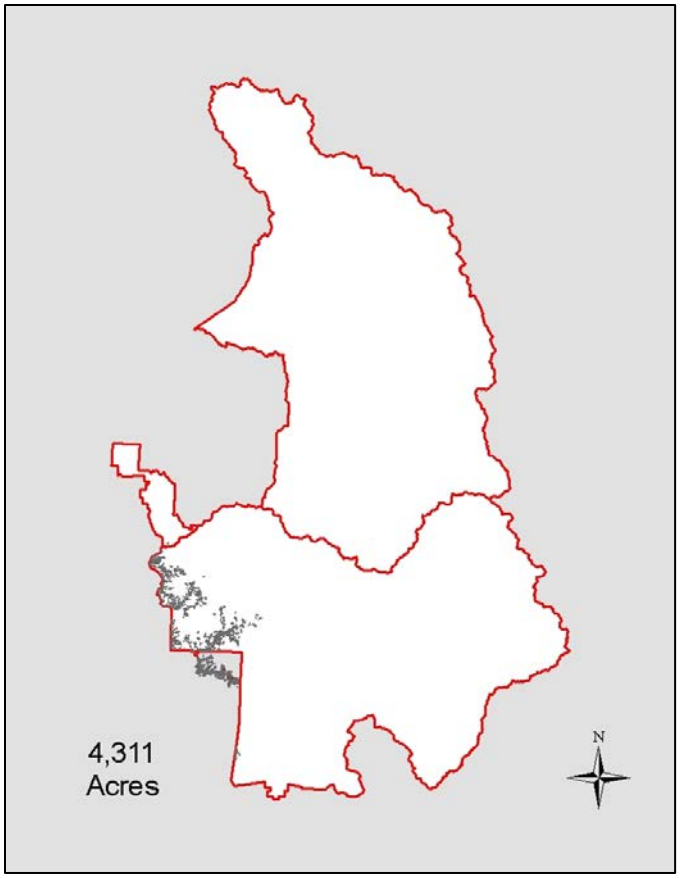


Figure 1044-1. Distribution of Interior Live Oak–California Buckeye/Birchleaf Mountain Mohogany–California Redbud Forest.

Accuracy:

Producer's accuracy: 83% (n=6)
User's accuracy: 100% (n=5)

Photo Interpretation Signature:

The photo signature of *Quercus wislizeni var. wislizeni* is red with small round crowns. The *Aesculus californica* looks yellow with small or medium irregularly shaped crowns and the *Cercocarpus montanus var. glaber* appears dark brown and coarse. The *Cercis canadensis var. texensis* is not distinct on the aerial photography. The stand has a rough pattern with *C. montanus var. glaber* occurring as the shrub understory to the *Q. wislizeni var. wislizeni* and *Aesculus californica* tree canopy (Figure 1044-2). *Adenostoma fasciculatum* generally is not found in significant amounts in mapped polygons, although adjacent stands may be mapped to that type.

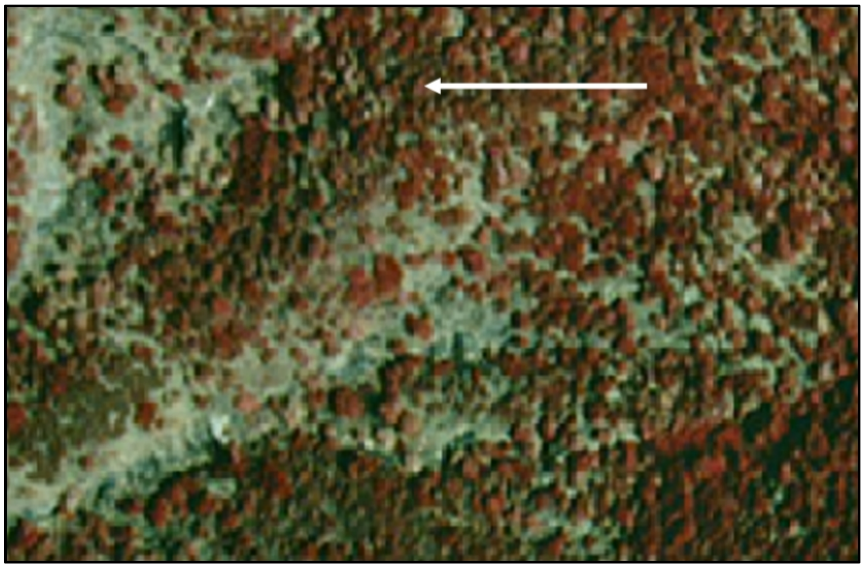


Figure 1044-2. Interior Live Oak–California Buckeye/Birchleaf Mountain Mohogany–California Redbud Forest signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Steepness – gentle to steep
Microclimate – xeric
Elevation – 389–1523 m (1275–4997 ft)
Shape – concave to convex
Slope position – low to midslope
Steepness – gentle to steep
Aspect – See Figure 1044-3.

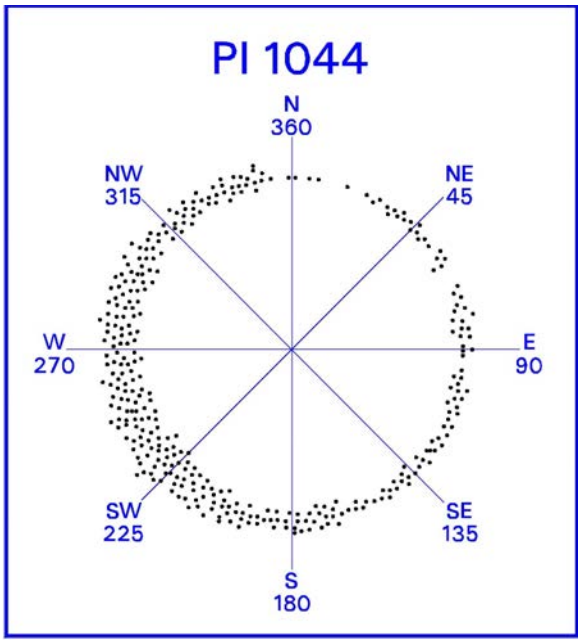


Figure 1044-3. Scatterplot of Interior Live Oak–California Buckeye/Birchleaf Mountain Mohogany–California Redbud Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- Interior Live Oak Woodland Alliance (1040)
- Interior Live Oak – Canyon Live Oak Woodland Association (1043)
- Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association (5011)

2000 – Broadleaf Deciduous Trees



Quaking Aspen/Big Sagebrush Forest. SEKI.0353_372.

2010 – Quaking Aspen Forest Alliance

Populus tremuloides Forest Alliance

Description:

The *Populus tremuloides* forest alliance is mapped on gentle to very steep slopes of varying aspect between 1818–3391 m (5963–11126 ft) across 6,159 acres of Sequoia and Kings Canyon National Parks (Figure 2010-1). Stands of this type are restricted to areas of relatively high moisture availability, including steep talus slopes at the upper limits of its elevational range. The overstory is dominated by *Populus tremuloides* in either tree or tall shrub form, with *Abies concolor, Calocedrus decurrens, Pinus contorta, or Pinus jeffreyi* frequently contributing low cover. The shrub layer is often made up of *Artemisia tridentata Chrysolepis sempervirens,* or *Salix spp.*The understory can be sparse or dense depending on moisture availability; more mesic sites often support a rich layer of mesophytic herbs. Areas dominated by the associations making up this alliance are usually subject to disturbance, such as avalanche or rock fall. Although the substrate may be either metamorphic or igneous in origin, stands of *Populus tremuloides* appear to frequently occur on metamorphic parent material. Soils are moderately to well drained sands and sandy loams. The hydrology is upland (NatureServe October 2006).

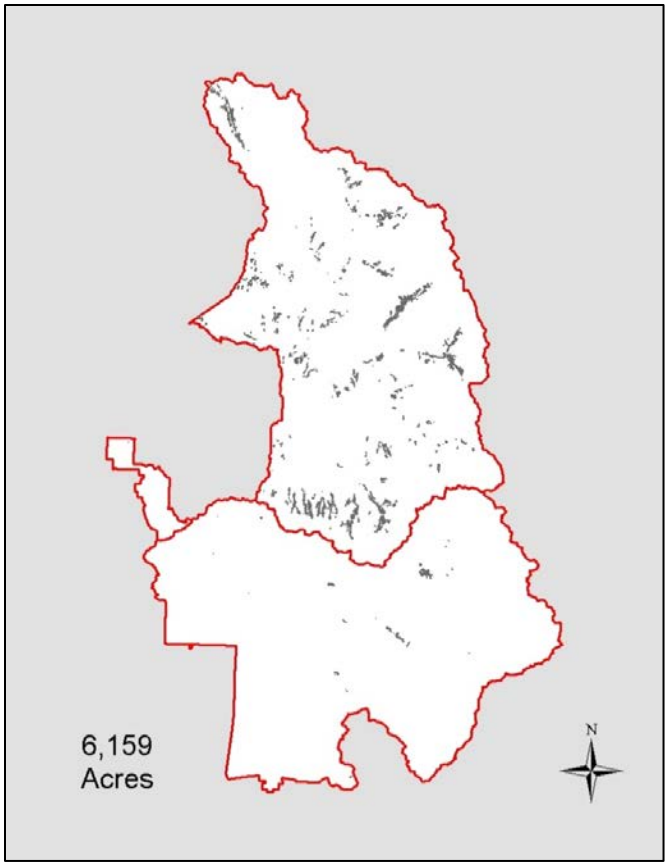


Figure 2010-1. Distribution of Quaking Aspen Forest.

Accuracy:
Producer's accuracy: 69 % (n=13)
User's accuracy: 100% (n=9)

Photo Interpretation Signature:
Populus tremuloides often yields a very bright orange to red signature and a texture that is consistent throughout the stand (Figure 2010-2). *Salix* is often mapped as a co-dominant in wetter stands with *Artemisia tridentata,* which is a common component in drier stands. Photo interpreters often note montane chaparral species such as *Chrysolepsis sempervirens* adjacent to stands of *P. tremuloides*; however mixing does not frequently occur except towards the margins of the stand.



Figure 2010-2. Quaking Aspen Forest signature. Photo reference: MOKA_NW.

Environmental Characteristics:
Microclimate – mesic
Elevation – 1818–3391 m (5963–11126 ft)
Shape – flat to concave to convex
Slope position – canyon bottom to high slope
Steepness – gentle to very steep
Aspect – See Figure 2010-3.

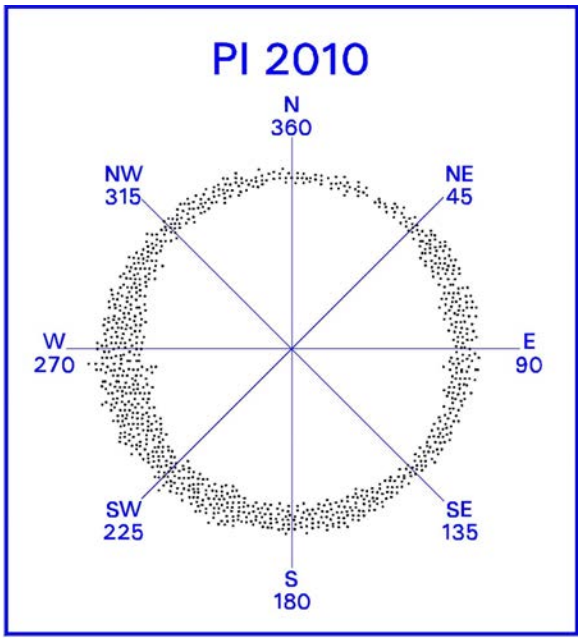


Figure 2010-3. Scatterplot of Quaking Aspen Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Conifer Reproduction (0910)
- Quaking Aspen/Willow spp.Forest Mapping Unit (2013)
- Quaking Aspen/Willow spp.Talus Mapping Unit (2014)
- Quaking Aspen/Big Sagebrush Forest Superassociation (2016)
- Quaking Aspen/Meadow Mapping Unit (2017)
- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- Bitter Cherry Shrubland Alliance (6300)
- Water Birch Shrubland Alliance (5300)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland mapping unit (5530)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp.Riparian Shrubland Mapping Unit (6600)

2013 – Quaking Aspen/Willow spp. Forest Mapping Unit
P*opulus tremuloides/Salix* spp. Forest Mapping Unit

Description:

The *Populus tremuloides*/*Salix spp.*forest mapping unit is mapped on gentle to moderately steep slopes of varying aspect between 2148–3297 m (7046–10817 ft) across 501 acres of Sequoia and Kings Canyon National Parks (Figure 2013-1). Frequently found adjacent to meadows and riparian corridors, stands of this mapping unit are characterized by at least 30% cover of *Populus tremuloides* emergent over dense, localized patches of at least 30% cover of *Salix spp.Populus balsamifera* is often present in the tree layer. The understory is composed of a diverse mix of mesic herbaceous species, often including *Pteridium aquilinum* or *Epilobium angustifolium*. Stands are temporarily to seasonally flooded. Soils are usually well-developed alluvium.

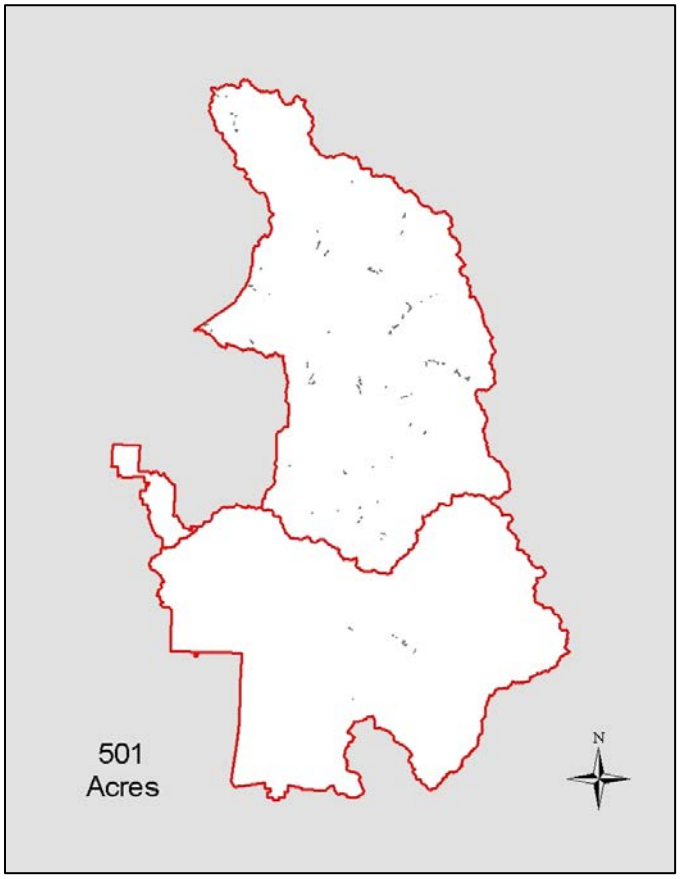


Figure 2013-1. Distribution of Quaking Aspen/Willow *spp.* Forest.

Accuracy:

Producer's accuracy: 83 % (n=6)
User's accuracy: 100% (n=5)

Photo Interpretation Signature:

The photo signature of *Populus tremuloides* has a smooth, even texture and brown or dark red color that typically occurs as a shrub while the willow species appears smooth with a lighter red signature (Figure 2013-2).

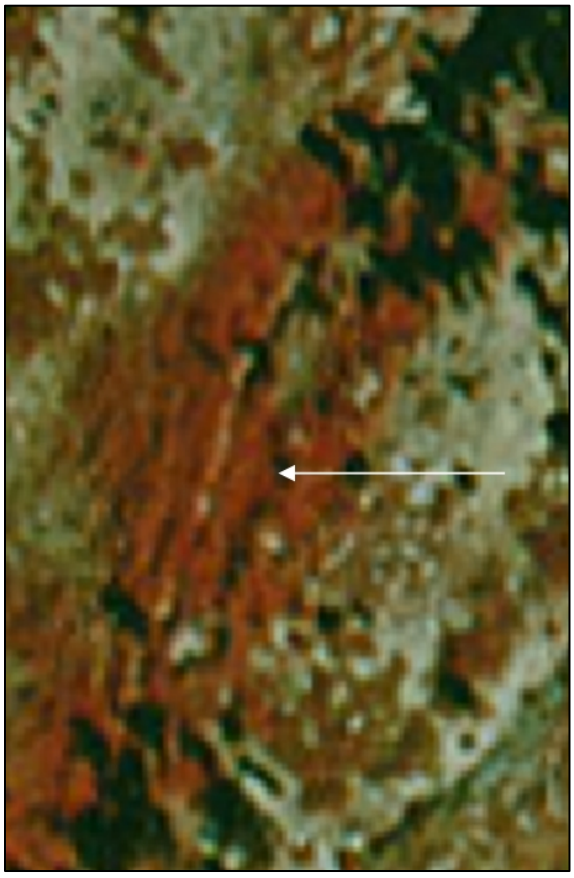


Figure 2013-2. Quaking Aspen/Willow spp. Forest signature. Photo reference: TDPE_SE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 2148–3297 m (7046–10817 ft)
Shape – flat to concave
Slope position – canyon bottoms and low slopes
Steepness – gentle to moderately steep
Aspect – See Figure 2013-3.

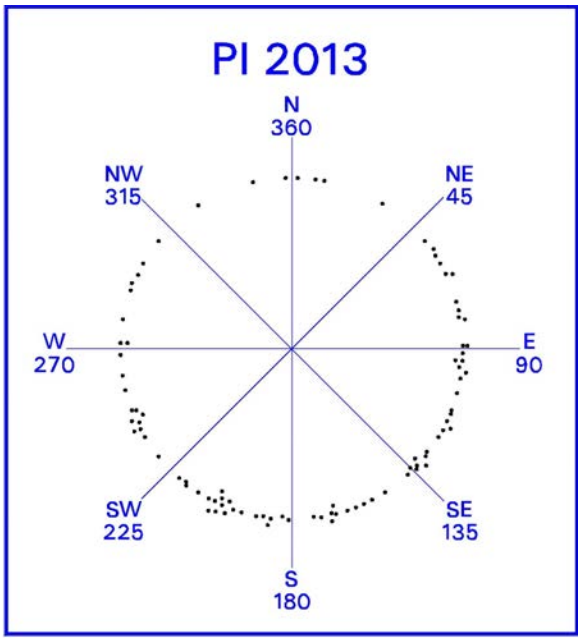


Figure 2013-3. Scatterplot of Quaking Aspen/Willow spp. Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Talus mapping unit (2014)
- Quaking Aspen/Meadow Mapping Unit (2017)
- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Bitter Cherry Shrubland Alliance (6300)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)

2014 – Quaking Aspen/Willow spp. Talus Mapping Unit
Populus tremuloides/Salix spp. Talus Mapping Unit

Description:
The *Populus tremuloides*/*Salix spp.* talus mapping unit is mapped on moderate to very steep talus slopes of varying aspect between 2181–3370 m (7154–11058 ft) across 1,468 acres of Sequoia and Kings Canyon National Parks (Figure 2014-1). These sparse to moderately dense stands support at least 5% cover of shrubby *Populus tremuloides* and at least 5% cover of *Salix spp*. emerging from broken talus. *Chrysolepis sempervirens* and *Artemisia tridentata* may also be present in the shrub layer. The understory of mesic herbaceous species often includes *Veratrum californicum, Pteridium aquilinum,* and *Castilleja miniata*. This type is frequently associated with avalanche courses and rock falls. Sites may be temporarily to seasonally flooded and have minimal soil development.

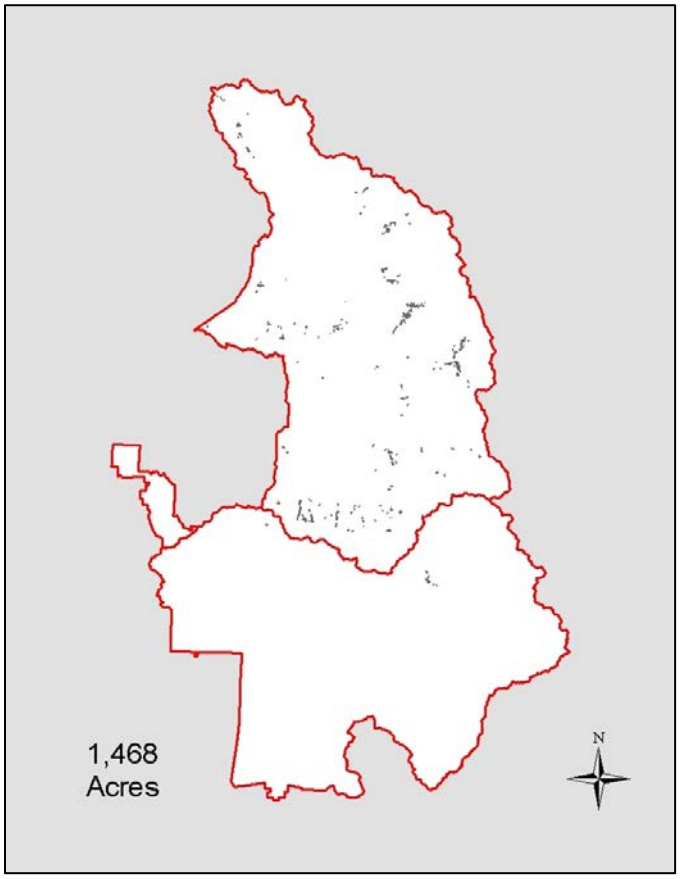


Figure 2014-1. Distribution of Quaking Aspen/Willow spp. Talus.

Accuracy:
Producer's accuracy: 77 % (n=13)
User's accuracy: 100% (n=10)

Photo Interpretation Signature:

The signature of *Populus tremuloides* varies from red to brown in color while smooth in texture and usually occurs in shrub form. The signature of the *Salix* is frequently lighter red in color than the *Populus tremuloides* and also has a smooth texture (Figure 2014-2).

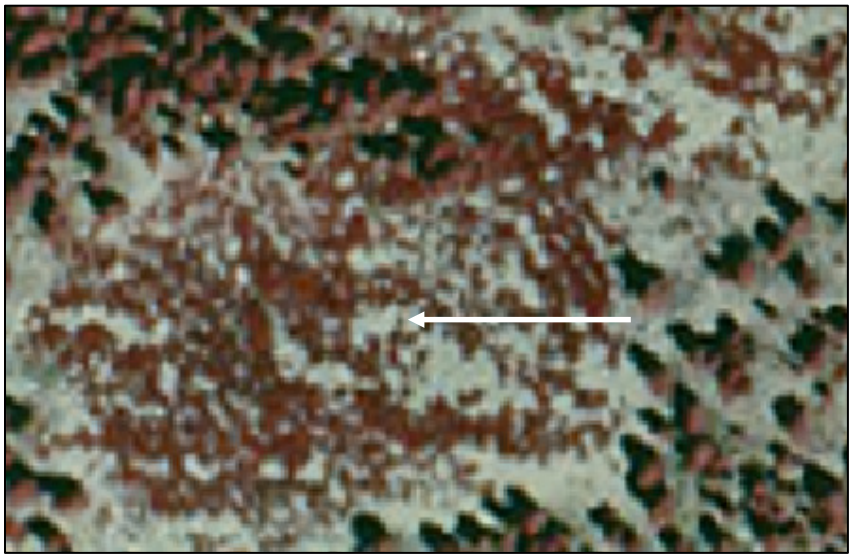


Figure 2014-2. Quaking Aspen/Willow spp. Talus signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – mesic
Elevation – 2181–3370 m (7154–11058 ft)
Shape – convex to concave
Slope position – low to high slope
Steepness – moderate to very steep
Aspect – See Figure 2014-3.

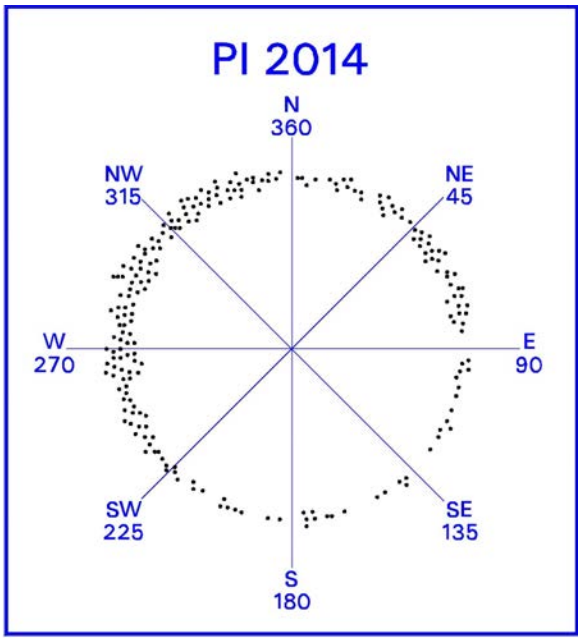


Figure 2014-3. Scatterplot of Quaking Aspen/Willow spp. Talus in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Quaking Aspen/Big Sagebrush Forest Superassociation (2016)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Talus Shrubland Mapping Unit (6700)

2016 – Quaking Aspen/Big Sagebrush Forest Superassociation
Populus tremuloides/Artemisia tridentata Forest Superassociation

Description:

The *Populus tremuloides/Artemisia tridentata* forest superassociation is mapped on gentle to steep slopes of varying aspect between 2010–3391 m (6596–11126 ft) across 2,636 acres of Sequoia and Kings Canyon National Parks (Figure 2016-1). This superassociation includes the most xeric of the *Populus tremuloides* types, which form sparse to nearly closed stands of *Populus tremuloides* (at least 5% cover) over a shrub layer of at least 5% cover of *Artemisia tridentata. P. tremuloides* frequently assumes a shrubby form in these stands. *Pinus contorta, P. jeffreyi,* and/or *Abies magnifica* may be emergent in the tree canopy. Other shrubs present may include *Ribes cereum, Symphoricarpos rotundifolius,* and/or *Holodiscus microphyllus*. Characteristic herbs may include *Monardella odoratissima, Apocynum androsaemifolium, Carex filifolia,* or *Gayophytum diffusum*. Sites are characterized by upland hydrology. Soils are well drained sandy loams (NatureServe October 2006).

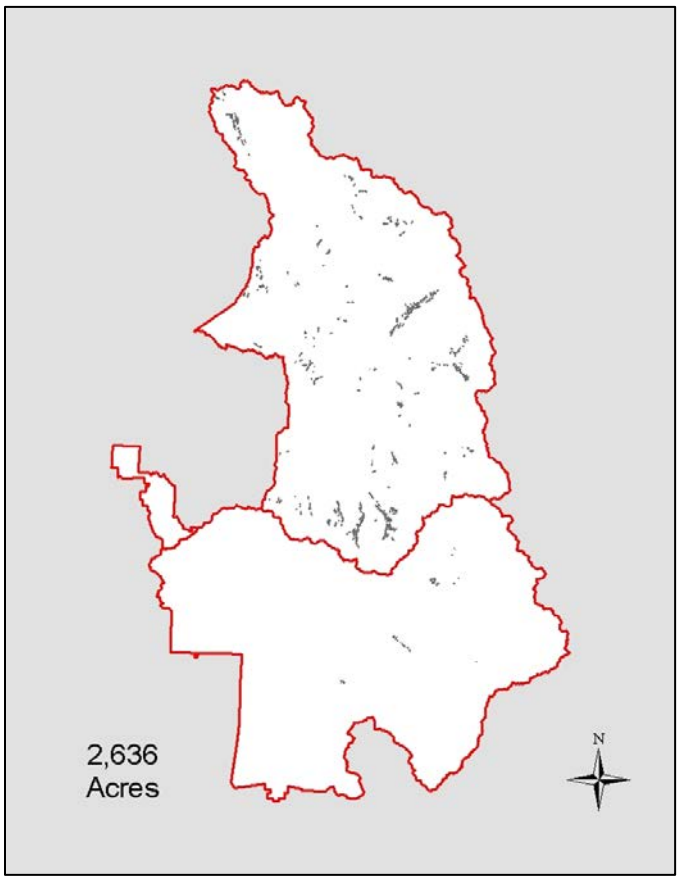


Figure 2016-1. Distribution of Quaking Aspen/Big Sagebrush Forest.

Accuracy:

Producer's accuracy: 100 % (n=19)
User's accuracy: 90% (n=21)

Photo Interpretation Signature:

The signature of *Populus tremuloides* in this type is pink or light red in color with a small round crown that appears smooth and is usually in shrub form. *Artemisia tridentata* has a uniform gray or brown signature and usually dominates the shrub layer (Figure 2016-2).

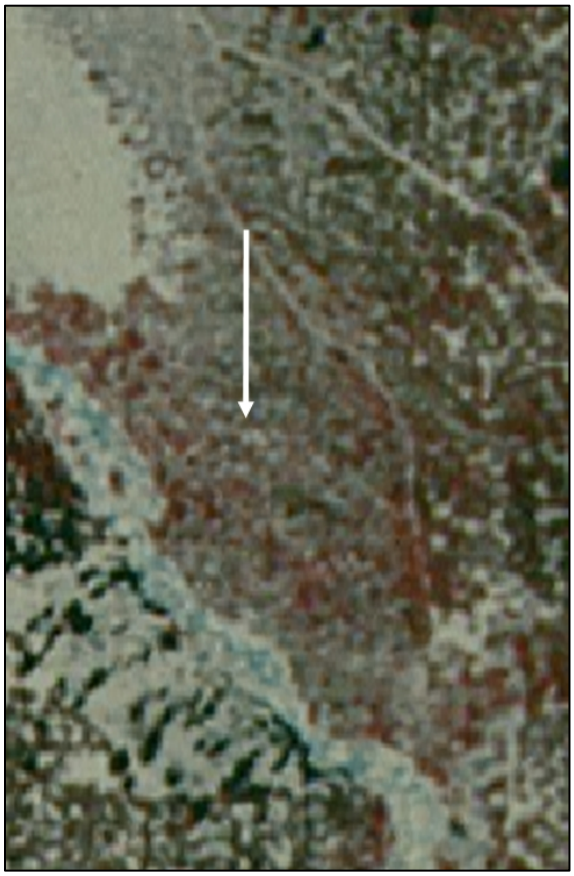


Figure 2016-2. Quaking Aspen/Big Sagebrush Forest signature. Photo reference: MOKA_NE.

Environmental Characteristics:

Microclimate – subxeric
Elevation – 2010–3391 m (6596–11126 ft)
Shape – concave to convex
Slope position – flats and lower slopes
Steepness – gentle to steep
Aspect – See Figure 2016-3.

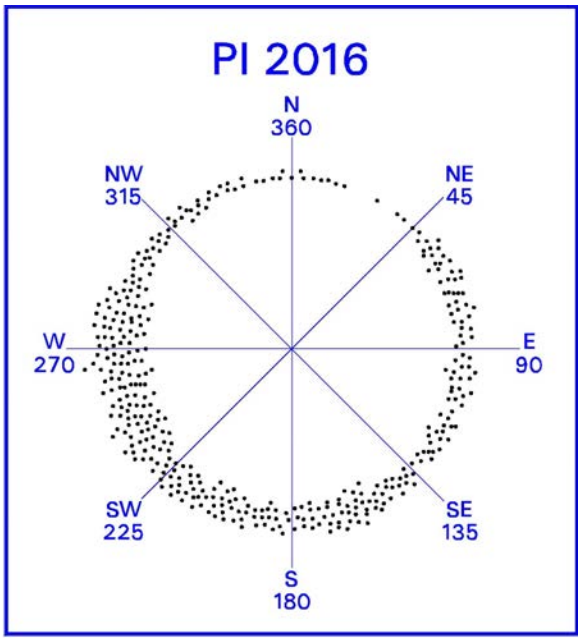


Figure 2016-3. Scatterplot of Quaking Aspen/Willow spp. Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Talus Mapping Unit (2014)
- Big Sagebrush Shrubland Alliance (5160)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)
- Willow spp. Talus Shrubland Mapping Unit (6700)

2017 – Quaking Aspen/Meadow Mapping Unit
Populus tremuloides/Meadow Mapping Unit

Description:
The *Populus tremuloides*/meadow mapping unit is mapped on gentle to very steep mesic slopes of varying aspect between 2284–2907 m (7494–9539 ft) across 79 acres in Sequoia and Kings Canyon National Parks (Figure 2017-1). The overstory of these open to closed stands is dominated by at least 5% cover of *Populus tremuloides* over a dense herbaceous layer of *Juncus spp, Poa spp., Carex spp.,* and *Elymus spp*. Soils are well developed and are often temporarily flooded.

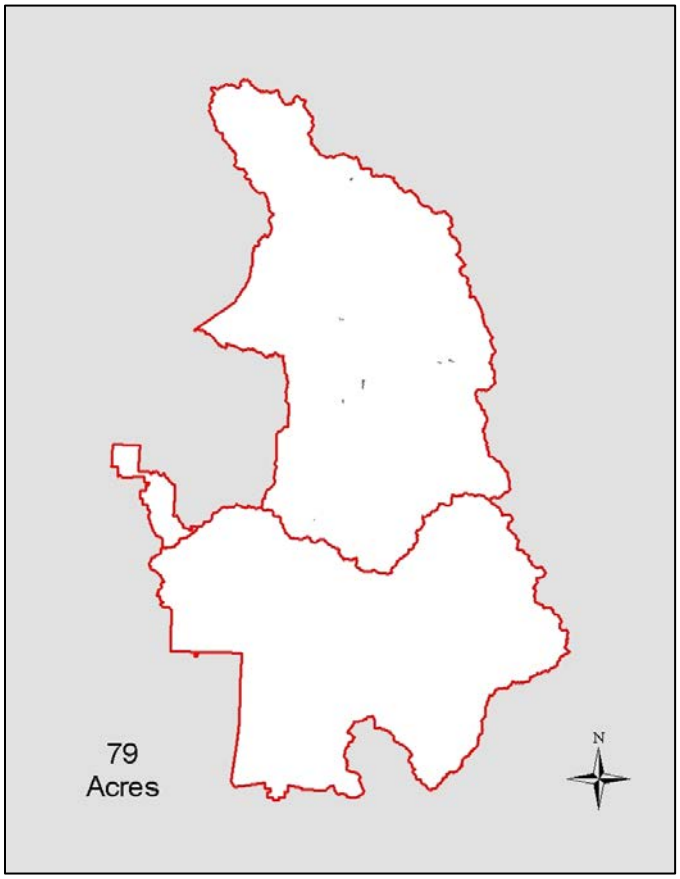


Figure 2017-1. Distribution of Quaking Aspen/Meadow.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
Populus tremuloides has a characteristic pattern and texture that appears consistent throughout the stands – crown size does vary but the textures between varying stand sizes are similar. Through field reconnaissance and the mapping of similar stands throughout the eastern Sierras, photo interpreters observe that colors vary from pink/orange to deeper reds depending on plant health and how mesic

the stand is. This type is mesic and often adjacent to meadows, which have a very smooth texture (Figure 2017-2).

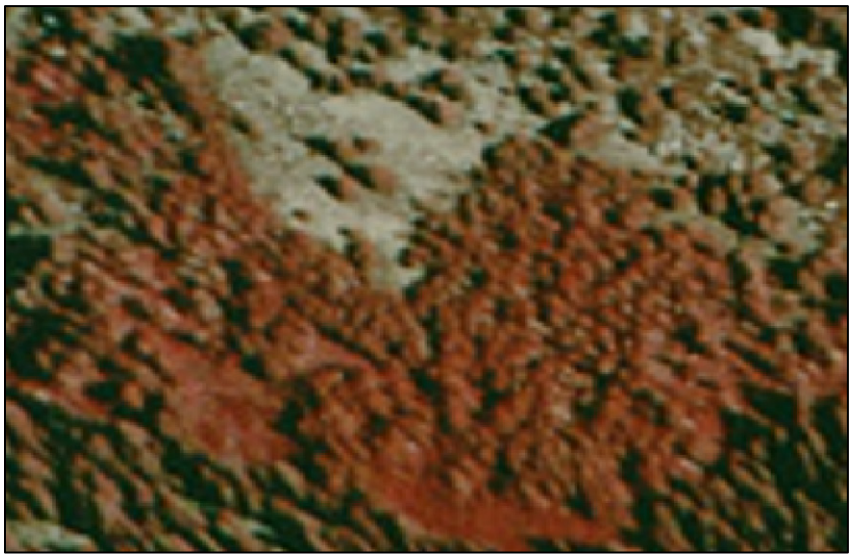


Figure 2017-2. Quaking Aspen/Meadow signature.

Environmental Characteristics:
Microclimate – mesic
Elevation – 2284–2907 m (7494–9539 ft)
Shape – neutral
Slope position – lower
Steepness – flat to gently sloping
Aspect – See Figure 2017-3.

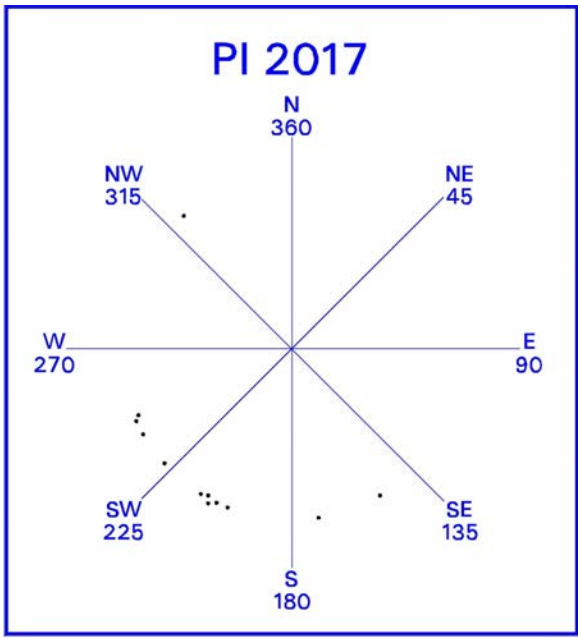


Figure 2017-3. Scatterplot of Quaking Aspen/Meadow in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Willow spp. Riparian Shrubland Mapping Unit (6600)

2020 – California Black Oak Forest Alliance



California Black Oak Forest. SEKI.0238_291.

2020 – California Black Oak Forest Alliance
Quercus kelloggii Forest Alliance

Description:
The *Quercus kelloggii* forest alliance is mapped on gentle to very steep slopes of varying aspect between 893–2641 m (2929–8664 ft) across 12,453 acres in Sequoia and Kings Canyon National Parks (Figure 2020-1). The overstory of these open to closed stands is dominated by *Quercus kelloggii*, with *Pinus ponderosa, Calocedrus decurrens, Pinus lambertiana* and/or *Quercus chrysolepis* often present. When present the shrub layer may include *Arctostaphylos patula, A. viscida, A. mewukka, Ceanothus spp.,* or *Ribes roezlii*. Stands often have an understory of *Chamaebatia foliolosa* and a dense carpet of leaf litter, and are often found in late-seral post fire environments. Soils are moderately well drained sandy clay loams, loams, and sandy loams. The hydrology is upland. (NatureServe October 2006) In the aggregated database, the *Quercus kelloggii* forest alliance includes the *Quercus kelloggii/Arctostaphylos patula* forest association (2021) and the *Quercus kelloggii/Arctostaphylos mewukka–Chamaebatia foliolosa* forest association (2026).

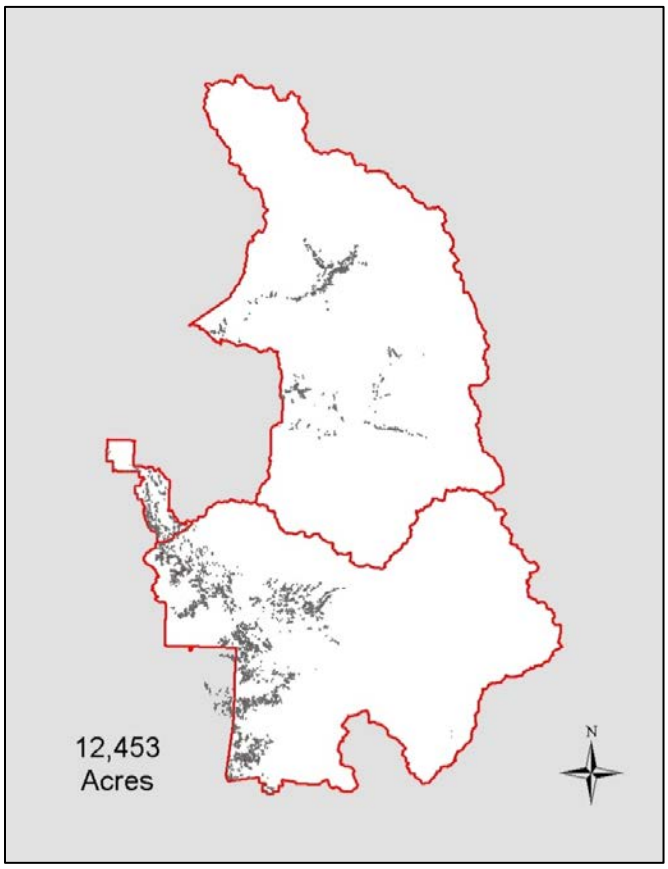


Figure 2020-1. Distribution of California Black Oak Forest.

Accuracy:
Producer's accuracy: 83% (n=53)
User's accuracy: 88% (n=50)

Photo Interpretation Signature:
The photo signature for *Quercus kelloggii* is bright red with widespread irregular round crowns and a smooth texture. The texture of *Q. kelloggii* stands vary from smooth to slightly mottled depending on conifer component, stand age, and structural diversity (Figure 2020-2).

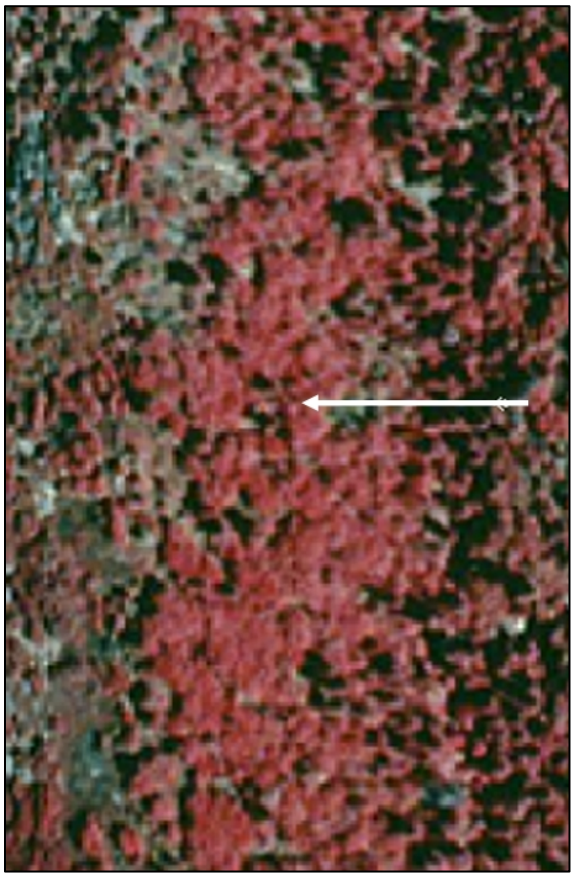


Figure 2020-2. California Black Oak Forest signature. Photo reference: GIFO_NW.

Environmental Characteristics:
Microclimate – submesic to subxeric
Elevation – 893–2641 m (2929–8664 ft)
Shape – variable; generally convex
Slope position – variable; low to high slope
Steepness – gentle to very steep
Aspect – See Figure 2020-3.

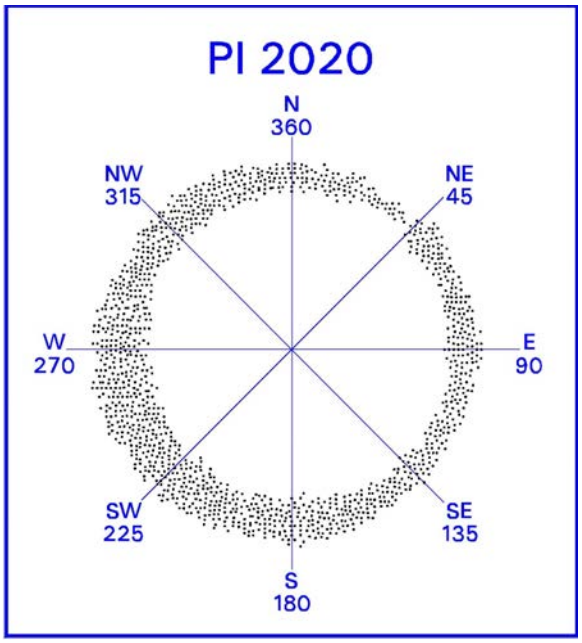


Figure 2020-3. Scatterplot of California Black Oak Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak Forest Alliance (1020)
- Canyon Live Oak–California Laurel Forest Superassociation (1024)
- Interior Live Oak Woodland Alliance (1040)
- Interior Live Oak – Canyon Live Oak Woodland Association (1043)
- Blue Oak Woodland Alliance (2030)
- Oregon White Oak Shrubland Alliance (6020)

2021 – California Black Oak/Greenleaf Manzanita Forest Association
Quercus kelloggii/Arctostaphylos patula Forest Association

Description:

The *Quercus kelloggii/Arctostaphylos patula* forest association is mapped on moderate to steep south to southwest facing slopes between 1455–2641 m (4774–8664 ft) across 2,017 acres in Sequoia and Kings Canyon National Parks (Figure 2021-1). These moderately open stands of Quercus kelloggii have an open to closed shrub layer dominated by *Arctostaphylos patula*. *Pinus ponderosa* may occur as a canopy emergent. *Ceanothus integerrimus* frequently occurs in the shrub layer, and *Chamaebatia foliolosa* is often an important understory component. Other montane chaparral shrub species, such as *Chrysolepis sempervirens* and *Ceanothus cordulatus* may also be present. The hydrology is upland, and the soils are moderately well developed sandy loams. (NatureServe October 2006) In the aggregated database, the *Quercus kelloggii*/*Arctostaphylos patula* forest association is aggregated into the *Quercus kelloggii* forest alliance (2020).

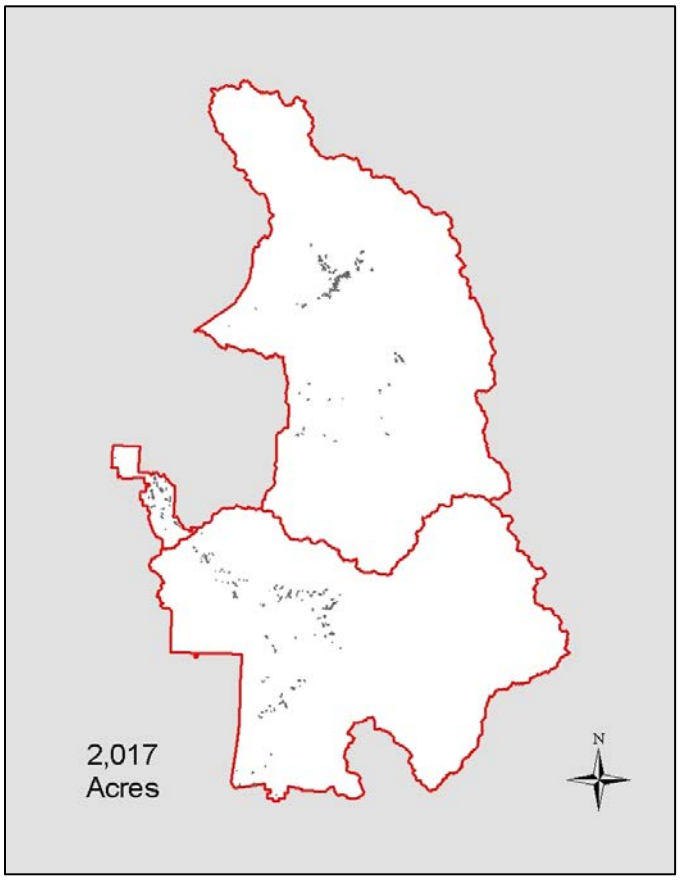


Figure 2021-1. Distribution of California Black Oak/Greenleaf Manzanita Forest.

Accuracy:

Producer's accuracy: 73% (n=11)
User's accuracy: 67 % (n=12)

Photo Interpretation Signature:

The photo signature for *Quercus kelloggii* is bright red with widespread irregular round crowns and a smooth texture. The signature for *Arctostaphylos patula* is an orange or orange-brown color with a coarse texture. The *Arctostaphylos patula* occurs as a sparse to dense understory to the *Quercus kelloggii* (Figure 2021-2).

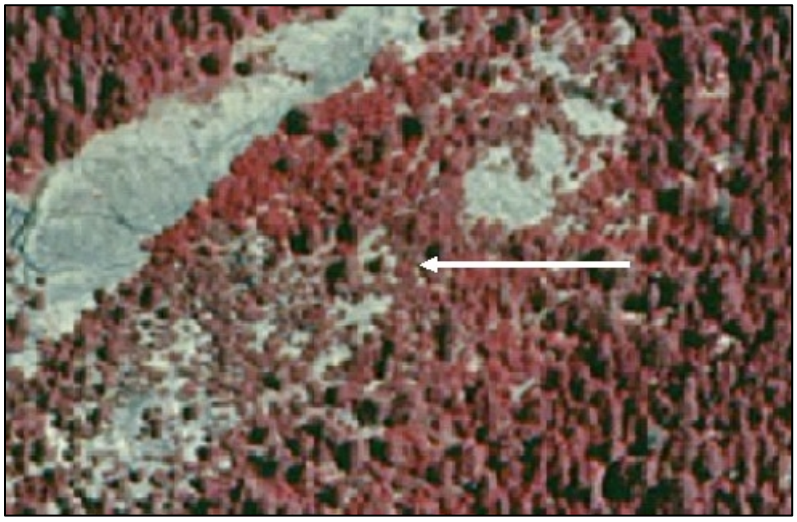


Figure 2021-2. California Black Oak/Greenleaf Manzanita Forest signature.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1455–2641 m (4774–8664 ft)
Shape – convex
Slope position – low to midslope
Steepness – moderate to steeply sloping
Aspect – See Figure 2021-3.

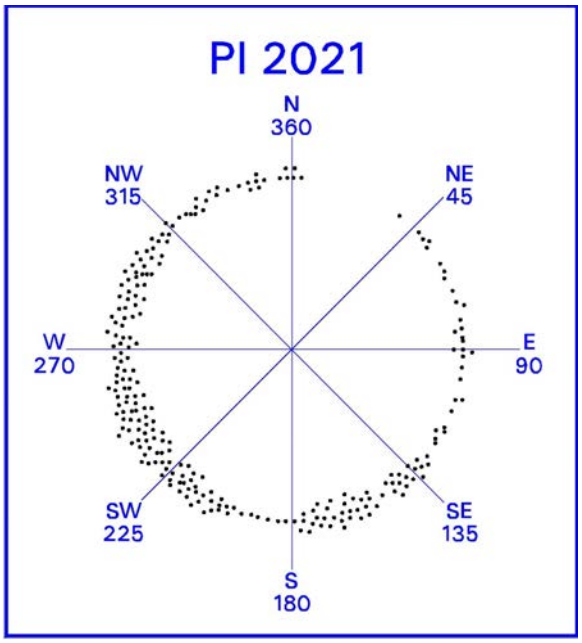


Figure 2021-3. Scatterplot of California Black Oak/Greenleaf Manzanita Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Whiteleaf Manzanita Forest Association (1022)
- Canyon Live Oak/Greenleaf Manzanita Forest Association (1029)
- California Black Oak/Indian Manzanita – Mountain Misery Forest Association (2026)
- Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association (6022)

2025 – California Black Oak/(Bracken Fern) Forest Mapping Unit
Quercus kelloggii/(*Pteridium aquilinum*) Forest Mapping Unit

Description:

The *Quercus kelloggii*/(*Pteridium aquilinum*) forest mapping unit is mapped on moderately steep southeast to southwest facing slopes between 1035–2091 m (3397–6860 ft) across 385 acres of Sequoia and Kings Canyon National Parks (Figure 2025-1). Stands are dominated by an open canopy of *Quercus kelloggii* over a dense herbaceous layer of grasses and herbaceous annuals, including *Bromus spp.* and *Torilis arvensis*; *Pteridium aquilinum* is often important. Shrubs generally contribute low cover to this type, but *Ceanothus integerrimus*, *Arctostaphylos viscida*, and *Cercocarpus montanus var. glaber* are frequently present. The hydrology is upland, but this type may occur on fringes of drier meadows; soils are moderately well drained silty clay loams and loams.

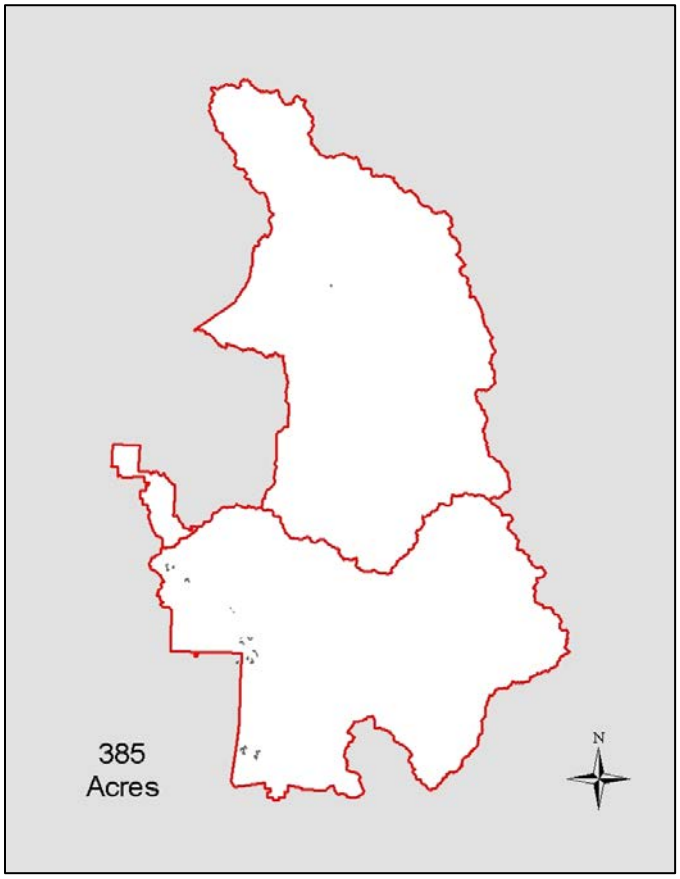


Figure 2025-1. Distribution of California Black Oak/(Bracken Fern) Forest.

Accuracy:

Producer's accuracy: 100 % (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:

The signature for the large *Quercus kelloggii* trees that typically occur in this association is dark red with broad, uneven rounded crowns that grow over an understory of annual grasses and herbs that appears gray or tan (Figure 2025-2).

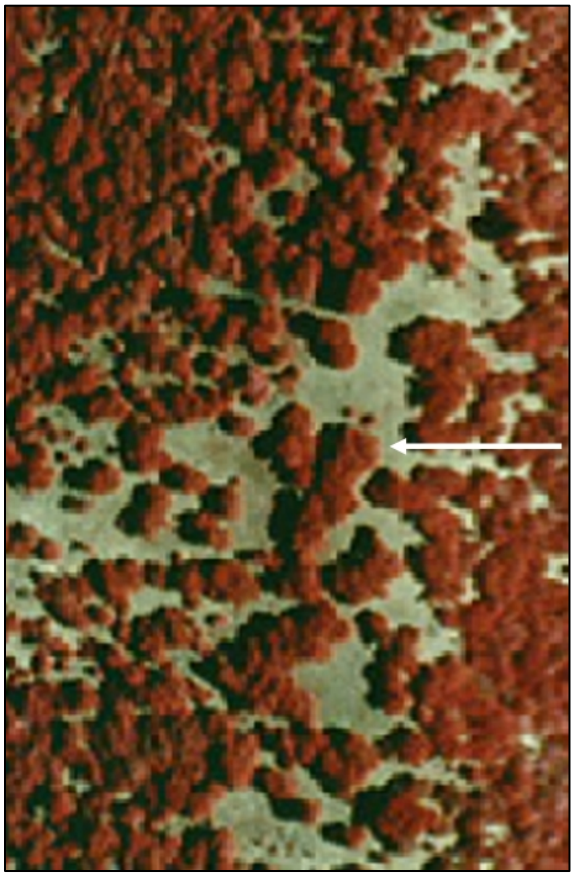


Figure 2025-2. California Black Oak/(Bracken Fern) Forest signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – subxeric
Elevation – 1035–2091 m (3397–6860 ft)
Shape – convex
Slope position – low slope
Steepness – moderately steep
Aspect – See Figure 2025-3.

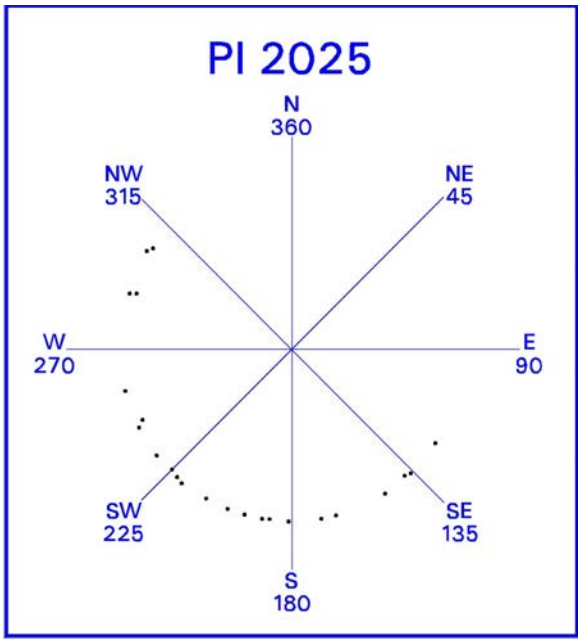


Figure 2025-3. Scatterplot of California Black Oak/(Bracken Fern) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Blue Oak/Brome spp.–American Wild Carrot Woodland Association (2033)

2026 – California Black Oak/Indian Manzanita–Mountain Misery Forest Association
Quercus kelloggii/Arctostaphylos mewukka–Chamaebatia foliolosa Forest Association

Description:

The *Quercus kelloggii/Arctostaphylos mewukka–Chamaebatia foliolosa* forest association is mapped on moderate to steep south to southwest facing slopes between 1140–2117 m (3740–6944 ft) across 1,387 acres in Sequoia and Kings Canyon National Parks (Figure 2026-1). These moderately open stands of *Quercus kelloggii* have an open to closed shrub layer dominated by *Arctostaphylos mewukka*, with a dense layer of *Chamaebatia foliolosa* characterizing the understory. *Arctostaphylos patula* and/or *Ceanothus integerrimus* may also be present in the shrub layer. The herbaceous layer is generally sparse, but may include a diverse array of xeric species such as *Galium sparsiflorum*, *Chlorogalum pomeridianum*, or *Elymus glaucus*. This type is often mapped in post-fire settings. The hydrology is upland, and the soils are moderately well drained sandy clay loams. (NatureServe October 2006) In the aggregated database, the *Quercus kelloggii/Arctostaphylos patula* forest association is aggregated into the *Quercus kelloggii* forest alliance (2020).

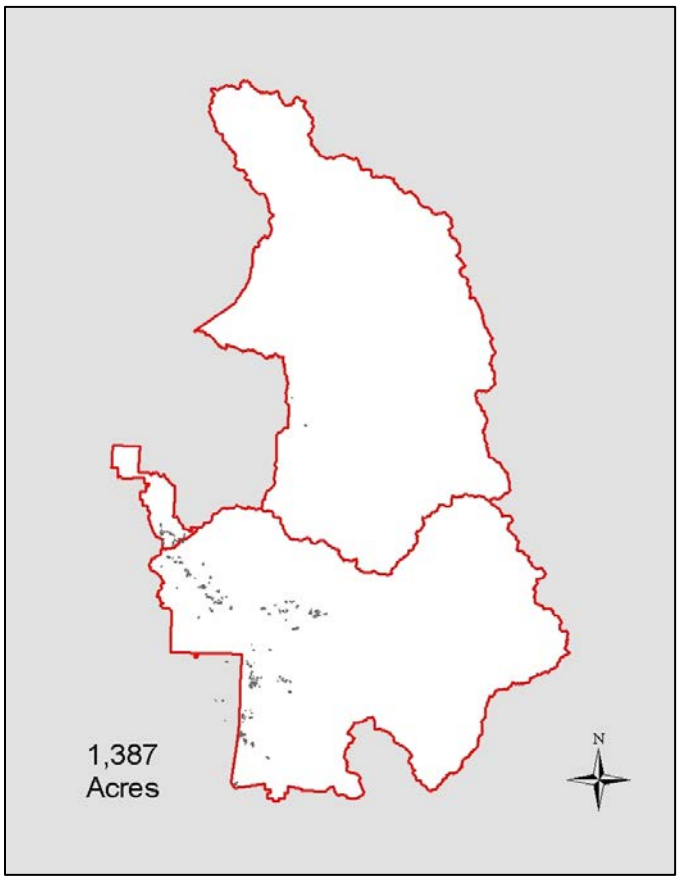


Figure 2026-1. Distribution of California Black Oak/Indian Manzanita–Mountain Misery Forest.

Accuracy:

Producer's accuracy: 100% (n=3)
User's accuracy: 60 % (n=5)

Photo Interpretation Signature:

The *Quercus kelloggii* signature is dark red with broad asymmetrical rounded crowns. The signature for *Arctostaphylos mewukka* is smooth and orange or tan in color. The signature for *Chamaebatia foliolosa* Mountain Misery is pink or red with a very smooth texture (Figure 2026-2). The *Chamaebatia foliolosa* and *Arctostaphylos mewukka* typically grow in post fire areas and can either occur together or alone as a sparse to dense understory beneath the *Quercus kelloggii* canopy.

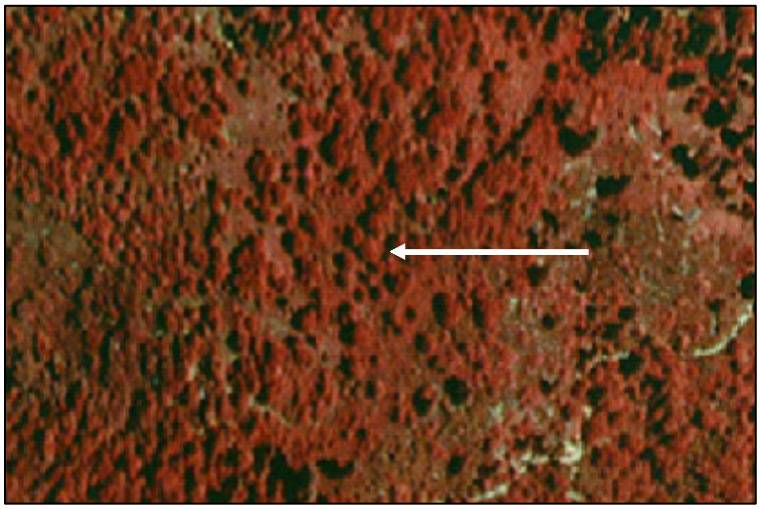


Figure 2026-2. California Black Oak/Indian Manzanita–Mountain Misery Forest signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1140–2117 m (3740–6944 ft)
Shape – convex
Slope position – low slope
Steepness – moderate to steep
Aspect – See Figure 2026-3.

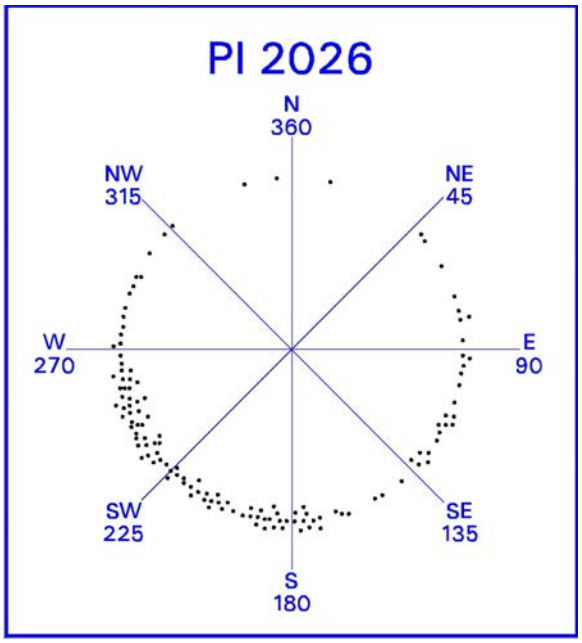


Figure 2026-3. Scatterplot of California Black Oak/Indian Manzanita–Mountain Misery Forest Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Whiteleaf manzanita Forest Association (1022)
- Canyon Live Oak/Greenleaf Manzanita Forest Association (1029)
- California Black Oak/Greenleaf Manzanita Forest Association (2021)
- Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association (6022)

2030 – Blue Oak Woodland Alliance



Blue Oak–California Buckeye–Interior Live Oak Woodland. SEKI.0211_178.

2030 – Blue Oak Woodland Alliance
Quercus douglasii Woodland Alliance

Description:
The *Quercus douglasii* woodland alliance is mapped on gentle to moderately steep south to southwest or west-facing slopes between 394–1462 m (1293–4796 ft) across 2,620 acres of Sequoia National Park (Figure 2030-1). Woodland associations in this alliance form the characteristic oak savannahs of the western foothills. Typical stands contain *Quercus douglasii* as an important or dominant species in the tree canopy, which may be two-tiered. Other trees may include *Quercus wislizeni var wislizeni, Aesculus californica, Quercus kelloggii,* and *Fraxinus dipetala*. Although shrub cover is usually low (less than 20% absolute cover) species present may include *Arctostaphylos viscida, Cercocarpus montanus var. glaber, Cercis canadensis var. texensis, Keckiella breviflora, Rhamnus ilicifolia, Ceanothus cuneatus, Eriodictyon californicum, Rhus trilobata*, and *Toxicodendron diversilobum*. The understory is made up of a diverse assemblage of annual grasses and herbaceous species, which is typically dominated by a mixture of *Bromus diandrus* or *B. hordeaceous, Avena fatua* or *A. barbata*. The hydrology is upland, and the soils are moderately well drained sandy clay loams (NatureServe October 2006).

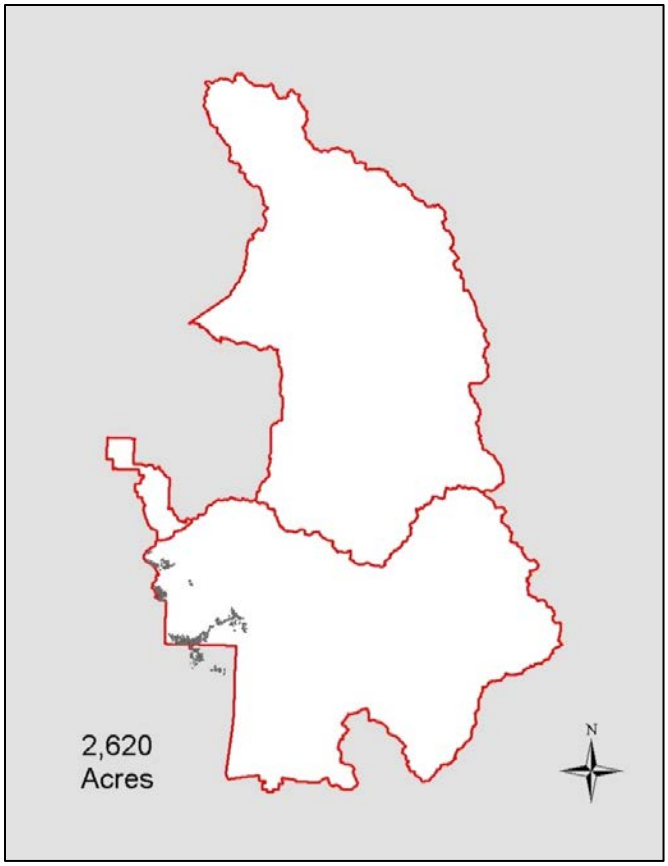


Figure 2030-1. Distribution of Blue Oak Woodland.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
The signature of *Quercus douglasii* is fairly consistent with a diffused open round crown that ranges in color from orange to brown on IR imagery. Figure 2030-2 shows the characteristic distribution of oaks in the Blue Oak Woodland as visible on true color DOQQ.

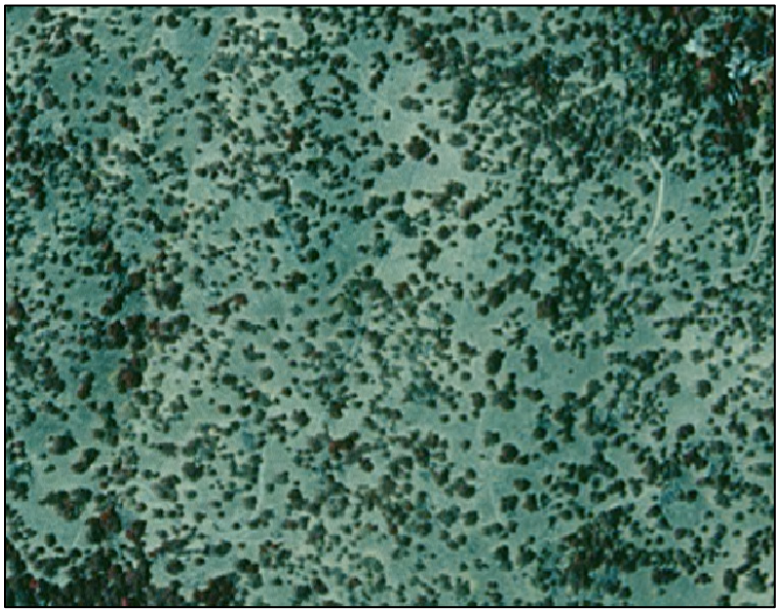


Figure 2030-2. Blue Oak Woodland signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 394–1462 m (1293–4796 ft)
Shape – concave to convex
Slope position – low slope
Steepness – gentle to moderate; occasionally steep
Aspect – See Figure 2030-3.

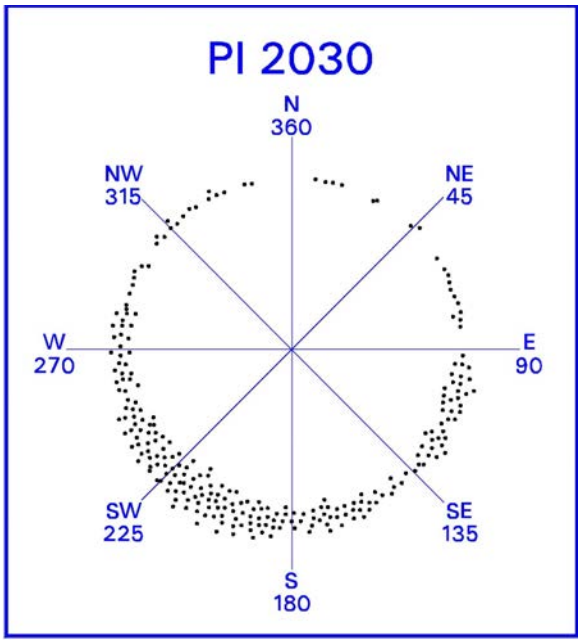


Figure 2030-3. Scatterplot of Blue Oak Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- California Black Oak Forest Alliance (2020)
- Blue Oak/Brome spp.–American Wild Carrot Woodland Association (2033)
- Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland Association (2034)
- Blue Oak–California Buckeye–(Interior Live Oak) Woodland Mapping Unit (2038)

2033 – Blue Oak/Brome spp.–American Wild Carrot Woodland Association
Quercus douglasii/Bromus spp.*–Daucus pusillus* Woodland Association

Description:

The *Quercus douglasii/ Bromus spp.–Daucus pusillus* woodland association is mapped on gentle to moderate south to southwest facing slopes between 419–1341 m (1375–4398 ft) across 618 acres of Sequoia National Park (Figure 2033-1). The tree canopy is open, with up to 50% absolute cover of Quercus douglasii. *Aesculus californica* and *Quercus wislezeni* may also contribute low amounts of cover. The sparse shrub layer (<10% absolute cover) may include *Arctostaphylos viscida*, *Eriodictyon californicum*, and *Ceanothus cuneatus*. The continuous herbaceous layer is dominated by *Bromus diandrus*, *B. hordeaceous*, and/or *Avena barbata*, with *Madia elegans*, *Holocarpha heermannii*, and *Lupinus bicolor* contributing significant cover during different times of the year. The hydrology is upland. Soils are moderately well drained sandy clay loams. (NatureServe October 2006).

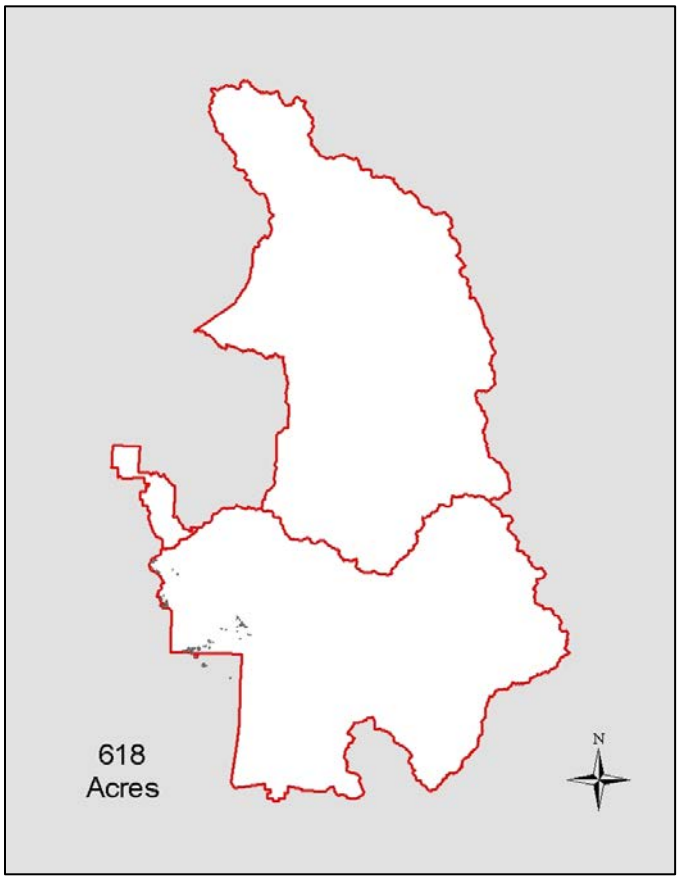


Figure 2033-1. Distribution of Blue Oak/Brome spp.–American Wild Carrot Woodland.

Accuracy:

Producer's accuracy: 100% (n=5)
User's accuracy: 100 % (n=5)

Photo Interpretation Signature:

The signature of *Quercus douglasii* is fairly consistent with a diffused open round crown that ranges in color from orange to brown over a smooth dense understory of non-native annual grasses and forbs (Figure 2033-2).

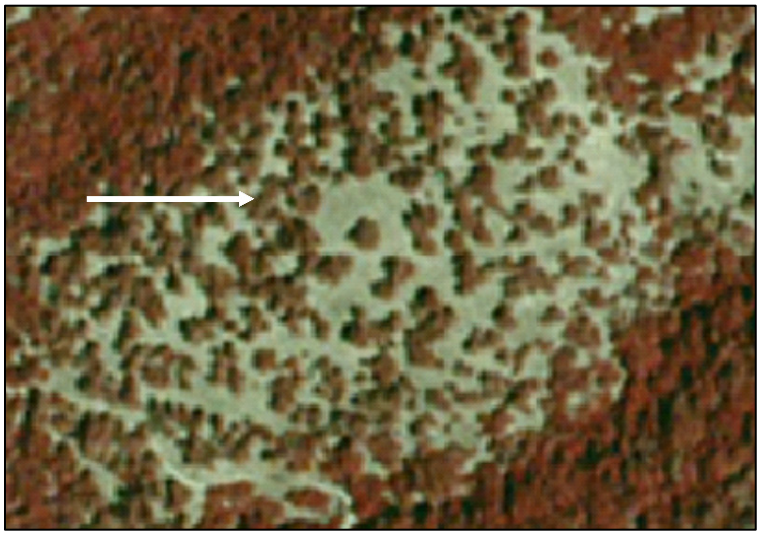


Figure 2033-2. Blue Oak/Brome spp.–American Wild Carrot Woodland signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – subxeric to xeric
Elevation – 419–1341 m (1375–4398 ft)
Shape – convex, undulating
Slope position – low to middle slope
Steepness – gentle to moderately sloping; occasionally steep
Aspect – See Figure 2033-3.

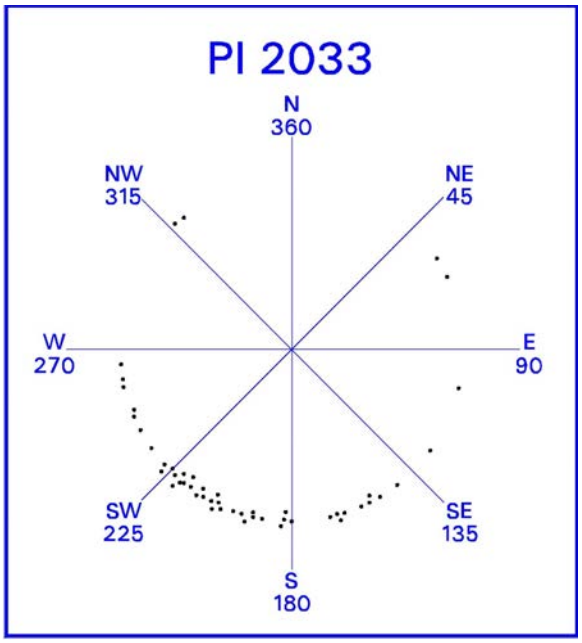


Figure 2033-3. Scatterplot of Blue Oak/Brome spp.–American Wild Carrot Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- California Black Oak/(Bracken Fern) Forest Mapping Unit (2025)
- Blue Oak Woodland Alliance (2030)
- Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland Association (2034)

2034 – Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland Association
Quercus douglasii–Quercus wislizeni var. *wislizeni/Bromus* spp.*–Daucus pusillus* Woodland Association

Description:

The *Quercus douglasii–Quercus wislizeni var. wislizeni*/*Bromus spp.–Daucus pusillus* woodland association is mapped on moderate to moderately steep slopes of south, southwest or west facing aspect between 394–1236 m (1293–4056 ft) across 1,014 acres of Sequoia National Park (Figure 2034-1). These open-canopied woodlands are co-dominated by *Quercus douglasii* and *Quercus wislizeni var wislizeni* in the tree layer, with *Aesculus californica* frequently contributing low cover and *Fraxinus dipetala* occasional in the subcanopy. The sparse shrub layer (<10% absolute cover) may include *Arctostaphylos viscida, Eriodictyon californicum, Ceanothus cuneatus,* and *Toxicodendron diversilobum. Bromus diandrus, B. hordeaceous, Avena barbata, Madia elegans, Torilis nodosa* and *Holocarpha heermanii* dominate the generally continuous and diverse herb layer. The hydrology is upland. Soils are moderately well developed sandy loams. (NatureServe October 2006).

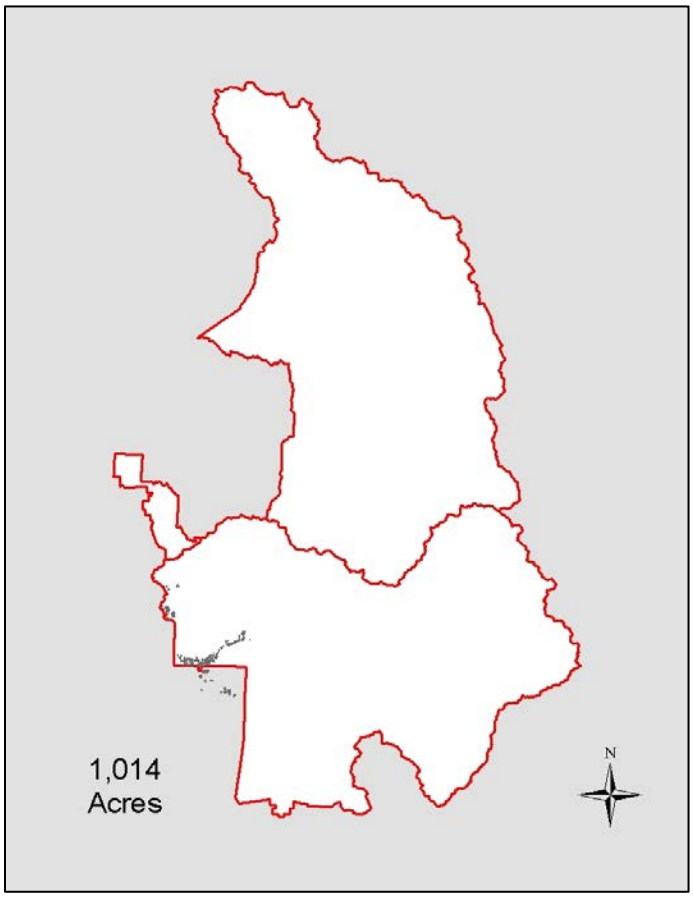


Figure 2034-1. Distribution of Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland.

Accuracy:

Producer's accuracy: 100 % (n=7)
User's accuracy: 100% (n=7)

Photo Interpretation Signature:

The signature for *Quercus douglasii* is orange or brown with a diffused, open crown. The *Q. wislizeni var. wislizeni* varies from dull to dark red in color with a small, round crown. Stands are generally open with a dense understory of annuals and grasses that appear gray or tan (Figure 2034-2).

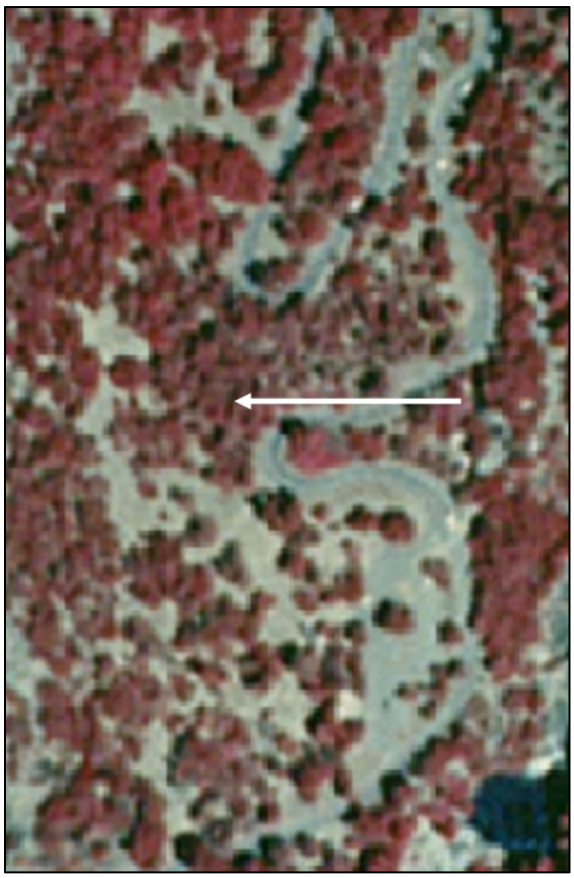


Figure 2034-2. Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland signature. Photo reference: GIFO_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 394–1236 m (1293–4056 ft)
Shape – convex to undulating
Slope position – low to mid slope
Steepness – moderate to moderately steep
Aspect – See Figure 2034-3.

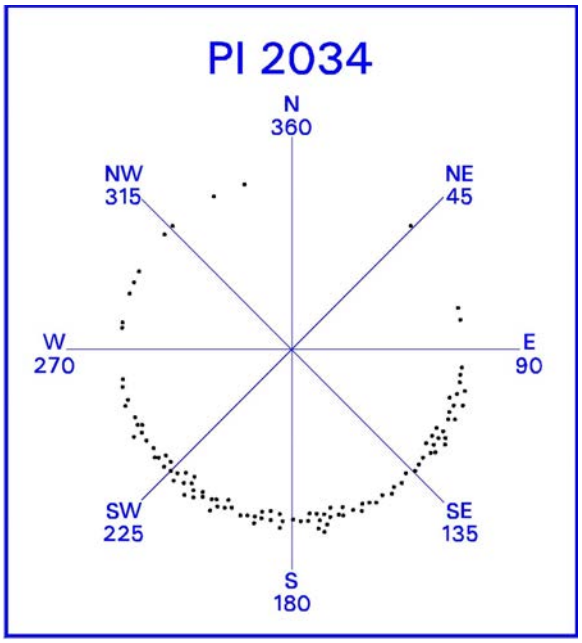


Figure 2034-3. Scatterplot of Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Interior Live Oak Woodland Alliance (1040)
- Blue Oak Woodland Alliance (2030)
- Blue Oak/Brome spp.–American Wild Carrot Woodland Association (2033)

2038 – Blue Oak–California Buckeye–(Interior Live Oak) Woodland Mapping Unit
Quercus douglasii–Aesculus californica–(*Quercus wislizeni* var. *wislizeni*) Woodland Mapping Unit

Description:

The *Quercus douglasii–Aesculus californica–(Quercus wislizeni var. wislizeni)* woodland mapping unit is mapped on moderately sloping predominantly south to southwest facing hillsides between 404–1462 m (1324–4796 ft) across 984 acres of Sequoia National Park (Figure 2038-1). The tree canopy is dominated by a mixture of *Quercus douglasii, Aesculus californica,* and *Q. wislizeni var. wislizeni* in two distinct expressions. One expression is characterized by open woodlands of *Quercus douglasii* and *Aesculus californica* occurring over a rich understory of primarily non-native annual grasses. In the other expression, the tree canopy is generally more closed and is dominated by a mixture of *Quercus douglasii, Aesculus californica* and *Q. wislizeni var. wislizeni*. Scattered understory shrubs can include *Rhamnus ilicifolia, Ceanothus cuneatus, Toxicodendron diversilobum, Cercocarpus montanus var. glaber,* and *Cercis canadensis var. texensis*. *Avena barbata, Bromus diandrus, B. hordeaceous, Holocarpha heermannii, Madia elegans,* and *Torilis nodosa* dominate the generally continuous and diverse herb layer. The hydrology is upland. Soils are moderately to well drained sandy clay loams.

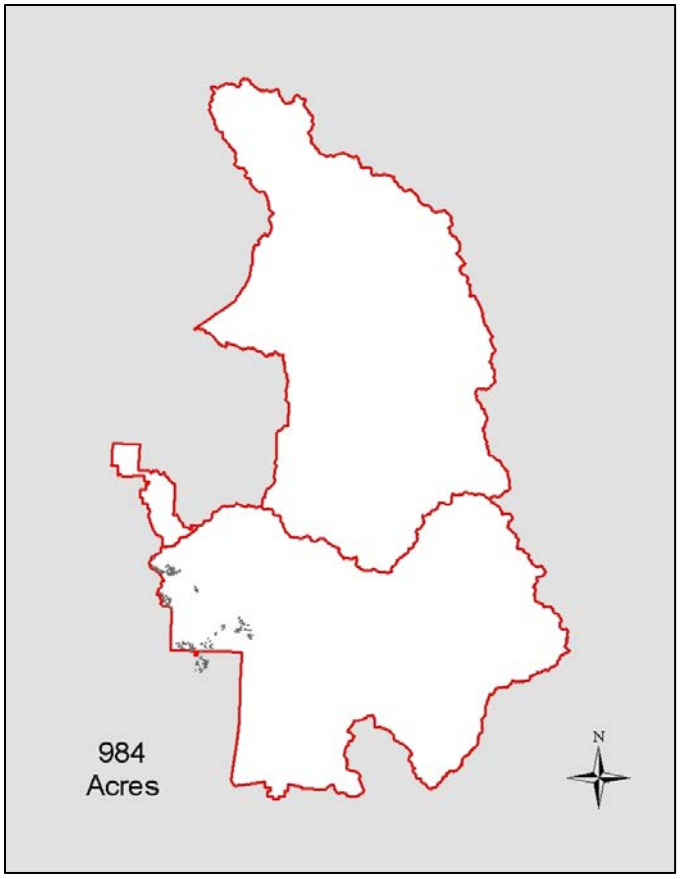


Figure 2038-1. Distribution of Blue Oak–California Buckeye–(Interior Live Oak) Woodland.

Accuracy:

Producer's accuracy: 100 % (n=2)
User's accuracy: 100% (n=2)

Photo Interpretation Signature:

The signature of *Quercus douglasii* varies from an orange to brown color with short, irregular or round crowns. The signature of *Aesculus californica* has a small or medium asymmetrical shaped yellow crown, and the signature of *Q. wislizeni var. wislizeni* varies from dull to dark red in color with a small, round crown. Stands are generally open with a dense understory of annual grasslands that appear gray or tan (Figure 2038-2). Overall stand signature varies depending on relative abundance of the canopy trees.

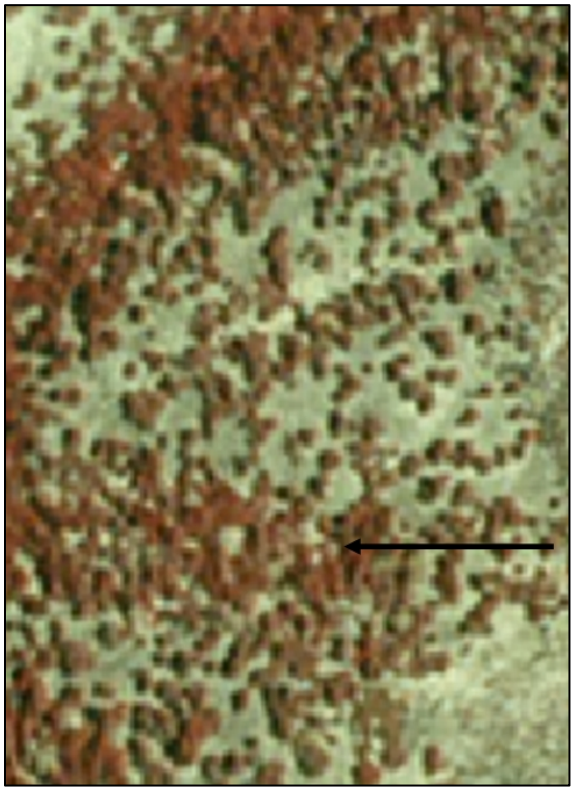


Figure 2038-2. Blue Oak–California Buckeye–(Interior Live Oak) Woodland signature. Photo reference: SHMO_SE.

Environmental Characteristics:

Microclimate – submesic to subxeric
Elevation – 404–1462 m (1324–4796 ft)
Shape – convex to concave
Slope position – low slope
Steepness – gentle to moderately steep; usually moderately sloping
Aspect – See Figure 2038-3.

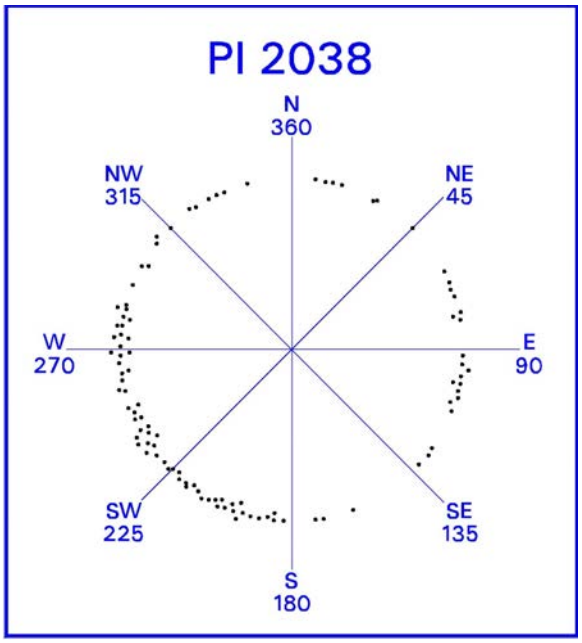


Figure 2038-3. Scatterplot of Blue Oak–California Buckeye–(Interior Live Oak) Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Blue Oak Woodland Alliance (2030)
- California Buckeye Woodland Alliance (2110)
- California Buckeye – Canyon Live Oak Woodland Association (2114)

2050 – Black Cottonwood Temporarily Flooded Forest Alliance



Black Cottonwood Forest. SEKI.0277_0402.

2050 – Black Cottonwood Temporarily Flooded Forest Alliance

Populus balsamifera ssp. *trichocarpa* Temporarily Flooded Forest Alliance

Description:

The *Populus balsamifera ssp. trichocarpa* temporarily flooded forest alliance is mapped on gentle to moderate slopes of varying aspect between 1203–2709 m (3948–8888 ft) across 1,333 acres of Sequoia and Kings Canyon National Parks (Figure 2050-1). These riparian stands can occupy alluvial terraces along streams and rivers, or form narrow stringers adjacent to streams with a much steeper slope. The tree layer is characteristically open to moderately dense and is dominated by *Populus balsamifera ssp. trichocarpa*. Other tree associates may include *Pinus ponderosa, Abies concolor, Alnus rhombifolia, Calocedrus decurrens, Pinus contorta* and occasionally *Quercus chrysolepis*, reflecting the drier associations frequently found in adjacent upland types. A shrub layer is usually present and may be dominated by *Ribes cereum, Salix spp.,* or *Cornus sericea*. Common species in the relatively sparse herbaceous layer include *Pteridium aquilinum, Artemisia douglasiana,* and *Equisetum hyemale*. Soils are well drained sands, sandy loams, and sandy clay loams. (NatureServe October 2006)

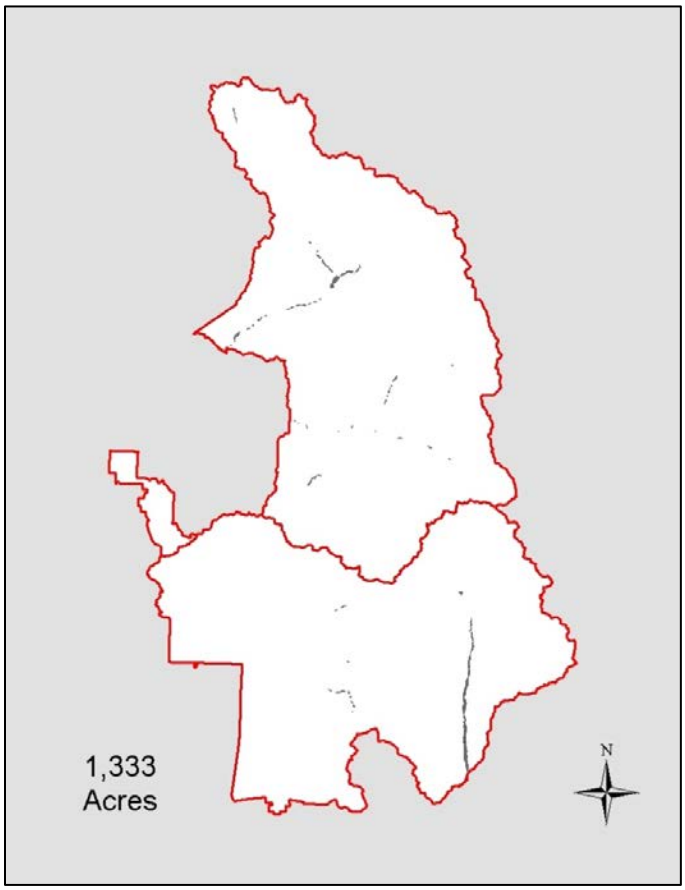


Figure 2050-1. Distribution of Black Cottonwood Temporarily Flooded Forest.

Accuracy:
Producer's accuracy: 75 % (n=8)
User's accuracy: 86% (n=7)

Photo Interpretation Signature:
The signature for Black Cottonwood ranges from a bright pink to dark red color with a large, irregular crown that exhibits a billowy texture (Figure 2050-2). Photo interpreters often map stands containing *Populus tremuloides* adjacent to or as a component of cottonwood stands. Stands of *Quercus chrysolepsis* occasionally are adjacent to cottonwood but are generally not noted by photo interpreters in stands containing *Populus balsamifera*.

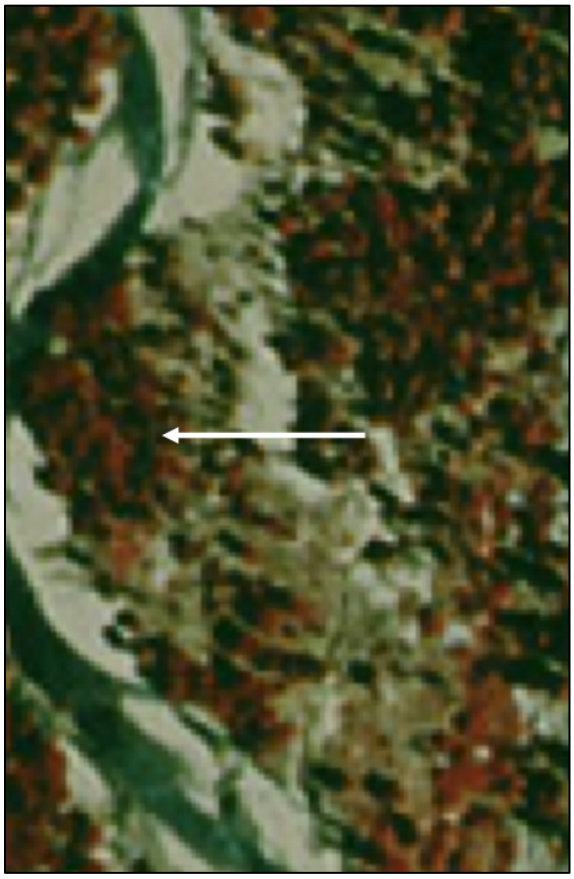


Figure 2050-2. Black Cottonwood Temporarily Flooded Forest signature. Photo reference: CHFA_NE

Environmental Characteristics:
Microclimate – temporarily flooded during growing season
Elevation – 1203–2709 m (3948–8888 ft)
Shape – flat to undulating
Slope position – canyon bottoms and low slopes
Steepness – level to gently sloping
Aspect – See Figure 2050-3.

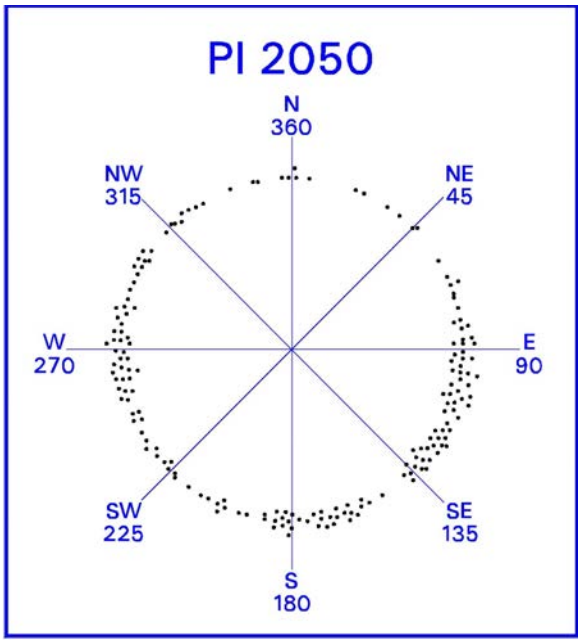


Figure 2050-3. Scatterplot of Black Cottonwood Temporarily Flooded Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Meadow Mapping Unit (2017)
- Black Cottonwood Forest Association (2053)
- White Alder Temporarily Flooded Forest Alliance (2060)
- Water Birch Shrubland Alliance (5300)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)

2053 – Black Cottonwood Forest Association

Populus balsamifera ssp. *trichocarpa* Forest Association

Description:

The *Populus balsamifera ssp. trichocarpa* forest association is mapped on gentle to steep slopes of varying aspects between 1349–2500 m (4425–8201 ft) across 831 acres of Sequoia and Kings Canyon National Parks (Figure 2053-1). These riparian stands can occupy alluvial terraces along streams and rivers, or form narrow stringers adjacent to streams with a much steeper slope. The overstory is dominated by *Populus balsamifera ssp. trichocarpa* with *Abies concolor* frequently occurring as a co-dominant. As mapped, *Pinus contorta* and *Populus tremuloides* may also contribute significant cover to the tree layer. *Alnus incana ssp. tenuifolia, Salix exigua,* and *Cornus sericea* are frequently found in the well-developed shrub layer, especially in mesic areas adjacent to the water's edge. A well-developed forb layer often includes *Artemisia douglasiana, Equisetum arvense,* and *Lupinus latifolius*. Sites are characterized by riparian hydrology, and soils are typically sandy loams. This association is closely related to the black cottonwood association described by Potter (2005).

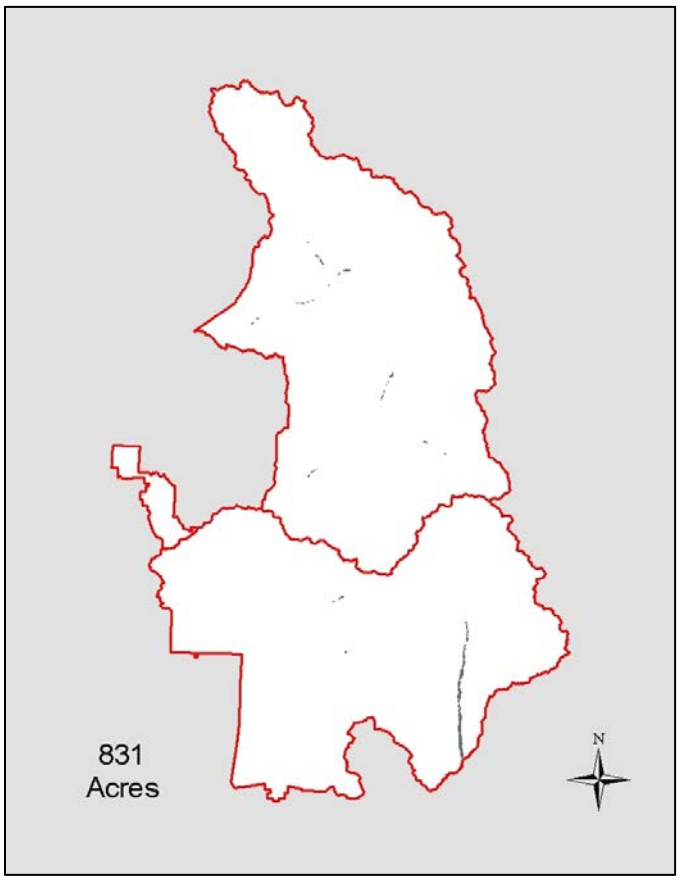


Figure 2053-1. Distribution of Black Cottonwood Forest.

Accuracy:

Producer's accuracy: 100 % (n=5)

User's accuracy: 83% (n=6)

Photo Interpretation Signature:

The signature for *Populus balsamifera ssp. trichocarpa* ranges from a bright pink to dark red color with a large, irregular crown that exhibits a billowy texture. The photo signature for *Abies concolor* is red with a narrow, conical crown that also has a billowy texture (Figure 2053-2).

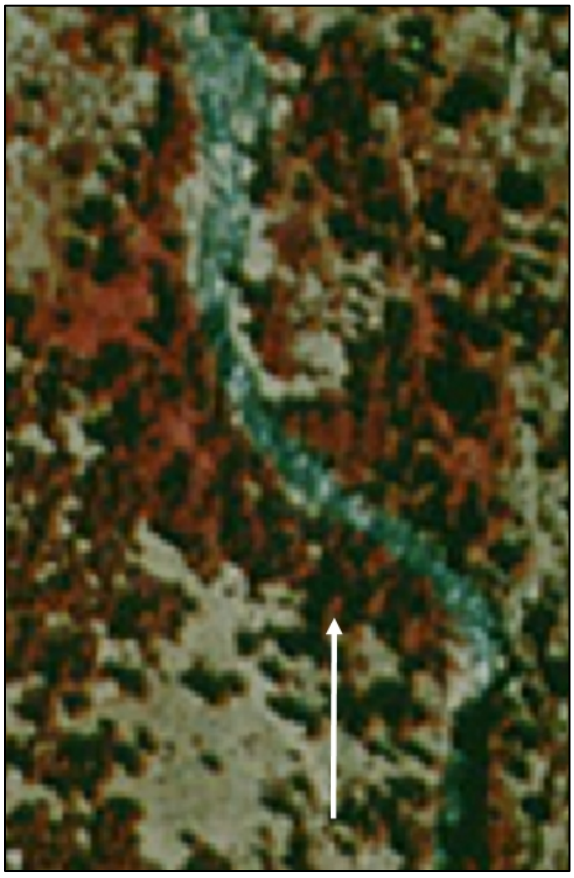


Figure 2053-2. Black Cottonwood Forest signature. Photo reference: MOKA_SE.

Environmental Characteristics:

Microclimate – temporarily to seasonally flooded
Elevation – 1349–2500 m (4425–8201 ft)
Shape – neutral
Slope position – lower
Steepness – flat
Aspect – See Figure 2053-3.

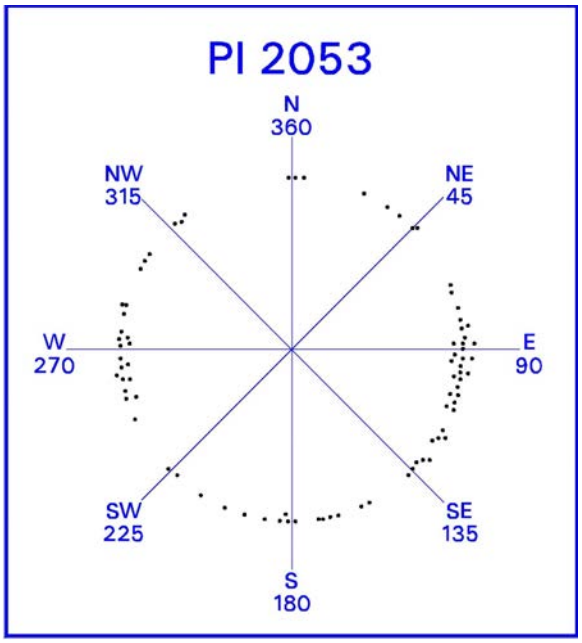


Figure 2053-3. Scatterplot of Black Cottonwood Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- White Alder Temporarily Flooded Forest Alliance (2060)
- White Fir Forest Mapping Unit (4081)
- Incense–Cedar–White Alder Forest Association (4111)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)

2060 – White Alder Temporarily Flooded Forest Alliance



White Alder Temporarily Flooded Forest. SEKI-AA.0152_702.

2060 – White Alder Temporarily Flooded Forest Alliance

Alnus rhombifolia Temporarily Flooded Forest Alliance

Description:

The *Alnus rhombifolia* temporarily flooded forest alliance is mapped along gentle to steeply sloping low to mid-elevation watercourses of varying aspect between 671–2073 m (2201–6802 ft) across 567 acres in Sequoia and Kings Canyon National Parks (Figure 2060-1). The tree canopy is dominated by *Alnus rhombifolia*, with *Platanus racemosa, Populus balsamifera, Quercus chrysolepis,* or *Acer macrophyllum* often co-dominating. *Calocedrus decurrens* frequently contributes low cover to the tree canopy. The shrub layer is usually dense and diverse and is frequently multi-layered, with *Pteridium aquilinum, Cornus sericea, Salix spp, Rubus leucodermis, Calycanthus occidentalis,* and/or *Toxicodendron diversilobum* contributing significant cover. The herbaceous layer can be either sparse or diverse, with species composition dependent on elevation, degree of canopy closure, and the composition of the surrounding vegetation. Stands are characterized by riverine hydrology and are temporarily/seasonally flooded. Soils are well drained loamy sands and sandy loams. (NatureServe October 2006)

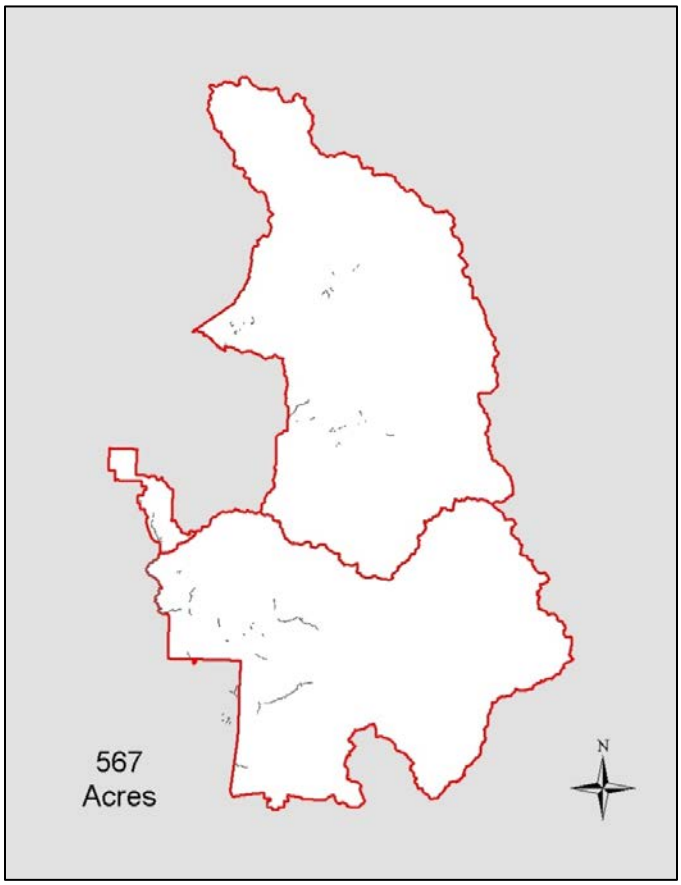


Figure 2060-1. Distribution of White Alder Temporarily Flooded Forest.

Accuracy:
Producer's accuracy: 83 % (n=6)
User's accuracy: 83% (n=6)

Photo Interpretation Signature:
Alnus rhombifolia appears bright pink or red with a small, rounded crown on the aerial photos and is usually found forming dense stands in riparian environments (Figure 2060-2). *Alnus rhombifolia* is also found in narrow canyons containing perennial streams in a variety of slope conditions.

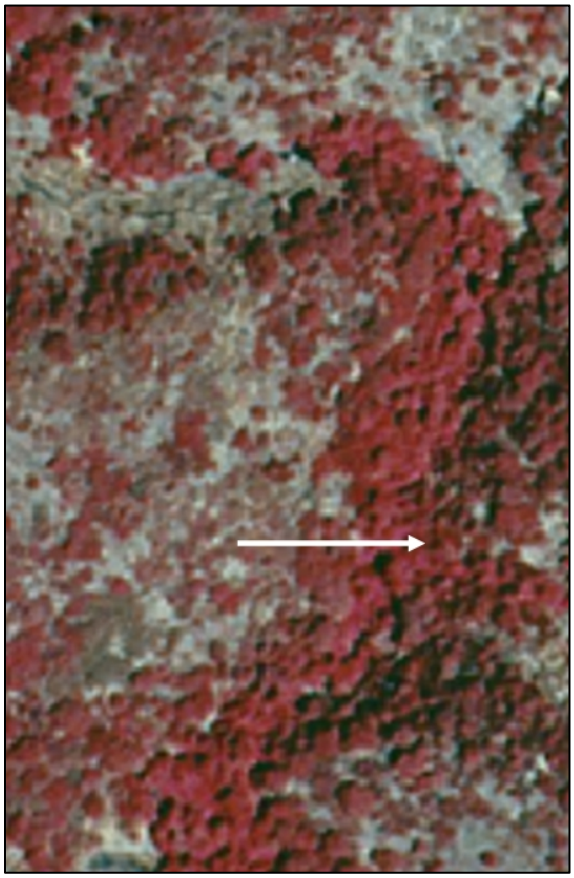


Figure 2060-2. White Alder Temporarily Flooded Forest signature. Photo reference: GIFO_NW.

Environmental Characteristics:
Microclimate – mesic
Elevation – 671–2073 m (2201–6802 ft)
Shape – generally flat
Slope position – canyon bottoms and low slopes
Steepness – gentle to moderately sloping
Aspect – See Figure 2060-3.

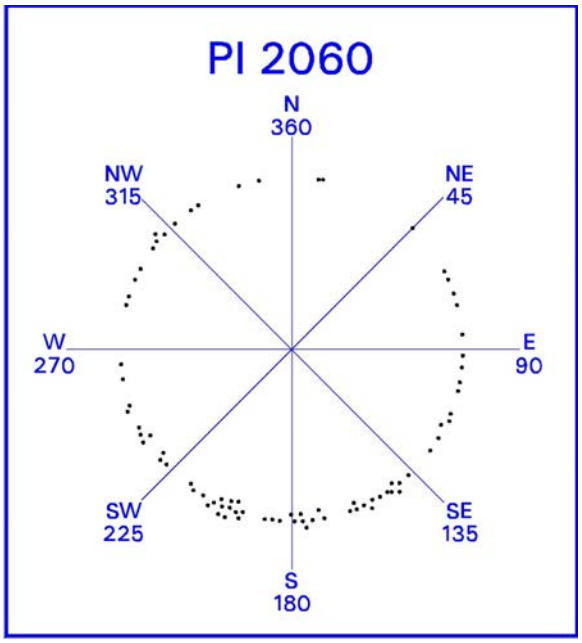


Figure 2060-3. Scatterplot of White Alder Temporarily Flooded Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- Black Cottonwood Forest Association (2053)
- Bigleaf Maple Forest Alliance (2080)
- California Sycamore Temporarily Flooded Woodland Alliance (2100)
- Incense–Cedar–White Alder Forest Association (4111)
- Water Birch Shrubland Alliance (5300)

2061 – White Alder–Red Willow–California Sycamore Forest Association
Alnus rhombifolia–Salix laevigata–Platanus racemosa Forest Association

Description:

The *Alnus rhombifolia–Salix laevigata–Platanus racemosa* forest association is mapped along gentle to moderately steep low elevation streams between 523–1063 m (1716–3488 ft) across 122 acres of Sequoia and Kings Canyon National Parks (Figure 2061-1). The tree layer of these riparian stands is characterized by *Platanus racemosa* mixed with varying amounts of *Alnus rhombifolia* and *Salix laevigata*. Frequently encountered shrubs include *Baccharis salicifolia, Salix lasiolepis, Toxicodendron diversilobum,* and *Vitis californica*. The understory is generally well developed, and most often is characterized by the presence of *Artemisia douglasiana, Carex nudata, Mimulus guttatus, Rumex crispus,* and *Torilis arvense*. Stands are characterized by temporarily flooded riparian hydrology. The soils are rocky sands and gravels. (Potter 2005).

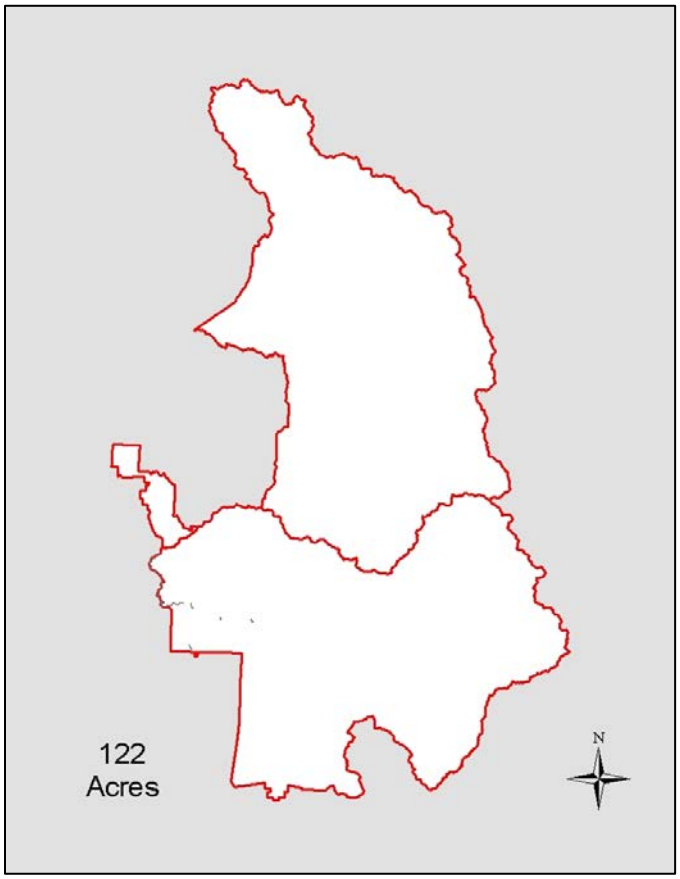


Figure 2061-1. Distribution of White Alder–Red Willow–California Sycamore Forest.

Accuracy:

Producer's accuracy: 67% (n=3)
User's accuracy: 100 % (n=2)

Photo Interpretation Signature:

The signature of *Platanus racemosa* is pink or red with an irregularly shaped expansive open crown. The signature of the *Alnus rhombifolia* is a brighter pink color with a small, rounded crown. The *Platanus racemosa* is usually larger in stature than the *Alnus rhombifolia* and they occur together in dense patches in riparian areas where they display a billowy texture (Figure 2061-2).

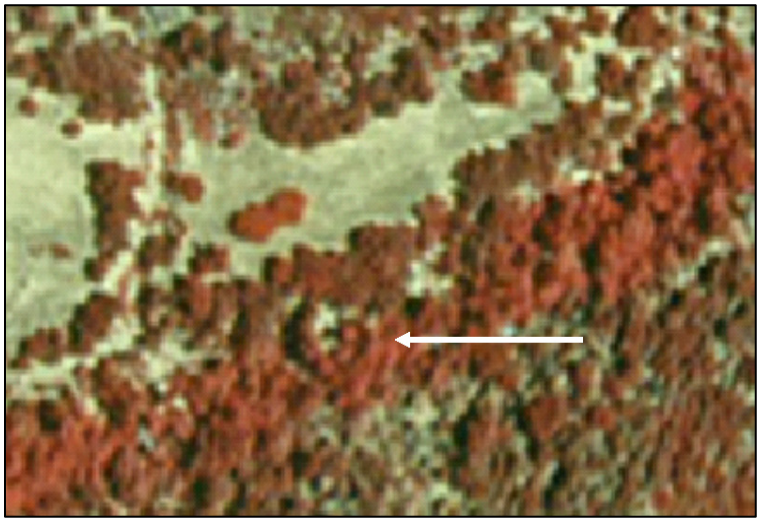


Figure 2061-2. White Alder–Red Willow–California Sycamore Forest signature. Photo reference: SHMO_SE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 523–1063 m (1716–3488 ft)
Shape – neutral
Slope position – drainage bottoms
Steepness – moderately sloping
Aspect – See Figure 2061-3.

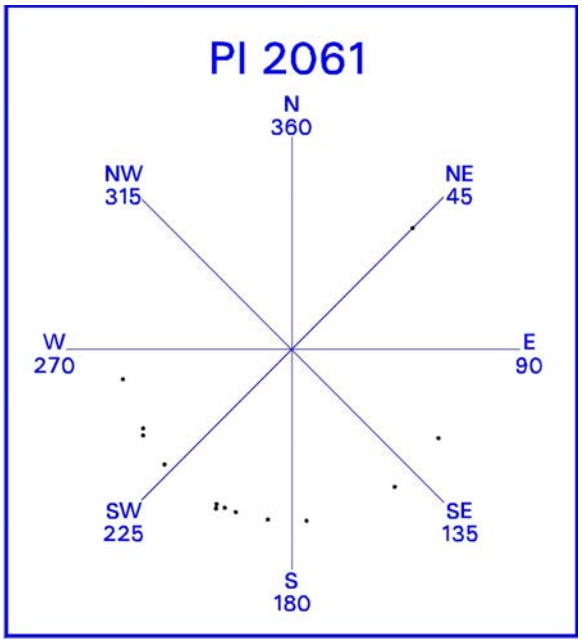


Figure 2061-3. Scatterplot of White Alder–Red Willow–California Sycamore Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- California Sycamore – (Canyon Live Oak–Interior Live Oak) Forest Mapping Unit (2102)

2080 – Bigleaf Maple Forest Alliance



Bigleaf Maple Forest. SEKI.0332_435.

2080 – Bigleaf Maple Forest Alliance

Acer macrophyllum Forest Alliance

Description:

The *Acer macrophyllum* forest alliance is mapped on mesic moderate to steep north-facing slopes between 1077–2270 m (3535–7448 ft) across 186 acres of Sequoia and Kings Canyon National Parks (Figure 2080-1). *Acer macrophyllum* dominates the tree canopy, although *Calocedrus decurrens, Quercus chrysolepis,* and *Torreya californica* may contribute minor amounts of cover. The herbaceous layer is generally sparse but may include *Dryopteris arguta, Toxicodendron diversilobum,* and other mesic lower montane/upper foothill species. Sites have upland or riparian hydrology and well drained rocky soils.

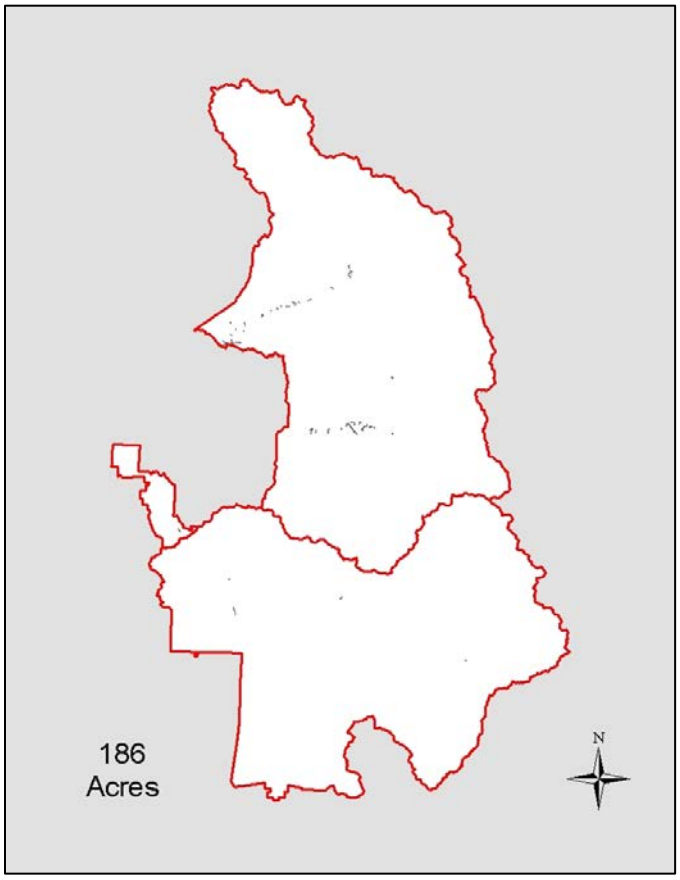


Figure 2080-1. Distribution of Bigleaf Maple Forest.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: 0% (n=1)

Photo Interpretation Signature:

The signature of *Acer macrophyllum* is a pink color with an expansive round crown. It is typically found in a dense patch along steep, rocky riparian environments and appears smooth in texture.

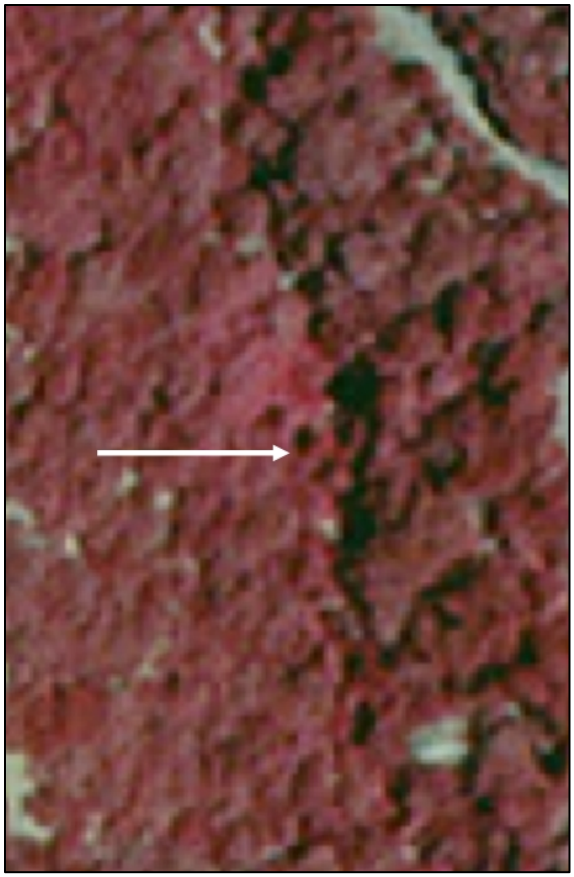


Figure 2080-2. Bigleaf Maple Forest signature. Photo reference: GIFO_SE.

Environmental Characteristics:
Microclimate – mesic
Elevation – 1077–2270 m (3535–7448 ft)
Shape – concave
Slope position – low slopes and valley bottoms
Steepness – moderately sloping to steep
Aspect – See Figure 2080-3.

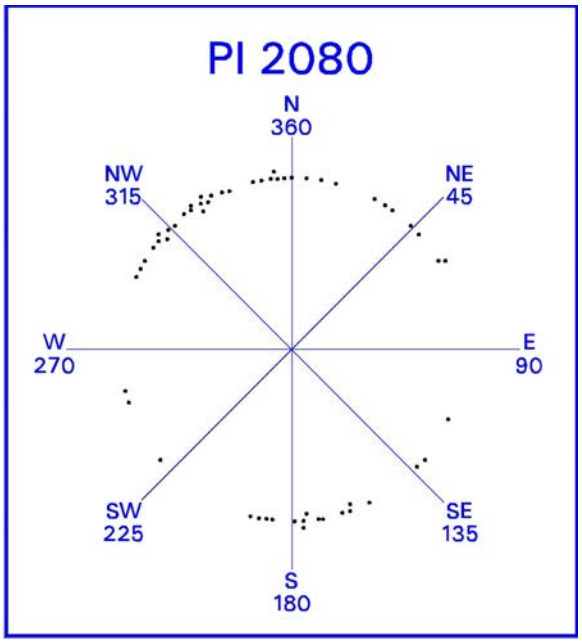


Figure 2080-3. Scatterplot of Bigleaf Maple Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- White Alder Temporarily Flooded Forest Alliance (2060)

2100 – California Sycamore Temporarily Flooded Woodland Alliance



California Sycamore – Canyon Live Oak Forest. SEKI.0400_445.

2100 – California Sycamore Temporarily Flooded Woodland Alliance

Platanus racemosa Temporarily Flooded Woodland Alliance

Description:

The *Platanus racemosa* temporarily flooded woodland alliance is mapped along gentle to moderately steep low elevation streams between 388–1383 m (1274–4536 ft) across 340 acres of Sequoia and Kings Canyon National Parks (Figure 2100-1). These communities are characterized by the dominance of *Platanus racemosa*, with *Quercus wislizeni var. wislizeni, Quercus chrysolepis,* or *Umbellularia californica* also important. *Alnus rhombifolia* may also contribute low cover. The shrub cover is generally sparse, but may include *Calycanthus occidentalis, Toxicodendron diversilobum, Cercis canadensis var. texensis* and/or *Salix spp*. The herbaceous layer is also relatively sparse but may include a variety of mesic foothill species. Stands are characterized by temporarily flooded riparian hydrology. Soils are rocky sands and gravels. (NatureServe October 2006).

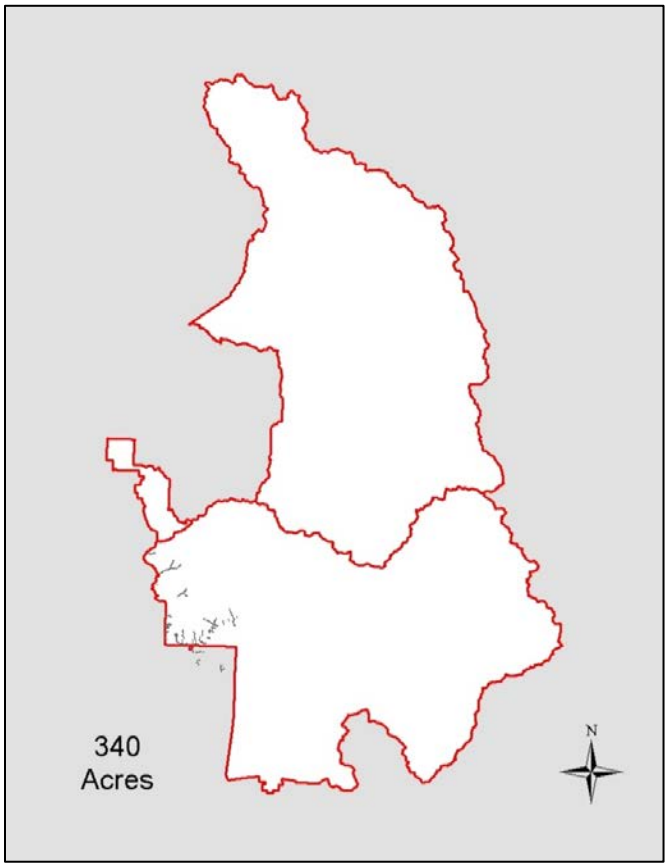


Figure 2100-1. Distribution of California Sycamore Temporarily Flooded Woodland.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
The signature of *Platanus racemosa* is pink with a broad, irregular, open crown and a smooth overall texture. *Quercus chrysolepis* is often present mixing along the drier edges of this alliance, especially along steep rocky interfaces (Figure 2100-2).

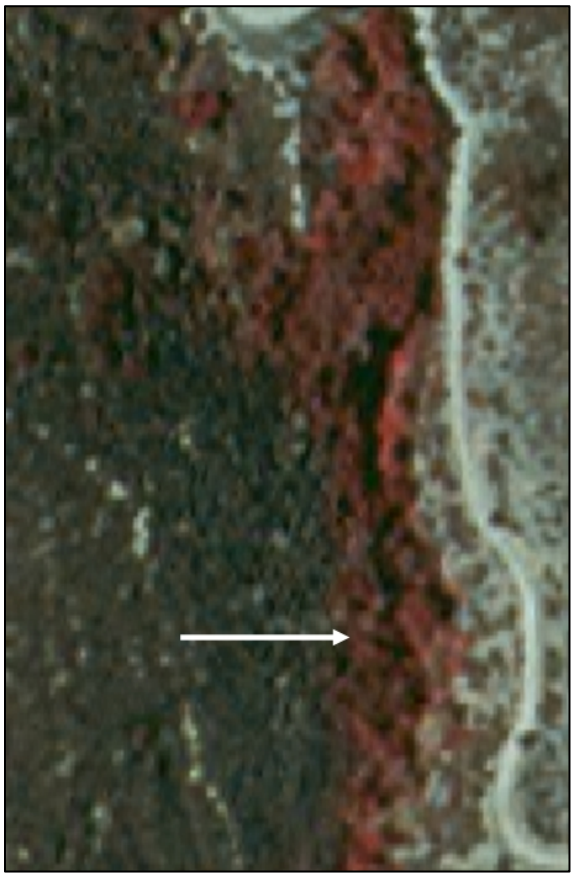


Figure 2100-2. California Sycamore Temporarily Flooded Woodland signature. Photo reference: GIFO_SW.

Environmental Characteristics:
Microclimate – mesic
Elevation – 388–1383 m (1274–4536 ft
Shape – neutral
Slope position – drainage bottoms
Steepness – gentle to moderate slopes
Aspect – See Figure 2100-3.

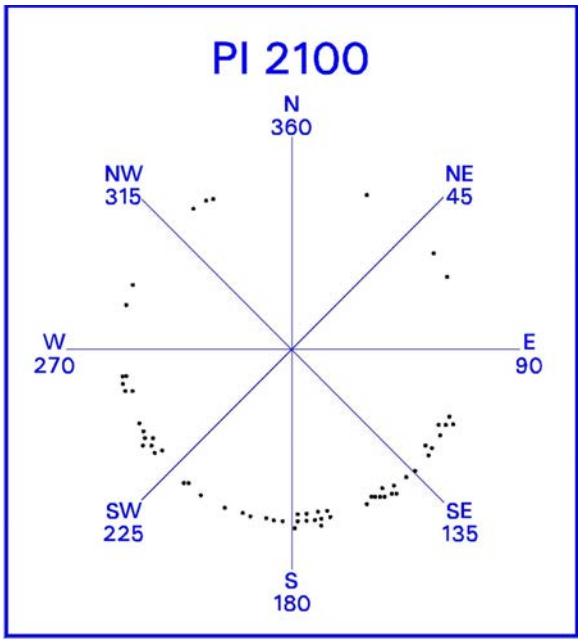


Figure 2100-3. Scatterplot of California Sycamore Temporarily Flooded Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- White Alder Temporarily Flooded Forest Alliance (2060)

2102 – California Sycamore–(Canyon Live Oak–Interior Live Oak) Forest Mapping Unit
Platanus racemosa–(*Quercus chrysolepis*–*Quercus wislizeni* var. *wislizeni*) Forest Mapping Unit

Description:

The *Platanus racemosa* – (*Quercus chrysolepis* – *Quercus wislizeni var. wislizeni*) forest mapping unit is mapped on gentle to moderate slopes adjacent to foothill rivers and streams between 417–1383 m (1368–4536 ft) across 312 acres of Sequoia National Park (Figure 2102-1). The tree layer of these closed riparian forest stands is co-dominated by *Platanus racemosa* and *Quercus chrysolepis*, with *Calocedrus decurrens* and *Umbellularia californica* occasionally contributing lower amounts of cover. *Toxicodendron diversilobum*, *Rhamnus tomentella*, and *Calycanthus occidentalis* are frequently found in the shrub layer. The herbaceous layer includes typical upland herbs such as *Galium spp*., *Trifolium spp*., *Bromus spp*., *Hypochaeris glabra*, *Pentagramma triangularis*, *Madia elegans*, and *Claytonia spp*., along with more typically riparian species such as *Artemisia douglasiana*. Sites are characterized by temporarily flooded, riparian hydrology and soils of moderately well drained sandy loam. This type is very similar to the California sycamore/poison oak association (Potter 2005) with the exception of the presence of *Quercus chrysolepis* in SEKI stands.

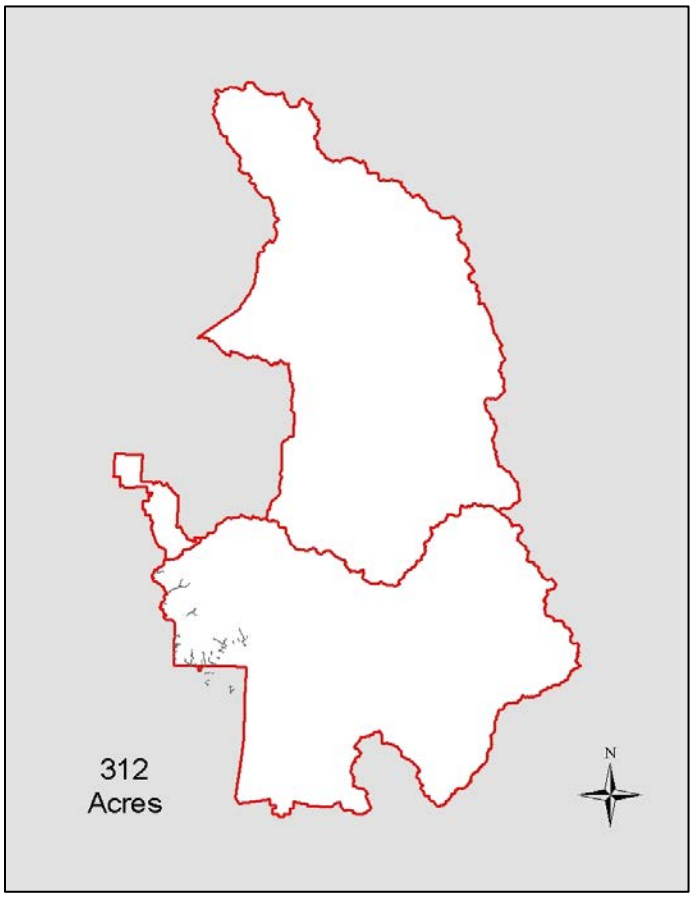


Figure 2102-1. Distribution of California Sycamore–(Canyon Live Oak–Interior Live Oak) Forest.

Accuracy:

Producer's accuracy: 100% (n=1)
User's accuracy: 100 % (n=1)

Photo Interpretation Signature:

The signature of *Platanus racemosa* is pink or red with a broad, irregularly shaped open crown. The photo signature of *Quercus chrysolepis* appears pink or red with a large round crown. The texture of this dense riparian vegetation is smooth and uniform (Figure 2012-2).

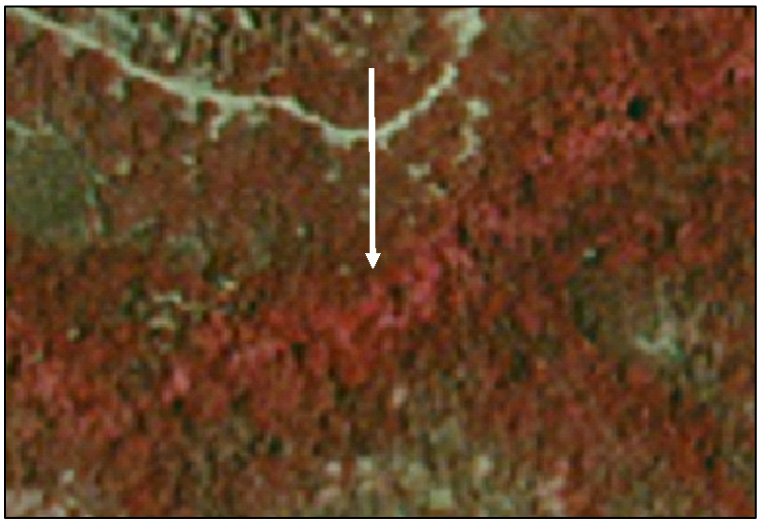


Figure 2102-2. California Sycamore–(Canyon Live Oak–Interior Live Oak) Forest signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 417–1383 m (1368–4536 ft)
Shape – neutral
Slope position – drainage bottoms
Steepness – moderate
Aspect – See Figure 2102-3.

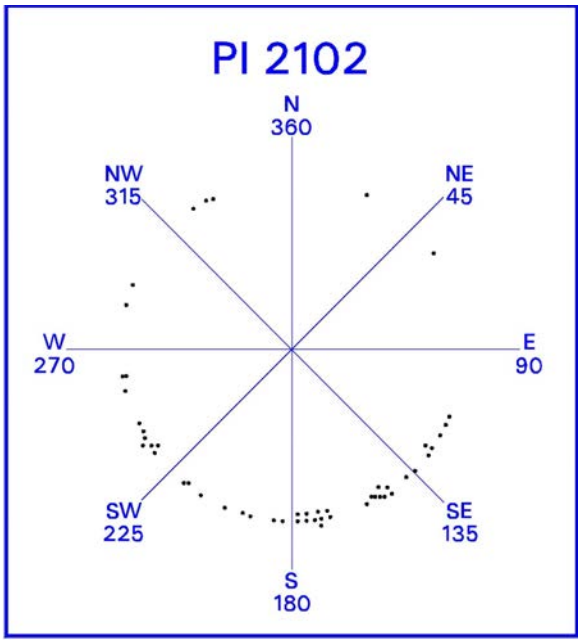


Figure 2102-3. Scatterplot of California Sycamore–(Canyon Live Oak–Interior Live Oak) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- White Alder Temporarily Flooded Forest Alliance (2060)

2110 – California Buckeye Woodland Alliance



California Buckeye–Birchleaf Mountain Mahogany–Canyon Live Oak–Black Oak Woodland.

2110 – California Buckeye Woodland Alliance

Aesculus californica Woodland Alliance

Description:

The *Aesculus californica* woodland alliance is mapped on generally steep north to east-facing low slopes between 451–1700 m (1481–5579 ft) across 1,484 acres of Sequoia National Park (Figure 2110-1). These small open stands are dominated by *Aesculus californica* and usually have *Quercus chrysolepis* or *Q. wislizeni var. wislizeni* contributing low cover. The sparse shrub layer is characterized by *Cercocarpus montanus var. glaber* and can also include *Fremontodendron californicum*. The understory is characterized by herbaceous plants typical of the foothill annual grassland. The hydrology is upland. Soils are moderately well drained sandy clay loams and silty clay loams. (NatureServe October 2006).

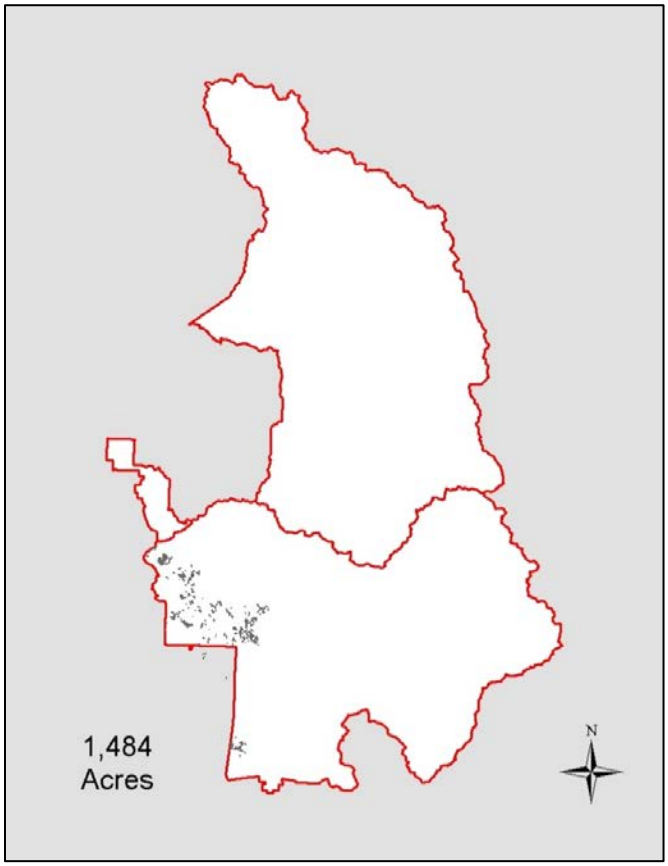


Figure 2110-1. Distribution of California Buckeye Woodland.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
The photo signature of *Aesculus californica* appears yellow with small to medium irregularly shaped crowns. The pure stands of *Aesculus californica* are usually small and dense with a billowy texture (Figure 2110-2).

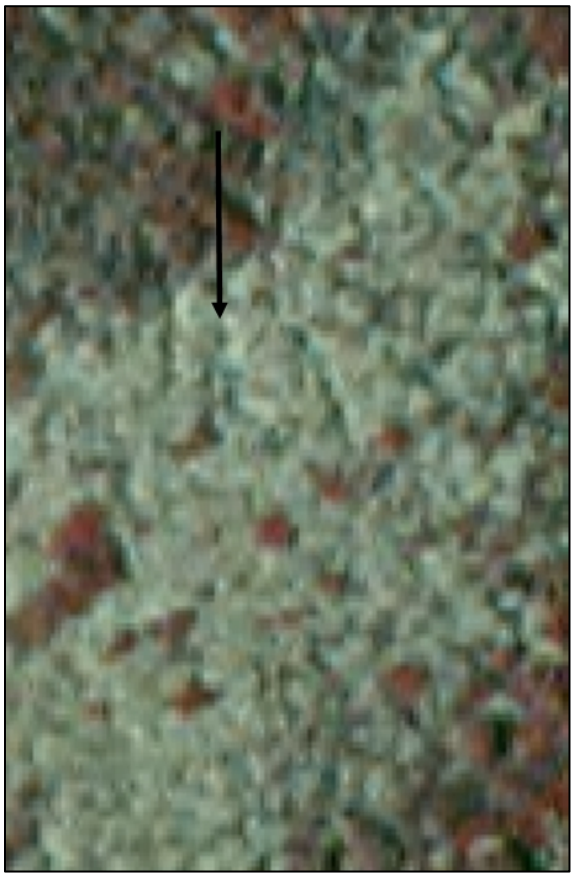


Figure 2110-2. California Buckeye Woodland signature. Photo reference: DEPE_NE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 451–1700 m (1481–5579 ft)
Shape – concave to convex
Slope position – low slope
Steepness – steep
Aspect – See Figure 2110-3.

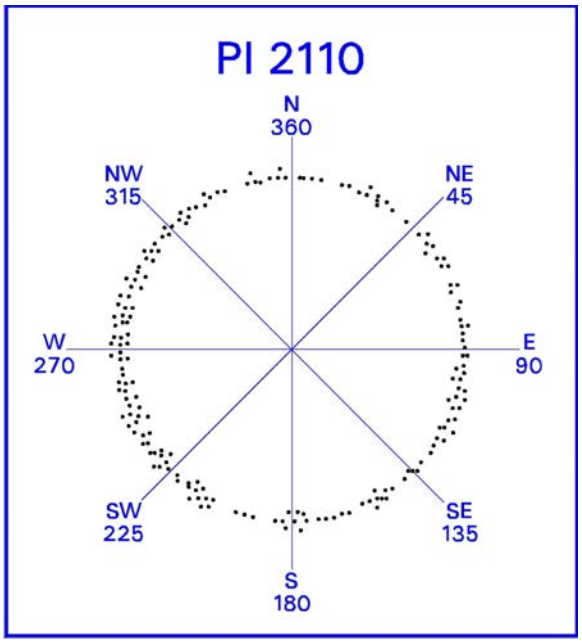


Figure 2110-3. Scatterplot of California Buckeye Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Blue Oak–California Buckeye–(Interior Live Oak) Woodland Mapping Unit (2038)
- Birchleaf Mountain Mahogany Shrubland Alliance (5010)

2114 – California Buckeye–Canyon Live Oak Woodland Association
Aesculus californica–Quercus chrysolepis Woodland Association

Description:
The *Aesculus californica–Quercus chrysolepis* woodland association [provisional] is mapped on gentle to very steep slopes of varying aspect between 666–1700 m (2186–5579 ft) across 1,400 acres of Sequoia National Park (Figure 2114-1). A moderately dense to closed tree canopy is co-dominated by *Aesculus californica* and *Quercus chrysolepis* on low to mid slope settings. Stands of this type are mapped at the upper end of the elevation range of *Aesculus californica*. Due to a lack of plot data for this often steep and inaccessible type, little is known about the understory composition. It is retained in the mapping classification based on field reconnaissance and input from the photo interpreters, who express confidence in its distribution in the Kaweah River drainage. Plot data is required to further describe this type.

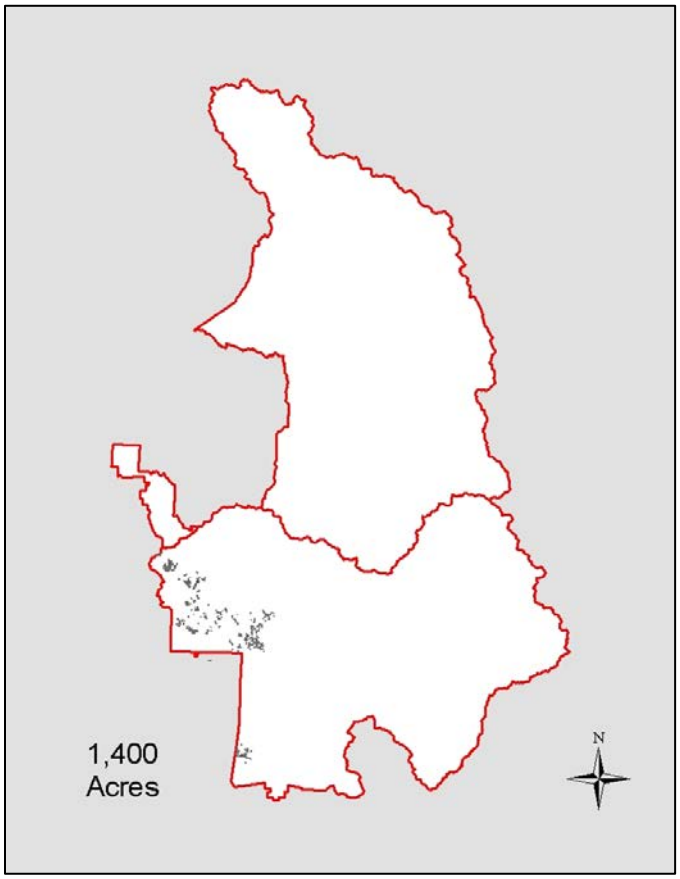


Figure 2114-1. Distribution of California Buckeye–Canyon Live Oak Woodland.

Accuracy:
Producer's accuracy: 100 % (n=1)
User's accuracy: 50% (n=2)

Photo Interpretation Signature:

In this woodland, the photo signature of *Aesculus californica* appears yellow with small to medium irregularly shaped crowns. The signature of *Quercus chrysolepis* is pink or red with a broad round crown. The texture of this woodland is variable: smooth where the *Quercus chrysolepis* dominates and rough or uneven where the *Aesculus californica* dominates (Figure 2114-2).



Figure 2114-2. California Buckeye–Canyon Live Oak Woodland signature. Photo reference: GIFO_NW.

Environmental Characteristics:

Microclimate – submesic
Elevation – 666–1700 m (2186–5579 ft)
Shape – neutral to concave
Slope position – mid to low
Steepness – gentle to very steep
Aspect – See Figure 2114-3.

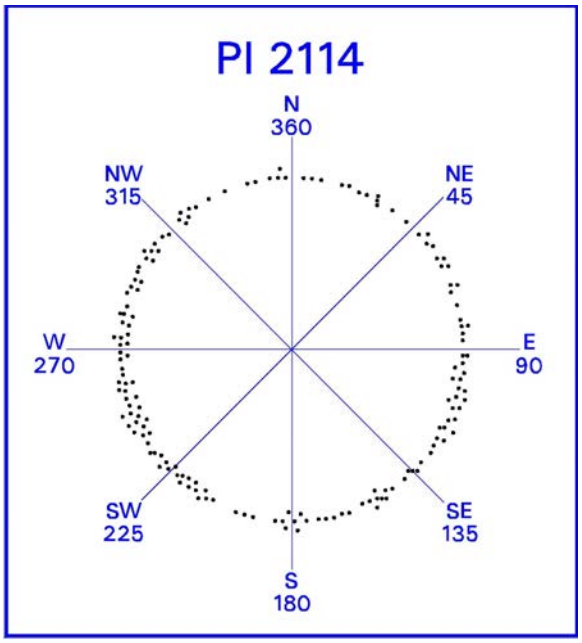


Figure 2114-3. Scatterplot of California Buckeye–Canyon Live Oak Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Blue Oak–California Buckeye–(Interior Live Oak) Woodland Mapping Unit (2038)

2500 – Superalliances and Alliance-Level Mapping Units

2530 – Montane Broadleaf Deciduous Trees Mapping Unit

Description:

The montane broadleaf deciduous trees mapping unit represents a formation level class that is mapped in only a few instances in Sequoia National Park on about 6 acres (Figure 2530-1). It is mapped on gentle to moderately steep north trending slopes between 1643–1883 m (5391–6177 ft). These patches of tall shrub to short tree vegetation in coniferous forest openings are dominated by such deciduous species as *Cornus nuttallii* and *Corylus cornuta*, which proved difficult to distinguish on the aerial photography.

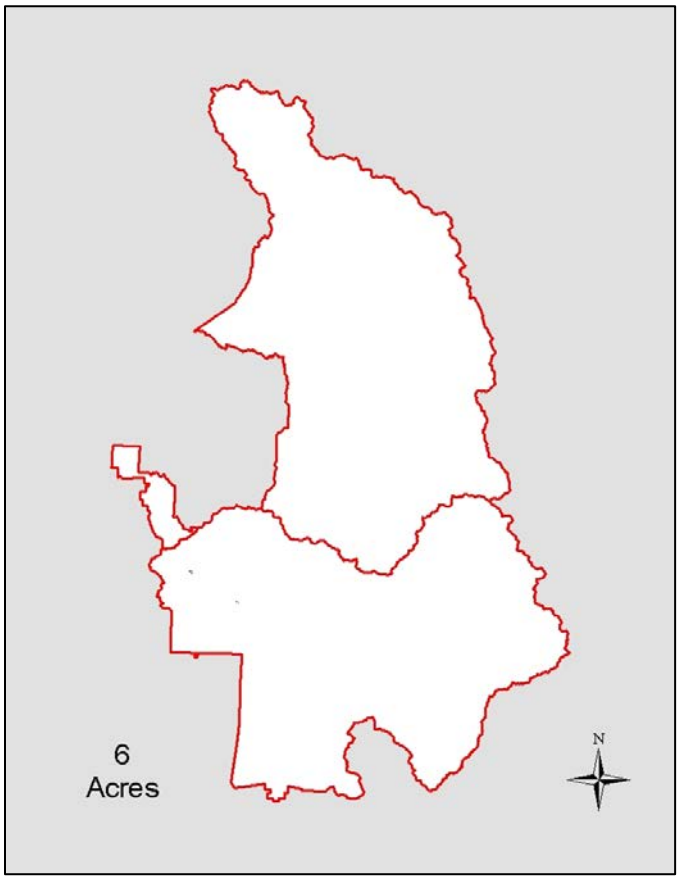


Figure 2530-1. Distribution of Montane Broadleaf Deciduous Trees.

Accuracy:

Producer's accuracy: 0% (n=1)
User's accuracy: % (n=0)

Photo Interpretation Signature:

This mapping unit is a back-off category for small openings in forest canopy. The signature is highly variable and it is not possible to represent its range with one aerial image.

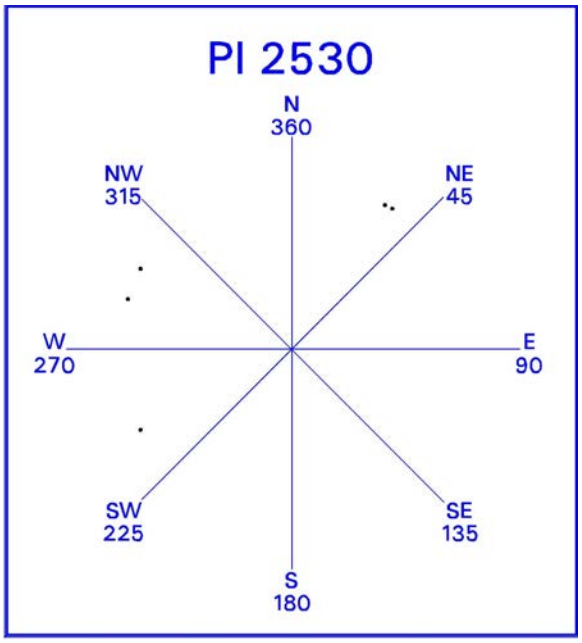


Figure 2530-2. Scatterplot of Montane Broadleaf Deciduous Trees in relation to aspect.

Environmental Characteristics:
Microclimate – submesic
Elevation – 1643–1883 m (5391–6177 ft)
Aspect – See Figure 2530-2.

3000 – Needleleaf Evergreen Pine Trees



Sierra Lodgepole Pine–Quaking Aspen Forest. SEKI.0250_340.

3010 – Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance

Pinus contorta var. *murrayana–Populus tremuloides*–(Pinus Jeffreyi) Forest Alliance

Description:

The *Pinus contorta var. murrayana–Populus tremuloides* alliance is mapped on gentle to moderate slopes of varying aspect between 2149–3235 m (7049–10613 ft) across 521 acres of Sequoia and Kings Canyon National Parks (Figure 3010-1). These types are often adjacent to or in close proximity to meadows. The relatively open tree canopy (20–70% absolute cover) is dominated by a mixture of *Pinus contorta var. murrayana* and *Populus tremuloides*, with *Abies concolor, A. magnifica,* and/or *Juniperus occidentalis var. australis* contributing lower amounts of cover. The shrub layer is generally sparse (<30% absolute cover) and can contain *Arctostaphylos patula, Artemisia tridentata, Ledum glandulosum,* and/or *Salix spp*. The herbaceous layer can be either sparse or dense depending on site conditions and is often characterized by *Poa pratensis, Elymus glaucus, Monardella sp., Epilobium angustatum,* and/or *Heracleum lanatum*.

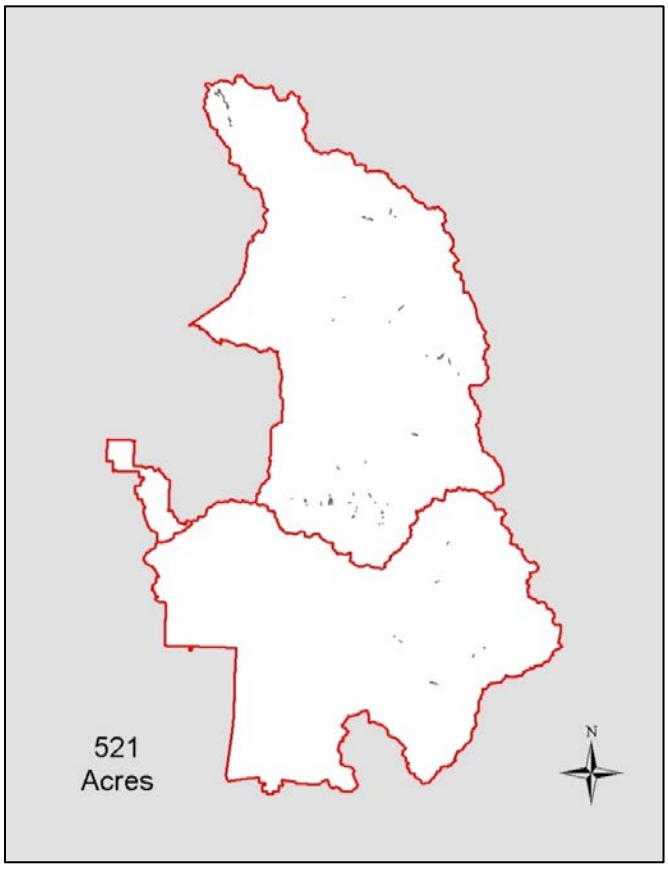


Figure 3010-1. Distribution of Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest.

Accuracy:

Producer's accuracy: 63% (n=8)

User's accuracy: 83% (n=6)

Photo Interpretation Signature:
The photo signature of *Pinus contorta var. murrayana* ranges from dark red to dark brown in color and a narrow, rounded shaped crown. *Populus tremuloides* conveys a brighter red to orange signature and often forms small patches among the conifers (Figure 3010-2).

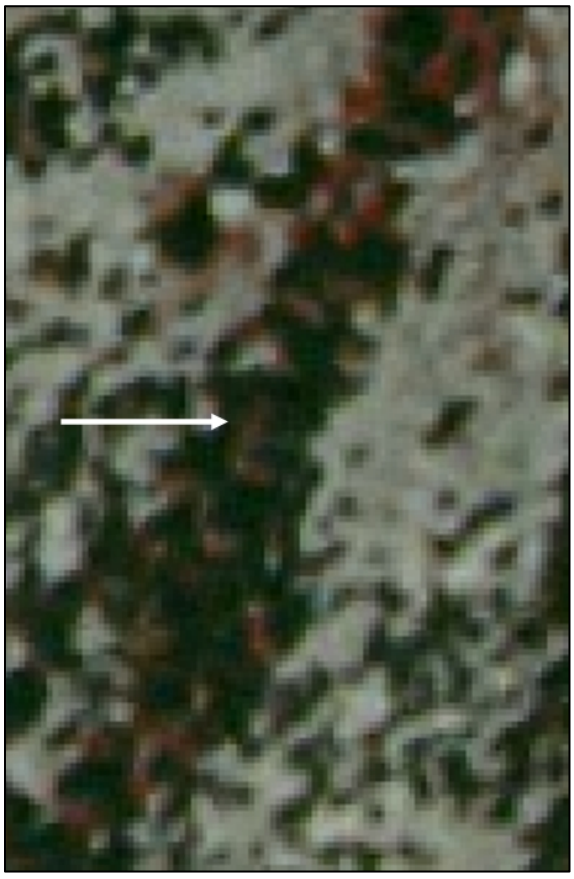


Figure 3010-2. Sierra Lodgepole Pine–Quaking Aspen Forest–(Jeffrey Pine) signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 2149–3235 m (7049–10613 ft)
Shape – flat to concave or undulating
Slope position – canyon bottom, low slope, midslope
Steepness – gentle to moderate
Aspect – See Figure 3010-3.

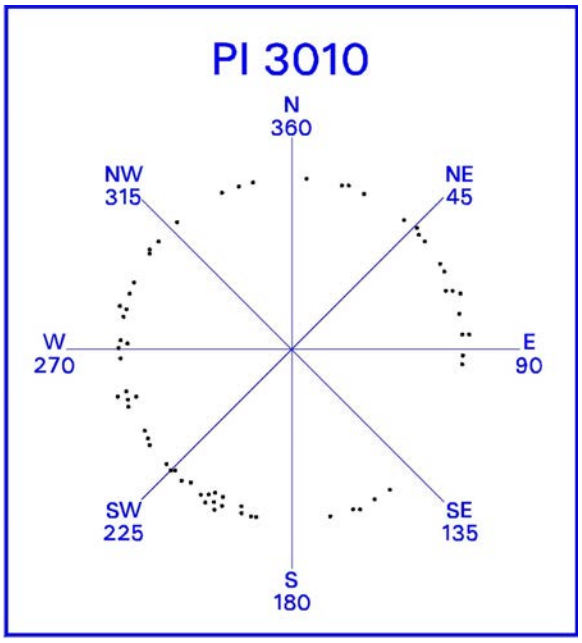


Figure 3010-3. Scatterplot of Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Sierra Lodgepole Pine Mesic Forest Superassociation (3048)

3012 – Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit
Pinus contorta var. *murrayana–Populus tremuloides*/(*Poa pratensis*) Forest Mapping Unit

Description:

The *Pinus contorta var. murrayana–Populus tremuloides*/(*Poa pratensis*) forest mapping unit is mapped on canyon bottoms and gentle slopes of various aspects between 2322–3005 m (7619–9859 ft) along the edges of moist meadows across 219 acres of Sequoia and Kings Canyon National Parks (Figure 3012-1). The tree canopy may be either open or closed and is dominated by a mixture of *Pinus contorta var. murrayana* and *Populus tremuloides*, with *Populus tremuloides* often occupying a subcanopy position. The shrub layer is sparse to absent. The herbaceous layer is made up of drier meadow species including *Juncus balticus, Poa pratensis*, and *Carex spp*. Soils are moderately well drained sandy clay loams on temporarily flooded sites.

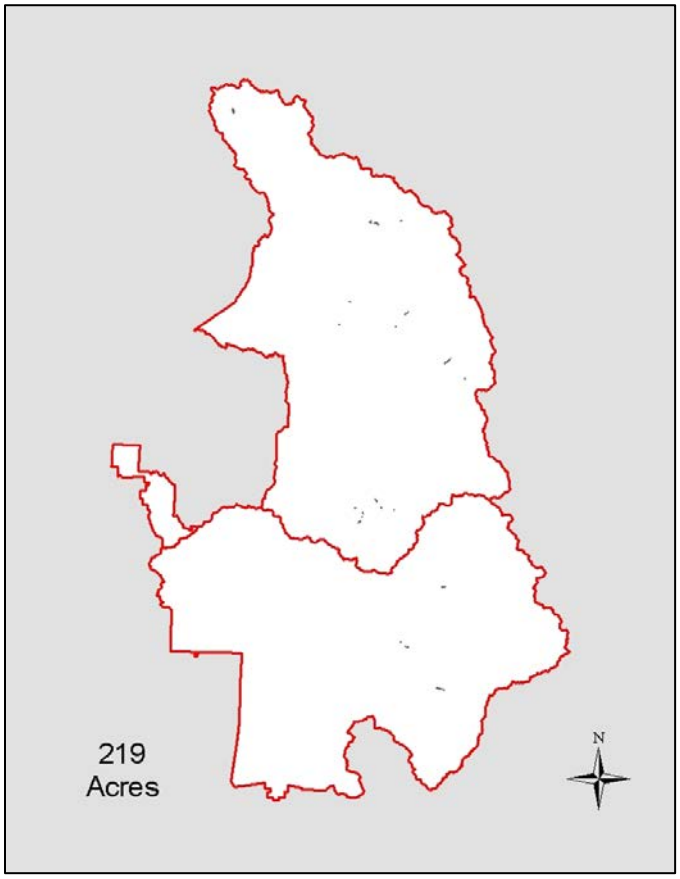


Figure 3012-1. Distribution of Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest.

Accuracy:

Producer's accuracy: 100% (n=5)
User's accuracy: 100 % (n=5)

Photo Interpretation Signature:

The photo signature of *Pinus contorta var. murrayana* ranges from dark red to dark brown in color with a narrow, rounded crown. *Populus tremuloides* has a brighter red to orange signature, and often occurs in small patches among the conifers. This is a particularly mesic type interlaced with the smooth signature of small meadows within and adjacent to the stand (Figure 3012-2).

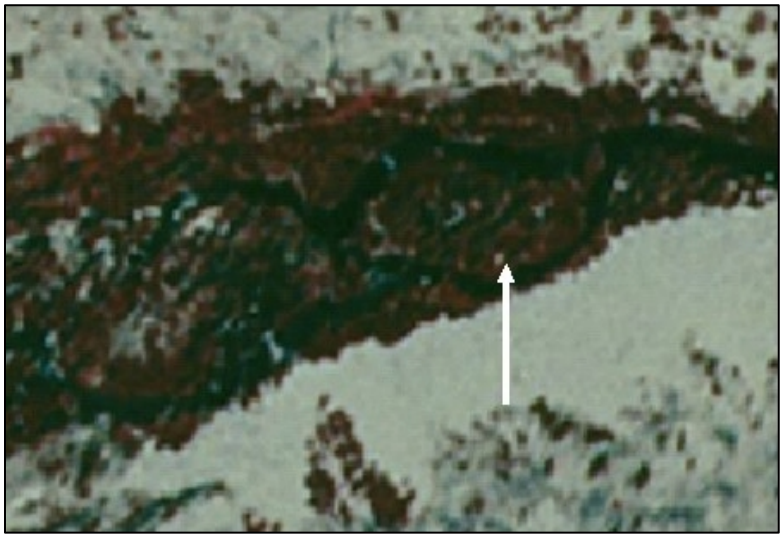


Figure 3012-2. Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest signature. Photo reference: MOKA_NW.

Environmental Characteristics:

Microclimate – mesic
Elevation – 2322–3005 m (7619–9859 ft)
Shape – flat
Slope position – canyon bottoms and low slopes
Steepness – gentle slopes
Aspect – See Figure 3012-3.

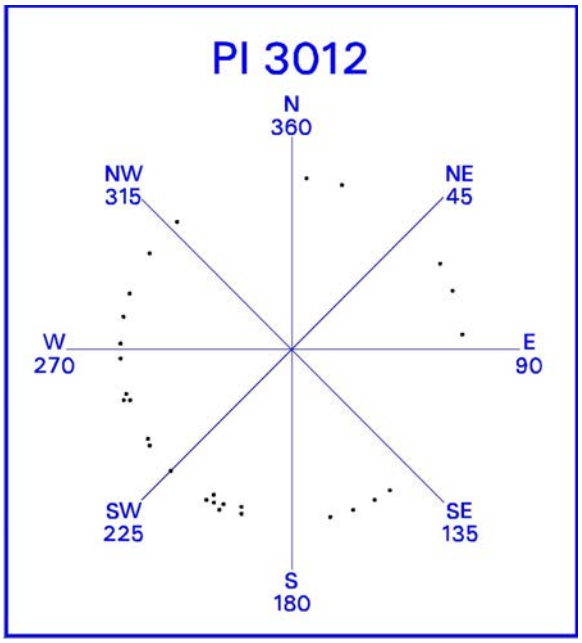


Figure 3012-3. Scatterplot of Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance (3010)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Upland Herbaceous (7000)
- Intermittently to Seasonally Flooded Meadow (8000)
- Semi-permanently to Permanently Flooded Meadow (9000)

3020 – Sierra Lodgepole Pine Forest Alliance



Sierra Lodgepole Pine/Arrowleaf Butterweed Forest. SEKI.0256_361.

3020 – Sierra Lodgepole Pine–Quaking Aspen Forest Alliance
Pinus contorta var. *murrayana–Populus tremuloides* Forest Alliance

Description:
The *Pinus contorta var. murrayana* forest alliance is mapped on a wide range of sites from gentle canyon bottoms to steep high slopes and ridges between 2028–3523 m (6655–11557 ft) across 17,252 acres of Sequoia and Kings Canyon National Parks (Figure 3020-1). Forests and woodlands included in this alliance are characterized by a closed to moderately open tree canopy that is dominated by *Pinus contorta var. murrayana*. *P. contorta ssp. murrayana* occupies a broad array of habitats in the Sierra Nevada, and this is reflected in the diverse range of associations it characterizes. Stands may be even- or multi-aged depending on geographic location, edaphic characteristics, and local fire history. Shrub and herbaceous layers may be present or absent depending on tree canopy characteristics and local site conditions. Stands are characterized by upland, palustrine, and seasonally flooded hydrology. Soils are well drained sands, loams, and sandy loams. (NatureServe October 2006).

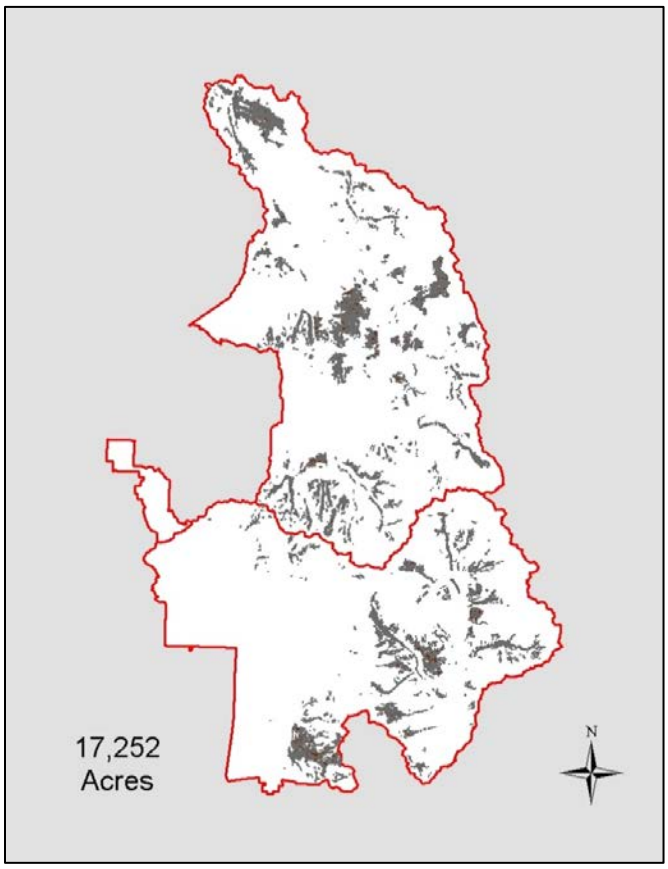


Figure 3020-1. Distribution of Sierra Lodgepole Pine Forest.

Accuracy:
Producer's accuracy: 0% (n=11)
User's accuracy: % (n=0)

Photo Interpretation Signature:

Pinus contorta var. murrayana trees have a highly variable signature due to the extremes of environments in which they are found from extremely xeric to wetland settings. Generally, the crown size is small to medium; colors range in the deep reds that are typical of other pine species. Adjacent to *Abies spp.* and *Tsuga mertensiana*, crowns of *P. contorta ssp. murrayana* appear lighter in color and are more rounded. In stands with *Pinus albicaulis*, the crowns of *Pinus contorta var. murrayana* are usually narrower (Figure 3020-2).

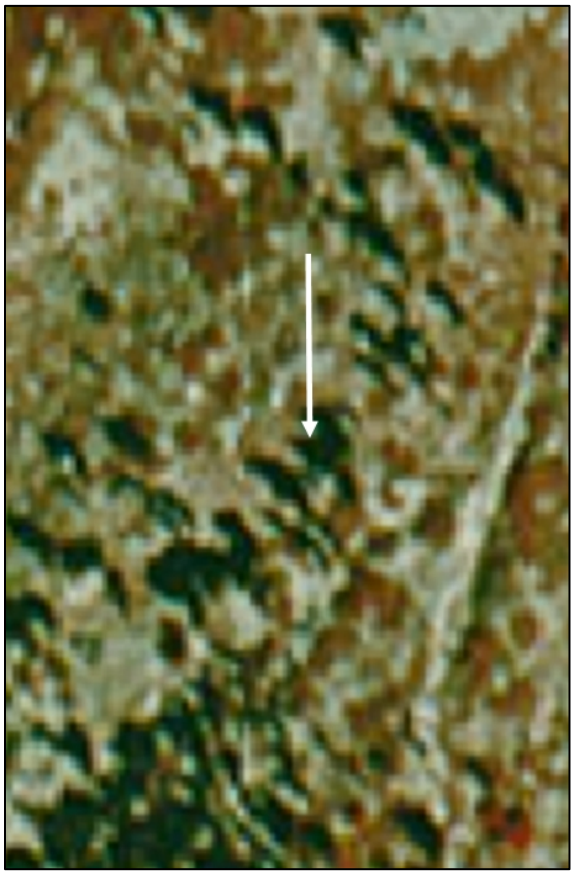


Figure 3020-2. Sierra Lodgepole Pine Forest signature. Photo reference: TDPE_SE.

Environmental Characteristics:

Microclimate – subxeric to mesic
Elevation – 2028–3523 m (6655–11557 ft)
Shape – concave to convex or undulating
Slope position – canyon bottoms to high slopes
Steepness – gentle to steep
Aspect – See Figure 3020-3.

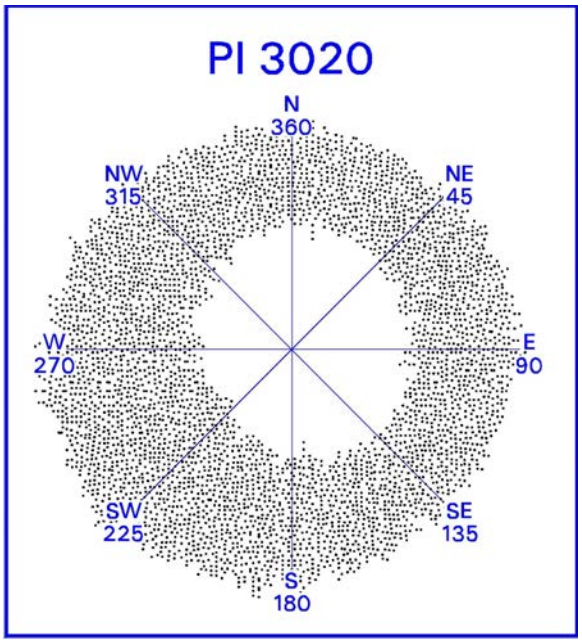


Figure 3020-3. Scatterplot of Sierra Lodgepole Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)

3021 – Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation

Pinus contorta var. *murrayana* Sparse/Outcrop Superassociation

Description:

The *Pinus contorta var. murrayana* sparse/outcrop superassociation is mapped on gentle to steep rock outcrops between 2526–3410 m (8289–11188 ft) across 3,574 acres of Sequoia and Kings Canyon National Parks (Figure 3021-1). The tree canopy of these open subalpine woodlands is characterized by extremely sparse *Pinus contorta var. murrayana* (usually below 5% absolute crown cover) on broad expanses of exposed slabs of granitic bedrock. *Abies magnifica, P. jeffreyi, P. balfouriana,* or *P. monticola* can also contribute low cover. The shrub layer is poorly developed, although scattered patches of *Chrysolepis sempervirens* and/or *Arctostaphylos patula* may be present. The herbaceous layer is also sparse, with scattered herbs (including *Penstemon newberryi, Streptanthus tortuosus, Carex exserta,* and *Juncus parryi*) growing out of rock fissures and in pockets of decomposed granitic soil. Stands are characterized by upland hydrology and well drained pockets of decomposed granite interspersed among surface rock. In the aggregated database, the *Pinus contorta var. murrayana* sparse/outcrop mapping unit is aggregated into the *Pinus contorta var. murrayana* woodlands superassociation mapping unit (3026).

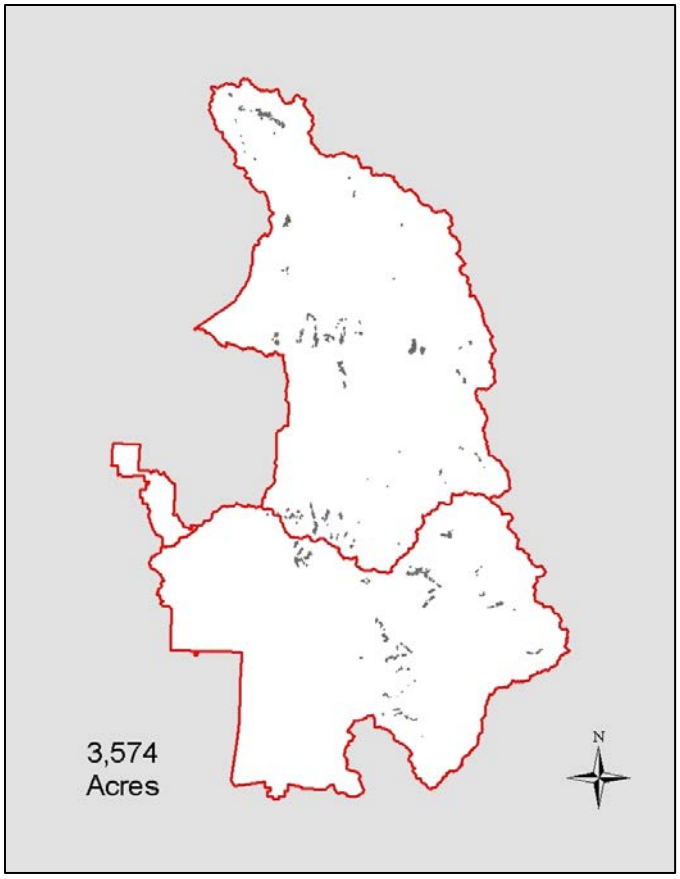


Figure 3021-1. Distribution of Sierra Lodgepole Pine/Sparse Outcrop Woodland.

Accuracy:

Producer's accuracy: 85% (n=27)
User's accuracy: 88% (n=26)

Photo Interpretation Signature:

The signature for *Pinus contorta var. murrayana* appears as irregularly shaped crowns that range in color from dark red to dark brown (Figure 3021-2). The trees are generally small in stature and typically occur in an open, sparse pattern, surrounded by vast areas of rock that contain tiny seeps where patchy shrubs may occur.

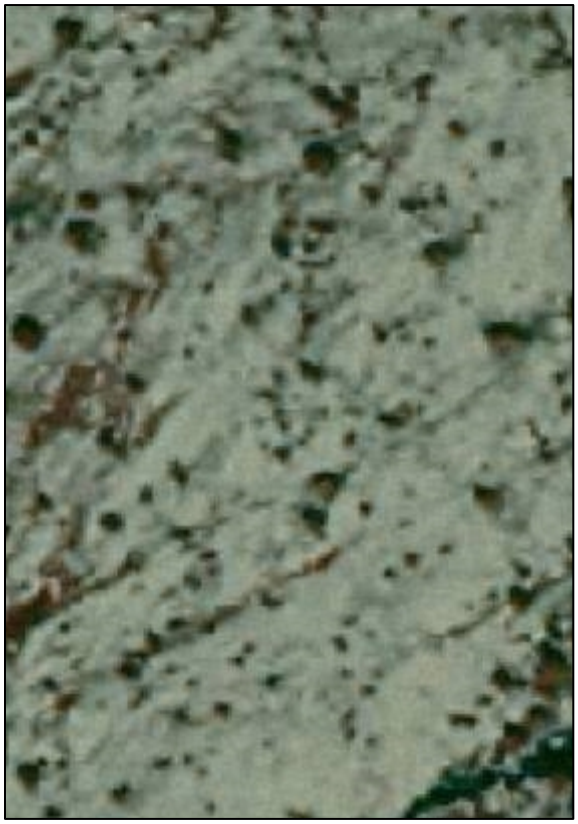


Figure 3021-2. Sierra Lodgepole Pine/Sparse Outcrop Woodland signature. Photo reference: MOSI_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2526–3410 m (8289–11188 ft)
Shape – convex to undulating
Slope position – low to middle slopes and broad flat uplands
Steepness – moderate to steep
Aspect – See Figure 3021-3.

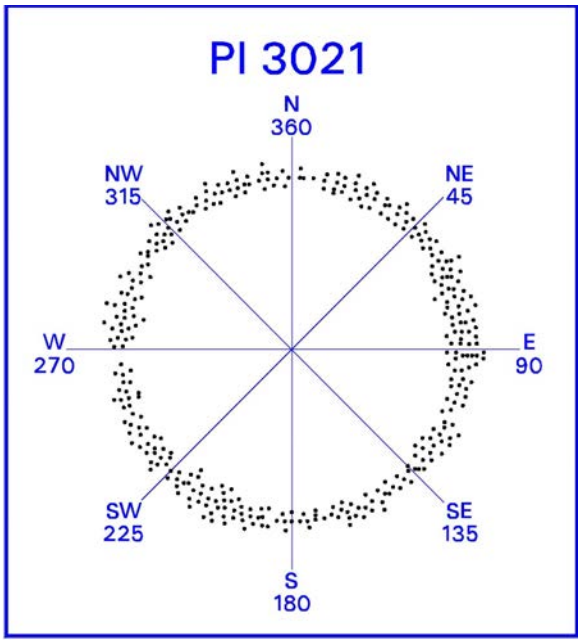


Figure 3021-3. Scatterplot of Sierra Lodgepole Pine/Sparse Outcrop Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Woodlands Superassociation (3026)
- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Sierra Lodgepole Pine–Xeric Forest Superassociation (3049)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3022 – Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit

Pinus contorta var. *murrayana*/(*Vaccinium uliginosum* ssp. *occidentale*) Forest Mapping Unit

Description:

The *Pinus contorta var. murrayana/(Vaccinium uliginosum ssp. occidentale)* meadow edge mapping unit is mapped along small streams and on the edges of meadows on gentle to moderate slopes of variable aspects between 2028–3388 m (6655–11117 ft) across 1,871 acres of Sequoia and Kings Canyon National Parks (Figure 3022-1). The tree canopy is dominated almost entirely by *Pinus contorta*, which may appear stunted in size. Scattered individuals of *Abies spp.* or *Tsuga mertensiana* can also be present. The shrub layer is well developed and is typically characterized by *Vaccinium uliginosum, Ledum glandulosum,* and *Phyllodoce breweri*. On moister sites *Senecio triangularis, Carex utriculata, Thalictrum sparsiflorum,* and *Calamagrostis canadensis* are common dominants of a dense herbaceous understory. Soils are somewhat poorly to poorly drained silty loams. The hydrology is palustrine. (NatureServe October 2006)

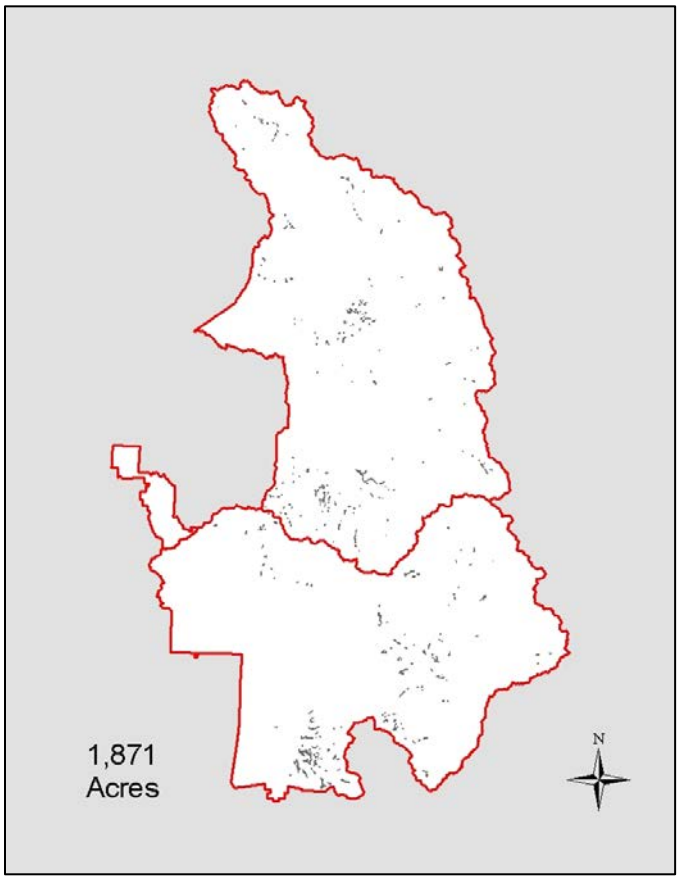


Figure 3022-1. Distribution of Sierra Lodgepole Pine/(Bog Blueberry) Forest.

Accuracy:

Producer's accuracy: 95% (n=20)

User's accuracy: 90% (n=21)

Photo Interpretation Signature:

The photo signature of *Pinus contorta var. murrayana* in this vegetation type is dark red or dark brown in color with narrowly rounded conical crowns. The herbaceous meadow understory often looks bright pink or red (Figure 3022-2). *Pinus contorta var. murrayana* is variable in stand density and crown size but generally occurs in a dispersed stands with numerous openings to the herbaceous understory.

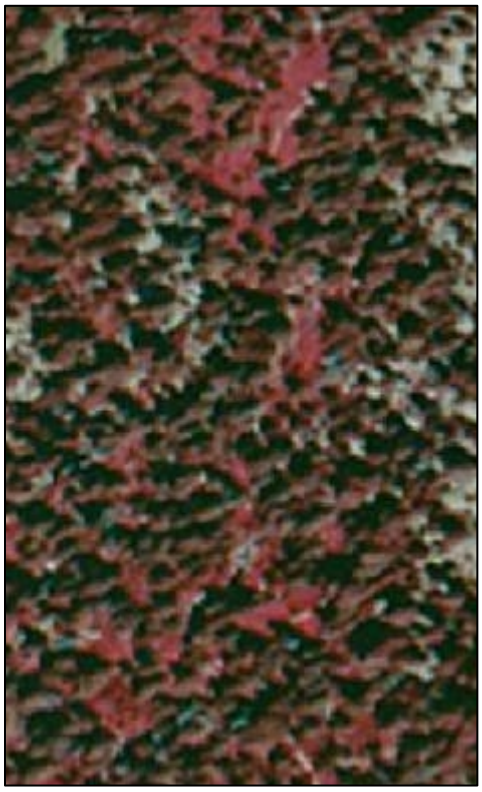


Figure 3022-2. Sierra Lodgepole Pine/(Bog Blueberry) Forest signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – mesic to hydric
Elevation – 2028–3388 m (6655–11117 ft)
Shape – flat to concave
Slope position – drainage bottoms and meadow edges
Steepness – flat to gently sloping
Aspect – See Figure 3022-3.

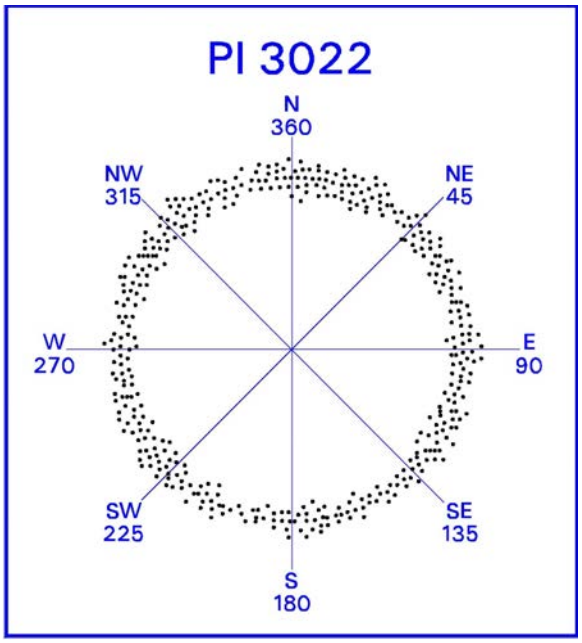


Figure 3022-3. Scatterplot of Sierra Lodgepole Pine/(Bog Blueberry) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures

- Sierra Lodgepole Pine–Quaking Aspen (Jeffrey Pine) Forest Alliance (3010)
- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Sierra Lodgepole Pine Woodlands Superassociation (3026)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole Pine Mesic Forest Superassociation (3048)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Upland Herbaceous (7000)
- Intermittently to Seasonally Flooded Meadow (8000)
- Semi-permanently to Permanently Flooded Meadow (9000)

3026 – Sierra Lodgepole Woodlands Superassociation

Pinus contorta ssp. *murrayana* Woodlands Superassociation

Description:

The *Pinus contorta var. murrayana* woodlands superassociation is an aggregation of the *Pinus contorta var. murrayana* sparse/outcrop mapping unit (3021), the *Pinus contorta var. murrayana* woodland association (3038), and the *Pinus contorta var. murrayana/Carex exserta* woodland association (3042). The aggregated mapping unit is mapped on open, rocky gentle to steep slopes of varying aspect between 2230–3454 m (7316–11333 ft) across 12,210 acres of Sequoia and Kings Canyon National Parks (Figure 3026-1). The open tree canopy of these subalpine woodlands is dominated by *Pinus contorta var. murrayana* (less than 30% cover), although *Abies magnifica, Juniperus occidentalis var. australis, Pinus albicaulis, P. balfouriana ssp. austrina, P. jeffreyi,* or *P. monticola* may contribute low amounts of cover. The sparse shrub layer may contain *Arctostaphylos patula, A. nevadensis, Artemisia tridentata, Chrysolepis sempervirens, Holodiscus microphyllus,* or *Phyllodoce breweri*. The herbaceous layer may be sparse or well developed, and may be characterized by dense patches of *Carex exserta (C. filifolia var. erostrata sensu* Hickman 1993) and/or *Juncus parryi* as well as lesser amounts of *Arenaria congesta, Calyptridium umbellatum, Penstemon newberryi,* or *Streptanthus tortuosus*. In the aggregated database, the *Pinus contorta var. murrayana* woodlands superassociation includes the *Pinus contorta var. murrayana* sparse/outcrop mapping unit (3021), the *Pinus contorta var. murrayana* woodland association (3038) and the *Pinus contorta var. murrayana/Carex exserta* woodland association (3042).

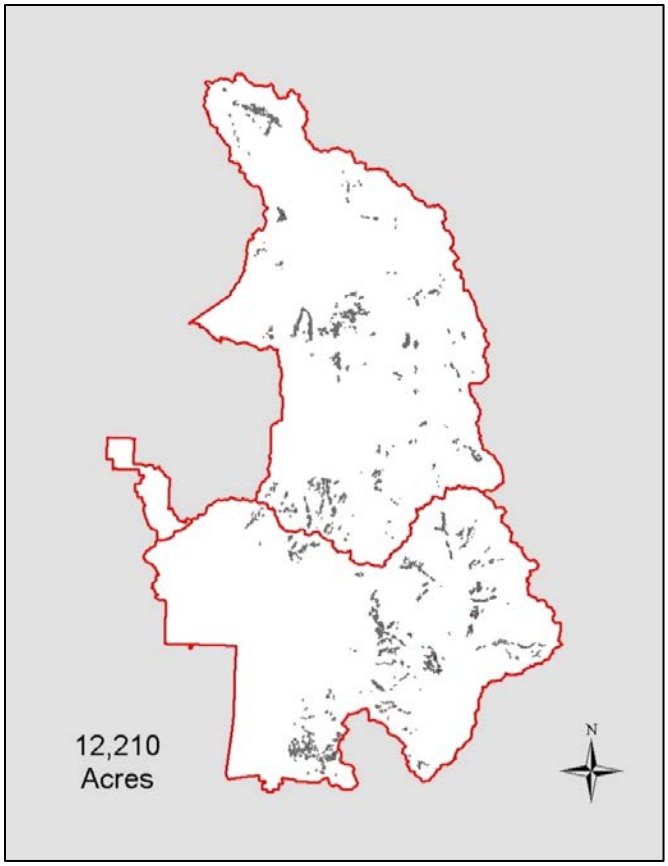


Figure 3026-1. Distribution of Sierra Lodgepole Woodlands.

Accuracy:
Producer's accuracy: 83% (n=88)
User's accuracy: 72% (n=102)

Photo Interpretation Signature:
This superassociation is aggregated from three similar *Pinus contorta var. murrayana* types that tend to occur on rocky, exposed sites. *P. contorta var. murrayana* has an irregularly shaped crown that ranges in color from dark red to dark brown. The *P. contorta var. murrayana* trees are typically small in stature, open and sparse and surrounded by vast areas of rock that contain tiny seeps where patchy shrubs may occur. When present, the dense herbaceous layer yields little or no infrared reflectance late in the growing season so its signature appears white or cream colored. *Abies magnifica*, which can be a canopy component, contrasts as a pinker color against the more common *P. contorta var. murrayana*.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2230–3454 m (7316–11333 ft)
Shape – convex, concave, flat, undulating
Slope position – canyon bottom, lowslope, midslope
Steepness – gentle to steep

Aspect – See Figure 3026-2.

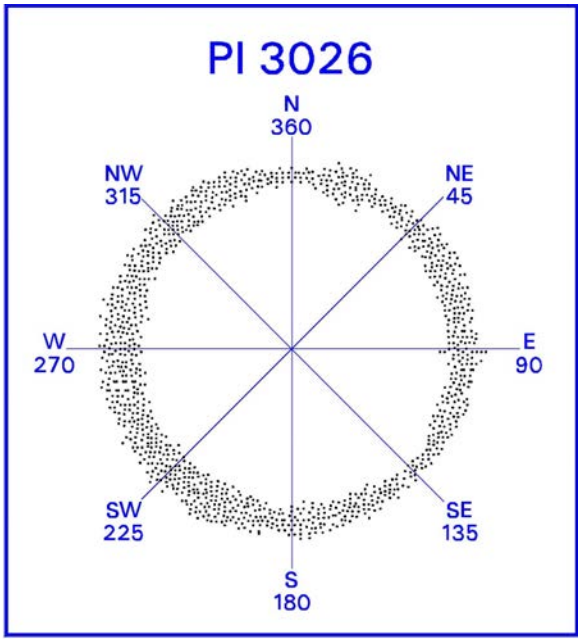


Figure 3026-2. Scatterplot of Sierra Lodgepole Woodlands in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Forest Alliance (3020)
- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Sierra Lodgepole Pine Mesic Forest Superassociation (3048)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Whitebark Pine/Davidson’s Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)

- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3028 – Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge) Forest Superassociation

Pinus contorta var. *murrayana*–(*Pinus albicaulis*)/(*Carex rossii–Carex exserta*) Forest Superassociation

Description:

The *Pinus contorta var. murrayana* – (*Pinus albicaulis*) / (*Carex rossii–Carex exserta*) forest association is an aggregation of the *Pinus contorta var. murrayana – Pinus albicaulis* / *Carex rossii* forest association (3033), the *Pinus contorta var. murrayana*/*Carex rossii* forest association (3041), and the *Pinus contorta var. murrayana–Pinus albicaulis*/*Carex exserta* forest association (3043). The aggregated mapping unit is mapped on gentle to steep slopes of varying aspect between 2468–3523 m (8197–11557 ft) across 21,139 acres of Sequoia and Kings Canyon National Parks (Figure 3028-1). The open tree canopy can be characterized by either pure stands of *Pinus contorta var. murrayana*, or at higher elevations, *Pinus contorta var. murrayana* in mixture with *P. albicaulis*. Lower elevation stands may have minor amounts of *Abies magnifica* or *P. monticola*. The sparse shrub layer may include *Chrysolepis sempervirens*, *Holodiscus microphyllus*, *Phyllodoce breweri*, or *Salix spp*. The herbaceous layer may be sparse or dense, with *Carex rossii* and *Juncus parryi* frequently encountered. On rockier sites, dense patches of *Carex exserta* often form in shallow soil depressions.

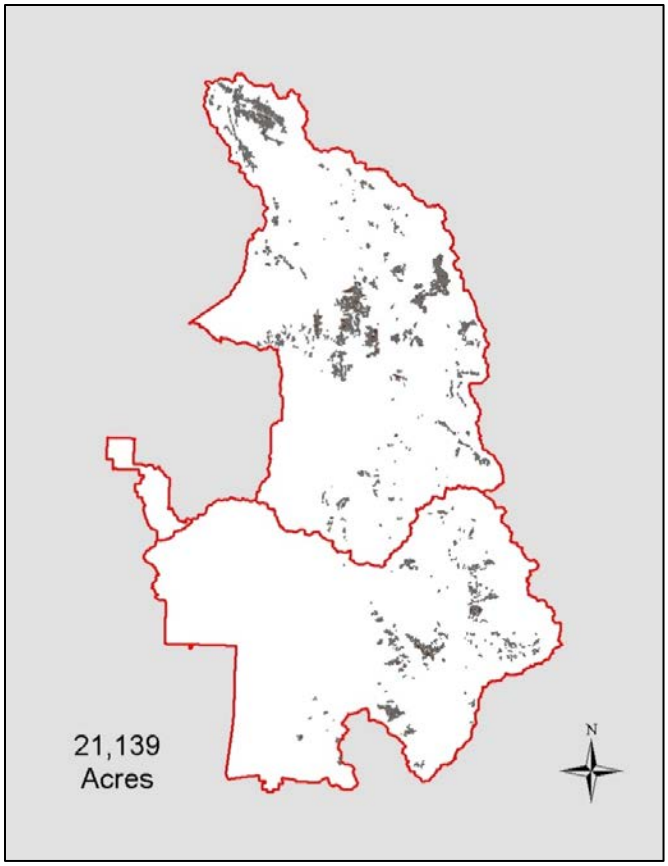


Figure 3028-1. Distribution of Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge Forest.

Accuracy:
Producer's accuracy: 69% (n=111)
User's accuracy: 81% (n=95)

Photo Interpretation Signature:
This superassociation is a high elevation aggregation composed of broader-crowned upright *Pinus albicaulis* trees that are generally lighter red than the associated *P. contorta var. murrayana* trees. The understory signature is pale to dark brown and generally not white except in rocky settings where *Carex exserta* often forms in pockets yielding a cream-colored signature.

Environmental Characteristics:
Microclimate – xeric to subxeric
Elevation – 2468–3523 m (8197–11557 ft)
Shape – flat, concave, convex, undulating
Slope position – canyon bottom, lowslope, midslope, highslope
Steepness – gentle to steep
Aspect – See Figure 3028-2.

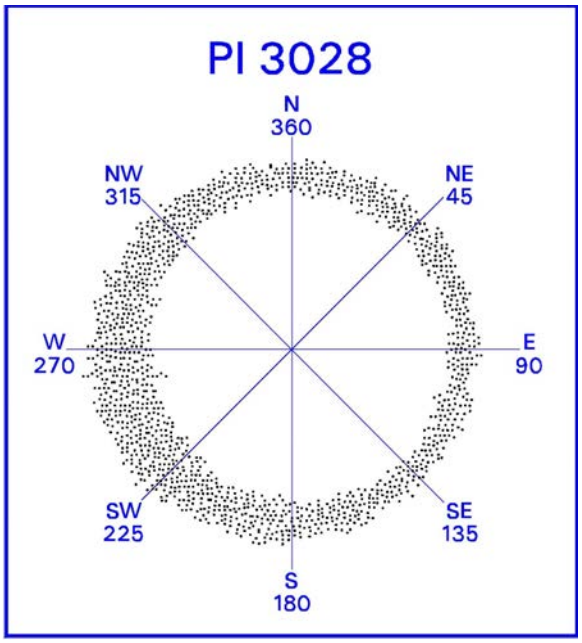


Figure 3028-2. Scatterplot of Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine/Big Sagebrush Forest Association (3034)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superassociation (3540)
- Mountain Hemlock–Sierra Lodgepole Pine Forest Association (4041)

3033 – Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association
Pinus contorta var. *murrayana–Pinus albicaulis/Carex rossii* Forest Association

Description:

The *Pinus contorta var. murrayana – Pinus albicaulis / Carex rossii* forest association is mapped on gentle to steep slopes of varying aspect between 2602–3441 m (8536–11288 ft) across 2,379 acres of Kings Canyon National Park (Figure 3033-1). The moderately open to closed tree canopy is dominated by a mixture of *Pinus contorta* and *P. albicaulis*, with each species contributing at least 10% relative cover. The generally sparse shrub layer may contain *Holodiscus microphyllus, Ledum glandulosum, Phyllodoce breweri, Chrysolepis sempervirens, Arctostaphylos nevadensis,* or *Vaccinium caespitosum*. The herbaceous layer is also generally sparse, and is characterized by the presence of *Carex rossii*. Other frequently encountered herbs include *Juncus parryi, Penstemon newberryi*, and *Arabis platysperma*. The hydrology is upland and soils are moderately to well drained sandy loams. (NatureServe October 2006) In the aggregated database, the *Pinus contorta var. murrayana–Pinus albicaulis / Carex rossii* forest association is aggregated into the *Pinus contorta var. murrayana–(Pinus albicaulis) / (Carex rossii–Carex exserta)* forest association (3028).

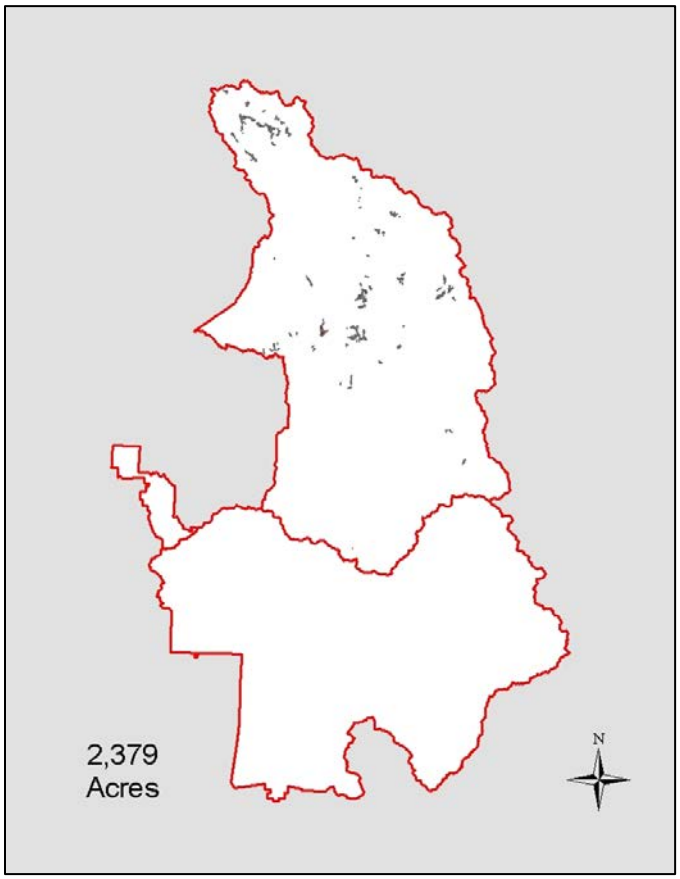


Figure 3033-1. Distribution of Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest.

Accuracy:

Producer's accuracy: 45% (n=22)
User's accuracy: 67 % (n=15)

Photo Interpretation Signature:

Pinus albicaulis usually displays a slightly lighter photo signature and has a more irregular crown than the dark red or dark brown *P. contorta var. murrayana*. The canopy density varies from fairly dense to sparse with an herbaceous understory that also has a variable density. *Carex rossii* is indiscernible on the aerial photos, but is referenced as an indicator species. The transitions between the *Pinus contorta var. murrayana–Pinus albicaulis / Carex rossii* forest association (3033) and the *Pinus contorta var. murrayana / Carex rossii* forest association (3041) often contain a significant *P. albicaulis* component in the understory tree layer that is not visible on the aerial photography (Figure 3033-2).

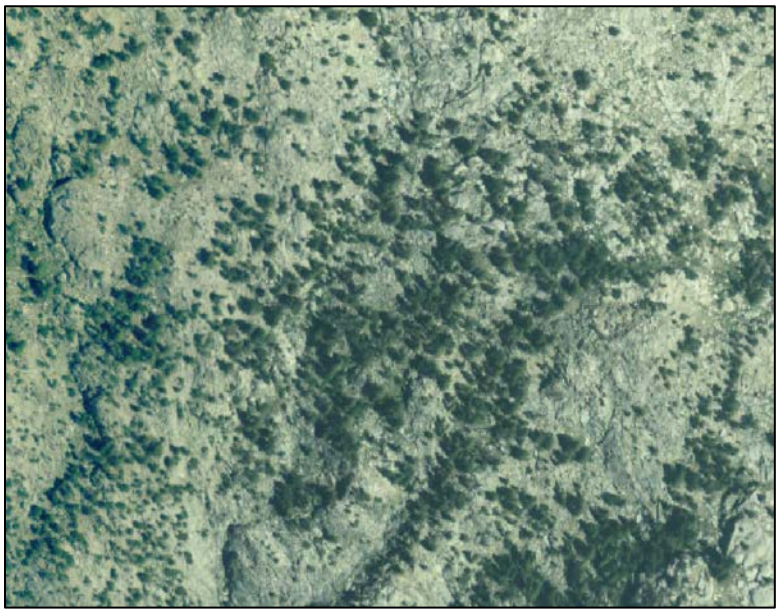


Figure 3033-2. Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest signature.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2602–3441 m (8536–11288 ft)
Shape – convex to undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3033-3.

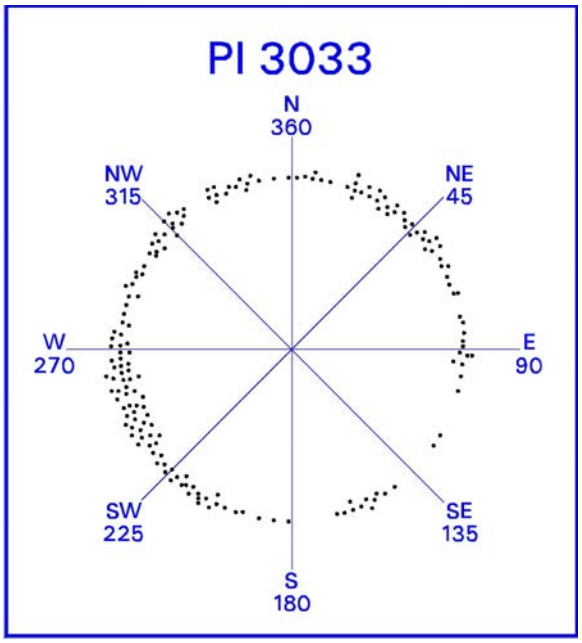


Figure 3033-3. Scatterplot of Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge) Forest (3028)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Pentemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)

3034 – Sierra Lodgepole Pine/Big Sagebrush Forest Association
Pinus contorta var. *murrayana/Artemisia tridentata* Forest Association

Description:
The *Pinus contorta var. murrayana/Artemisia tridentata* forest association is mapped on gentle to moderately steep slopes of varying aspect between 2468–3198 m (8098–10492 ft) across 356 acres of Sequoia and Kings Canyon National Parks (Figure 3034-1). The tree canopy of these relatively open, xeric stands is dominated by *Pinus contorta var. murrayana*, although *Juniperus occidentalis var. australis, P. jeffreyi, P. monticola,* and/or *Abies magnifica* may be present and sometimes important. The shrub layer ranges in cover from 10–70% and is dominated by *Artemisia tridentata*, with *Holodiscus microphyllus, Chrysolepis sempervirens*, and *Arctostaphylos patula* also contributing significant cover. The herbaceous layer may be sparse to dense and is characterized by such dryland species as *Carex exserta, C. rossii, Monardella odoratissima*, and *Achnatherum sp*. The hydrology is upland and soils are well drained sands and sandy loams. (NatureServe October 2006).

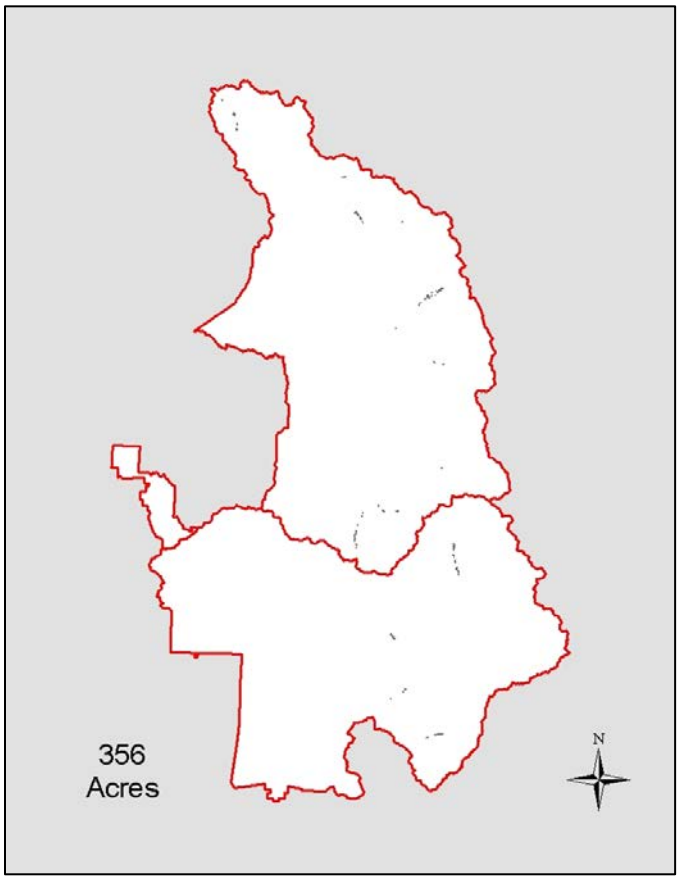


Figure 3034-1. Distribution of Sierra Lodgepole Pine/Big Sagebrush Forest.

Accuracy:
Producer's accuracy: 70% (n=10)
User's accuracy: 100% (n=7)

Photo Interpretation Signature:

In this environment, *Pinus contorta var. murrayana* trees exhibit a typical dark red to brown signature and generally smaller stature in comparison with the gray-trending *Artemisia tridentata*. Bare ground is an extensive component of the signature (Figure 3034-2).

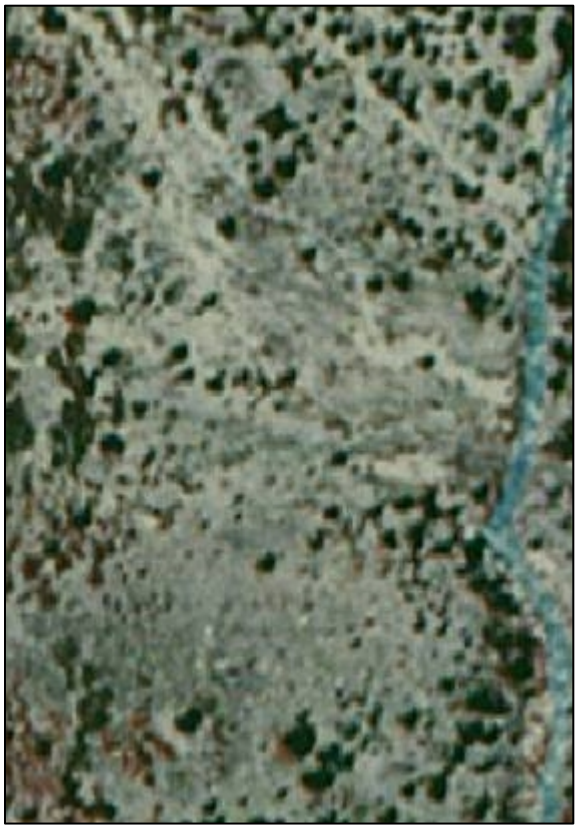


Figure 3034-2. Sierra Lodgepole Pine/Big Sagebrush Forest signature. Photo reference: MOKA_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2468–3198 m (8098–10492 ft)
Shape – flat to concave, convex
Slope position – canyon bottom, low slope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 3034-3.

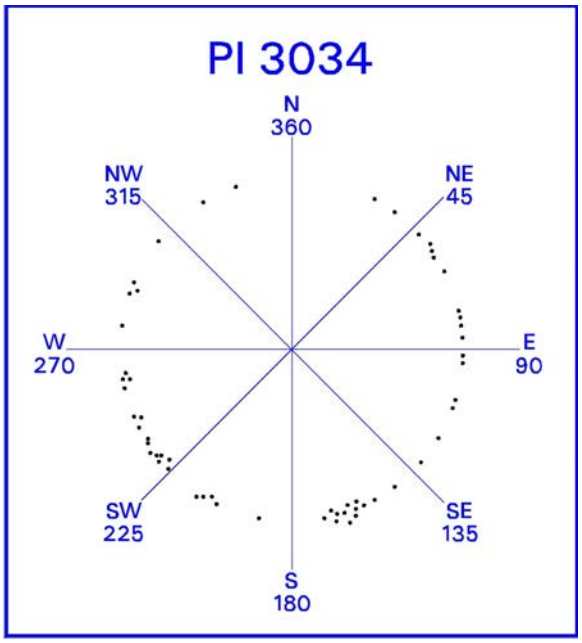


Figure 3034-3. Scatterplot of Sierra Lodgepole Pine/Big Sagebrush Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)
- Big Sagebrush Shrubland Alliance (5160)

3038 – Sierra Lodgepole Pine Woodland Association
Pinus contorta var. *murrayana* Woodland Association

Description:
The *Pinus contorta var. murrayana* woodland association is mapped on gentle to steep slopes of varying aspect between 2230–3434 m (7316–11267 ft) across 3,692 acres of Sequoia and Kings Canyon National Parks (Figure 3038-1). The open tree canopy is dominated by *Pinus contorta var. murrayana*, although *Abies magnifica* may also be important and *P. monticola* and *P. balfouriana* may also be present. The sparse shrub layer may contain *Holodiscus microphyllus, Chrysolepis sempervirens, Arctostaphylos nevadensis, Arctostaphylos patula,* or *Artemisia tridentata*. The herbaceous layer is also sparse, but may include *Carex exserta, Arenaria congesta, Juncus parryi,* or *Calyptridium umbellatum* among other xeric species. The hydrology is upland. (NatureServe October 2006). In the aggregated database, the *Pinus contorta var. murrayana* woodland association is aggregated into the *Pinus contorta var. murrayana* woodlands superassociation (3026).

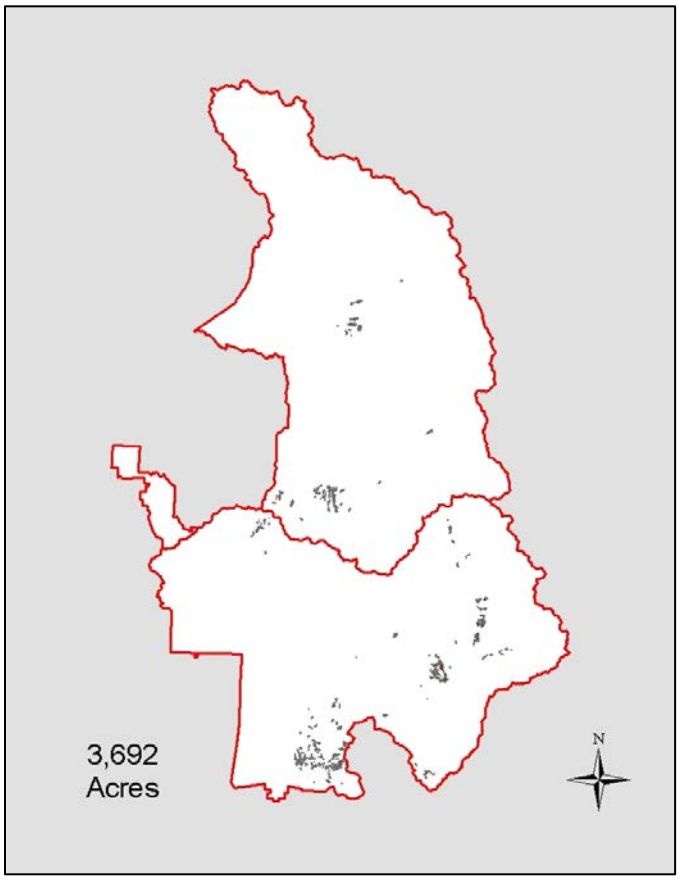


Figure 3038-1. Distribution of Sierra Lodgepole Pine Woodland.

Accuracy:
Producer's accuracy: 80% (n=15)
User's accuracy: 52% (n=23)

Photo Interpretation Signature:

The signature of *Pinus contorta var. murrayana* is typically narrow, rounded brown crowns in an open setting over a sparse herbaceous understory with little or no shrub component. Glacial rubble is considered a more indicative environment than consolidated rock for this type. *Abies magnifica*, which can be a component of these stands, contrasts as a pinker color against the more common *P. contorta var. murrayana* (Figure 3038-2).

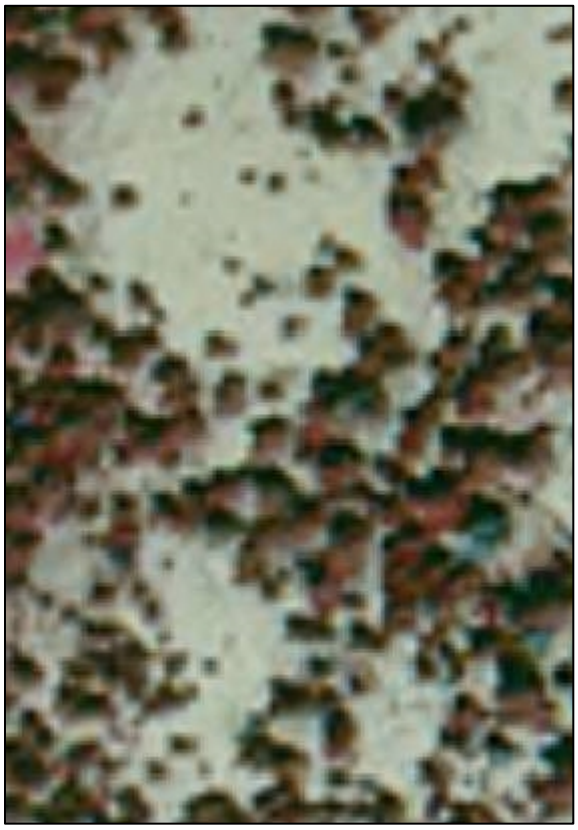


Figure 3038-2. Sierra Lodgepole Pine Woodland signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2230–3434 m (7316–11267 ft)
Shape – flat, concave, convex, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3038-3.

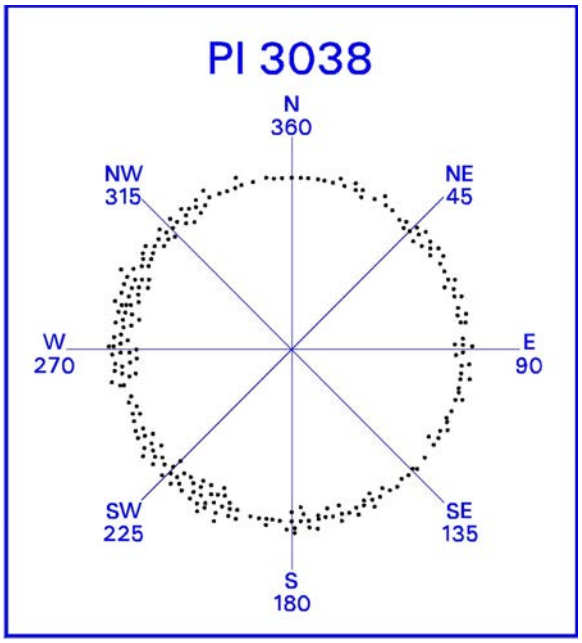


Figure 3038-3. Scatterplot of Sierra Lodgepole Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Forest Alliance (3020)
- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine Woodlands Superassociation (3026)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3041 – Sierra Lodgepole Pine/Ross Sedge Forest Association
Pinus contorta var. *murrayana/Carex rossii* Forest Association

Description:

The *Pinus contorta var. murrayana*/*Carex rossii* forest association is mapped on xeric, gentle to steep slopes of varying aspect between 2468–3485 m (8197–11434 ft) across 9,710 acres of Sequoia and Kings Canyon National Parks (Figure 3041-1). The open to closed tree canopy is dominated by *Pinus contorta var. murrayana*, with small amounts of cover (<5%) contributed by *P. monticola*, *Abies magnifica*, or *P. albicaulis*. The shrub layer is sparse to absent but may contain significant amounts of *Phyllodoce breweri* or *Ribes spp.* The sparse, dry herbaceous layer is characterized by the presence of *Carex rossii*, and may also include *Carex exserta*, *Achnatherum occidentale*, *Elymus elymoides*, *Juncus parryi*, and/or *Lupinus breweri* along with other xeric species. The hydrology is upland. (NatureServe October 2006). In the aggregated database, the *Pinus contorta var. murrayana*/*Carex rossii* forest association is aggregated into the *Pinus contorta var. murrayana*–(*Pinus albicaulis*) / (*Carex rossii*–*Carex exserta*) forest association (3028).

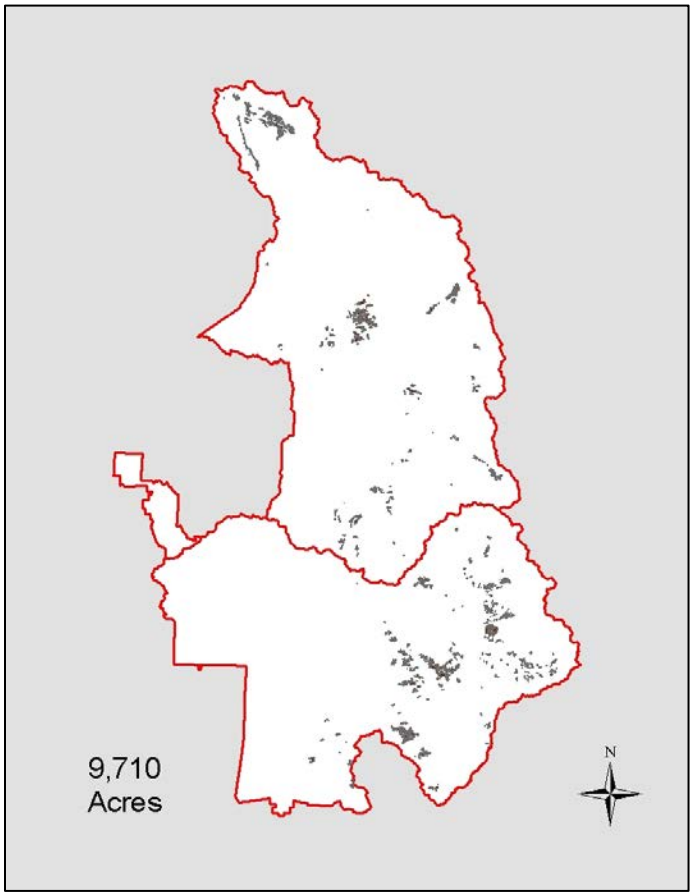


Figure 3041-1. Distribution of Sierra Lodgepole Pine/Ross Sedge Forest.

Accuracy:

Producer's accuracy: 51% (n=51)
User's accuracy: 70 % (n=37)

Photo Interpretation Signature:

The photo signature of the xerix-trending stands of *Pinus contorta var. murrayana* is dark red or dark brown with narrow, irregularly shaped crowns (Figure 3041-2). These stands often occur as dense woodlands in somewhat xeric settings. *Carex rossii* is not discernible on the aerial photos but is referenced as an indicator species. Transitional areas between *Pinus contorta var. murrayana–Pinus albicaulis*/*Carex rossii* (3033) and *Pinus contorta var. murrayana* /*Carex rossii* (3041) often contain a significant *P. albicaulis* component in the understory tree layer that is not visible on the aerial photography.

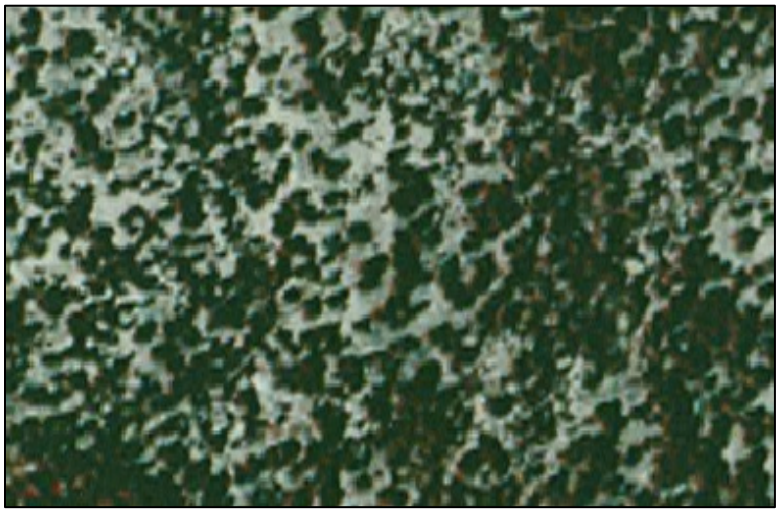


Figure 3041-2. Sierra Lodgepole Pine/Ross Sedge Forest signature. Photo reference: MOKA_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2468–3485 m (8197–11434 ft)
Shape – flat, concave, convex, undulating
Slope position – canyon bottom, low slope, midslope
Steepness – gentle to steep
Aspect – See Figure 3041-3.

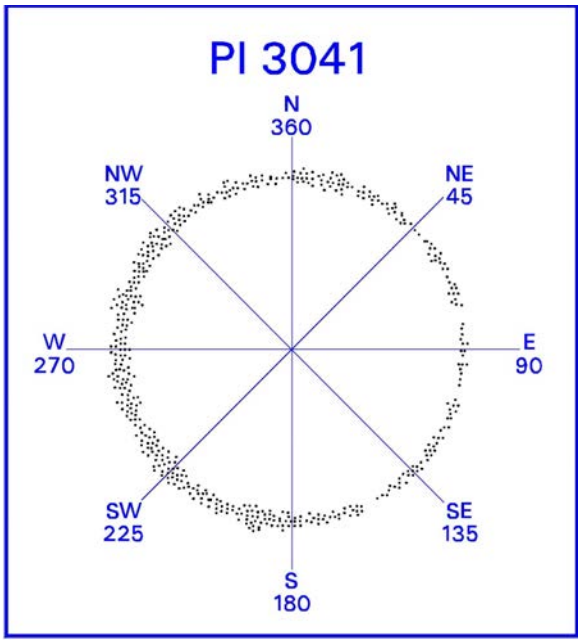


Figure 3041-3. Scatterplot of Sierra Lodgepole Pine/Ross Sedge Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge) Forest (3028)
- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine/Big Sagebrush Forest Association (3034)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)
- Mountain Hemlock–Sierra Lodgepole Pine Forest Association (4041)

3042 – Sierra Lodgepole Pine/Shorthair Sedge Woodland Association
Pinus contorta var. *murrayana/Carex exserta* Woodland Association

Description:

The *Pinus contorta var. murrayana/Carex exserta* woodland association is mapped on gentle to moderately steep slopes of varying aspect between 2478–3454 m (8131–11333 ft) across 4,945 acres of Sequoia and Kings Canyon National Parks (Figure 3042-1). The open tree canopy is dominated by *Pinus contorta var. murrayana*, although *P. albicaulis, P. balfouriana*, or *Abies magnifica* may contribute low amounts of cover. The shrub layer is sparse to absent; when present, it may include *Arctostaphylos patula, Chrysolepis sempervirens, Holodiscus microphyllus,* or *Phyllodoce breweri*. The herbaceous layer is characterized by dense patches of *Carex exserta (C. filifolia var. erostrata sensu* Hickman 1993), but may also include significant cover of *Juncus parryi*. The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006). In the aggregated database, the *Pinus contorta var. murrayana/Carex exserta* woodland association is aggregated into the *Pinus contorta var. murrayana* woodlands superassociation (3026).

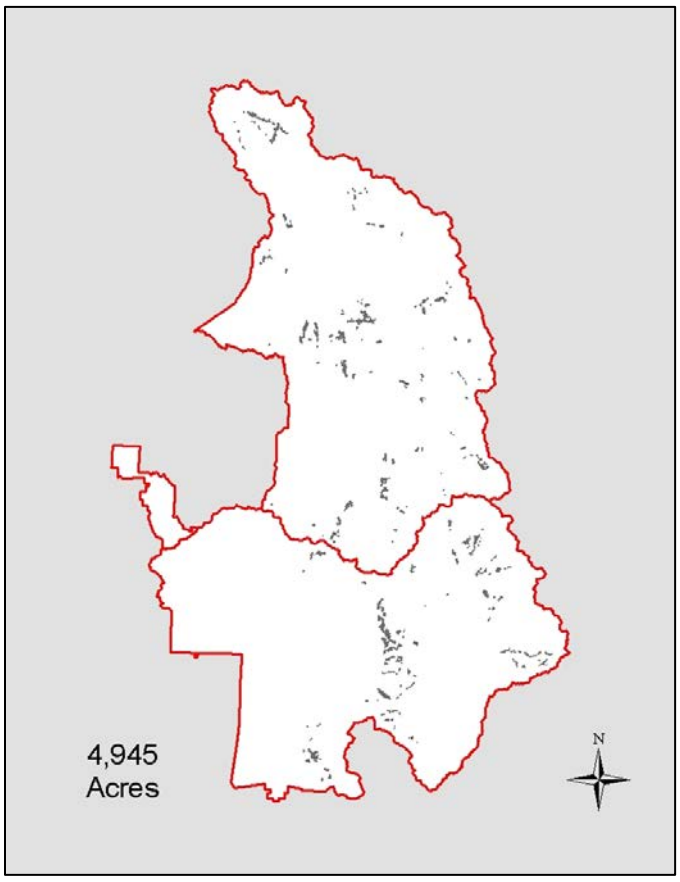


Figure 3042-1. Distribution of Sierra Lodgepole Pine/Shorthair Sedlge Woodland.

Accuracy:

Producer's accuracy: 65% (n=46)
User's accuracy: 57% (n=53)

Photo Interpretation Signature:

The photo signature of *Pinus contorta var. murrayana* in this mesic type is dark brown or red with a narrow, rounded crown. Generally open, the dense *Carex exserta* layer yields little or no infrared reflectance late in the growing season so its signature appears white or cream colored (Figure 3042-2). Stands of *P. contorta var. murrayana* in *C. exserta* settings are less rocky than mixed *P. contorta var. murrayana* and *P. albicaulis* stands in similar settings.

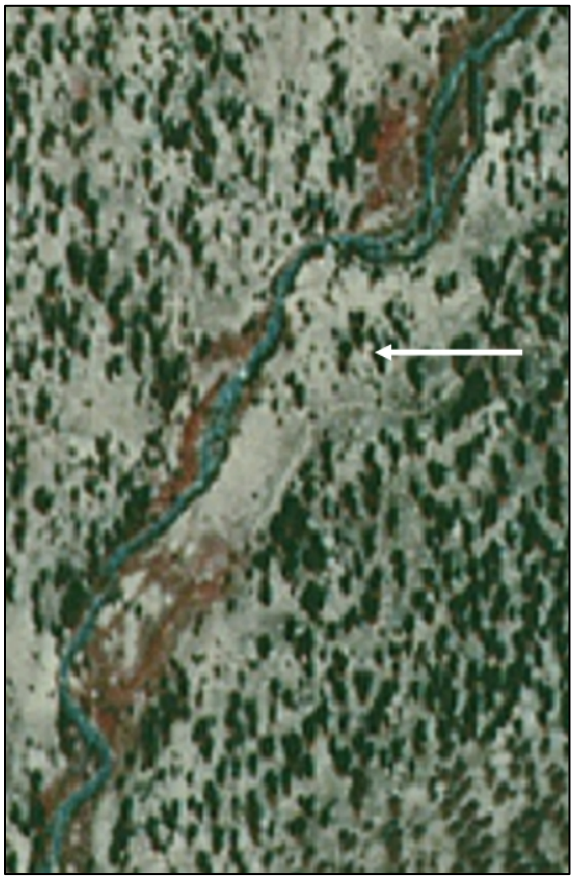


Figure 3042-2. Sierra Lodgepole Pine/Shorthair Sedlge Woodland signature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2478–3454 m (8131–11333 ft)
Shape – convex, concave, flat, undulating
Slope position – canyon bottom, low slope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 3042-3.

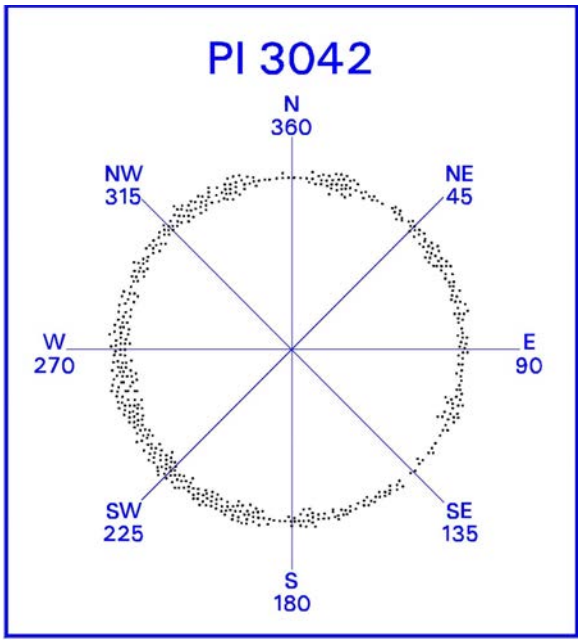


Figure 3042-3. Scatterplot of Sierra Lodgepole Pine/Shorthair Sedlge Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Sierra Lodgepole Pine Woodlands Superassociation (3026)
- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Sierra Lodgepole Pine Mesic Forest Superassociation (3048)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)

3043 – Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association
Pinus contorta var. *murrayana–Pinus albicaulis/Carex exserta* Forest Association

Description:

The *Pinus contorta var. murrayana–Pinus albicaulis/Carex exserta* forest association is mapped on gentle to steep slopes of varying aspect between 2858–3523 m (9375–11557 ft) across 9,050 acres of Sequoia and Kings Canyon National Parks (Figure 3043-1). The open tree canopy is dominated by a mixture of *Pinus contorta and P. albicaulis*. The sparse shrub layer may include *Chrysolepis sempervirens, Holodiscus microphyllus, Phyllodoce breweri*, or *Salix orestera*.The herbaceous layer may be sparse or moderately dense and is characterized by patches of *Carex filifolia*. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006). In the aggregated database, the *Pinus contorta var. murrayana–Pinus albicaulis/Carex filifolia* association is aggregated into the *Pinus contorta var. murrayana–(Pinus albicaulis) / (Carex rossii–Carex exserta)* forest association (3028).

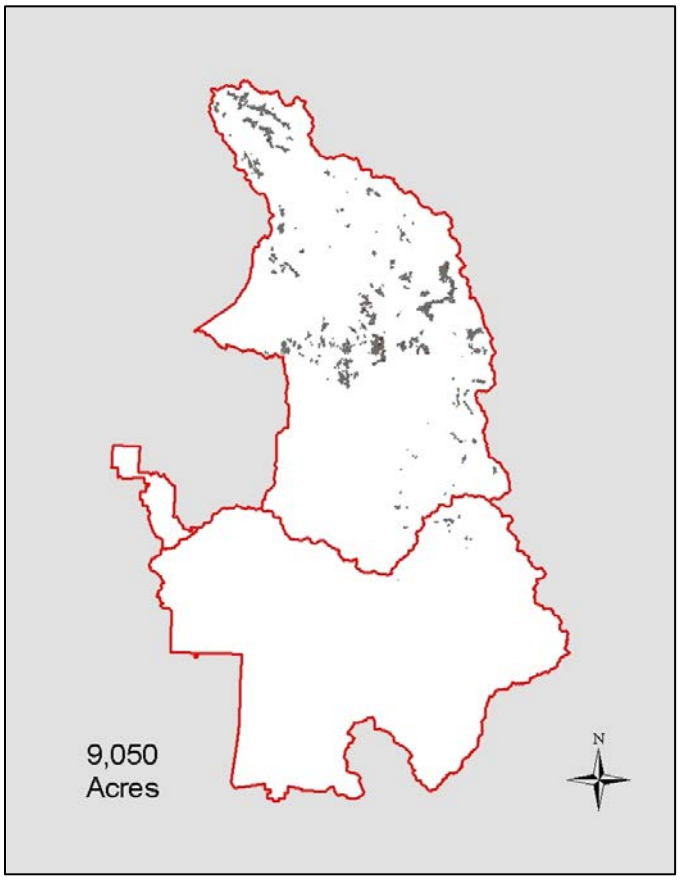


Figure 3043-1. Distribution of Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest.

Accuracy:

Producer's accuracy: 76% (n=38)
User's accuracy: 67% (n=43)

Photo Interpretation Signature:

The *Pinus contorta var. murrayana* looks dark red or brown on the aerial photos in this association. *P. contorta var. murrayana* is smaller in stature with a more compact crown than the larger *P. albicaulis*, which looks slightly lighter in color but has broad, multiple branching crowns (Figure 3043-2). Canopy density is variable and is often patchy within the stand. There is generally a moderate to dense smooth herbaceous layer of *Carex exserta* except when interrupted by rocky outcroppings.

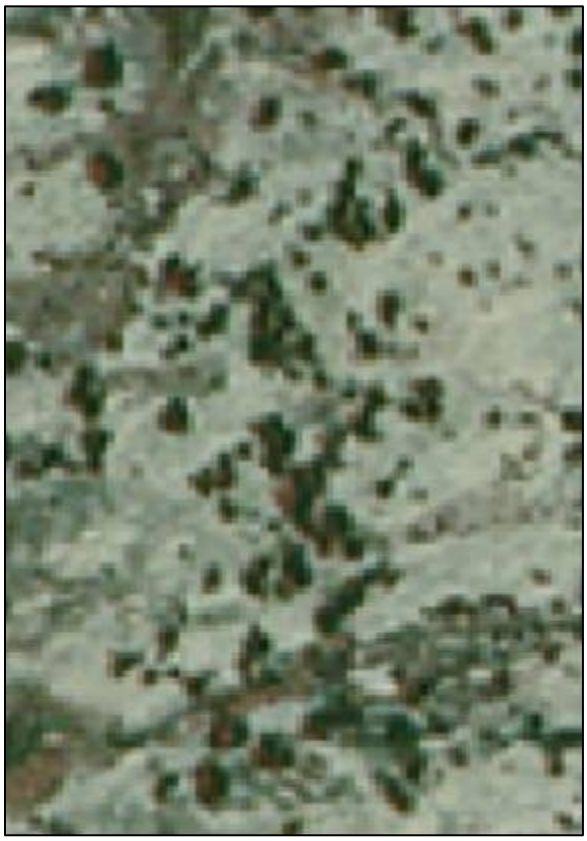


Figure 3043-2. Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest signature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2858–3523 m (9375–11557 ft)
Shape – convex, flat, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3043-3.

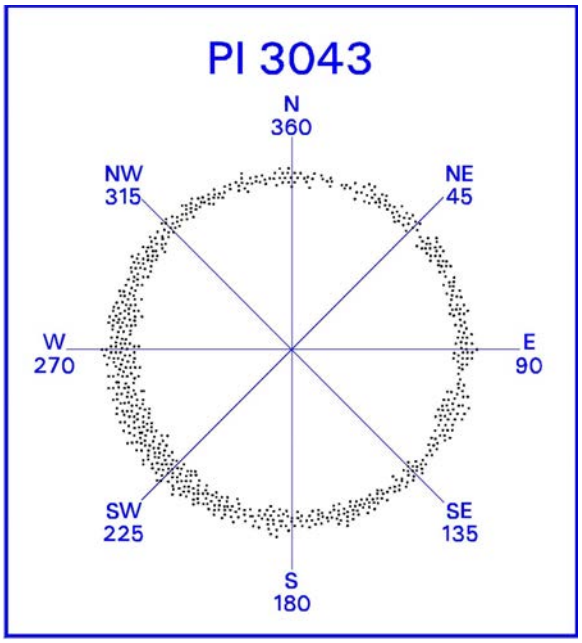


Figure 3043-3. Scatterplot of Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge–Shorthair Sedge) Forest (3028)
- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)

3048 – Sierra Lodgepole Pine Mesic Forest Superassociation

Pinus contorta var. *murrayana* Mesic Forest Superassociation

Description:

The *Pinus contorta var. murrayana* mesic forest superassociation is mapped on gentle to moderately steep slopes of varying aspect between 2153–3430 m (7064–11254 ft) across 12,292 acres of Sequoia and Kings Canyon National Parks (Figure 3048-1). This superassociation represents a combination of several mesic types, which are dominated by *Pinus contorta var. murrayana* in the tree canopy and support an understory of mesic shrubs and herbs. The shrub layer can be sparse to dense, and often includes *Ledum glandulosum, Phyllodoce breweri, Ribes spp., Salix spp., Vaccinium caespitosum*, and/or *Vaccinium uliginosum ssp. occidentale*. The herbaceous layer can also be sparse or dense, and is often characterized by such mesic herbs as *Allium validum, Aster alpigenus var. andersonii, Carex spp., Dodecatheon spp., Senecio triangularis,* and/or *Veratrum californicum var. californicum*. Sites are characterized by palustrine, seasonally saturated hydrology. Soils are moderately to poorly drained sandy clay loams and silty loams.

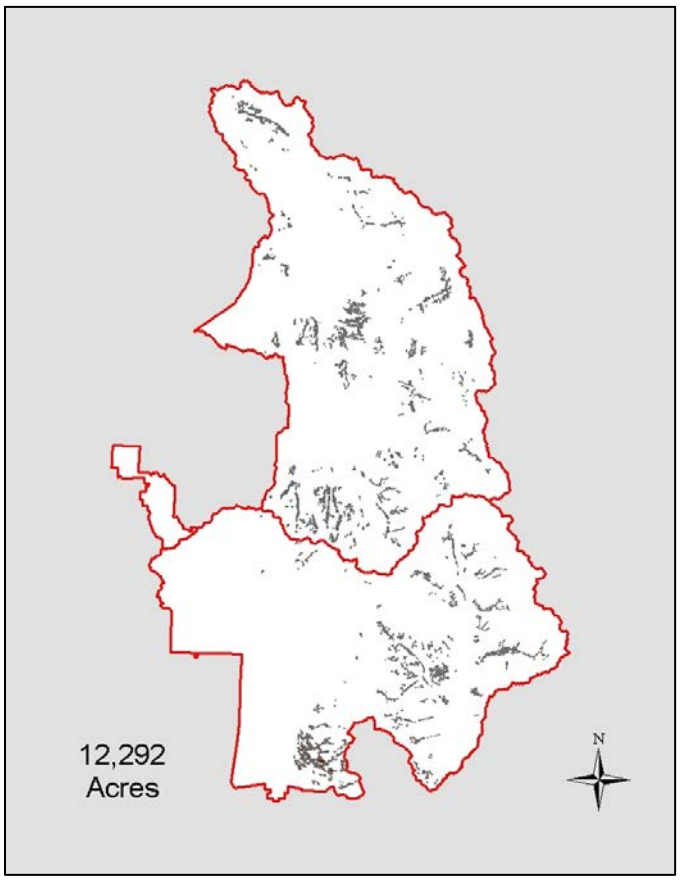


Figure 3048-1. Distribution of Sierra Lodgepole Pine Mesic Forest.

Accuracy:

Producer's accuracy: 87% (n=68)

User's accuracy: 84% (n=70)

Photo Interpretation Signature:

In this mesic mapping unit, the *Pinus contorta var. murrayana* signature typically yields a dark red or dark brown small rounded crown. The *Pinus contorta var. murrayana* trees usually occur in a uniform compact pattern with small openings in the canopy that show a mesic herbaceous signature that looks pink in the photo. Although less common, these stands can also occur in a more open woodland setting, revealing a mesic dense pink herbaceous understory (Figure 3048-2).

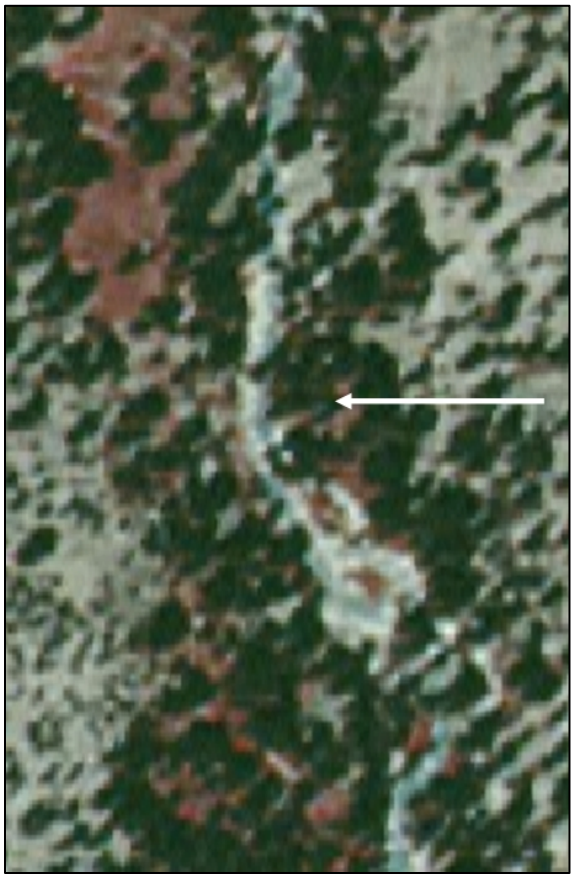


Figure 3048-2. Sierra Lodgepole Pine Mesic Forest signature. Photo reference: MOKA_NE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 2153–3430 m (7064–11254 ft)
Shape – concave, convex, flat, undulating
Slope position – canyon bottom, low slope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 3048-3.

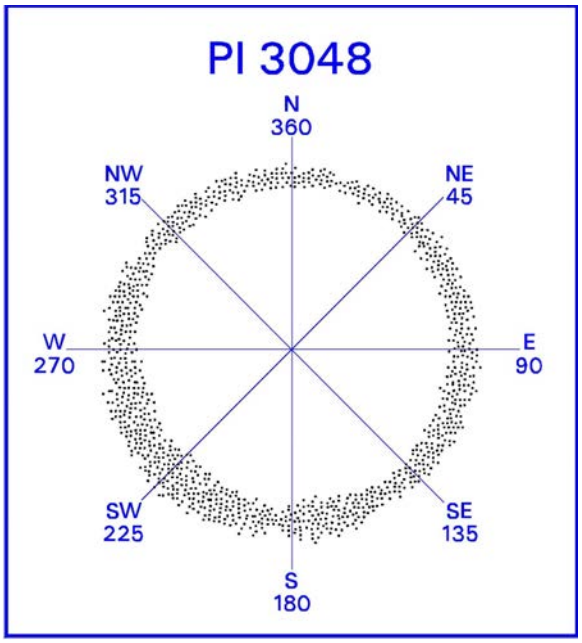


Figure 3048-3. Scatterplot of Sierra Lodgepole Pine Mesic Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance (3010)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)

3049 – Sierra Lodgepole Pine Xeric Forest Superassociation

Pinus contorta var. *murrayana* Xeric Forest Superassociation

Description:

The *Pinus contorta var. murrayana* xeric forest superassociation is mapped on gentle to steep slopes of varying aspect between 2114–3204 m (6936–10511 ft) across 2,169 acres of Sequoia and Kings Canyon National Parks (Figure 3049-1). This superassociation represents a combination of several xeric types that are dominated by *Pinus contorta var. murrayana* in the tree canopy and support a sparse understory of shrubs and herbs. The tree canopy may also include lesser amounts of *Abies concolor, A. magnifica, Juniperus occidentalis var. australis, P. balfouriana ssp. austrina, P. jeffreyi* or *P. monticola*. The shrub layer is absent to sparse; but when present, it may contain *Arctostaphylos patula, Artemisia tridentata, Ceanothus cordulatus, Chrysolepis sempervirens,* or *Holodiscus microphyllus*. The herbaceous layer is generally sparse and may include *Achnatherum spp., Carex filifolia, Carex rossii, Elymus elymoides Gayophytum spp.,* and/or *Juncus parryi*. The hydrology is upland. Soils are well drained sands and sandy loams.

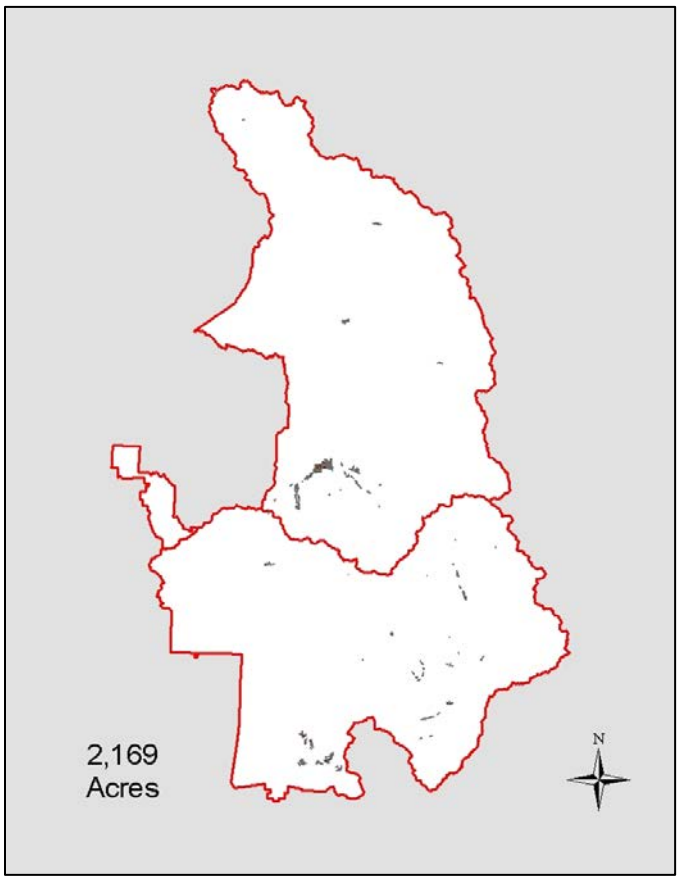


Figure 3049-1. Distribution of Sierra Lodgepole Pine Xeric Forest.

Accuracy:

Producer's accuracy: 62% (n=21)

User's accuracy: 65% (n=20)

Photo Interpretation Signature:

The *Pinus contorta var. murrayana* type is assigned where association level mapping is not feasible, such as in lower than normal elevations where understory openings appear light on the photography or in recent post disturbance settings (Figure 3049-2). It is also assigned where other conifer species are a significant component (5–10%), yet don't fit described associations (such as *Pinus jeffreyi*).



Figure 3049-2. Sierra Lodgepole Pine Xeric Forest signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2114–3204 m (6936–10511 ft)
Shape – convex, undulating
Slope position – low slope, midslope, ridgetop
Steepness – gentle to steep
Aspect – See Figure 3049-3.

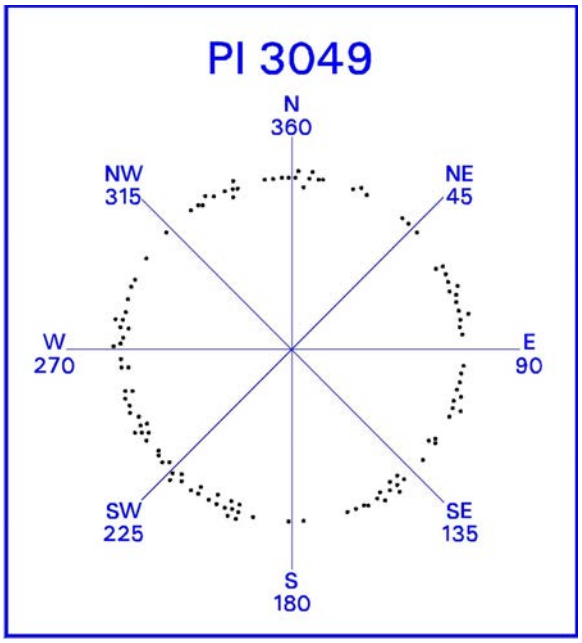


Figure 3049-3. Scatterplot of Sierra Lodgepole Pine Xeric Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine/Big Sagebrush Forest Association (3034)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine Mesic Forest Superassociation (3048)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)

3050 – Ponderosa Pine Woodland Alliance



Ponderosa Pine Forest.

3050 – Ponderosa Pine Woodland Alliance

Pinus ponderosa Woodland Alliance

Description:

The *Pinus ponderosa* woodland alliance is mapped on gentle to steep primarily south to southwest-facing slopes between 1165–2125 m (3821–6971 ft) across 488 acres in Sequoia and Kings Canyon National Parks (Figure 3050-1). The open tree canopy is often dominated by *Pinus ponderosa*, with *Abies concolor, P. lambertiana, Quercus chrysolepis, and Q. kelloggii* often occurring as co-dominants and *Calocedrus decurrens* sometimes contributing low cover. The shrub layer can be sparse or dense and may contain *Arctostaphylos patula, A. viscida, Ceanothus cordulatus, C. integerrimus var. californicus, Chamaebatia foliolosa,* and/or *Chrysolepis sempervirens* as important species. The herbaceous layer is characteristically sparse. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

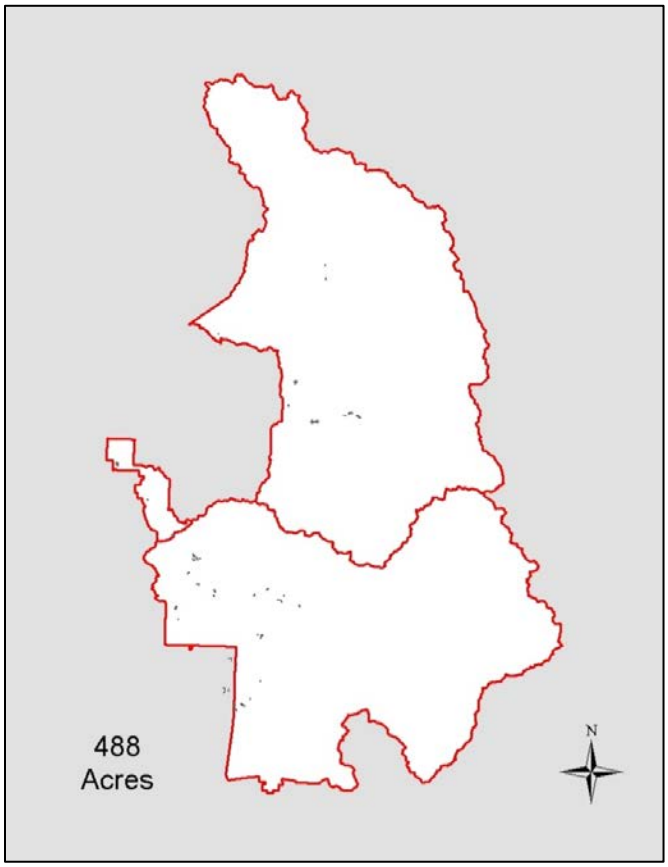


Figure 3050-1. Distribution of Ponderosa Pine Woodland.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
Pinus ponderosa generally has a very rounded crown ranging in size from medium to large when occurring in open non-rocky stands. Separation from *P. jeffreyi* is next to impossible, although in ideal situations, *P. ponderosa* tend to be a bit brighter red (Figure 3050-2). Overlap in the range of these two species, however, eclipses this comparison in most cases.

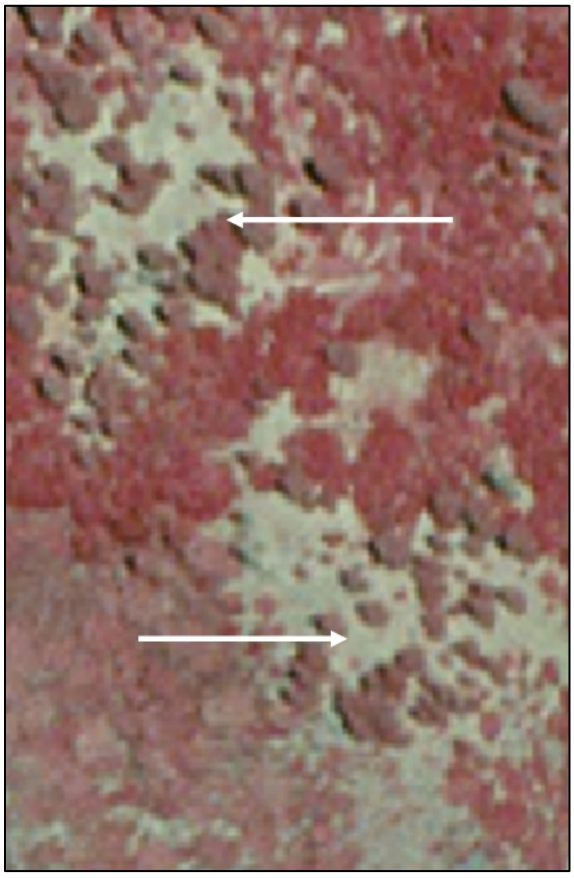


Figure 3050-2. Ponderosa Pine Woodland signature. Photo reference: GIFO_SE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1165–2125 m (3821–6971 ft)
Shape – concave, convex
Slope position – canyon bottom, low slope, midslope
Steepness – gentle to steep
Aspect – See Figure 3050-3.

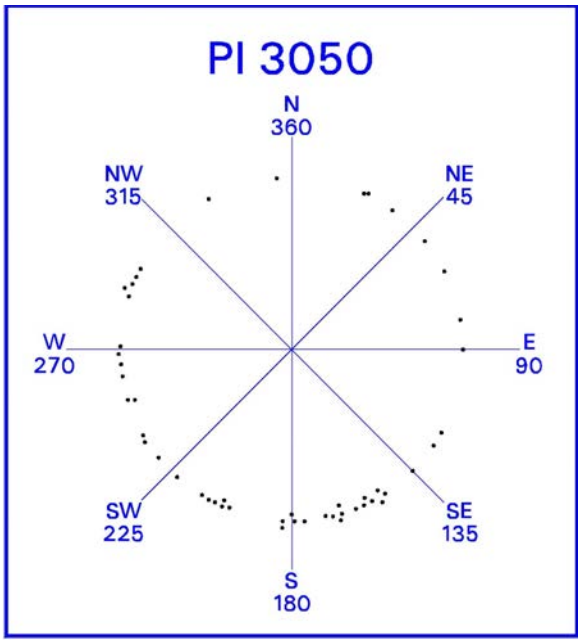


Figure 3050-3. Scatterplot of Ponderosa Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association (3053)
- Ponderosa Pine–Incense–cedar Forest Alliance (3060)
- Jeffrey Pine Woodland Alliance (3070)

3053 – Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association
Pinus ponderosa–Quercus kelloggii/Arctostaphylos viscida Woodland Association

Description:
The *Pinus ponderosa–Quercus kelloggii/Arctostaphylos viscida* woodland is mapped on moderately steep to steep south to southwest facing slopes between 1165–2125 m (3821–6971 ft) across 282 acres of Sequoia National Park (Figure 3053-1). The open tree canopy is dominated by a mixture of *Pinus ponderosa* and *Quercus kelloggii*, with *Q. chrysolepis* occasionally contributing low cover. The shrub layer may be sparse or dense and is dominated by *Arctostaphylos viscida*. The herbaceous layer is characteristically sparse. The hydrology is upland. (NatureServe October 2006).

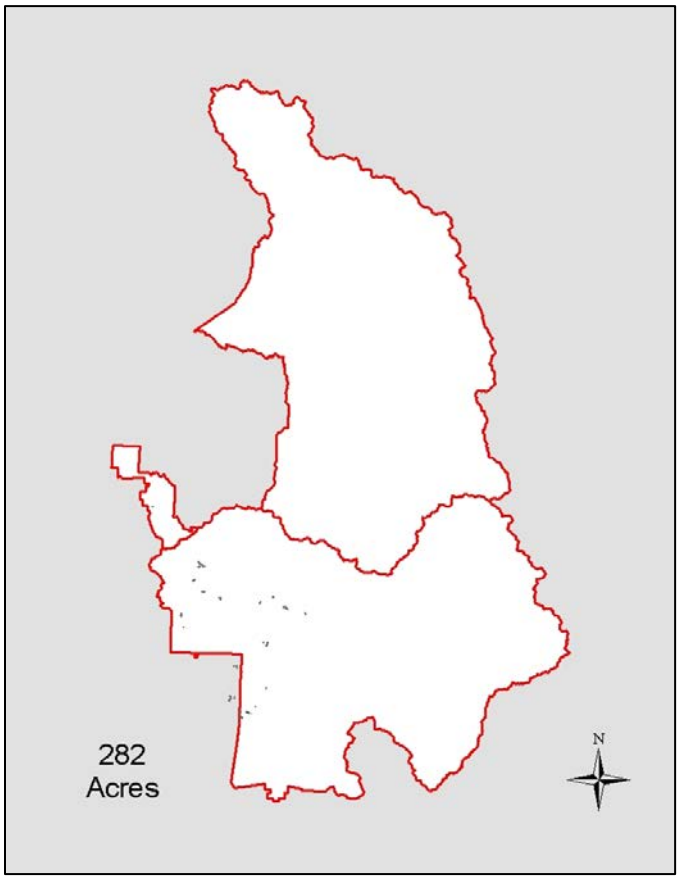


Figure 3053-1. Distribution of Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland.

Accuracy:
Producer's accuracy: 0% (n=1)
User's accuracy: % (n=0)

Photo Interpretation Signature:
The signature of *Pinus ponderosa* is pink or light red in color and individual trees have a moderately sized rounded crown. *Quercus kelloggii* appears as a bright red medium sized tree with a broad uneven rounded crown (Figure 3053-2). *Arctostaphylos viscida* looks coarse in texture and is a light

orange or light brown color. *P. ponderosa* occurs as a sparse overstory to the minor component of *Q. kelloggii* and the understory of *A. viscida*, which can be variable but is usually sparse.

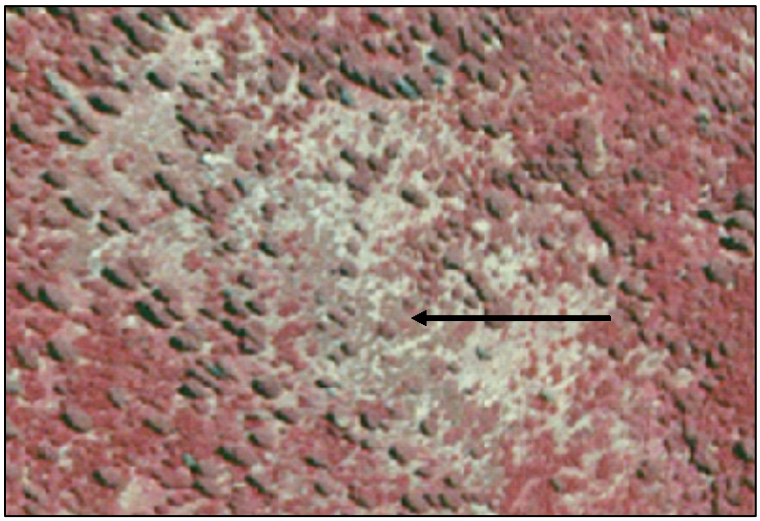


Figure 3053-2. Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland signature. Photo reference: GIFO_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1165–2125 m (3821–6971 ft)
Shape – convex
Slope position – midslope
Steepness – moderately steep to steep
Aspect – See Figure 3053-3.

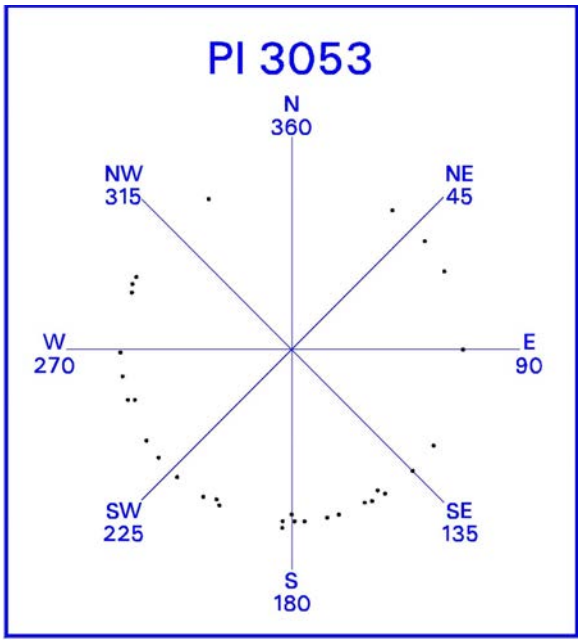


Figure 3053-3. Scatterplot of Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine Woodland Alliance (3050)
- Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association (3061)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3062)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3084)

3060 – Ponderosa Pine–Incense-cedar Forest Alliance



Ponderosa Pine–Incense-cedar–Black Oak Forest. SEKI.0229_292.

3060 – Ponderosa Pine–Incense-cedar Forest Alliance

Pinus ponderosa–Calocedrus decurrens Forest Alliance

Description:

The *Pinus ponderosa–Calocedrus decurrens* forest alliance is mapped on gentle to steep slopes of varying aspect (although primarily south to southwest or west facing) between 927–2367 m (3041–7765 ft) across 13,688 acres of Sequoia and Kings Canyon National Parks (Figure 3060-1). The open to closed tree canopy is dominated by a mixture of *Pinus ponderosa* and *Calocedrus decurrens*, with *Abies concolor, P. lambertiana, Quercus chrysolepis*, and/or *Q. kelloggii* frequently important. When mapped along water courses and on river terraces, *Calocedrus decurrens* may dominate the canopy, with *Alnus rhombifolia*, *A. concolor*, *Acer macrophyllum*, and/or *Torreya californica* also present. The shrub layer may be sparse or dense, with *Arctostaphylos mewukka*, *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cordulatus, C. integerrimus, Cornus sericea, Corylus cornuta var. californica, Chamaebatia foliolosa* and/or *Rubus parviflorus* contributing the highest amount of cover. The herbaceous layer is characteristically sparse, but may include dense patches of annual grasses or *Pteridium aquilinum*. The hydrology is upland or riverine. Soils are moderately well drained to well drained sandy loams or sandy clay loams. (NatureServe October 2006).

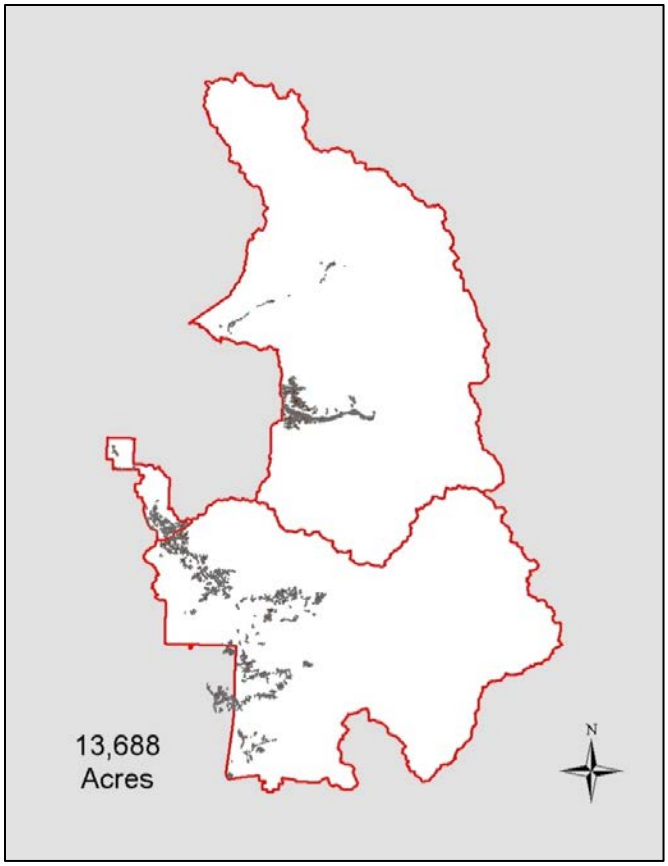


Figure 3060-1. Distribution of Ponderosa Pine–Incense-cedar Forest.

Accuracy:
Producer's accuracy: 56% (n=9)
User's accuracy: 71% (n=7)

Photo Interpretation Signature:
Calocedrus decurrens is generally not distinguishable on the imagery due to its low cover and general sub-canopy nature. When visible in small patches, it tends to yield a brighter red signature than the adjacent pines and has a narrower crown (Figure 3060-2). Most stands have dense canopy cover.

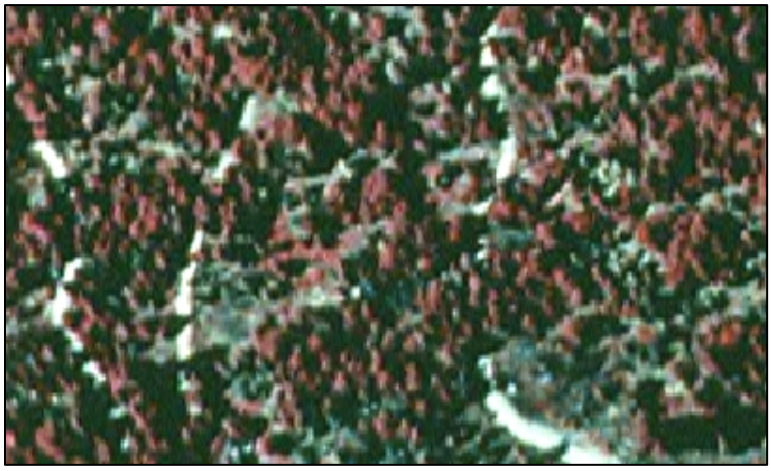


Figure 3060-2. Ponderosa Pine–Incense-cedar Forest signature. Photo reference: CAMO_SE.

Environmental Characteristics:
Microclimate – submesic to xeric
Elevation – 927–2367 m (3041–7765 ft)
Shape – primarily convex; concave, undulating, flat
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3060-3.

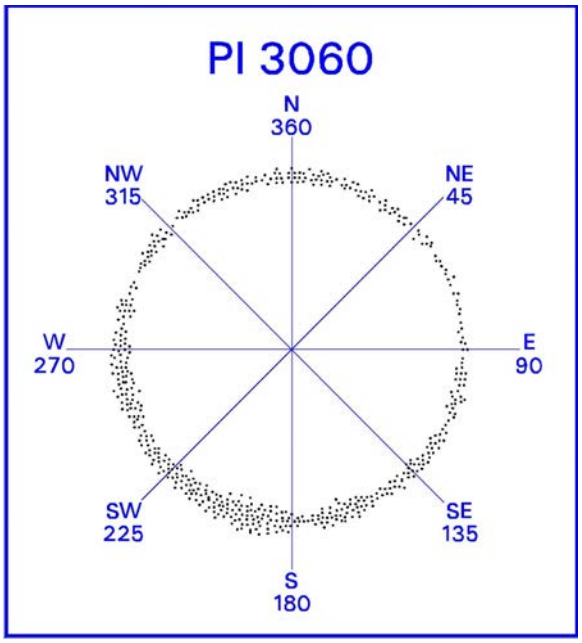


Figure 3060-3. Scatterplot of Ponderosa Pine–Incense-cedar Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine Woodland Alliance (3050)
- Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association (3061)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3062)
- Ponderosa Pine–Incense-cedar–California Black Oak Forest Association (3063)

3061 – Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association
Pinus ponderosa–Calocedrus decurrens–Quercus chrysolepsis/Chamaebatia foliolosa Forest Association

Description:

The *Pinus ponderosa–Calocedrus decurrens–Quercus chrysolepis/Chamaebatia foliolosa* forest association is mapped on gentle to moderately steep slopes of varying aspect between 1360–2367 m (4462–7765 ft) across 1,235 acres of Sequoia and Kings Canyon National Parks (Figure 3061-1). The open tree canopy is dominated by a mixture of 10–60% cover of *Pinus ponderosa* and *Calocedrus decurrens*, and at least 5% cover of *Quercus chrysolepis*. *Abies concolor, P. lambertiana*, and *Q. kelloggii* may also be present in the tree canopy. The shrub layer may be sparse or dense and is often characterized by the presence of *Chamaebatia foliolosa*; *Arctostaphylos viscida* or *Arctostaphylos patula* may also be present. The herbaceous layer is characteristically sparse. The hydrology is upland. (NatureServe October 2006).

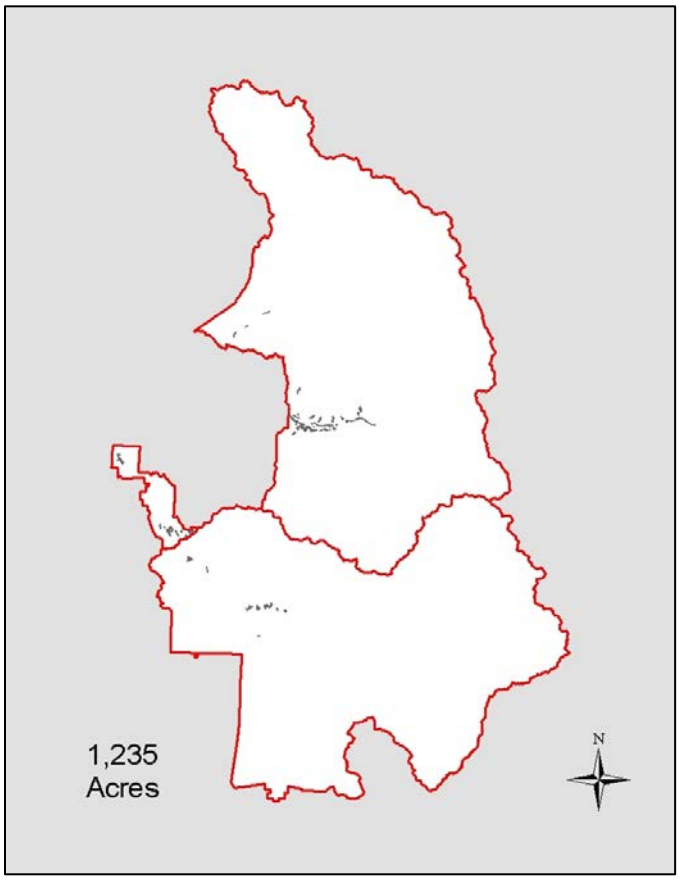


Figure 3061-1. Distribution of Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest.

Accuracy:

Producer's accuracy: 33% (n=6)
User's accuracy: 100% (n=2)

Photo Interpretation Signature:

The *Pinus ponderosa–Calocedrus decurrens–Quercus chrysolepis/Chamaebatia foliolosa* forest association is a difficult type to map as it occurs in steep settings with rocky ravines where *Quercus chrysolepis* often takes hold. *Q. kelloggii* is often visible in the canopy adjacent to the rocky ravines. Conifer density is often highly variable within the canopy. *Chamaebatia foliolosa* is noted in the openings as a smooth bright orange to red signature but can be obscured by shadows of the adjacent canopy (Figure 3061-2).

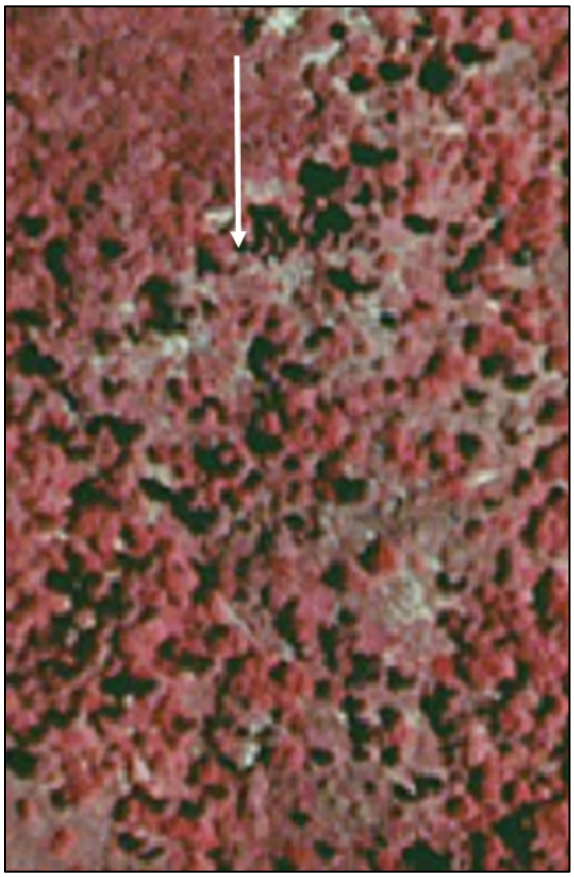


Figure 3061-2. Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest signature. Photo reference: LODG_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1360–2367 m (4462–7765 ft)
Shape – convex, concave
Slope position – low slope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 3061-3.

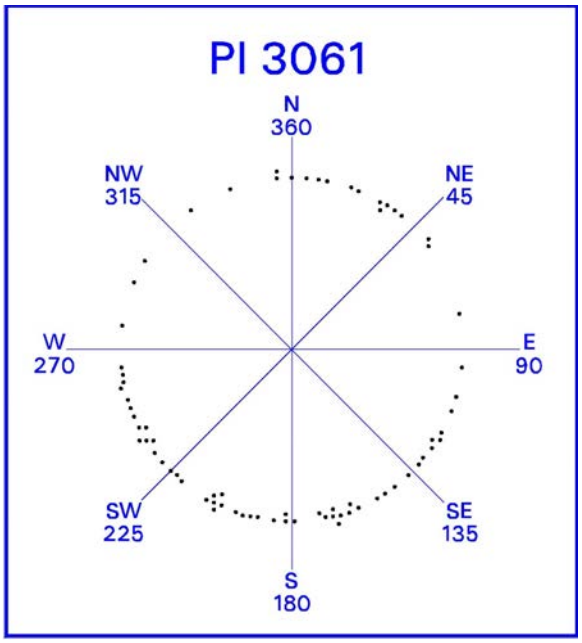


Figure 3061-3. Scatterplot of Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak–(Ponderosa Pine–Incense-cedar) Forest Superassociation (1023)
- Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association (3053)
- Ponderosa Pine–Incense-cedar Forest Alliance (3060)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3062)
- Ponderosa Pine–Incense-cedar–California Black Oak Forest Association (3063)

3062 – Ponderosa Pine-Incense-cedar/Mountain Misery Forest Association
Pinus ponderosa–Calocedrus decurrens/Chamaebatia foliolosa Forest Association

Description:
The *Pinus ponderosa–Calocedrus decurrens/Chamaebatia foliolosa* forest association is mapped on moderately steep south to southeast or southwest facing slopes between 1245–2297 m (4086–7535 ft) across 6,056 acres of Sequoia and Kings Canyon National Parks (Figure 3062-1). The open to closed tree canopy is dominated by a mixture of *Pinus ponderosa* and *Calocedrus decurrens*, with *Abies concolor, P. lambertiana* and *Quercus kelloggii* frequently present. *Q. chrysolepis* is notably absent from this association. The shrub layer is sparse to well developed and is characterized by *Chamaebatia foliolosa*; it may also contain *Arctostaphylos patula, A. viscida, Ceanothus cordulatus*, or *C. integerrimus var. californicus*. The herbaceous layer is characteristically sparse. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

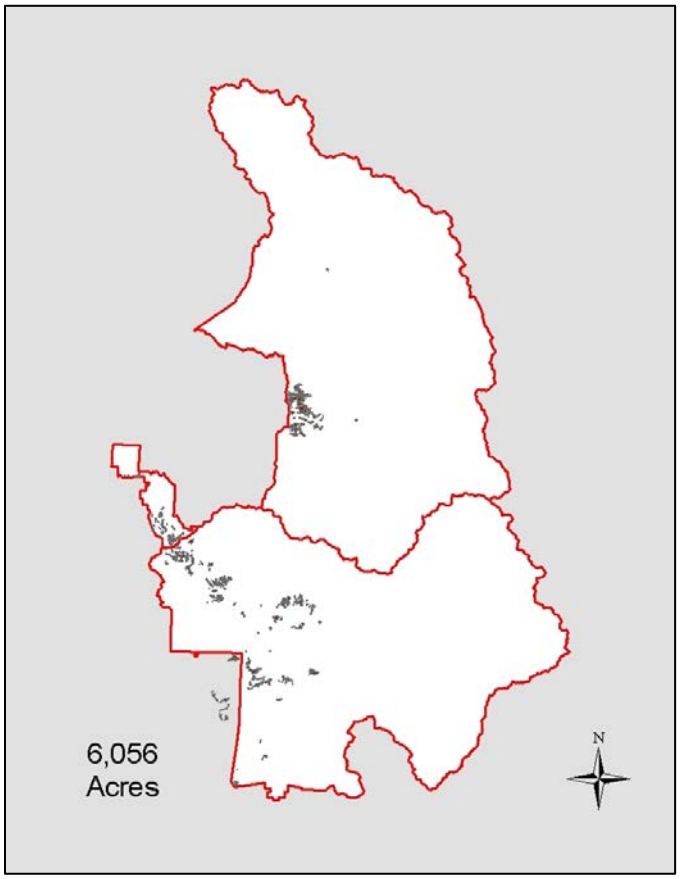


Figure 3062-1. Distribution of Ponderosa Pine–Incense-cedar/Mountain Misery Forest.

Accuracy:
Producer's accuracy: 100% (n=12)
User's accuracy: 93% (n=13)

Photo Interpretation Signature:

The *Pinus ponderosa–Calocedrus decurrens/Chamaebatia foliolosa* forest association is very similar to *Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii* forest association (3063). It is mapped only where *Chamaebatia foliolosa* is visible in the understory openings. Openings to the canopy appear bright orange to red, yielding a very smooth signature; however these openings can be quite small and local in the stand. *Quercus kelloggii* has a more irregular shaped and larger crown *than P. ponderosa* and is often noted as a subcanopy component of the tree layer (Figure 3062-2).

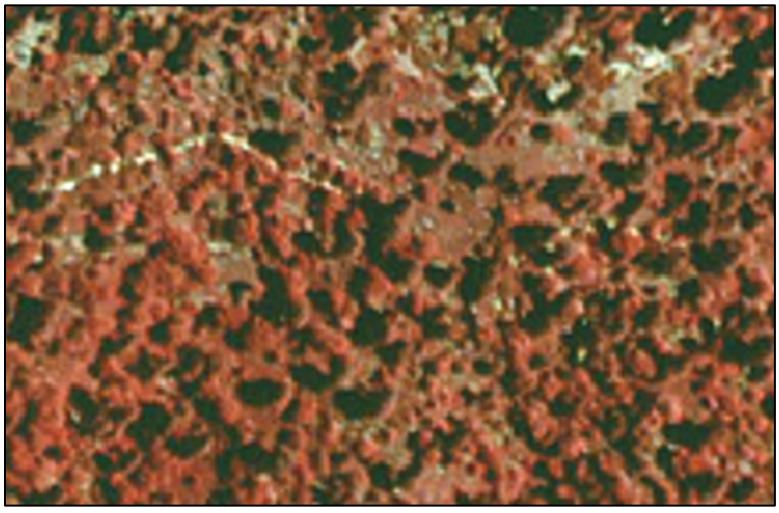


Figure 3062-2. Ponderosa Pine–Incense-cedar/Mountain Misery Forest signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – submesic
Elevation – 1245–2297 m (4086–7535 ft)
Shape – convex
Slope position – low slope, midslope
Steepness – moderately steep
Aspect – See Figure 3062-3.

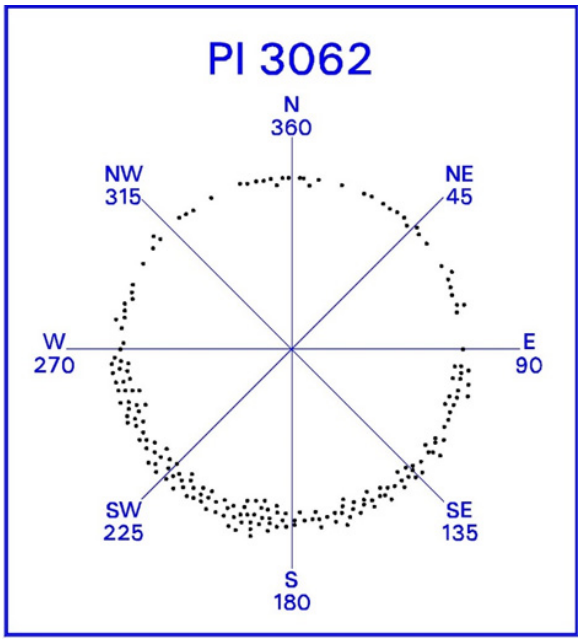


Figure 3062-3. Scatterplot of Ponderosa Pine–Incense-cedar/Mountain Misery Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association (3053)
- Ponderosa Pine–Incense-cedar Forest Alliance (3060)
- Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association (3061)
- Ponderosa Pine–Incense-cedar–California Black Oak Forest Association (3063)

3063 – Ponderosa Pine–Incense-cedar–California Black Oak Forest Association
Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii Forest Association

Description:

The *Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii* forest association is mapped on gentle to steep southerly trending slopes between 1109–2199 m (3640–7216 ft) across 5,702 acres of Sequoia and Kings Canyon National Parks (Figure 3063-1). The closed tree canopy is dominated by a mixture of *Pinus ponderosa* and *Calocedrus decurrens*, with *Quercus kelloggii* often, but not always, a significant component. *Abies concolor*, *Pinus lambertiana*, and/or *Quercus chrysolepis* may also be important. The shrub layer may be sparse to well developed; when present it may contain *Arctostaphylos mewukka*, *A. patula*, *A. viscida*, *Ceanothus integerrimus*, and/or *Chamaebatia foliolosa*. The herbaceous layer is characteristically sparse. The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006).

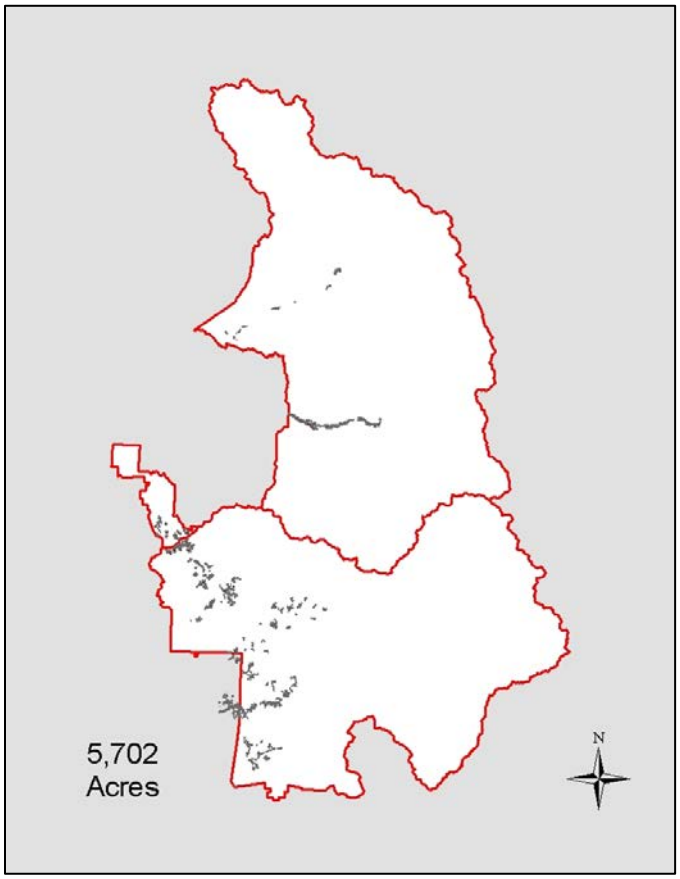


Figure 3063-1. Distribution of Ponderosa Pine–Incense-cedar–California Black Oak Forest.

Accuracy:

Producer's accuracy: 100% (n=20)
User's accuracy: 87% (n=23)

Photo Interpretation Signature:

Pinus ponderosa is not as bright red as Quercus kelloggii, and when the two species co-occur the signature difference is noticeable when they are both in the overstory (Figure 3063-2). Understory oaks in the subcanopy tree layer are generally not detectable on the imagery since most stands are in forest-like settings.

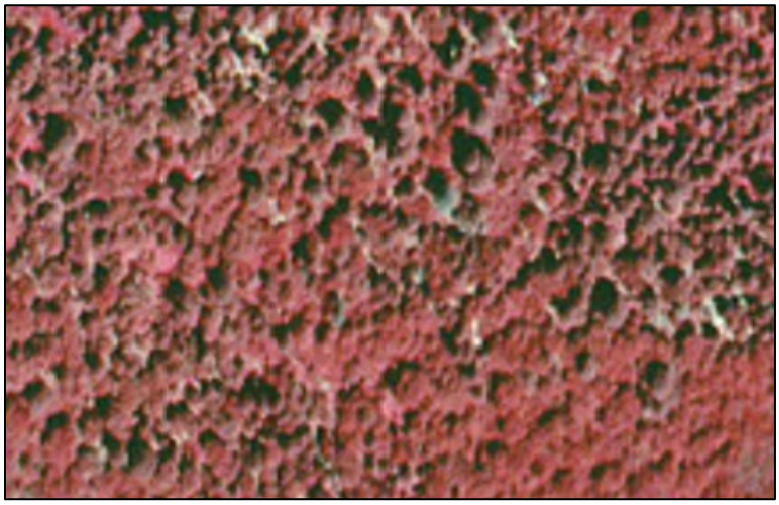


Figure 3062-2. Ponderosa Pine–Incense-cedar–California Black Oak Forest signature. Photo reference: GIFO_NW.

Environmental Characteristics:

Microclimate – submesic to mesic
Elevation – 1109–2199 m (3640–7216 ft)
Shape – concave, convex, flat, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3063-3.

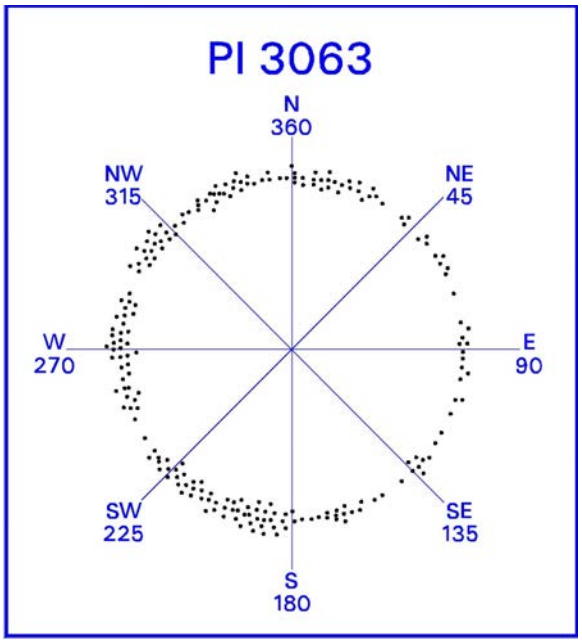


Figure 3063-3. Scatterplot of Ponderosa Pine–Incense-cedar–California Black Oak Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak–(Ponderosa Pine–Incense-cedar) Forest Superassociation 1023)
- Ponderosa Pine–Incense-cedar Forest Alliance (3060)
- Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Association (3061)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3062)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

3070 – Jeffrey Pine Woodland Alliance



Jeffrey Pine/Greenleaf Manzanita Woodland. SEKI.0004_02.

3070 – Jeffrey Pine Woodland Alliance
Pinus jeffreyi Woodland Alliance

Description:
The *Pinus jeffreyi* woodland alliance is mapped on gentle to very steep slopes of varying aspect between 1600–3085 m (5248–10120 ft) across 43,823 acres of Sequoia and Kings Canyon National Parks (Figure 3070-1). The open tree canopy is dominated by *Pinus jeffreyi*, with *Abies concolor, A. magnifica, Calocedrus decurrens, Juniperus occidentalis var. australis, Pinus contorta var. murrayana, P. lambertiana*, and/or *Quercus kelloggii* also frequently present. The shrub layer may be sparse or well developed and may contain *Arctostaphylos nevadensis, A. patula, Artemisia tridentata, Ceanothus cordulatus, Chamaebatia foliolosa, Chrysolepis sempervirens, Eriogonum wrightii, Prunus emarginata, Ribes cereum*, or *Ribes roezlii var. roezlii*. The herbaceous layer is characteristically sparse, with *Apocynum androsaemifolium, Elymus elymoides, Erigeron breweri, Eriogonum nudum, Gayophytum sp*., and *Pteridium aquilinum* frequently encountered. The hydrology is upland. Soils are well drained sandy loams and loamy sands. (NatureServe October 2006). In the aggregated database, the *Pinus jeffreyi* woodland alliance includes the *Pinus jeffreyi–Abies concolor* woodland & *Abies concolor–Pinus lambertiana–Pinus jeffreyi* forest superalliance (3550).

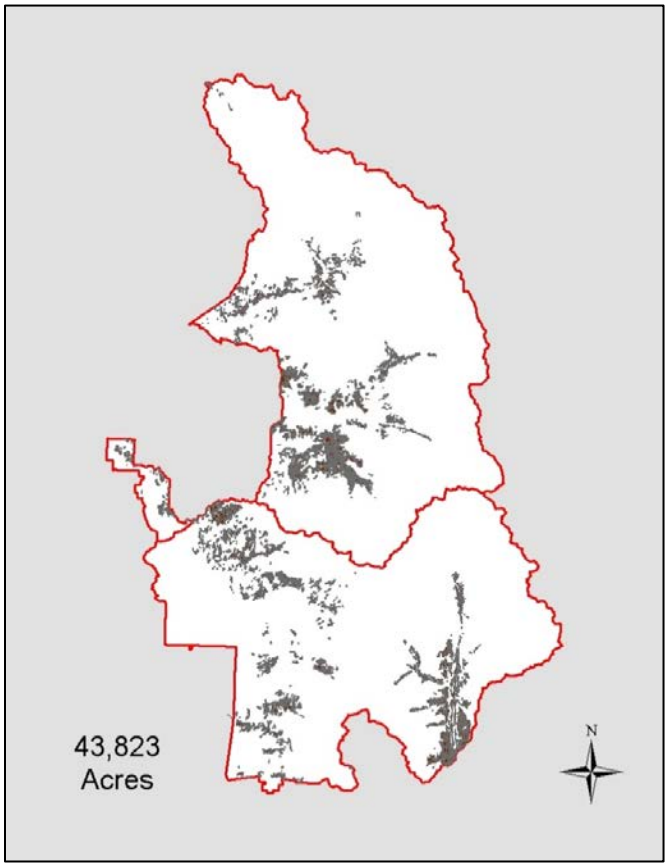


Figure 3070-1. Distribution of Jeffrey Pine Woodland.

Accuracy:
Producer's accuracy: 52% (n=25)
User's accuracy: 62% (n=21)

Photo Interpretation Signature:
Pinus jeffreyi generally have very large rounded crowns, especially in open woodlands. Although their signature is less variable than most pines, the overall signature of this type is highly dependent on associated conifer species such as *Abies concolor* or *Juniperus occidentalis var. australis* (Figure 3070-2).

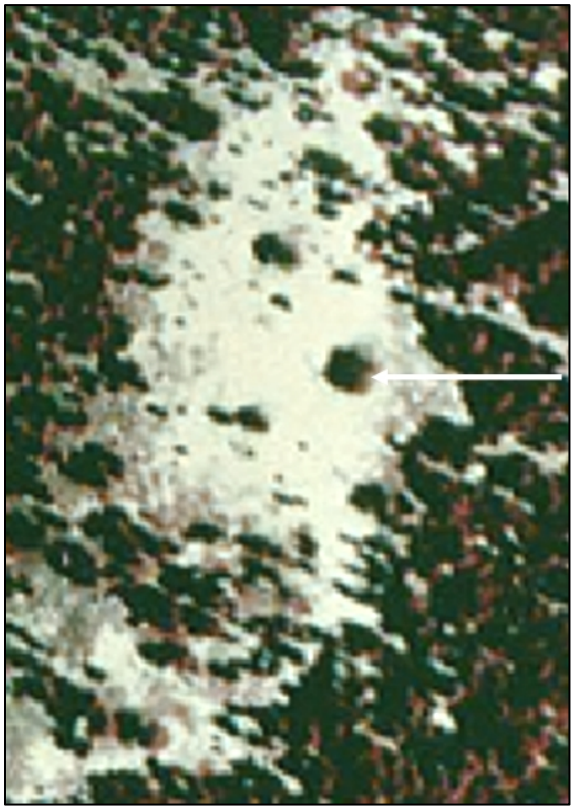


Figure 3070-2. Jeffrey Pine Woodland signature. Photo reference: MOSI_SW.

Environmental Characteristics:
Microclimate – xeric to sub mesic
Elevation – 1600–3085 m (5248–10120 ft).
Shape – concave, convex, flat, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to very steep
Aspect – See Figure 3070-3.

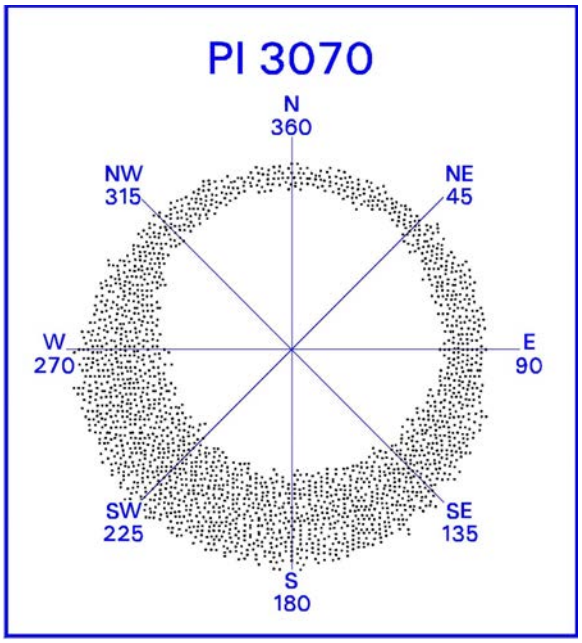


Figure 3070-3. Scatterplot of Jeffrey Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine Woodland Alliance (3050)
- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- Western White Pine Woodland Alliance (3130)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- Sierra Juniper Woodland Alliance (4100)
- Greenleaf Manzanita Shrubland Alliance (5090)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)

3072 – Jeffrey Pine/Greenleaf Manzanita Woodland Association
Pinus jeffreyi/Arctostaphylos patula Woodland Association

Description:
The *Pinus jeffreyi/Arctostaphylos patula* woodland association is mapped on gentle to very steep slopes of primarily south to southwest facing aspect between 1707–3085 m (5602–10120 ft) across 17,464 acres of Sequoia and Kings Canyon National Parks (Figure 3072-1). The tree canopy is dominated by open stands of *Pinus jeffreyi* emergent to a sparse to dense shrub layer. Although dominated by *Arctostaphylos patula*, the shrub layer may also contain significant amounts of *Artemisia tridentata, Ceanothus cordulatus*, and/or *Chrysolepis sempervirens*. The herbaceous layer is sparse to absent. The hydrology is upland. Soils are well drained sandy loams. (Potter 1994, NatureServe October 2006).

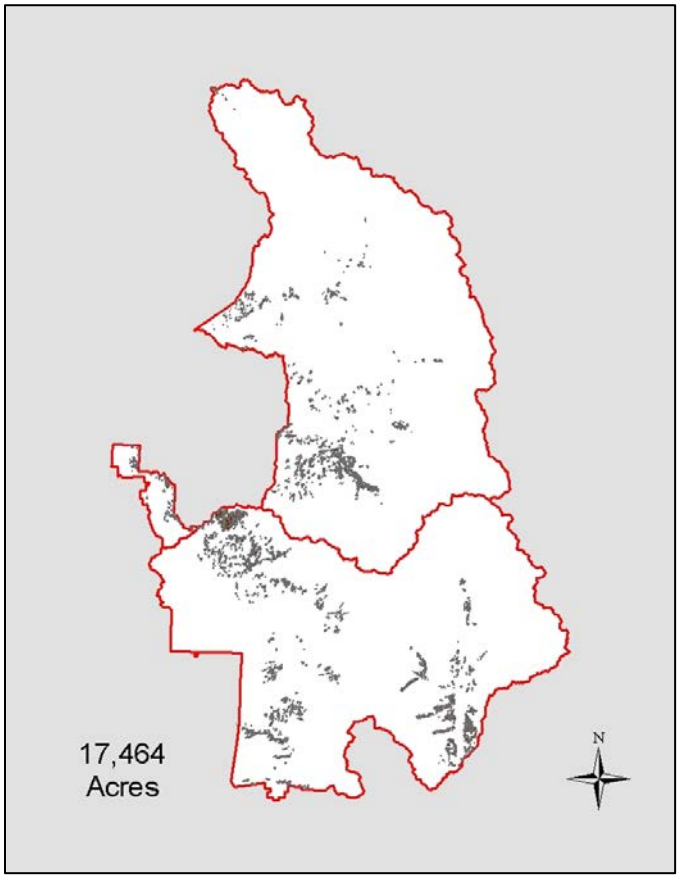


Figure 3072-1. Distribution of Jeffrey Pine/Greenleaf Manzanita Woodland.

Accuracy:
Producer's accuracy: 89% (n=56)
User's accuracy: 89% (n=56)

Photo Interpretation Signature:

The signature for *Pinus jeffreyi* is pink or light red with a large, full round crown. The canopy is open where a sparse to dense understory of *Arctostaphylos patula* appears coarse and orange or orange-brown in color (Figure 3072-2). Other shrubs may be present in the understory. Photo interpreters map this type in extremely sparse to slightly sparse conifer settings that are almost always rocky.

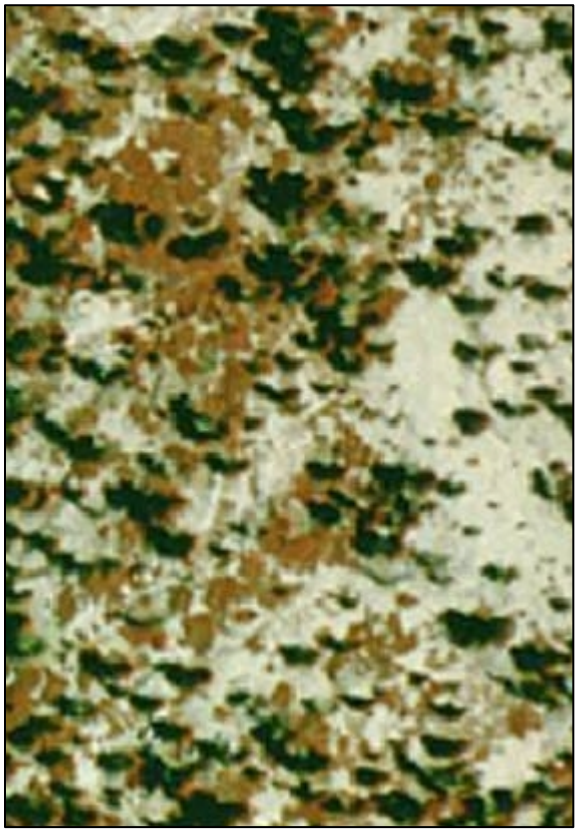


Figure 3072-2. Jeffrey Pine/Greenleaf Manzanita Woodland signature. Photo reference: MUGR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1707–3085 m (5602–10120 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to very steep
Aspect – See Figure 3072-3.

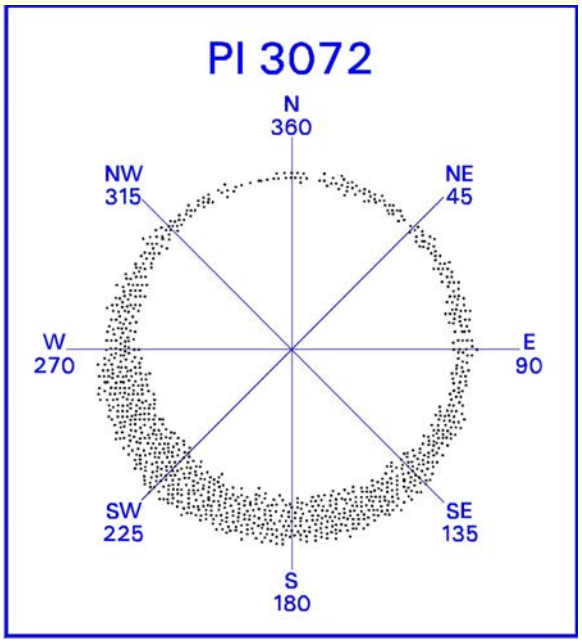


Figure 3072-3. Scatterplot of Jeffrey Pine/Greenleaf Manzanita Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine Woodland Alliance (3070)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3084)
- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- Sierra Juniper Woodland Association (4108)

3073 – Jeffrey Pine/Whitethorn Ceanothus Woodland Association
Pinus jeffreyi/Ceanothus cordulatus Woodland Association

Description:
The *Pinus jeffreyi/Ceanothus cordulatus* woodland association is mapped on gentle to steep south to southwest facing slopes between 1807–2938 m (5927–9639 ft) across 1,095 acre of Sequoia and Kings Canyon National Parks (Figure 3073-1). The open tree canopy is dominated by *Pinus jeffreyi*, with *Abies concolor* also often important. The shrub layer is dominated by patches of *Ceanothus cordulatus*, with *Arctostaphylos patula* and *Chrysolepis sempervirens* frequently mixed in. The herbaceous layer is characteristically sparse but often includes *Elymus elymoides* as well as other scattered perennial herbs and grasses. The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006).

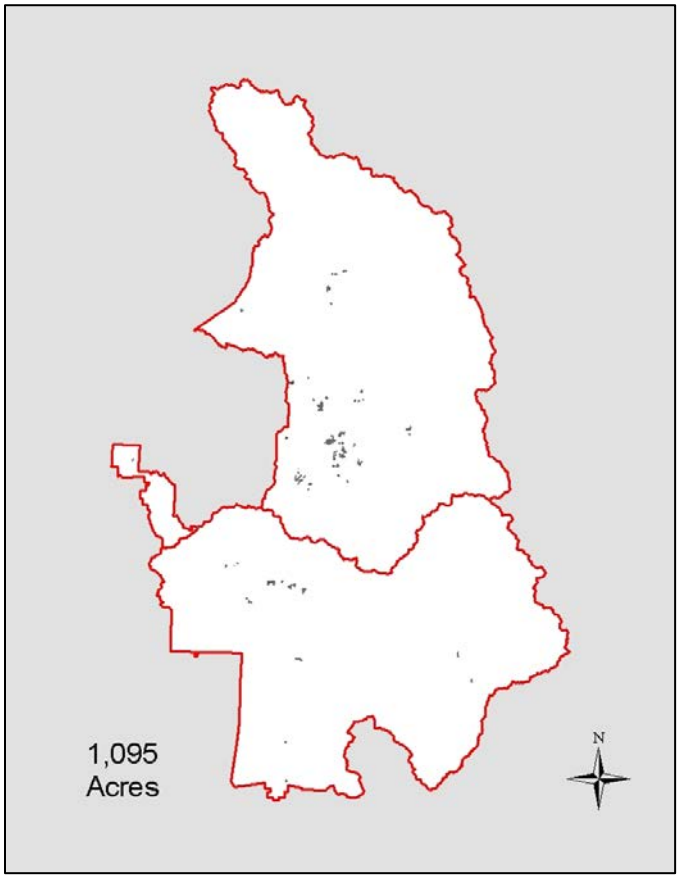


Figure 3073-1. Distribution of Jeffrey Pine/Whitethorn Ceanothus Woodland.

Accuracy:
Producer's accuracy: 67% (n=3)
User's accuracy: 50% (n=4)

Photo Interpretation Signature:

Due to this being a post disturbance vegetation type, the photo signature for *Pinus jeffreyi* in these stands is variable. They can appear as large red or pink trees with a broad, round crown or they can have smaller crowns from younger trees returning in late seral conditions. The density of the *P. jeffreyi* is usually sparse with a dense understory of *Ceanothus cordulatus* chaparral that appears as a smooth textured, pink colored shrub (Figure 3073-2).

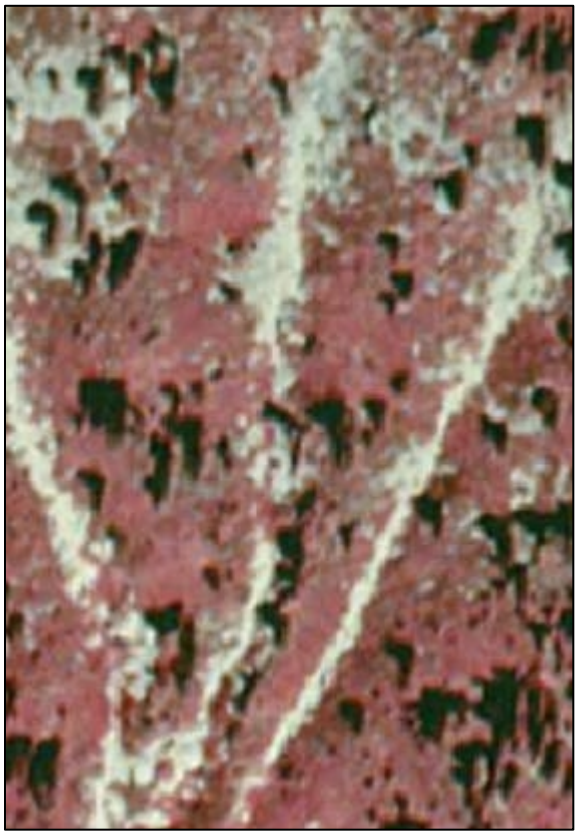


Figure 3073-2. Jeffrey Pine/Whitethorn Ceanothus Woodland signature. Photo reference: LODG_NW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1807–2938 m (5927–9639 ft)
Shape – convex, undulating
Slope position – low slope, midslope
Steepness – gentle to steep
Aspect – See Figure 3073-3.

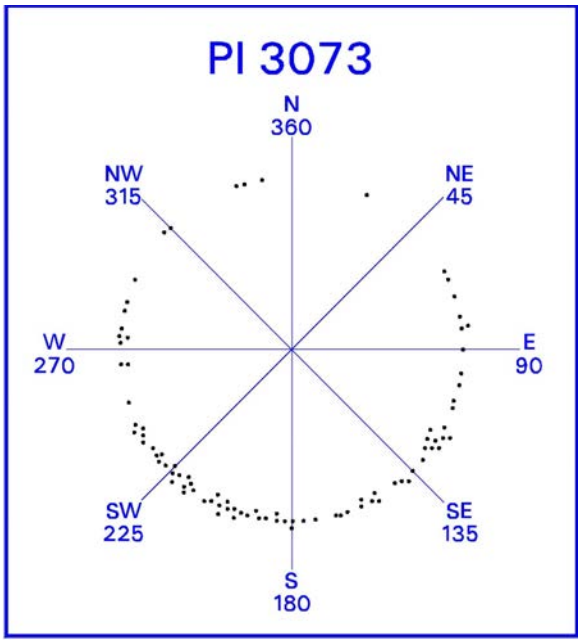


Figure 3073-3. Scatterplot of Jeffrey Pine/Whitethorn Ceanothus Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine Woodland Alliance (3070)
- Jeffrey Pine/Gre
- enleaf Manzanita Woodland Association (3072)
- Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association (3084)
- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitehorn Ceanothus Forest Mapping Unit (4095)

3080 – Jeffrey Pine Woodland Alliance (continued)

3083 – Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Woodland Association
Pinus jeffreyi–Abies concolor/Symphoricarpos rotundifolius/Elymus elymoides Association

Description:

The *Pinus jeffreyi–Abies concolor/Elymus elymoides* association is mapped on gentle to moderate slopes of varying aspect between 1769–2919 m (5805–9576 ft) across 9,518 acres of Sequoia and Kings Canyon National Parks (Figure 3083-1). The open tree canopy is dominated by a mixture of *Pinus jeffreyi* and *Abies concolor*, with *P. contorta* also sometimes important. The shrub layer is generally sparse but may contain *Ceanothus cordulatus* and/or *Chrysolepis sempervirens*. The herbaceous layer is sparse but often includes such dryland species as *Elymus elymoides* and *Gayophytum spp*. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

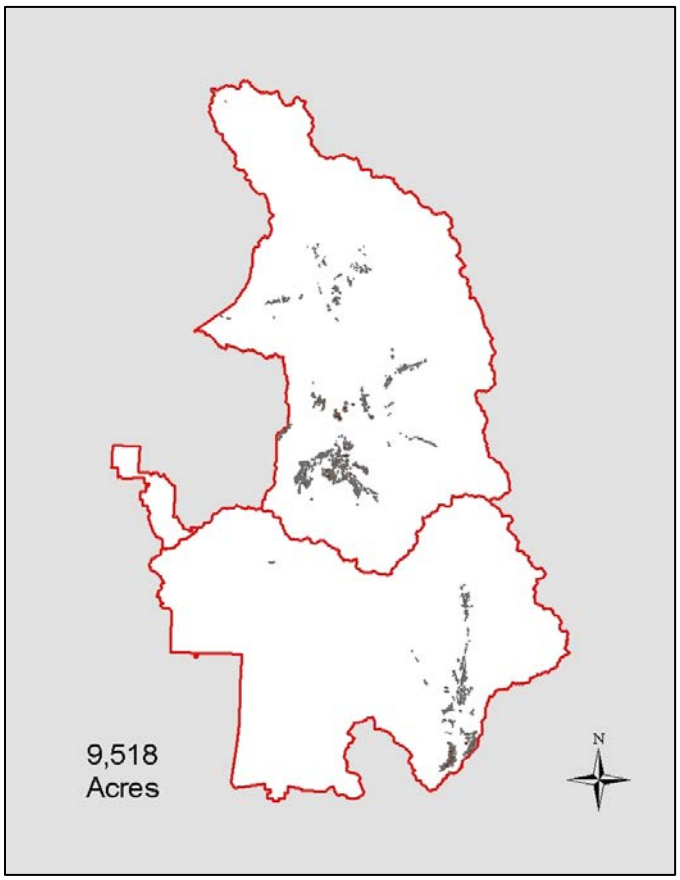


Figure 3083-1. Distribution of Jeffrey Pine–White Fir/Roundleaf Snowberry /Squirreltail Woodland.

Accuracy:

Producer's accuracy: 90% (n=29)
User's accuracy: 72% (n=36)

Photo Interpretation Signature:

The signature for *Pinus jeffreyi* is a pink or light red color with a broad, round crown. The *Abies concolor* have narrow conical crowns that appear dark red in color, and occasionally display a small white top (due to die back at the top of the tree) in the aerial photos (Figure 3083-2). The stand can vary from dispersed to dense and can have some shrub presence in the understory. *Elymus elymoides* is not visible on the aerial photos since it is generally sparse in the herbaceous layer.

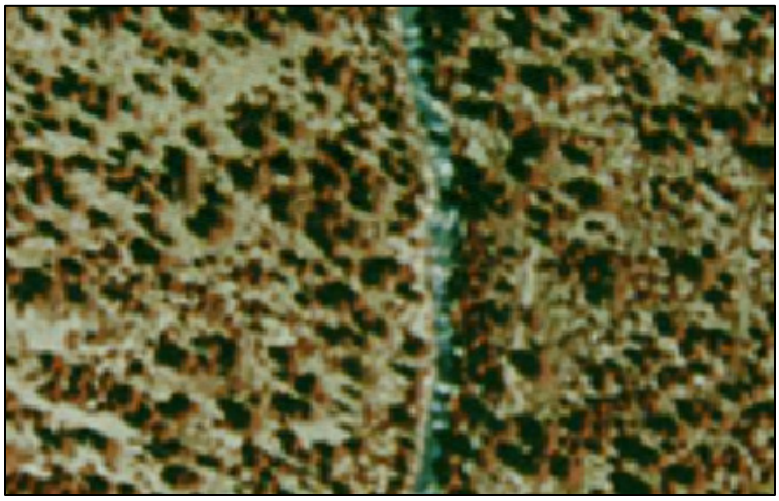


Figure 3083-2. Jeffrey Pine–White Fir/Roundleaf Snowberry /Squirreltail Woodland signature. Photo reference: MOKA_SE.

Environmental Characteristics:

Microclimate – xeric to sub xeric
Elevation – 1769–2919 m (5805–9576 ft)
Shape – flat, undulating
Slope position – low slope
Steepness – gentle to moderate
Aspect – See Figure 3083-3.

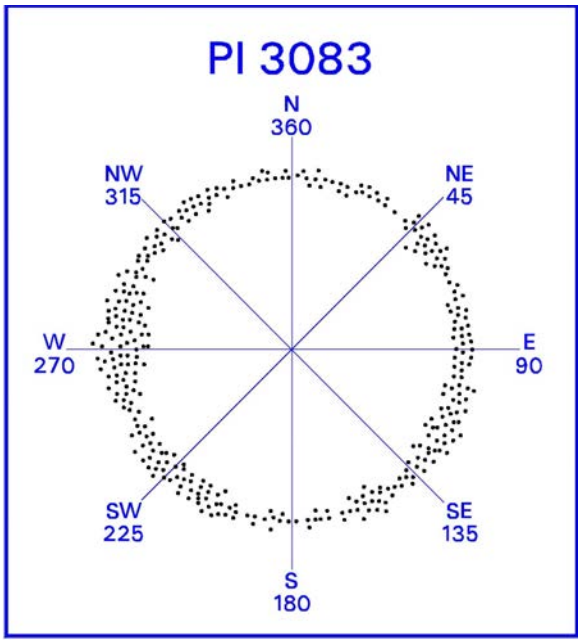


Figure 3083-3. Scatterplot of Jeffrey Pine–White Fir/Roundleaf Snowberry /Squirreltail Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine Woodland Alliance (3070)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

3084 – Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association
Pinus jeffreyi–Quercus chrysolepis/Arctostaphylos viscida Woodland Association

Description:
The *Pinus jeffreyi–Quercus chrysolepis/Arctostaphylos viscida* woodland association is mapped on steep, dry slopes between 1646–2749 m (5401–9019 ft) across 1,583 acres of Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland in Kings Canyon National Park (Figure 3084-1). The open tree canopy is dominated by open *Pinus jeffreyi* (usually less than 10% cover) emergent to a sparse canopy layer of *Quercus chrysolepis*. The sparse shrub layer usually contains *Arctostaphylos viscida* and/or *A. patula*. The hydrology is upland. (NatureServe October 2006).

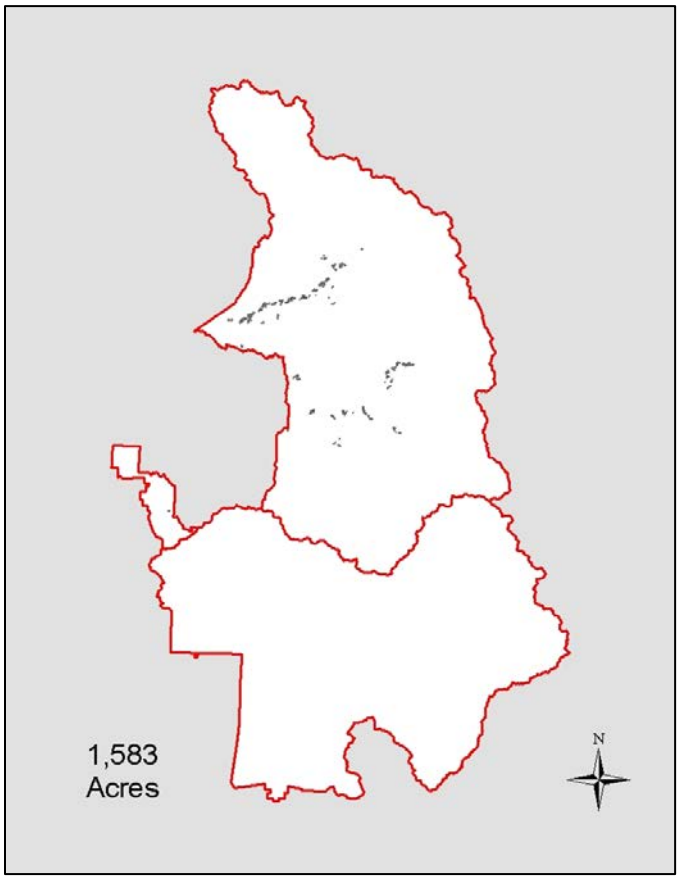


Figure 3084-1. Distribution of Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland.

Accuracy:
Producer's accuracy: 100% (n=3)
User's accuracy: 75% (n=4)

Photo Interpretation Signature:
Pinus jeffreyi yields less infrared reflectance than normal due to the extremely dry settings it is found in. *Quercus chrysolepis* appears brighter and visibly shorter than the conifer. *Arctostaphylos viscida*

yields a dark brown signature in this setting on IR imagery. Figure 3084-2 shows the characteristic signature on true color DOQQ.

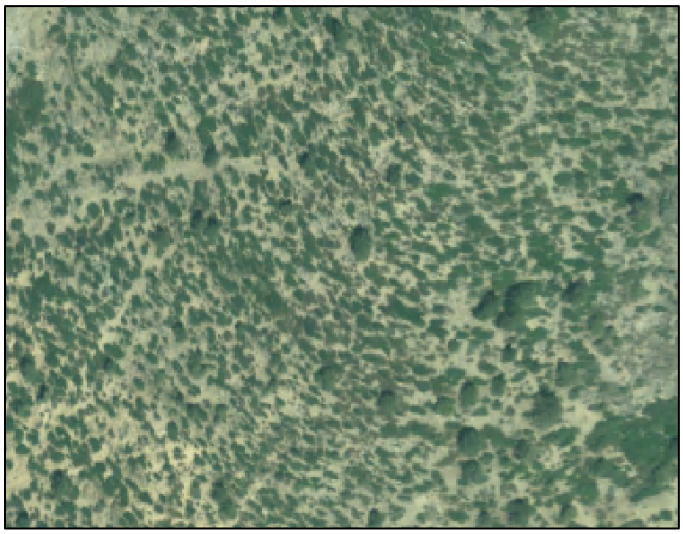


Figure 3084-2. Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland signature. Photo reference: MOKA_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1646–2749 m (5401–9019 ft)
Shape – convex
Slope position – variable
Steepness – steep
Aspect – See Figure 3084-3.

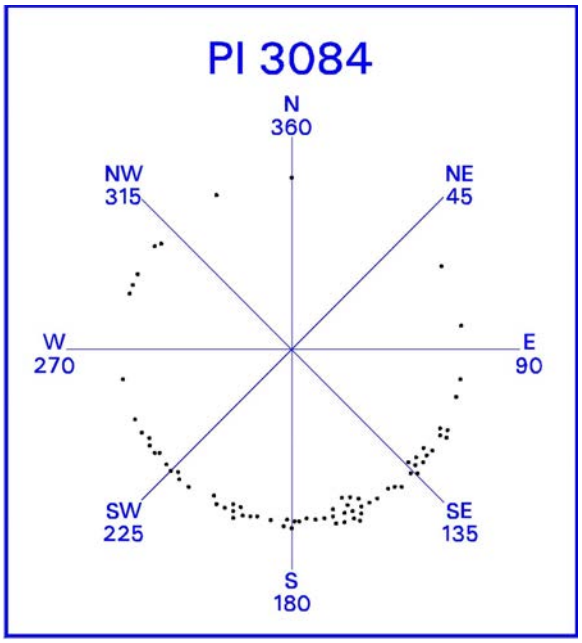


Figure 3084-3. Scatterplot of Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association (3053)
- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)

3085 – Jeffrey Pine–California Red Fir Woodland Association
Pinus jeffreyi–Abies magnifica Woodland Association

Description:
The *Pinus jeffreyi–Abies magnifica* woodland association is mapped on moderate to steep slopes of varying aspect between 2270–3031 m (7447–9943 ft) across 3,077 acres of Sequoia and Kings Canyon National Parks (Figure 3085-1). The open tree canopy is dominated by a mixture of *Pinus jeffreyi* and *Abies magnifica*, with *P. contorta var. murrayana* often important and *P. lambertiana* contributing lesser amounts of cover. The shrub layer can be sparse or well developed, and frequently contains *Arctostaphylos patula, Ceanothus cordulatus*, and/or *Chrysolepis sempervirens*. *Arabis platysperma, Eriogonum nudum*, and *Achnatherum occidentale* are the most frequent species in the herb layer, which averages between 20 and 25% cover. The hydrology is upland. (NatureServe October 2006, Potter 1994).

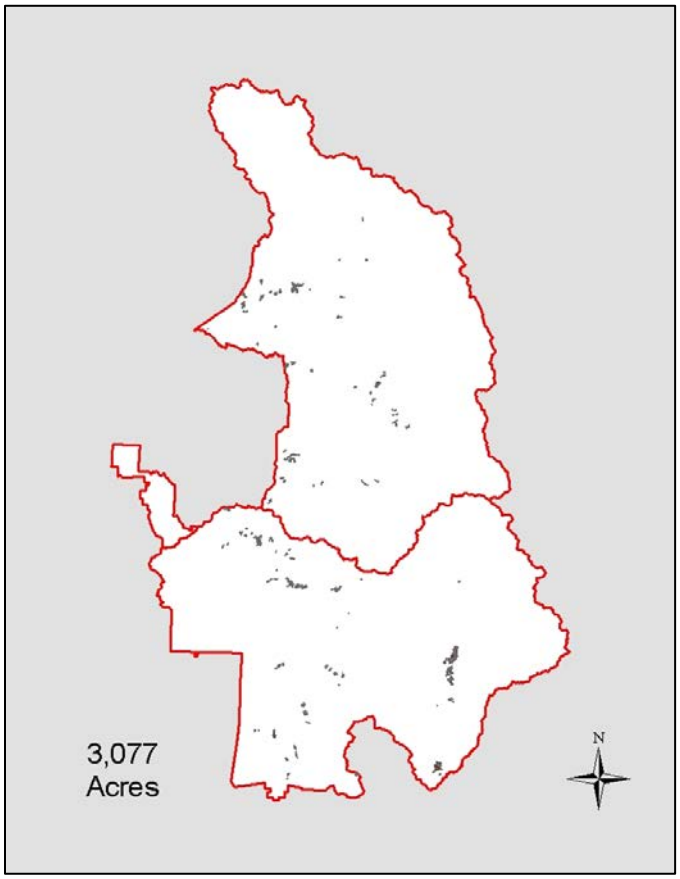


Figure 3085-1. Distribution of Jeffrey Pine–California Red Fir Woodland.

Accuracy:
Producer's accuracy: 88% (n=8)
User's accuracy: 88% (n=8)

Photo Interpretation Signature:

The *Pinus jeffreyi–Abies magnifica* woodland association is mapped in transitional areas between xeric high elevation stands of *Pinus jeffreyi* and more mesic stands dominated by *Abies magnifica*. Scattered *Pinus lambertiana* are not usually visible in these stands (Figure 3085-2).

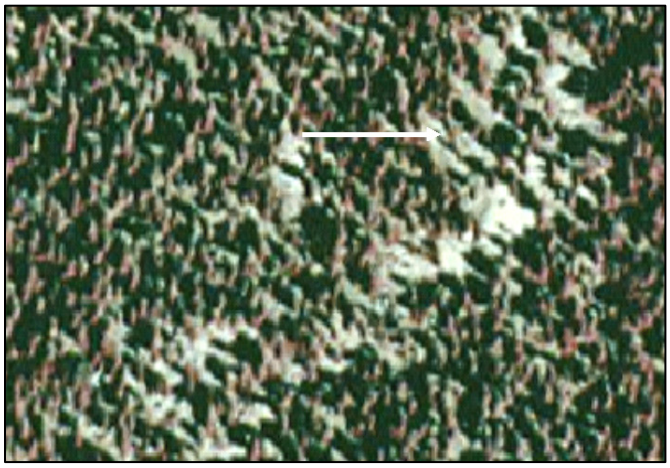


Figure 3085-2. Jeffrey Pine–California Red Fir Woodland signature. Photo reference: MUGR_SE.

Environmental Characteristics:

Microclimate – xeric to subxeric
Elevation – 2270–3031 m (7447–9943 ft)
Shape – convex, undulating
Slope position – midslope, high slope, ridgetop
Steepness – moderate to steep
Aspect – See Figure 3085-3.

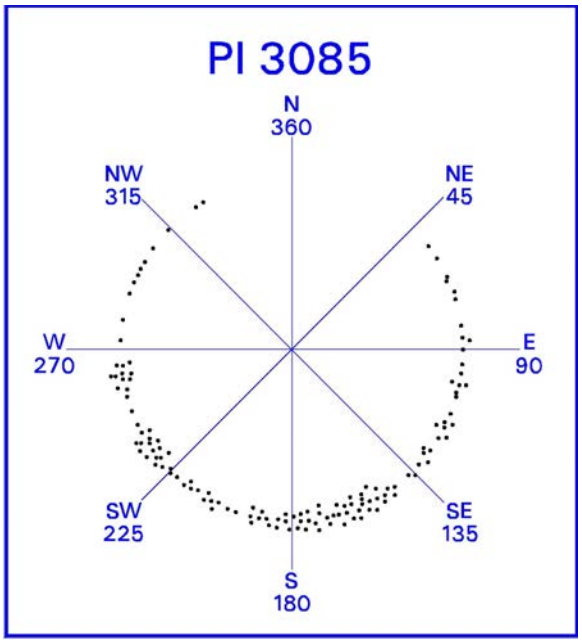


Figure 3085-3. Scatterplot of Jeffrey Pine–California Red Fir Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- California Red Fir Forest Association (4051)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)

3110 – Singleleaf Pinyon Pine Woodland Alliance



Singleleaf Pinyon Pine–Canyon Live Oak. SEKI.1745_2161.

3110 – Singleleaf Pinyon Pine Woodland Alliance

Pinus monophylla Woodland Alliance

Description:

The *Pinus monophylla* woodland alliance is mapped on steep slopes of varying aspect between 1203–2706 m (3946–8879 ft) across 7,653 acres of Sequoia and Kings Canyon National Parks (Figure 3110-1). The open tree canopy is dominated by *Pinus monophylla*, often in mixture with *Quercus chrysolepis*. The shrub layer can be well developed and is most often dominated by *Arctostaphylos viscida* or shrubby *Q.chrysolepis*; *Garrya flavescens* may also be present. The herbaceous layer is sparse to absent. The hydrology is upland. Soils are well drained loamy sands.

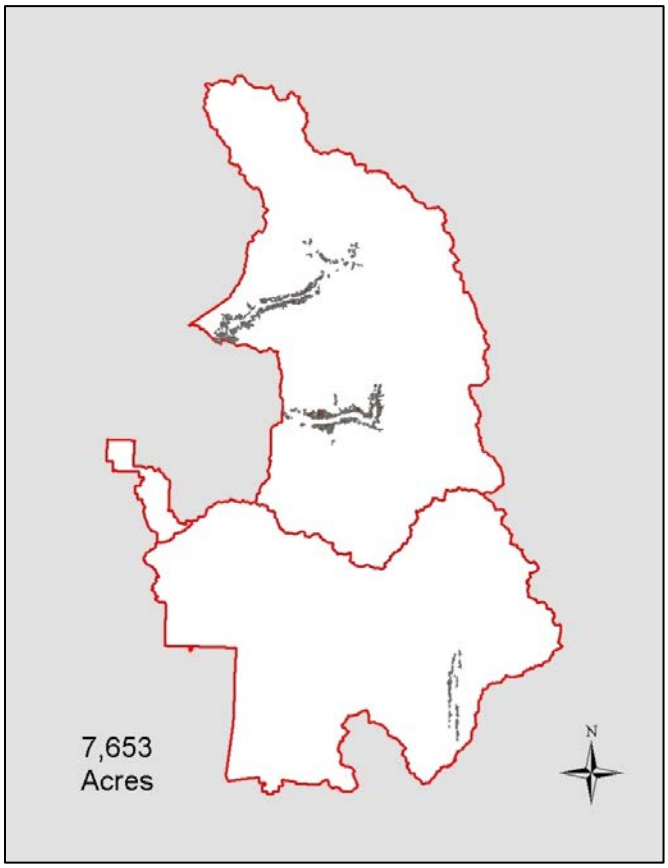


Figure 3110-1. Distribution of Singleleaf Pinyon Pine Woodland.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:

These small, sparse pines yield little or no color infrared signature and have irregularly shaped crowns. Open rock and bare ground is the dominant visual in most mapped stands. *Quercus*

chrysolepis is typically the brightest signature on IR imagery. Figure 3110-2 shows the signature on true color DOQQ.

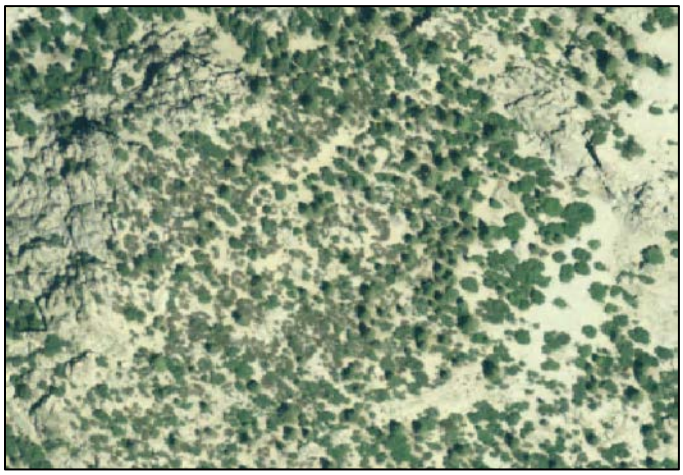


Figure 3110-2. Singleleaf Pinyon Pine Woodland signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1203–2706 m (3946–8879 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – steep to very steep
Aspect – See Figure 3110-3.

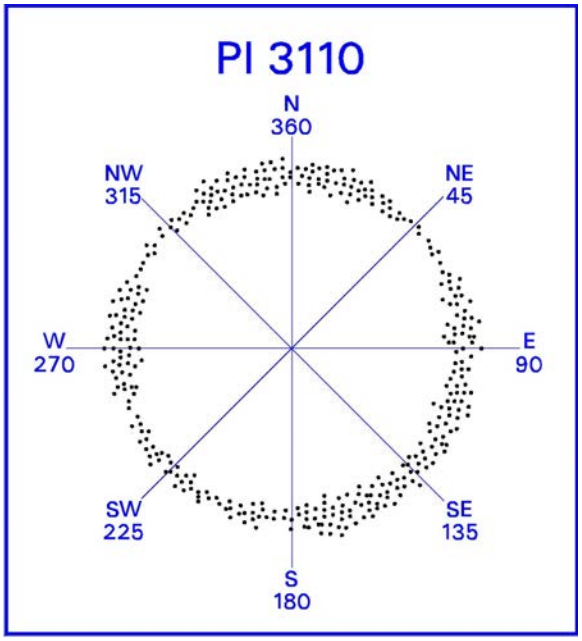


Figure 3110-3. Scatterplot of Singleleaf Pinyon Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association (3114)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3114 – Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association
Pinus monophylla–Quercus chrysolepis/Arctostaphylos viscida Woodland Association

Description:
The *Pinus monophylla–Quercus chrysolepis/Arctostaphylos viscida* woodland mapping unit is mapped on steep slopes of varying aspect between 1203–2706 m (3946–8879 ft) across 7,651 acres of Sequoia and Kings Canyon National Parks (Figure 3114-1). The open tree canopy is dominated by a mixture of *Pinus monophylla* and *Quercus chrysolepis*. The shrub layer can be well developed and is most often dominated by *Arctostaphylos viscida* or shrubby *Q. chrysolepis; Garrya flavescens* may also be present. The herbaceous layer is sparse to absent. The hydrology is upland. Soils are well drained loamy sands.

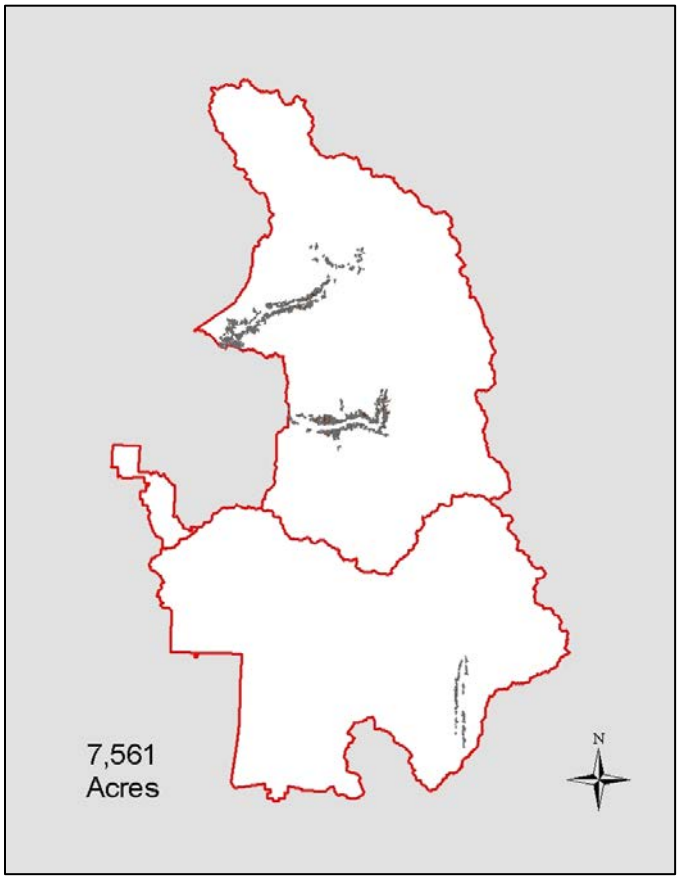


Figure 3114-1. Distribution of Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland.

Accuracy:
Producer's accuracy: 100% (n=23)
User's accuracy: 100% (n=23)

Photo Interpretation Signature:
The *Pinus monophylla* is a short, small tree with irregularly shaped crowns, characterized by a light or medium pink color. *Quercus chrysolepis* appears as a short tree that has bright pink or red colored

broad, round crowns. Typically the dense *Quercus chrysolepis* occurs adjacent to or over a coarse tan or brown shrub layer that ranges from sparse to dense patches. *Cercocarpus* is generally extremely sparse in this type; when visible it tends to be a very dark brown on IR imagery. Figure 3114-2 shows the signature on true color DOQQ.

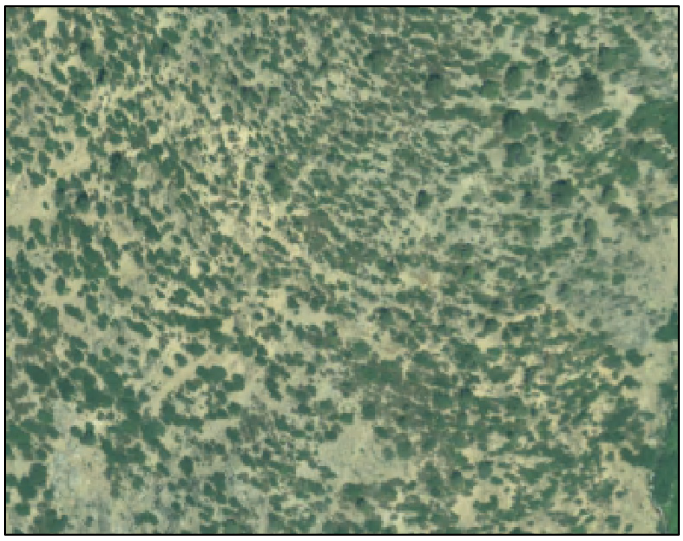


Figure 3114-2. Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1203–2706 m (3946–8879 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – steep to very steep
Aspect – See Figure 3114-3.

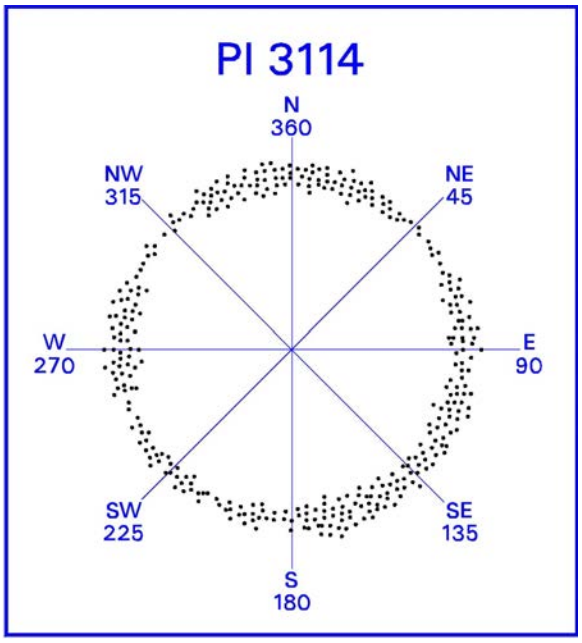


Figure 3114-3. Scatterplot of Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak Forest Alliance (1020)
- Singleleaf Pinyon Pine Woodland Alliance (3110)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Curl-leaf Mountain Mahogany Woodland Alliance (5230)

3130 – Western White Pine Woodland Alliance



Western White Pine Woodland. SEKI-AA.0314.

3130 – Western White Pine Woodland Alliance

Pinus monticola Woodland Alliance

Description:

The *Pinus monticola* woodland alliance is mapped on gentle to steep primarily north to northeast facing slopes between 1773–3278 m (5817–10756 ft) across 13,422 acres of Sequoia and Kings Canyon National Parks (Figure 3130-1). The open tree canopy of the associations making up this alliance is dominated by *Pinus monticola*; other important conifers may include *Abies magnifica* and *P. contorta var. murrayana*. In Sequoia National Park, these stands may also include low cover of *P. balfouriana ssp. austrina*. The shrub layer can be either sparse or well developed and frequently contains dense patches of *Arctostaphylos patula, Chrysolepis sempervirens*, and/or *Holodiscus microphyllus*. The herbaceous layer is characteristically sparse, but frequently includes *Achnatherum occidentale*, *Aster breweri, Carex exserta, Carex rossii,* and/or *Juncus parryi*. The hydrology is upland. Soils are moderately to well drained sandy loams. (NatureServe October 2006).

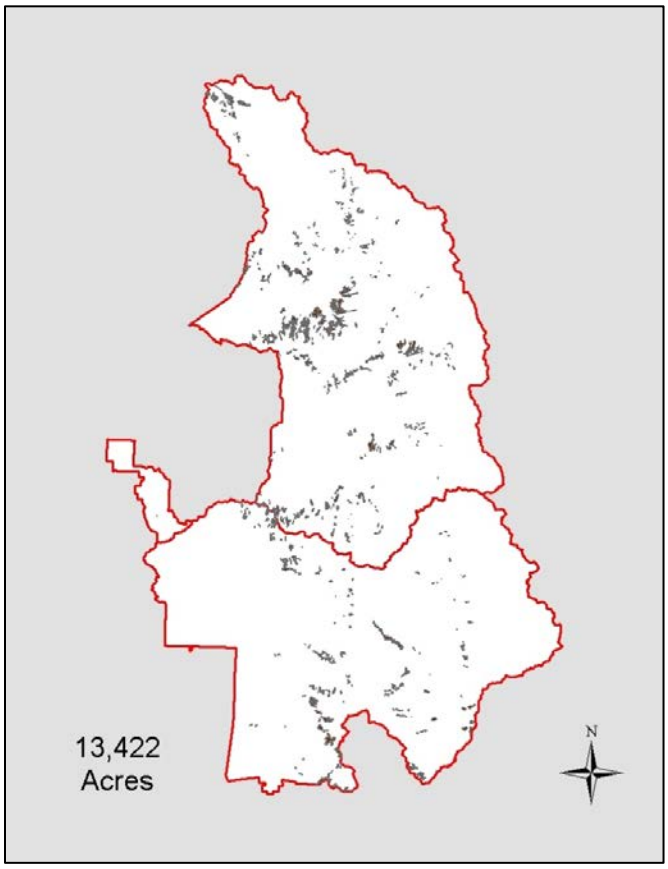


Figure 3130-1. Distribution of Western White Pine Woodland.

Accuracy:

Producer's accuracy: 67% (n=9)

User's accuracy: 75% (n=8)

Photo Interpretation Signature:
The signature of *Pinus monticola* is dark pink or red and has a large, irregular, diffused crown shape (Figure 3130-2). These stands are typically open and have either a rocky or an herbaceous understory.

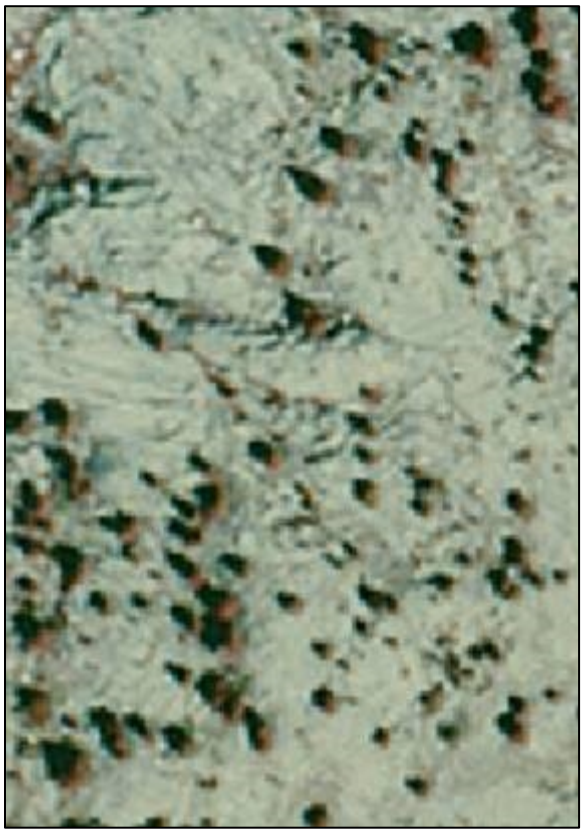


Figure 3130-2. Western White Pine Woodland signature. Photo reference: MOSI_SW.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1773–3278 m (5817–10756 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3130-3.

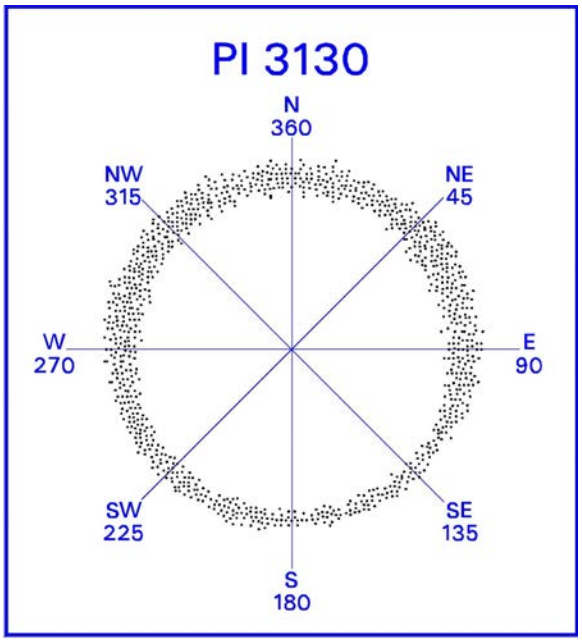


Figure 3130-3. Scatterplot of Western White Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine Woodland Association (3038)
- Jeffrey Pine Woodland Alliance (3070)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Whitebark Pine Woodland Alliance (3140)
- Limber Pine Woodland Alliance (3150)
- Foxtail Pine Woodland Alliance (3200)
- Foxtail Pine Woodland Superassociation (3203)
- Foxtail Pine–Western White Pine Woodland Superassociation (3204)
- Mountain Hemlock–Western White Pine Forest Association (4033)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)

- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3132 – Western White Pine–Sierra Lodgepole Pine Woodland Association
Pinus monticola–Pinus contorta var. *murrayana* Woodland Association

Description:

The *Pinus monticola–Pinus contorta var. murrayana* woodland association is mapped on moderate to steep slopes of varying aspect between 2495–3278 m (8186–10756 ft) across 9,121 acres of Sequoia and Kings Canyon National Parks (Figure 3132-1). The open tree canopy is dominated by a mixture of *Pinus monticola* and *P. contorta var. murrayana,* with each species contributing at least 10% relative cover to the canopy. *Abies magnifica, P. albicaulis,* and *P. balfouriana ssp. austrina* are also often present at low cover. The shrub layer can be sparse or well developed and is frequently dominated by *Arctostaphylos patula, Chrysolepis sempervirens,* and/or *Holodiscus microphyllus*. The characteristically sparse herbaceous layer may include *Arabis platysperma, Aster breweri, Carex exserta, C. rossii*, and *Juncus parryi*. The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006). In the aggregated database, the *Pinus monticola–Pinus contorta var. murrayana* woodland association is aggregated into the *Pinus monticola–Pinus contorta var. murrayana–(Abies magnifica)* forest mapping unit (4540).

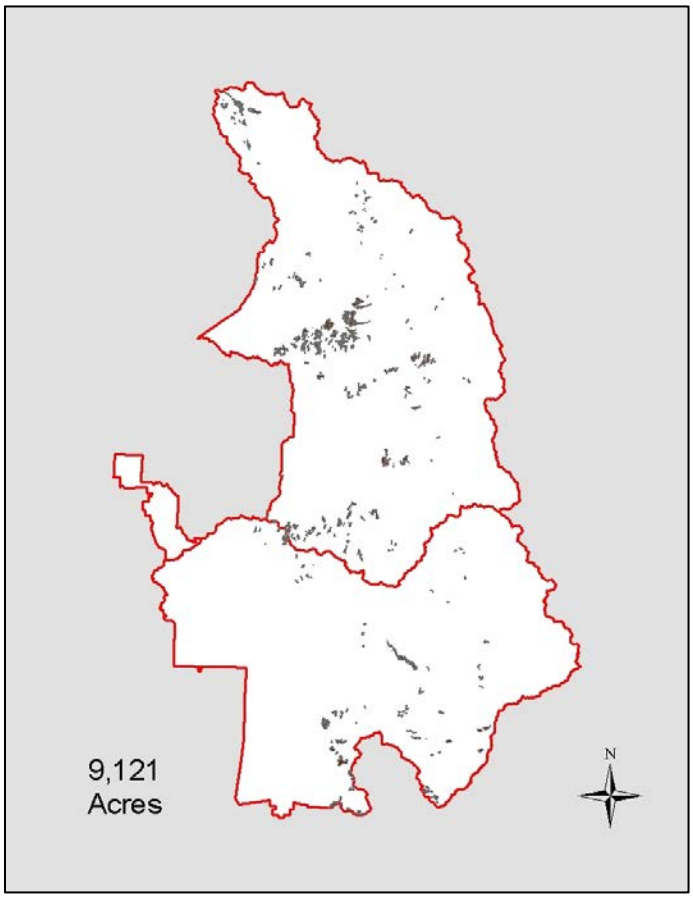


Figure 3132-1. Distribution of Western White Pine–Sierra Lodgepole Pine Woodland.

Accuracy:

Producer's accuracy: 75% (n=24)
User's accuracy: 64% (n=28)

Photo Interpretation Signature:

The photo signature of the *Pinus monticola* is red or pink in color, and has large, open irregularly shaped crowns. The signature of *P. contorta var. murrayana* is red or brown in color with a tight, rounded crown. These stands are typically open. Settings can be somewhat rocky and usually display minimal understory signature (Figure 3132-2).

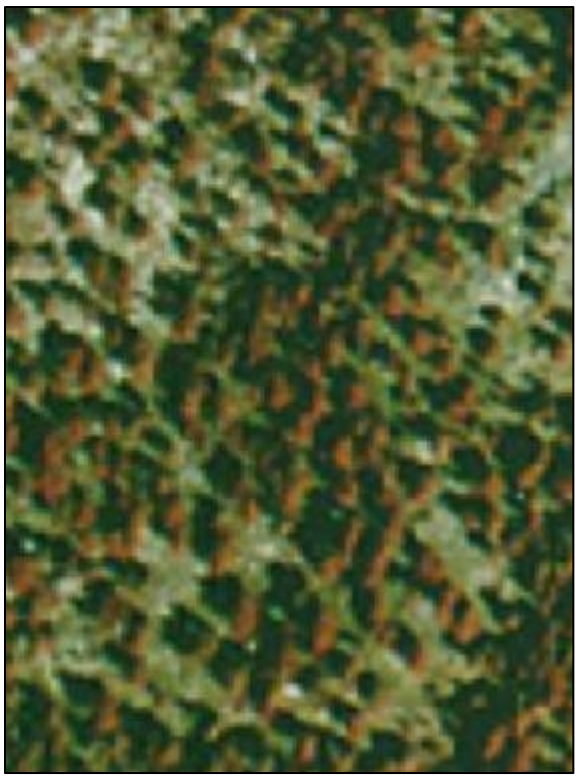


Figure 3132-2. Western White Pine–Sierra Lodgepole Pine Woodland signature. Photo reference: TDPE_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2495–3278 m (8186–10756 ft)
Shape – convex, concave, undulating
Slope position – midslope, high slope, ridgetop
Steepness – moderate to steep
Aspect – See Figure 3132-3.

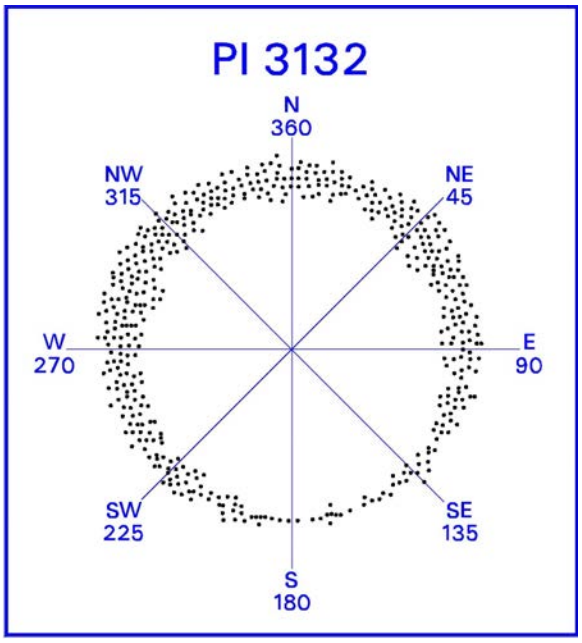


Figure 3132-3. Scatterplot of Western White Pine–Sierra Lodgepole Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Western White Pine Woodland Alliance (3130)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Whitebark Pine Woodland Alliance (3140)
- Foxtail Pine–Western White Pine Woodland Superassociation
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)
- Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association (4043)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3133 – Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit

Pinus monticola/(*Arctostaphylos patula–Chrysolepis sempervirens–Holodiscus discolor*) Woodland Mapping Unit

Description:

The *Pinus monticola*/(*Arctostaphylos patula–Chrysolepis sempervirens–Holodiscus discolor*) woodland mapping unit is mapped on moderately steep to steep slopes of varying aspect between 2313–3278 m (7588–10756 ft) across 2,477 acres of Sequoia and Kings Canyon National Parks (Figure 3133-1). The open tree canopy is dominated by *Pinus monticola*, with other subalpine conifers (*Abies magnifica*, *P. balfouriana ssp. austrina*, and/or *P. contorta var. murrayana*) sometimes contributing low amounts of cover. The shrub layer is well developed and may include dense patches of *Arctostaphylos nevadensis*, *A. patula*, *Chrysolepis sempervirens*, and/or *Holodiscus microphyllus*. The herbaceous layer is characteristically sparse. The hydrology is upland. Soils are well drained sands.

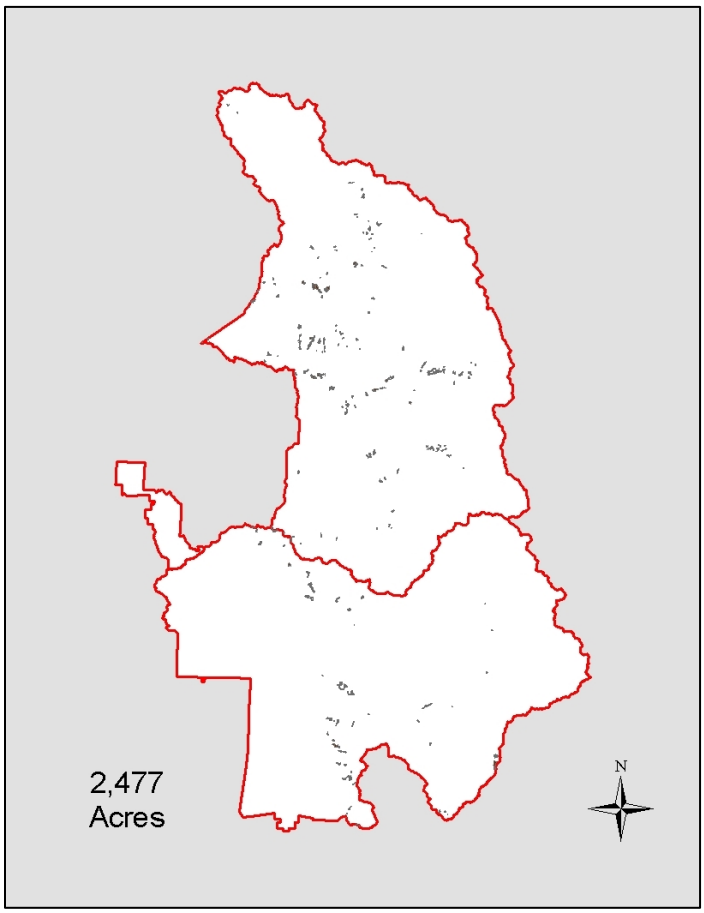


Figure 3133-1. Distribution of Western White Pine/(Greenleaf Manzanitea–Bush Chinquapin–Oceanspray) Woodland.

Accuracy:

Producer's accuracy: 0% (n=1)
User's accuracy: 0% (n=1)

Photo Interpretation Signature:

The photo signature of *Pinus monticola* is typically red or pink with broad, irregularly shaped crowns. The shrubs in this mapping unit appear smooth overall with some tufts interspersed, ranging in color from brown to orange, depending on what species are present (Figure 3133-2). The stand pattern varies, but is predominantly found as sparse clumps of Western White Pine trees over the mixed shrubs that can range from a dispersed to a more dense undercover. Photo interpreters mapped this association generally along ridges, adjacent spurs and upper exposed slopes.

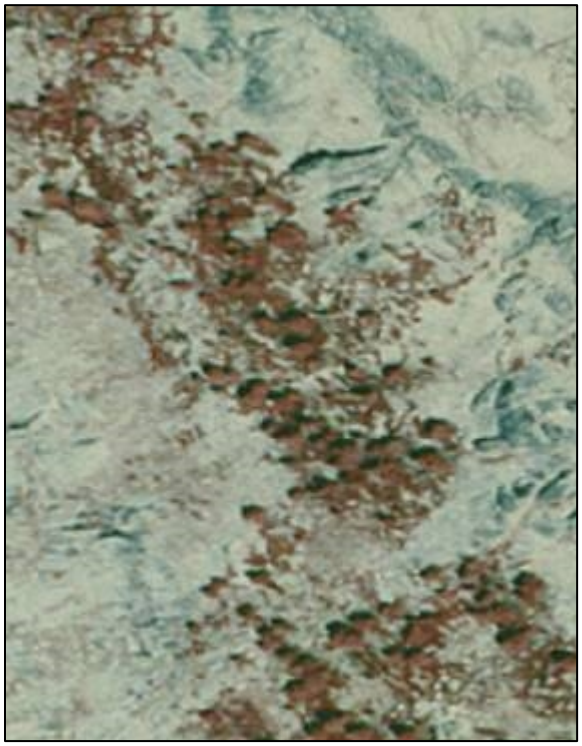


Figure 3133-2. Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland signature. Photo reference: TDPE_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2313–3278 m (7588–10756 ft)
Shape – convex, concave
Slope position – ridges, adjacent spurs and upper exposed slopes
Steepness – moderately steep to steep
Aspect – See Figure 3133-3.

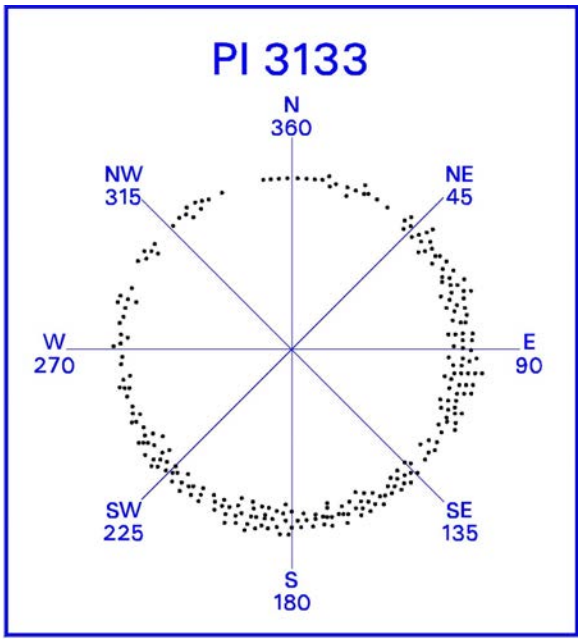


Figure 3133-3. Scatterplot of Western White Pine/(Greenleaf Manzanitea–Bush Chinquapin–Oceanspray) Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Whitebark Pine Woodland Alliance (3140)
- Foxtail Pine/Bush Chinquapin Woodland Association (3202)
- Foxtail Pine–Western White Pine Woodland Superassociation (3204)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

3140 – Whitebark Pine Woodland Alliance



Whitebark Pine Woodland. SEKI.0163_93.

3140 – Whitebark Pine Woodland Alliance

Pinus albicaulis Woodland Alliance

Description:

Associations within the *Pinus albicaulis* woodland alliance are mapped on gentle to very steep subalpine slopes of varying aspect between 2501–3841 m (8204–12603 ft) across 36,539 acres of Sequoia and Kings Canyon National Parks (Figure 3140-1). The open tree canopy is dominated by *Pinus albicaulis*, with *P. balfouriana ssp. austrina, P. contorta var. murrayana,* or *Tsuga mertensiana* important in mixed types. Trees may be either upright at lower elevations, or form dense krummholz stands near treeline. The shrub layer can be sparse or well developed; *Chrysolepis sempervirens, Holodiscus microphyllus, Phyllodoce breweri* and *Vaccinium caespitosum* may be important components, depending on local site characteristics. The herbaceous layer ranges from absent on steeper rocky sites to a moderately dense cover of graminoids or forbs on more mesic sites, where characteristic species may include *Carex exserta, C. rossii, Eriogonum ovalifolium, Juncus parryi, Penstemon davidsonii* and *Trisetum spicatum*. The hydrology is upland. Soils are well-drained sandy loams. (NatureServe October 2006).

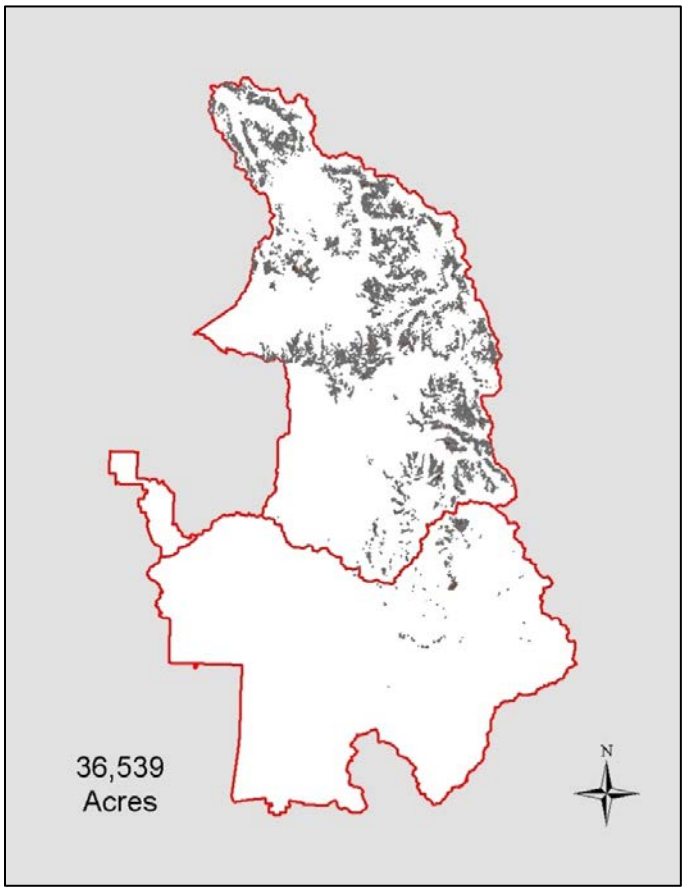


Figure 3140-1. Distribution of Whitebark Pine Woodland.

Accuracy:
Producer's accuracy: 50% (n=4)
User's accuracy: 67% (n=3)

Photo Interpretation Signature:
The signature of *Pinus albicaulis* is variable. It can look dark brown or dark red in color with an irregularly shaped crown that can sometimes look like multiple crowns emanating from a single trunk. It can also appear in a krummholz form where the tree is extremely short and twisted with a spreading crown, sometimes looking like a red or brown colored shrub. *P. albicaulis* tends to have a somewhat lighter colored signature than *P. contorta var. murrayana* and a less rounded crown (Figure 3140-2).

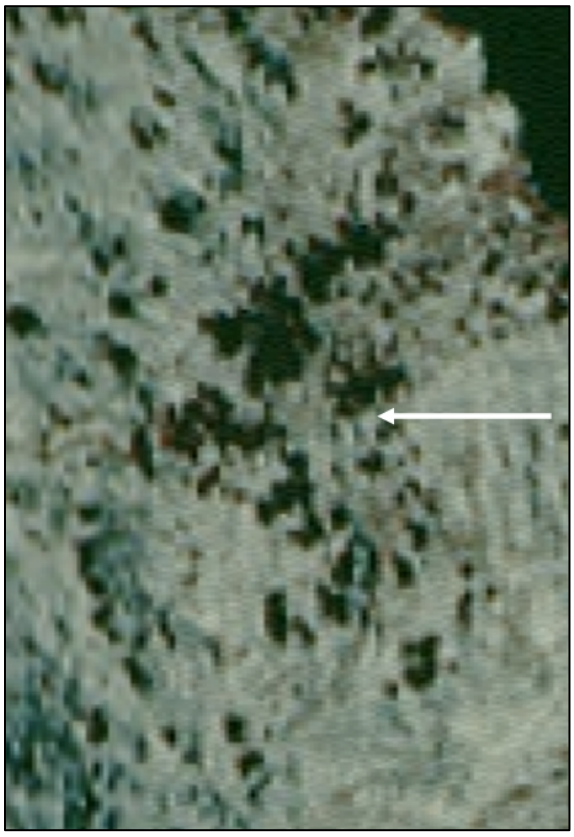


Figure 3140-2. Whitebark Pine Woodland signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – xeric to sub mesic
Elevation – 2501–3841 m (8204–12603 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to very steep
Aspect – See Figure 3140-3.

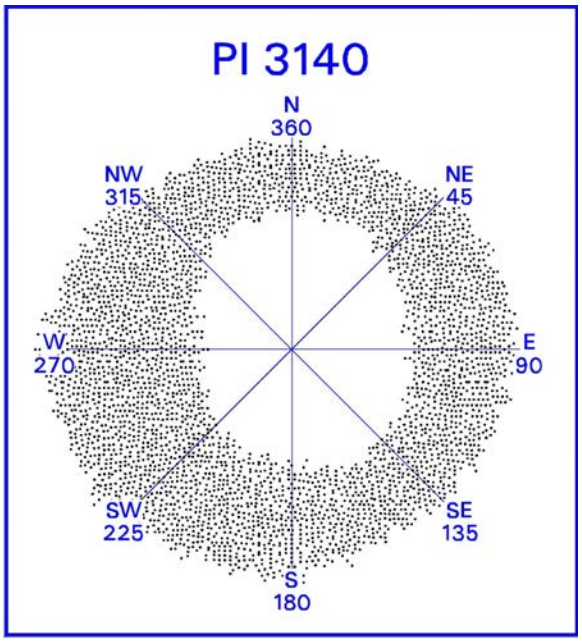


Figure 3140-3. Scatterplot of Whitebark Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Limber Pine Woodland Alliance (3150)
- Foxtail Pine Woodland Alliance (3200)
- Foxtail Pine/Bush Chinquapin Woodland Association (3202)
- Foxtail Pine Woodland Superassociation (3203)
- Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3530)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)

3142 – Whitebark Pine/Davidson's Penstemon Woodland Association
Pinus albicaulis/Penstemon davidsonii Woodland Association

Description:
The *Pinus albicaulis/Penstemon davidsonii* woodland association is mapped on steep slopes of varying aspect between 2697–3841 m (8847–12603 ft), attains the highest elevation of the *Pinus albicaulis* types mapped in Sequoia and Kings Canyon National Parks, and occupies 17,845 acres (Figure 3142-1). The dominant growth form is krummholz, characterized by dense shrub-like mats of *P. albicaulis* with occasional emergent, upright stems. Scattered individuals of stunted *P. contorta var. murrayana* may also be present. *Ribes montigenum* and/or *Artemisia tridentata* may be present in the shrub layer. The herbaceous layer is sparse but may include patches of *Achnatherum occidentale, Carex exserta, C. rossii, Eriogonum ovalifolium, Lupinus lepidus, Juncus drummondii, J. parryi,* and/or *Penstemon davidsonii*. The hydrology is upland. (NatureServe October 2006).

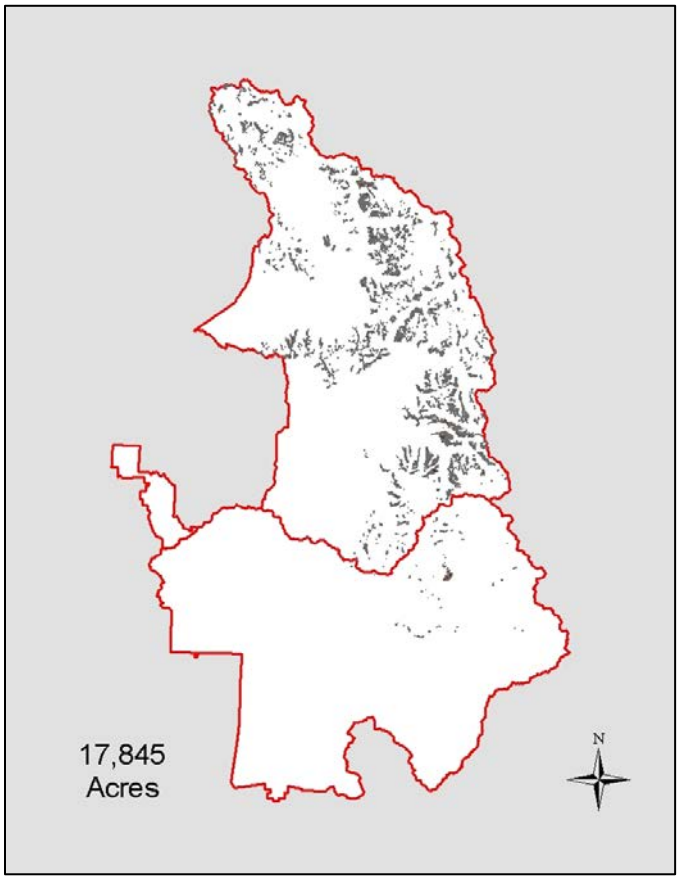


Figure 3142-1. Distribution of Whitebark Pine/Davidson's Penstemon Woodland.

Accuracy:
Producer's accuracy: 98% (n=40)
User's accuracy: 100% (n=39)

Photo Interpretation Signature:

The signature for the *Pinus albicaulis* in this association is typically a krummholz tree. It looks brown with a smooth looking round crown, occurring in sparse clumps in rocky areas (Figure 3142-2). *Penstemon davidsonii* is not discernible on the aerial photo but is referenced as an indicator species in this high elevation association.

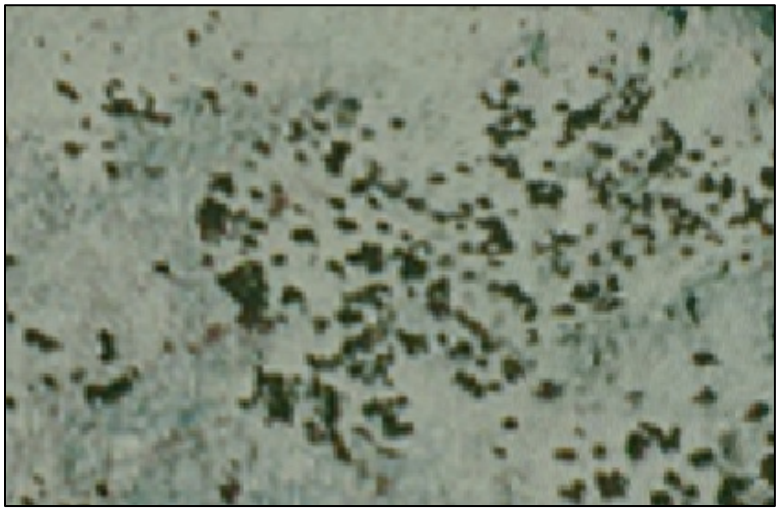


Figure 3142-2. Whitebark Pine/Davidson's Penstemon Woodland signature. Photo reference: MOBR_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2697–3841 m (8847–12603 ft)
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – steep
Aspect – See Figure 3142-3.

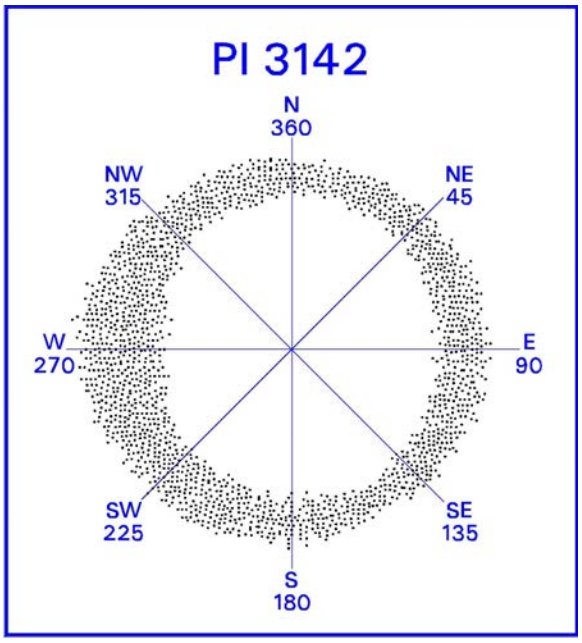


Figure 3142-3. Scatterplot of Whitebark Pine/Davidson's Penstemon Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Whitebark Pine/Shorthair Sedge Woodland Association (3144)
- Foxtail Pine Woodland Superassociation (3203)
- Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland Mapping Unit (3520)
- Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3530)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)

3144 – Whitebark Pine/Shorthair Sedge Woodland Association
Pinus albicaulis/Carex exserta Woodland Association

Description:
The *Pinus albicaulis/Carex exserta* woodland association is mapped on gentle to steep slopes of varying aspect between 2806–3670 m (9205–12040 ft) across 15,461 acres of Sequoia and Kings Canyon National Parks (Figure 3144-1). The tree canopy is dominated by *Pinus albicaulis*, but *P. balfouriana ssp. austrina* and *P. contorta var. murrayana* may also be present. The shrub layer is sparse to absent, with occasional *Holodiscus microphyllus*. The understory is dominated by *Carex exserta (C. filifolia var. erostrata sensu* Hickman 1993), with *Eriogonum ovalifolium, Juncus parryi, Penstemon davidsonii, Phyllodoce breweri*, and/or *Vaccinium caespitosum* often contributing lower amounts of cover. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

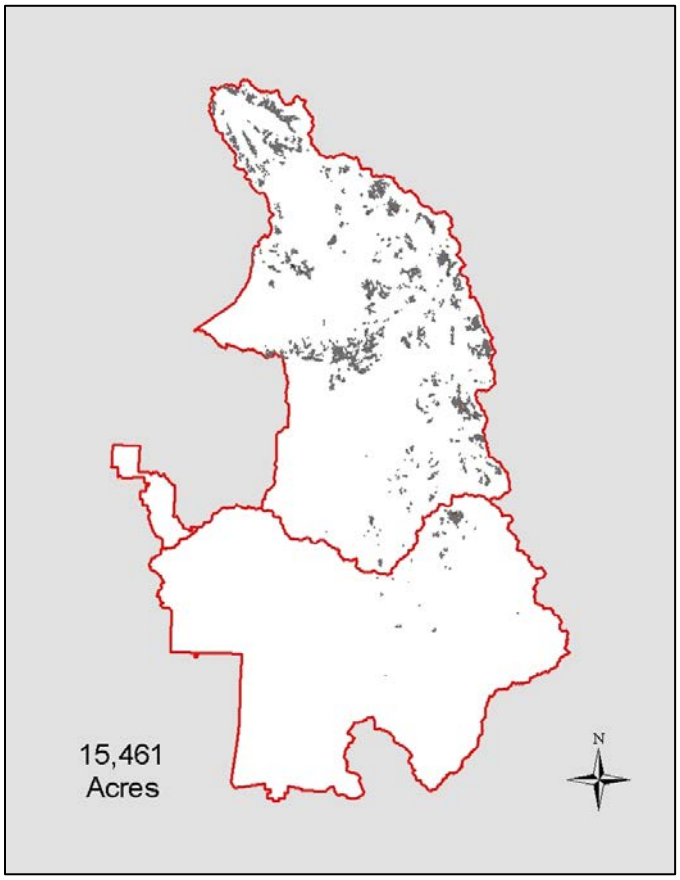


Figure 3144-1. Distribution of Whitebark Pine/Shorthair Sedge Woodland.

Accuracy:
Producer's accuracy: 87% (n=30)
User's accuracy: 81% (n=32)

Photo Interpretation Signature:

Pinus albicaulis typically appears short and occasionally in krummholz form in this association. These small brown trees occur in a sparse density over the moderate to dense pockets of *Carex exserta*, which appear as a cream or tan color in the photo. There are often dry, narrow, linear meadows running through or adjacent to these stands and there is often gray colored scree mixed in with the *C. exserta* (Figure 3144-2).

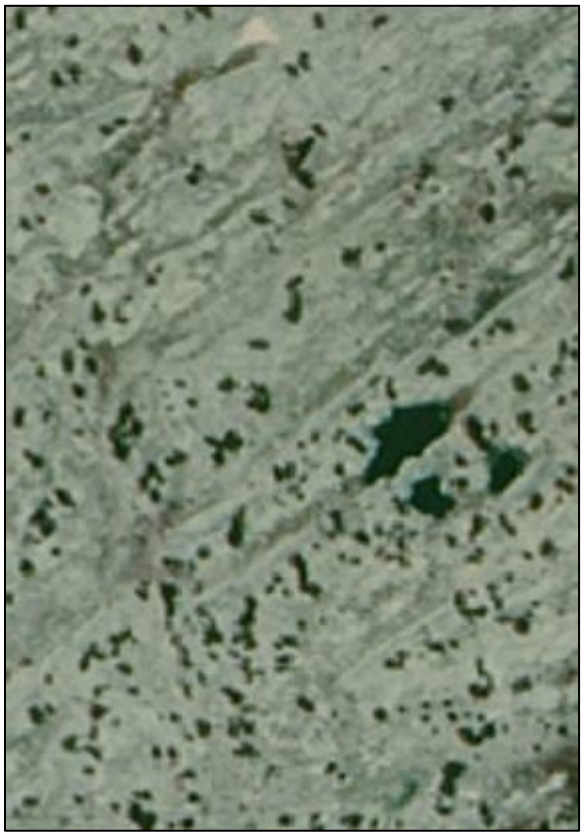


Figure 3144-2. Whitebark Pine/Shorthair Sedge Woodland signature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – xeric to sub xeric
Elevation – 2806–3670 m (9205–12040 ft)
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3144-3.

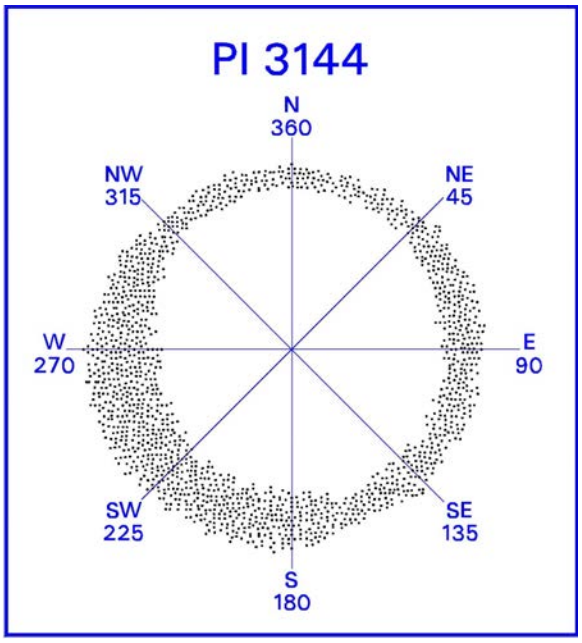


Figure 3144-3. Scatterplot of Whitebark Pine/Shorthair Sedge Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)

3148 – Whitebark Pine–Mountain Hemlock Woodland Association
Pinus albicaulis–Tsuga mertensiana Woodland Association

Description:
The *Pinus albicaulis – Tsuga mertensiana* woodland association is mapped on steep northwest to northeast facing slopes between 2804–3335 m (9198–10940 ft) across 185 acres of Kings Canyon National Park (Figure 3148-1). The tree canopy is dominated by a sparse to moderately dense mixture of *Pinus albicaulis* and *Tsuga mertensiana*, with each species contributing at least 5% cover. The shrub layer commonly includes *Ribes montigenum* and *Salix drummondiana*. The sparse herbaceous layer can be relatively diverse, and commonly includes *Selaginella watsonii, Antennaria rosea, Arabis platysperma, Carex exserta, C. rossii, Cryptogramma acrostichoides, Elymus elymoides, Juncus parryi, Penstemon newberryi, Phlox diffusa, Phyllodoce breweri, Sedum obtusatum, Penstemon newberryi*, and/or *Trisetum spicatum*. The hydrology is upland. (NatureServe October 2006).

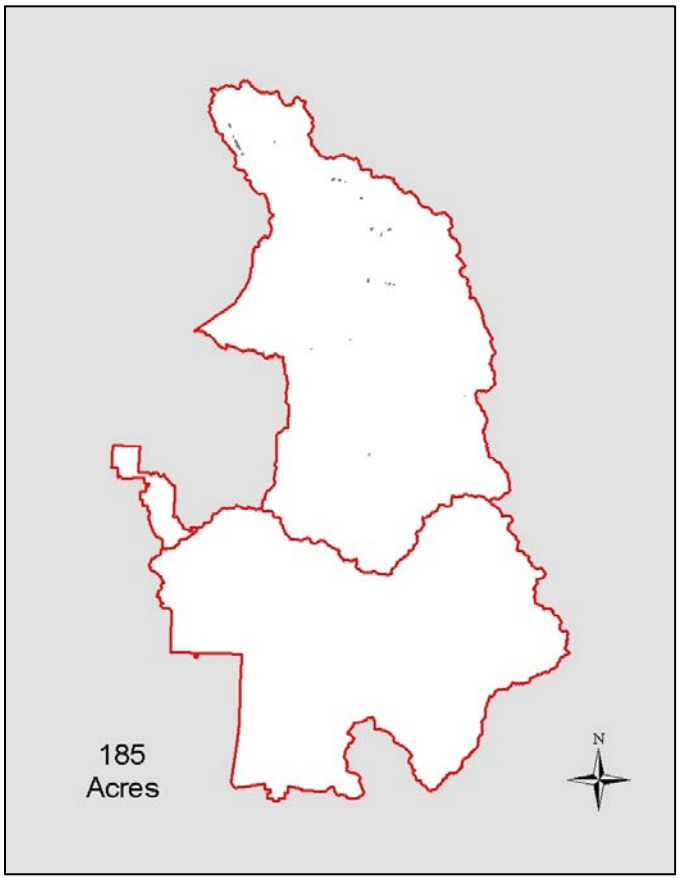


Figure 3148-1. Distribution of Whitebark Pine–Mountain Hemlock Woodland.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:

Most stands noted by photo interpreters contain trees that appear reduced in size, although not technically krummholz in form. Stands are generally very small and distinctions between the two conifers are difficult to establish; *Tsuga mertensiana* generally has narrower crowns and a somewhat darker green signature (Figure 3148-2). Stands are generally mapped in submesic conditions on steep north trending upper slopes.

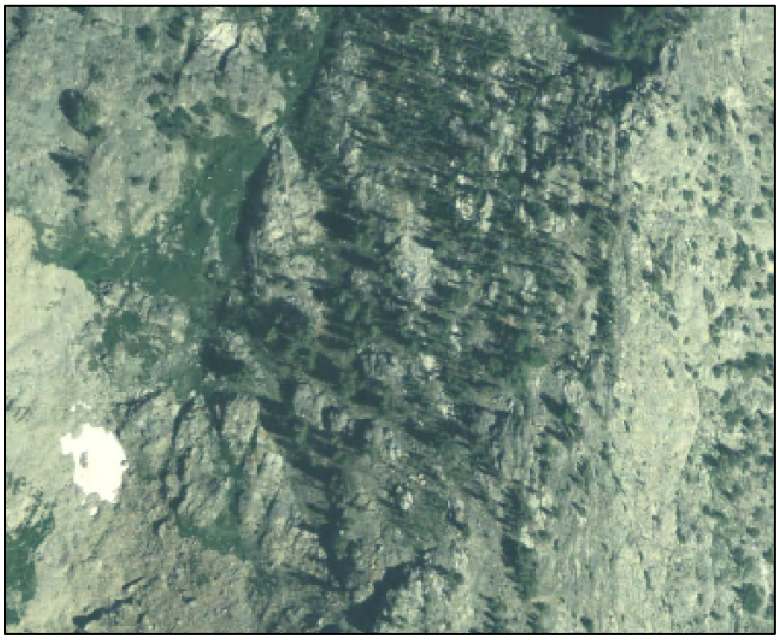


Figure 3148-2. Whitebark Pine–Mountain Hemlock Woodland signature. Photo reference: MOBR_SW.

Environmental Characteristics:

Microclimate – xeric to submesic
Elevation – 2804–3335 m (9198–10940 ft)
Shape – concave to neutral
Slope position – upper slopes
Steepness – steep
Aspect – See Figure 3148-3.

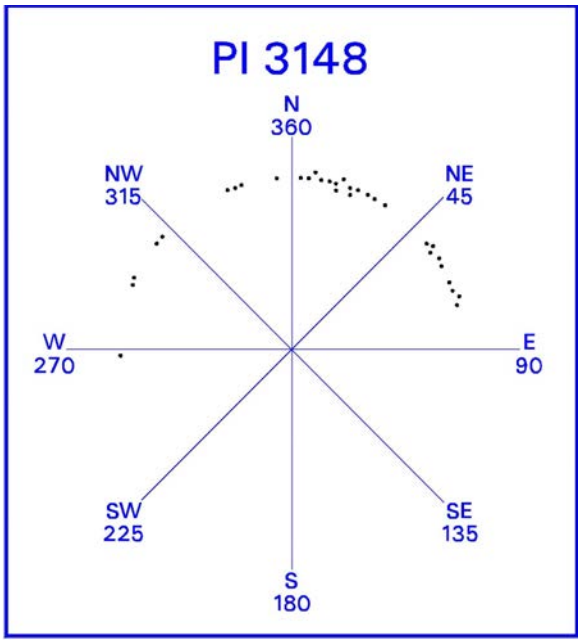


Figure 3148-3. Scatterplot of Whitebark Pine–Mountain Hemlock Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Mountain Hemlock–Western White Pine Forest Association (4033)
- Mountain Hemlock–Sierra Lodgepole Pine Forest Association (4041)
- Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association (4043)

3150 – Limber Pine Woodland Alliance



Limber Pine Woodland. East Lake, Kings Canyon National Park. Photo: Connie Millar.

3150 – Limber Pine Woodland Alliance

Pinus flexilis Woodland Alliance

Description:

The *Pinus flexilis* woodland alliance is mapped on moderate to steep southwest to northeast facing slopes between 2232–3544 m (7324–11628 ft) across 547 acres of Sequoia and Kings Canyon National Parks (Figure 3150-1). The tree canopy of this seldom encountered type is characterized by the presence of *Pinus flexilis*, but may include *Abies concolor, P. albicaulis, P. balfouriana ssp. austrina, P. contorta var. murrayana, P. jeffreyi*, and/or *P. monticola*. In stands near the Kern crest, the canopy is most frequently codominated by *P.balfouriana ssp. austrina*; west of the Kern Canyon, *P. contorta var. murrayana* is more important. The shrub layer commonly contains *Arctostaphylos patula, Artemisia tridentata, Chrysolepis sempervirens,* and/or *Holodiscus microphyllus*.The herbaceous layer is sparse. The hydrology is upland. (NatureServe October 2006).

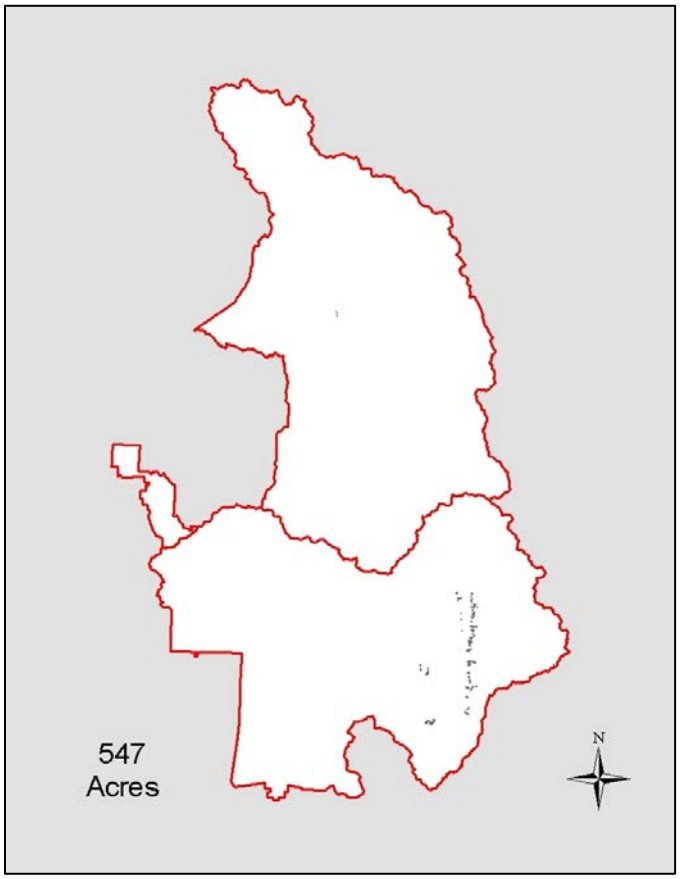


Figure 3150-1. Distribution of Limber Pine Woodland.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
Pinus flexilis is a small to medium sized tree that has an irregularly shaped crown that sometimes looks windswept. It is found in very steep canyons, sometimes over a sparse mixed shrub layer, but usually in rocky environments (Figure 3150-2). Mapped stands are generally small in size.

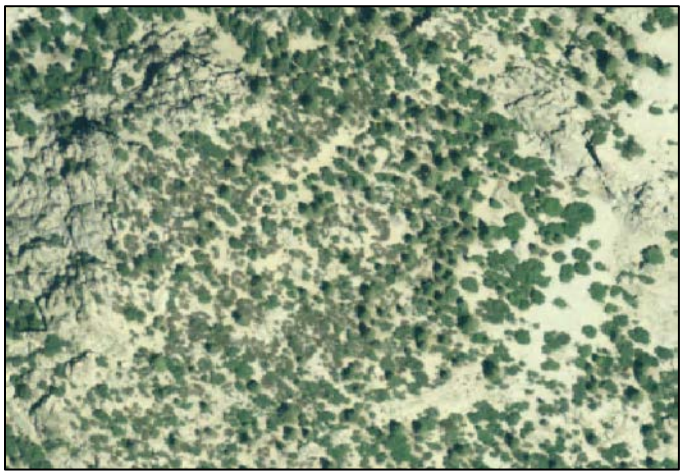


Figure 3150-2. Limber Pine Woodland signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2232–3544 m (7324–11628 ft)
Shape – concave, convex, undulating
Slope position – midslope, ridgetop
Steepness – moderately steep to steep
Aspect – See Figure 3150-3.

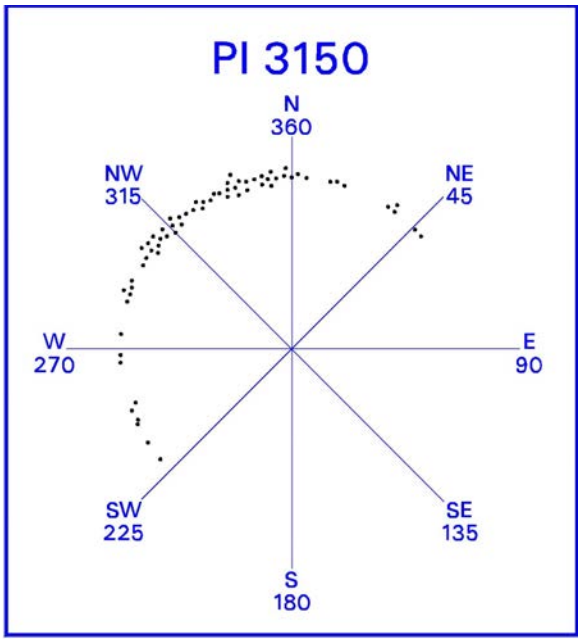


Figure 3150-3. Scatterplot of Limber Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine Woodland Alliance (3130)
- Whitebark Pine Woodland Alliance (3140)
- Foxtail Pine Woodland Alliance (3200)
- Sierra Juniper Woodland Alliance (4100)

3200 – Foxtail Pine Woodland Alliance



Foxtail Pine–Western White Pine Woodland. SEKI-AA.0479_1044.

3200 – Foxtail Pine Woodland Alliance

Pinus balfouriana ssp. *austrina* Woodland Alliance

Description:

The *Pinus balfouriana ssp. austrina* woodland alliance is mapped on gentle to steep subalpine slopes of varying aspect between 2506–3829 m (8223–12561ft) across 33,874 acres of Sequoia and Kings Canyon National Parks (Figure 3200-1). The open tree canopy is dominated by *Pinus balfouriana ssp. austrina*, but may also include *Abies magnifica, Juniperus occidentalis var. australis, P. albicaulis, P. contorta var. murrayana, P. flexilis, P. jeffreyi*, or *P. monticola. P. balfouriana ssp. Austrina* only occasionally forms krummholz stands at high elevations. The shrub layer may be sparse to relatively dense and is most frequently dominated by *Chrysolepis sempervirens*, although *Arctostaphylos nevadensis, A. patula*, or *Holodiscus discolor* are also sometimes important. The herbaceous layer is characteristically sparse to absent but when developed the most frequently encountered associates include *Achnatherum occidentale, Arabis platysperma, Carex exserta, C. rossii, Elymus elymoides, Eriogonum polypodum*, and *Juncus parryi*. The hydrology is upland. (NatureServe October 2006).

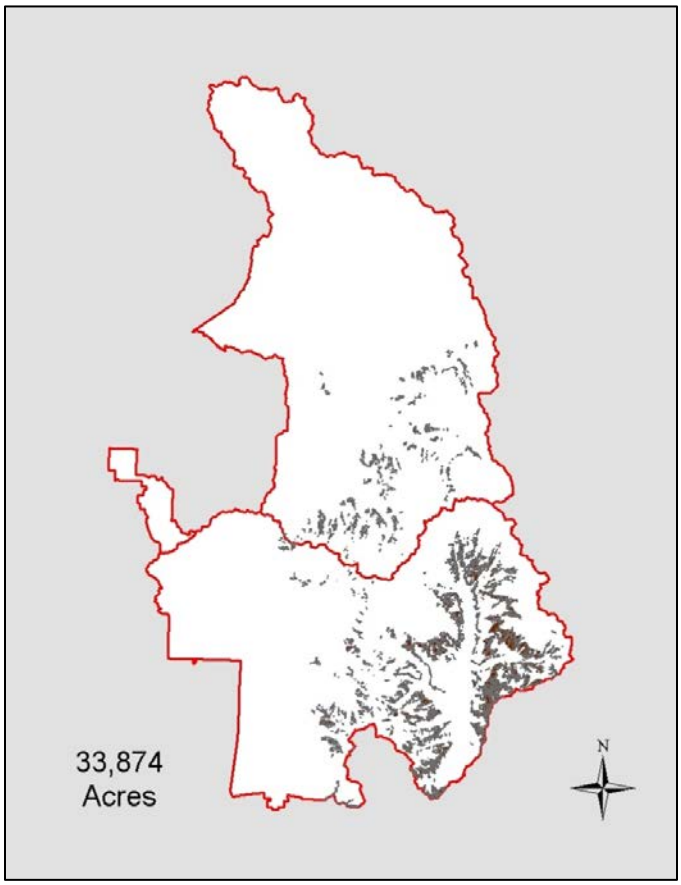


Figure 3200-1. Distribution of Foxtail Pine Woodland.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
Pinus balfouriana ssp. austrina has a highly variable crown shape and size ranging from broad in open pure stands at high elevations to narrow crowns in dense stands especially when sharing dominance with *P. contorta var. murrayana. P. balfouriana ssp. austrina* generally yields a dark red to magenta signature that is usually darker than *P. contorta var. murrayana*, which frequently co-dominates stands at lower elevations (Figure 3200-2). Photo interpreters generally noted *Chrysolepis sempervirens* or *Arctostaphylos nevadensis* as occasional shrub components of south trending lower elevation stands.

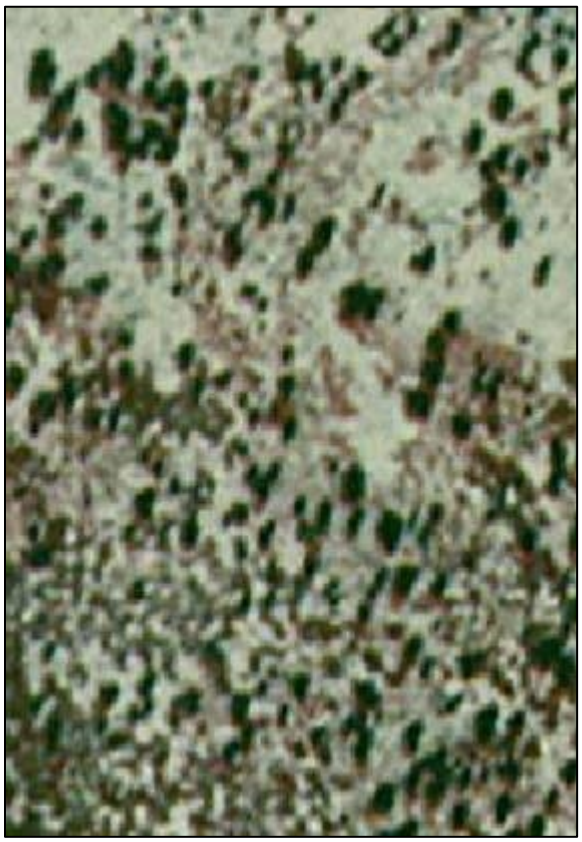


Figure 3200-2. Foxtail Pine Woodland signature. Photo reference: MOKA_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2506–3829 m (8223–12561ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to very steep

Aspect – See Figure 3200-3.

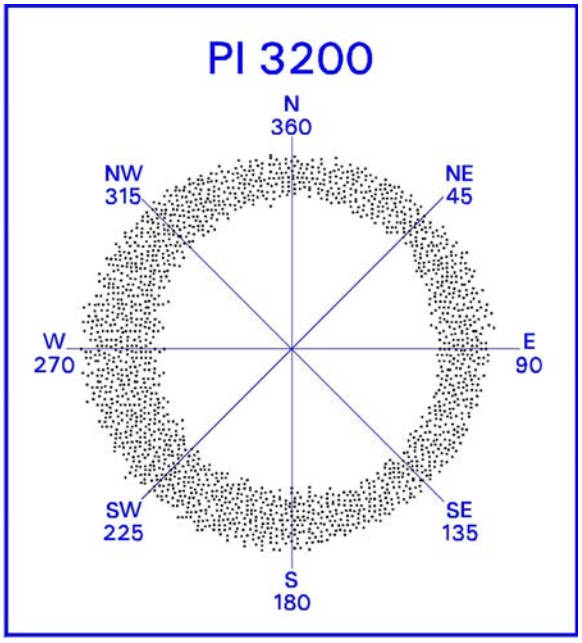


Figure 3200-3. Scatterplot of Foxtail Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine Woodland Alliance (3130)
- Whitebark Pine Woodland Alliance (3140)
- Limber Pine Woodland Alliance (3150)

3202 – Foxtail Pine/Bush Chinquapin Woodland Association
Pinus balfouriana ssp. *austrina/Chrysolepis sempervirens* Woodland Association

Description:
The *Pinus balfouriana ssp. austrina/Chrysolepis sempervirens* woodland association is mapped on relatively steep slopes of primarily south to west facing xeric subalpine slopes between 2679–3521 m (8791–11553 ft) across 4,525 acres of Sequoia and Kings Canyon National Parks (Figure 3202-1). The open tree canopy is dominated by *Pinus balfouriana ssp. austrina*, but may also include *Juniperus occidentalis var. australis, P. contorta var. murrayana, P. jeffreyi, or P. monticola*. The shrub layer is well developed and is characterized by the presence by *Chrysolepis sempervirens*, although *Arctostaphylos nevadensis, Artemisia tridentata*, and *Holodiscus discolor* are also frequently encountered. The herbaceous layer is absent to sparse. The hydrology is upland.

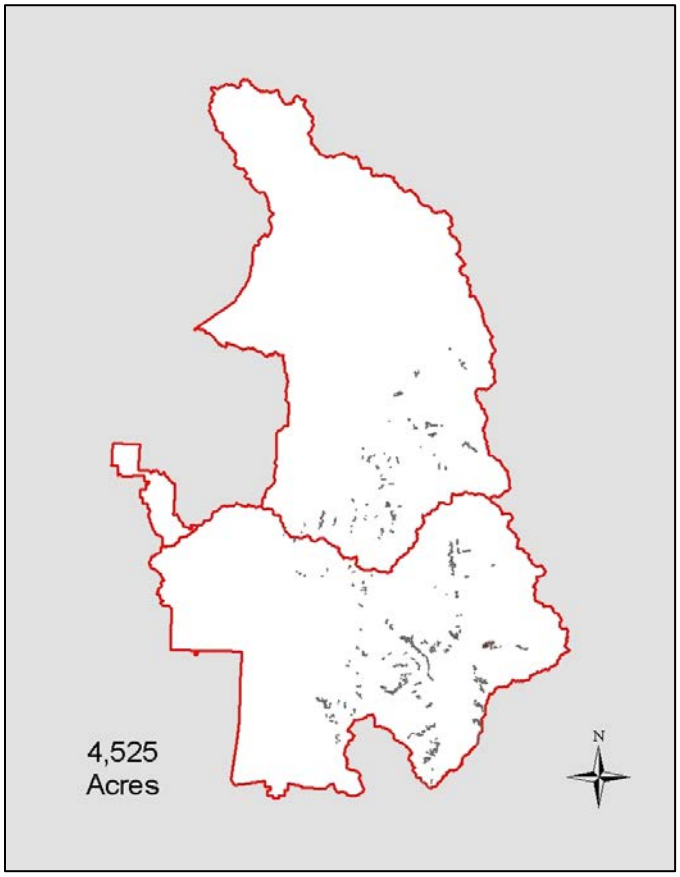


Figure 3202-1. Distribution of Foxtail Pine/Bush Chinquapin Woodland.

Accuracy:
Producer's accuracy: 100% (n=9)
User's accuracy: 90% (n=10)

Photo Interpretation Signature:

Pinus balfouriana ssp. austrina in this xeric setting have a less reflective signature, but individual trees are large and crowns are broad. The shrub understory is bright red when *Chrysolepis sempervirens* dominates and brown when *Arctostaphylos nevadensis* is dominant in the understory.

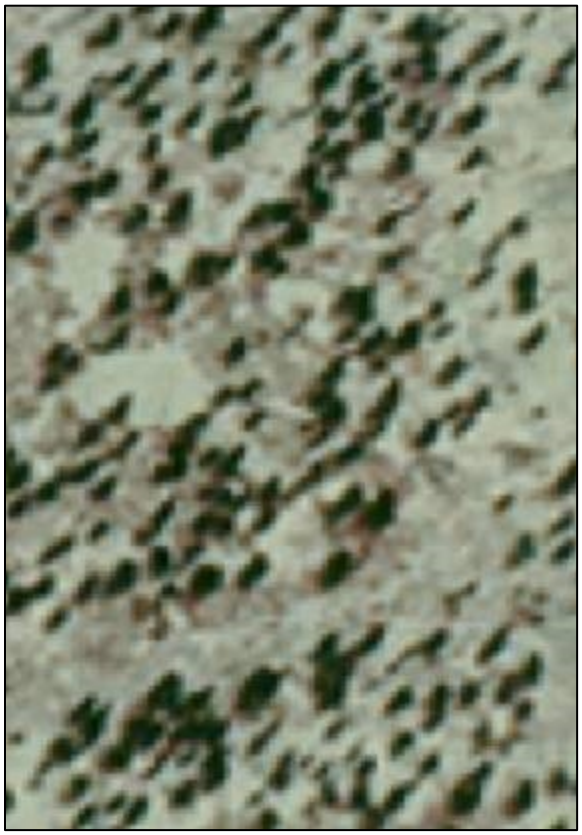


Figure 3202-2. Foxtail Pine/Bush Chinquapin Woodland signature. Photo reference: MOKA_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2679–3521 m (8791–11553 ft)
Shape – primarily convex, but also concave or undulating
Slope position – midslope, high slope
Steepness – somewhat to very steep
Aspect – See Figure 3202-3.

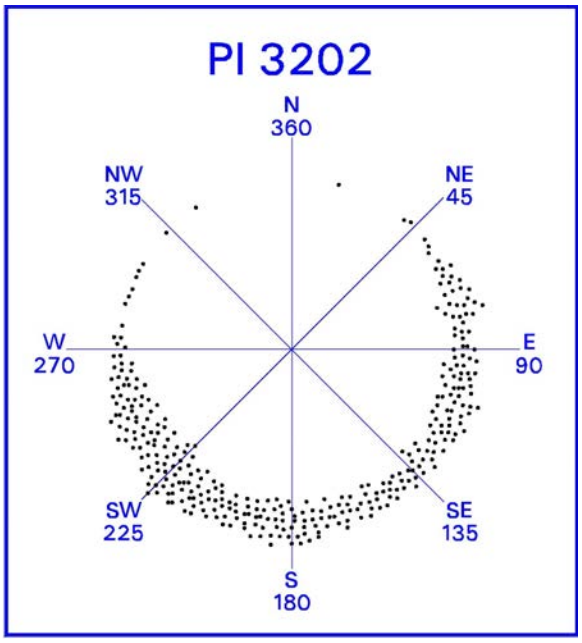


Figure 3202-3. Scatterplot of Foxtail Pine/Bush Chinquapin Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Whitebark Pine Woodland Alliance (3140)
- Foxtail Pine Woodland Superassociation (3203)

3203 – Foxtail Pine Woodland Superassociation

Pinus balfouriana ssp. *austrina* Woodland Superassociation

Description:

The *Pinus balfouriana ssp. austrina* woodland superassociation is mapped on gentle to steep subalpine slopes of varying aspect between 2506–3609 m (8223–11840 ft) across 21,186 acres of Sequoia and Kings Canyon National Parks (Figure 3203-1). The open tree canopy is dominated by *Pinus balfouriana ssp. austrina*, with *Pinus albicaulis, P. contorta var. murrayana*, and/or *P. monticola* contributing low amounts of cover. Shrub cover is generally low, but *Chrysolepis sempervirens, Holodiscus discolor*, and *Phyllodoce breweri* are frequently present. The herbaceous layer is sparse but often includes *Achnatherum occidentale, Arabis platysperma, Carex exserta, C. rossii, Elymus elymoides, Eriogonum polypodum*, and *Juncus parryi*. The hydrology is upland. (NatureServe October 2006).

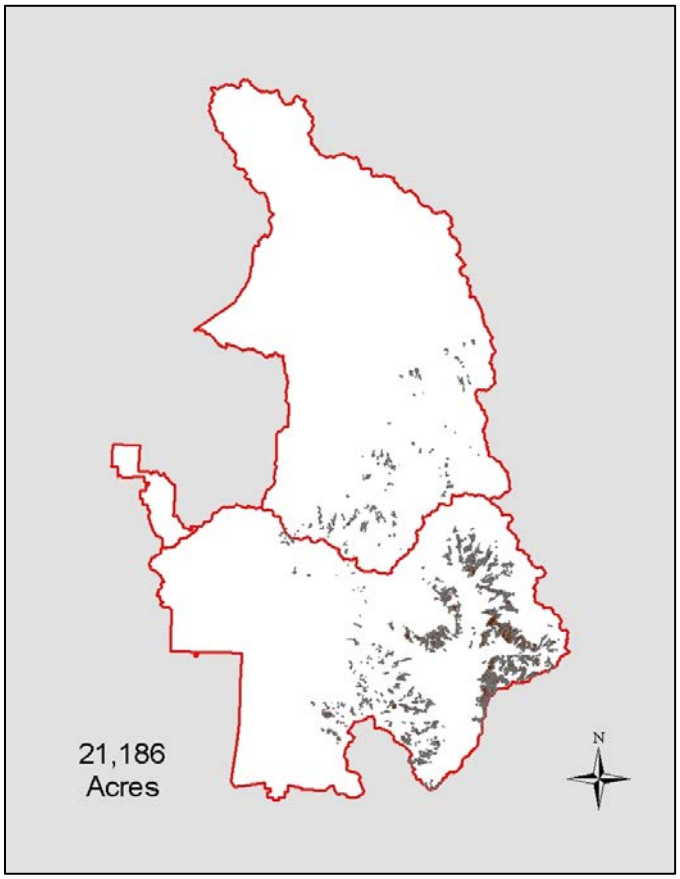


Figure 3203-1. Distribution of Foxtail Pine Woodland Superassociation.

Accuracy:

Producer's accuracy: 85% (n=33)

User's accuracy: 85% (n=33)

Photo Interpretation Signature:

Pinus balfouriana ssp. austrina in nearly pure stands generally have medium to large crowns, even in the highest elevation stands where other conifers are typically much smaller. Stands are rather open with little or no herbaceous understory, yielding a white signature adjacent to the pine woodland.



Figure 3203-2. Foxtail Pine Woodland Superassociation signature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2506–3609 m (8223–11840 ft)
Shape – convex, undulating
Slope position – midslope, high slope, ridgetop
Steepness – gentle to steep
Aspect – See Figure 3203-3.

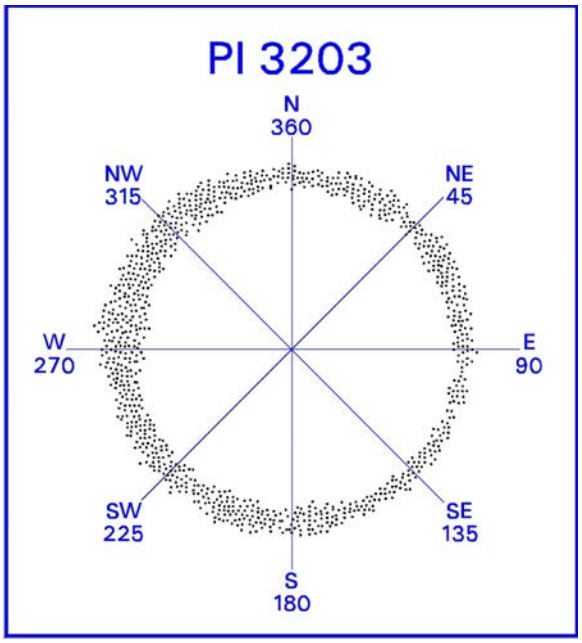


Figure 3202-3. Scatterplot of Foxtail Pine Woodland Superassociation in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine Woodland Alliance (3130)
- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- Foxtail Pine/Bush Chinquapin Woodland Association (3202)
- Foxtail Pine–Western White Pine Woodland Superassociation (3204)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)

3204 – Foxtail Pine–Western White Pine Woodland Superassociation

Pinus balfouriana ssp. *austrina–Pinus monticola* Woodland Superassociation

Description:

The *Pinus balfouriana ssp. austrina–Pinus monticola* woodland superassociation is mapped on moderately steep to steep slopes of varying aspect in the upper montane between 2537–3343 m (8322–10967 ft) across 6,992 acres of Sequoia and Kings Canyon National Parks (Figure 3204-1). The open tree canopy is dominated by a mixture of *Pinus balfouriana ssp. austrina* and *P. monticola*, with *Abies magnifica* and *P. contorta var. murrayana* frequently contributing low to moderate amounts of cover. Shrubs may be absent but can be important, with the shrub layer most frequently dominated by patches of *Chrysolepis sempervirens*. The herbaceous layer may also be sparse to well developed, with *Artemisia norvegica ssp. saxatilis*, *Elymus elymoides*, *Lupinus latifolius var. columbianus*, and *Monardella odoratissima* most frequently characterizing the understory. The hydrology is upland.

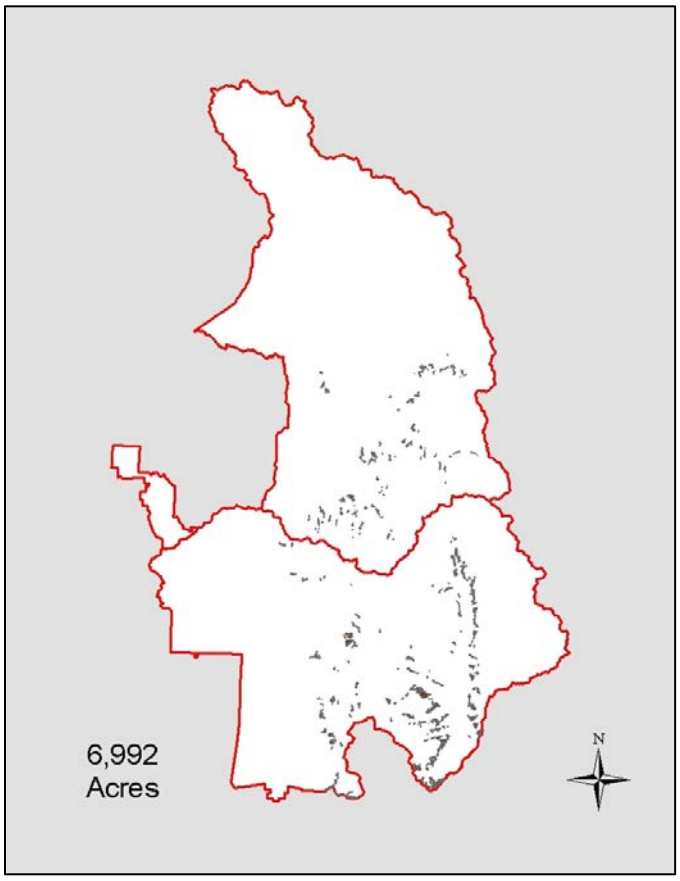


Figure 3204-1. Distribution of Foxtail–Western White Pine Woodland Superassociation.

Accuracy:

Producer's accuracy: 67% (n=18)

User's accuracy: 80% (n=15)

Photo Interpretation Signature:

Pinus monticola generally is lighter in color than the *adjacent P. balfouriana ssp. austrina*; and are usually a bit taller with a less rounded crown. Generally, they are a less common component to the *P. balfouriana ssp. austrina. P. contorta var. murrayana* can be in the canopy and usually has a narrow crown in this type. When *Abies magnifica* is a component of the stand, it is similar in color to the *Pinus monticola* (Figure 3204-2).

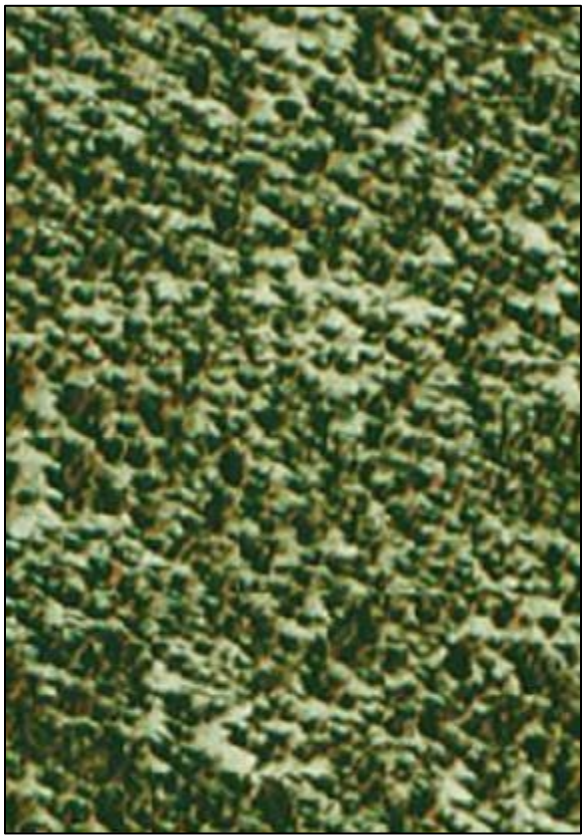


Figure 3204-2. Foxtail Pine–Western White Pine Woodland Superassociation signature. Photo reference: MOKA_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2537–3343 m (8322–10967 ft)
Shape – convex, undulating
Slope position – midslope, high slope, ridgetop
Steepness – moderately steep to steep
Aspect – See Figure 3204-3.

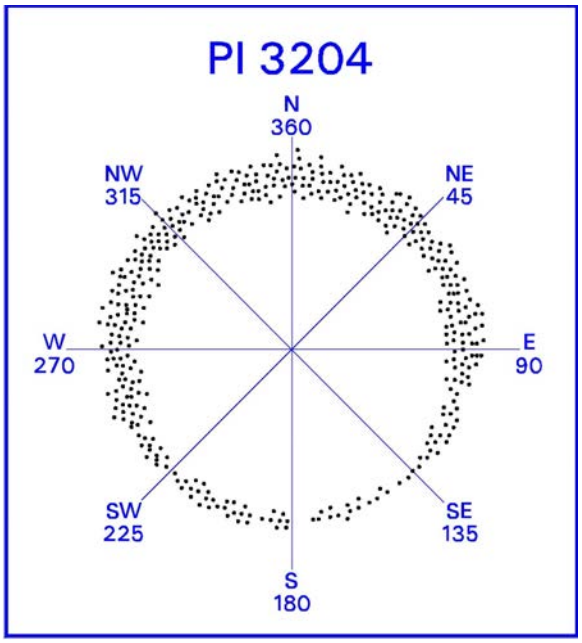


Figure 3204-3. Scatterplot of Foxtail Pine–Western White Pine Woodland Superassociation in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Foxtail Pine Woodland Superassociation (3203)
- California Red Fir–Western White Pine Forest Association (4057)

3205 – Dead Foxtail Pine Mapping Unit

Dead *Pinus balfouriana* ssp. *austrina* Mapping Unit

Description:

The dead *Pinus balfouriana ssp. austrina* mapping unit is mapped on moderate to steep convex subalpine slopes of varying aspect between 3015–3829 m (9893–12561 ft) across 1,024 acres of Sequoia and Kings Canyon National Parks (Figure 3205-1).This mapping unit is most frequently adjacent to living stands of *Pinus balfouriana ssp. austrina*. The open tree canopy is characterized by dead *P. balfouriana ssp. austrina*, and may consist of either standing snags and/or downed logs. The shrub layer is absent, and the herbaceous layer is characteristically sparse. When mapped above the current treeline, these "ghost forests" likely represent a lowering of treeline due to climate change over the last several millennia, with general declines in temperature and possibly increasing moisture. Forest interior sites are more likely to represent foxtail killed by fire over the last couple of hundred years where re-establishment of the forest is occurring slowly; in some cases, such burned stands may occur all the way up to treeline and be confused with climate change (Anthony Caprio, pers. comm., October 2006). The hydrology of this type is upland.



Figure 3205-1. Distribution of Dead Foxtail Pine.

Accuracy:

Producer's accuracy: 100% (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:

Stands of dead *Pinus balfouriana ssp. austrina* are extremely difficult to detect, as the standing trees yield almost no signature adjacent to the talus or scree underneath. Trees are more discernable when down as opposed to erect. Denser stands are more easily recognizable.

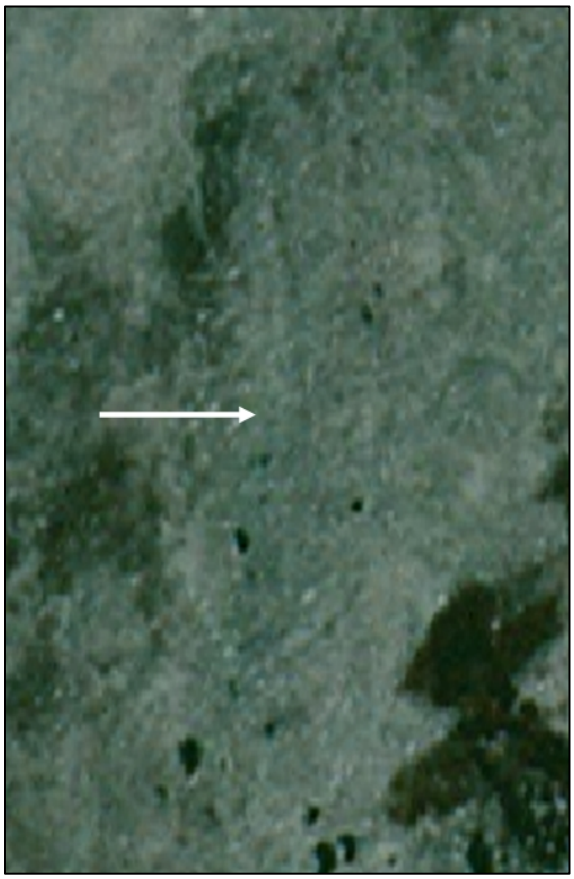


Figure 3205-2. Dead Foxtail Pine signature. Photo reference: MOWI_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 3015–3829 m (9893–12561 ft)
Shape – convex
Slope position – midslope to high slope
Steepness – moderate to steep
Aspect – See Figure 3205-3.

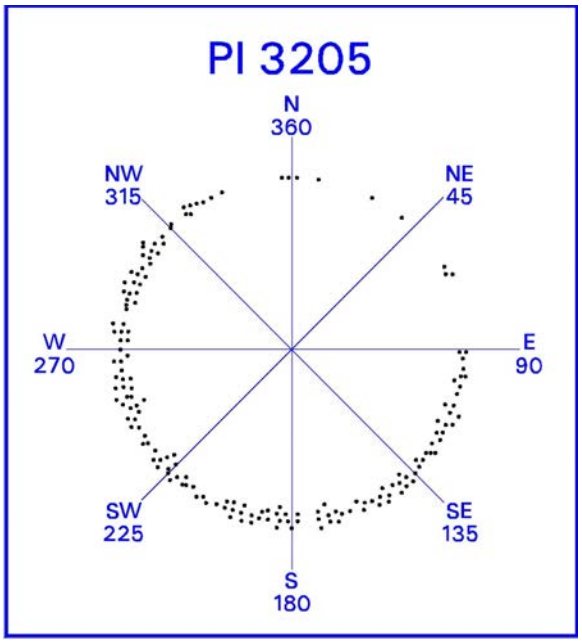


Figure 3205-3. Scatterplot of Dead Foxtail Pine in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Alpine Scree Slope (0200)
- Foxtail Pine Woodland Superassociation (3203)

3520 – (Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland Mapping Unit (*Pinus balfouriana* ssp. *austrina–Pinus contorta* var. *murrayana–Pinus albicaulis*) Krummholz Woodland Mapping Unit

Description:

The *(Pinus balfouriana ssp. austrina–Pinus contorta var. murrayana–Pinus albicaulis)* krummholz woodland mapping unit is mapped on occasionally gentle to more typically very steep rocky subalpine slopes between 3097–3703 m (10162–12148 ft) across 792 acres of Sequoia National Park (Figure 3520-1) . These stands of low-lying, wind pruned krummholz trees over loose sands or talus define the upper edge of the timberline. Because individual species of krummholz cannot be determined from aerial photography, this mapping unit includes stands dominated by a single species and also those that represent mixtures of two pines. North of the Kings-Kern divide, *Pinus albicaulis* and *P. contorta var. murrayana* are the most frequently encountered krummholz pines, while in the headwaters of the Kern River, *P. albicaulis* and *P. balfouriana ssp. austrina* occur in mixture. To the south, *P. contorta var. murrayana* (and less frequently, *P. balfouriana ssp. austrina*) dominate. Shrubs are rare in these stands, and the sparse herbaceous layer is characterized by scattered alpine perennial species. Hydrology is upland.

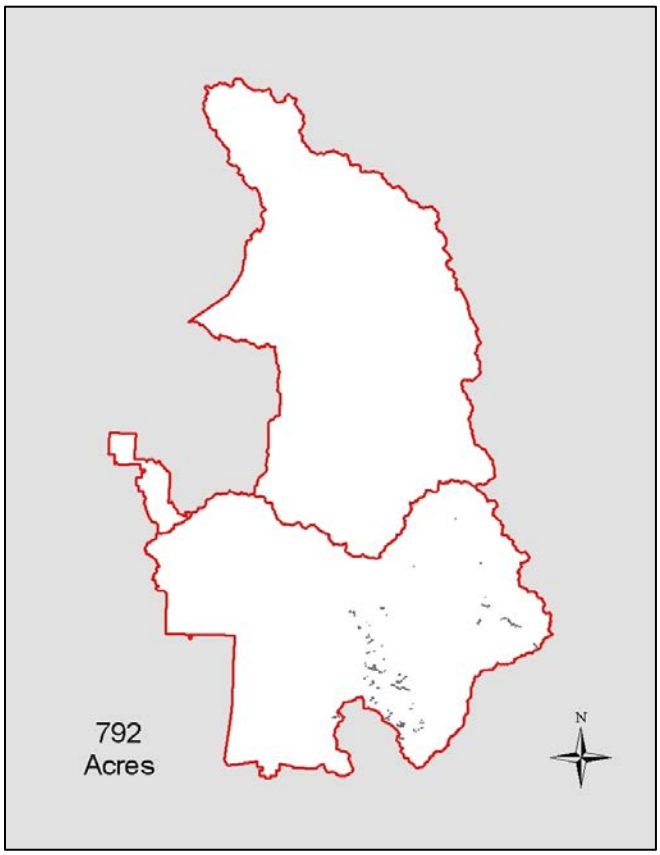


Figure 3520-1. Distribution of (Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland.

Accuracy:

Producer's accuracy: 100% (n=2)
User's accuracy: 100% (n=2)

Photo Interpretation Signature:

The photo interpretation signature is used when photo interpreters cannot reliably separate out conifer types using environmental correlates or color infrared signature (Figure 3520-2).

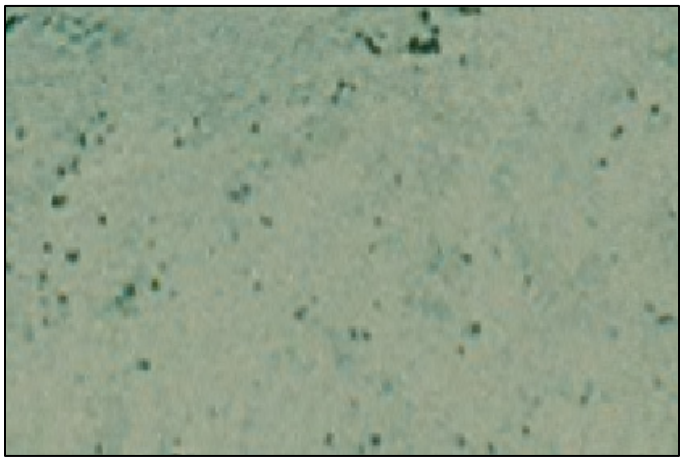


Figure 3520-2. (Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland signature. Photo reference: TDPE_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 3097–3703 m (10162–12148 ft)
Shape –
Slope position – lowslope, midslope, highslope, ridgetop
Steepness – gentle to very steep
Aspect – See Figure 3520-3.

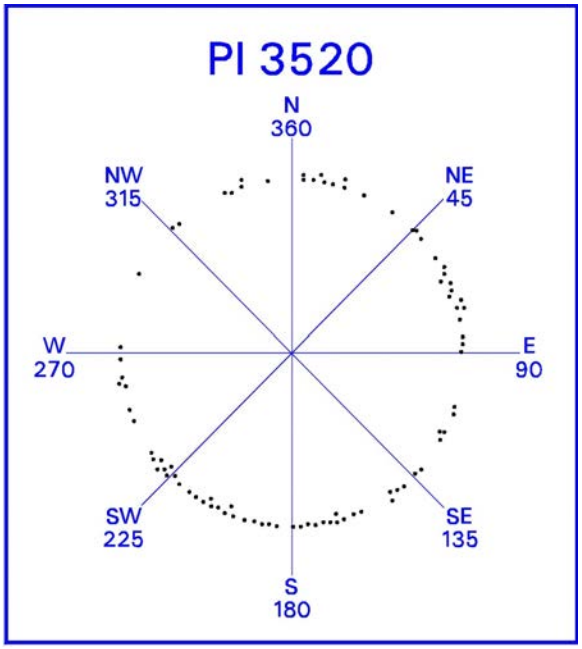


Figure 3520-3. Scatterplot of Limber Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson Penstemon association (3142)
- Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3530)

3530 – Whitebark Pine–Foxtail Pine–Lodgepole Pine Woodland Superalliance

Pinus albicaulis–Pinus balfouriana ssp. *austrina–Pinus contorta* var. *murrayana* Woodland Superalliance

Description:

The *Pinus albicaulis–Pinus balfouriana ssp. austrina–Pinus contorta var. murrayana* superalliance is mapped on moderate to very steep slopes of varying aspect between 2612–3666 m (8568–12029 ft) across 8,892 acres of Sequoia and Kings Canyon National Parks (Figure 3530-1). The open tree canopy is dominated by a mixture of *Pinus albicaulis, Pinus balfouriana ssp. austrina,* and/or *Pinus contorta var. murrayana*. Stands of this type may be dominated by any one of these three tree taxa, depending on local site conditions; the difficulty in distinguishing these from one another on the aerial photography requires the use of this mapping unit. The shrub layer may be sparse or relatively well developed, and may contain *Chrysolepis sempervirens, Holodiscus microphyllus*, and/or *Phyllodoce breweri*. The herbaceous layer may also be sparse or well developed, with *Carex filifolia* most likely to contribute significant cover. They hydrology is upland. Soils are well drained sandy loams.

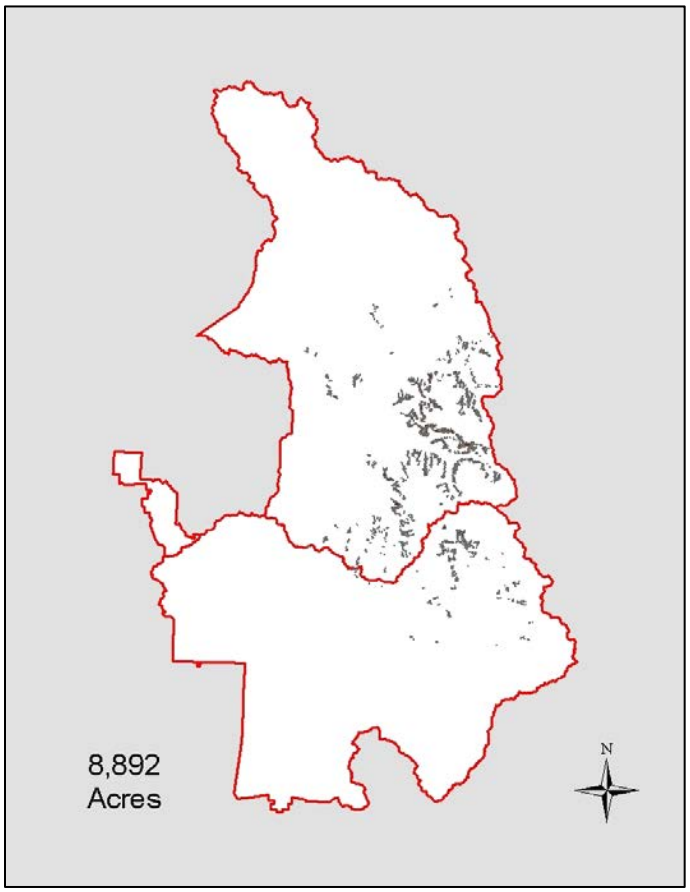


Figure 3530-1. Distribution of Whitebark Pine–Foxtail Pine–Lodgepole Pine Woodland Superalliance.

Accuracy:

Producer's accuracy: 94% (n=32)
User's accuracy: 88% (n=34)

Photo Interpretation Signature:

Mapped when the photo interpreter recognizes both *Pinus albicaulis* and *P. balfouriana ssp. austrina* with or without *P. contorta var. murrayana* in stands where canopies range from sparse to moderate. *P. balfouriana ssp. austrina* are generally much larger than *P. albicaulis* where at these high elevations the *P. albicaulis* often assumes a krummholz form. Colors are often quite similar between the two pines (Figure 3530-2).

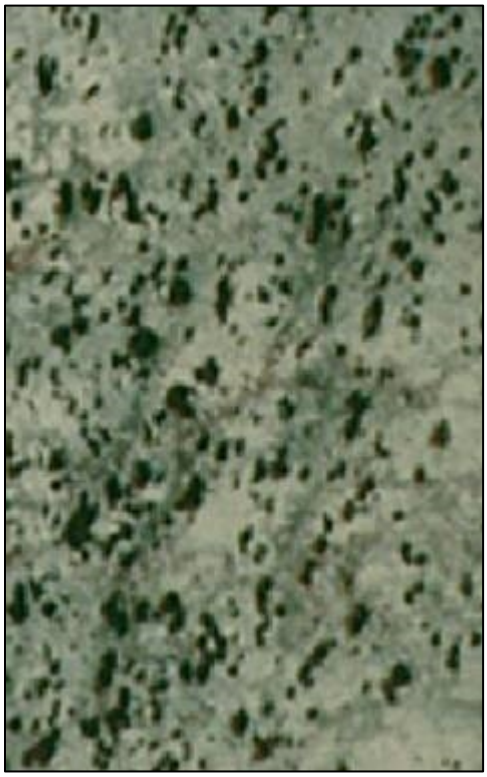


Figure 3530-2. Whitebark Pine–Foxtail Pine–Lodgepole Pine Woodland signature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2612–3666 m (8568–12029 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – moderate to very steep
Aspect – See Figure 3530-3.

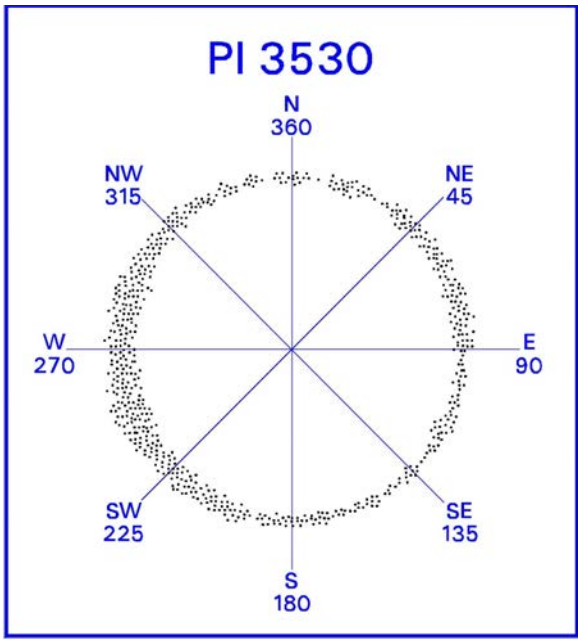


Figure 3530-3. Scatterplot of Whitebark Pine–Foxtail Pine–Lodgepole Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson's Penstemon Woodland Association (3142)
- (Foxtail Pine–Sierra Lodgepole Pine–Whitebark Pine) Krummholz Woodland Mapping Unit (3520)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)

3540 – Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance

Pinus balfouriana ssp. *austrina–Pinus contorta* var. *murrayana* Woodland Superalliance

Description:

The *Pinus balfouriana ssp. austrina–Pinus contorta var. murrayana* superalliance is mapped on gentle to steep subalpine slopes of variable aspects between 2602–3506 m (8536–11502 ft) across 26,593 acres of Sequoia and Kings Canyon National Parks (Figure 3540-1). The open tree canopy is dominated by a variable mixture of *P. balfouriana ssp. austrina* and *P. contorta var. murrayana,* but may also frequently include *Abies magnifica* and/or *P. monticola*. These stands are mapped as a superalliance due to the difficulty of determining which conifer is dominant in any given location. The shrub layer is generally sparse (0–40% absolute cover) but is most frequently dominated by patches of *Chrysolepis sempervirens* or *Phyllodoce breweri*. The characteristically sparse herbaceous layer most often includes *Achnatherum occidentale, Carex exserta, C. rossii*, and *Juncus parryi*. The hydrology is upland.

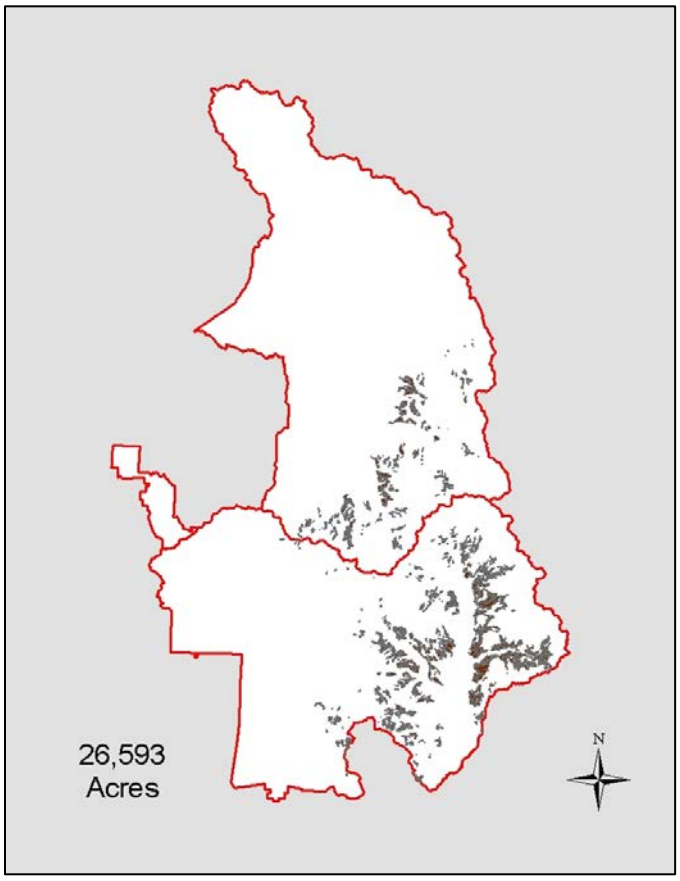


Figure 3540-1. Distribution of Foxtail Pine–Sierra Lodgepole Pine Woodland.

Accuracy:

Producer's accuracy: 82% (n=50)

User's accuracy: 67% (n=61)

Photo Interpretation Signature:

Compared with other foxtail pine associations, this type is generally mapped on better developed soils in less steep and less rocky environments. Stands can be moderately dense. Separating the two species can be nearly impossible, especially at the lower elevation ranges where *Pinus balfouriana ssp. austrina* contributes less than 10% of the coniferous component. Photo interpreters rely on upslope stands of *P. balfouriana ssp. austrina* and downslope *P. contorta var. murrayana* and use a high degree of inference to determine the cut off points between both higher elevation pure stands of *P. balfouriana ssp. austrina* and lower elevation *P. contorta var. murrayana* associations.

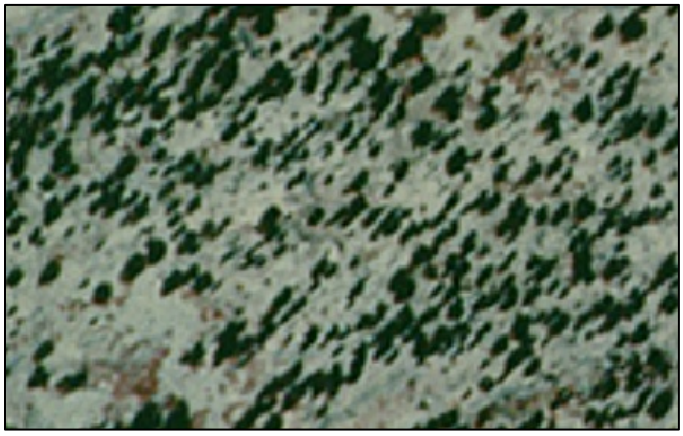


Figure 3540-2. Foxtail Pine–Sierra Lodgepole Pine Woodland sigature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2602–3506 m (8536–11502 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3540-3.

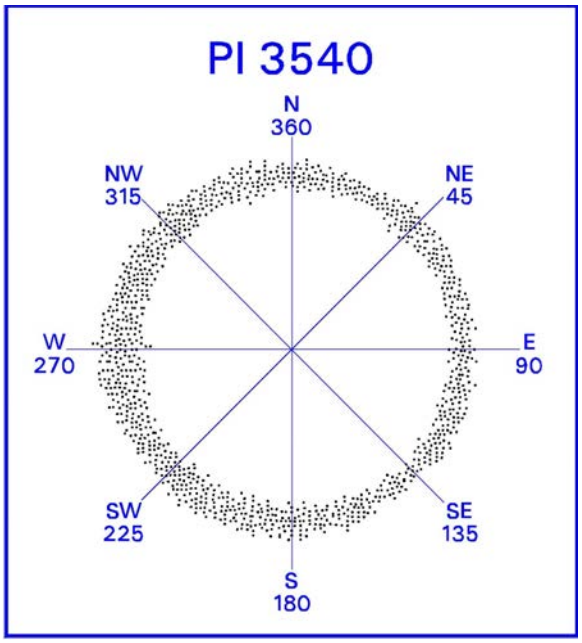


Figure 3540-3. Scatterplot of Foxtail Pine–Sierra Lodgepole Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association (3033)
- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Sierra Lodgepole Pine/Shorthair Sedge Woodland Association (3042)
- Sierra Lodgepole–Whitebark Pine/Shorthair Sedge Forest Association (3043)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Foxtail Pine Woodland Superassociation (3203)
- Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3530)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)

3550 – White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit

Pinus jeffreyi–Abies concolor Woodland & *Abies concolor–Pinus lambertiana–Pinus jeffreyi* Woodland Mapping Unit

Description:

The *Pinus jeffreyi–Abies concolor* woodland & *Abies concolor–Pinus lambertiana–Pinus jeffreyi* forest superalliance is mapped on gentle to steep slopes of varying aspect between 1600–2725 m (5248–8941 ft) across 9,835 acres of Sequoia and Kings Canyon National Parks (Figure 3550-1). The tree canopy can be open or closed, and is dominated by a mixture of *Pinus jeffreyi* and *Abies concolor* with *P. lambertiana* often important. *A.magnifica, Calocedrus decurrens, P. contorta var. murrayana,* and *Quercus kelloggii* may also contribute varying amounts of cover. The shrub layer may be sparse or well developed with *Arctostaphylos patula, Ceanothus cordulatus, Chrysolepis sempervirens, Prunus emarginata*, and *Ribes spp*. most frequently encountered. The herbaceous layer is poorly developed; commonly encountered species include *Apocynum androsaemifolium, Elymus elymoides, Erigeron breweri, Eriogonum nudum,* and *Pteridium aquilinum*. The hydrology is upland. Soils are well drained loamy sand. In the aggregated database, the *Pinus jeffreyi–Abies concolor* woodland & *Abies concolor–Pinus lambertiana–Pinus jeffreyi* forest superalliance is aggregated into the *Pinus jeffreyi* woodland alliance (3070).

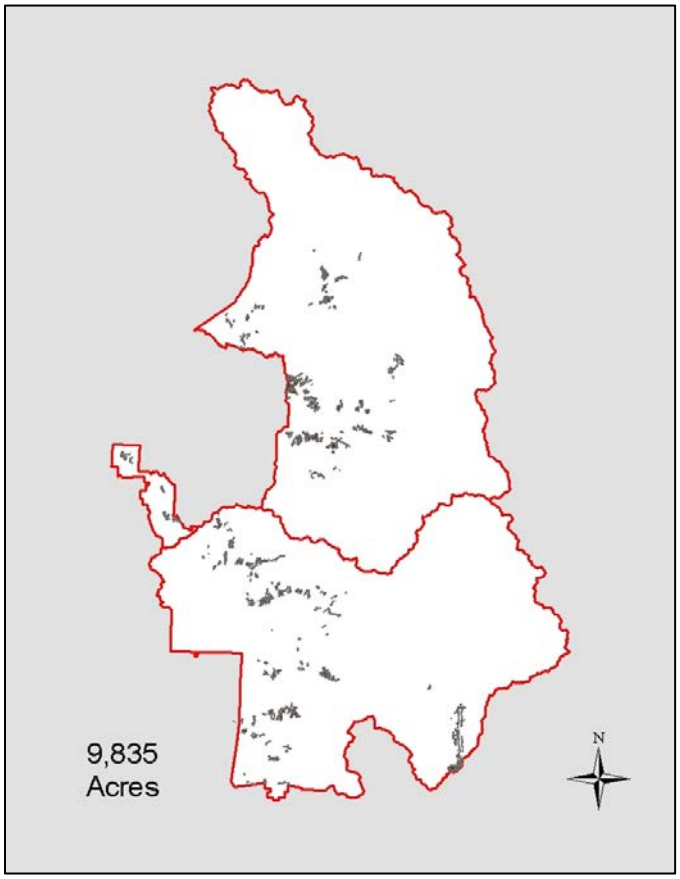


Figure 3550-1. Distribution of White Fir–Jeffrey Pine–(Sugar Pine) Woodland.

Accurary:
Not available

Photo Interpretation Signature:
This woodland is typically a dense stand of trees with few shrubs visible in the understory. The signature for *Pinus jeffreyi* is a pink or light red color with a broad, round crown, while the *Abies concolor* is a dark red color, occasionally with a white top, with narrow conical crowns in the aerial photos. The *P. lambertiana* is pink or red with a large star shaped crown (Figure 3550-2).

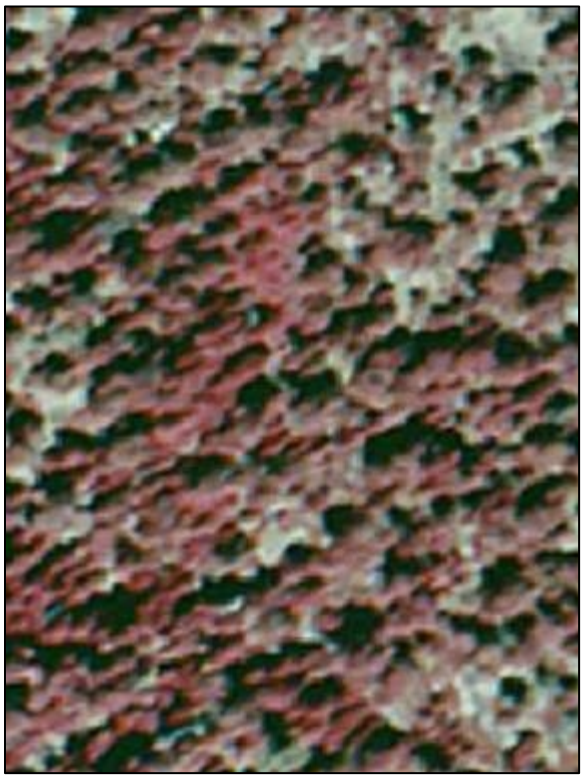


Figure 3550-2. White Fir–Jeffrey Pine–(Sugar Pine) Woodland signature. Photo reference: LODG_SNW.

Environmental Characteristics:
Microclimate – xeric to subxeric
Elevation – 1600–2725 m (5248–8941 ft)
Shape – convex, concave, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 3550-3.

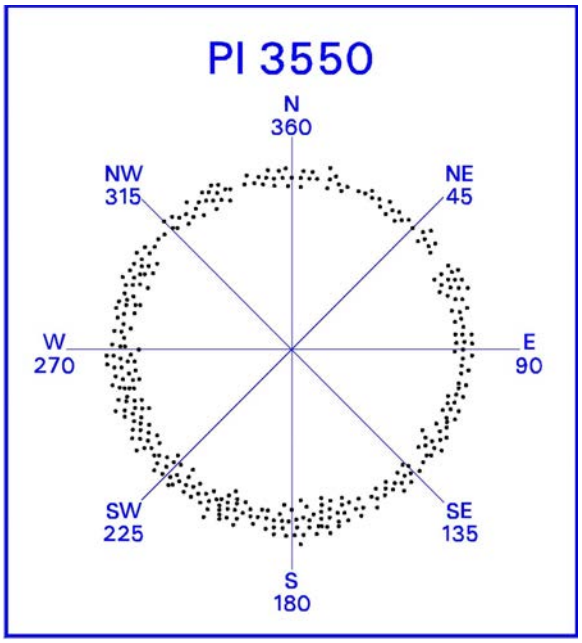


Figure 3550-3. Scatterplot of Whitebark Pine–Foxtail Pine–Lodgepole Pine Woodland in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Woodland Association (3083)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir Forest Mapping Unit (4081)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

4000 – Needleleaf Evergreen Conical-form



Giant Sequoia–Sugar Pine/Pacific Dogwood Forest. SEKI-AA.0282_896.

4020 – Giant Sequoia Forest Alliance



Giant Sequoia Forest, Giant Forest, Sequoia National Park.

4020 – Giant Sequoia Forest Alliance

Sequoiadendron giganteum Forest Alliance

Description:

The *Sequoiadendron giganteum* forest alliance is mapped on gentle to steep slopes of varying aspect between 1371–2426 m (4497–7958 ft) on the western slope of the Great Western Divide across 11,398 acres of Sequoia and Kings Canyon National Parks (Figure 4020-1). The tree canopy is dominated by a mixture of montane conifers, including *Abies concolor, Calocedrus decurrens,* and *Pinus lambertiana*, which provide a matrix within which *Sequoiadendron giganteum* provides an important component. A secondary layer of *Cornus nuttallii* is frequently present. The shrub layer is generally open and contains scattered patches of *Ceanothus integerrimus, Chrysolepis sempervirens, Corylus cornuta var. californica*, and young conifers. The herbaceous layer is generally sparse but can be locally well developed depending on microsite characteristics; it frequently includes *Adenocaulon bicolor, Draperia systyla, Galium spp., Lupinus polyphyllus var. burkei,* and *Pteridium aquilinum.* The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006).

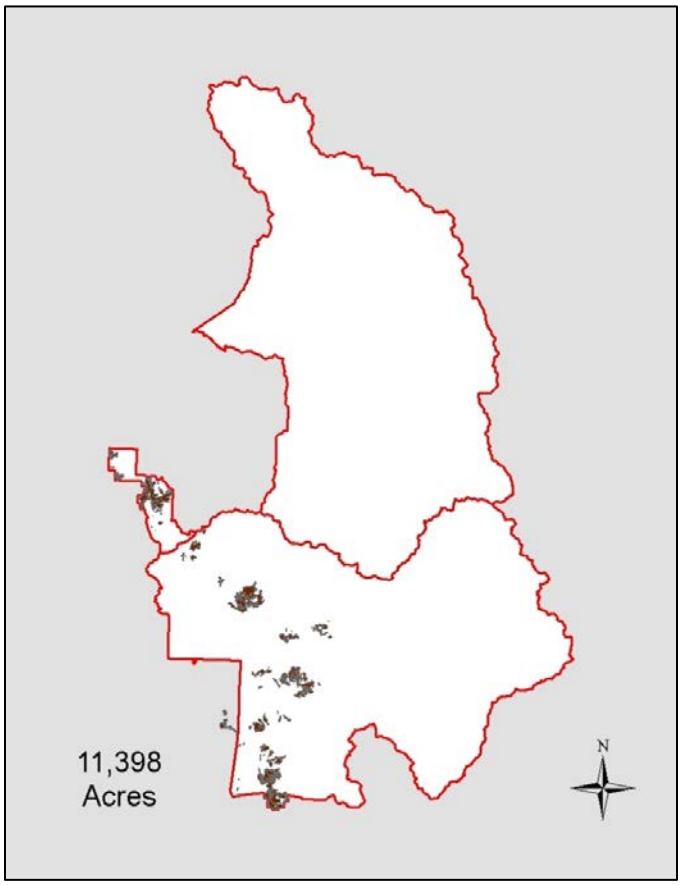


Figure 4020-1. Distribution of Giant Sequoia Forest.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
The signature for *Sequoiadendron giganteum* is slightly variable since it can occur in a variety of settings. The signature is a red irregular shaped tree crown that ranges in density from moderately dense to dense, sometimes with openings in the canopy that reveal post disturbance shrubs or bare ground. Crown sizes are huge and billowy, with vegetative portions extending broadly down the main stem, which is especially evident toward air photo edges (Figure 4020-2).

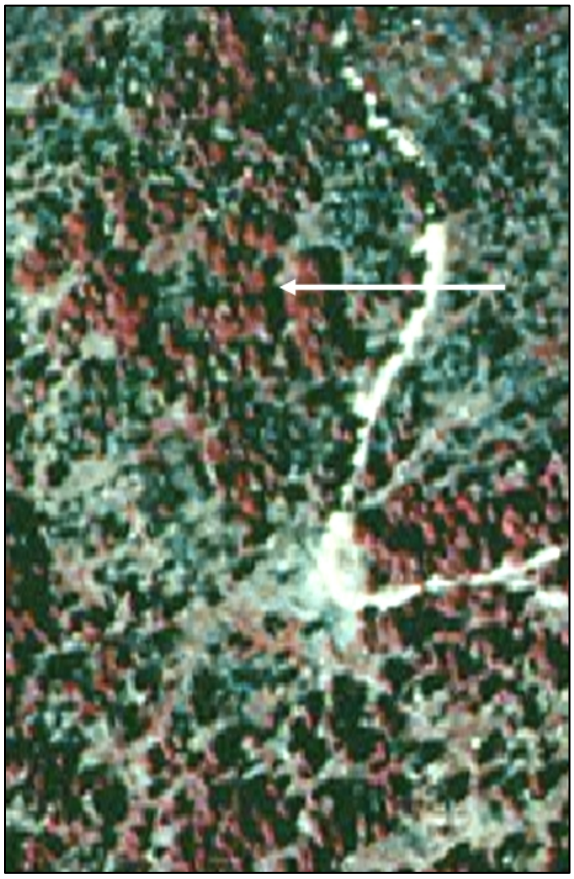


Figure 4020-2. Giant Sequoia Forest signature. Photo reference: CAMO_SE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 1371–2426 m (4497–7958 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 4020-3.

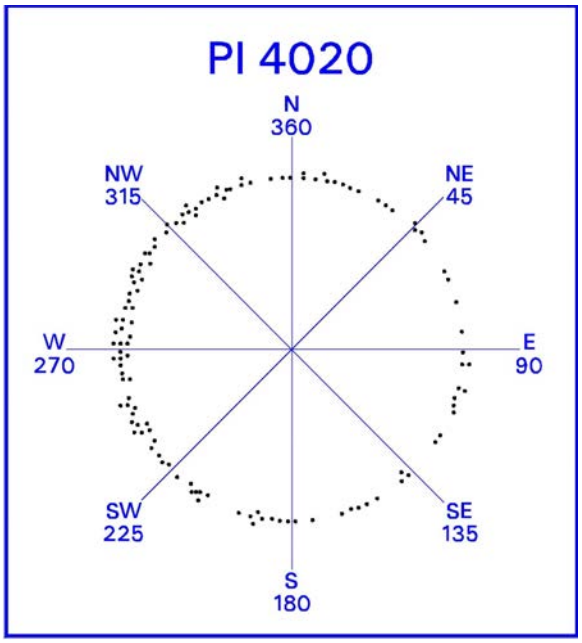


Figure 4020-3. Scatterplot of Giant Sequoia Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association (4021)
- Giant Sequoia–White Fir–California Red Fir Forest Association (4023)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

4021 – Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association

Sequoiadendron giganteum–Pinus lambertiana/Cornus nuttallii Forest Association

Description:

The *Sequoiadendron giganteum–Pinus lambertiana*/*Cornus nuttallii* forest is mapped on gentle to steep montane slopes of varying aspect between 1371–2426 m (4497–7958 ft) across 9,554 acres of Sequoia and Kings Canyon National Parks (Figure 4021-1). The tree canopy is dominated by a mixture of *Abies concolor, Calocedrus decurrens, Pinus lambertiana*, and *Sequoiadendron giganteum*, frequently with a patchy subcanopy of *Cornus nuttallii*. The shrub layer is generally open and contains scattered patches of *Ceanothus integerrimus, Chrysolepis sempervirens, Corylus cornuta var. californica*, and young conifers. The herbaceous layer is characteristically sparse but can be locally well developed depending on microsite characteristics; it frequently includes *Adenocaulon bicolor, Draperia systyla, Galium spp., Lupinus polyphyllus var. burkei*, and *Pteridium aquilinum*. The hydrology is upland. (NatureServe October 2006)

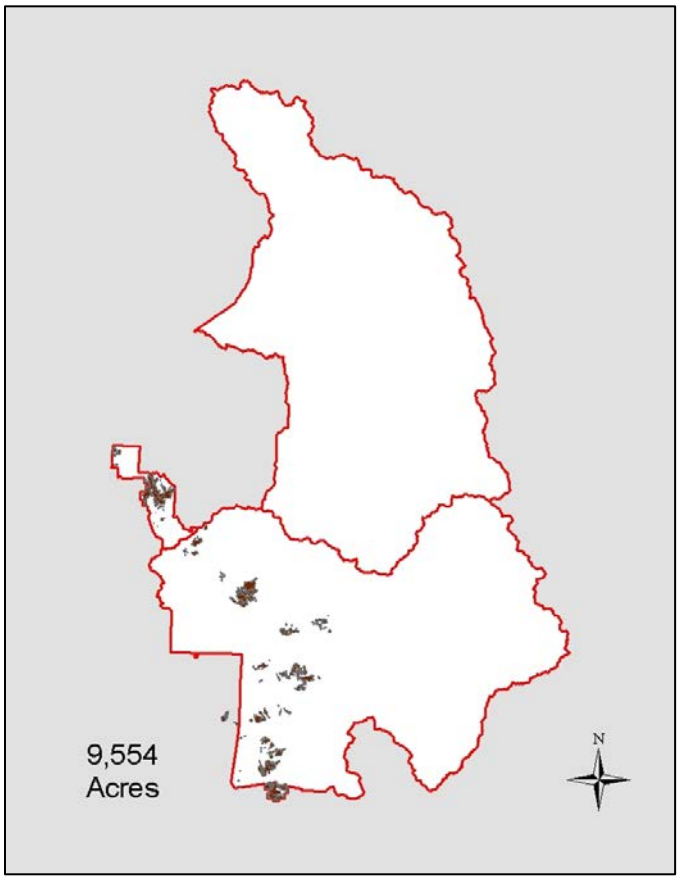


Figure 4021-1. Distribution of Giant Sequoia–Sugar Pine/Pacific Dogwood Forest.

Accuracy:

Producer's accuracy: 86% (n=7)

User's accuracy: 100% (n=6)

Photo Interpretation Signature:

In this association, the photo signature for *Sequoiadendron giganteum* is a very large tree with a dark red to orange irregular billowy shaped crown, and the *Pinus lambertiana* signature looks like a smaller pink or red tree with a large star shaped crown. *Abies concolor* sometimes makes up a minor component and has a narrow, red, conical. *Cornus nuttallii* is not always present in this forest type and is not distinct on the aerial photo unless noted in forest openings. Stands are generally dense with very few openings in the canopy (Figure 4021-2).

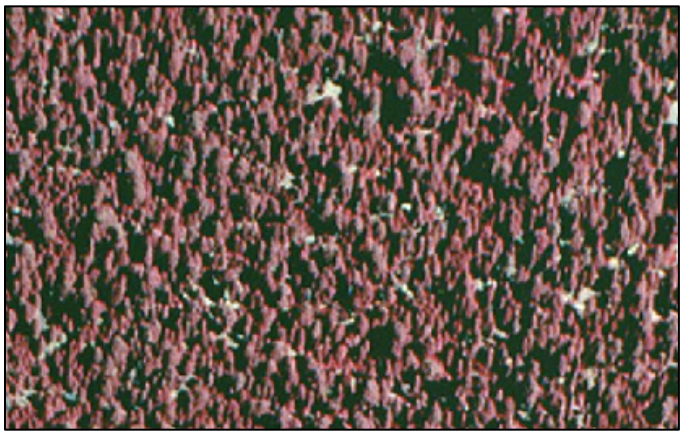


Figure 4021-2. Giant Sequoia–Sugar Pine/Pacific Dogwood Forest signature. Photo reference: GIFO_SE.

Environmental Characteristics:

Microclimate – submesic
Elevation – 1371–2426 m (4497–7958 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope
Steepness – gentle to steep
Aspect – See Figure 4021-3.

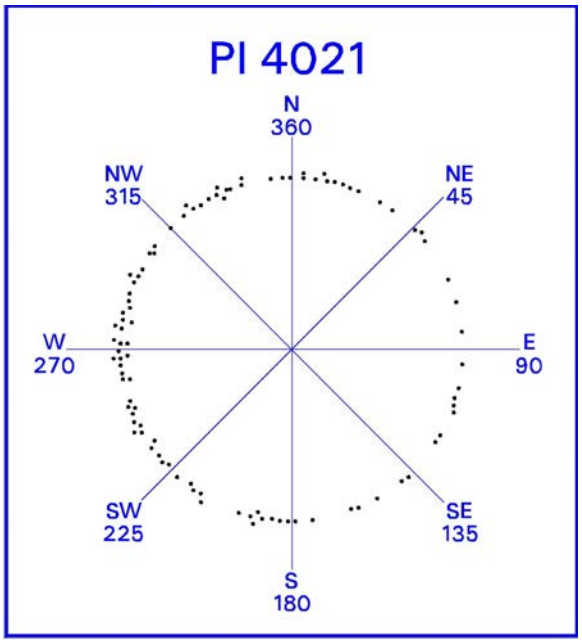


Figure 4021-3. Scatterplot of Giant Sequoia–Sugar Pine/Pacific Dogwood Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Giant Sequoia Forest Alliance (4020)
- Giant Sequoia–White Fir–California Red Fir Forest Association (4023)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

4023 – Giant Sequoia–White Fir–California Red Fir Forest Association

Sequoiadendron giganteum–Abies concolor–Abies magnifica Forest Association

Description:

The *Sequoiadendron giganteum–Abies concolor–Abies magnifica* forest is mapped on moderately steep to steep south to southwest facing slopes between 1900–2576 m (6232–8450 ft) across 1,489 acres of Sequoia and Kings Canyon National Parks (Figure 4023-1). This forest type represents the highest elevation expression of the *Sequoiadendron giganteum* forest alliance. The tree canopy is dominated by a mixture of *Abies concolor, A. magnifica,* and *Sequoiadendron giganteum*. The shrub layer is generally sparse, but may contain patches of *Chrysolepis sempervirens, Corylus cornuta var. californica*, and/or *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to well developed; the most frequently encountered species include *Galium sparsiflorum, Lupinus polyphyllus var. burkei, Osmorhiza brachypoda*, and *Pteridium aquilinum*. The hydrology is upland.

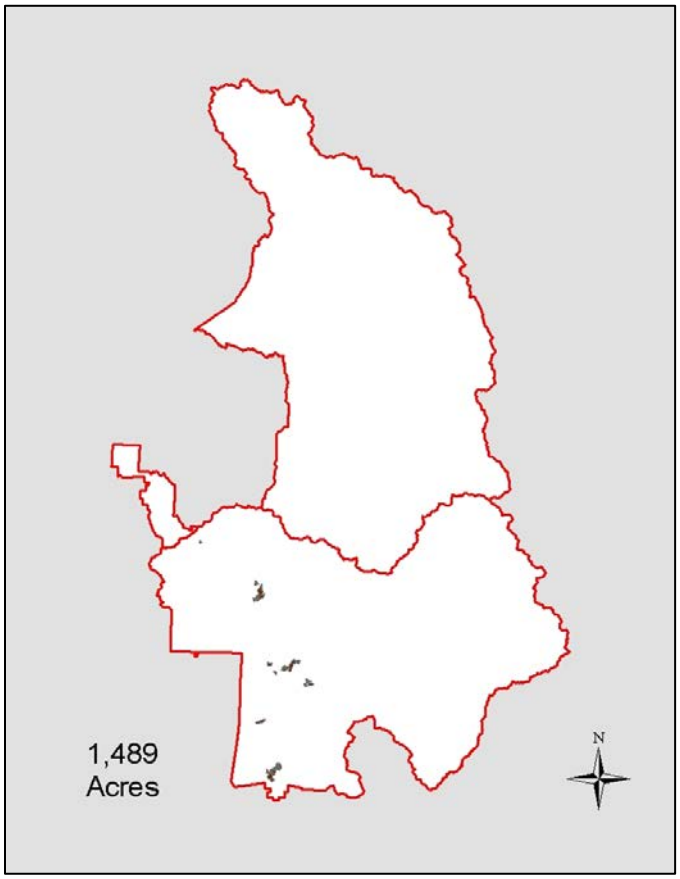


Figure 4023-1. Distribution of Giant Sequoia–White Fir–Red Fir Forest.

Accuracy:

Producer's accuracy: 100% (n=2)

User's accuracy: 100% (n=2)

Photo Interpretation Signature:

The *Sequoiadendron giganteum* photo signature is a typically large tree with a dark red, irregularly shaped crown. *Abies magnifica* is a red or dark red color with a large, broad, conical crown, and *A. concolor* has a red signature that looks like a skinny tree with a narrow conical crown (Figure 4023-2). Stands are generally dense with very few openings in the canopy. There is little or no presence of *Pinus lambertiana* in this forest type and *A. magnifica* often dominates the canopy.

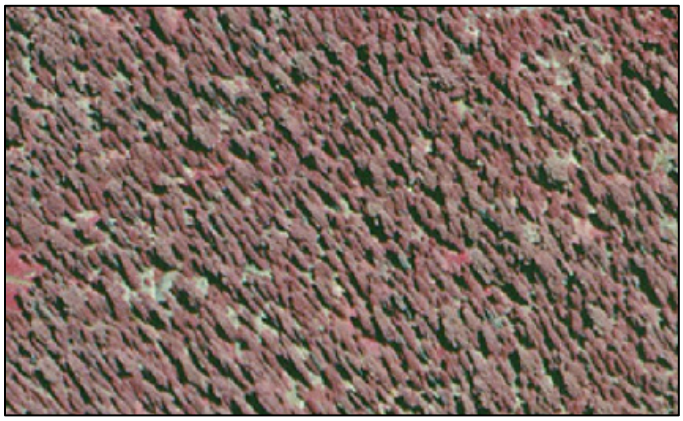


Figure 4023-2. Giant Sequoia–White Fir–Red Fir Forest signature. Photo reference: LODG_SW.

Environmental Characteristics:

Microclimate – submesic
Elevation – 1900–2576 m (6232–8450 ft)
Shape – convex
Slope position – midslope, high slope
Steepness – moderately steep to steep
Aspect – See Figure 4023-3.

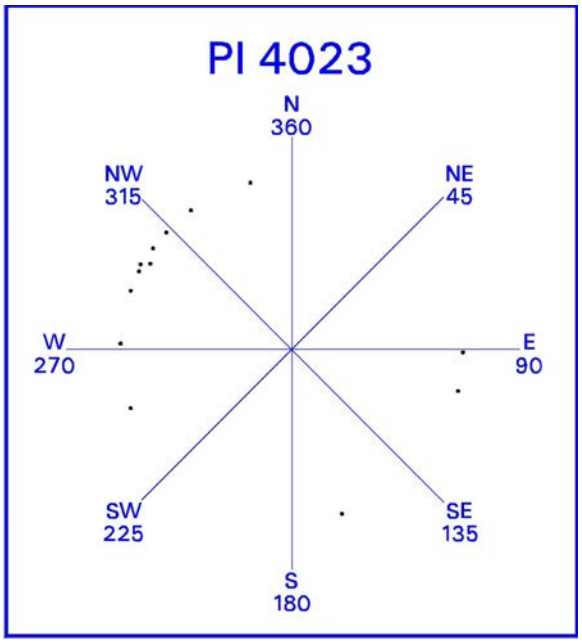


Figure 4023-3. Scatterplot of Giant Sequoia–White Fir–Red Fir Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Giant Sequoia Forest Alliance (4020)
- Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association (4021)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

4030 – Mountain Hemlock Forest Alliance



Mountain Hemlock Forest. SEKI.0258_367.

4030 – Mountain Hemlock Forest Alliance

Tsuga mertensiana Forest Alliance

Description:

The *Tsuga mertensiana* forest alliance is mapped on moderately steep to steep north to northeast facing slopes between 2535–3302 m (8317–10832 ft) across 1,387 acres of Sequoia and Kings Canyon National Parks (Figure 4030-1). The open, sometimes stunted tree canopy is dominated by *Tsuga mertensiana*, but may also have significant amounts of *Pinus contorta var. murrayana* and/or *P. monticola*. Low amounts of *Abies magnifica* or *P. albicaulis* may also be present. The shrub layer is well developed and contains a mesic understory of *Cassiope mertensiana, Ledum glandulosum, Phyllodoce breweri*, and *Ribes velutinum*. The herbaceous layer can be sparse or dense, and most frequently includes *Antennaria spp., Aquilegia formosa, Arabis platysperma, Aster breweri, Cryptogramma acrostichoides, Epilobium angustifolium ssp. circumvagum, Heuchera micrantha, Orthilia secunda,* and/or *Selaginella watsonii*. The hydrology is upland. Soils are well drained sandy loams to moderately well drained loams. (NatureServe October 2006).

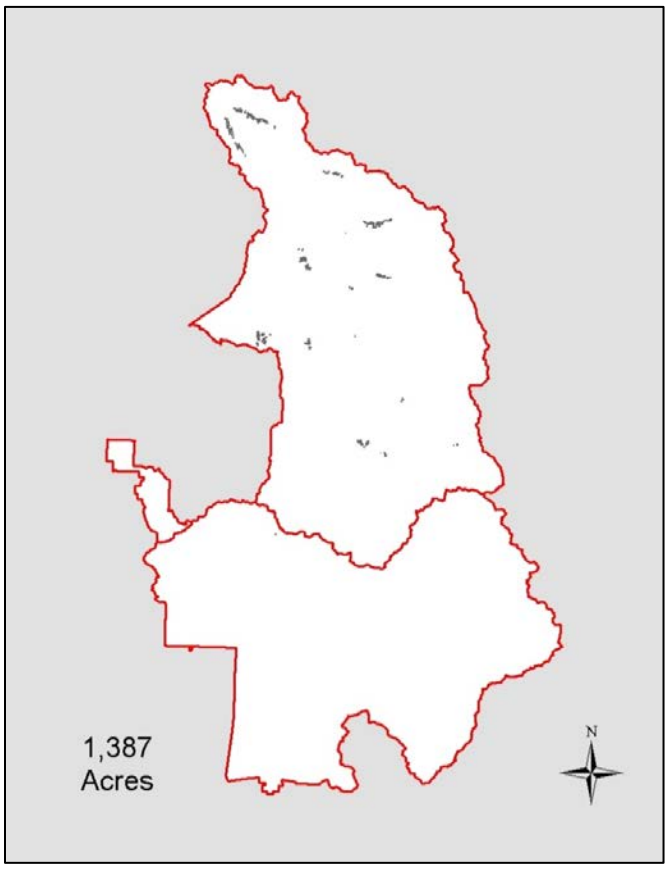


Figure 4030-1. Distribution of Mountain Hemlock Forest.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
Tsuga mertensiana generally occurs in very small stands in Kings Canyon, but individual trees are usually quite large with a conical to irregularly shaped crown (Figure 4030-2). Colors are deep red on IR imagery and occur in moderately dense to dense stands. Most stands are viewed off the photo center (nadir) on steep north trending slopes yielding signatures where much of the crown can be viewed in some situations. Confusion is possible between *T. mertensiana* and large *P. albicaulis* or *P. monticola*.

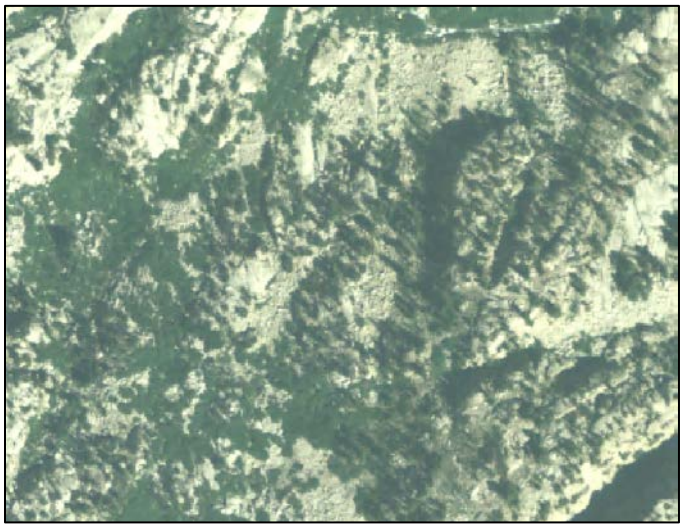


Figure 4030-2. Mountain Hemlock Forest.

Environmental Characteristics:
Microclimate – mesic
Elevation – 2535–3302 m (8317–10832 ft)
Shape – concave, undulating
Slope position – midslope
Steepness – moderately steep to steep
Aspect – See Figure 4030-3.

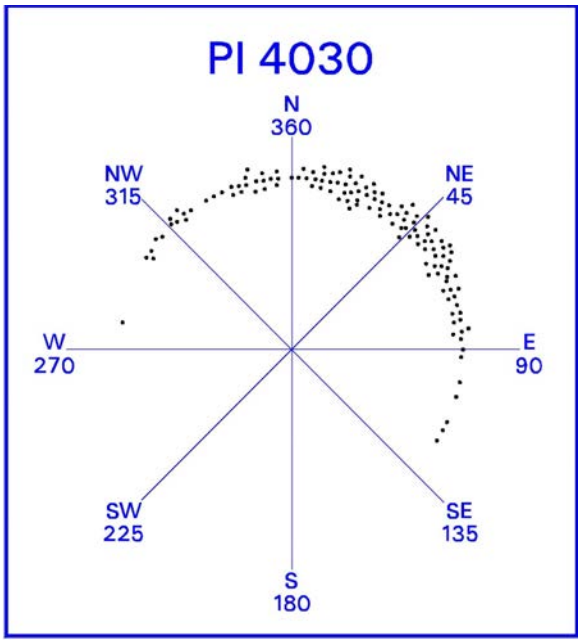


Figure 4030-3. Scatterplot of Mountain Hemlock Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- California Red Fir Forest Association (4051)

4033 – Mountain Hemlock–Western White Pine Forest Association

Tsuga mertensiana–Pinus monticola Forest Association

Description:

The *Tsuga mertensiana–Pinus monticola* forest association is mapped on steep north facing slopes between 2703–3103 m (8867–10180 ft) across 292 acres of Sequoia and Kings Canyon National Parks (Figure 4033-1). The open tree canopy is dominated by a mixture of *Tsuga mertensiana* and *Pinus monticola*. *P. contorta var. murrayana* and/or *Abies magnifica* may also be present in the canopy but do not contribute significant cover. The shrub layer is characteristically sparse but may include *Ledum glandulosum, Phyllodoce breweri, Ribes montigenum,* and/or *Ribes velutinum*. The herbaceous layer is typically open and may include *Arabis platysperma, Poa secunda, Arabis lyallii, Poa wheeleri, Juncus parryi*, and *Carex rossii*. The hydrology is upland. Soils are well drained loams and sandy loams. (NatureServe October 2006, Potter 1998)

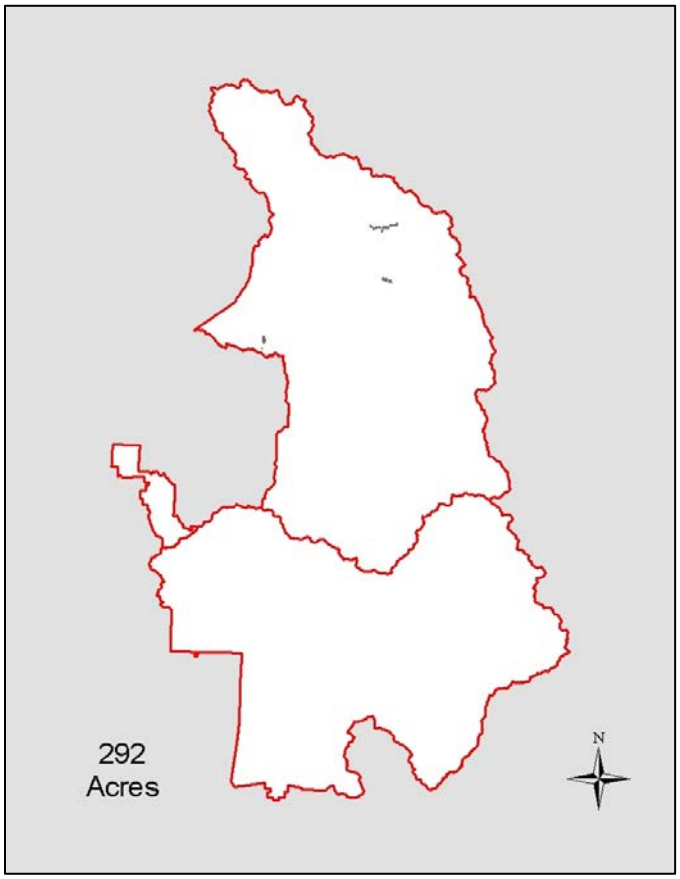


Figure 4033-1. Distribution of Mountain Hemlock–Western White Pine Forest.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:

This type is mapped in steep north upper slopes where adjacent stands of *Pinus monticola* are noted by the photo interpreter. Both species are very similar when co-occurring but *Tsuga mertensiana* is usually a bit darker red with a less diffused crown (Figure 4033-2).

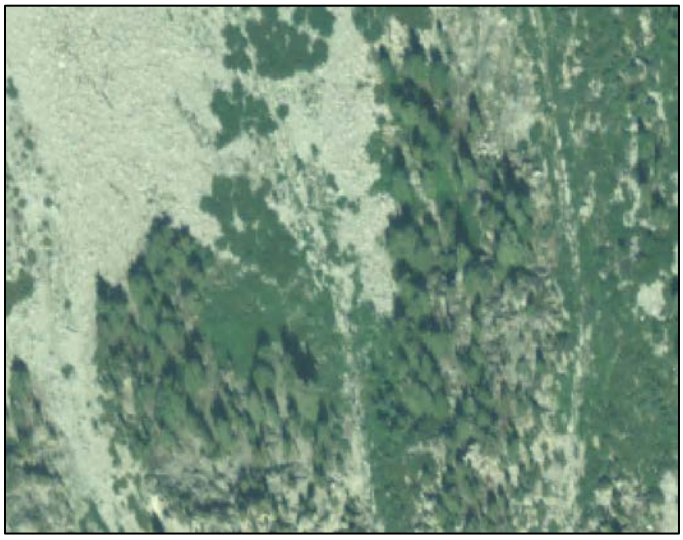


Figure 4033-2. Mountain Hemlock–Western White Pine Forest.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2703–3103 m (8867–10180 ft)
Shape – various
Slope position – midslope, high slope
Steepness – steep
Aspect – See Figure 4033-3.

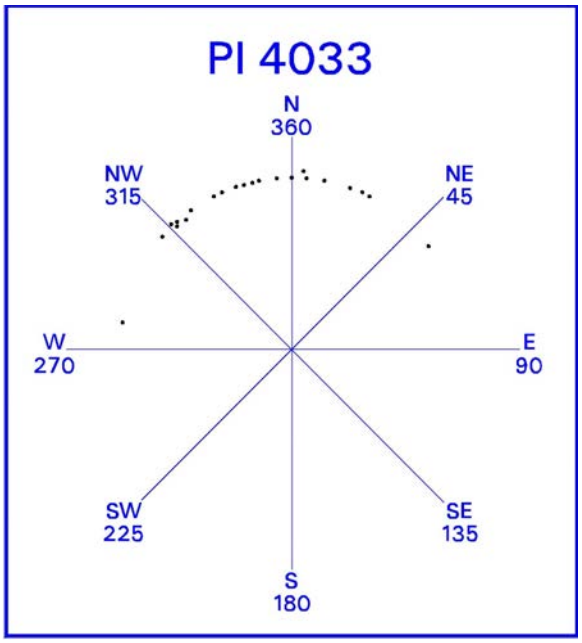


Figure 4033-3. Scatterplot of Mountain Hemlock–Western White Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Whitebark Pine–Mountain Hemlock Woodland Association (3148)
- Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association (4043)

4041 – Mountain Hemlock–Sierra Lodgepole Pine Forest Association
Tsuga mertensiana–Pinus contorta var. *murrayana* Forest Association

Description:

The *Tsuga mertensiana–Pinus contorta var. murrayana* forest association is mapped on moderately steep north to northeast facing slopes between 2727–3180 m (8947–10433 ft) across 238 acres of Sequoia and Kings Canyon National Parks (Figure 4041-1). The open tree canopy is dominated by a mixture of *Tsuga mertensiana* and *Pinus contorta var. murrayana*, with each species contributing at least 10% relative cover. *P. monticola* and/or *Abies magnifica* may also be present in the canopy but do not contribute significant cover. The shrub layer is characteristically sparse but may include significant amounts of *Ledum glandulosum* and/or *Phyllodoce breweri*. The herbaceous layer is typically open and may include *Arabis platysperma, Poa secunda, Juncus parryi,* and *Carex rossii*. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

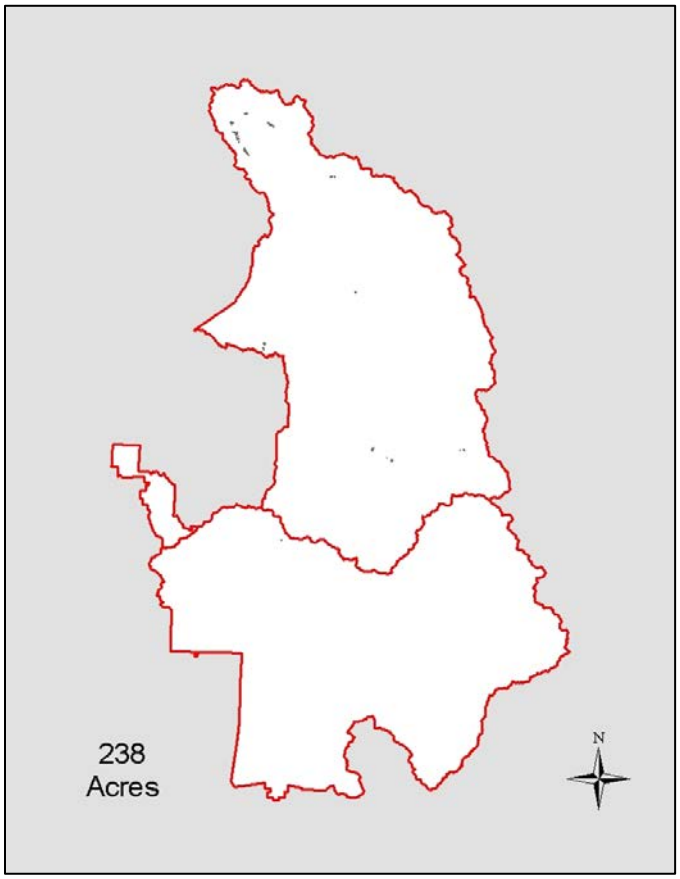


Figure 4041-1. Distribution of Mountain Hemlock–Sierra Lodgepole Pine Forest.

Accuracy:

Producer's accuracy: 50 % (n=2)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:

Stands are often dense yielding variability in color between the *Pinus contorta var. murrayana* and the brighter adjacent *Tsuga mertensiana* (Figure 4041-2). This type for the most part is mapped on gentler slopes compared with other hemlock associations, often grading into drier *Pinus contorta var. murrayana/Carex rossii* forests downslope.

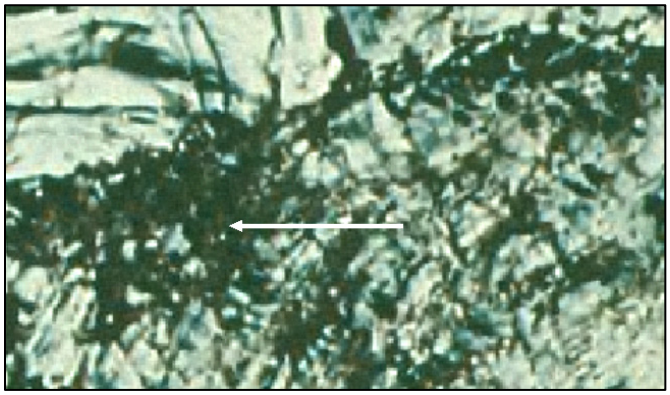


Figure 4041-2. Mountain Hemlock–Sierra Lodgepole Pine Forest signature. Photo reference: MOSI-SW.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2727–3180 m (8947–10433 ft)
Shape – concave, convex
Slope position – low slope, midslope
Steepness – moderately steep
Aspect – See Figure 4041-3.

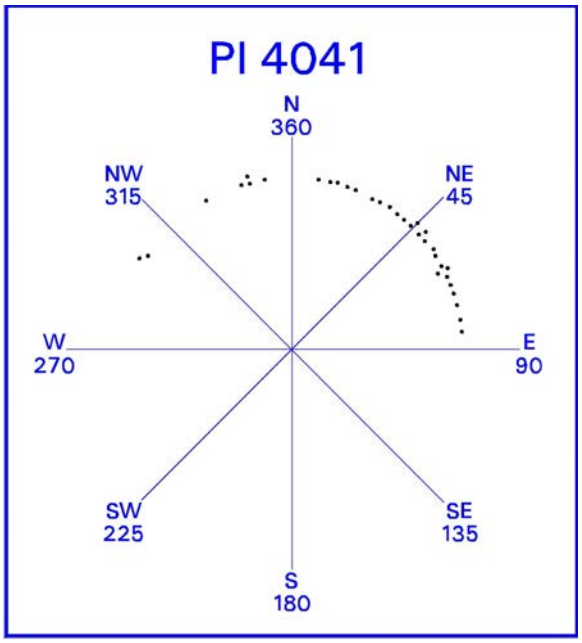


Figure 4041-3. Scatterplot of Mountain Hemlock–Sierra Lodgepole Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine/Ross Sedge Forest Association (3041)
- Whitebark Pine–Mountain Hemlock Woodland Association (3148)
- Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association (4043)

4042 – Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest Mapping Unit
Tsuga mertensiana–Pinus contorta var. *murrayana–Pinus albicaulis* Forest Mapping Unit

Description:

The *Tsuga mertensiana–Pinus contorta var. murrayana–Pinus albicaulis* mapping unit is mapped on moderately steep north to northeast facing slopes between 285–3302 m (9380–10832 ft) across 285 acres of Sequoia and Kings Canyon National Parks (Figure 4042-1). The open tree canopy is dominated by a mixture of *Tsuga mertensiana, Pinus contorta var. murrayana,* and *P. albicaulis*, with at least 10% relative cover of each tree species. The shrub layer is characteristically sparse but may include patches of *Ledum glandulosum* and/or *Phyllodoce breweri*. The herbaceous layer is typically open and may include a variety of herbs such as *Juncus parryi, Penstemon newberryi*, or *Selaginella watsonii*. The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006)

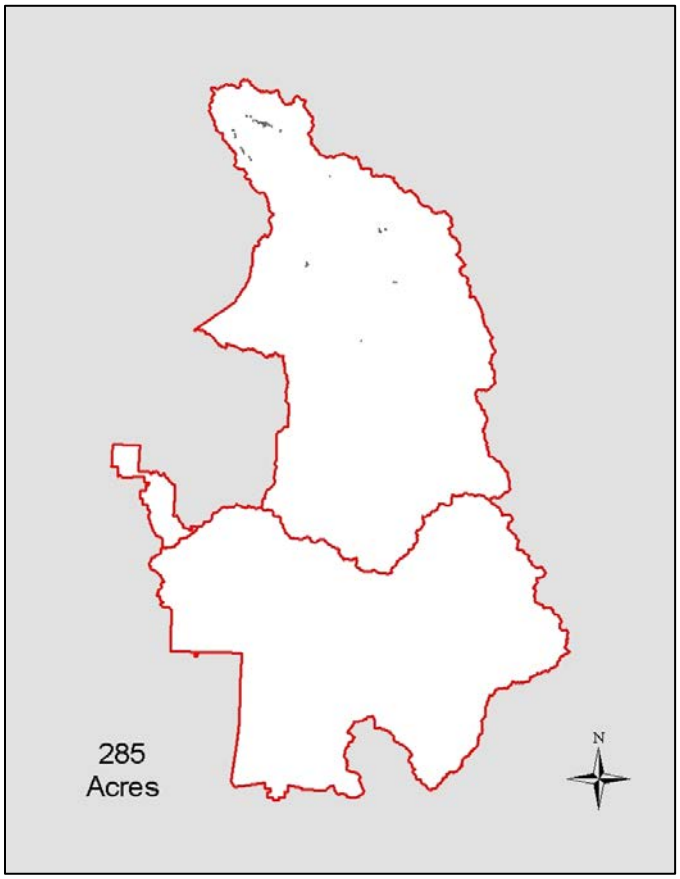


Figure 4042-1. Distribution of Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest.

Accuracy:

Producer's accuracy: 100 % (n=3)
User's accuracy: 75% (n=4)

Photo Interpretation Signature:

A high-elevation *Tsuga mertensiana* type is almost impossible to distinguish from the *Pinus albicaulis–Tsuga mertensiana* mesic forest superassociation (3148) where *Pinus contorta var. murrayana* is not easily seen. In this community, *P. contorta var. murrayana* are inconspicuous and generally have to be inferred by the photo interpreter as this type is usually found just downslope from *Tsuga mertensiana* and *P. albicaulis*. Separation between *Tsuga mertensiana* and *P. albicaulis* is fairly easy; at higher elevations *P. albicaulis* often display a krummholz form, while *T. mertensiana* generally maintains its tree-like stature. Figure 4042-2 shows an example of this forest mapping unit.

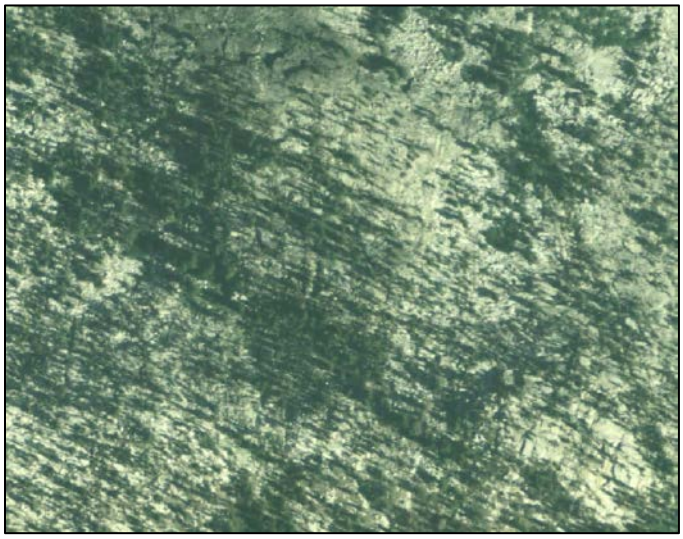


Figure 4042-2. Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest signature.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2859–3302 m (9380–10832 ft)
Shape – concave, convex
Slope position – midslope
Steepness – moderately steep
Aspect – See Figure 4042-3.

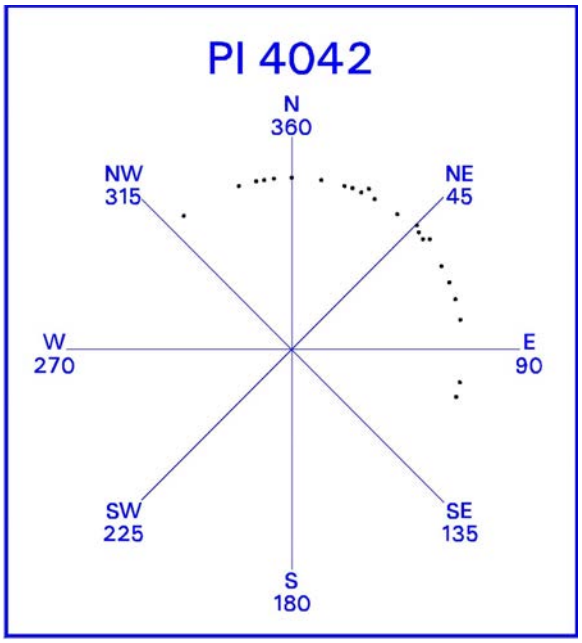


Figure 4042-3. Scatterplot of Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whitebark Pine–Mountain Hemlock Woodland Association (3148)
- Mountain Hemlock–Sierra Lodgepole Pine Forest Association (4041)

4043 – Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association
Tsuga mertensiana–Pinus contorta var. *murrayana–Pinus monticola* Forest Association

Description:
The *Tsuga mertensiana–Pinus contorta var. murrayana–Pinus monticola* forest association is mapped on moderately steep north to northeast facing slopes between 2859–3302 m (9380–10832 ft) across 519 acres of Sequoia and Kings Canyon National Parks (Figure 4043-1). The open tree canopy is dominated by a mixture of *Tsuga mertensiana, Pinus contorta var. murrayana,* and *P. monticola*, with at least 10% relative cover of each tree species. *Abies magnifica* is occasionally present in the overstory. The shrub layer is characteristically sparse but may include patches of *Ribes spp*. and/or *Phyllodoce breweri*. The herbaceous layer is typically open and may include a variety of herbs such as *Juncus parryi, Penstemon newberryi, Poa secunda,* or *Selaginella watsonii*. The hydrology is upland. Soils are moderately well drained to well drained sandy clay loams or loams. (NatureServe October 2006)

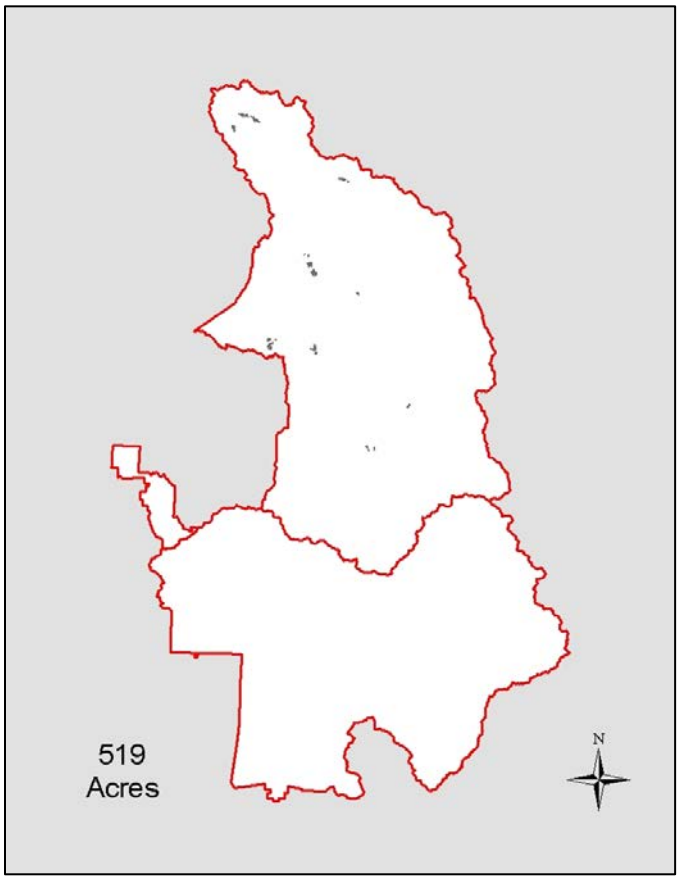


Figure 4043-1. Distribution of Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest.

Accuracy:
Producer's accuracy: 100 % (n=3)
User's accuracy: 100% (n=3)

Photo Interpretation Signature:

Some of the *Tsuga mertensiana* associations may prove too fine to map, especially between this type and the type often found adjacent to it on steeper slopes: *Tsuga mertensiana–Pinus monticola* forest association (4033). These two associations are likely not separable using just the aerial photography. It is necessary to distinguish these two associations based on environmental setting. Figure 4043-2 shows an example of this forest association.

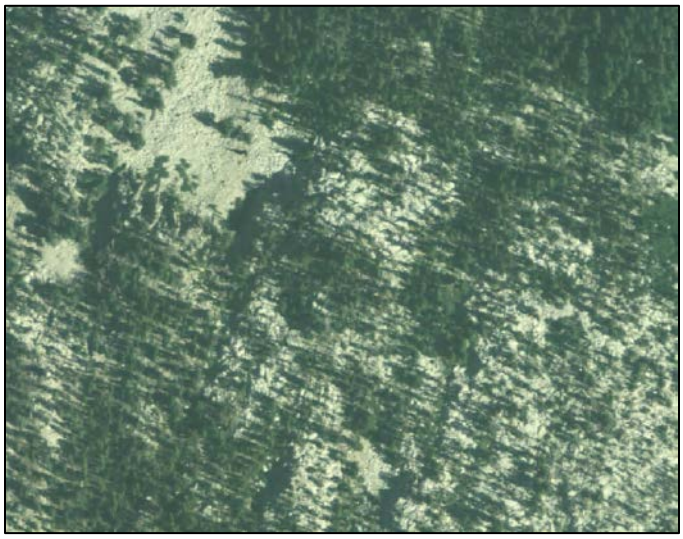


Figure 4043-2. Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest signature.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2859–3302 m (9380–10832 ft)
Shape – convex
Slope position – midslope
Steepness – steep
Aspect – See Figure 4043-3.

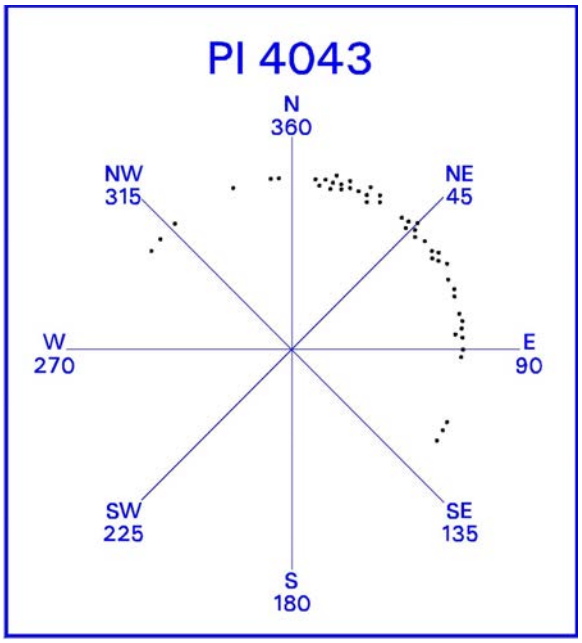


Figure 4043-3. Scatterplot of Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Whitebark Pine–Mountain Hemlock Woodland Association (3148)
- Mountain Hemlock–Western White Pine Forest Association (4033)
- Mountain Hemlock–Sierra Lodgepole Pine Forest Association (4041)

4050 – California Red Fir Forest Alliance



California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest. SEKI-AA.0615_1168.

4050 – California Red Fir Forest Alliance

Abies magnifica Forest Alliance

Description:

The *Abies magnifica* forest alliance is mapped on gentle to steep slopes of varying aspect between 2003–3275 m (6572–10744 ft) across 65,566 acres of Sequoia and Kings Canyon National Parks (Figure 4050-1). The tree canopy of associations in this upper montane alliance is dominated by *Abies magnifica*. Other trees in the canopy may include *A. concolor*, *Pinus contorta var. murrayana*, *P. jeffreyi*, *P. lambertiana*, and *P. monticola*. The shrub layer ranges from absent to well developed, and most frequently includes *Acer glabrum*, *Arctostaphylos nevadensis*, *A. patula*, *Artemisia tridentata*, *Ceanothus cordulatus*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Ledum glandulosum*, *Phyllodoce breweri*, *Prunus emarginata*, *Ribes spp*., or *Symphoricarpos mollis*. The herbaceous layer is characteristically sparse to absent, with *Apocynum androsaemifolium*, *Arabis spp*., *Aster breweri*, *Carex rossii*, *Elymus elymoides*, *Hieracium albiflorum*, *Lupinus latifolius var. columbianus*, *Monardella odoratissima, Pedicularis semibarbata, Pteridium aquilinum, Pyrola picta*, and *Senecio triangularis* among the most frequently encountered species. The hydrology is upland. Soils are moderately well drained to well drained sandy loams. (NatureServe October 2006).

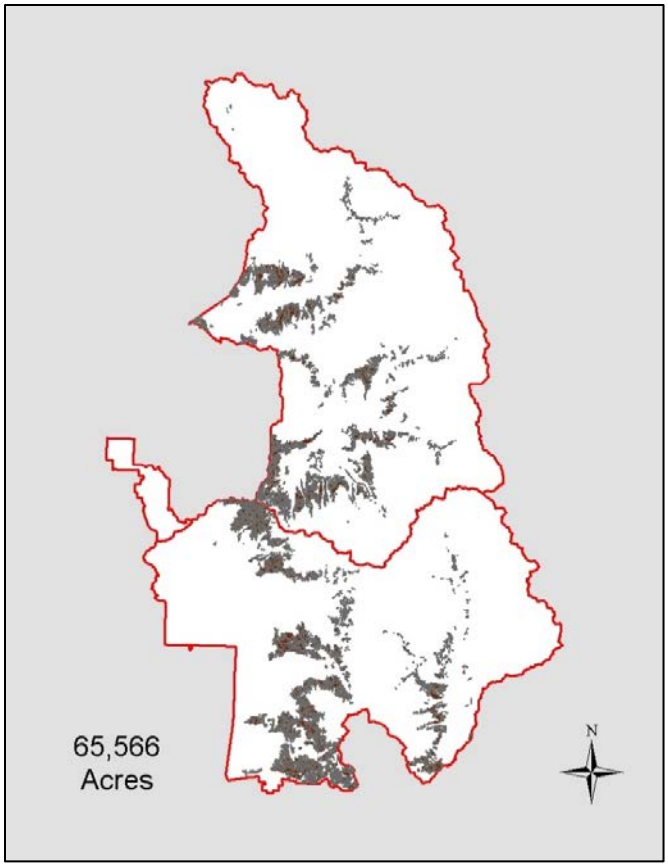


Figure 4050-1. Distribution of California Red Fir Forest Alliance.

Accuracy:
Producer's accuracy: 0% (n=4)
User's accuracy: % (n=0)

Photo Interpretation Signature:
The signature of *Abies magnifica* is a large tree with a broad, deep red crown—darker red than similar white fir, which often displays some dead growth at the top of the tree. Figure 4050-2 shows the signature of a California red fir forest.



Figure 4050-2. California Red Fir Forest signature.

Environmental Characteristics:
Microclimate – submesic
Elevation – 2003–3275 m (6572–10744 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope, ridgetop
Steepness – gentle to steep
Aspect – See Figure 4050-3.

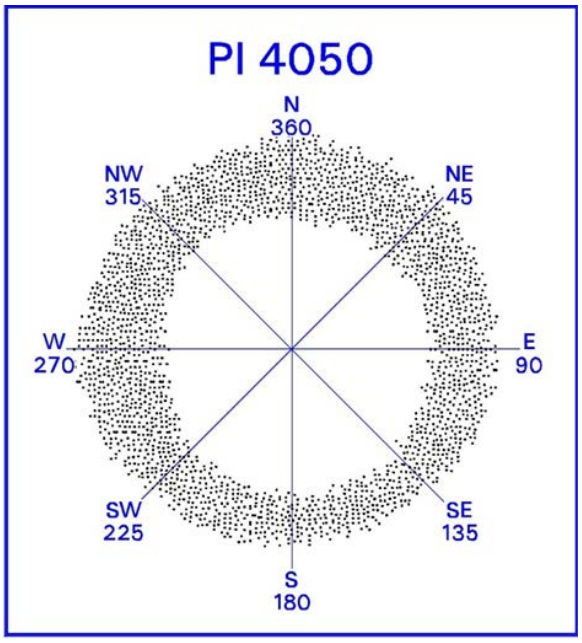


Figure 4050-3. Scatterplot of California Red Fir Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–White Fir Forest Alliance (4070)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)

4051 – California Red Fir Forest Association
Abies magnifica Forest Association

Description:
The *Abies magnifica* forest association is mapped on moderate to steep slopes of varying aspect between 2182–3127 m (7159–10259 ft) across 10,732 acres of Sequoia and Kings Canyon National Parks (Figure 4051-1). The typically dense and multi-layered tree canopy is dominated by *Abies magnifica*. The shrub layer is usually absent; however, *Arctostaphylos nevadensis, Chrysolepis sempervirens,* and *Ceanothus cordulatus* may be present on drier or disturbed sites. The sparse herbaceous layer may contain *Aster breweri, Corallorhiza maculata, Pedicularis semibarbata,* and *Pyrola picta* along with significant regeneration of *A. magnifica*. The hydrology is upland. Soils are well drained sandy loam. (NatureServe October 2006)

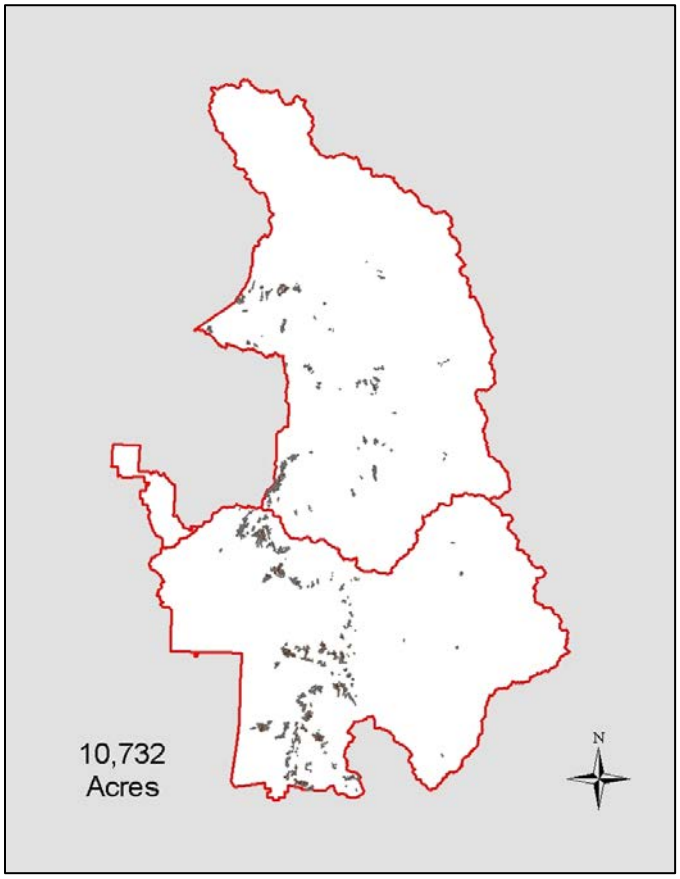


Figure 4051-1. Distribution of California Red Fir Forest Association.

Accuracy:
Producer's accuracy: 77% (n=13)
User's accuracy: 77% (n=13)

Photo Interpretation Signature:

The *Abies magnifica* photo signature is a large tree with a broad, red, conical crown. The stand is usually very dense, but can be slightly open in disturbed settings or toward the edge of stands. Overall signature in this association is very uniform due to the high dominance of *A. magnifica* (Figure 4051-2).

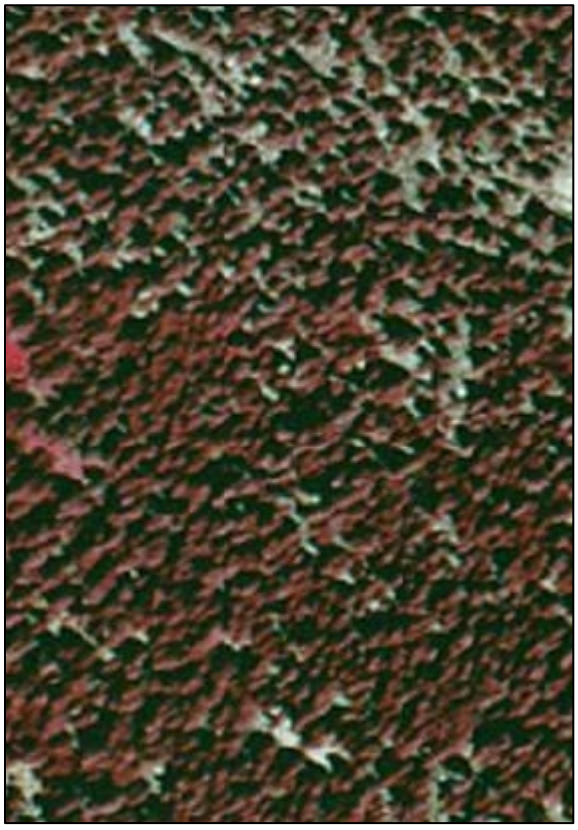


Figure 4051-2. California Red Fir Forest signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2182–3127 m (7159–10259 ft)
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 4051-3.

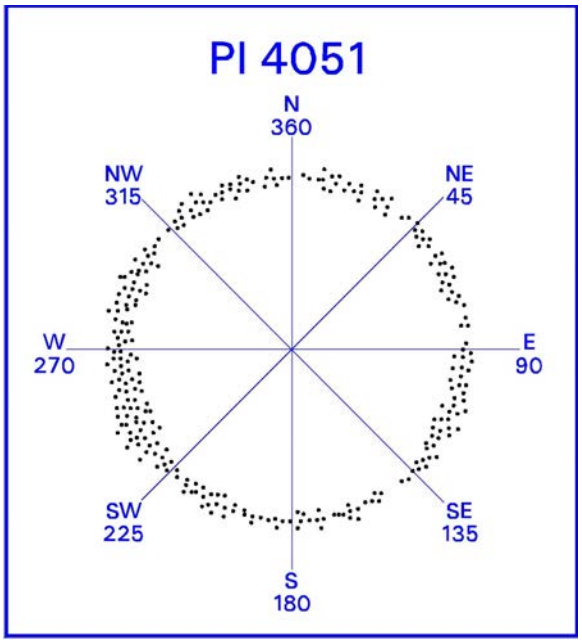


Figure 4051-3. Scatterplot of California Red Fir Forest Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine–California Red Fir Woodland Association (3085)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- California Red Fir–White Fir Forest Association (4071)
- White Fir Forest Mapping Unit (4081)
- White Fir Mature Even-age Stands Mapping Unit (4082)

4054 – California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit

Abies magnifica/Arctostaphylos nevadensis–(*Arctostaphylos patula–Ceanothus cordulatus*) Forest Mapping Unit

Description:

The *Abies magnifica/Arctostaphylos nevadensis–(Arctostaphylos patula–Ceanothus cordulatus*) forest mapping unit is mapped on moderate to steep slopes of varying aspect between 2200–3167 m (7219–10391 ft) across 1,401 acres of Sequoia and Kings Canyon National Parks (Figure 4054-1). The characteristically open tree canopy is dominated by *Abies magnifica*. Other trees in the canopy may include *A. concolor, Pinus contorta var. murrayana, P. jeffreyi, P. lambertiana,* and *P. monticola*. The shrub layer is typically dominated by mats of *Arctostaphylos nevadensis*, but may also include patches of *A. patula, Artemisia tridentata, Ceanothus cordulatus, Chrysolepis sempervirens, Holodiscus discolor, Prunus emarginata*, or *Ribes spp*. The herbaceous layer is characteristically sparse to absent, but most frequently includes *Arabis spp., Aster breweri, Elymus elymoides,* or *Pteridium aquilinum*. The hydrology is upland. (NatureServe October 2006, Potter 1998). In the aggregated database, the *Abies magnifica/Arctostaphylos nevadensis–(Arctostaphylos patula–Ceanothus cordulatus*) forest mapping unit is aggregated into the *Abies magnifica–(Pinus monticola)/(Arctostaphylos nevadensis–Chrysolepis sempervirens)* forest mapping unit (4064).

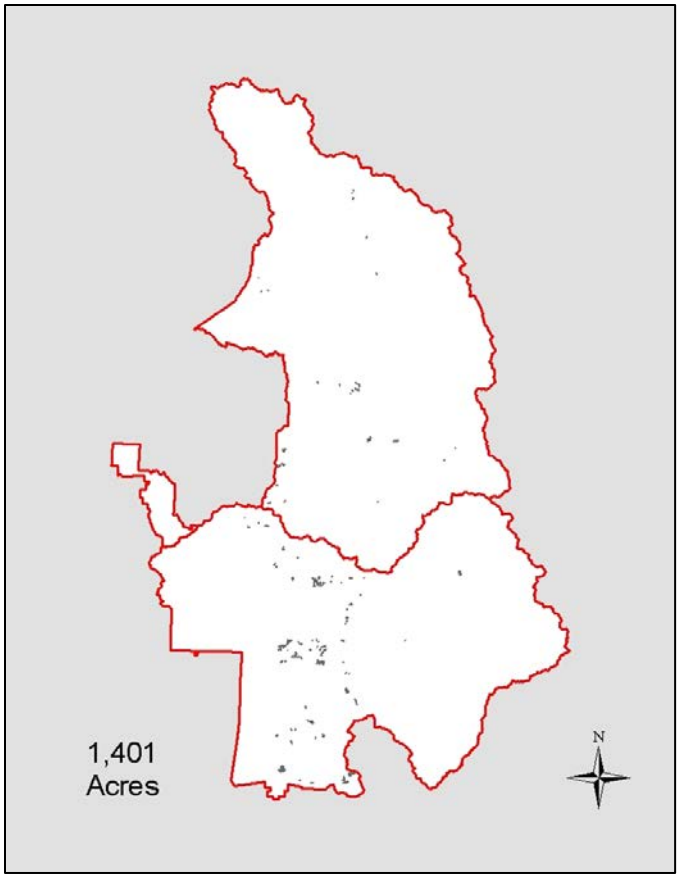


Figure 4054-1. Distribution of California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest.

Accuracy:

Producer's accuracy: 67% (n=6)
User's accuracy: 100% (n=4)

Photo Interpretation Signature:

The *Abies magnifica* photo signature is a large tree with a broad, red, conical crown. The stand is usually open with mixed shrubs that look smooth and orange or pink in the understory. The shrubs that occur in this stand: (generally *Arctostaphylos nevadensis*, *A. patula* and *Chrysolepis sempervirens*) give the signature significant variability (Figure 4054-2). Other conifers that may be a minor component of the stand, especially *Pinus jeffreyi,* as a rule yield a lighter pink signature.

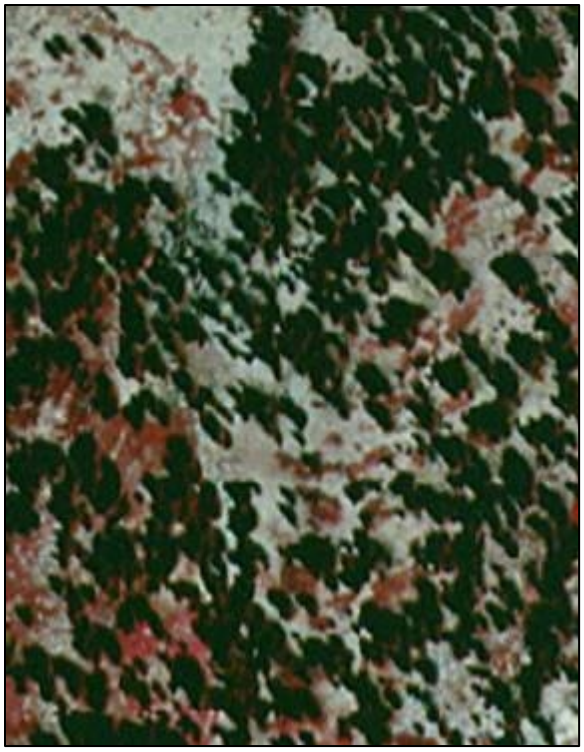


Figure 4054-2. California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest. Photo reference: LODG_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2200–3167 m (7219–10391 ft)
Shape – convex
Slope position – low slope, midslope, high slope, ridgetop
Steepness – moderate to steep
Aspect – See Figure 4054-3.

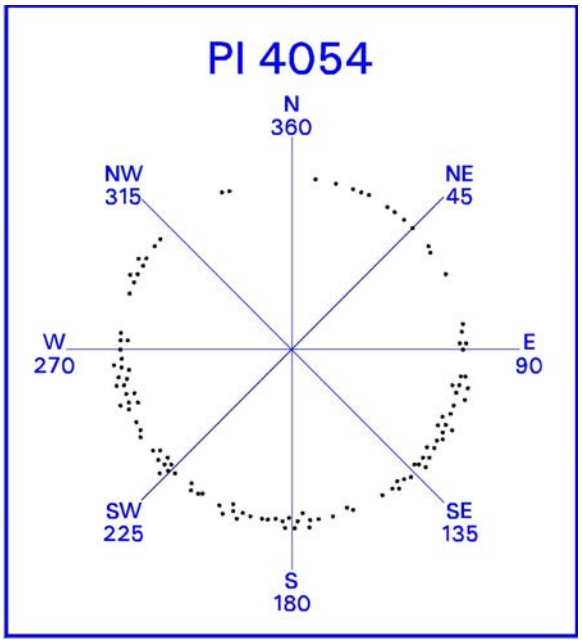


Figure 4054-3. Scatterplot of California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- California Red Fir Forest Alliance (4050)
- California Red Fir Forest Association (4051)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- California Red Fir–White Fir Forest Alliance (4070)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)

4055 – California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association
Abies magnifica–Pinus monticola–Pinus contorta var. *murrayana* Forest Association

Description:

The *Abies magnifica–Pinus monticola–Pinus contorta var. murrayana* forest association is mapped on gentle to steep slopes of varying aspect between 2383–3275 m (7819–10744 ft) across 16,212 acres of Sequoia and Kings Canyon National Parks (Figure 4055-1). The moderately dense tree canopy is dominated by a mixture of *Abies magnifica, Pinus monticola* and *P. contorta var. murrayana*. The shrub layer is absent to sparse, with *Arctostaphylos nevadensis, A. patula, Chrysolepis sempervirens* and various *Ribes spp.* among the most frequently encountered species. The herbaceous layer is also sparse to absent, with *Arabis spp., Aster breweri, Elymus elymoides, Pteridium aquilinum,* and *Senecio triangularis* most common. The hydrology is upland. Soils are well drained sands or sandy loams. (NatureServe 2006, Potter 1998). In the aggregated database, the *Abies magnifica–Pinus monticola–Pinus contorta var. murrayana* forest association is aggregated into the *Pinus monticola–Pinus contorta var. murrayana–(Abies magnifica)* forest mapping unit (4540).

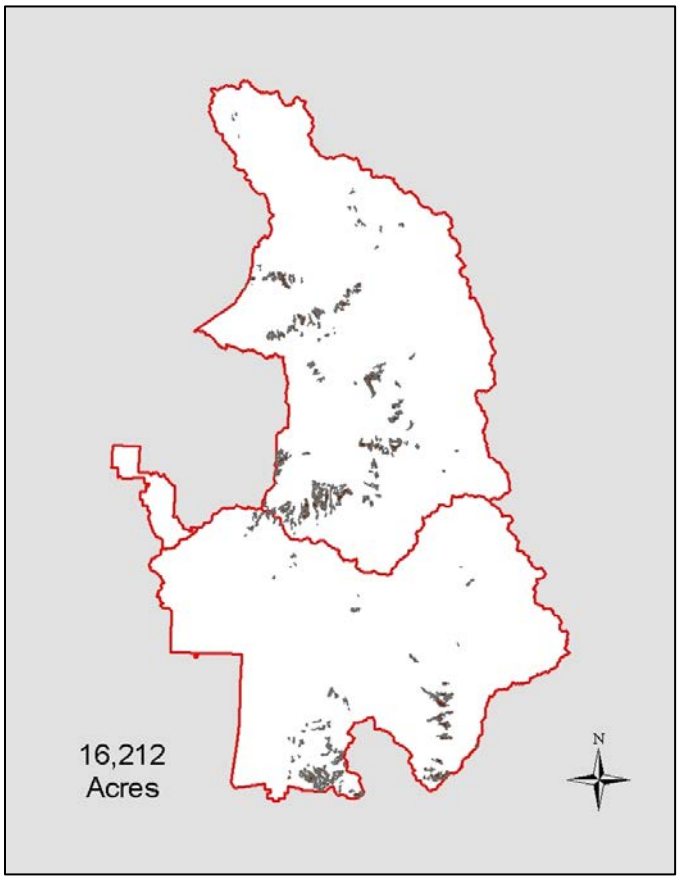


Figure 4055-1. Distribution of California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest.

Accuracy:

Producer's accuracy: 63 % (n=19)

User's accuracy: 75% (n=16)

Photo Interpretation Signature:

The *Abies magnifica* photo signature is typically a large tree with a broad, red, conical crown. The signature of *Pinus monticola* is a dark pink or red crown that is shaped irregularly. The photo signature of *P. contorta var. murrayana* appears is a dark red or brown colored crown with a pointed or irregular shape (Figure 4055-2). The signatures for *P. monticola* and the *A. magnifica* can be similar where the two conifers co-occur, and this association is therefore difficult to determine based on signature alone. Photo interpreters map this type in less steep settings than other *P. monticola* types and in slightly more mesic conditions.

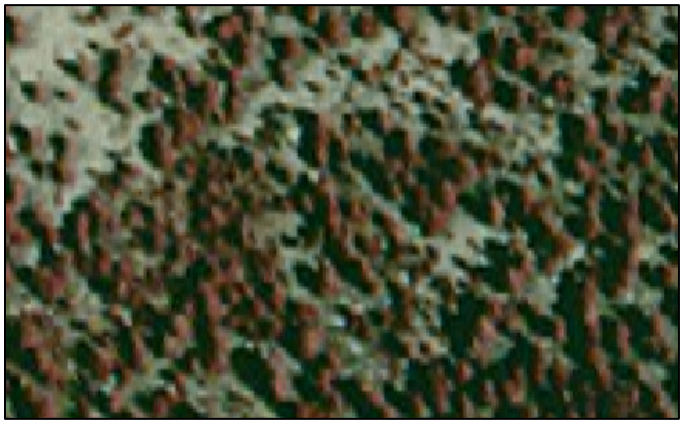


Figure 4055-2. California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest signature. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2383–3275 m (7819–10744 ft).
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope, ridgetop
Steepness – gentle to steep
Aspect – See Figure 4055-3.

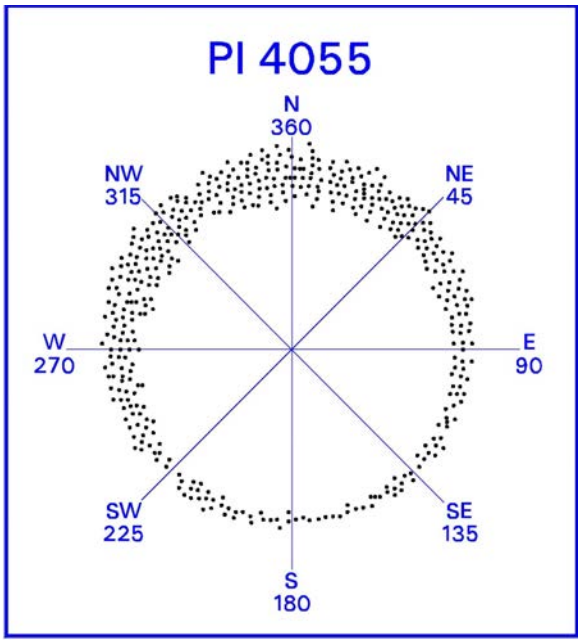


Figure 4055-3. Scatterplot of California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)
- California Red Fir Forest Association (4051)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)

4057 – California Red Fir–Western White Pine Forest Association
Abies magnifica–Pinus monticola Forest Association

Description:
The *Abies magnifica–Pinus monticola* forest association is mapped on moderate to very steep slopes of predominantly north to northeast or northwest facing aspect between 2003–3169 m (6572–10398 ft) across 14,380 acres of Sequoia and Kings Canyon National Parks (Figure 4057-1). The moderately dense tree canopy is dominated by a mixture of *Abies magnifica* and *Pinus monticola*, with occasional *A. concolor, Juniperus occidentalis var. australis, P. balfouriana ssp. austrina,* or *P. jeffreyi*. *A. magnifica* is the dominant tree in this association, but *P. monticola* is always present and contributes relatively high cover. The shrub layer is absent to sparse, with patches of *Arctostaphylos nevadensis, A. patula, Chrysolepis sempervirens,* and various *Ribes spp*. among the most frequently encountered species. The sparse to absent herbaceous layer is characterized by *Arabis platysperma* and *Aster breweri*. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006, Potter 1998).

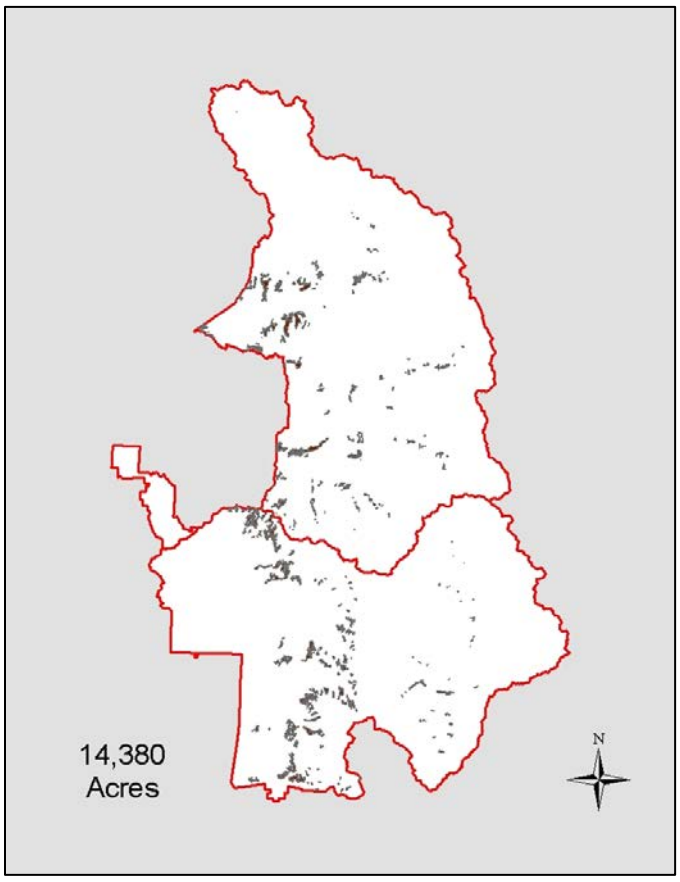


Figure 4057-1. Distribution of California Red Fir–Western White Pine Forest.

Accuracy:
Producer's accuracy: 61% (n=23)
User's accuracy: 70% (n=20)

Photo Interpretation Signature:

The photo signature for *Abies magnifica* appears as a large tree with a broad, red, conical crown and the signature for *Pinus monticola* looks like a large, irregularly shaped dark pink or red crown. The canopy for this type ranges from open to closed and has an uneven texture (Figure 4057-2). Photo interpreters map this type in fairly steep north trending settings that trended between xeric and mesic. It is mapped generally on steeper and higher slopes than the *Abies magnifica–Pinus monticola–Pinus contorta var. murrayana* forest association (4055).

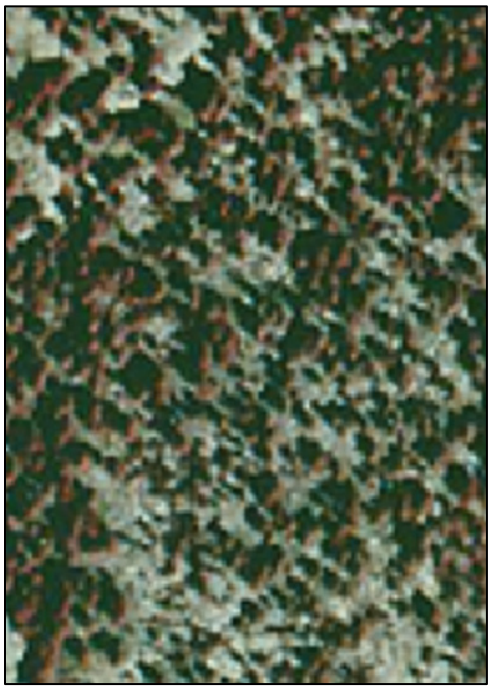


Figure 4057-2. California Red Fir–Western White Pine Forest. Photo reference: MOSI_SW.

Environmental Characteristics:

Microclimate – submesic
Elevation – 2003–3169 m (6572–10398 ft)
Shape – concave, convex, undulating
Slope position – midslope, high slope, ridgetop
Steepness – moderate to very steep
Aspect – See Figure 4057-3.

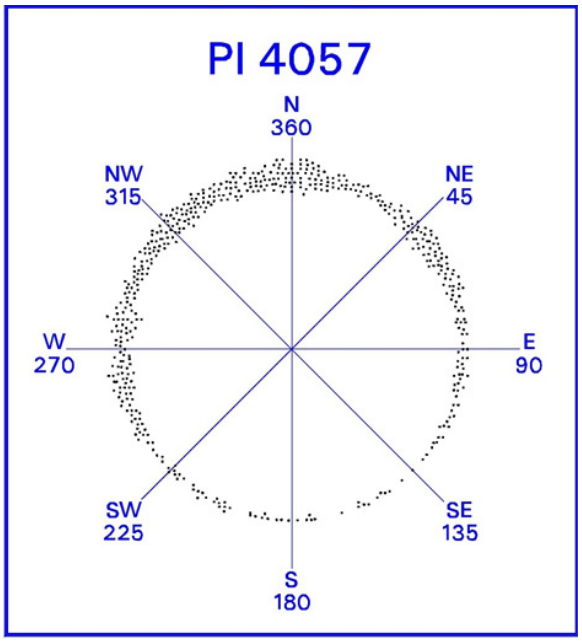


Figure 4057-3. Scatterplot of California Red Fir–Western White Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- Foxtail Pine–Western White Pine Woodland Superassociation
- California Red Fir Forest Association (4051)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)

4060 – California Red Fir Forest Alliance

4063 – California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit
Abies magnifica–Pinus contorta var. *murrayana/Hieracium albiflorum* Forest Mapping Unit

Description:

The *Abies magnifica–Pinus contorta var. murrayana/Hieracium albiflorum* forest association is mapped on gentle to moderately steep slopes of varying aspect between 2018–3172 m (6620–10406 ft) across 11,028 acres of Sequoia and Kings Canyon National Parks (Figure 4063-1). The dense, multi-layered tree canopy is dominated by a mixture of *Abies magnifica and Pinus contorta var. murrayana. A. concolor* may also be important and scattered *P. jeffreyi* and *P. monticola* may also occur. In some cases east of the Great Western Divide, *A. concolor* can either be dominant or co-dominant with *A. magnifica* and/or *P. contorta var. murrayana*. Conifer regeneration dominates the shrub layer, with *Ribes spp*. characterizing moister sites and patches of *Ceanothus cordulatus* and *Chrysolepis sempervirens* indicating drier conditions. The herbaceous layer is characterized by the presence of scattered *Hieraceum albiflorum*, with *Arabis platysperma, Carex rossii, Kelloggia galioides, Osmorhiza chilensis, Pedicularis semibarbata,* and *Poa bolanderi* frequently encountered as well. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006, Potter 1998).

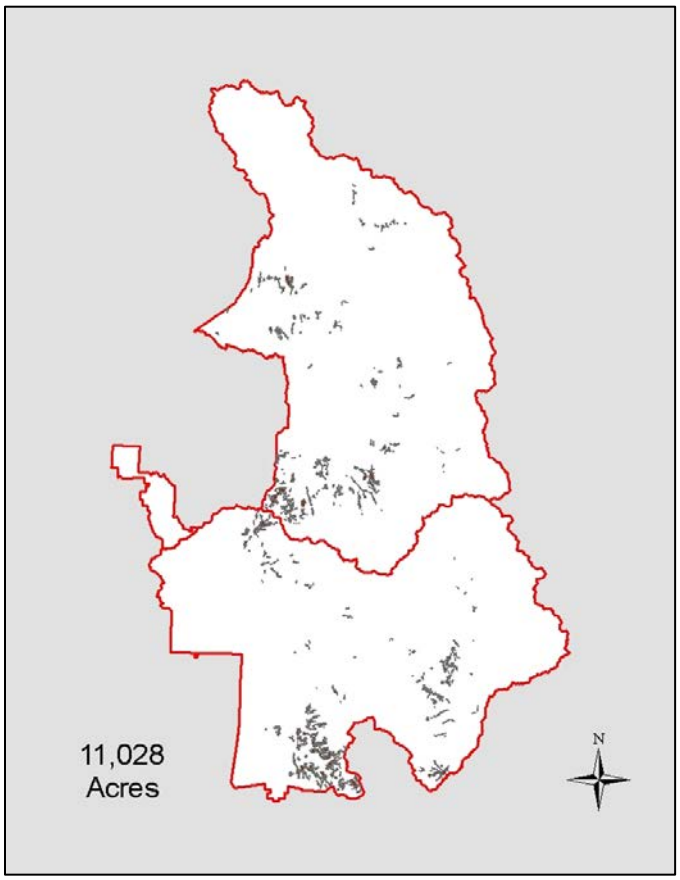


Figure 4063-1. Distribution of California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest.

Accuracy:
Producer's accuracy: 90% (n=29)
User's accuracy: 76% (n=34)

Photo Interpretation Signature:
The *Abies magnifica* photo signature is a large tree with a broad, red, conical crown. The photo signature of *Pinus contorta var. murrayana* appears as a dark red or brown colored crown with a pointed or irregular shape (Figure 4063-2). Where the two conifers share dominance it is difficult to distinguish individual trees, so photo interpreters note overall signature trends of the stand. In this association, it appears more variable in color than pure *P. contorta var. murrayana* or *A. magnifica* associations. This association is usually very dense and located in mesic environments.

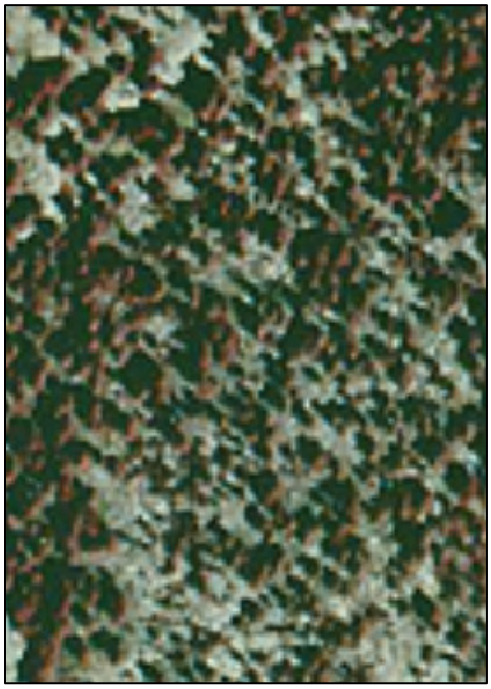


Figure 4063-2. California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest. Photo reference: LODG_NW.

Environmental Characteristics:
Microclimate – submesic
Elevation – 2018–3172 m (6620–10406 ft)
Shape – concave, convex, flat, undulating
Slope position – low slope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 4063-3.

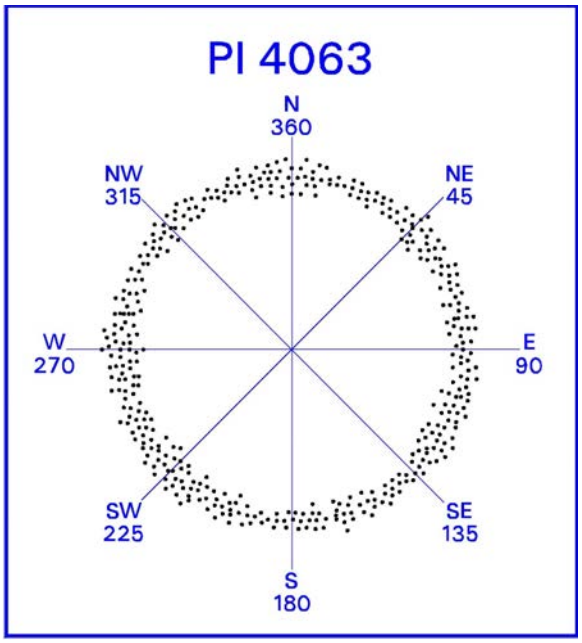


Figure 4063-3. Scatterplot of California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine Mesic Forest Superassociation (3048)
- California Red Fir Forest Association (4051)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–White Fir Forest Association (4071)
- White Fir Forest Mapping Unit (4081)

4064 – California Red Fir–(Western White Pine)/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit



California Red Fir–Western White Pine Forest.

4064 – California Red Fir–(Western White Pine)/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit

Abies magnifica–(*Pinus monticola*)/(*Arctostaphylos nevadensis–Chrysolepis sempervirens*) Forest Mapping Unit

Description:

The Abies magnifica–(*Pinus monticola*)/(*Arctostaphylos nevadensis–Chrysolepis sempervirens*) forest mapping unit is an aggregation of the *Abies magnifica/Arctostaphylos nevadensis–*(*Arctostaphylos patula–Ceanothus cordulatus*) forest mapping unit (4054) and the *Abies magnifica–Pinus monticola/(Arctostaphylos nevadensis–Chrysolepis sempervirens*) forest mapping unit (4065). The aggregated type is mapped on moderate to steep slopes of varying aspects between 2074–3274 m (6803–10741 ft), across 11,818 acres of Sequoia and Kings Canyon National Parks (Figure 4064-1). The characteristically open tree canopy is dominated by *Abies magnifica*, with *Pinus monticola* codominant at higher elevations and on upper slopes. The shrub layer can be dominated by either *Arctostaphylos nevadensis* or *Chrysolepis sempervirens*, with A. patula or *Ceanothus cordulatus* occasionally important. The herbaceous layer is characteristically sparse to absent, but most frequently includes *Arabis spp., Aster breweri, Elymus elymoides, Monardella odoratissima* or *Pteridium aquilinum*. The hydrology is upland.

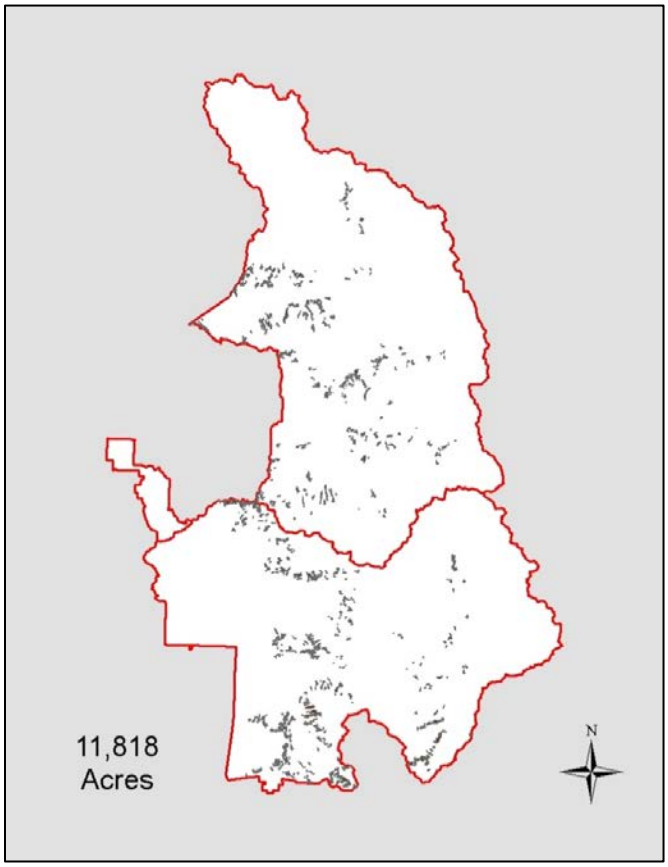


Figure 4064-1. Distribution of California Red Fir–(Western White Pine)/Pinemat Manzanita–Bush Chinquapin) Forest.

Accuracy:

Producer's accuracy: 88 % (n=17)
User's accuracy: 75% (n=20)

Photo Interpretation Signature:

The *Abies magnifica–(Pinus monticola)/(Arctostaphylos nevadensis–Chrysolepis sempervirens)* forest mapping unit represents an aggregated high elevation mixed conifer type containing *Abies magnifica* and usually *Pinus monticola* over a shrub understory. Signatures vary widely depending on shrub understory and disturbance history, and generally post fire settings contain more *Ceanothus cordulatus*).

Environmental Characteristics:

Microclimate – xeric
Elevation – 2074–3274 m (6803–10741 ft)
Shape – neutral to convex
Slope position – mid to upper slopes
Steepness – moderate to steep
Aspect – See Figure 4064-2.

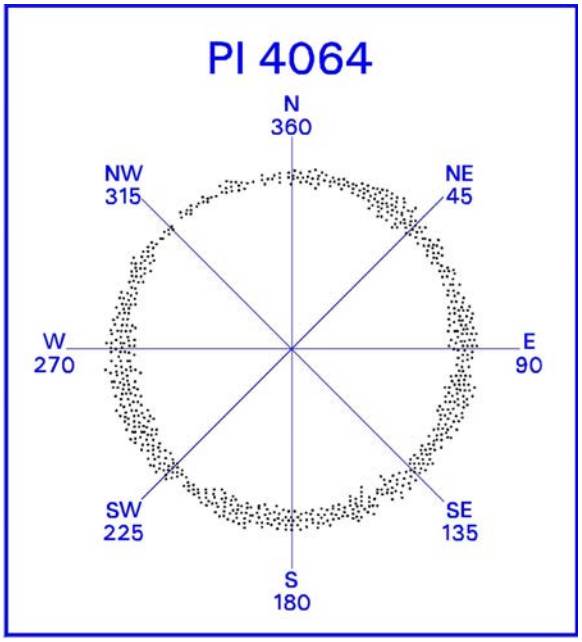


Figure 4064-2. Scatterplot of California Red Fir–(Western White Pine)/Pinemat Manzanita–Bush Chinquapin) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine Woodland Alliance (3130)

- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- California Red Fir Forest Alliance (4050)
- California Red Fir Forest Association (4051)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit (4065)
- California Red Fir–White Fir Forest Alliance (4070)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)

4065 – California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest Mapping Unit

Abies magnifica–Pinus monticola/(*Arctostaphylos nevadensis–Chrysolepis sempervirens*) Forest Mapping Unit

Description:

The *Abies magnifica–Pinus monticola/(Arctostaphylos nevadensis–Chrysolepis sempervirens)* forest mapping unit is mapped on moderate to steep slopes of varying aspect between 2074–3274 m (6803–10741 ft) across 10,417 acres of Sequoia and Kings Canyon National Parks (Figure 4065-1). The characteristically open tree canopy is dominated by a mixture of *Abies magnifica* and *Pinus monticola*. Other trees in the canopy may include *P. balfouriana ssp. austrina, P. contorta var. murrayana,* and *P. jeffreyi*. The shrub layer is typically dominated by mats of *Arctostaphylos nevadensis* or patches of *Chrysolepis sempervirens*. The herbaceous layer is characteristically sparse to absent, but most frequently includes *Achnatherum occidentale, Arabis platysperma, Aster breweri, Elymus elymoides*, and *Monardella odoratissima*. The hydrology is upland. Soils are well drained sands or sandy loams. (NatureServe October 2006, Potter 1998). In the aggregated database, the *Abies magnifica–Pinus monticola/(Arctostaphylos nevadensis–Chrysolepis sempervirens)* forest mapping unit is aggregated into the *Abies magnifica–(Pinus monticola)/(Arctostaphylos nevadensis–Chrysolepis sempervirens)* forest mapping unit (4064).

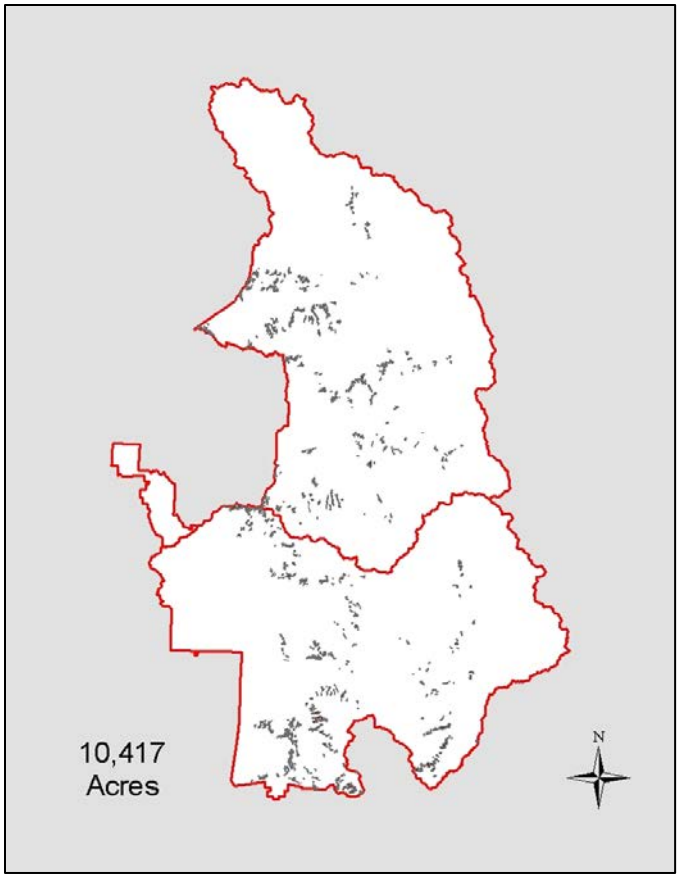


Figure 4065-1. Distribution of California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest.

Accuracy:

Not available.

Photo Interpretation Signature:

The *Abies magnifica* photo signature is a large tree with a broad, red, conical crown. The signature of the *Pinus monticola* is a dark pink or red crown that is shaped irregularly. There is sparse to dense shrub understory that appears brown, orange or pink depending on species dominance (Figure 4065-2).



Figure 4063-2. California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest signature. Photo reference: MUGR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2074–3274 m (6803–10741 ft)
Shape – convex
Slope position – midslope, high slope, ridgetop
Steepness – moderate to steep
Aspect – See Figure 4065-3.

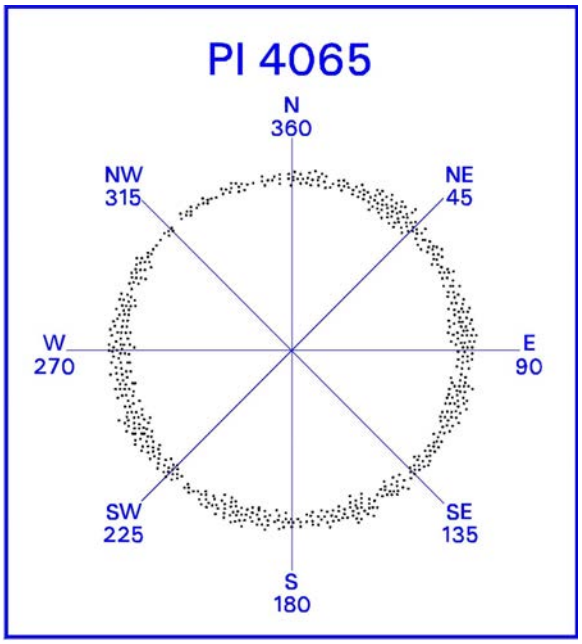


Figure 4065-3. Scatterplot of California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland Mapping Unit (3133)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)

4070 – California Red Fir–White Fir Forest Alliance



California Red Fir–White Fir Forest. Photo reference: SEKI.003_24.

4070 – California Red Fir–White Fir Forest Alliance

Abies magnifica–Abies concolor Forest Alliance

Description:

The *Abies magnifica–Abies concolor* forest alliance is mapped on gentle to steep slopes of varying aspect between 1703–3077 m (5587–10095 ft) across 32,043 acres of Sequoia and Kings Canyon National Parks (Figure 4070-1). The tree canopy of associations in this montane alliance is dominated by a mixture of *Abies magnifica* and *A. concolor*. Other trees in the canopy may include *Juniperus occidentalis var. australis, Pinus contorta var. murrayana, P. jeffreyi, P. lambertiana,* and *P. monticola*. The shrub layer ranges from absent to well developed, and most frequently includes *Acer glabrum, Arctostaphylos patula, Ceanothus cordulatus, Chrysolepis sempervirens, Prunus emarginata, Ribes spp.,* or *Symphoricarpos spp.* The herbaceous layer is characteristically sparse to absent, with *Apocynum androsaemifolium, Arabis platysperma, Aster breweri, Elymus glaucus, Hieracium albiflorum, Lupinus spp., Monardella odoratissima, Pteridium aquilinum*, and *Pyrola picta* among the most frequently encountered species. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006). In the aggregated database, the *Abies magnifica–Abies concolor* forest alliance includes the *Abies magnifica–Abies concolor* forest association (4071), the. *Abies magnifica–Abies concolor–Pinus jeffreyi* forest association (4072), and the *Abies magnifica–Abies concolor–Pinus lambertiana* forest association (4073).

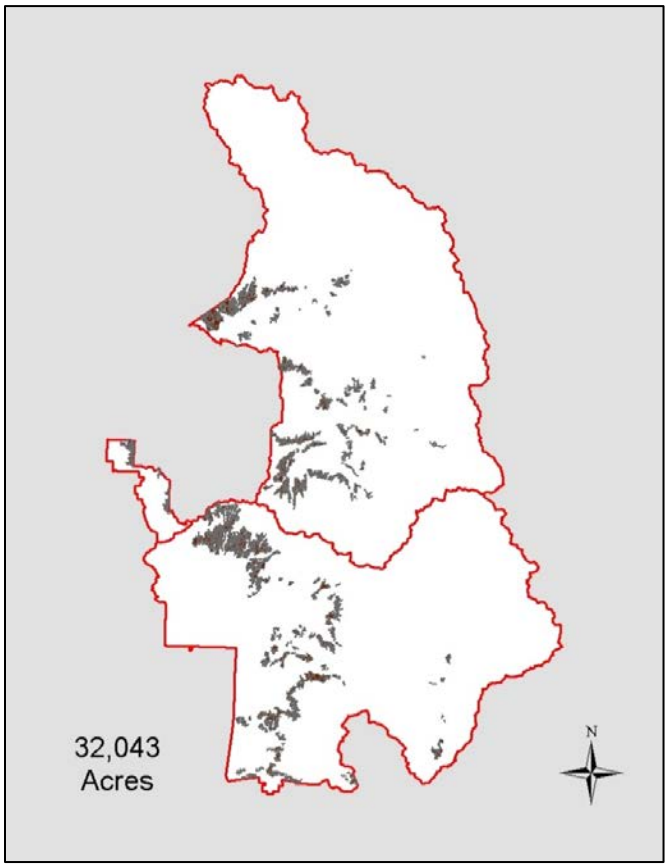


Figure 4070-1. Distribution of California Red Fir–White Fir Forest Alliance.

Accuracy:
Producer's accuracy: 96% (n=25)
User's accuracy: 60% (n=40)

Photo Interpretation Signature:
The photo signature of *Abies magnifica* is a large tree with a broad, red, conical crown. *A. concolor* appears brighter red with narrow conical crowns in the aerial photos, sometimes with a white dot on the tip of the crown as a result of die off (Figure 4070-2). *A. magnifica* is generally a larger tree with a crown that remains full further down the main stem than the smaller *A. concolor*. Separation between the two species is extremely difficult on signature alone except in the most optimal circumstances.

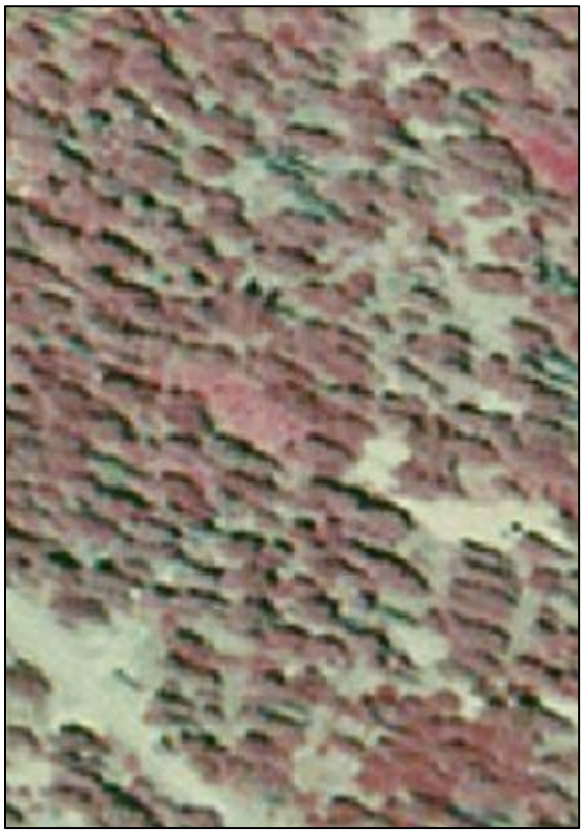


Figure 4070-2. California Red Fir–White Fir Forest signature. Photo reference: GIFO_NE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 1703–3077 m (5587–10095 ft)
Shape – concave, convex, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 4070-3.

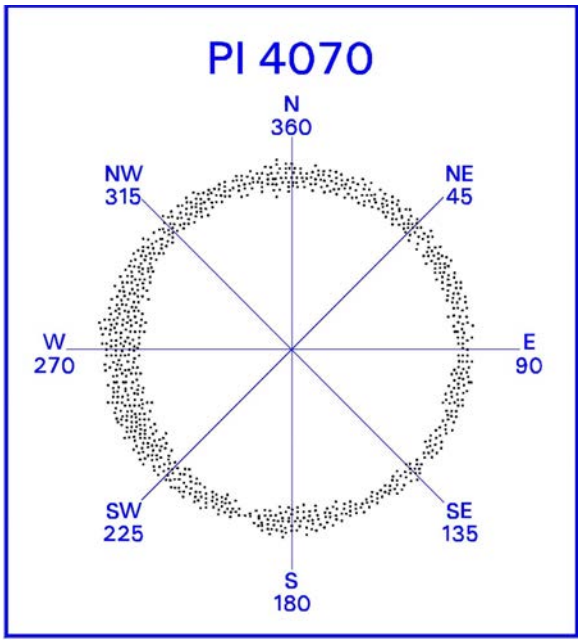


Figure 4070-3. Scatterplot of California Red Fir–White Fir Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- California Red Fir Forest Alliance 4050)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–White Fir Forest Association (4071)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)

4071 – California Red Fir–White Fir Forest Association
Abies magnifica–Abies concolor Forest Association

Description:

The *Abies magnifica–Abies concolor* forest association is mapped on gentle to steep slopes of varying aspect between 1951–3077 m (6401–10095 ft) across 17,376 acres of Sequoia and Kings Canyon National Parks (Figure 4071-1). The dense tree canopy is dominated by a mixture of *Abies magnifica* and *A. concolor*. The shrub layer ranges from absent to well developed, and most frequently includes *Ceanothus cordulatus, Chrysolepis sempervirens, Prunus emarginata, Ribes spp.,* or *Symphoricarpos spp.* The herbaceous layer is characteristically sparse to absent, with *Apocynum androsaemifolium, Arabis platysperma, Aster breweri, Elymus glaucus, Hieracium albiflorum, Lupinus spp., Monardella odoratissima, Pteridium aquilinum,* and *Pyrola picta* among the most frequently encountered species. The hydrology is upland. Soils are well drained sandy loams. In the aggregated database, the *Abies magnifica–Abies concolor* forest association is aggregated into the *Abies magnifica–Abies concolor* forest alliance (4070).

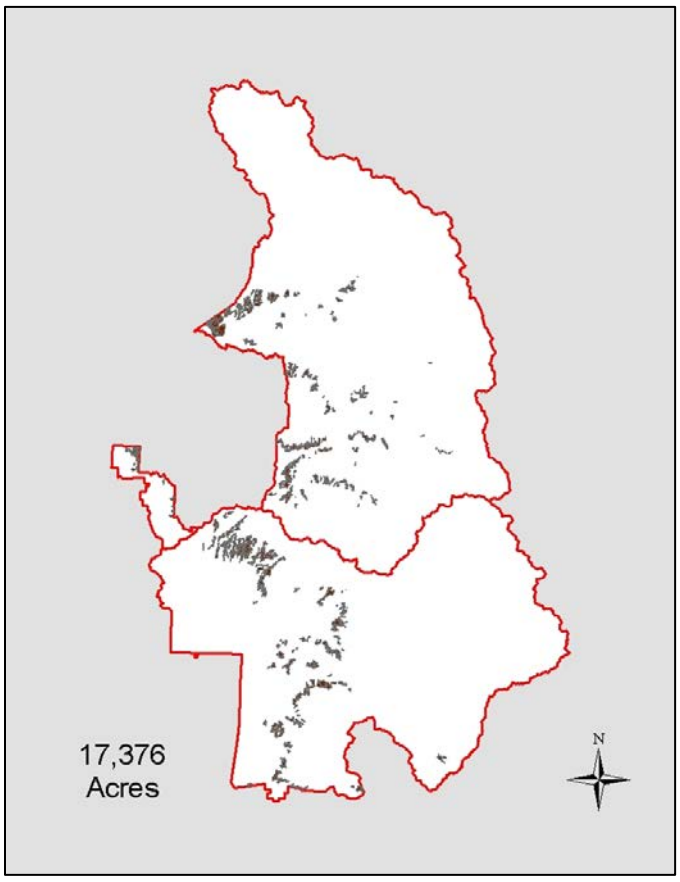


Figure 4071-1. Distribution of California Red Fir–White Fir Forest Association.

Accuracy:

Producer's accuracy: 83% (n=12)
User's accuracy: 50% (n=20)

Photo Interpretation Signature:

The photo signature of *Abies magnifica* is a large tree with a broad, red, conical crown. *A. concolor* appears brighter red with narrow conical crowns in the aerial photos, sometimes with a white dot on the tip of the crown (due to die off) (Figure 4071-2). *A. magnifica* is generally a larger tree than the smaller *A. concolor*. These forests are usually dense and are difficult to distinguish from the pure *A. concolor* (4081) and pure *A. magnifica* (4051) stands.

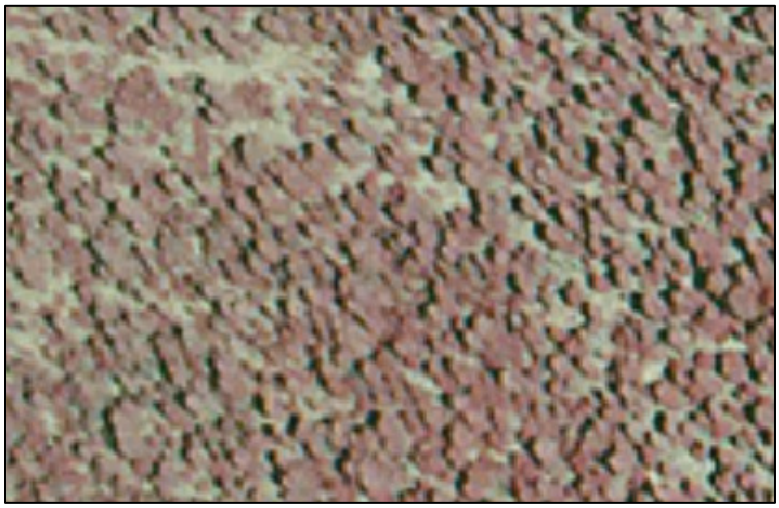


Figure 4071-2. California Red Fir–White Fir Forest. Photo reference: LODG_NW.

Environmental Characteristics:

Microclimate – mesic
Elevation – 1951–3077 m (6401–10095 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope
Steepness – gentle to steep
Aspect – See Figure 4071-3.

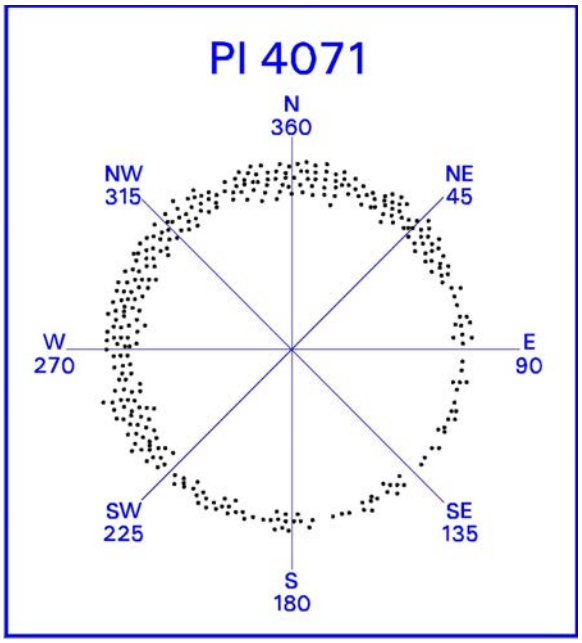


Figure 4071-3. Scatterplot of California Red Fir–White Fir Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Woodland Association (3083)
- California Red Fir Forest Association (4051)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- California Red Fir–White Fir Forest Alliance (4070)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir Forest Mapping Unit (4081)
- White Fir Mature Even-age Stands Mapping Unit (4082)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

4072 – California Red Fir–White Fir–Jeffrey Pine Forest Association
Abies magnifica–Abies concolor–Pinus jeffreyi Forest Association

Description:

The *Abies magnifica–Abies concolor–Pinus jeffreyi* forest association is mapped on moderate to steep slopes of varying aspect between 1939–2897 m (6361–9506 ft) across 10,080 acres of Sequoia and Kings Canyon National Parks (Figure 4072-1). The moderately dense tree canopy is characterized by *Abies concolor* and *Pinus jeffreyi* in mixture with *A. magnifica*. The shrub layer may be sparse or consist of patches of *Arctostaphylos patula, Ceanothus cordulatus, Chrysolepis sempervirens, Prunus emarginata,* or *Symphoricarpos rotundifolius*. The herbaceous layer is typically poorly developed, with *Hieracium albiflorum, Kelloggia galioides, Pedicularis semibarbata, Phacelia hydrophylloides,* and *Viola purpurea* most frequently encountered. Sites are upland and soils are well-drained sandy loams. (Potter 1998). In the aggregated database, the *Abies magnifica–Abies concolor–Pinus jeffreyi forest* association is aggregated into the *Abies magnifica–Abies concolor* forest alliance (4070).

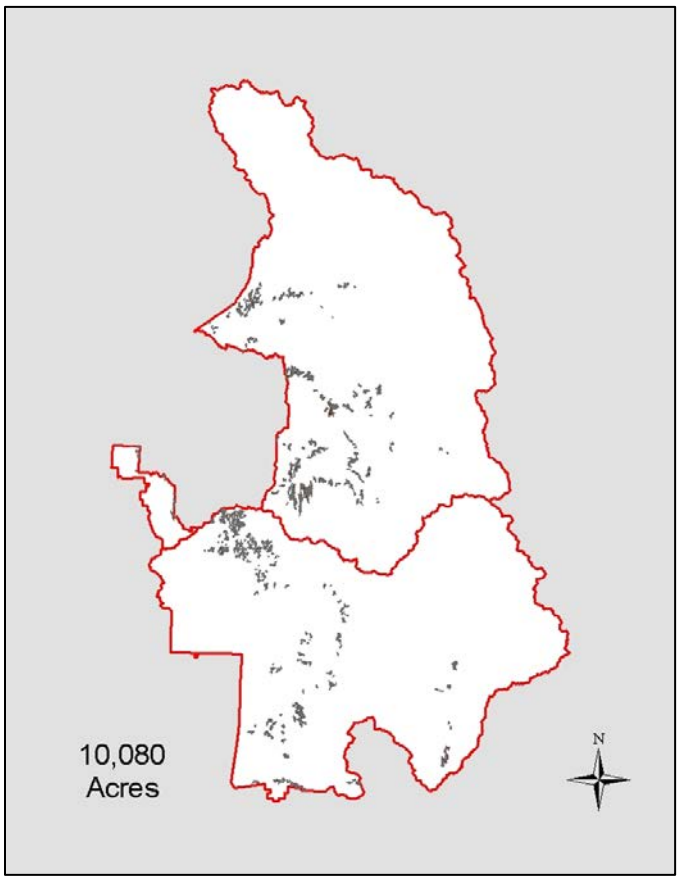


Figure 4072-1. Distribution of California Red Fir–White Fir–Jeffrey Pine Forest Association.

Accuracy:

Producer's accuracy: 88% (n=8)
User's accuracy: 50% (n=14)

Photo Interpretation Signature:

The *Pinus jeffreyi* photo signature has a large, pink or red colored, round crown. *Abies magnifica* has a broad, red, conical crown remaining full further down the main stem. *A. concolor* is smaller than the *P. jeffreyi* or *A. magnifica* and appears brighter red with narrow conical crowns on the aerial photos, sometimes with a white tip on the crown (from die off) (Figure 4072-2). This is generally a woodland type where *P. jeffreyi* is usually identifiable due to the larger rounded crown. It sometimes has a minor shrub component to the rocky understory.

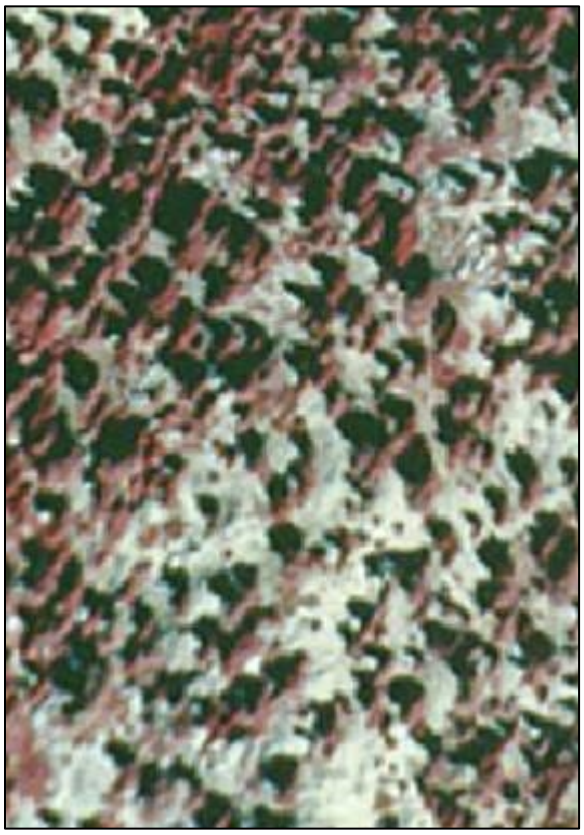


Figure 4072-2. California Red Fir–White Fir Forest–Jeffrey Pine Forest signature. Photo reference: MUGR_SE.

Environmental Characteristics:

Microclimate – xeric to sub mesic
Elevation – 1939–2897 m (6361–9506 ft)
Shape – neutral to slightly convex
Slope position – lowslope, midslope, highslope
Steepness – moderate to steep
Aspect – See Figure 4072-3.

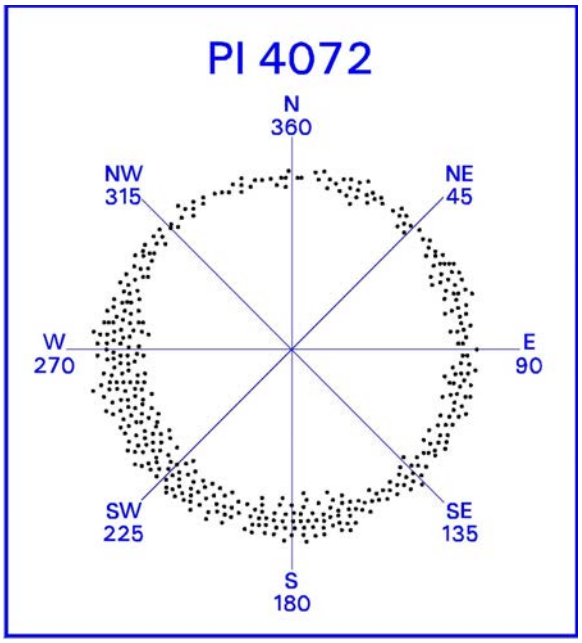


Figure 4072-3. Scatterplot of California Red Fir–White Fir–Jeffrey Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Woodland Association (3083)
- Jeffrey Pine–California Red Fir Woodland Association (3085)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–White Fir Forest Alliance (4070)
- California Red Fir–White Fir Forest Association (4071)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir Forest Mapping Unit (4081)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)

4073 – California Red Fir–White Fir–Sugar Pine Forest Association
Abies magnifica–Abies concolor–Pinus lambertiana Forest Association

Description:

The *Abies magnifica–Abies concolor–Pinus lambertiana* forest association is mapped on moderate to steep slopes of varying aspect between 1703–2611 m (5587–8567 ft) across 4,457 acres of Sequoia and Kings Canyon National Parks (Figure 4073-1). The tree canopy of these dense multi-layered forest stands is generally dominated by a mixture of *Abies concolor* and *A. magnifica*, and characterized by the presence of scattered *Pinus lambertiana. Calocedrus decurrens* and *P. jeffreyi* may also occur. The shrub layer may be patchy or sparse, with *Chrysolepis sempervirens* and *Ribes spp*. most frequently encountered. The characteristically sparse herbaceous layer most often includes *Aster breweri, Monardella odoratissima, Hieracium albiflorum,* and/or *Pteridium aquilinum.* Sites are upland and soils are well-drained sandy loams or loams. (NatureServe January 2007). In the aggregated database, the *Abies magnifica–Abies concolor–Pinus lambertiana* forest association is aggregated into the *Abies magnifica–Abies concolor* forest alliance (4070).

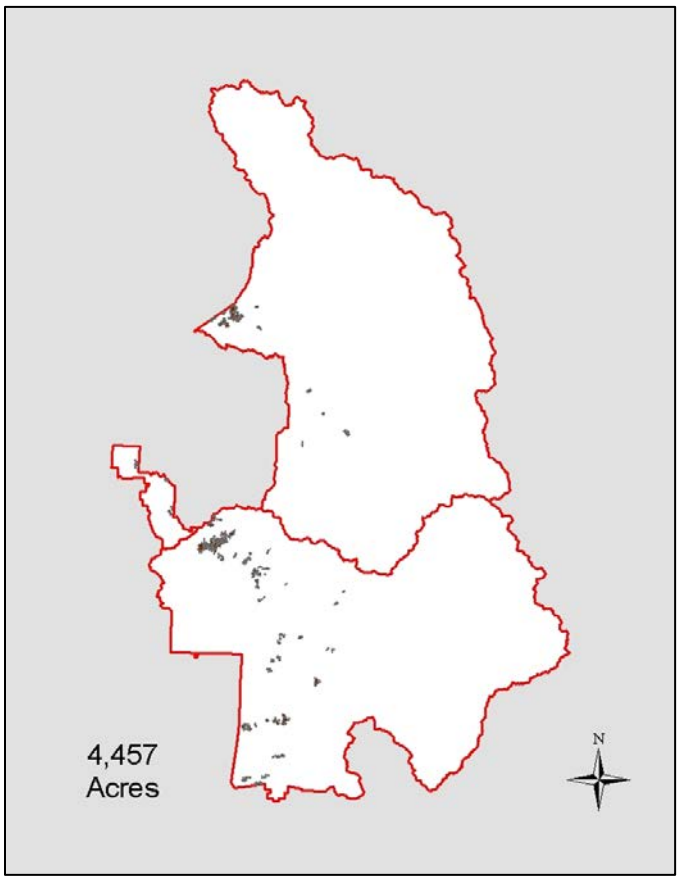


Figure 4073-1. Distribution of California Red Fir–White Fir–Sugar Pine Forest Association.

Accuracy:

Producer's accuracy: 100% (n=5)
User's accuracy: 83% (n=6)

Photo Interpretation Signature:

The *Pinus lambertiana* photo signature has a large pink or red star shaped crown. The *Abies magnifica* signature looks like a large tree with a broad, red, conical crown. The *A. concolor* is smaller than the *P. lambertiana* or the *A. magnifica* and appears brighter red with narrow conical crowns on the aerial photos, sometimes with a white tip on the crown (due to die off) (Figure 4073-2). This is generally a closed stand, but can have some openings where there may be a minor shrub component. There can be a minor component of *P. jeffreyi*.

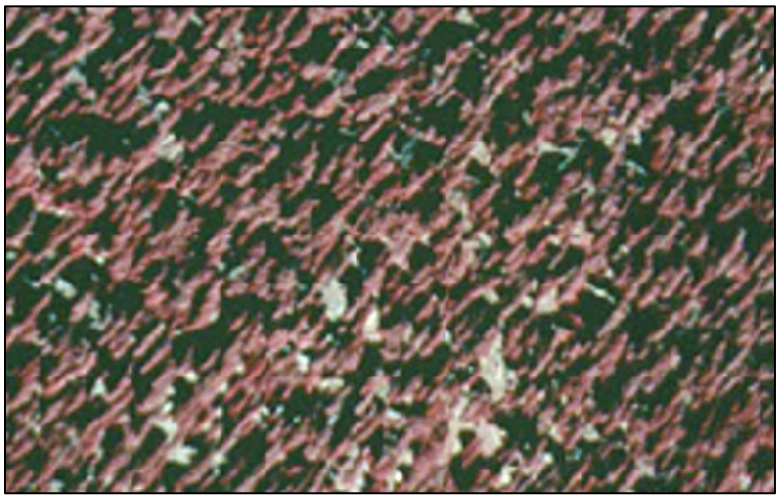


Figure 4073-2. California Red Fir–White Fir–Sugar Pine Forest. Photo reference: MUGR_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1703–2611 m (5587–8567 ft)
Shape – neutral to slightly convex
Slope position – lowslopes and midslopes
Steepness – moderate to steep
Aspect – See Figure 4073-3.

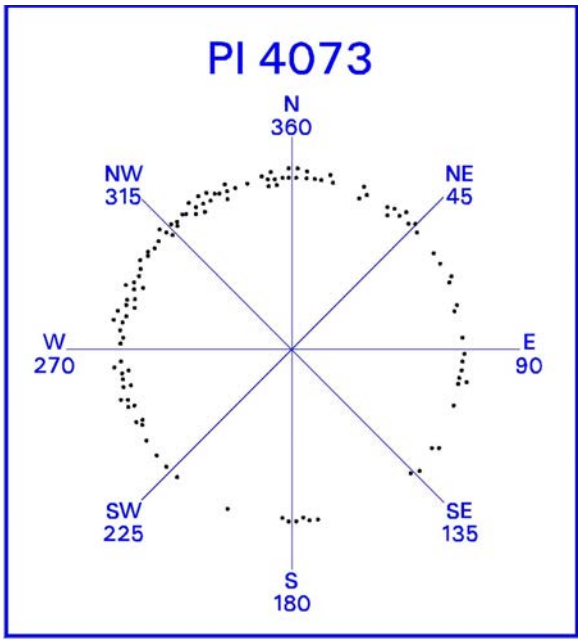


Figure 4073-3. Scatterplot of California Red Fir–White Fir–Sugar Pine Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association (4021)
- Giant Sequoia–White Fir–California Red Fir Forest Association (4023)
- California Red Fir–White Fir Forest Alliance (4070)
- California Red Fir–White Fir Forest Association (4071)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- White Fir Forest Mapping Unit (4081)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)

4080 – White Fir–Sugar Pine Forest Alliance



White Fir–Sugar Pine–Incense-cedar Forest. Photo reference: SEKI-AA.0030_540.

4080 – White Fir–Sugar Pine Forest Alliance

Abies concolor–Pinus lambertiana Forest Alliance

Description:

The *Abies concolor–Pinus lambertiana* forest alliance is mapped on gentle to steep slopes of varying aspect between 1109–2897 m (3638–9504 ft) across 39,691 acres of Sequoia and Kings Canyon National Parks (Figure 4080-1). This forest alliance includes some of the most extensive montane forests mapped in the two parks, including stands of what is frequently referred to as the 'mixed conifer' forest. The tree canopy is dominated by a mixture of *Abies concolor* and *Pinus lambertiana*, with *Calodedrus decurrens* important on lower elevation sites. Other trees in the canopy frequently include *P. jeffreyi, P. ponderosa*, and/or *Quercus kelloggii; P. contorta var. murrayana* may also occur in colder air drainages. The shrub layer is dominated by regeneration of the coniferous overstory and may also contain *Arctostaphylos patula, Ceanothus cordulatus, Chamaebatia foliolosa, Chrysolepis sempervirens, Cornus nuttallii, Corylus cornuta var. californica, Prunus emarginata,* or *Ribes spp*. depending on site conditions. The herbaceous layer is characteristically sparse, but frequently includes *Adenocaulon bicolor, Apocynum androsaemifolium, Draperia systyla, Galium sparsiflorum, Hieracium albiflorum,* and/or *Pteridium aquilinum* in addition to young conifer seedlings. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

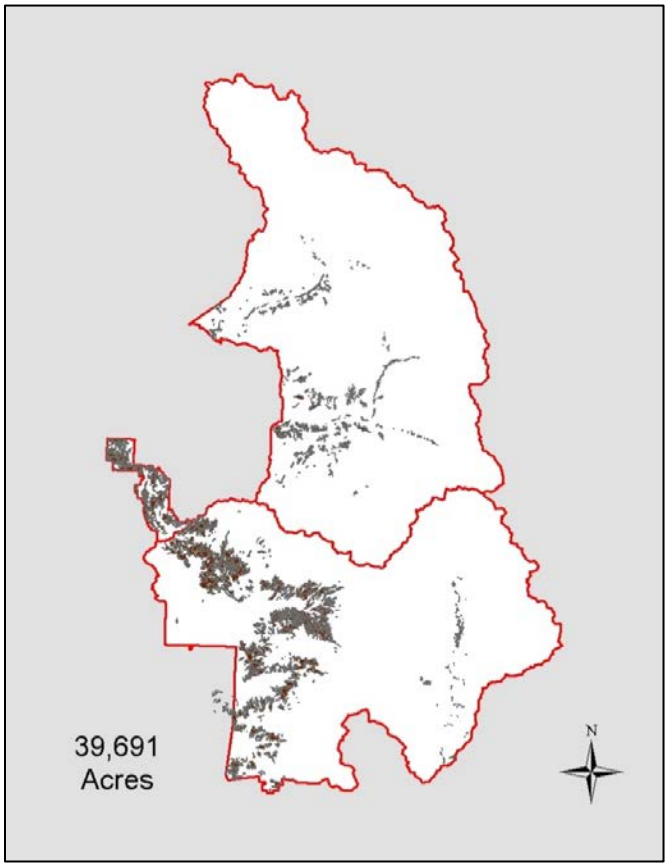


Figure 4080-1. Distribution of White Fir–Sugar Pine Forest Alliance.

Accuracy:
Producer's accuracy: 50% (n=4)
User's accuracy: 67% (n=3)

Photo Interpretation Signature:
Photo interpreters map this alliance in dense woodland or forest settings that open up only in post disturbance-related settings such as following fire. Mature *Pinus lambertiana* maintain their large star-shaped crown even in forest settings and contrast easily with the narrow conical crowns of the *Abies concolor* (Figure 4080-2).



Figure 4080-2. White Fir Forest–Sugar Pine Forest Alliance signature. Photo reference: GIFO_NE.

Environmental Characteristics:
Microclimate – sub-mesic
Elevation – 1109–2897 m (3638–9504 ft)
Shape – concave, convex, flat, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 4080-3.

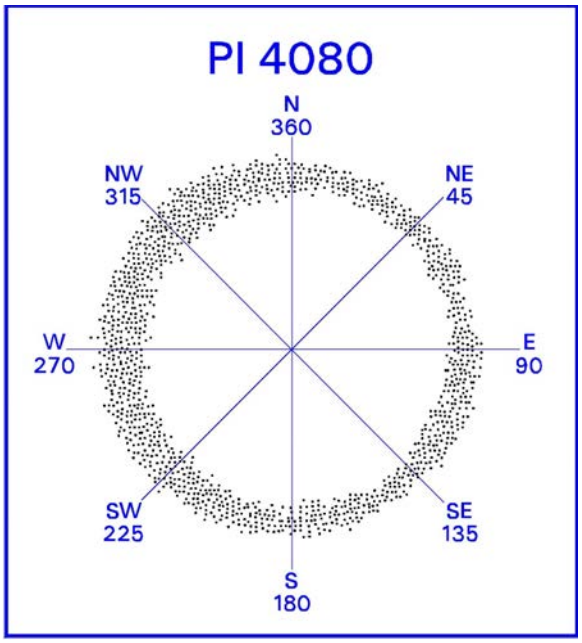


Figure 4080-3. Scatterplot of White Fir–Sugar Pine Forest Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- California Red Fir Forest Alliance (4050)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–White Fir Forest Alliance (4070)
- White Fir Forest Mapping Unit (4081)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)

4081 – White Fir Forest Mapping Unit
Abies concolor Mapping Unit

Description:
The *Abies concolor* forest mapping unit is mapped on gentle to moderately steep slopes of varying aspect between 1109–2897 m (3638–9504 ft) across 5,128 acres of Sequoia and Kings Canyon National Parks (Figure 4081-1). The open to dense tree canopy is characterized by the dominance of *Abies concolor*, with *Calocedrus decurrens, Pinus jeffreyi*, and *P. lambertiana* frequently co-occuring. A subcanopy of *Cornus nuttalli, Corylus cornuta,* or *Quercus kelloggii* may be present. The shrub layer may be sparse to dense, with *Arctostaphylos patula, Ceanothus cordulatus, Ribes spp*., and *Symphoricarpos* most frequently encountered. The herbaceous layer is characteristically sparse, but in more open stands may be well developed. Frequently encountered species include *Apocynum androsaemifolium, Galium sparsiflorum, Gayophytum spp.,* and *Pteridium aquilinum*. Soils of these upland stands are well-drained sandy loams and loams.

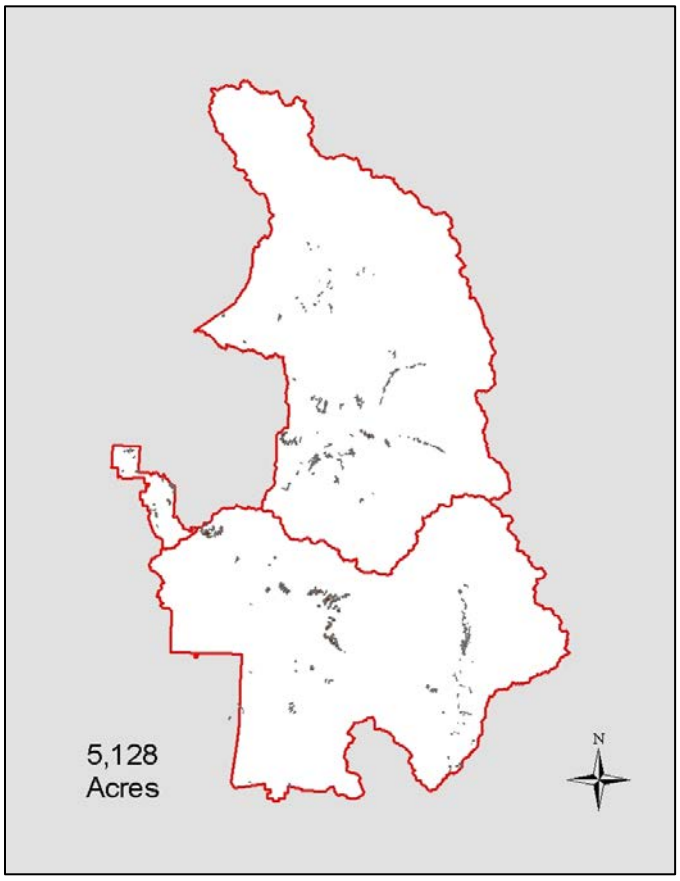


Figure 4081-1. Distribution of White Fir Forest.

Accuracy:
Producer's accuracy: 76% (n=29)
User's accuracy: 92% (n=24)

Photo Interpretation Signature:

Mapped where little or no *Pinus lambertiana* is observed, primarily in narrow protected ravines and coves. Crown canopy appears as a uniform *Abies concolor* signature of narrow conical crowns (Figure 4081-2).

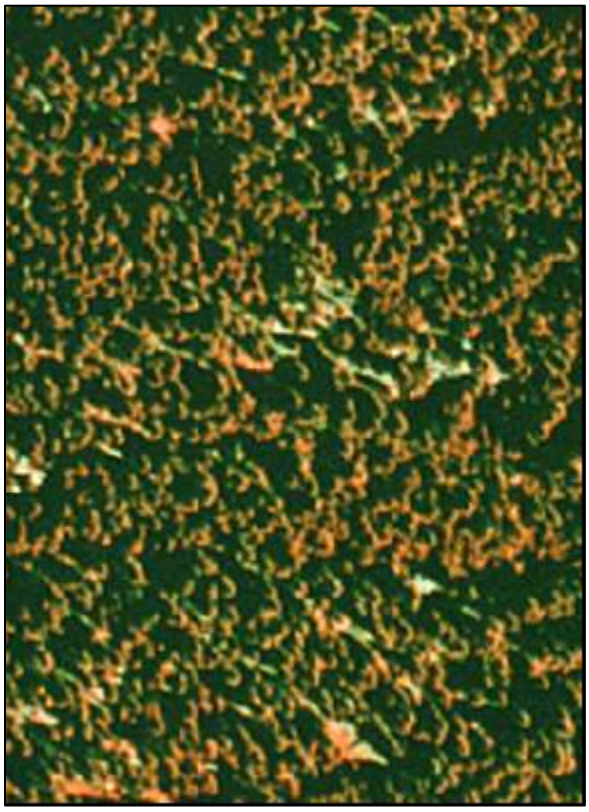


Figure 4081-2. White Fir Forest signature. Photo reference: MUGR_SW.

Environmental Characteristics:

Microclimate – xeric to submesic
Elevation – 1109–2897 m (3638–9504 ft)
Shape – neutral to concave
Slope position – canyon bottom, lowslope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 4081-3.

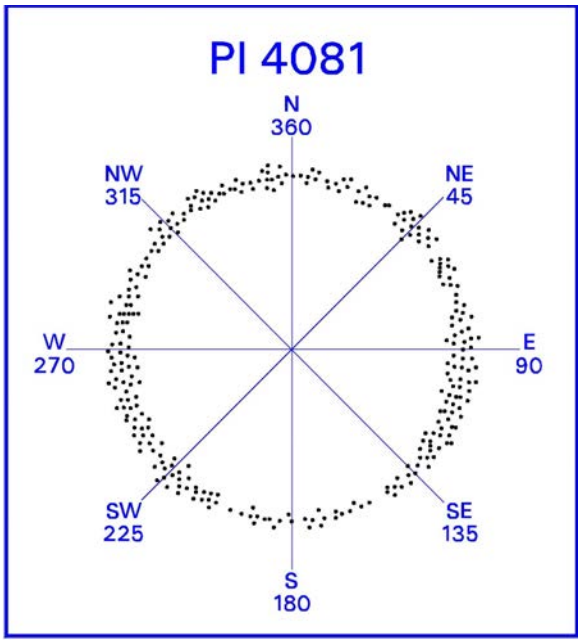


Figure 4081-3. Scatterplot of White Fir Forest in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Black Cottonwood Forest Association (2053)
- Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Woodland Association (3083)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- California Red Fir Forest Association (4051)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- California Red Fir–White Fir Forest Association (4071)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir Mature Even-age Stands Mapping Unit (4082)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094

4082 – White Fir Mature Even-age Stands Mapping Unit
Abies concolor Mature Even-age Stands Mapping Unit

Description:
The *Abies concolor* mature even-age stands mapping unit is mapped on gentle to moderately steep slopes of varying aspect between 1510–953 m (4953–3128 ft) across 3,279 acres of Sequoia and Kings Canyon National Parks (Figure 4082-1). The tree canopy is dominated by *Abies concolor*, with *A. magnifica, Calodedrus decurrens* and *Pinus lambertiana* also frequently important. The defining characteristic of these stands is the dominance of even-aged mature (as opposed to the regeneration mapped as conifer reproduction (910) *A. concolor*, likely indicating late post burn status.

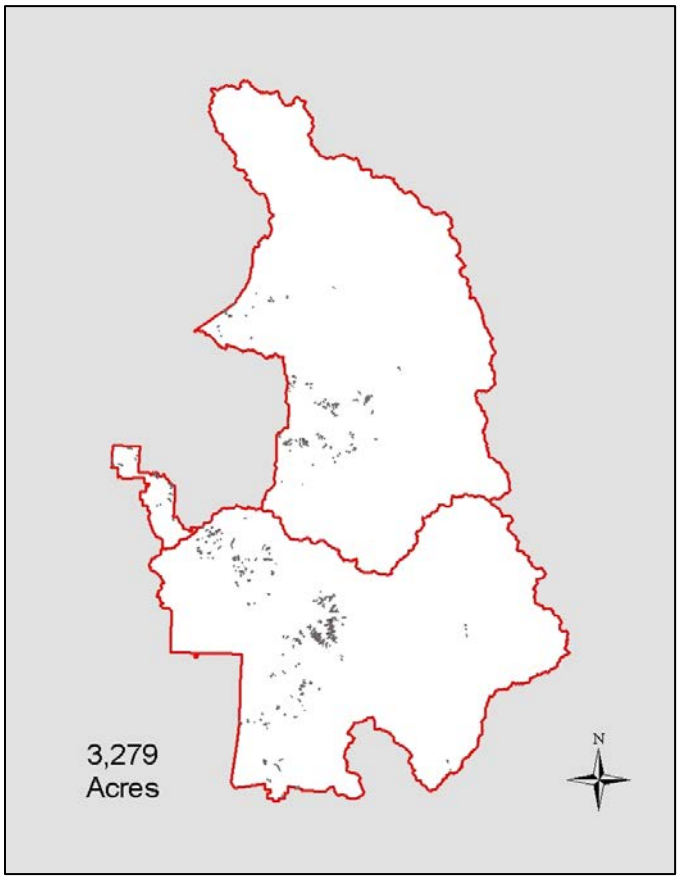


Figure 4082-1. Distribution of White Fir Mature Even-age Stands Mapping Unit.

Accuracy:
Producer's accuracy: 100% (n=8)
User's accuracy: 89% (n=9)

Photo Interpretation Signature:
Even age stands of young *Abies concolor* give off a fairly regular patterning throughout the stand—young firs tend to have a brighter infrared signature (Figure 4082-2).

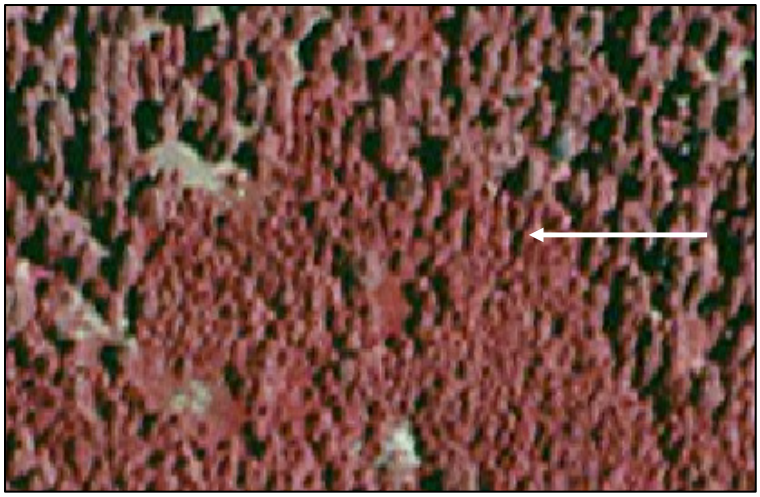


Figure 4082-2. White Fir Mature Even-age Stands Mapping Unit signature. Photo reference: GIFO_NW.

Environmental Characteristics:

Microclimate – xeric to submesic
Elevation – 1510–953 m (4953–3128 ft)
Shape – neutral to concave
Slope position – canyon bottom, lowslope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 4082-3.

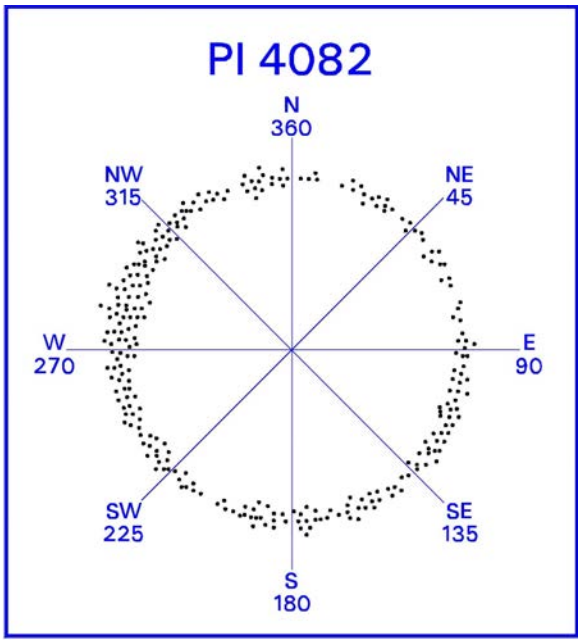


Figure 4082-3. Scatterplot of White Fir Mature Even-age Stands Mapping Unit in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Conifer Reproduction (0910)

- California Red Fir Forest Association (4051)
- California Red Fir–White Fir Forest Association (4071)
- White Fir Forest Mapping Unit (4081)

4084 – White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit

Abies concolor–(*Abies magnifica–Pinus lambertiana–Pinus jeffreyi*)/*Ceanothus cordulatus*–(*Arctostaphylos patula*) Forest Mapping Unit

Description:

The *Abies concolor*–(*Abies magnifica–Pinus lambertiana–Pinus jeffreyi*)/*Ceanothus cordulatus*–(*Arctostaphylos patula*) forest mapping unit is mapped on moderate to moderately steep slopes of varying aspect between 1641–2792 m (5384–9160 ft) across 1,471 acres of Sequoia and Kings Canyon National Parks (Figure 4084-1). The tree canopy of these open to moderately dense stands is dominated by *Abies concolor*, with *A. magnifica*, *Pinus jeffreyi*, and/or *P. lambertiana* contributing varying amounts of cover. *A. concolor* generally dominates the canopy layer; *A. magnifica*, *P. jeffreyi*, and/or *P. lambertiana* can be present, subordinate or exist occasionally as a co-dominant. The shrub layer is typically well developed, and is characterized by patches of *Ceanothus cordulatus*, although *Arctostaphylos patula* is frequently important. The herbaceous layer is characteristically sparse, with *Apocynum androsaemifolium, Eriogonum nudum*, and *Gayophytum spp.* most frequently encountered. This mapping unit is mapped most frequently in post-fire environments.

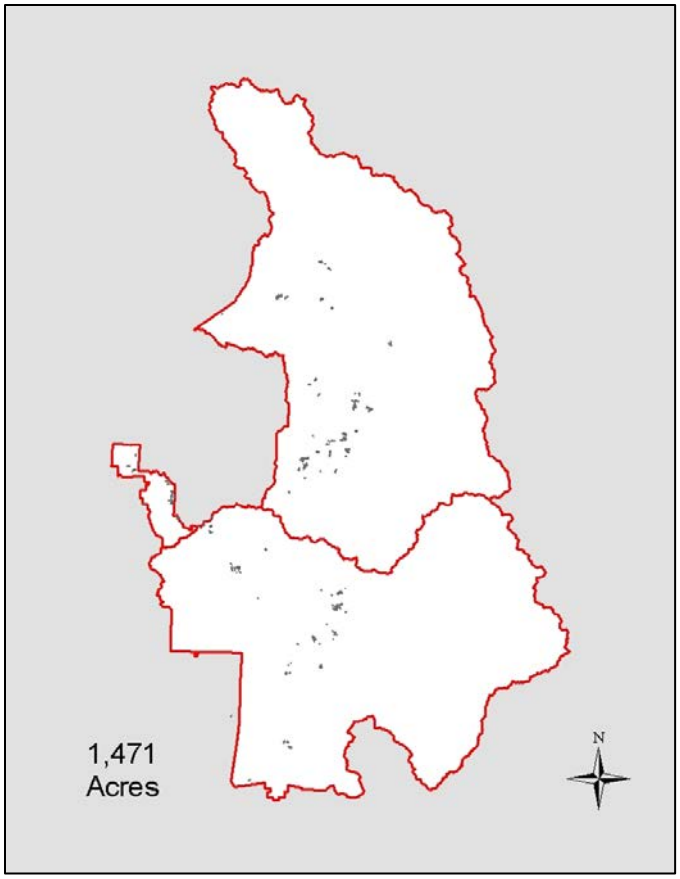


Figure 4084-1. Distribution of White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit.

Accuracy:

Producer's accuracy: 67% (n=3)
User's accuracy: 67% (n=3)

Photo Interpretation Signature:

This type is typical in disturbance related openings in *Abies concolor* and *Abies concolor–Pinus lambertiana* types in post fire settings. The *Ceanothus cordulatus* signature tends to be uniformly smooth and pink. The conifer signature varies due to the variable composition of the tree canopy (Figure 4084-2).

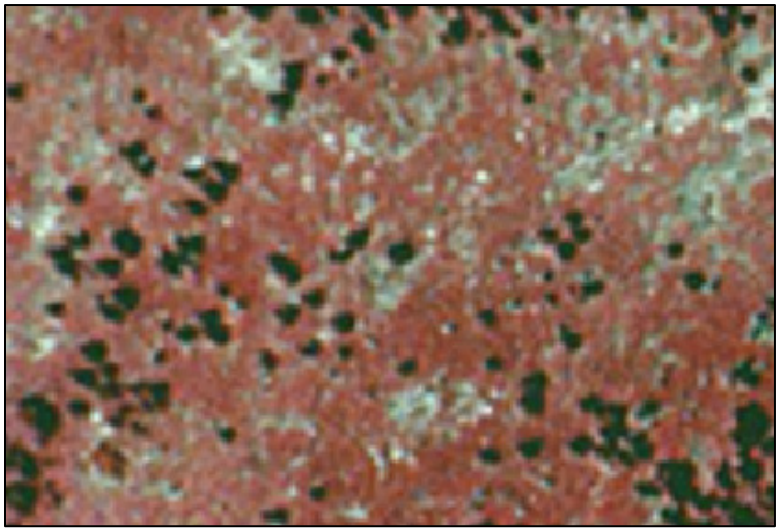


Figure 4084-2. White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit signature. Photo reference: TDPE_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 1641–2792 m (5384–9160 ft)
Shape – variable
Slope position – lowslope, midslope
Steepness – moderate to steep
Aspect – See Figure 4084-3.

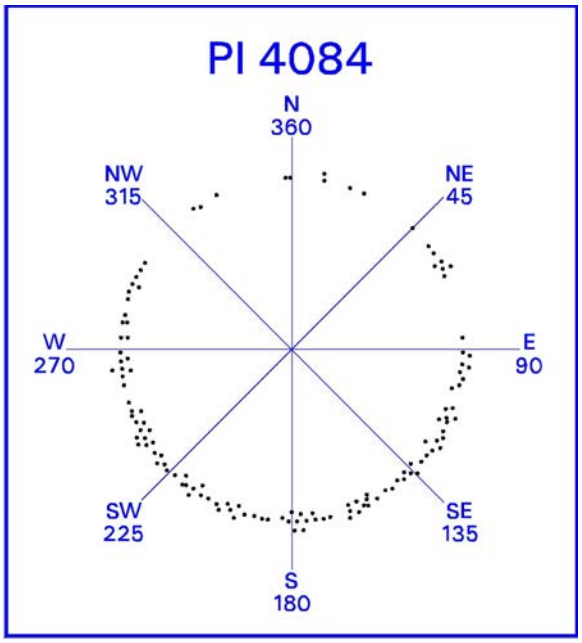


Figure 4084-3. Scatterplot of White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Conifer Reproduction (0910)
- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- California Red Fir Forest Alliance (4050)
- California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita–Whitethorn Ceanothus) Forest Mapping Unit (4054)
- California Red Fir–White Fir Forest Alliance (4070)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)
- Whitethorn Ceanothus Shrubland Alliance (5110)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)



White Fir Sugar Pine Forest. SEKI.0919_1987.

4094 – White Fir–Sugar Pine–Incense-cedar Forest Superassociation

Abies concolor–Pinus lambertiana–Calocedrus decurrens Forest Superassociation

Description:

The *Abies concolor–Pinus lambertiana–Calocedrus decurrens* forest superassociation is mapped on moderate to steep montane slopes of varying aspect between 1253–2530 m (4110–8302 ft) across 24,772 acres of Sequoia and Kings Canyon National Parks (Figure 4094-1). Stands of this late successional forest are characterized by a dense, several layered conifer overstory co-dominated by *Abies concolor* and *Calocedrus decurrens*, with *Pinus lambertiana* consistently present as a minor associate. *P. jeffreyi, P. ponderosa,* and/or *Quercus kelloggii* may also be present. The shrub layer is dominated by regeneration of the coniferous overstory and may also contain *Arctostaphylos patula, Ceanothus cordulatus, Chamaebatia foliolosa, Chrysolepis sempervirens, Cornus nuttallii, Corylus cornuta var. californica, Prunus emarginata,* or *Ribes spp.* The sparse herbaceous layer is characterized by *Adenocaulon bicolor,* with *Draperia systyla, Galium sparsiflorum, Hieracium albiflorum, Pteridium aquilinum*, and *Smilacina racemosa* among the most frequently encountered herbaceous species. The hydrology is upland. Soils are well drained sandy loams. (Fites 1994, NatureServe October 2006).

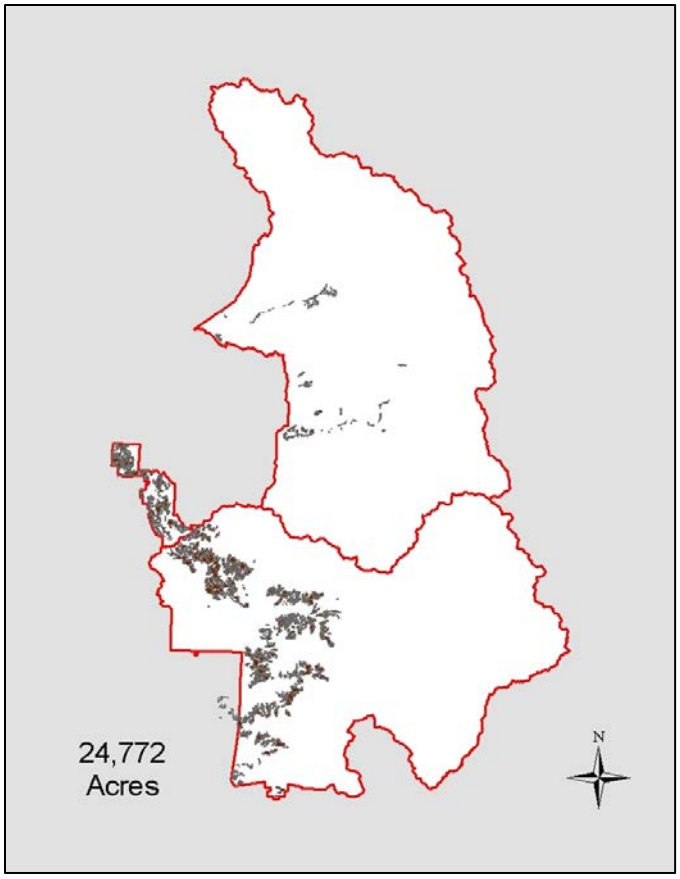


Figure 4094-1. Distribution of White Fir–Incense-cedar Forest Superassociation.

Accuracy:

Producer's accuracy: 84% (n=25)
User's accuracy: 84% (n=25)

Photo Interpretation Signature:

The *Abies concolor–Pinus lambertiana–Calocedrus decurrens* forest superassociation may form extensive transitions between the *Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii* forest association (3063) at lower elevations and the *Abies magnifica–Abies concolor–Pinus lambertiana* forest association (4073) at higher elevations. In these settings, it can be extremely difficult to differentiate accurately. *Pinus lambertiana* has a crown signature similar to *P. monticola*, but with even more extensive branching higher up on the main stem. *Calocedrus decurrens* is not discernable in a mixed conifer environment. It generally occurs in closed stands with little disturbance. (Figure 4094-2).

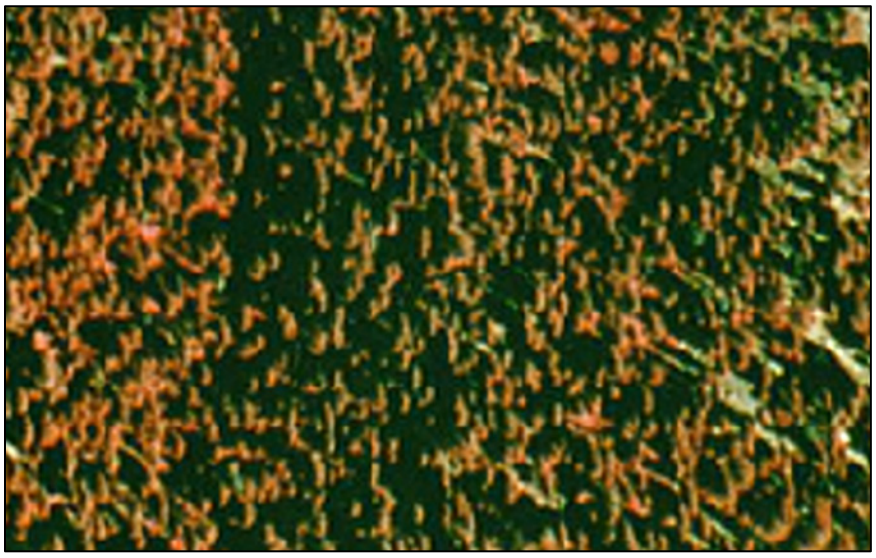


Figure 4094-2. White Fir–Sugar Pine–Incense-cedar superassociation signature. Photo reference: MUGR_SW.

Environmental Characteristics:

Microclimate – xeric to submesic
Elevation – 1253–2530 m (4110–8302 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 4094-3.

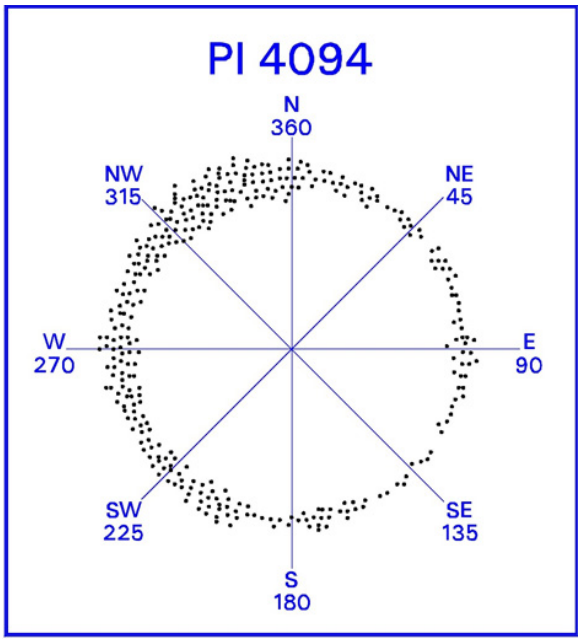


Figure 4094-3. Scatterplot of White Fir–Sugar Pine–Incense-cedar superassociation in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Ponderosa Pine–Incense-cedar–California Black Oak Forest Association (3063)
- White Fir–Jeffrey Pine–(Sugar Pine) Woodland Mapping Unit (3550)
- Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association (4021)
- Giant Sequoia–White Fir–California Red Fir Forest Association (4023)
- California Red Fir–White Fir Forest Association (4071)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir Forest Mapping Unit (4081)
- White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit (4095)

4095 – White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit
Abies concolor–Pinus lambertiana/Arctostaphylos patula–Ceanothus cordulatus Forest Mapping Unit

Description:

The *Abies concolor–Pinus lambertiana/Arctostaphylos patula–Ceanothus cordulatus* forest mapping unit is mapped on moderate to steep slopes of varying aspect between 1415–2491 m (4643–8172 ft) across 3,083 acres of Sequoia and Kings Canyon National Parks (Figure 4095-1). The tree canopy is dominated by *Abies concolor*, with *Pinus lambertiana* consistently present as a minor associate. The shrub layer is well developed and contains a mixture of *Arctostaphylos patula* and *Ceanothus cordulatus*. *Prunus emarginata* and/or *Ribes spp.* may also be present. The herbaceous layer is poorly developed to absent. The hydrology is upland. Soils are moderately well drained sandy loams.

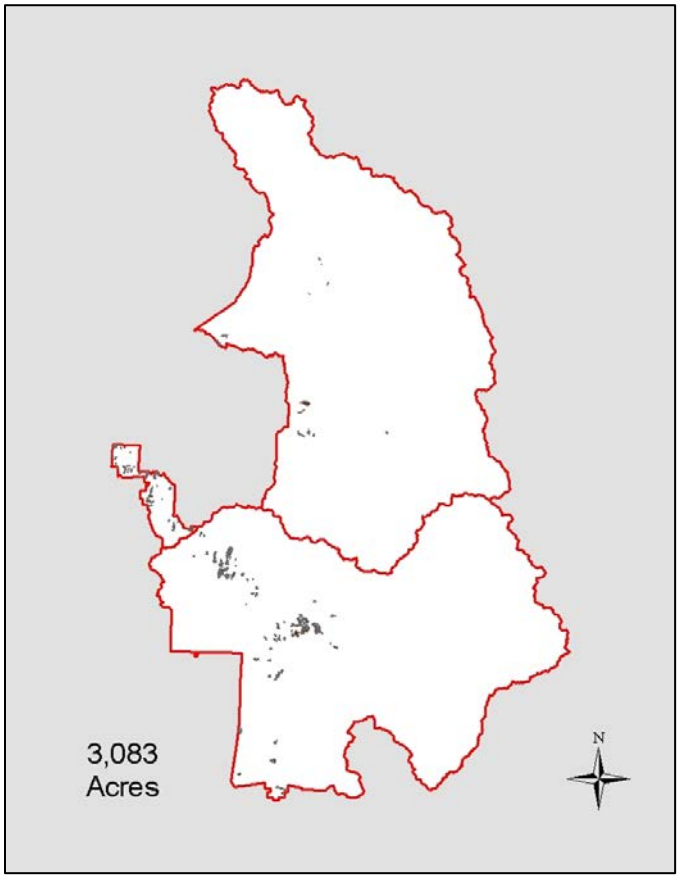


Figure 4095-1. Distribution of White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit.

Accuracy:

Producer's accuracy: 100% (n=6)
User's accuracy: 75% (n=8)

Photo Interpretation Signature:

This type is similar to higher elevation conifer / shrub types where *Abies magnifica* dominates the canopy. There is a frequent presence of *Pinus lambertiana* separating out this lower elevation mixed conifer community from those where *Abies magnifica dominates*. There are also adjacent and nearby stands of vegetation in modeling out this type, such as black oak or canyon oak which again are not associated with the higher elevation mixed conifer.

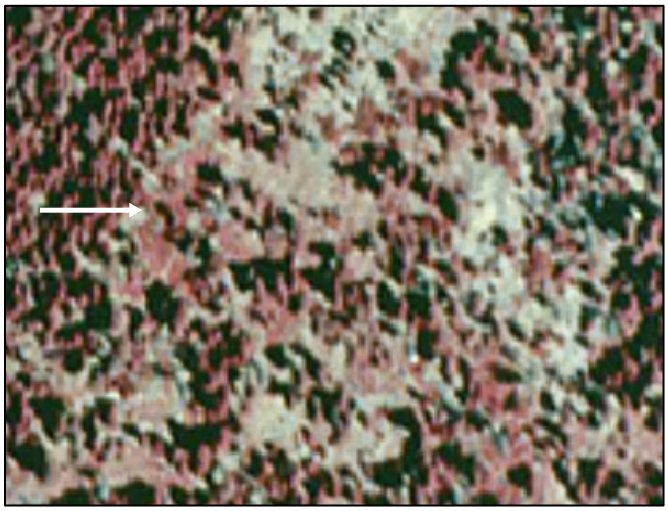


Figure 4095-2. White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit signature. Photo reference: GIFO_NE.

Environmental Characteristics:

Microclimate – xeric to sub mesic
Elevation – 1415–2491 m (4643–8172 ft)
Shape – variable
Slope position – low slope, midslope
Steepness – moderate to steep
Aspect – See Figure 4095-3.

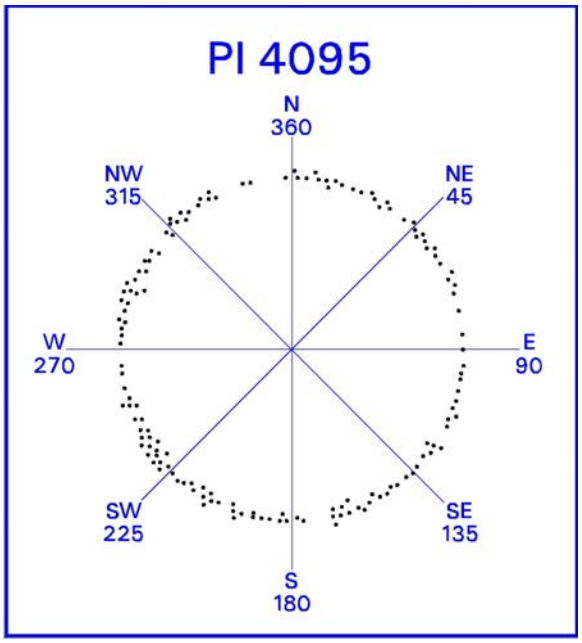


Figure 4095-3. Scatterplot of White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine/Whitethorn Ceanothus Woodland Association (3073)
- Giant Sequoia Forest Alliance (4020)
- California Red Fir Forest Alliance (4050)
- California Red Fir–White Fir Forest Alliance (4070)
- California Red Fir–White Fir–Jeffrey Pine Forest Association (4072)
- California Red Fir–White Fir–Sugar Pine Forest Association (4073)
- White Fir–Sugar Pine Forest Alliance (4080)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- White Fir–Sugar Pine–Incense-cedar Forest Superassociation (4094)

4100 – Sierra Juniper Woodland Alliance



Sierra Juniper Woodland. SEKI.0038_54.

4100 – Sierra Juniper Woodland Alliance

Juniperus occidentalis var. *australis* Woodland Alliance

Description:

The *Juniperus occidentalis var. australis* woodland alliance is mapped on moderate to very steep exposed, rocky slopes of primarily south to southwest aspect between 1966–3335 m (6450–10942 ft) across 20,984 acres in Sequoia and Kings Canyon National Parks (Figure 4100-1). Although the sparse tree canopy is characterized by the presence of *Juniperus occidentalis var. australis, Pinus jeffreyi* is often the dominant tree. *Abies magnifica, P. balfouriana ssp. austrina, P. contorta var. murrayana*, and *P. monticola* are also common associates. The shrub layer can be sparse or well developed, and is most frequently dominated by *Arctostaphylos nevadensis, A. patula, Artemisia tridentata, Cercocarpus ledifolius, Chrysolepis sempervirens, Eriogonum wrightii, Holodiscus microphyllus,* or *Ribes cereum*. The herbaceous layer is sparse, with *Carex exserta, Elymus elymoides*, and *Penstemon newberryi* among the most frequently encountered species. The hydrology is upland. Soils are moderately well drained to well drained sandy loam. (NatureServe October 2006).

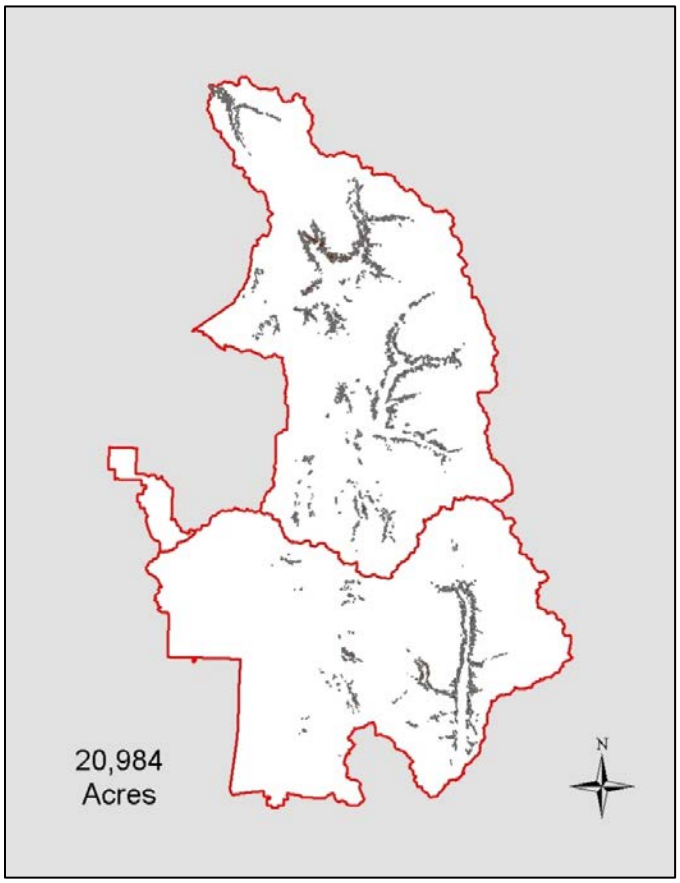


Figure 4100-1. Distribution of Sierra Juniper Woodland Alliance.

Accuracy:
Producer's accuracy: 67% (n=9)
User's accuracy: 86% (n=7)

Photo Interpretation Signature:
Photo interpreters note the presence of *Juniperus occidentalis var. australis* nearly always in rocky settings (Figure 4100-2). When present in stands with *Pinus jeffreyi*, the two trees are hard to separate, although *J. occidentalis var. australis* generally has a brighter red crown than the larger more rounded *P. jeffreyi*. Young *P. jeffreyi* and *J. occidentalis var. australis* are often indistinguishable.

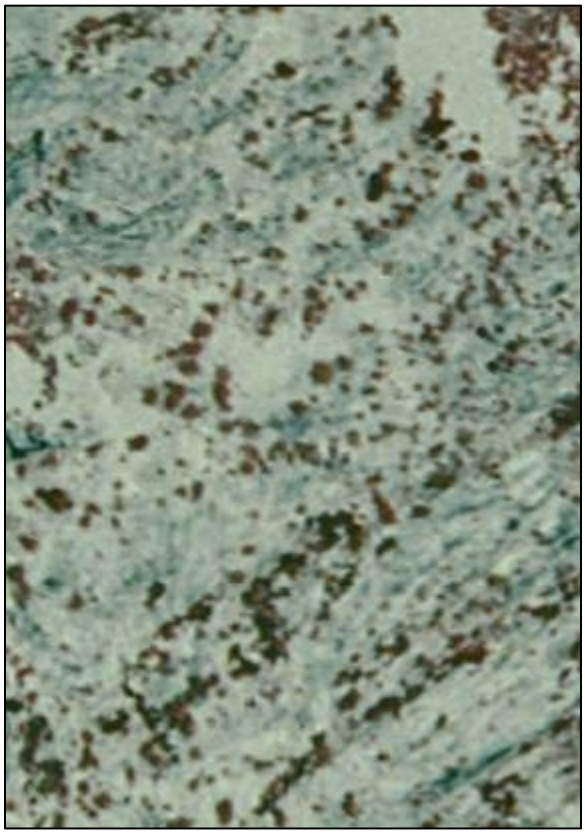


Figure 4100-2. Sierra Juniper Woodland Alliance signature. Photo reference: MOKA_NW.

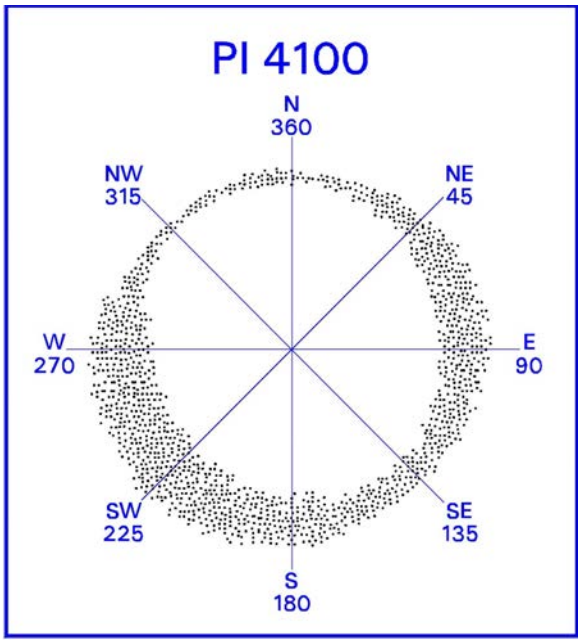


Figure 4100-3. Scatterplot of Sierra Juniper Woodland Alliance in relation to aspect.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1966–3335 m (6450–10942 ft)
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – moderate to very steep
Aspect – See Figure 4100-3.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Jeffrey Pine Woodland Alliance (3070)
- Singleleaf Pinyon Pine Woodland Alliance (3110)
- Western White Pine Woodland Alliance (3130)
- Whitebark Pine Woodland Alliance (3140)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

4107 – Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association
Juniperus occidentalis var. *australis–Cercocarpus ledifolius/Artemisia tridentata* Woodland Association

Description:

The *Juniperus occidentalis var. australis–Cercocarpus ledifolius / Artemisia tridentata* woodland association is mapped on moderately steep south to southwest facing rocky outcrops between 2123–3306 m (6965–10845 ft across 3,393 acres in Sequoia and Kings Canyon National Parks (Figure 4107-1). The open tree canopy is dominated by *Juniperus occidentalis var. australis,* with occasional *Pinus jeffreyi*. The shrub layer may be sparse to dense, and is characterized by the presence of *Cercocarpus ledifolius*; as mapped in Sequoia and Kings Canyon National Parks, *Artemisia tridentata* may or may not be present. Dense patches of *Arctostaphylos patula* or *Chrysolepis sempervirens* may also be present. The sparse herbaceous layer is composed primarily of dryland graminoids such as *Elymus elymoides*. The hydrology is upland. (NatureServe October 2006).

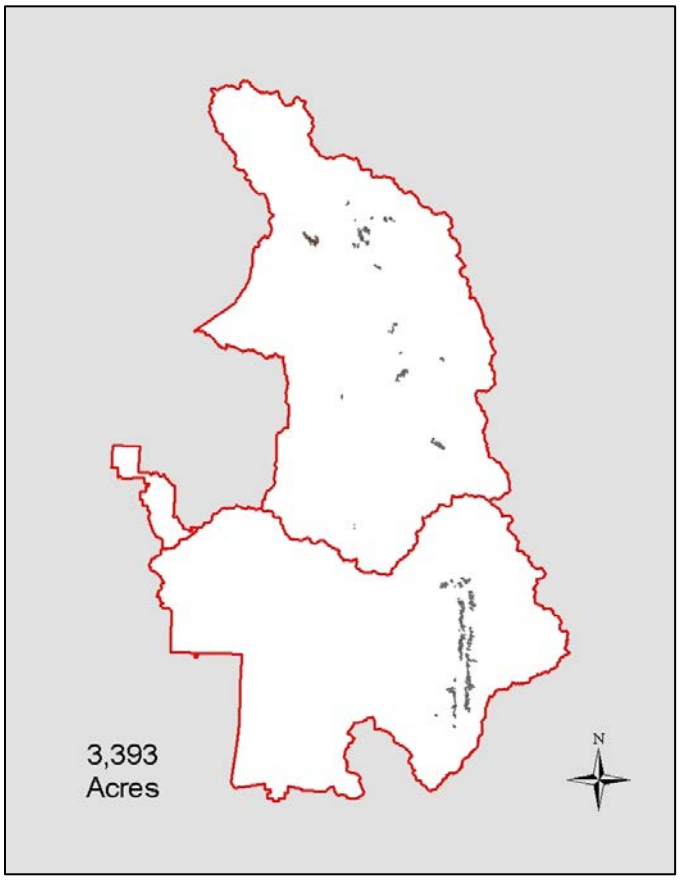


Figure 4107-1. Distribution of Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association.

Accuracy:

Producer's accuracy: 0% (n=1)
User's accuracy: % (n=0)

Photo Interpretation Signature:

The *Juniperus occidentalis var. australis–Cercocarpus ledifolius / Artemisia tridentata* woodland association is a very dry, rocky type where typical montane chaparral species are replaced with *Cercocarpus ledifolius,* yielding a very dark brown signature (Figure 4107-2). Both trees and shrubs are usually very sparse in cover, which distinguishes it from *Juniperus occidentalis var. australis* stands that grow over other montane chaparral species that sometimes form a fairly dense shrub layer.

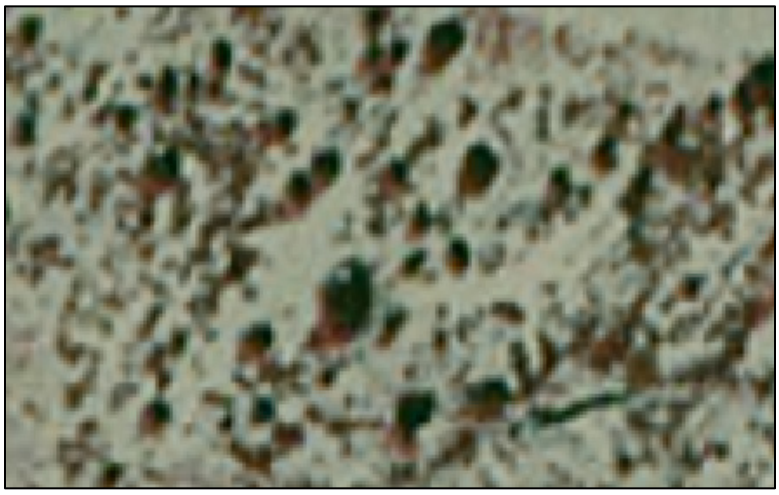


Figure 4107-2. Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association signature. Photo reference: MOKA_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2123–3306 m (6965–10845 ft)
Shape – undulating
Slope position – low slope, midslope, high slope
Steepness – moderately steep
Aspect – See Figure 4107-3.

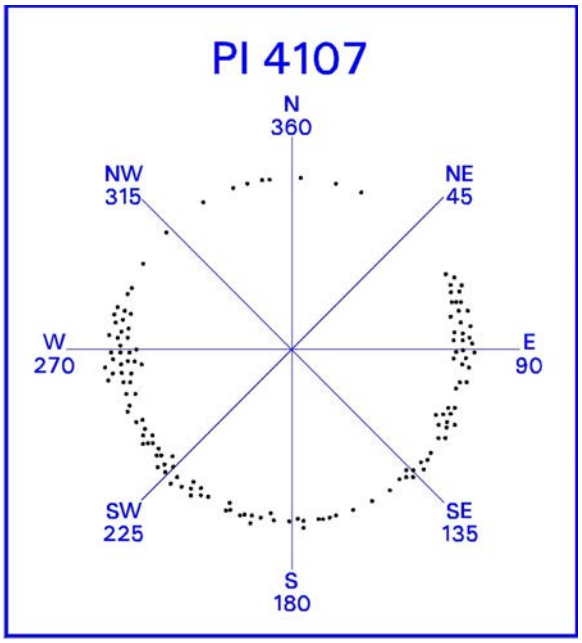


Figure 4107-3. Scatterplot of Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Singleleaf Pinyon Pine Woodland Alliance (3110)
- Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association (3114)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland (3133)
- Whitebark Pine Woodland Alliance (3140)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

4108 – Sierra Juniper Woodland Association

Juniperus occidentalis var. *australis* Woodland Association

Description:

The *Juniperus occidentalis* var. *australis* woodland association is mapped on moderate to very steep dry, rocky slopes of varying aspect between 2105–3335 m (6906–10942 ft) across 10,601 acres of Sequoia and Kings Canyon National Parks (Figure 4108-1). The tree canopy of these open woodlands is characterized by the presence of *Juniperus occidentalis* var. *australis*, with *Pinus jeffreyi* frequently occurring as a codominant. *Abies magnifica*, *P. balfouriana ssp. austrina*, *P. contorta var. murrayana*, or *P. monticola* may also be present. The sparse to well developed shrub layer is most frequently dominated by *Arctostaphylos patula*, with *A. nevadensis*, *Artemisia tridentata*, *Ceanothus cordulatus*, and/or *Chrysolepis sempervirens* also frequently encountered. The herbaceous layer is typically sparse and is characterized by *Elymus elymoides*, *Elymus glaucus*, *Eriogonum spp*., and/or *Penstemon newberryi*.

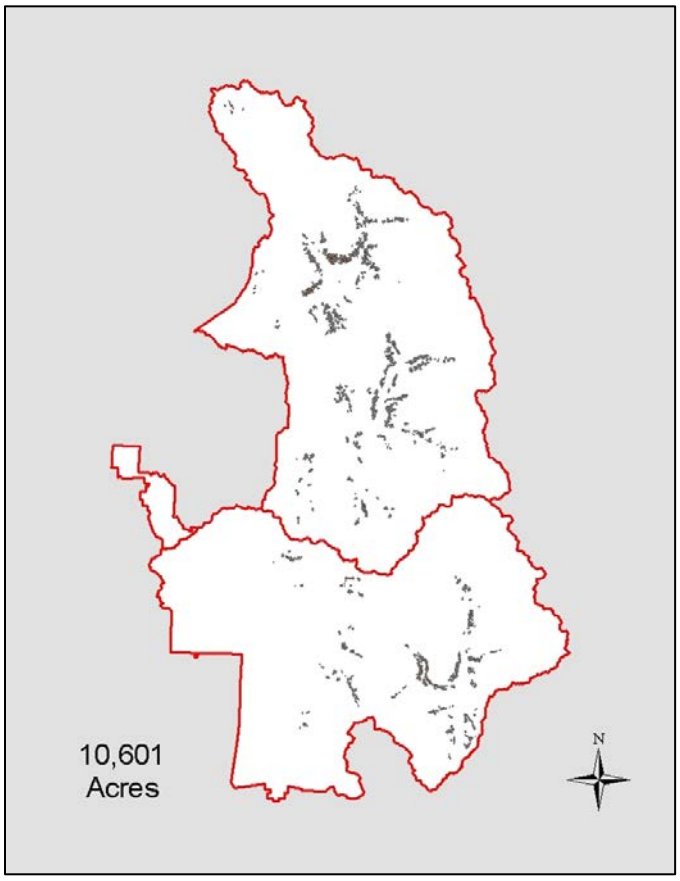


Figure 4108-1. Distribution of Sierra Juniper Woodland Association.

Accuracy:

Producer's accuracy: 76% (n=29)

User's accuracy: 81% (n=27)

Photo Interpretation Signature:

The presence of montane chaparral species, especially *Arctostaphylos patula* or *Chrysolepis sempervirens,* is used by the photo interpreters to denote this *Juniperus occidentalis var. australis* association (Figure 4108-2). Stands are often noted with a *Pinus jeffreyi* component and overall the conifer overstory is a bit denser than the other two *J. occidentalis var. australis* associations.



Figure 4108-2. Sierra Juniper Woodland Association signature. Photo reference: MOKA_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2105–3335 m (6906–10942 ft)
Shape – rocky outcrops
Slope position – lowslope, midslope, highslope, ridgetop
Steepness – moderate to very steep
Aspect – See Figure 4108-3.

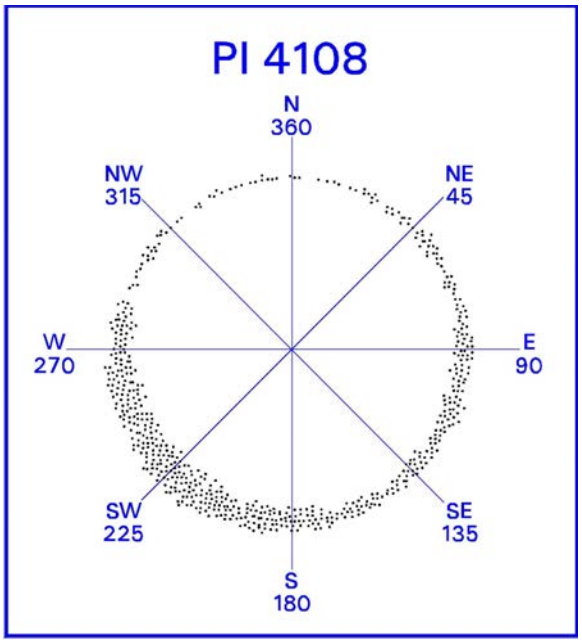


Figure 4108-3. Scatterplot of Sierra Juniper Woodland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine Woodland Association (3038)
- Jeffrey Pine/Greenleaf Manzanita Woodland Association (3072)
- Singleleaf Pinyon Pine Woodland Alliance (3110)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland (3133)
- Whitebark Pine Woodland Alliance (3140)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

4109 – Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation

Juniperus occidentalis var. *australis*/(*Holodiscus discolor–Artemisia tridentata*) Woodland Superassociation

Description:

The *Juniperus occidentalis var. australis/(Holodiscus discolor–Artemisia tridentata*)woodland superassociation is mapped on moderate to very steep dry rocky slopes of varying aspect between 2048–3320 m (6720–10892 ft) across 4,331 acres of Sequoia and Kings Canyon National Parks (Figure 4109-1). The tree canopy of these open woodlands is dominated by *Juniperus occidentalis var. australis,* with lesser amounts of *Pinus balfouriana ssp. austrina, P. contorta var. murrayana*, or *P. jeffreyi* often present. The shrub layer is typically well developed and may be dominated by either *Artemisia tridentata* or *Holodiscus discolor. Arctostaphylos patula, Chrysolepis sempervirens*, and *Eriogonum wrightii* may also be present in the shrub layer. The herbaceous layer may be sparse to well developed, and is most frequently characterized by dryland species such as *Carex exserta, Elymus elymoides, Eriogonum nudum*, and *Monardella odoratissima*.

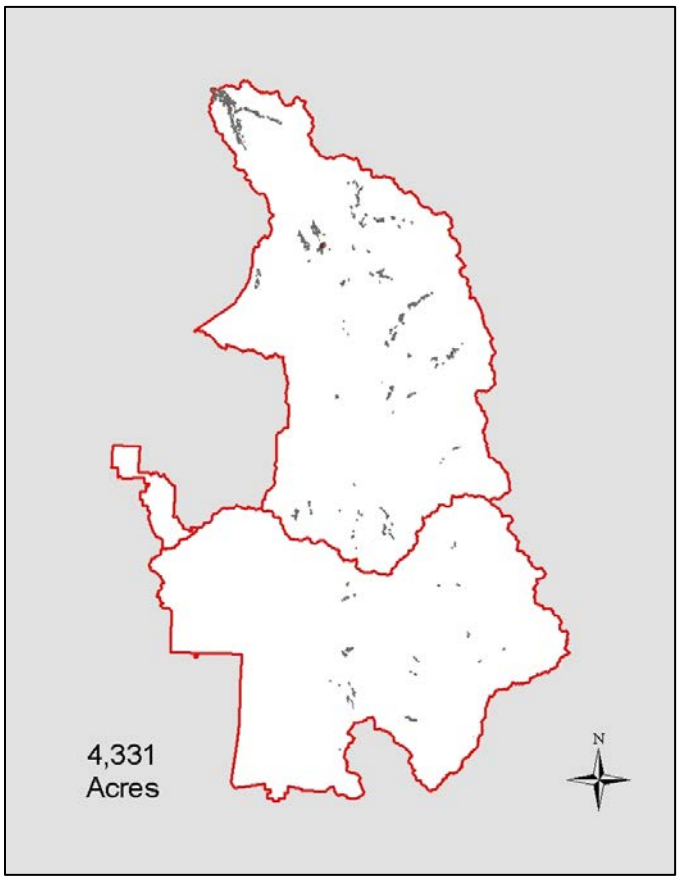


Figure 4109-1. Distribution of Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation.

Accuracy:

Producer's accuracy: 81% (n=26)

User's accuracy: 88% (n=24)

Photo Interpretation Signature:

Photo interpreters infer the presence of *Holodiscus discolor* (as it is not detectable on the imagery) by noting the absence of montane chaparral in extremely rocky, sparsely vegetated settings (Figure 4109-2). Conifer cover (usually just *Juniperus occidentalis var. australis*) is extremely sparse.

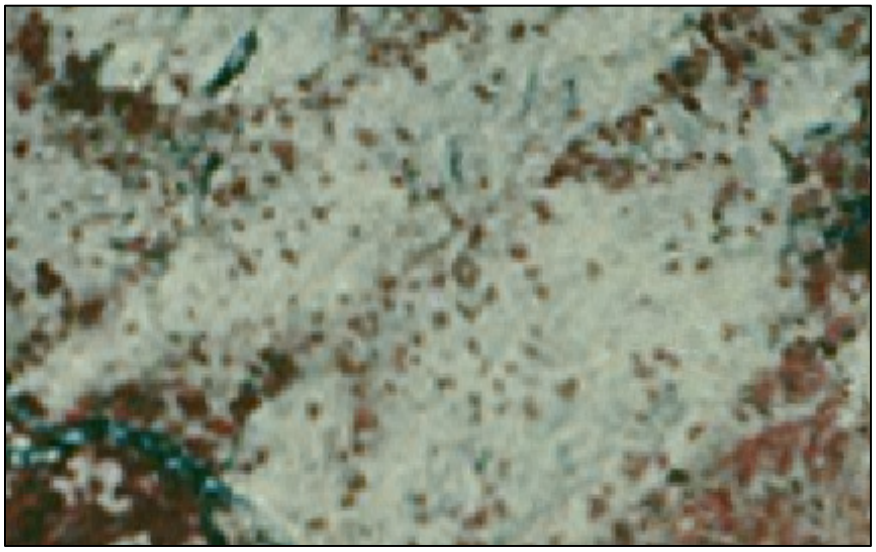


Figure 4109-2. Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation signature. Photo reference: MOKA_NW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 2048–3320 m (6720–10892 ft)
Shape – convex
Slope position – lowslope, midslope, highslope
Steepness – moderate to very steep
Aspect – See Figure 4109-3.

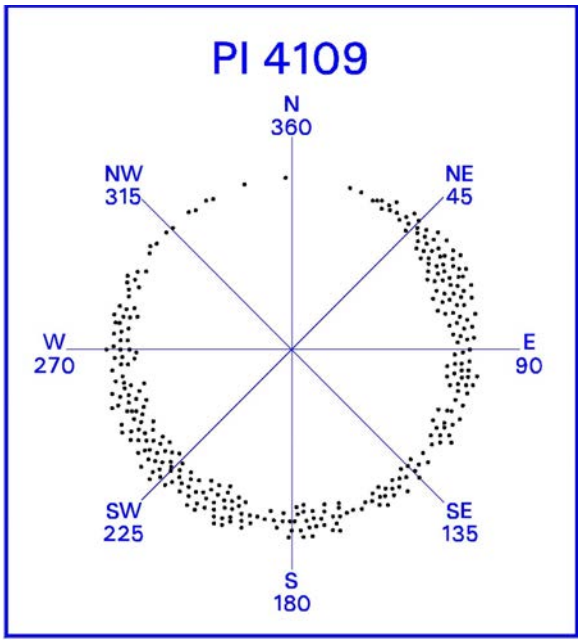


Figure 4109-3. Scatterplot of Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine/Big Sagebrush Forest Association (3034)
- Sierra Lodgepole Pine Woodland Association (3038)
- Singleleaf Pinyon Pine Woodland Alliance (3110)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland (3133)
- Whitebark Pine Woodland Alliance (3140)
- Sierra Juniper Woodland Alliance (4100)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)

4110 – Incense-cedar Forest Alliance



Incense-cedar–White Alder Forest. SEKI.0264_125.

4111 – Incense-cedar–White Alder Forest Association
Calocedrus decurrens–Alnus rhombifolia Forest Association

Description:
The *Calocedrus decurrens–Alnus rhombifolia* forest association is mapped on gentle to moderately steep north facing lowslopes and canyon bottoms between 927–2113 m (3041–6931 ft) across 326 acres of Sequoia and Kings Canyon National Parks (Figure 4111-1). These stands are associated with watercourses and river terraces. The tree canopy is dominated by a mixture of *Calocedrus decurrens* and Alnus rhombifolia, with occasional contributions by *Abies concolor*, *Acer macrophyllum*, and/or *Torreya californica*. The sparse shrub layer is dominated by regenerating conifers and may also contain *Cornus sericea*, *Corylus cornuta* var. *californica*, and *Rubus parviflorus*. The herbaceous layer is sparse to absent but may contain a mix of upland and wetland species. The hydrology is upland to riverine. (Potter 2005).

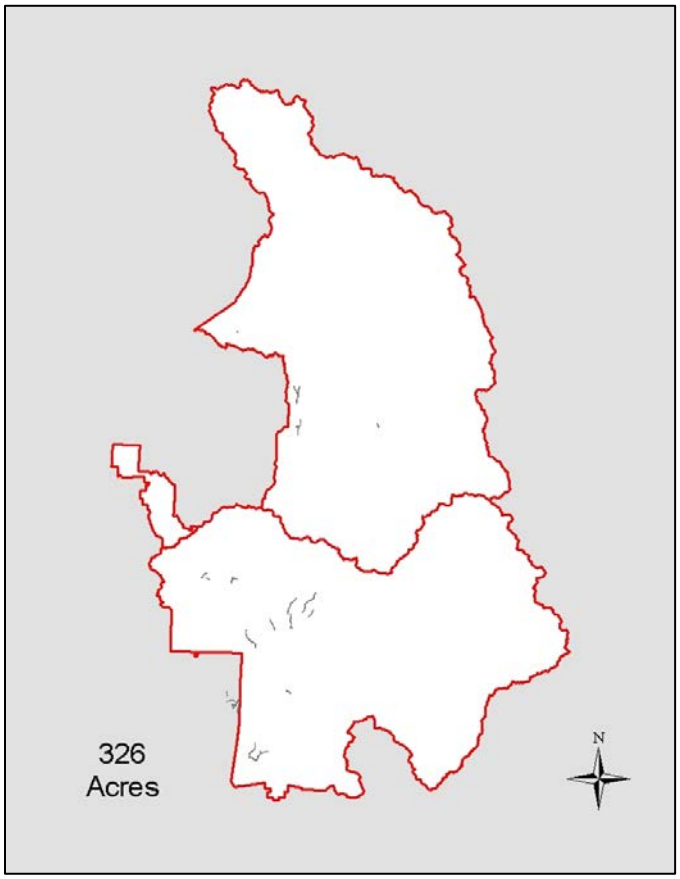


Figure 4111-1. Distribution of Incense-cedar–White Alder Forest Association.

Accuracy:
Producer's accuracy: 100% (n=2)
User's accuracy: 100% (n=2)

Photo Interpretation Signature:

This type is found in watersheds large enough to support perennial streams within the lower mixed conifer belt. Most stands are in deeply incised non-glaciated narrow canyons that are too narrow to map. In this setting, *Calocedrus decurrens* generally has a narrower more conical crown than *Pinus ponderosa* (Figure 4111-2).

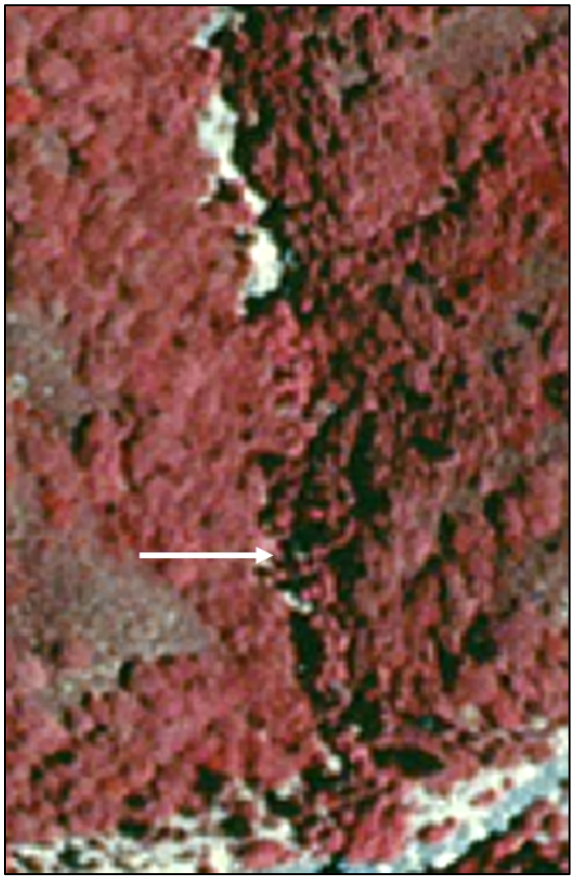


Figure 4111-2. Incense-cedar–White Alder Forest Association signature. Photo reference: LODG_SW.

Environmental Characteristics:

Microclimate – mesic
Elevation – 927–2113 m (3041–6931 ft)
Shape – concave to flat
Slope position – canyon bottom, low slope
Steepness – gentle to moderately steep
Aspect – See Figure 4111-3.

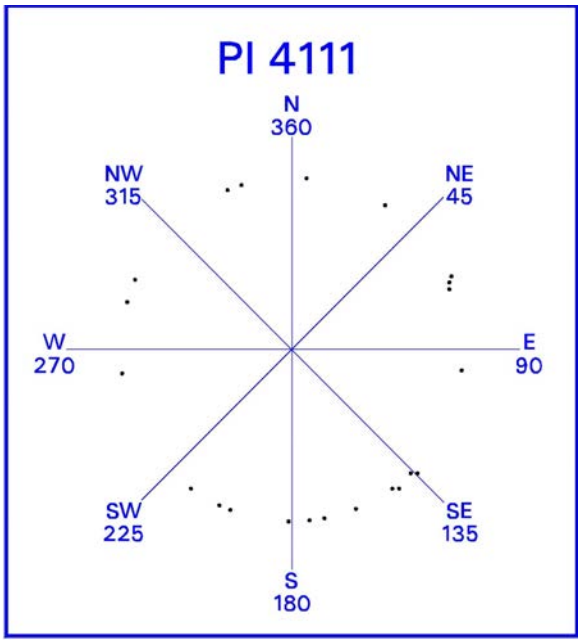
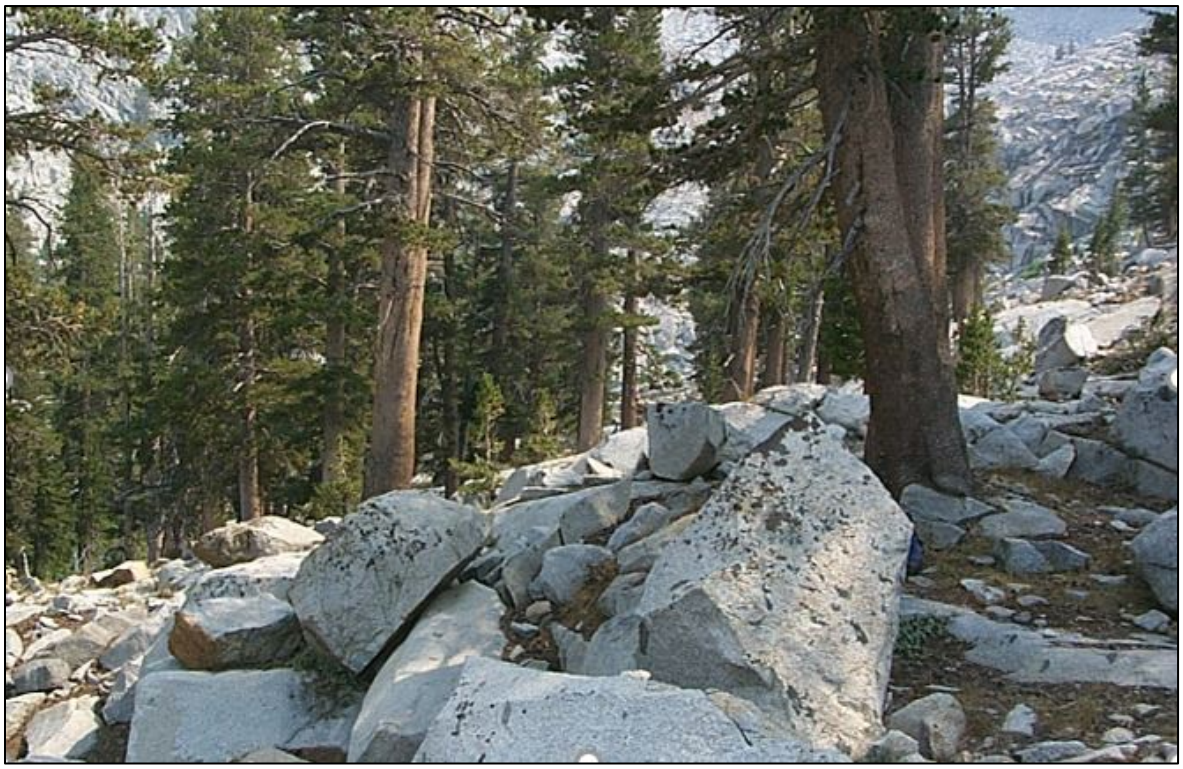


Figure 4111-3. Scatterplot of Incense-cedar–White Alder Forest Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Black Cottonwood Forest Association (2053)
- White Alder Temporarily Flooded Forest Alliance (2060)
- Ponderosa Pine–Incense-cedar Forest Alliance (3060)



Western White Pine–Sierra Lodgepole Pine.

4540 – Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland Superassociation

Pinus monticola–Pinus contorta var. *murrayana–*(*Abies magnifica*) Woodland Superassociation

Description:

The *Pinus monticola–Pinus contorta* var. *murrayana–*(*Abies magnifica*) forest mapping unit is an aggregation of the *Pinus monticola–Pinus contorta* var. *murrayana* woodland association (3132) and the *Abies magnifica–Pinus monticola–Pinus contorta* var. *murrayana* woodland association (4055). The aggregated mapping unit is mapped on gentle to steep slopes of varying aspect between 2383–3278 m (7819–10756 ft) across 25,333 acres of Sequoia and Kings Canyon National Parks (Figure 4540-1). The open to moderately dense tree canopy is dominated by a mixture of *Pinus monticola* and *P. contorta* var. *murrayana*, with *Abies magnifica* important in lower elevation stands. *P. albicaulis*, and *P. balfouriana ssp*. *austrina* are also often present at low cover. The shrub layer is absent to well developed; when present, it is frequently dominated by *Arctostaphylos nevadensis*, *A. patula*, *Chrysolepis sempervirens*, various *Ribes spp*. and/or *Holodiscus microphyllus*. The herbaceous layer is sparse to absent, with *Arabis spp*., *Aster breweri*, *Elymus elymoides*, *Pteridium aquilinum*, *Carex exserta*, *C. rossii*, *Juncus parryi* and *Senecio triangularis* most common. The hydrology is upland. Soils are well drained sands or sandy loams. (NatureServe 2006, Potter 1998: *Abies magnifica–Pinus monticola–Pinus contorta* var. *murrayana* Forest Association) (NatureServe October 2006: *Pinus monticola–Pinus contorta* var. *murrayana* / sparse understory woodland Association).

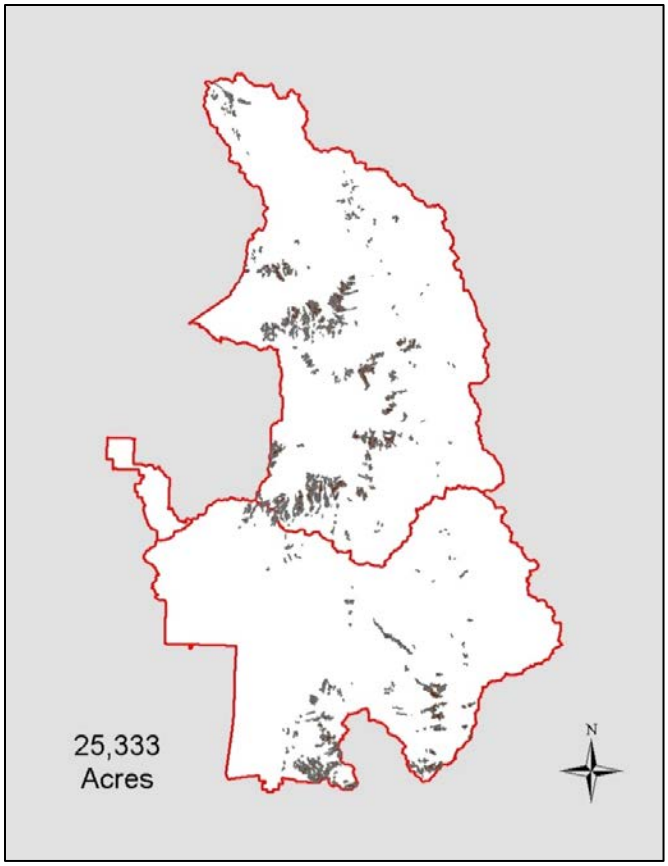


Figure 4540-1. Distribution of Western White Pine–Sierra Lodgepole Pine–(California Red fir) Woodland Superassociation.

Accuracy:
Producer's accuracy: 74% (n=43)
User's accuracy: 73% (n=44)

Photo Interpretation Signature:
This is a high elevation mixed conifer aggregation, allowing the presence or absence of *Abies magnifica* in the canopy. This type is mapped when photo interpreters note the presence of both *Pinus monticola* and *P. contorta var. murrayana* in the stand (Figure 4540-2). This aggregated type is created in recognition of the difficulty in interpreting the relative dominance of the two pine species in addition to the amount of *A. magnifica* present in a stand.

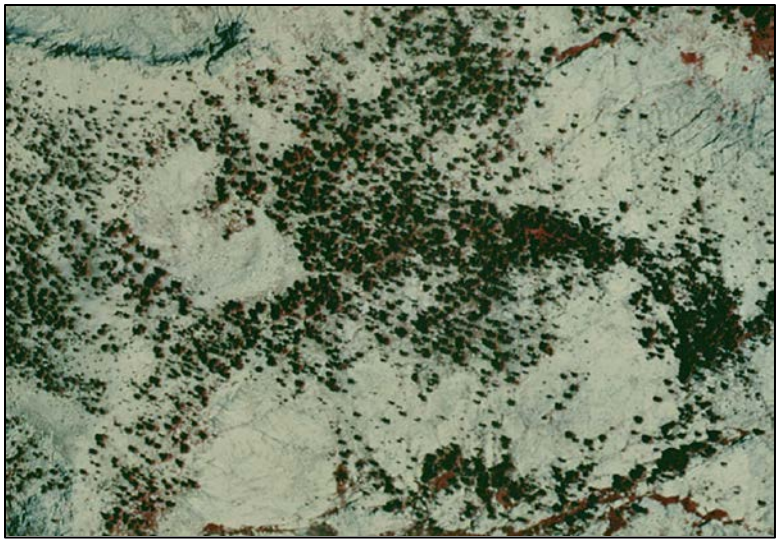


Figure 4540-2. Western White Pine–Sierra Lodgepole Pine–(California Red fir) Woodland signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2383–3278 m (7819–10756 ft)
Shape – convex, concave, undulating
Slope position – lowslope, midslope, highslope, ridgetop
Steepness – gentle to steep
Aspect – See Figure 4540-3.

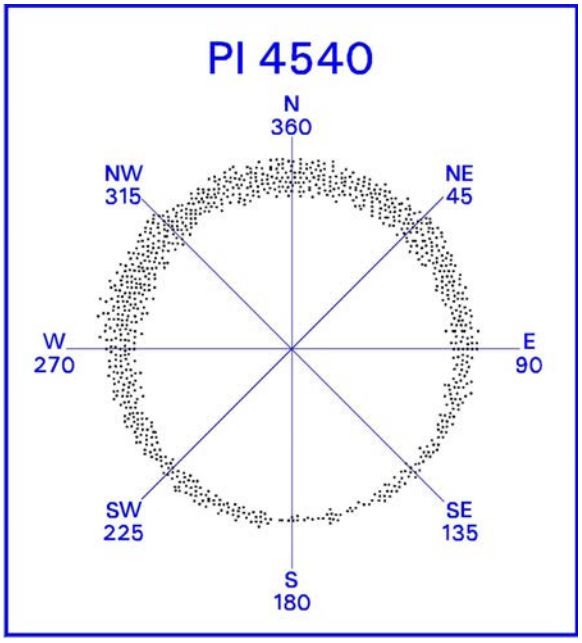


Figure 4540-3. Scatterplot of Western White Pine–Sierra Lodgepole Pine–(California Red fir) Woodland Mapping Unit in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine–California Red Fir Woodland Association (3085)
- Western White Pine Woodland Alliance (3130)
- Western White Pine–Sierra Lodgepole Pine Woodland Association (3132)
- Western White Pine/(Greenleaf Manzanita–Bush Chinquapin–Oceanspray) Woodland (3133)
- Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance (3540)
- California Red Fir Forest Association (4051)
- California Red Fir–Western White Pine Forest Association (4057)
- California Red Fir–Sierra Lodgepole Pine/Whiteflower Hawkweed Forest Mapping Unit (4063)
- California Red Fir–Western White Pine/(Pinemat Manzanita–Bush Chinquapin) Forest (4065)
- Sierra Lodgepole Pine Sparse/Outcrop Woodland Superassociation (3021)
- Sierra Lodgepole Pine Woodland Association (3038)
- Sierra Lodgepole Pine Xeric Forest Superassociation (3049)
- Whitebark Pine Woodland Alliance (3140)
- Foxtail Pine–Western White Pine Woodland Superassociation (3204)
- Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association (4043)
- California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest Association (4055)
- California Red Fir–Western White Pine Forest Association (4057)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Sierra Juniper Woodland Association (4108)
- Sierra Juniper/(Oceanspray–Big Sagebrush) Woodland Superassociation (4109)

5000 – Evergreen Shrubs



Birchleaf Mountain Mahogany Shrubland. SEKI.0224_272.

5010 – Birchleaf Mountain Mahogany Shrubland Alliance

Cercocarpus montanus var. *glaber* Shrubland Alliance

Description:

The *Cercocarpus montanus var. glaber* shrubland alliance is mapped on moderate to steep slopes of varying aspect between 490–1964 m (1607–6443 ft) across 4,041 acres of Sequoia and Kings Canyon National Parks (Figure 5010-1). The canopy of associations in this alliance is dominated by large, sometimes tree-like *Cercocarpus montanus var. glaber* (*C. betuloides sensu* Hickman 1993), often in association with *Aesculus californica, Quercus chrysolepis, Q. kelloggii, Q.wislezeni*, and/or *Umbellularia californica*. The dense and diverse shrub layer is not well differentiated from the tree canopy. Shrub associates include *Adenostoma fasciculatum, Arctostaphylos mewukka, A. viscida, Ceanothus spp., Cercis canadensis var. texensis, Chamaebatia foliolosa, Eriodictyon californicum, Fremontodendron californicum ssp. californicum, Quercus garryana var. breweri, Quercus wislizeni var.wislizeni, Rhamnus ilicifolia, Toxicodendron diversilobum,* and *Umbellularia californica*. The herbaceous layer can be sparse or well developed, and is often composed of a rich mix of low elevation graminoids and forbs. The hydrology is upland. Soils are well drained sandy loams to sandy clay loams. (NatureServe October 2006).

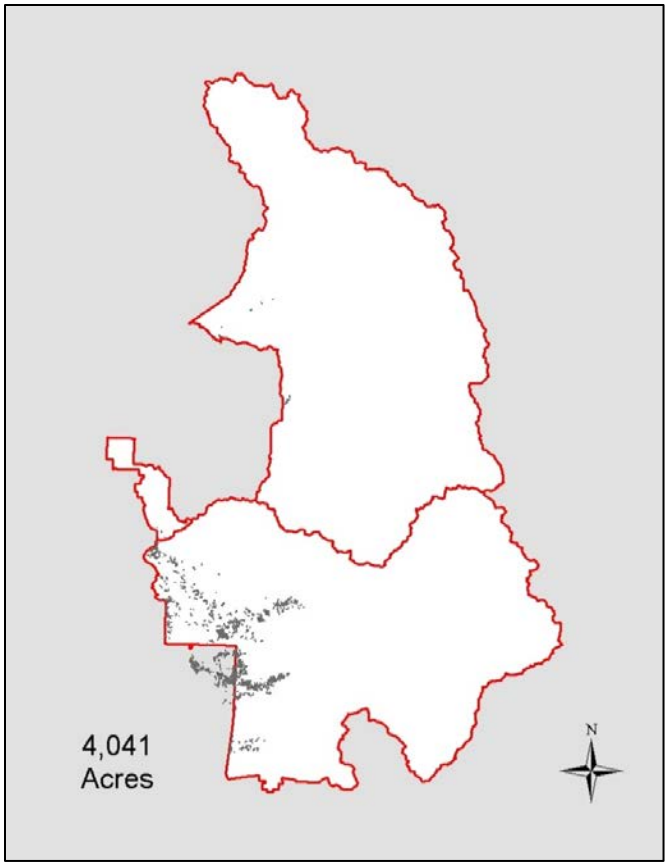


Figure 5010-1. Distribution of Birchleaf Mountain Mahogany Shrubland Alliance.

Accuracy:
Producer's accuracy: 50% (n=2)
User's accuracy: 50% (n=2)

Photo Interpretation Signature:
Cercocarpus montanus var. glaber generally yields a very dark brown signature on the imagery with a stipple like pattern as reflected in the narrow crowns (Figure 5010-2). *Cercocarpus montanus var. glaber is* similar in signature (especially color) to *Adenostoma fasciculatum*; however not as smooth in texture.

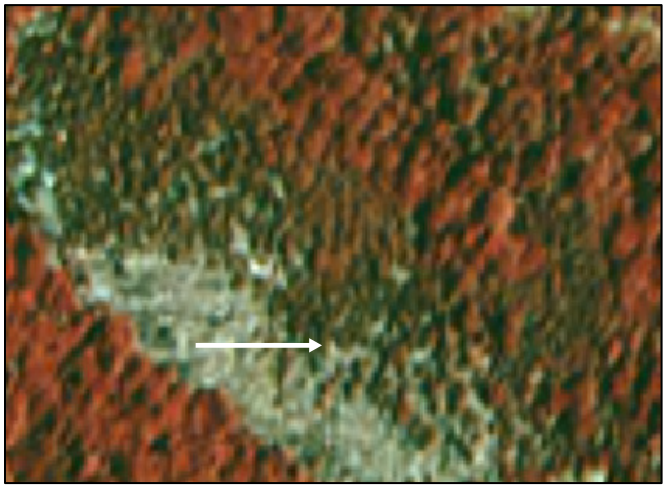


Figure 5010-2. Birchleaf Mountain Mahogany Shrubland Alliance signature. Photo reference: SHMO_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – between 490–1964 m (1607–6443 ft)
Shape – convex
Slope position – low slope, midslope, high slope, ridgetop
Steepness – moderately steep to steep
Aspect – See Figure 5010-3.

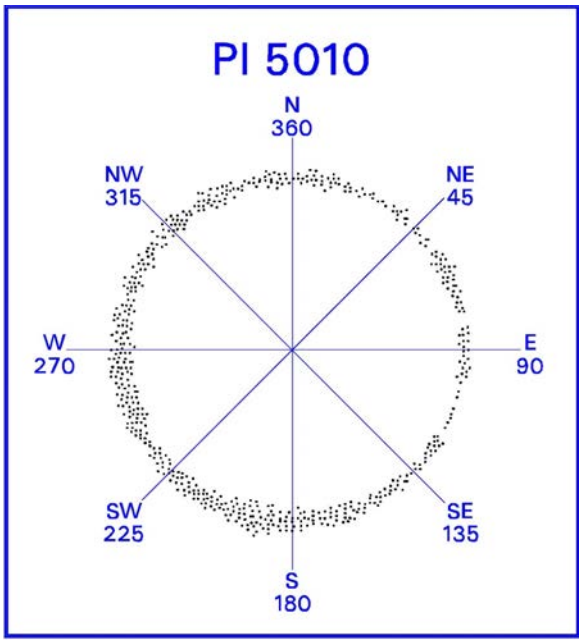


Figure 5010-3. Scatterplot of Birchleaf Mountain Mahogany Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- California Buckeye Woodland Alliance (2110)
- Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association (5011)
- Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association (5012)
- Whiteleaf Manzanita Shrubland Alliance (5070)
- Curl-leaf Mountain Mahogany Woodland Alliance (5230)

5011 – Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association

Cercocarpus montanus var. *glaber–Cercis canadensis* var. *texensis–Fremontodendron californicum* ssp. *californicum* Shrubland Association

Description:

The *Cercocarpus montanus var. glaber–Cercis canadensis var. texensis–Fremontodendron californicum ssp. californicum* shrubland association is mapped on moderately steep north to northeast facing slopes between 490–1711 m (1607–5615 ft) across 943 acres of Sequoia National Park (Figure 5011-1). The canopy of this relatively dense shrubland is not clearly differentiated, but is dominated by *Cercocarpus montanus var. glaber (C. betuloides sensu* Hickman 1993*).*Tree associates frequently include *Aesculus californica, Quercus chrysolepis, Quercus wislizeni var.wislizeni, and Umbellularia californica.* Shrub associates include *Adenostoma fasciculatum, Arctostaphylos mewukka, A. viscida, Ceanothus spp., Cercis canadensis var. texensis, Eriodictyon californicum, Fremontodendron californicum ssp. californicum, Rhamnus ilicifolia,* and *Toxicodendron diversilobum*. The herbaceous layer is relatively well developed and is composed of a diverse mix of low elevation annual graminoids and forbs.

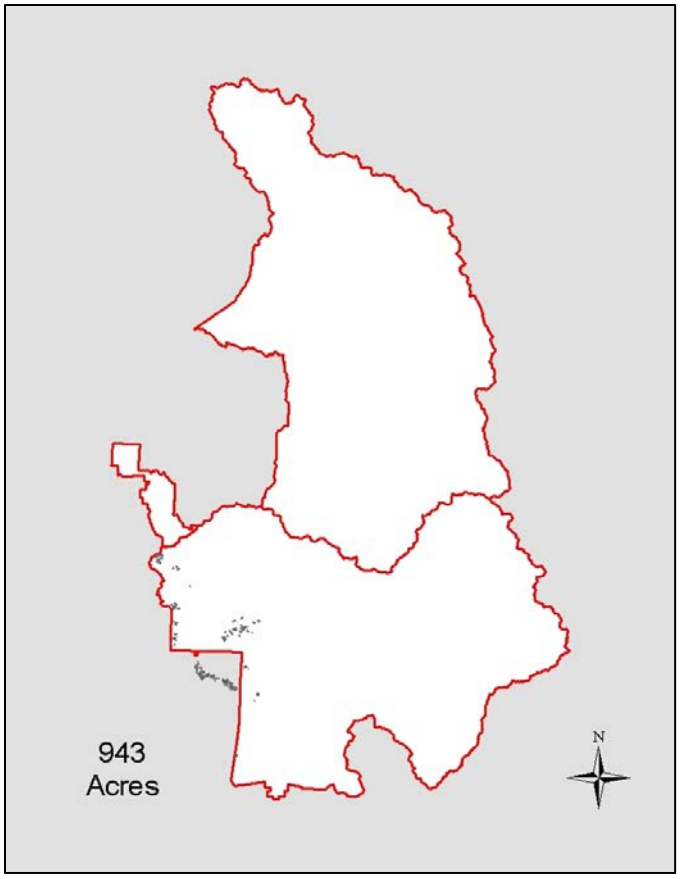


Figure 5011-1. Distribution of Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association.

Accuracy:

Producer's accuracy: 100% (n=1)
User's accuracy: 50% (n=2)

Photo Interpretation Signature:

Photo interpreters infer the presence of *Holodiscus discolor* (as it is not detectable on the imagery) by noting the absence of montane chaparral in extremely rocky, sparsely vegetated settings (Figure 5011-2). Conifer cover (usually just *Juniperus occidentalis var. australis*) is extremely sparse.

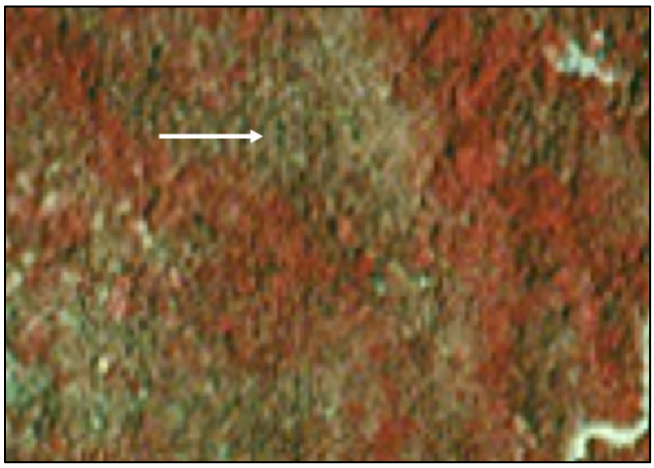


Figure 5011-2. Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 490–1711 m (1607–5615 ft)
Shape – convex
Slope position – low slope, midslope
Steepness – moderately steep
Aspect – See Figure 5011-3.

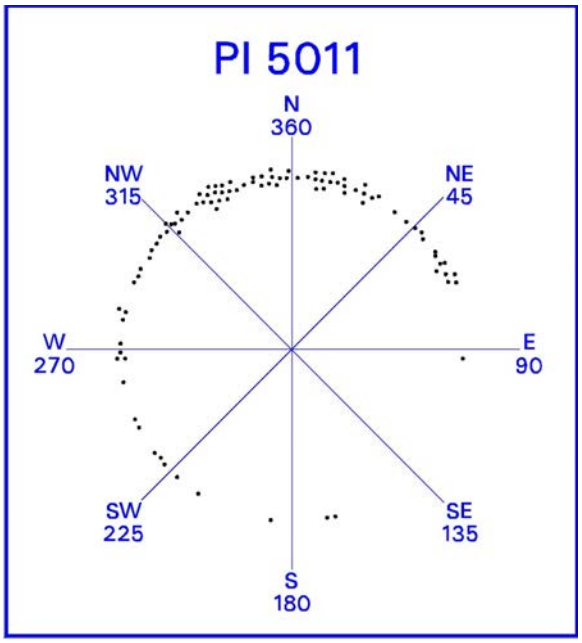


Figure 5011-3. Scatterplot of Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany–California Redbud Forest Association (1044)
- Birchleaf Mountain Mahogany Shrubland Alliance (5010)
- Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association (5012)

5012 – Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association
Cercocarpus montanus var. *glaber–Arctostaphylos viscida* Shrubland Association

Description:

The *Cercocarpus montanus var. glaber*/*Arctostaphylos viscida* shrubland association is mapped on moderately steep to steep south facing slopes between 767–1964 m (2516–6443 ft) across 1,496 acres of Sequoia and Kings Canyon National Parks (Figure 5012-1). The overstory is dominated by large specimens of *Cercocarpus montanus var. glaber (C. betuloides sensu* Hickman 1993), with emergent *Pinus ponderosa, Quercus chrysolepis, Q. kelloggii,* or *Umbellularia californica* sometimes present as well. The shrub layer is well developed and is dominated by *C. montanus var. glaber,* with either *Arctostaphylos mewukka* or *A. viscida* present as co-dominants. *Ceanothus cuneatus* may also be important. The herbaceous layer can be sparse or well developed and is most often characterized by the presence of annual *Bromus spp*. The hydrology is upland.

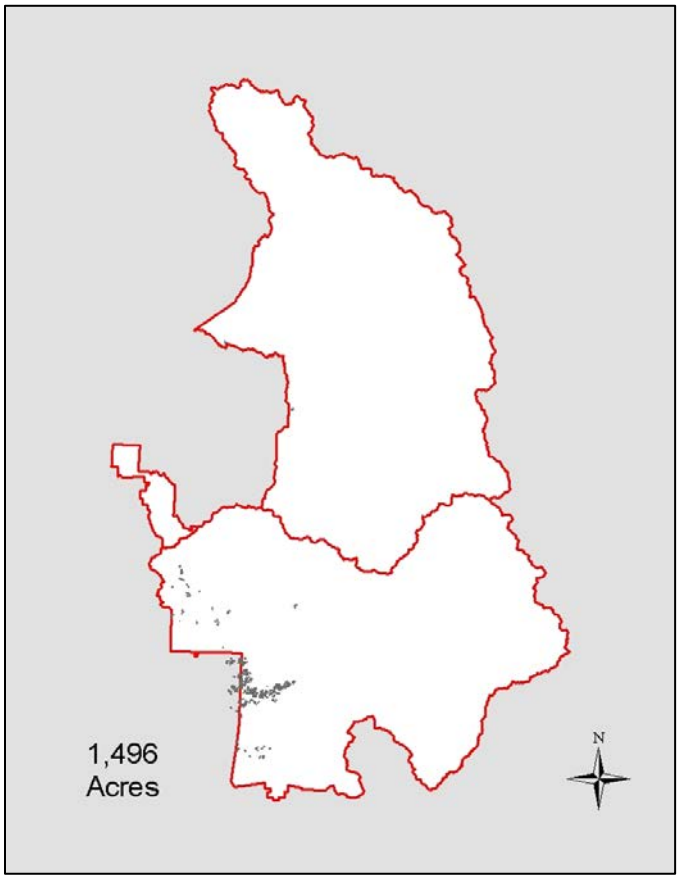


Figure 5012-1. Distribution of Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association.

Accuracy:

Producer's accuracy: 100% (n=1)
User's accuracy: 50% (n=2)

Photo Interpretation Signature:

Photo interpreters infer the presence of *Holodiscus discolor* (as it is not detectable on the imagery) by noting the absence of montane chaparral in extremely rocky, sparsely vegetated settings (Figure 5011-2). Conifer cover (usually just *Juniperus occidentalis var. australis*) is extremely sparse.

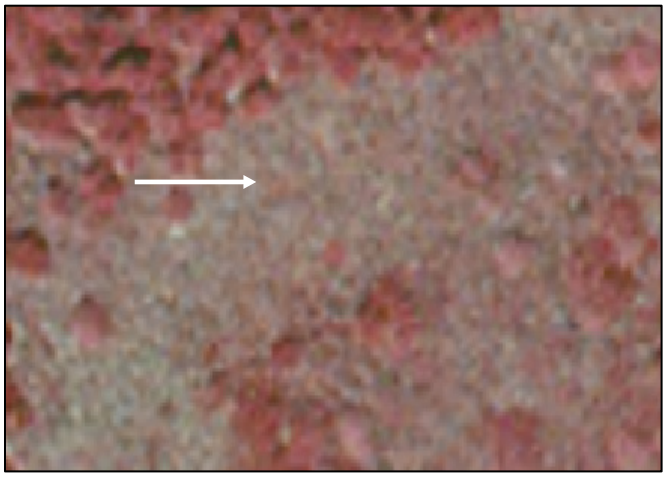


Figure 5012-2. Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association signature. Photo reference: GIFO_NW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 767–1964 m (2516–6443 ft)
Shape – convex
Slope position – low slope, midslope, high slope
Steepness – moderately steep to steep
Aspect – See Figure 5012-3.

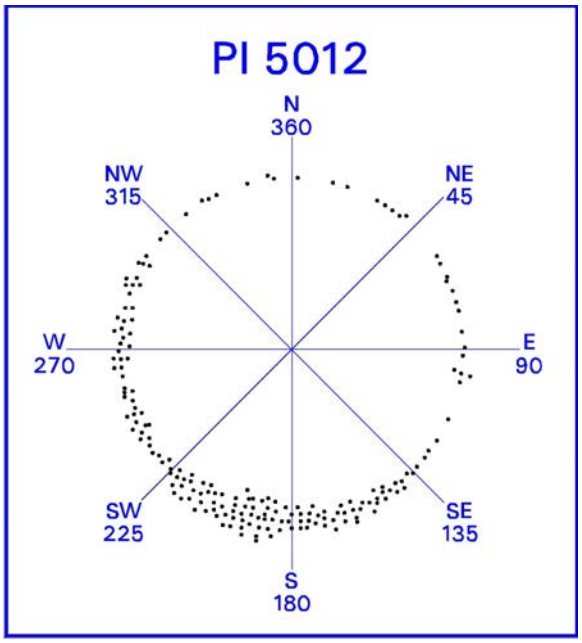


Figure 5012-3. Scatterplot of Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- Birchleaf Mountain Mahogany Shrubland Alliance (5010)
- Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association (5011)
- Whiteleaf Manzanita Shrubland Alliance (5070)

5020 – Chamise Shrubland Alliance



Chamise Shrubland.

5020 – Chamise Shrubland Alliance (includes 5021)
Adenostoma fasciculatum Shrubland Alliance

Description:
The *Adenostoma fasciculatum* shrubland alliance is mapped on moderate to steep slopes of varying aspect between 486–1725 m (1595–5658 ft) across 9,965 acres of Sequoia National Park (Figure 5020-1). The shrub canopy is dominated by a dense, usually impenetrable thicket of *Adenostoma fasciculatum*. Other shrubs that may contribute significant cover include *Arctostaphylos viscida, Ceanothus cuneatus, Cercocarpus montanus var. glaber, Quercus berberidifolia*, and occasionally *Yucca whipplei*. Scattered *Pinus ponderosa, Quercus chrysolepis*, and *Q. wislizenii var. wislizenii* are sometimes emergent to the shrub canopy. The herbaceous layer is sparse to non-existent. Following fire, stands of *A. fasciculatum* are frequently succeeded by a diverse mix of chaparral shrubs and herbs that give way to the *A. fasciculatum* dominated types within 5 to 10 years. The hydrology is upland. (NatureServe October 2006).

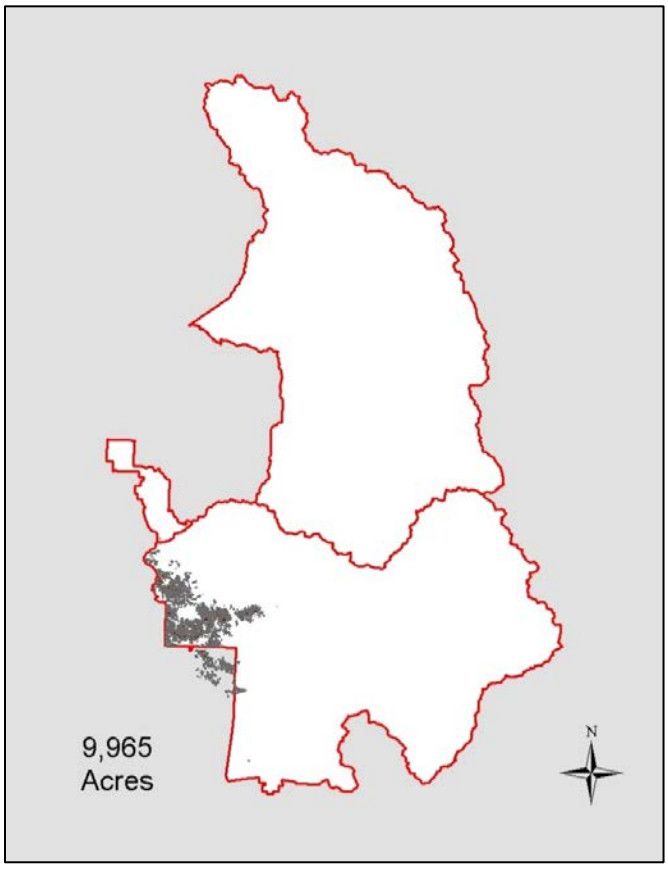


Figure 5020-1. Distribution of Chamise Shrubland Alliance.

This alliance includes stands with *Adenostoma fasciculatum* cover greater than 60%. If *Adenostoma fasciculatum* is 30–60%, and another species has 30–60% cover, then the stand is a member of a mixed alliance. In the aggregated database, the *Adenostoma fasciculatum* shrubland alliance includes the *Adenostoma fasciculatum* shrubland association (5021).

Accuracy:
Producer's accuracy: 89% (n=9)
User's accuracy: 80% (n=10)

Photo Interpretation Signature:
Adenostoma fasciculatum tends to have a dark brown to brown-green signature depending on the extent of post flower inflorescence remaining on the stems when the aerial photos are taken (Figure 5020-2). The signature of pure, undisturbed stands of *A. fasciculatum* is similar throughout California.

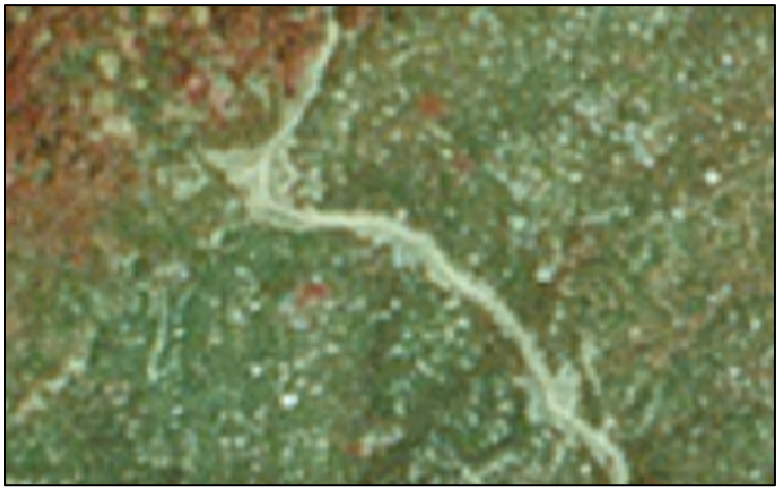


Figure 5020-2. Chamise Shrubland Alliance signature. Photo reference: SHMO_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 486–1725 m (1595–5658 ft)
Shape – convex
Slope position – low slope, midslope, ridgetop
Steepness – moderate to steep
Aspect – See Figure 5020-3.

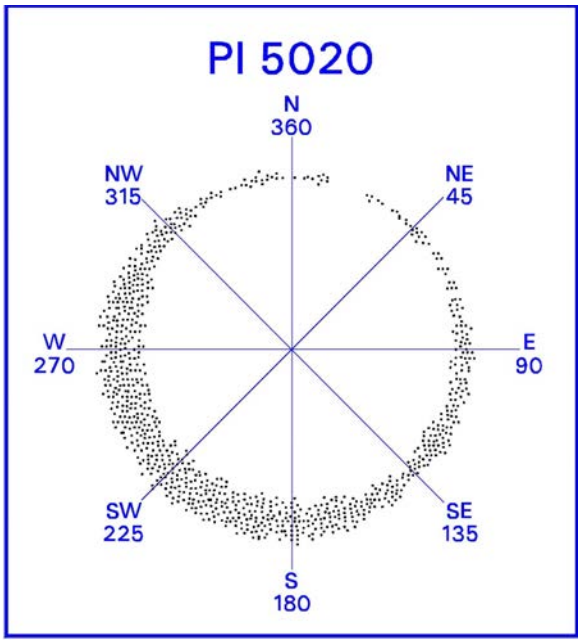


Figure 5020-3. Scatterplot of Chamise Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Chamise Shrubland Association (5021)
- Chamise–California Yerba Santa Shrubland Association (5025)
- Chamise–Buckbrush Shrubland Association (5031)

5021 – Chamise Shrubland Association

Adenostoma fasciculatum Shrubland Association

Description:

The *Adenostoma fasciculatum* shrubland association is mapped on hot, exposed, moderately steep to steep south, southwest or west facing slopes between 486–1506 m (1595–4940 ft) across 4,281 acres of Sequoia National Park (Figure 5021-1). The shrub canopy is dominated by a dense, usually impenetrable thicket of *Adenostoma fasciculatum. Arctostaphylos viscida, Ceanothus cuneatus, Cercocarpus montanus var. glaber, Quercus berberidifolia,* and *Yucca whipplei* may also occur in the shrub layer but do not contribute significant cover. The herbaceous layer is sparse to absent, with the understory characterized primarily by leaf litter from the dominant shrub. Herbaceous species may include *Vulpia myuros, Eriophyllum confertiflorum, Aira caryophyllea, Bromus hordeaceus, Daucus pusillus, Erodium cicutarium, Galium parisiense, Hypochaeris glabra, Pentagramma triangularis,* and *Trifolium microcephalum.* (NatureServe October 2006). In the aggregated database, the *Adenostoma fasciculatum* shrubland association is aggregated into the *Adenostoma fasciculatum* shrubland alliance (5020).

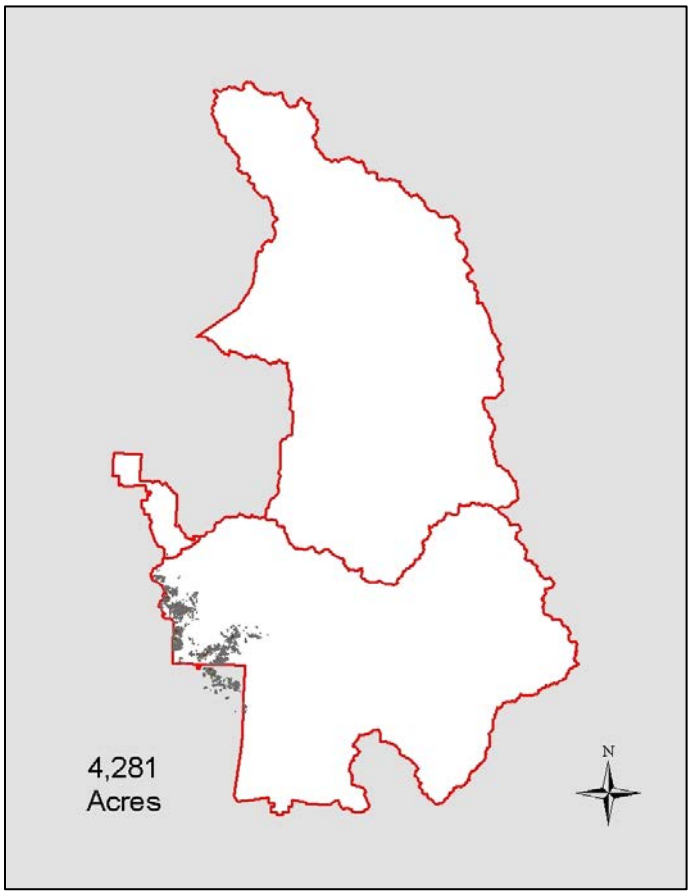


Figure 5021-1. Distribution of Chamise Shrubland Association.

Accuracy:

Producer's accuracy: 80% (n=5)
User's accuracy: 67% (n=6)

Photo Interpretation Signature:

The *Adenostoma fasciculatum* shrubland association is mapped in areas where photo signature appears uniform across the stand and where stands are relatively undisturbed. Overall signature is uniform and smooth trending towards the mid browns, with *Arctostaphylos viscida* trending to the oranges and *Ceanothus cuneatus* trending towards the pinks (Figure 5021-2). The signature of these pure stands may vary due to rockiness or age of stand.

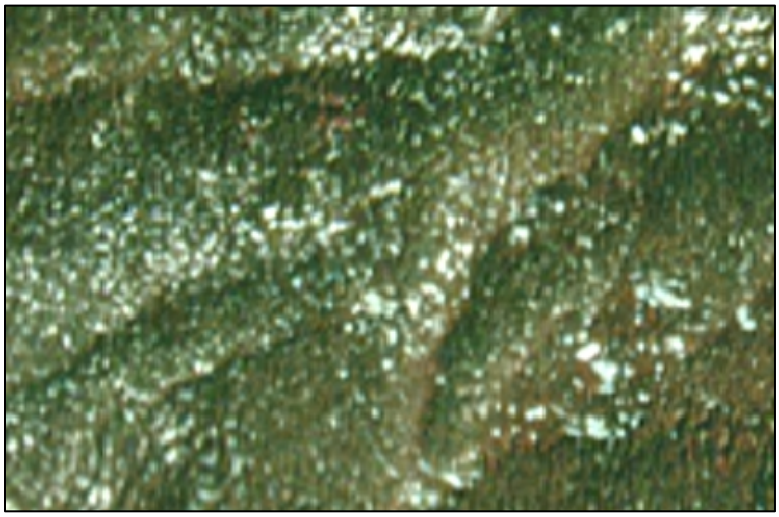


Figure 5021-2. Chamise Shrubland Association signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 486–1506 m (1595–4940 ft)
Shape – convex
Slope position – low slope, midslope
Steepness – moderately steep to steep
Aspect – See Figure 5021-3.

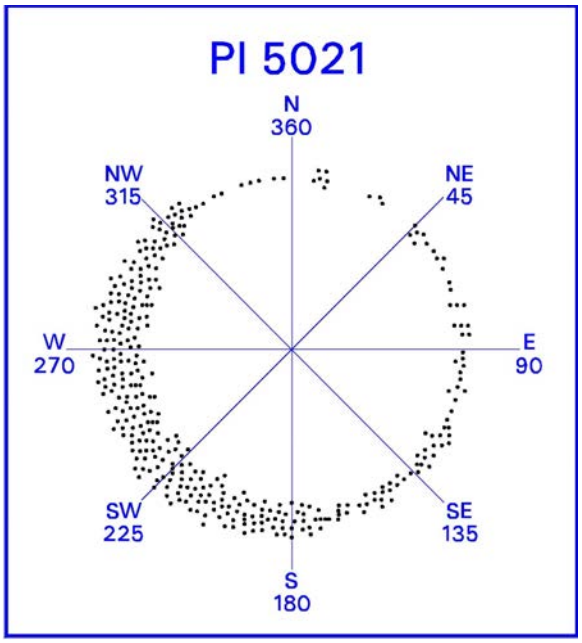


Figure 5021-3. Scatterplot of Chamise Shrubland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Chamise Shrubland Alliance (5020)
- Chamise/Whiteleaf Manzanita Shrubland Association (5022)
- Chamise–Chaparral Yucca Shrubland Association (5023)
- Chamise–California Yerba Santa Shrubland Association (5025)
- Chamise–Buckbrush Shrubland Association (5031)

5022 – Chamise/Whiteleaf Manzanita Shrubland Association
Adenostoma fasciculatum/Arctostaphylos viscida Shrubland Association

Description:
The *Adenostoma fasciculatum/Arctostaphylos viscida* shrubland association is mapped on moderate to steep exposed slopes of varying aspect between 635–1725 m (2082–5658 ft) across 2,412 acres of Sequoia and Kings Canyon National Parks (Figure 5022-1). The shrub canopy is dominated by a dense, usually impenetrable mixture of *Adenostoma fasciculatum* and *Arctostaphylos viscida*, with each species contributing at least 20% cover. Lesser amounts of *Ceanothus cuneatus, Cercocarpus montanus var. glaber, Dendromecon rigida*, and *Fraxinus dipetala* may also be present. The herbaceous layer is sparse to absent, with the understory characterized primarily by leaf litter from the dominant shrub species. Frequently encountered herbaceous species include annual graminoids and forbs characteristic of dry foothill sites, such as *Bromus spp., Vulpia spp.,* and *Galium spp*. The hydrology is upland. Soils are well drained sandy loams.

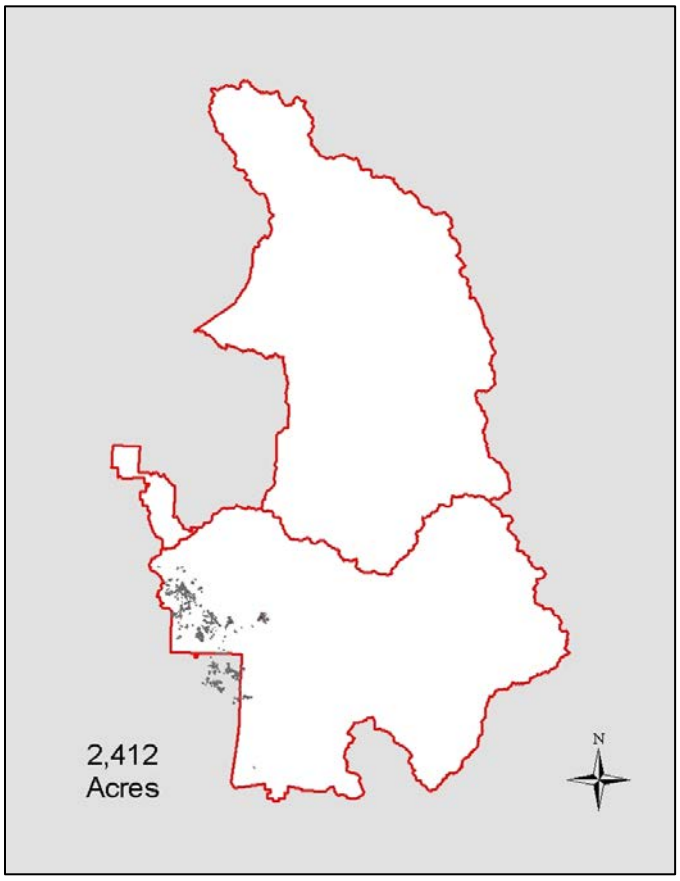


Figure 5022-1. Distribution of Chamise/Whiteleaf Manzanita Shrubland Association.

Accuracy:
Producer's accuracy: 75% (n=4)
User's accuracy: 100% (n=3)

Photo Interpretation Signature:

Arctostaphylos viscida is distinguished by a rounded defined crown, especially evident in stands that have not burned recently. In contrast, the *Adenostoma fasciculatum* has a diffused and undefined crown. Colors range from brown to pink depending on which species is dominant (Figure 5022-2).



Figure 5022-2. Chamise/Whiteleaf Manzanita Shrubland Association signature. Photo reference: GIFO_SW.

Environmental Characteristics:

Microclimate – xeric
Elevation – 635–1725 m (2082–5658 ft)
Shape – convex
Slope position – low slope, midslope, ridgetop
Steepness – moderate to steep
Aspect – See Figure 5022-3.

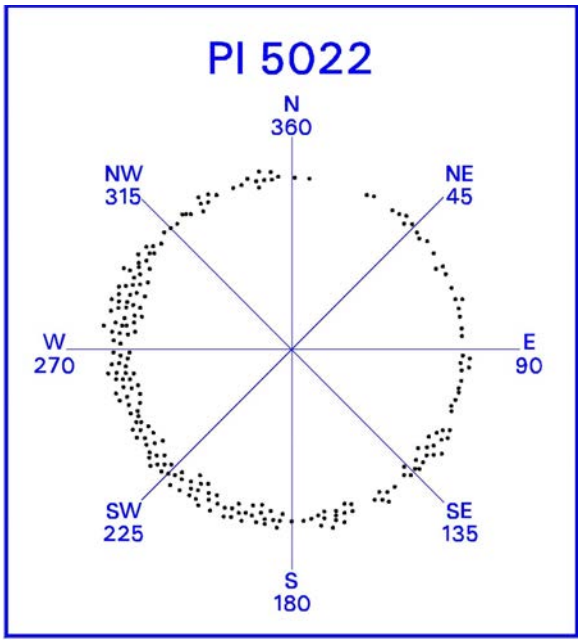


Figure 5022-3. Scatterplot of Chamise/Whiteleaf Manzanita Shrubland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Chamise Shrubland Association (5021)
- Chamise–Buckbrush Shrubland Association (5031)
- Whiteleaf Manzanita Shrubland Alliance (5070)

5023 – Chamise–Chaparral Yucca Shrubland Association
Adenostoma fasciculatum–Yucca whipplei Shrubland Association

Description:
The *Adenostoma fasciculatum–Yucca whipplei* shrubland association is mapped on gentle to steep slopes of generally south to westfacing aspect between 650–1338 m (2134–4390 ft) across 158 acres of Sequoia and Kings Canyon National Parks (Figure 5023-1). The canopy of this dense shrubland is dominated by *Adenostoma fasciculatum*. The association is characterized by the presence of *Yucca whipplei*, which often occurs in openings in the chaparral. Plot data are lacking to describe the understory of this type, which is frequently associated with marble substrate.

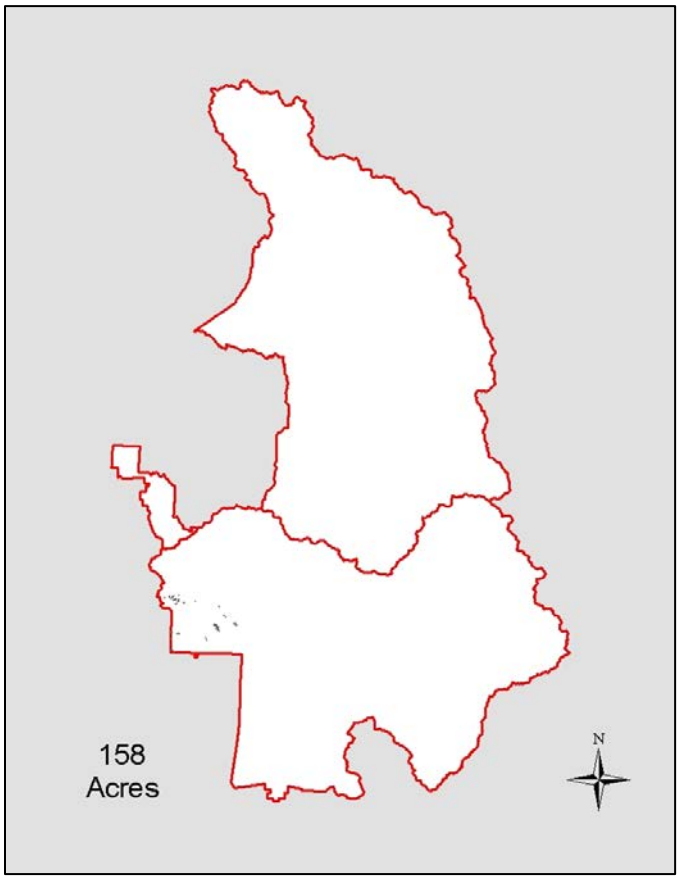


Figure 5023-1. Distribution of Chamise–Chaparral Yucca Shrubland Association.

Accuracy:
Producer's accuracy: 100% (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:
When *Yucca whipplei* is a significant component of *Adenostoma fasciculatum* stands, it is visible as light colored dots within the typical dark brown signature of *A. fasciculatum* (Figure 5023-2). This

association is discernable only when *Y. whipplei* makes up at least 3–5% of the stand and is visible in relatively open settings.

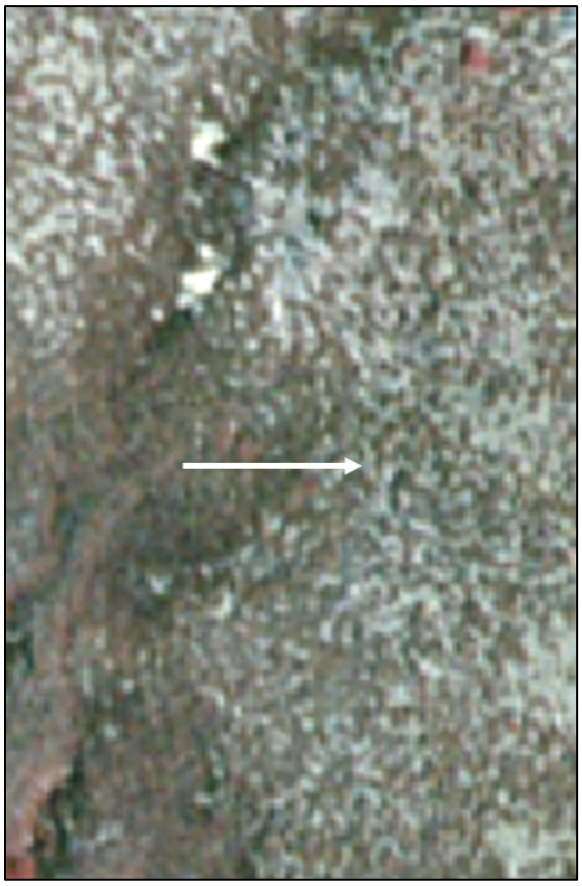


Figure 5023-2. Chamise–Chaparral Yucca Shrubland Association signature. Photo reference: GIFO_SE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 650–1338 m (2134–4390 ft)
Shape – convex
Slope position – variable; mid to high slopes
Steepness – gentle to steep
Aspect – See Figure 5023-3.

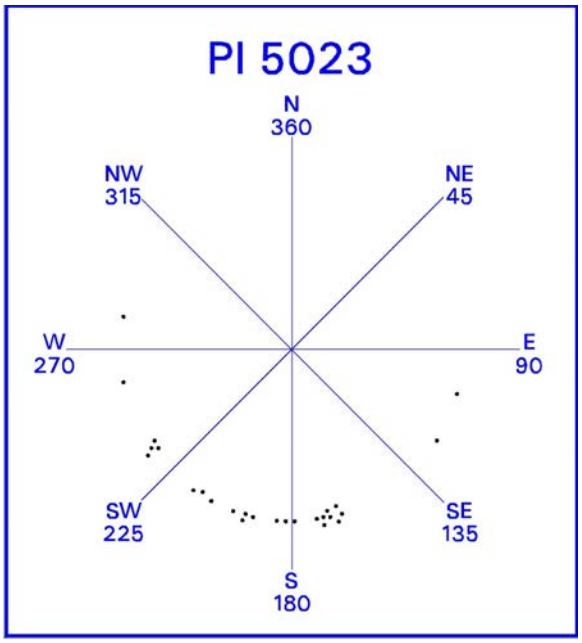


Figure 5023-3. Scatterplot of Chamise–Chaparral Yucca Shrubland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Chamise Shrubland Association (5021)
- Chaparral Yucca Shrubland Alliance (5270)

5025 – Chamise–California Yerba Santa Shrubland Association
Adenostoma fasciculatum–Eriodictyon californicum Shrubland Association

Description:

The *Adenostoma fasciculatum–Eriodictyon californicum* shrubland association is mapped on relatively recently burned (within 2–5 years), moderately steep to steep slopes of varying aspect between 542–1604 m (1777–5264 ft) across 1,567 acres of Sequoia and Kings Canyon National Parks (Figure 5025-1). This mapping unit captures areas that are midsuccessional between *Adenostoma fasciculatum* dominated shrublands and the diverse fire-following community that is relatively short-lived. The open to closed shrub layer is dominated by a highly variable mixture of *Adenostoma fasciculatum, Arctostaphylos viscida, Ceanothus cuneatus, Dendromecon rigida, Eriodictyon californicum, Lotus scoparius, and Malacothamnus fremontii.* The herbaceous layer is often well developed and can include a diverse mixture of such species *as Allophyllum gilioides, Anagallis arvensis, Avena barbata, Bromus diandrus, B. hordeaceous, B. madritensis, Calochortus amoenus, Calystegia malacophylla, Centaurea melitensis, Chlorogalum pomeridianum var. pomeridianum, Dichelostemma capitatum, Galium parisiense, Gnaphalium californicum, Hypochaeris glabra, Layia pentachaeta, Lotus spp., Phacelia cicutaria var. cicutaria, Pterostegia drymarioides, and Solanum xanti.* The hydrology is upland. Soils are well-drained sandy clay loams.

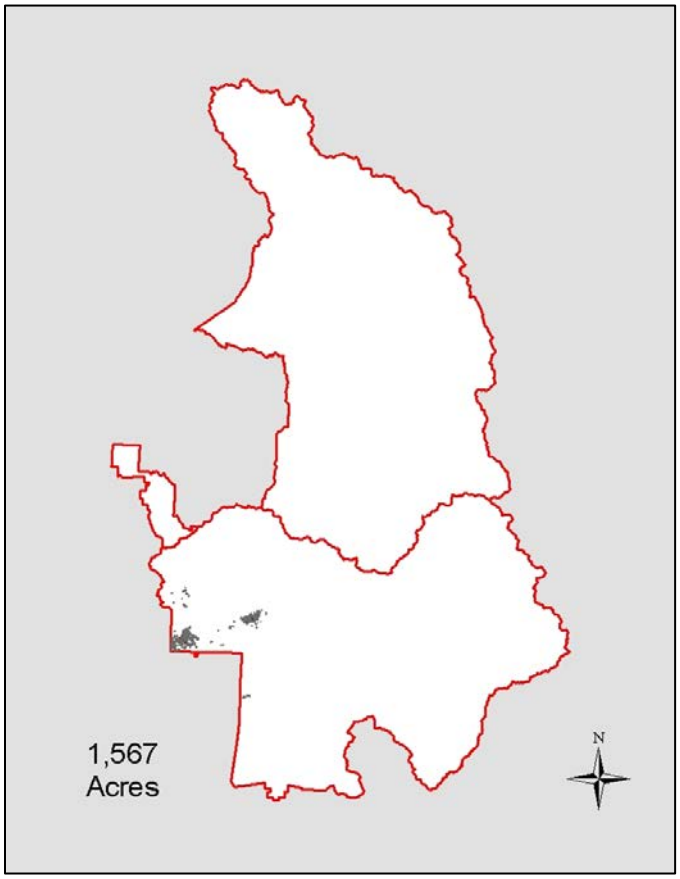


Figure 5025-1. Distribution of Chamise–California Yerba Santa Shrubland Association.

Accuracy:

Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:

This type has a highly variable signature, generally dependent on date, frequency and intensity of past burns and the resulting species composition (Figure 5025-2). Generally the only common signature characteristic in post burn stands is the relative smooth texture the younger plants give off on the imagery.



Figure 5025-2. Chamise–California Yerba Santa Shrubland Association signature. Photo reference: GIFO_SE.

Environmental Characteristics:

Microclimate – xeric
Elevation – 542–1604 m (1777–5264 ft)
Shape – convex
Slope position – low slope, midslope, ridgetop
Steepness – moderately steep to steep
Aspect – See Figure 5025-3.

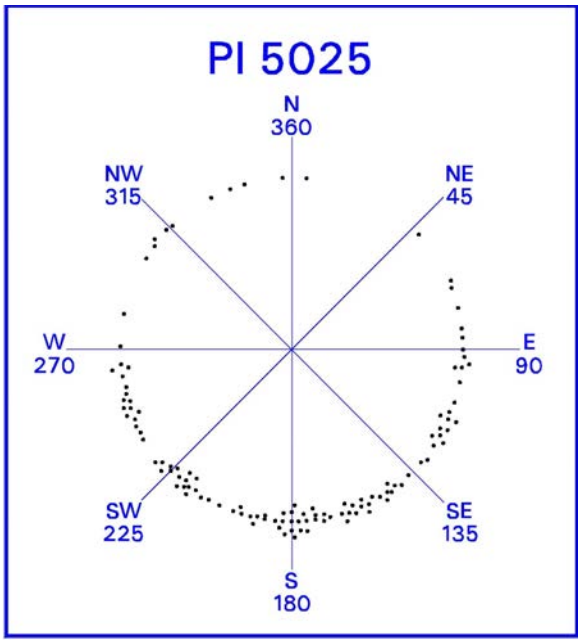


Figure 5025-3. Scatterplot of Chamise–California Yerba Santa Shrubland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Chamise Shrubland Alliance (5020)
- Chamise Shrubland Association (5021)
- Chamise–Buckbrush Shrubland Association (5031)

5030 – Chamise–Buckbrush Shrubland Alliance



Chamise Buckbrush Shrubland. SEKI.0296_910.

5031 – Chamise–Buckbrush Shrubland Association

Adenostoma fasciculatum–Ceanothus cuneatus Shrubland Association

Description:

The *Adenostoma fasciculatum–Ceanothus cuneatus* shrubland association is mapped on moderate to steep exposed slopes of varying aspect between 671–1579 m (2200–5181 ft) across 444 acres of Sequoia and Kings Canyon National Parks (Figure 5031-1). The shrub canopy is dominated by an open to closed mixture of *Adenostoma fasciculatum* and *Ceanothus cuneatus,* with each species contributing at least 20% cover. Lesser amounts *of Arctostaphylos viscida, Cercocarpus montanus var. glaber*, and *Fraxinus dipetala* may also be present. The herbaceous layer is generally sparse to absent, although gaps in the shrub canopy can support dense patches of annual grasses and forbs. Frequently encountered herbaceous species include annual graminoids and forbs characteristic of dry foothill sites, such as *Bromus spp., Vulpia spp.*, and *Galium spp*. The hydrology is upland. Soils are well drained sandy loams to clay loams. (NatureServe October 2006).

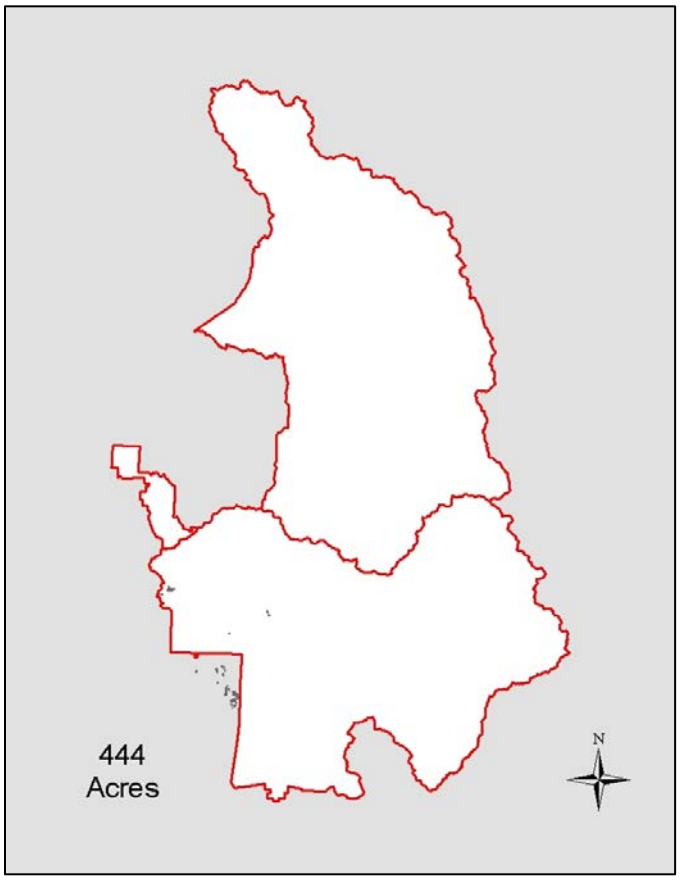


Figure 5031-1. Distribution of Chamise–Buckbrush Shrubland Association.

Accuracy:

Producer's accuracy: 0% (n=1)

User's accuracy: 0% (n=1)

Photo Interpretation Signature:

Adenostoma fasciculatum is generally the dominant in this setting. *Ceanothus cuneatus* gives off a light orange to pink signature and integrates evenly with the browner *A. fasciculatum* (Figure 5031-2). Generally a late post fire type (higher amounts of *C. cuneatus* may indicate more recent burn history), the signature is characteristically smoother than that of pure *A. fasciculatum*.



Figure 5031-2. Chamise–Buckbrush Shrubland Association signature.

Environmental Characteristics:

Microclimate – xeric
Elevation – 671–1579 m (2200–5181 ft)
Shape – convex
Slope position – low slope, midslope, upper slope
Steepness – moderate to steep
Aspect – See Figure 5031-3.

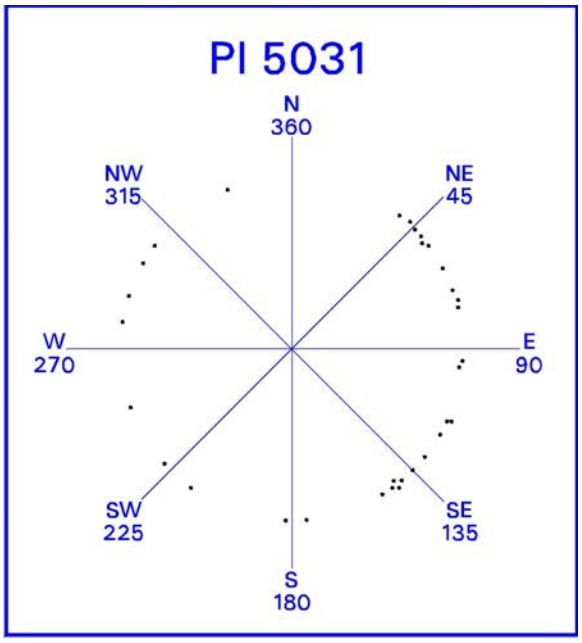


Figure 5031-3. Scatterplot of Chamise–Buckbrush Shrubland Association in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Chamise Shrubland Alliance (5020)
- Chamise Shrubland Association (5021)
- Chamise/Whiteleaf Manzanita Shrubland Association (5022)
- Chamise–California Yerba Santa Shrubland Association (5025)

5050 – Buckbrush Shrubland Alliance



Buckbrush Shrubland. SEKI.0404_465.

5050 – Buckbrush Shrubland Alliance
Ceanothus cuneatus Shrubland Alliance

Description:
The *Ceanothus cuneatus* shrubland alliance is mapped on moderate to steep south to southwest facing slopes between 488–1760 m (1600–5773 ft) across 109 acres of Sequoia and Kings Canyon National Parks (Figure 5050-1). The shrub layer is dominated by *Ceanothus cuneatus*, with *Aesculus californica, Quercus chrysolepis*, or *Q. douglasii* occasionally emergent. Other shrub species may include *Adensostoma fasciculatum*, *Cercocarpus montanus var. glaber*, or *Eriodictyon californicum*. The herbaceous layer is generally sparse. Most stands of this type are established after disturbance and are transitional to other chaparral and forest vegetation types. The hydrology is upland. (NatureServe October 2006).

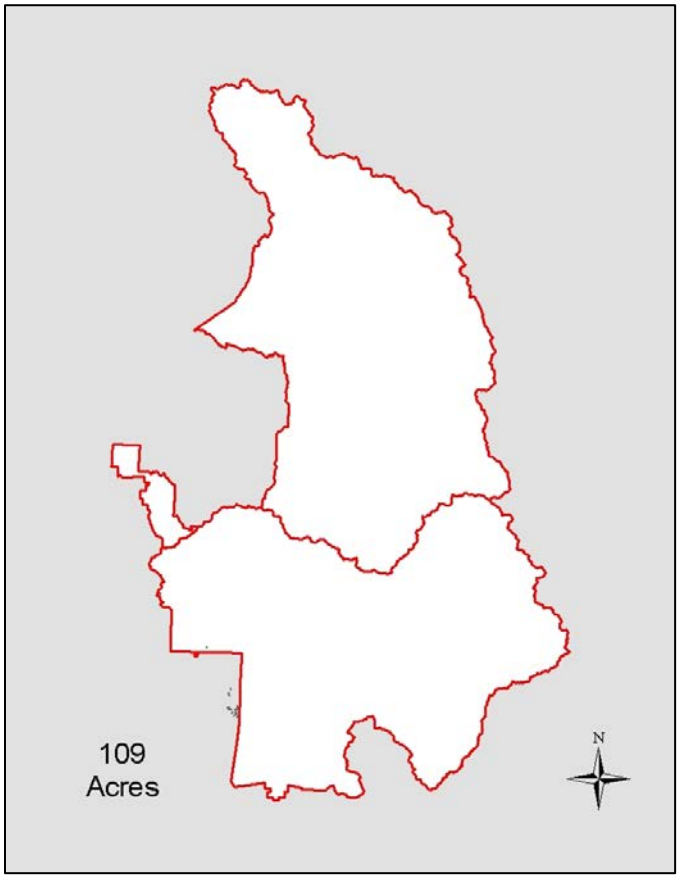


Figure 5050-1. Distribution of Buckbrush Shrubland Alliance.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
Ceanothus cuneatus gives off an orange to pinkish signature that is generally quite smooth, which is typical of post disturbance types of chaparral (Figure 5050-2).

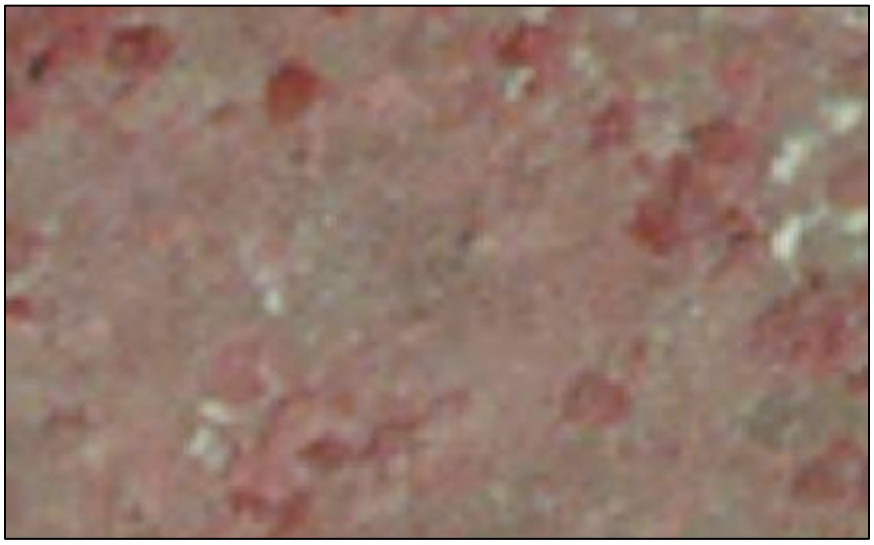


Figure 5050-2. Buckbrush Shrubland Alliance signature. Photo reference: LODG_SW.

Environmental Characteristics:
Microclimate – xeric
Elevation – 488–1760 m (1600–5773 ft)
Shape – convex
Slope position – low slope
Steepness – moderate to steep
Aspect – See Figure 5050-3.

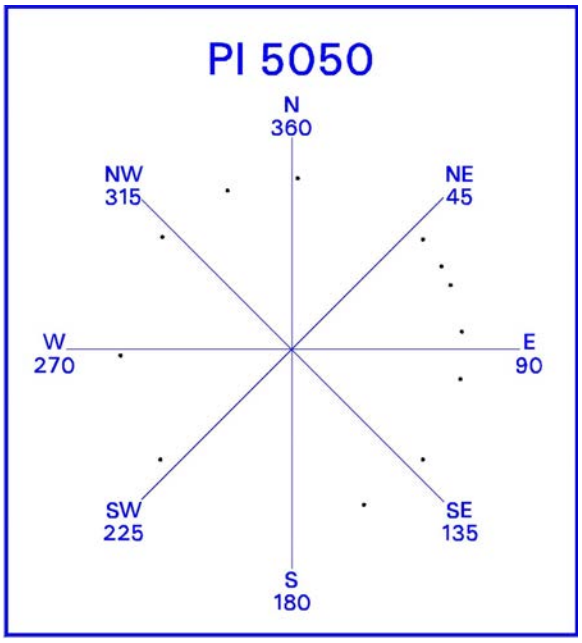


Figure 5050-3. Scatterplot of Buckbrush Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whiteleaf Manzanita Shrubland Alliance (5070)
- Chaparral Whitethorn Shrubland Alliance (5060)

5060 – Chaparral Whitethorn Shrubland Alliance

Ceanothus leucodermis Shrubland Alliance

Description:

The *Ceanothus leucodermis* shrubland alliance is mapped on moderately steep to steep slopes between 753–1673 m (2472–5490 ft) across 186 acres of Sequoia and Kings Canyon National Parks (Figure 5060-1). The shrub canopy is dominated by *Ceanothus leucodermis*. Other shrubs present may include *Adenostoma fasciculatum, Arctostaphylos viscida, Ceanothus integerrimus, Eriodictyon californicum, Rhus trilobata,* or *Yucca whipplei*. This short-lived shrub community depends on fire for establishment, and will transition to other shrub or tree dominated types in its absence. The herbaceous layer is sparse. The hydrology is upland. (NatureServe October 2006).

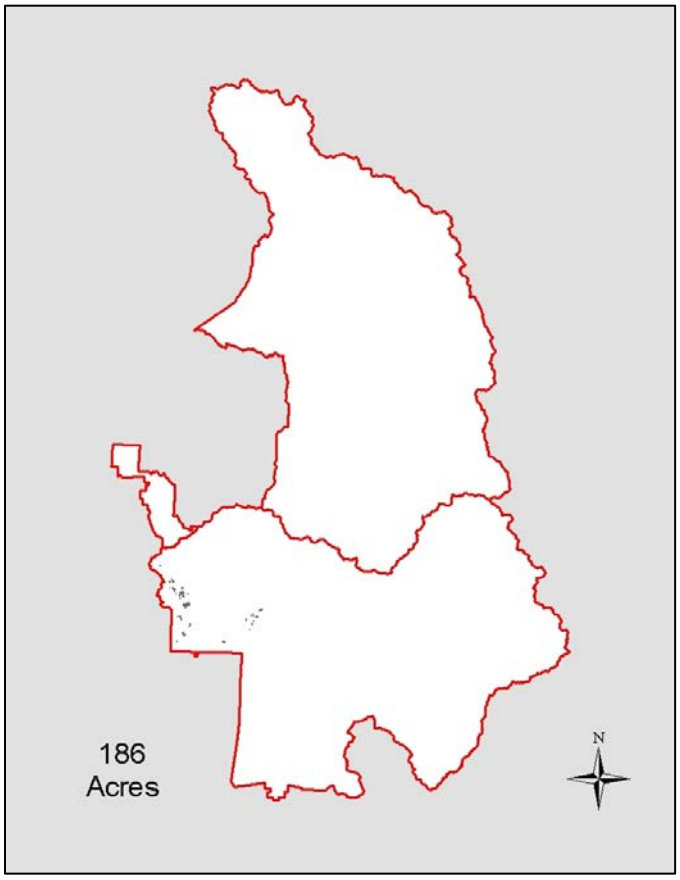


Figure 5060-1. Distribution of Chaparral Whitethorn Shrubland Alliance.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
Ceanothus leucodermis is very similar to wedge-leaf *C. cuneatus* except it is generally a bit more orange and is usually found in more pure stands (Figure 5060-2). *C. cuneatus* often occurs with *Adenostoma fasciculatum* as a mixed type.

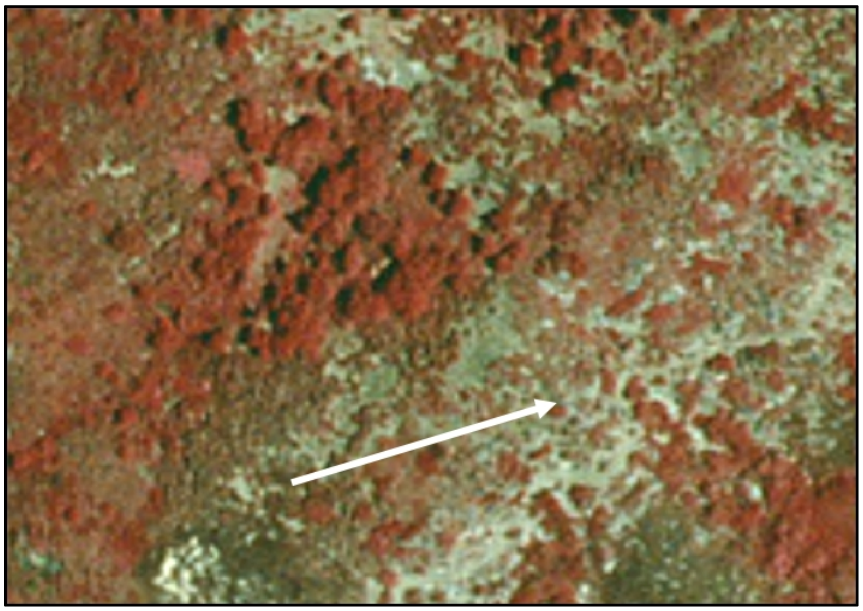


Figure 5060-2. Chaparral Whitethorn Shrubland Alliance signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 753–1673 m (2472–5490 ft)
Shape – convex
Slope position – midslope, upper slope
Steepness – moderately steep to steep
Aspect – See Figure 5060-3.

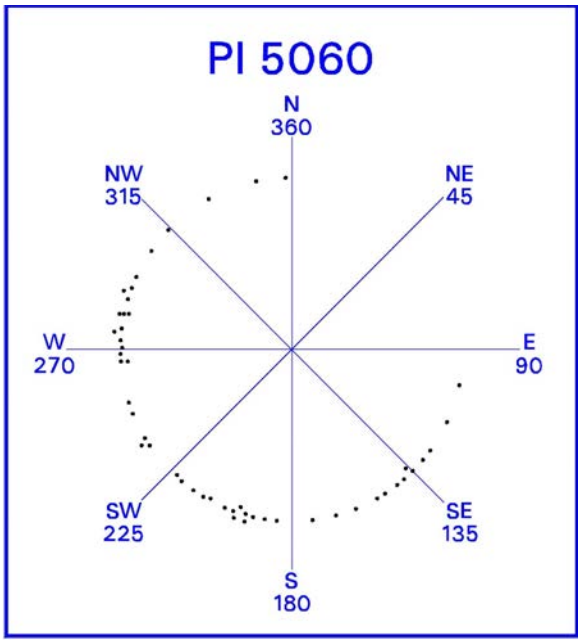
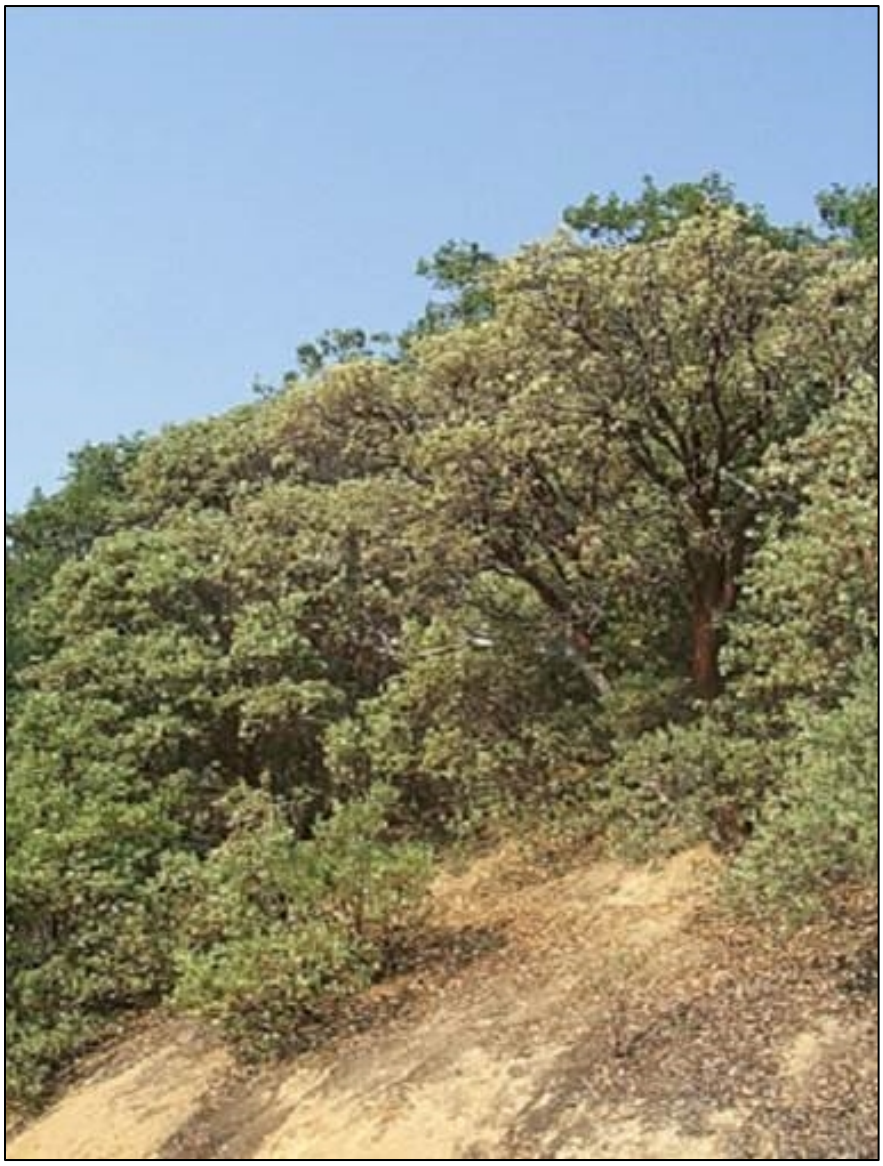


Figure 5060-3. Scatterplot of Chaparral Whitethorn Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whitethorn Ceanothus Shrubland Alliance (5110)
- Bitter Cherry Shrubland Alliance (6300)
- Buckbrush Shrubland Alliance (5050)

5070 – Whiteleaf Manzanita Shrubland Alliance



Whiteleaf Manzanita Shrubland. SEKI-AA.0231_823.

5070 – Whiteleaf Manzanita Shrubland Alliance

Arctostaphylos viscida Shrubland Alliance

Description:

The *Arctostaphylos viscida* shrubland alliance is mapped on moderately steep slopes of primarily southfacing aspect between 625–2118 m (2049–6950 ft) across 546 acres of Sequoia and Kings Canyon National Parks (Figure 5070-1). The dense shrub layer is dominated by *Arctostaphylos viscida*, although stands of *A. mewukka* may also be mapped as this type. Other shrub associates commonly include *Adenostoma fasciculatum, Ceanothus cuneatus, C. leucodermis, C. betuloides, Quercus garryana var. breweri, Q.wislizeni var.wislizeni,* and *Rhamnus tomentella*. In areas where adjacent to forests or woodlands, emergent *Pinus ponderosa, Q. chrysolepis*, and *Q. kelloggii* may occur. The herbaceous layer is sparse to absent, although the perennial bulb *Chlorogalum pomeridianum var. pomeridianum* is frequently present. The hydrology is upland. (NatureServe October 2006).

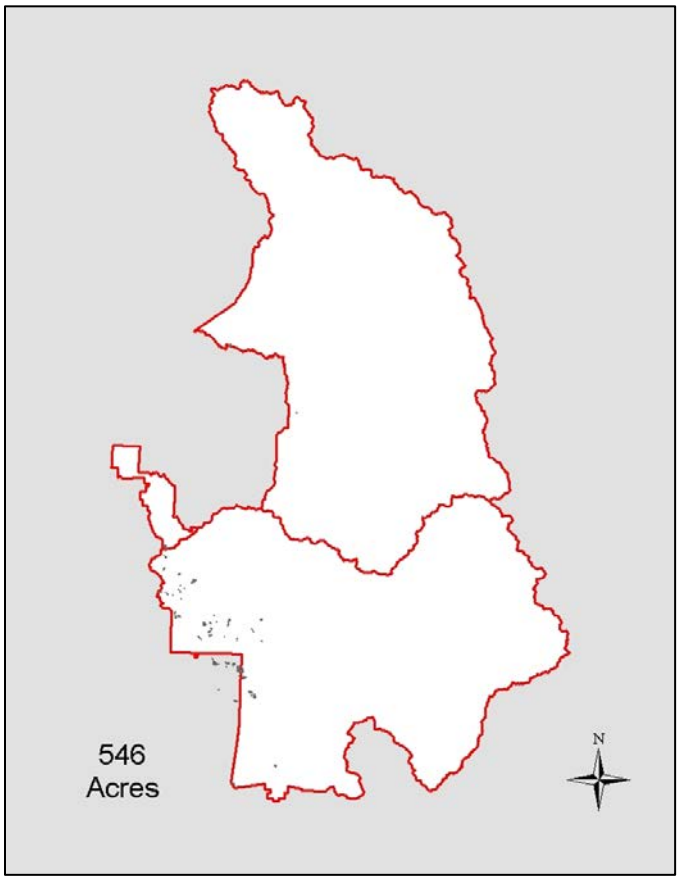


Figure 5070-1. Distribution of Whiteleaf Manzanita Shrubland Alliance.

Accuracy:

Producer's accuracy: 50% (n=2)

User's accuracy: 100% (n=1)

Photo Interpretation Signature:
The texture of the *Arctostaphylos viscida* shrubland alliance is more hummocky than other low elevation chaparral stands, reflecting the often distinct crown of *Arctostaphylos viscida*. Signatures yield a generally orange color in most stands. Pure stands are noted by photo interpreters on ridgelines and adjacent spurs (Figure 5070-2).



Figure 5070-2. Whiteleaf Manzanita Shrubland Alliance signature. Photo reference: GIFO_SE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 625–2118 m (2049–6950 ft)
Shape – convex
Slope position – midslope, ridgelines
Steepness – moderately steep
Aspect – See Figure 5070-3.

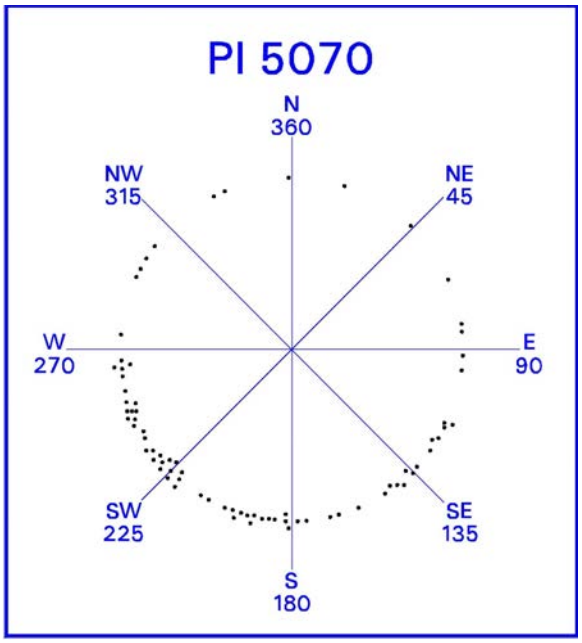


Figure 5070-3. Scatterplot of Whiteleaf Manzanita Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Birchleaf Mountain Mahogany Shrubland Alliance (5010)
- Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association (5012)
- Chamise/Whiteleaf Manzanita Shrubland Association (5022)
- Buckbrush Shrubland Alliance (5050)
- Greenleaf Manzanita Shrubland Alliance (5090)
- Mountain Misery Dwarf-shrubland Alliance (5130)

5080 – Bush Chinquapin Shrubland Alliance



Bush Chinquapin Shrubland. SEKI.0012_09.

5080 – Bush Chinquapin Shrubland Alliance

Chrysolepis sempervirens Shrubland Alliance

Description:

The *Chrysolepis sempervirens* shrubland alliance is mapped on moderate to steep xeric slopes of varying aspect between 2014–3561 m (6608–11683 ft) across 3,604 acres of Sequoia and Kings Canyon National Parks (Figure 5080-1). The dense shrub canopy is dominated by *Chrysolepis sempervirens*. Other shrubs may include *Arctostaphylos patula, Artemisia tridentata, Holodiscus discolor, Prunus emarginata,* and *Ribes cereum*. Emergent tree species are occasional and may include *Abies magnifica, A. concolor, Pinus balfouriana ssp. austrina, P. contorta var. murrayana,* or *P. monticola.* The herbaceous layer is characteristically sparse, with *Achnatherum occidentale ssp. occidentalis, Ageratina occidentalis, Apocynum androsaemifolium, Castilleja applegatei ssp. disticha, Elymus elymoides ssp. californicus, Monardella odoratissima,* and *Pteridium aquilinum* among the most frequently encountered species. The hydrology is upland. Soils are well drained sands and sandy loams. (NatureServe October 2006). In the aggregated database, the *Chrysolepis sempervirens* shrubland alliance is aggregated into the *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland superalliance (5590).

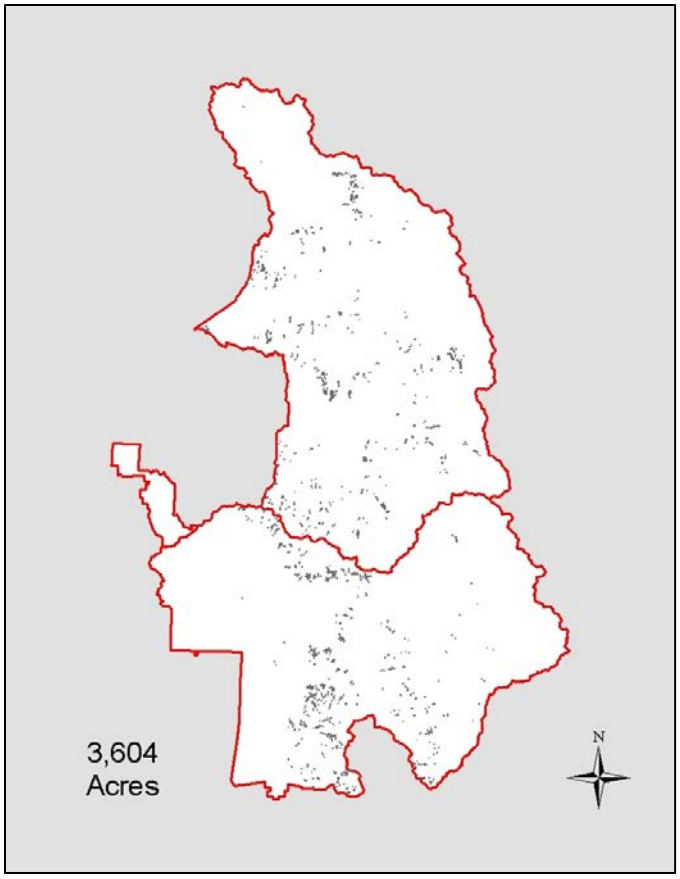


Figure 5080-1. Distribution of Bush Chinquapin Shrubland Alliance.

Accuracy:
Producer's accuracy: 56% (n=16)
User's accuracy: 64% (n=14)

Photo Interpretation Signature:
Generally, *Chrysolepis sempervirens* yields the brightest infrared signature of all the montane chaparral species and thus may be confused with more mesic shrub species, such as *Salix* or *Betula occidentalis* (Figure 5080-2). Higher elevation conifers are an occasional emergent to the shrub layer.

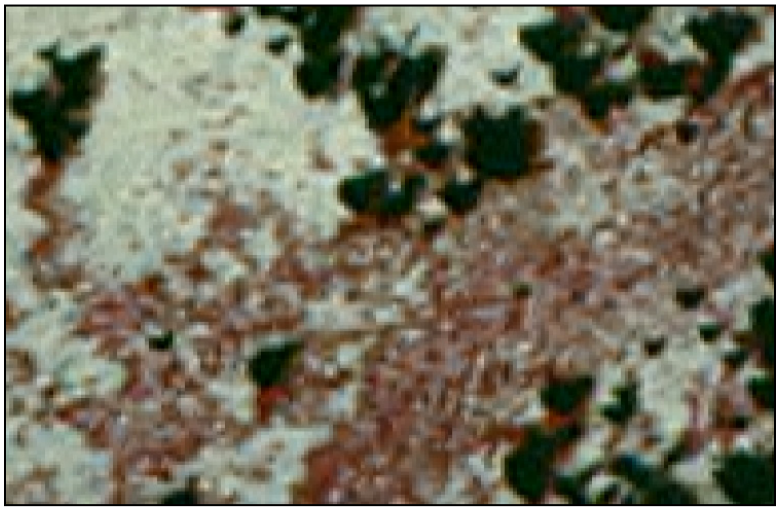


Figure 5080-2. Bush Chinquapin Shrubland Alliance signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2014–3561 m (6608–11683 ft).
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 5080-3.

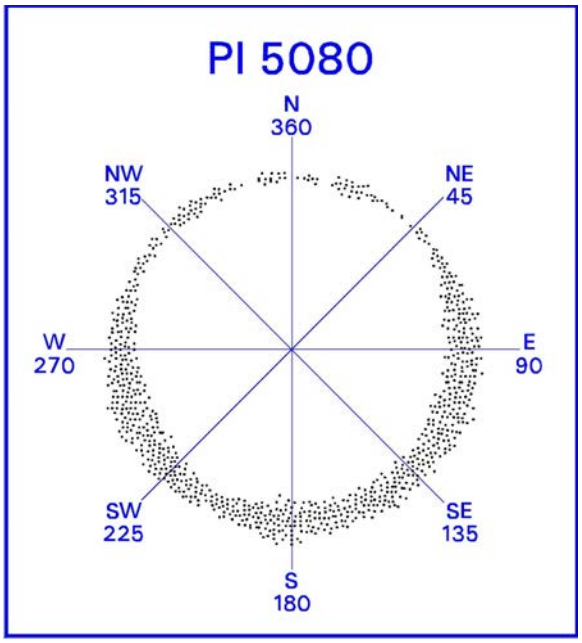


Figure 5080-3. Scatterplot of Bush Chinquapin Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Greenleaf Manzanita Shrubland Alliance (5090)
- Pinemat Manzanita Dwarf-shrubland Alliance (5280)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)
- Willow spp. Talus Shrubland Mapping Unit (6700)

5090 – Greenleaf Manzanita Shrubland Alliance



Greenleaf Manzanita Shrubland.

5090 – Greenleaf Manzanita Shrubland Alliance

Arctostaphylos patula Shrubland Alliance

Description:

The *Arctostaphylos patula* shrubland alliance is mapped on gentle to steep primarily south to southwest facing xeric slopes between 1423–3095 m (4670–10153 ft) across 2,252 acres of Sequoia and Kings Canyon National Parks (Figure 5090-1). The open to closed shrub canopy is dominated by *Arctostaphylos patula*. Other shrubs that may be present include *Artemisia tridentata*, *Ceanothus cordulatus*, *Chrysolepis sempervirens*, and/or *Prunus emarginata*. Emergent tree species are occasionally present and may include *Abies concolor*, *A. magnifica*, *Calocedrus decurrens*, *Juniperus occidentalis var. australis*, *Pinus contorta var. murrayana*, *P. jeffreyi*, *P. lambertiana*, *P. ponderosa*, *Quercus chrysolepis*, or *Q. kelloggii*, depending on elevation and the composition of the adjacent forest. The herbaceous layer is typically sparse, and is frequently characterized by dryland herbs such as *Achnatherum occidentale*, *Apocynum androsaemifolium*, *Bromus tectorum*, *Calyptridium umbellatum*, *Comandra umbellata ssp. californica*, and *Elymus elymoides*. The hydrology is upland. Soils are well drained sandy loams. (NatureServe October 2006).

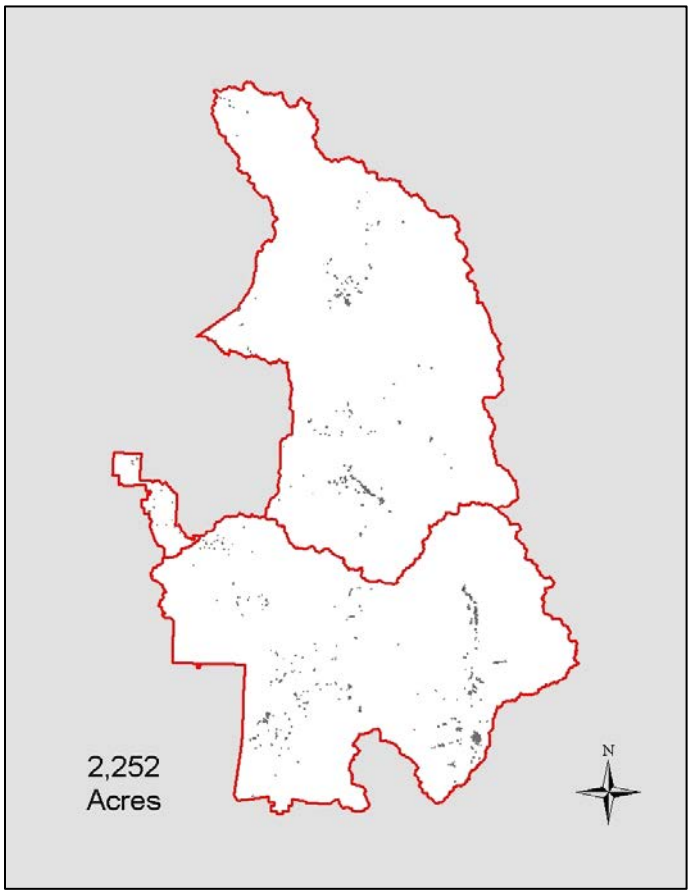


Figure 5090-1. Distribution of Greenleaf Manzanita Shrubland Alliance.

Accuracy:
Producer's accuracy: 72% (n=25)
User's accuracy: 90% (n=20)

Photo Interpretation Signature:
Arctostaphylos patula yields a signature intermediate in color between *A. viscida* (light orange) and *Chrysolepis sempervirens* (usually bright red). *A. nevadensis* yields a similar signature but has smaller crowns. Figure 5090-2 shows an example of the Greenleaf Manzanita Shrubland Alliance signature.

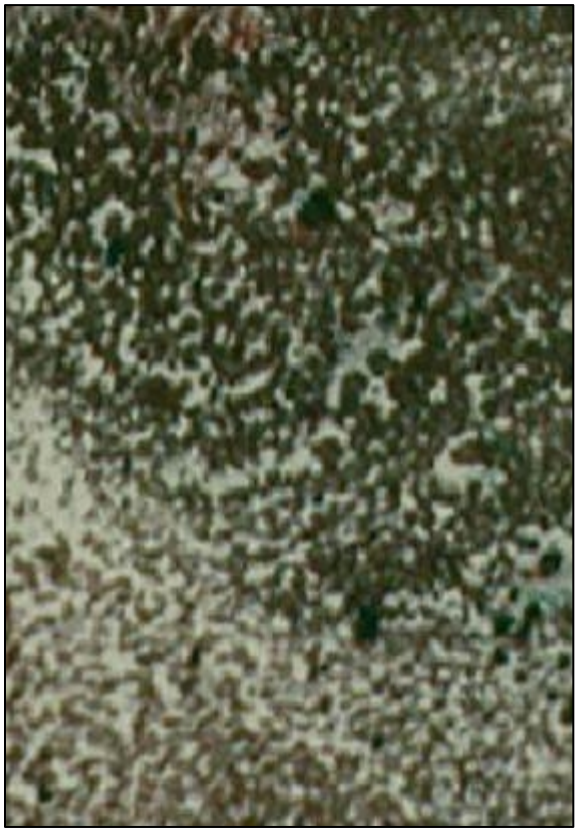


Figure 5090-2. Greenleaf Manzanita Shrubland Alliance signature. Photo reference: MOKA_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1423–3095 m (4670–10153 ft)
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 5090-3.

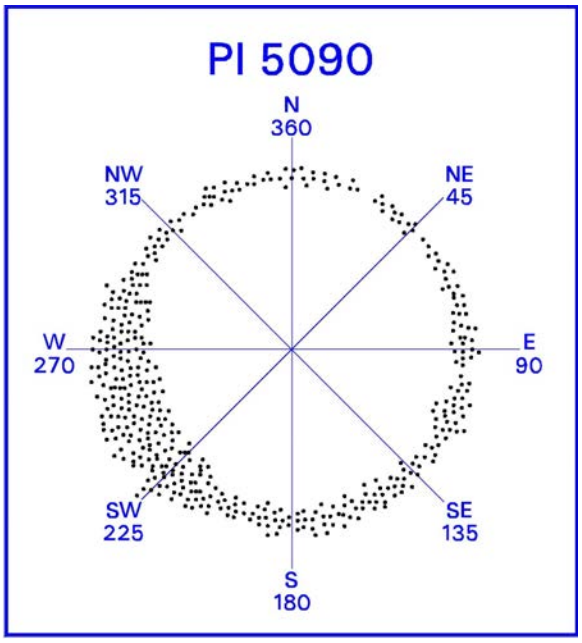


Figure 5090-3. Scatterplot of Greenleaf Manzanita Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Jeffrey Pine Woodland Alliance (3070)
- Whiteleaf Manzanita Shrubland Alliance (5070)
- Bush Chinquapin Shrubland Alliance (5080)
- Pinemat Manzanita Dwarf-shrubland Alliance (5280)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)

5110 – Whitethorn Ceanothus Shrubland Alliance



Whitethorn Ceanothus Shrubland. SEKI.0013_09.

5110 – Whitethorn Ceanothus Shrubland Alliance

Ceanothus cordulatus Shrubland Alliance

Description:

The *Ceanothus cordulatus* shrubland alliance is mapped on moderately steep south to southwest facing xeric slopes between 1059–3075 m (3473–10090 ft) across 2,411 acres in Sequoia and Kings Canyon National Parks (Figure 5110-1). The generally dense shrub canopy is dominated by *Ceanothus cordulatus*, with *Arctostaphylos patula*, *Chrysolepis sempervirens*, or *Prunus emarginata* often contributing significant cover. An emergent young tree layer is often present and may include *Abies concolor*, *Pinus jeffreyi*, or *Quercus kelloggii*. The herbaceous layer is characteristically sparse but often includes *Lotus crassifolius* and/or *Pteridium aquilinum*. This post-fire community is usually considered successional to *A. concolor* or *A. magnifica* forest. The hydrology is upland. Soils are well drained sands or sandy loams. (NatureServe October 2006). In the aggregated database, the *Ceanothus cordulatus* shrubland alliance is aggregated into the *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland superalliance (5590).

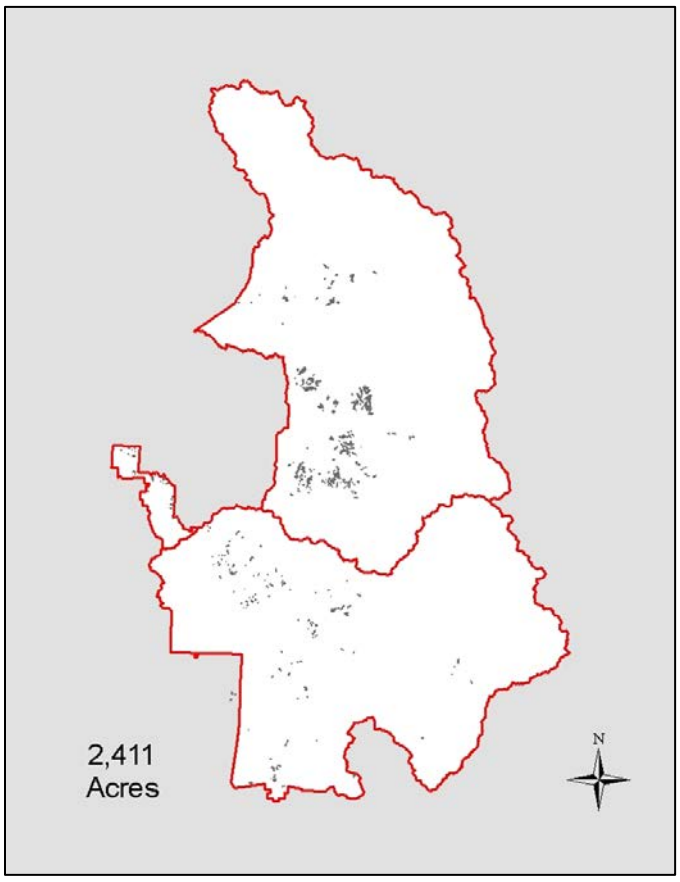


Figure 5110-1. Distribution of Whitethorn Ceanothus Shrubland Alliance.

Accuracy:

Producer's accuracy: 46% (n=13)

User's accuracy: 67% (n=9)

Photo Interpretation Signature:
Ceanothus cordulatus has a smooth pink to red signature, and young stands may be occasionally confused with herbaceous signatures (Figure 5110-2). Younger stands with more recent fire history tend to be more pure and have a smoother signature while older stands tend to mix with other montane chaparral species, thus creating difficulty in determining relative shrub density.

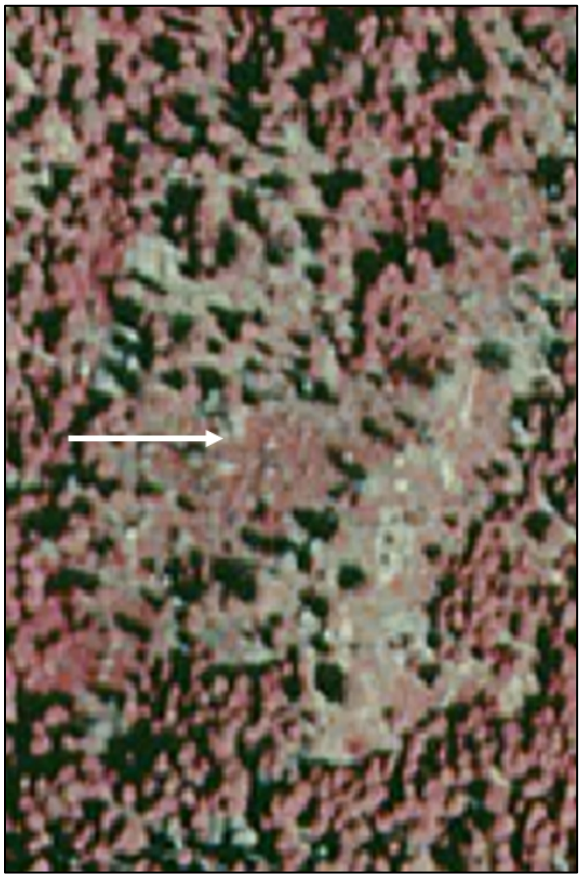


Figure 5110-2. Whitethorn Ceanothus Shrubland Alliance signature. Photo reference: GIFO_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1059–3075 m (3473–10090 ft)
Shape – convex, undulating
Slope position – low slope, midslope
Steepness – moderately steep
Aspect – See Figure 5110-3.

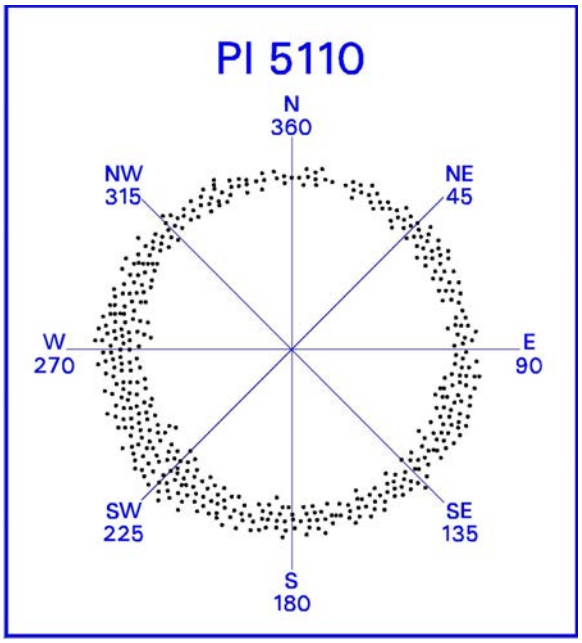


Figure 5110-3. Scatterplot of Whitethorn Ceanothus Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- Chaparral Whitethorn Shrubland Alliance (5060)
- Bitter Cherry Shrubland Alliance (6300)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)
- Deerbrush Shrubland Alliance (6010)
- Mesic Post Fire Herbaceous Mapping Unit (7702)
- Post Fire Shrub/Herbaceous Mapping Unit (7703)

5130 – Mountain Misery Dwarf Shrubland Alliance



Mountain Misery Dwarf Shrubland.

5130 – Mountain Misery Dwarf shrubland Alliance
Chamaebatia foliolosa Dwarf-shrubland Alliance

Description:
The *Chamaebatia foliolosa* dwarf-shrubland alliance (provisional) is mapped on gentle to steep slopes of primarily south to southwest facing aspect between 1451–2413 m (4761–7916 ft) across 287 acres of sequoia and Kings Canyon National Parks (Figure 5130-1). This dwarf-shrubland is dominated by *Chamaebatia foliolosa*, which sometimes forms small interstitial stands following disturbance in the lower and middle elevation montane forests. Field sampling is needed to describe and verify this type.

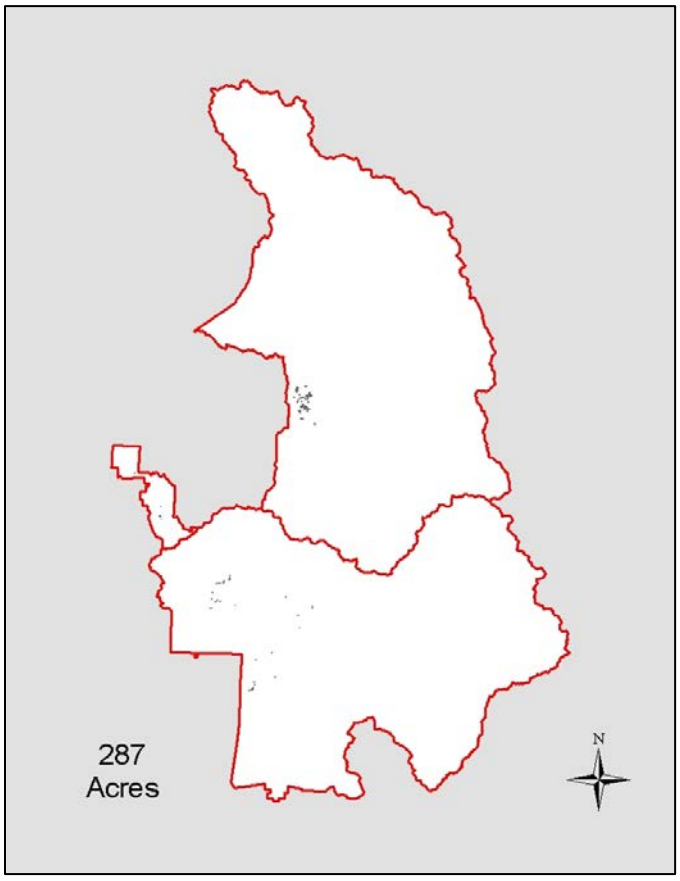


Figure 5130-1. Distribution of Mountain Misery Dwarf Shrubland Alliance.

Accuracy:
Producer's accuracy: 0% (n=1)
User's accuracy: % (n=0)

Photo Interpretation Signature:
Chamaebatia foliolosa yields a bright orange to pink signature with a smooth texture (Figure 5130-2). Emergent conifers or taller shrubs stand out adjacent to the generally continuous, even mat of *C.*

foliolosa. Most patches are too small to pull out as mappable stands—larger, mappable stands are associated with more recent burns.

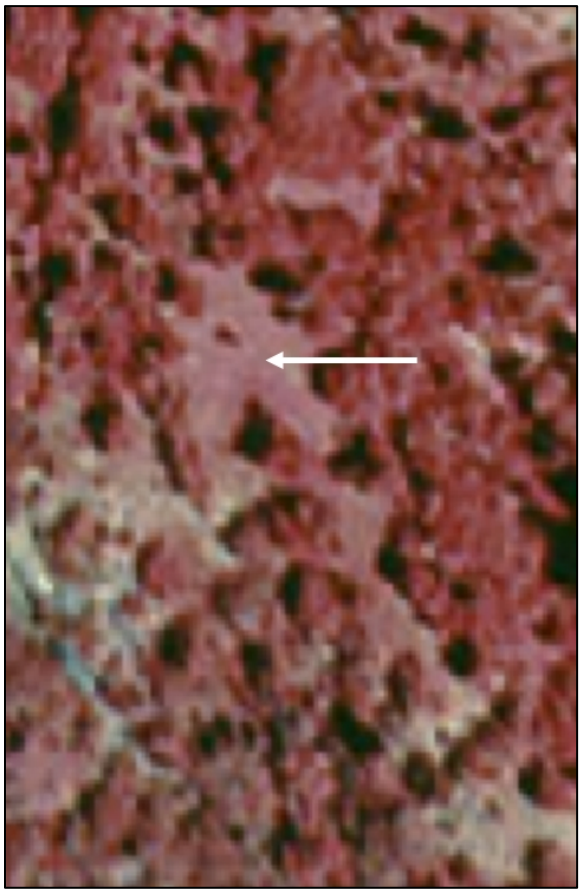


Figure 5130-2. Mountain Misery Dwarf Shrubland Alliance signature. Photo reference: GIFO_SW.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1451–2413 m (4761–7916 ft)
Shape – variable
Slope position – variable
Steepness – variable
Aspect – See Figure 5130-3.

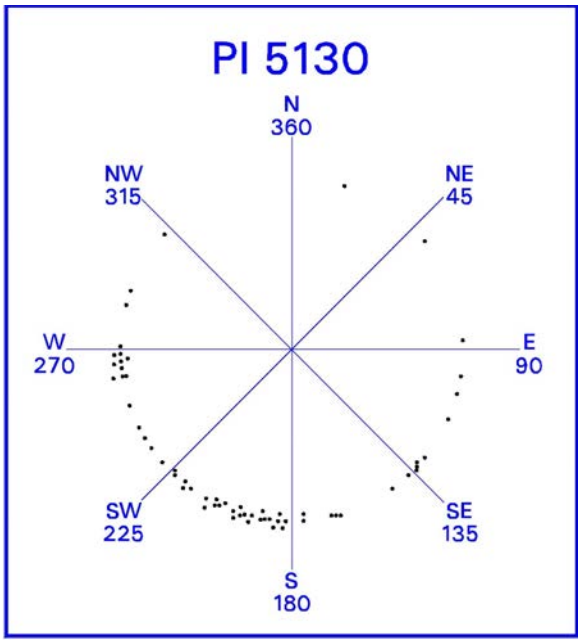


Figure 5130-3. Scatterplot of Mountain Misery Dwarf Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Mesic Post Fire Herbaceous Mapping Unit (7702)
- Post Fire Shrub/Herbaceous Mapping Unit (7703)

5140 – Indian Manzanita Shrubland Alliance



Indian Manzanita Shrubland. SEKI-AA.0068_705.

5140 – Indian Manzanita Shrubland Alliance

Arctostaphylos mewukka Shrubland Alliance

Description:

The *Arctostaphylos mewukka* shrubland alliance is mapped on moderately steep south to southwest facing slopes between 1135–1999 m (3723–6559 ft) across 653 acres of Sequoia and Kings Canyon National Parks (Figure 5140-1). The dense shrub canopy is dominated by *Arctostaphylos mewukka*, but most often occurs in mixture with lower amounts of *Ceanothus cordulatus, C. cuneatus, C. integerrimus var. californicus, Cercocarpus , Quercus garryana var. breweri,* or *Q. wislizeni var. wislizeni*. Emergent trees may include *Pinus ponderosa, Q. chrysolepis, Q. kelloggii,* or *Q. wislizeni var. wislizeni*. The characteristically sparse herbaceous layer frequently contains non-native *Bromus spp.* This resprouting manzanita type is maintained by fire, although in areas where fire has been absent for many decades large mature stands appear to persist.

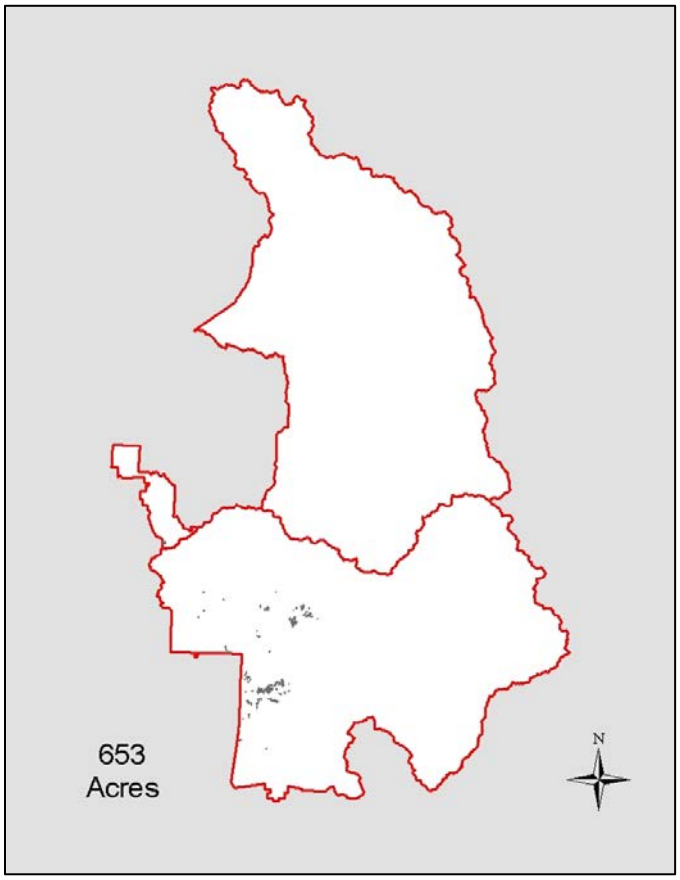


Figure 5140-1. Distribution of Indian Manzanita Shrubland Alliance.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
The signature of *Arctostaphylos mewukka* is similar to that of *A. Viscida,* but the texture is generally more even and cover more continuous as is typical of more recent post fire signatures (Figure 5140-2). The signature is also similar to other post-fire *Ceanothus* types but tends to be less bright.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1135–1999 m (3723–6559 ft)
Shape – convex
Slope position – midslope
Steepness – moderately steep
Aspect – See Figure 5140-3.

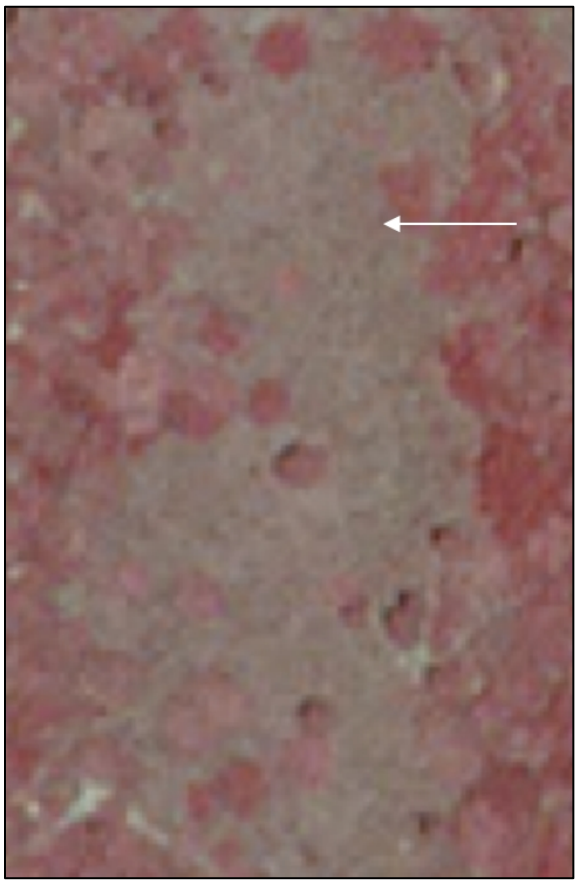


Figure 5140-2. Indian Manzanita Shrubland Alliance signature. Photo reference: GIFO_SW.

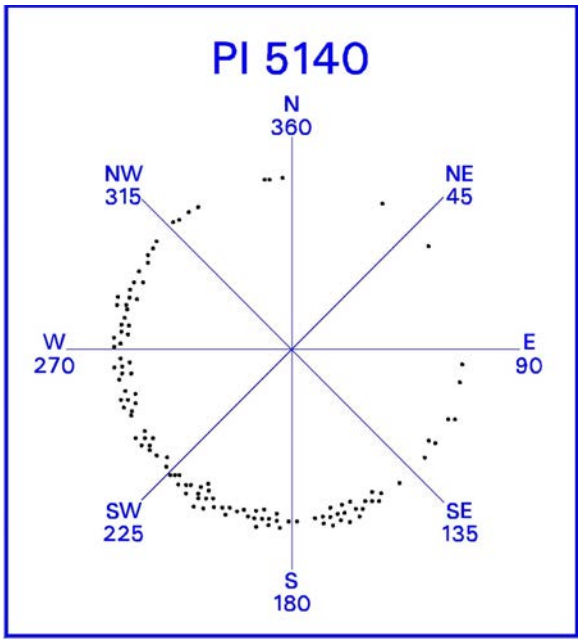


Figure 5140-3. Scatterplot of Indian Manzanita Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Whiteleaf Manzanita Shrubland Alliance (5070)
- Chaparral Whitethorn Shrubland Alliance (5060)

5160 – Big Sagebrush Shrubland Alliance



Big Sagebrush Alliance.

5160 – Big Sagebrush Shrubland Alliance

Artemisia tridentata Shrubland Alliance

Description:

The *Artemisia tridentata* shrubland alliance is mapped on moderate to steep slopes and canyon bottoms of varying aspect between 1611–3502 m (5284–11489 ft) across 3,154 acres of Sequoia and Kings Canyon National Parks (Figure 5160-1). The sparse to moderately dense shrub canopy (25–70% cover) is dominated by *Artemisia tridentata ssp. vaseyana*. Other shrub species present may include *Arctostaphylos patula*, *Ceanothus cordulatus*, *Chrysolepis sempervirens*, *Eriogonum wrightii*, *Holodiscus discolor*, *Ribes cereum*, or *Symphoricarpos rotundifolius*. Emergent trees may include *Abies magnifica*, *Juniperus occidentalis var. australis*, *Pinus contorta var. murrayana*, or *P. jeffreyi*. The herbaceous layer may be sparse or well developed, with *Achnatherum occidentale*, *Apocynum androsaemifolium*, *Castilleja applegatei*, *Elymus elymoides*, *E. glaucus*, *Eriogonum nudum*, *Hazardia whitneyi var. whitneyi*, *Monardella odoratissima*, and *Pteridium aquilinum* among the most frequently encountered species. The hydrology is upland. Soils are moderately well drained sandy loams. (NatureServe October 2006).

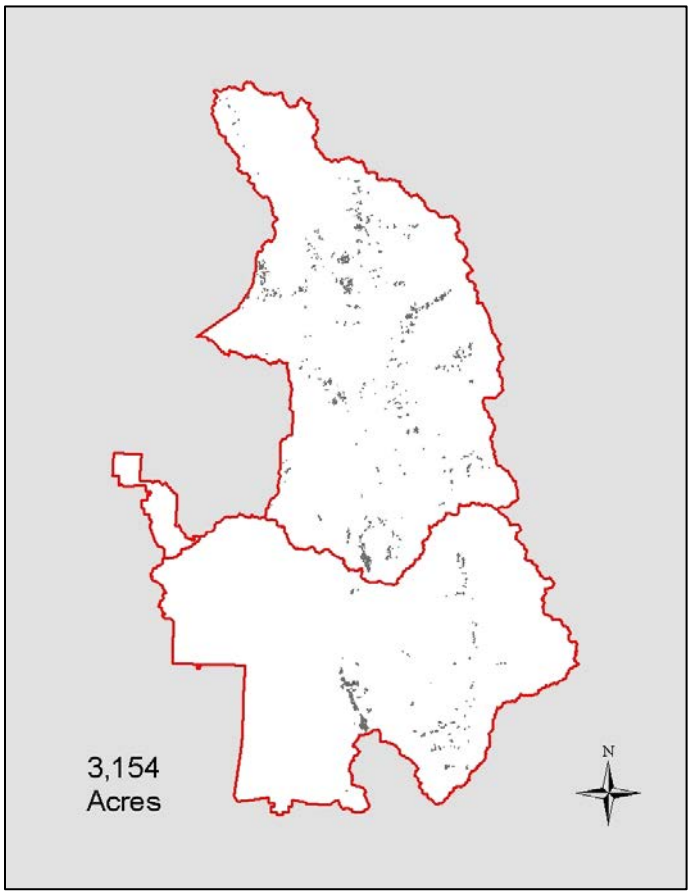


Figure 5160-1. Distribution of Big Sagebrush Shrubland Alliance.

Accuracy:
Producer's accuracy: 79% (n=14)
User's accuracy: 92% (n=12)

Photo Interpretation Signature:
Artemisia tridentata generally has a gray to light pink signature depending on the health of the plants in the stand and proximity to meadow edge grasses (Figure 5160-2).

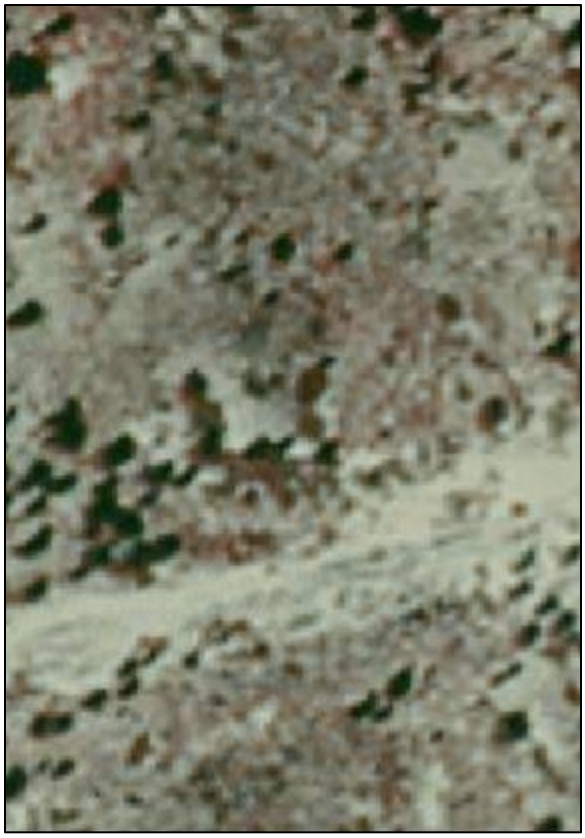


Figure 5160-2. Big Sagebrush Shrubland Alliance signature. Photo reference: MOKA_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1611–3502 m (5284–11489 ft)
Shape – convex, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 5160-3.

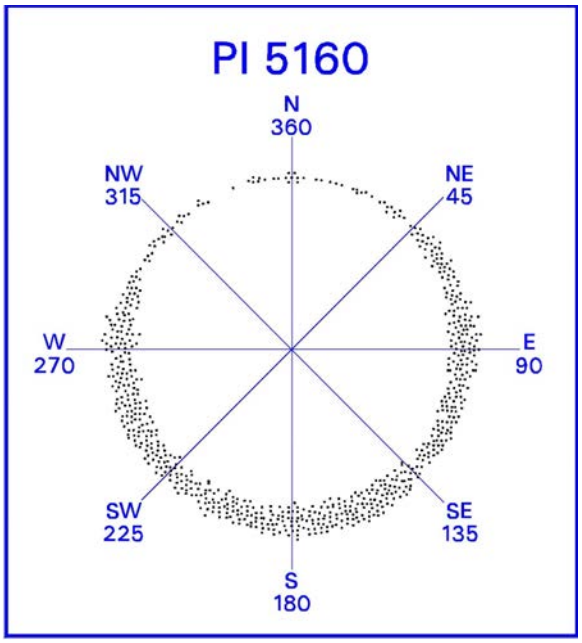


Figure 5160-3. Scatterplot of Big Sagebrush Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Quaking Aspen/Big Sagebrush Forest Superassociation (2016)
- Sierra Lodgepole Pine/Big Sagebrush Forest Association (3034)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance (5590)
- Upland Herbaceous (7000)
- Shorthair Sedge Herbaceous Alliance (7120)

5200 – Timberline Sagebrush Shrubland Alliance



Timberland Sagebrush Shrubland. SEKI.058_09.

5200 – Timberline Sagebrush Shrubland Alliance
Artemisia rothrockii Shrubland Alliance

Description:
The *Artemisia rothrockii* shrubland alliance is mapped on gently sloping meadow and forest margins between 2786–3569 m (9140–11709 ft) across 255 acres of Sequoia and Kings Canyon National Parks (Figure 5200-1). The relatively open shrub canopy is dominated by *Artemisia rothrockii*. Emergent subalpine conifers, such as *Pinus balfouriana ssp. austrina, P. contorta var. murrayana,* and *P. albicaulis*, may be present. The herbaceous layer reflects that of the surrounding vegetation, and frequently includes *Carex exserta, Eriogonum incanum, Juncus balticus, Monardella odoratissima* and/or *Penstemon heterodoxus*. The hydrology is upland. (NatureServe October 2006)

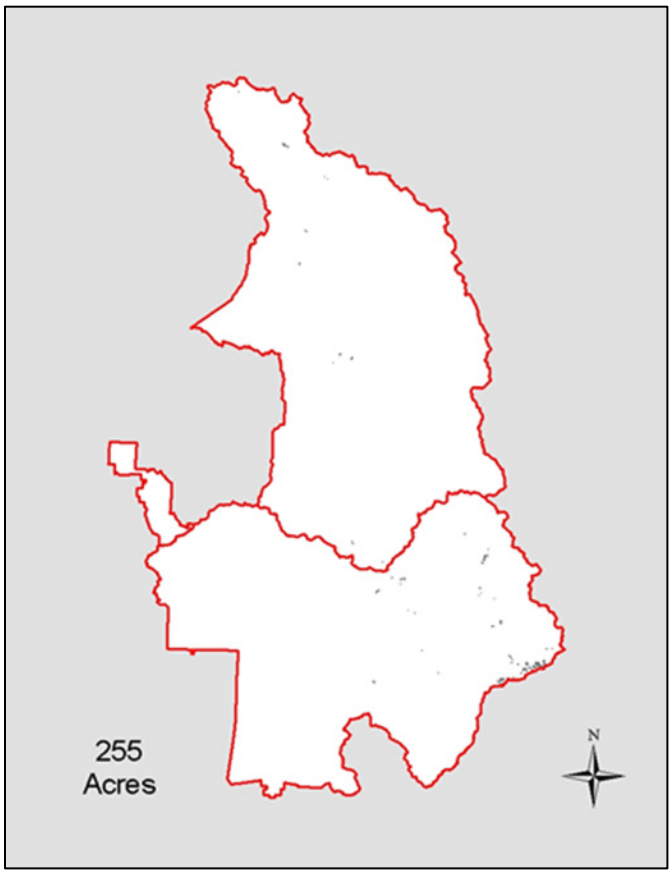


Figure 5200-1. Distribution of Timberline Sagebrush Shrubland Alliance.

Accuracy:
Producer's accuracy: 50% (n=4)
User's accuracy: 50% (n=4)

Photo Interpretation Signature:
An extremely difficult type to discern on the photography, stands are generally very small and sparse; often occurring within and adjacent to drier meadows. Slight texture along the meadow edge can be helpful in determining this type (Figure 5200-2).



Figure 5200-2. Timberline Sagebrush Shrubland Alliance signature. Photo reference: TPDE_SE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 2786–3569 m (9140–11709 ft)
Shape – undulating
Slope position – low slope
Steepness – gentle
Aspect – See Figure 5200-3.

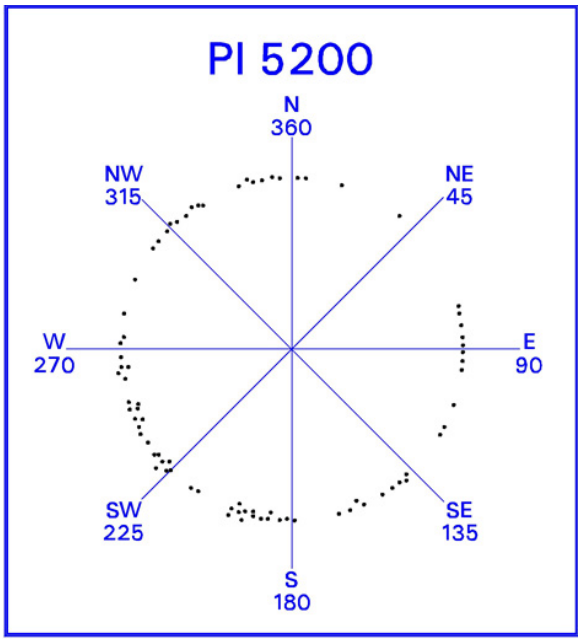


Figure 5200-3. Scatterplot of Timberline Sagebrush Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance 5510)
- Upland Herbaceous (7000)

5230 – Curl-leaf Mountain Mahogany Woodland Alliance
Cercocarpus ledifolius Woodland Alliance

Description:
The *Cercocarpus ledifolius* woodland alliance is mapped on dry, rocky southfacing slopes and ridges between 2169–3384 m (7117–11104 ft) across 674 acres of Sequoia and Kings Canyon National Parks (Figure 5230-1). The tree layer is characterized by an open canopy of *Cercocarpus ledifolius*, with *Juniperus occidentalis var. australis* or *Pinus monophylla* present as well. The shrub canopy often includes *Artemisia tridentata ssp. vaseyana*, or *Holodiscus discolor*. The herbaceous layer is relatively sparse and is characterized by native bunchgrasses. (NatureServe October 2006)

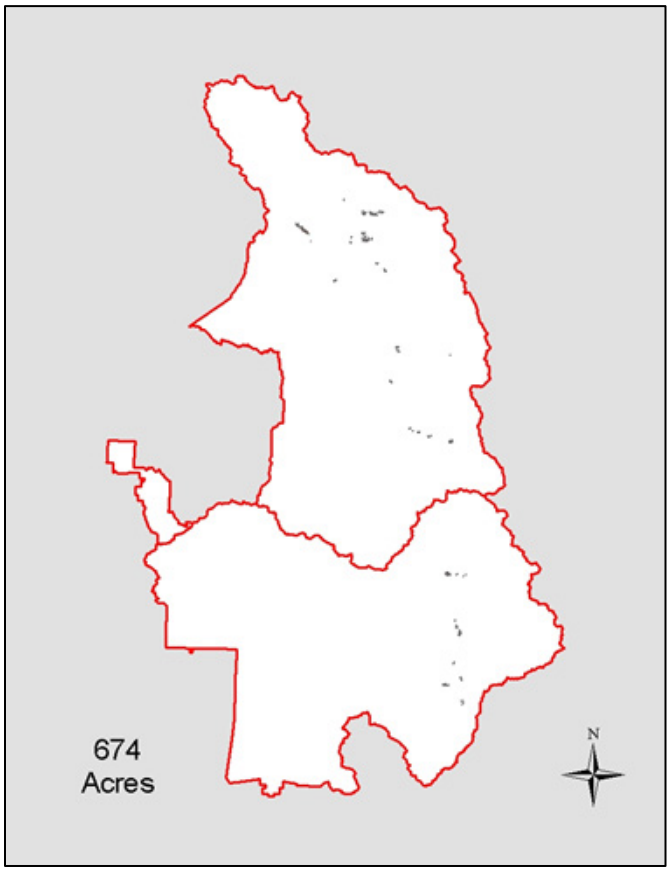


Figure 5230-1. Distribution of Curl-leaf Mountain Mahogany Woodland Alliance.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
This type is generally found in sparse settings, and most individuals yield a dark brown signature (Figure 5230-2). Stands that form an understory to *Pinus monophylla* are often very sparse and difficult to detect.

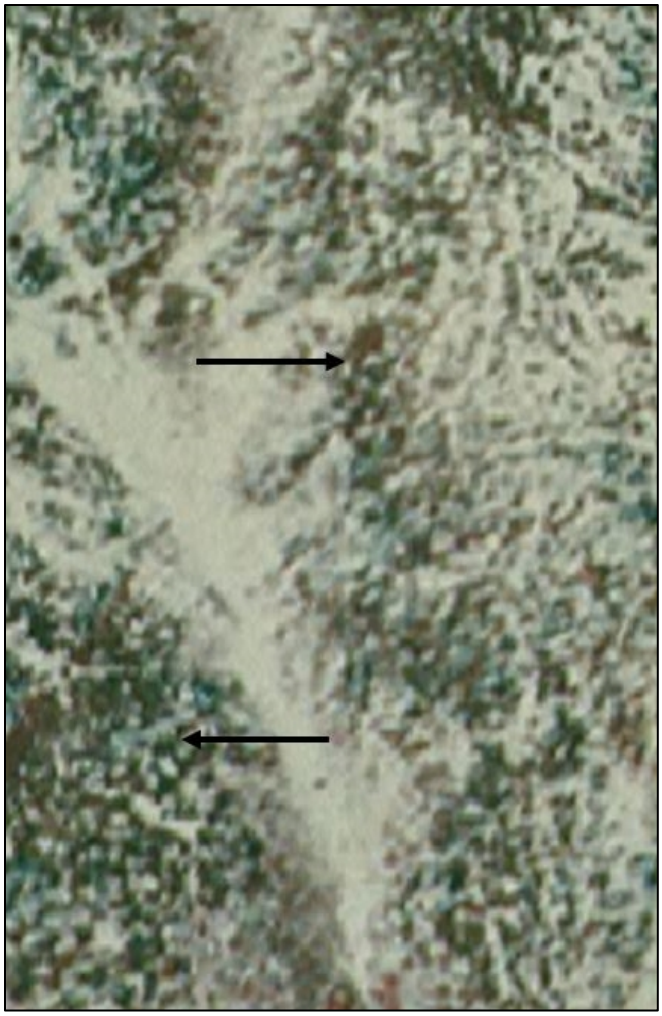


Figure 5230-2. Curl-leaf Mountain Mahogany Woodland Alliance signature. Photo reference: MOKA_NE.

Environmental Characteristics:
Microclimate – Xeric
Elevation – 2169–3384 m (7117–11104 ft)
Shape – Neutral to convex
Slope position – Mid to upper
Steepness – Steep to very steep
Aspect – See Figure 5230-3.

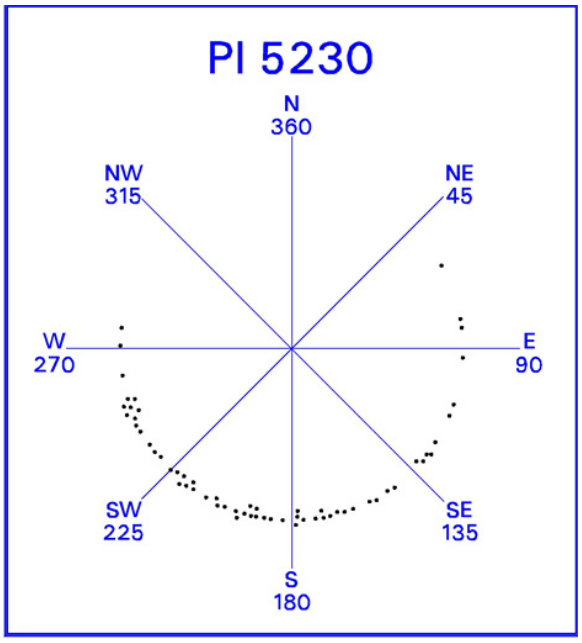


Figure 5230-3. Scatterplot of Curl-leaf Mountain Mahogany Woodland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Singleleaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association (3114)
- Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association (4107)
- Birchleaf Mountain Mahogany Shrubland Alliance (5010)

5270 – Chaparral Yucca Shrubland Alliance



Chaparral Yucca Shrubland. SEKI.0183_128.

5270 – Chaparral Yucca Shrubland Alliance

Yucca whipplei Shrubland Alliance

Description:

The *Yucca whipplei* shrubland alliance is mapped on steep, south facing rocky marble outcrops between 438–2063 m (1438–6768 ft) across 463 acres in Sequoia and Kings Canyon National Parks (Figure 5270-1). The sparse shrub canopy is dominated by scattered *Yucca whipplei*. Other frequently encountered shrub associates include *Adenostoma fasciculatum, Cercocarpus montanus var. glaber, Eriodictyon californicum*, and *Toxicodendron diversilobum*. The herbaceous layer can be sparse to well developed, and is often dominated by a mixture of annual grassland species. *Selaginella hansenii* frequently co-occurs with *Y. whipplei* in these stands. The hydrology is upland.

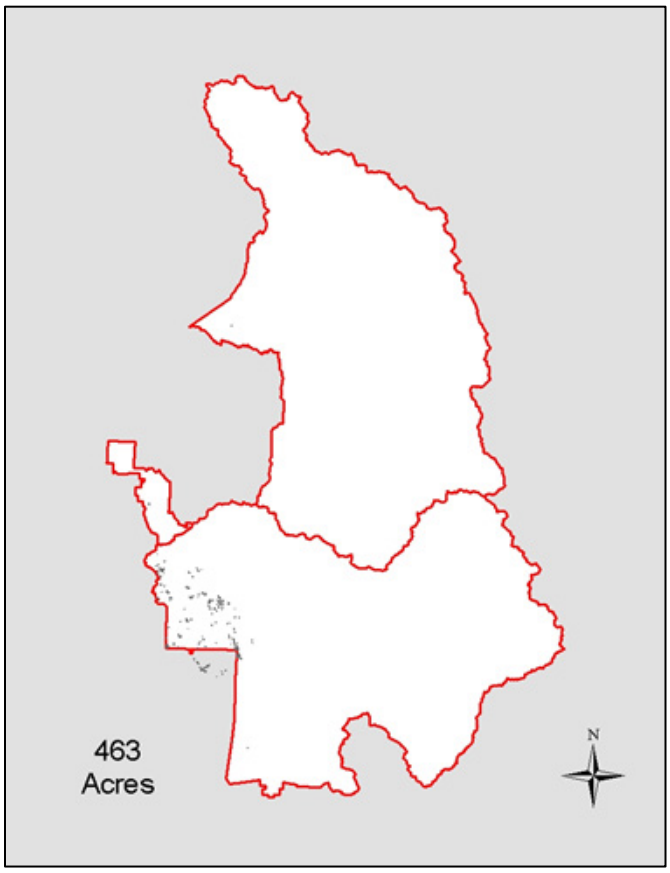


Figure 5270-1. Distribution of Chaparral Yucca Shrubland Alliance.

Accuracy:

Producer's accuracy: 57% (n=4)

User's accuracy: 100% (n=7)

Photo Interpretation Signature:
The *Yucca whipplei* shrubland alliance is mappable only where *Yucca whipplei* forms relatively dense patches. They are sometimes discernable against rocky backgrounds as extremely small crowned individuals, often showing up with a yellowish or white color (Figure 5270-2).

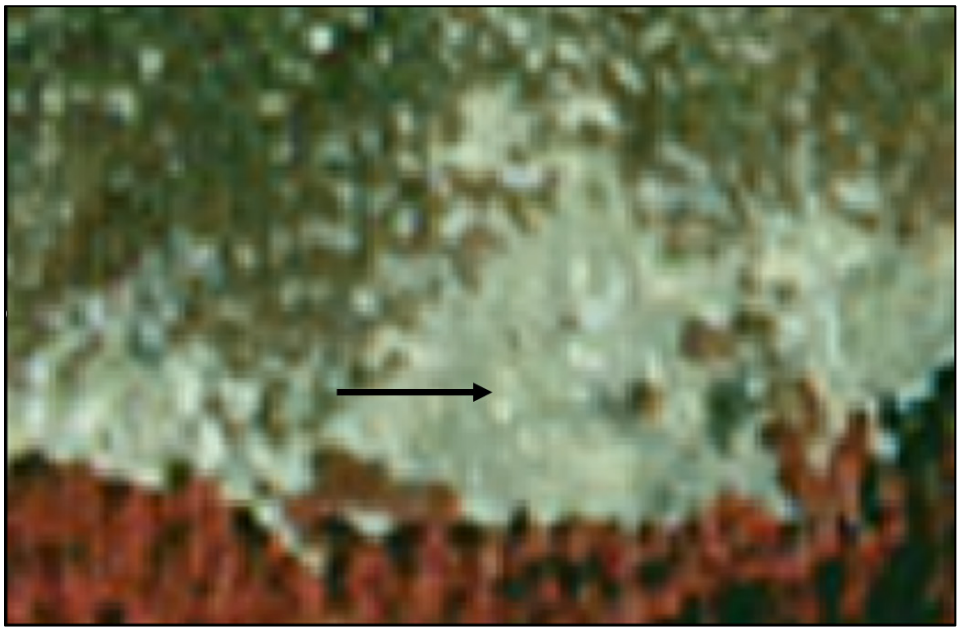


Figure 5270-2. Chaparral Yucca Shrubland Alliance signature. Photo reference: SHMO_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 438–2063 m (1438–6768 ft)
Shape – convex
Slope position – low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 5270-3.

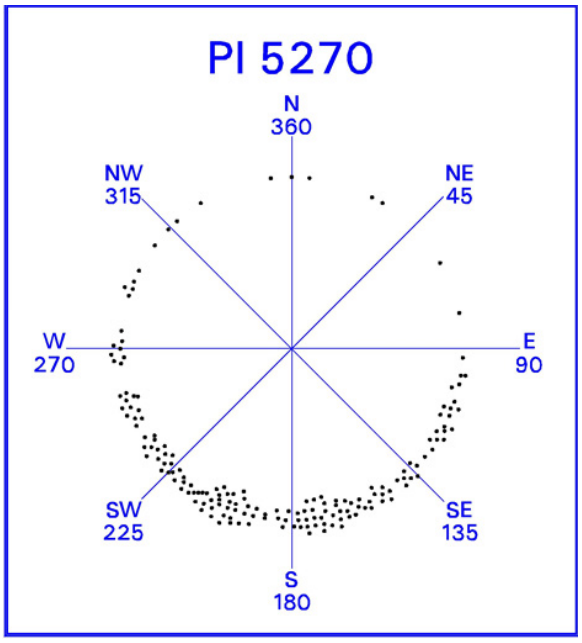


Figure 5270-3. Scatterplot of Chaparral Yucca Shrubland Alliance in relation to aspect.

Types with Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- Chamise–Chaparral Yucca Shrubland Association (5023)

5280 – Pinemat Manzanita Dwarf-shrubland Alliance



Pinemat Manzanita Dwarf-shrubland. SEKI.0020_13.

5280 – Pinemat Manzanita Dwarf-shrubland Alliance
Arctostaphylos nevadensis Dwarf-shrubland Alliance

Description:
The *Arctostaphylos nevadensis* dwarf-shrubland alliance is mapped on gentle to moderate northeast to southwest facing slopes between 2427–3394 m (7964–11136 ft) across 306 acres of Sequoia and Kings Canyon National Parks (Figure 5280-1). The shrub canopy is dominated by low-lying mats of *Arctostaphylos nevadensis*. Other shrub associates may include *A. patula, Chrysolepis sempervirens*, or *Holodiscus discolor.* The sparse to absent herbaceous layer may include scattered *Calochortus leichtlinii, Castilleja applegatei ssp. disticha, Cymopterus terebinthinus var. californicus, Elymus elymoides ssp. californicus, Eriogonum nudum, Gayophytum diffusum ssp. diffusum*, and/or *Penstemon newberryi*. This type is most often found at upper montane forest margins, and is frequently adjacent to stands of *Abies magnifica* and *Pinus monticola*. The hydrology is upland. Soils are well-drained sandy loams.

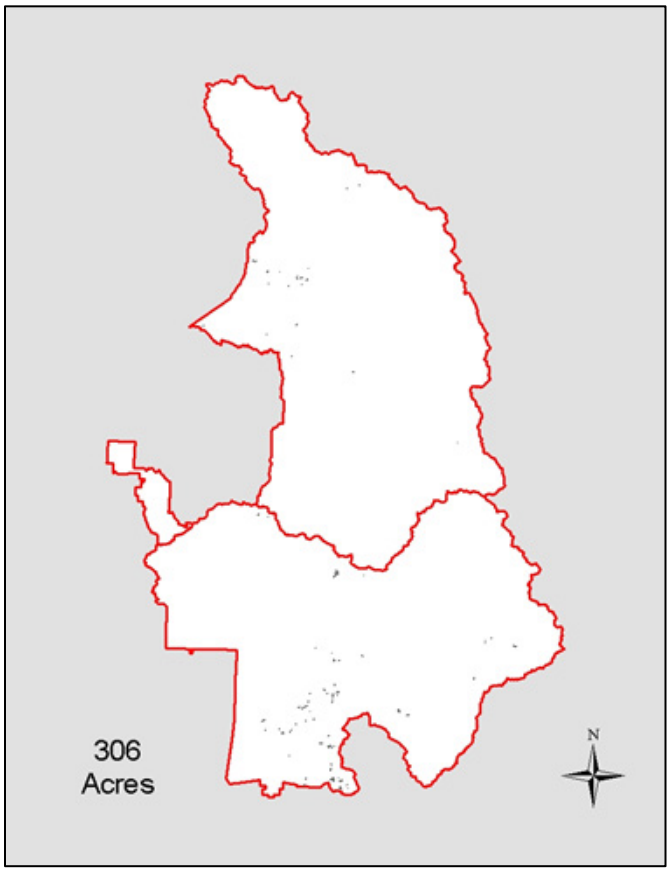


Figure 5280-1. Distribution of Pinemat Manzanita Dwarf-shrubland Alliance.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: 0% (n=1)

Photo Interpretation Signature:
Arctostaphylos nevadensis is similar to *A. patula* in color but has a smoother texture (Figure 5280-2). This type often occurs at forest edges but generally in very small stands except as an understory to higher elevation mixed conifers. Most stands are below mimum mapping unit as they are difficult to map in this setting.

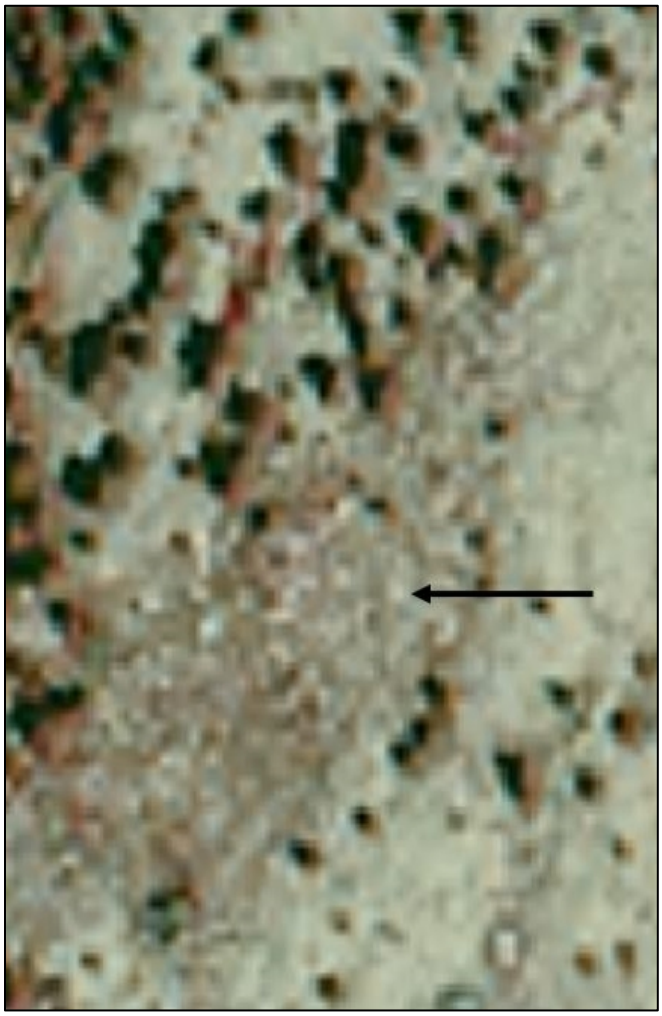


Figure 5280-2. Pinemat Manzanita Dwarf-shrubland Alliance signature. Photo reference: MOSI_SW.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2427–3394 m (7964–11136 ft)
Shape – convex
Slope position – midslope, high slope
Steepness – moderate
Aspect – See Figure 5280-3.

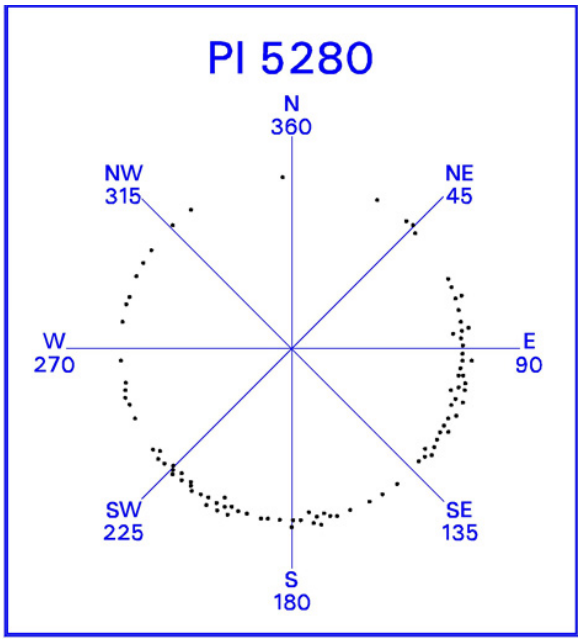


Figure 5280-3. Scatterplot of Pinemat Manzanita Dwarf-shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Bush Chinquapin Shrubland Alliance (5080)
- Greenleaf Manzanita Shrubland Alliance (5090)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)

5300 – Water Birch Shrubland Alliance



Water Birch Shrubland. 5200_SEKI.058_09.

5300 – Water Birch Shrubland Alliance

Betula occidentalis Shrubland Alliance

Description:

The *Betula occidentalis* shrubland alliance is mapped along watercourses and on spring-fed mesic montane and subalpine slopes between 1999–2954 m (6559–9693 ft) across 157 acres in Kings Canyon National Park (Figure 5300-1). It is a common east side species, and stands dominated by *Betula occidentalis* are restricted to the eastern portions of Kings Canyon National Park. *Cornus sericea* frequently co-dominates the shrub layer, with *Salix spp*. often contributing significant cover as well. The herbaceous layer is dense and species rich, with *Pteridium aquilinum* and *Rubus parviflorus* occuring as dominants over a variety of mesic herbs. Sites are characterized by upland or riparian hydrology and well drained sandy clay loam soils. (NatureServe October 2006).

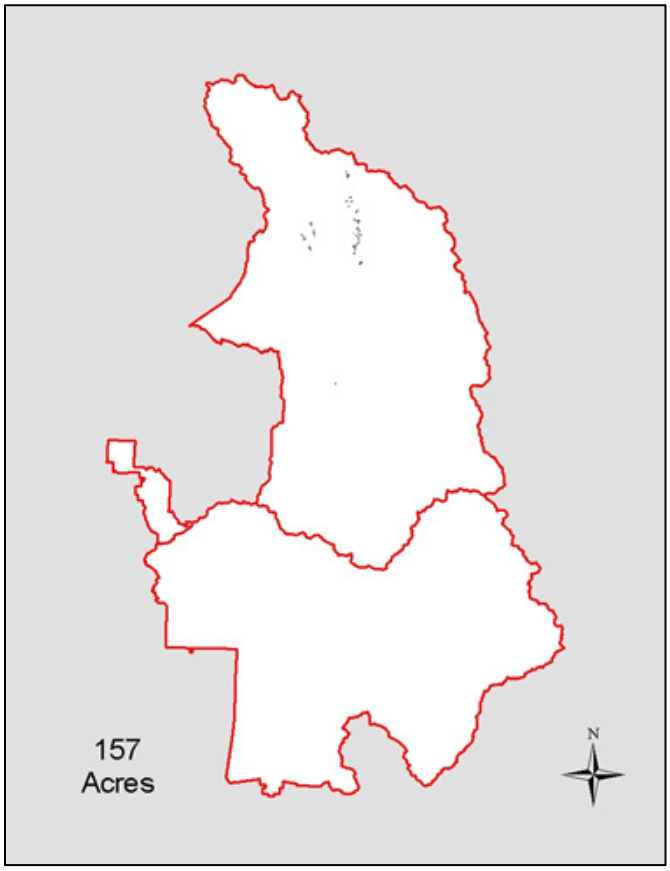


Figure 5300-1. Distribution of Water Birch-Shrubland Alliance.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
The photo signature for *Betula occidentalis* is pink in color with a rounded crown that appears as a smooth textured shrub in isolated thickets along steep riparian environments (Figure 5300-2).



Figure 5300-2. Water Birch Shrubland Alliance signature.

Environmental Characteristics:
Microclimate – mesic
Elevation – 1999–2954 m (6559–9693 ft)
Shape – concave
Slope position – low to midslope
Steepness – gentle to moderately sloping
Aspect – See Figure 5300-3.

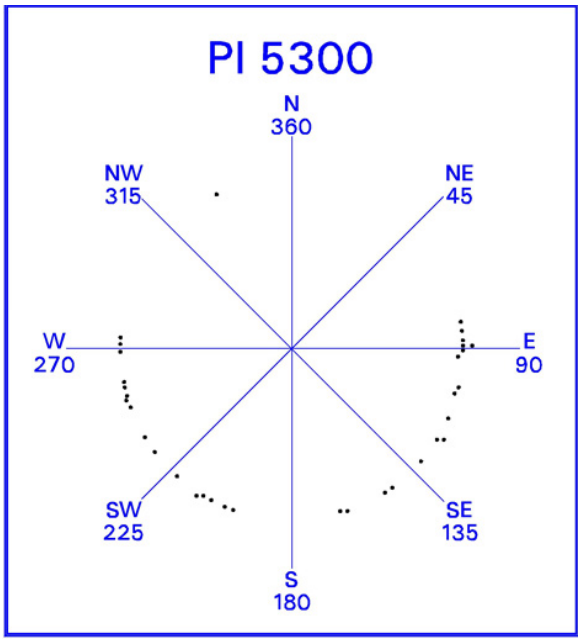


Figure 5300-3. Scatterplot of Water Birch Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- White Alder Temporarily Flooded Forest Alliance (2060)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Bitter Cherry Shrubland Alliance (6300)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Willow spp. Talus Shrubland Mapping Unit (6700)

5500 – Superalliances and Alliance-level Mapping Units

5510 – Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance

Artemisia tridentata ssp. *vaseyana* Shrubland & *Artemisia rothrockii* Shrubland & *Holodiscus discolor* Shrubland & *Phyllodoce breweri* Shrubland Superalliance

Description:

The *Artemisia tridentata ssp. vaseyana* shrubland & *Artemisia rothrockii* shrubland & *Holodiscus discolor* shrubland and *Phyllodoce breweri* shrubland superalliance is mapped on gentle to moderately steep slopes of varying aspect between 2000–3860 m (6563–12665 ft) across 12,298 acres of Sequoia and Kings Canyon National Parks (Figure 5510-1). The shrub canopy of this mapping unit can be dominated by *Artemisia rothrockii, Artemisia tridentata ssp. vaseyi, Eriogonum wrightii, Holodiscus discolor, Ledum glandulosum,* or *Phyllodoce breweri*. All of these are low lying, relatively open stands of sub-shrubs that occur in openings within the subalpine forest or above treeline and which are difficult to differentiate using aerial photography. The hydrology is upland. Soils are well-drained sandy loams.

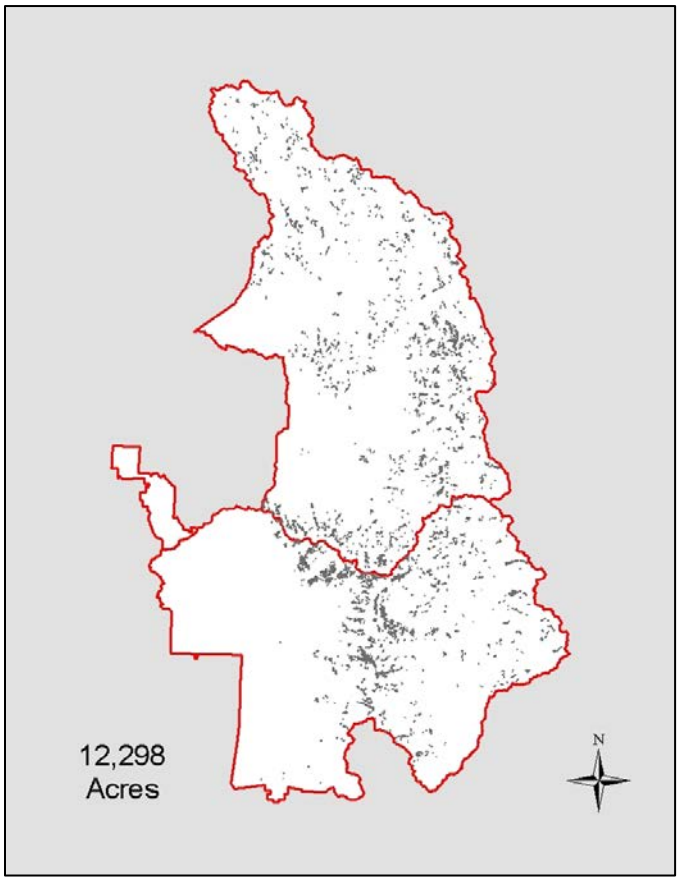


Figure 5510-1. Distribution of Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance

Accuracy:
Producer's accuracy: 100% (n=21)
User's accuracy: 91% (n=23)

Photo Interpretation Signature:
This is an extremely difficult signature to detect. It is generally sparse and rocky in scree, talus or rocky settings (Figure 5510-2). The signature varies depending on rock type, setting, and plant density, which is almost always sparse.

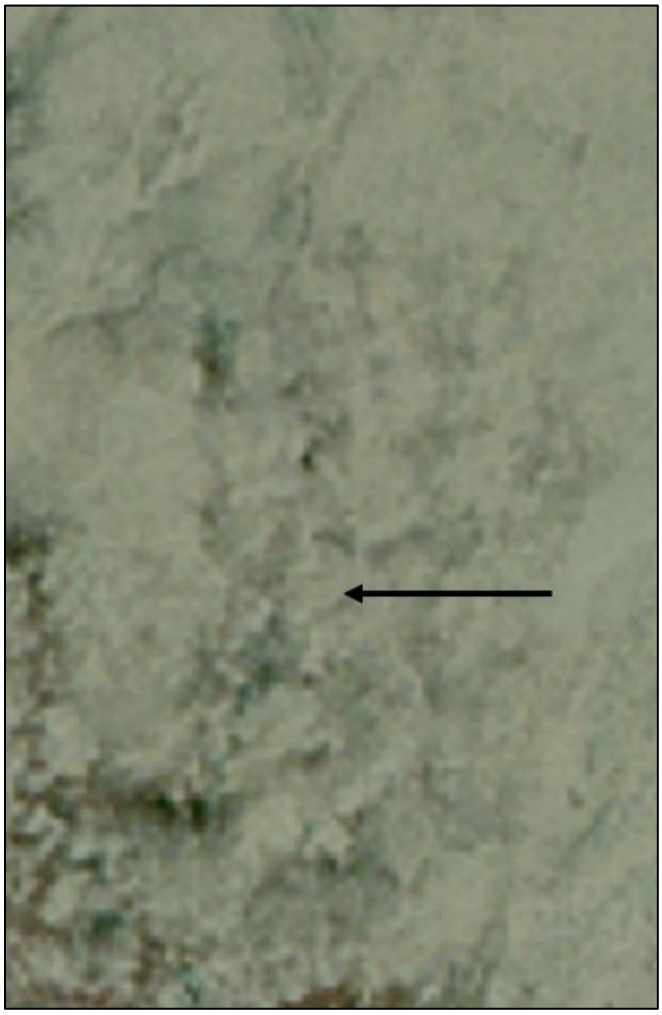


Figure 5510-2. Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 2000–3860 m (6563–12665 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope

Steepness – gentle to moderately steep
Aspect – See Figure 5510-3.

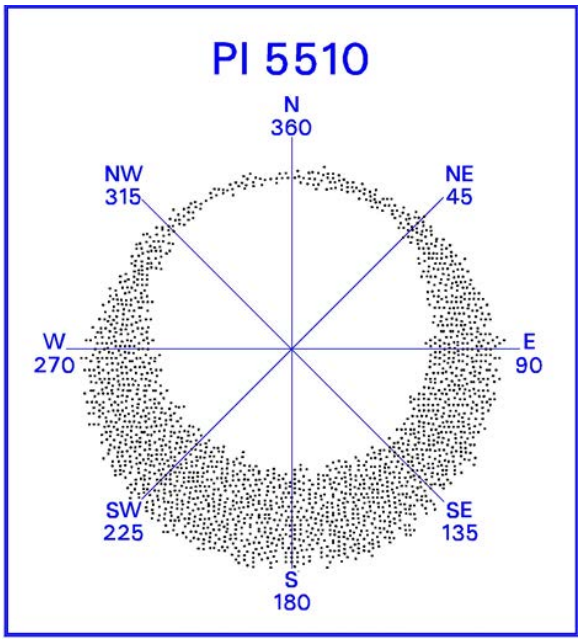


Figure 5510-3. Scatterplot of Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Alpine Scree Slope (0200)
- Non-alpine Talus (0950)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Big Sagebrush Shrubland Alliance (5160)
- Timberline Sagebrush rubland Alliance (5200)
- Red Mountainheather Dwarf-shrubland Alliance (5550)

5520 – Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit

Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus Shrubland Mapping Unit

Description:

The *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland mapping unit is mapped on moderate to steep primarily south to southwest facing slopes between 1627–3478 m (5338–11412 ft) across 13,973 acres of Sequoia and Kings Canyon National Parks (Figure 5520-1). These stands represent the more xeric phase of what has traditionally been treated as mixed montane chaparral. The dense shrub canopy is dominated by a mixture of *Arctostaphylos patula, Ceanothus cordulatus*, and *Chrysolepis sempervirens* in varying amounts. Other shrub species present may include *Acer glabrum, Arctostaphylos nevadensis, Artemisia tridentata, Chamaebatia foliolosa, Eriogonum wrightii, Holodiscus discolor, Prunus emarginata, Ribes cereum, Sambucus mexicana,* or *Symphoricarpos spp;* however, one or more of the three primary xeric chaparral species must dominate. Emergent trees may include *Abies concolor, A. magnifica, Calocedrus decurrens, Juniperus occidentalis var. australis, Pinus jeffreyi, P. lambertiana* or *P. monticola*. The herbaceous layer is typically sparse to absent, but frequently includes *Apocynum androsaemifolium, Elymus glaucus, Epilobium angustifolium, Eriogonum nudum, Lotus crassifolius, Monardella odoratissima,* and/or *Pteridium aquilinum.* In the aggregated database, the *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland mapping unit is aggregated into the *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* montane chaparral superalliance (5590).

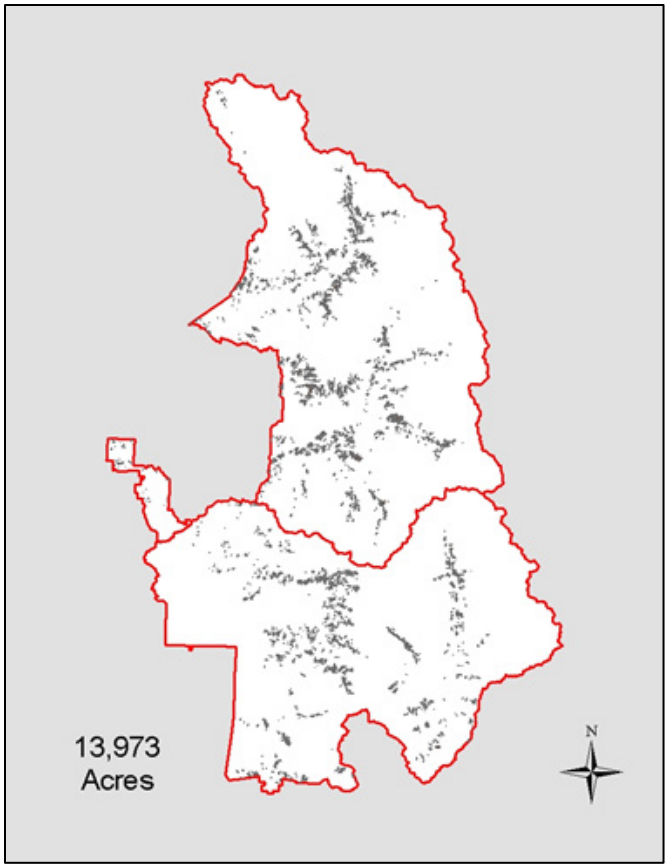


Figure 5520-1. Distribution of Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit.

Accuracy:
Producer's accuracy: 88% (n=41)
User's accuracy: 71% (n=51)

Photo Interpretation Signature:
A mix of montane chaparral species is noted in this mapping unit and gives off a wide variation of signatures depending on species dominance in the stand (Figure 5520-2). See individual types for specific signatures.

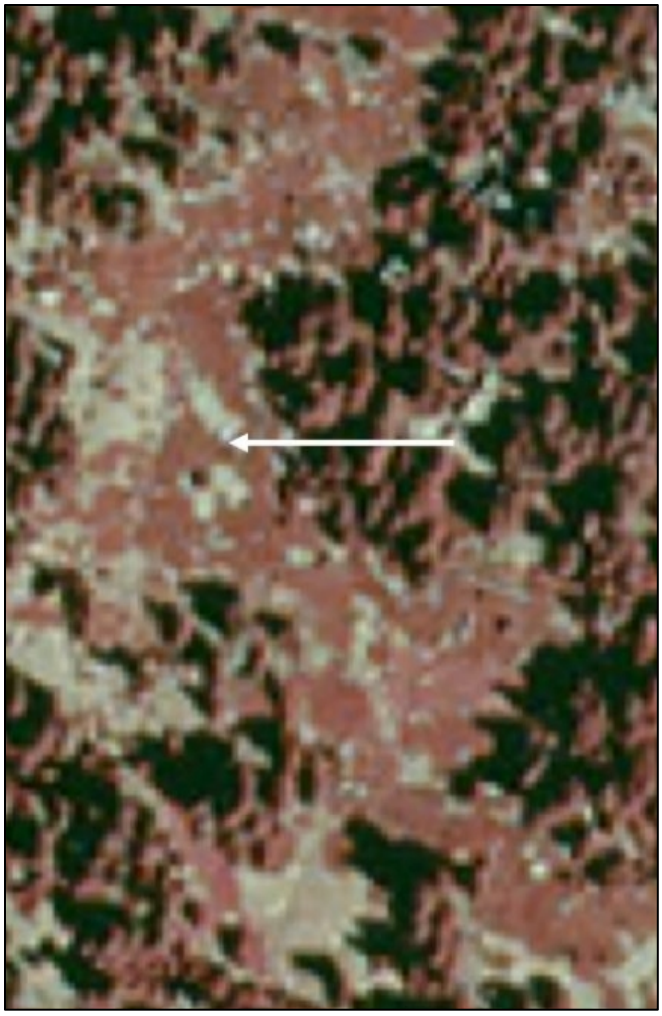


Figure 5520-2. Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1627–3478 m (5338–11412 ft)
Shape – convex, undulating
Slope position – low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 5520-3.

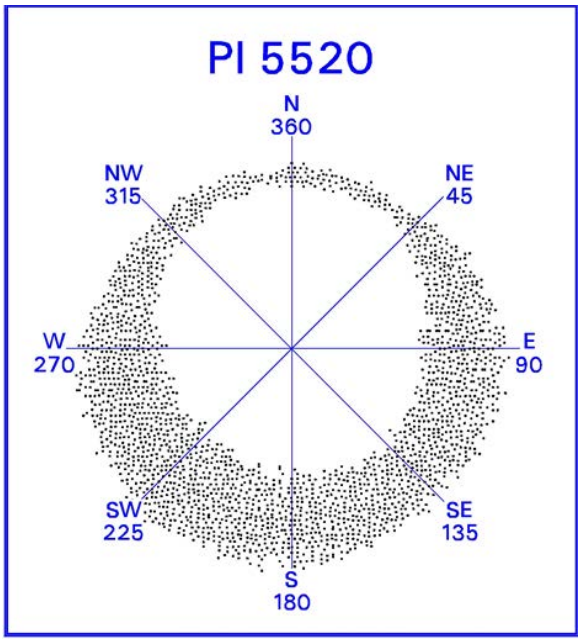


Figure 5520-3. Scatterplot of Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen/Big Sagebrush Forest Superassociation (2016)
- Jeffrey Pine Woodland Alliance (3070)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- Bush Chinquapin Shrubland Alliance (5080)
- Greenleaf Manzanita Shrubland Alliance (5090)
- Whitethorn Ceanothus Shrubland Alliance (5110)
- Big Sagebrush Shrubland Alliance (5160)
- Pinemat Manzanita Dwarf-shrubland Alliance (5280)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)
- Deerbrush Shrubland Alliance (6010)

5530 – Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit

Prunus emarginata–Ribes spp.–(*Acer glabrum*) Shrubland Mapping Unit

Description:

The *Prunus emarginata–Ribes spp.–(Acer glabrum*) shrubland mapping unit is mapped on moderate to steep primarily south to southeast facing slopes between 1434–3417 m (4704–11211 ft) across 3,252 acres of Sequoia and Kings Canyon National Parks (Figure 5530-1). These stands represent the more mesic phase of what has traditionally been treated as mixed montane chaparral. The dense shrub canopy is co-dominated by a mixture of *Prunus emarginata* and various species of *Ribes (Ribes cereum, R. montigenum, R. nevadense,* or *R. roezlii*), with *Acer glabrum* frequently contributing significant cover as well. Other shrub species present may include *Arctostaphylos nevadensis, A. patula, Artemisia tridentata, Ceanothus cordulatus, Chrysolepis sempervirens, Eriogonum wrightii, Holodiscus discolor, Rubus parviflorus, Salix spp.,* or *Sambucus mexicana*. Emergent trees may include *Abies concolor, A. magnifica, Pinus jeffreyi,* or *Quercus kelloggii*. The herbaceous layer can be sparse or well developed and is most frequently characterized by *Artemisia ludoviciana* or *Pteridium aquilinum*. The hydrology is upland.

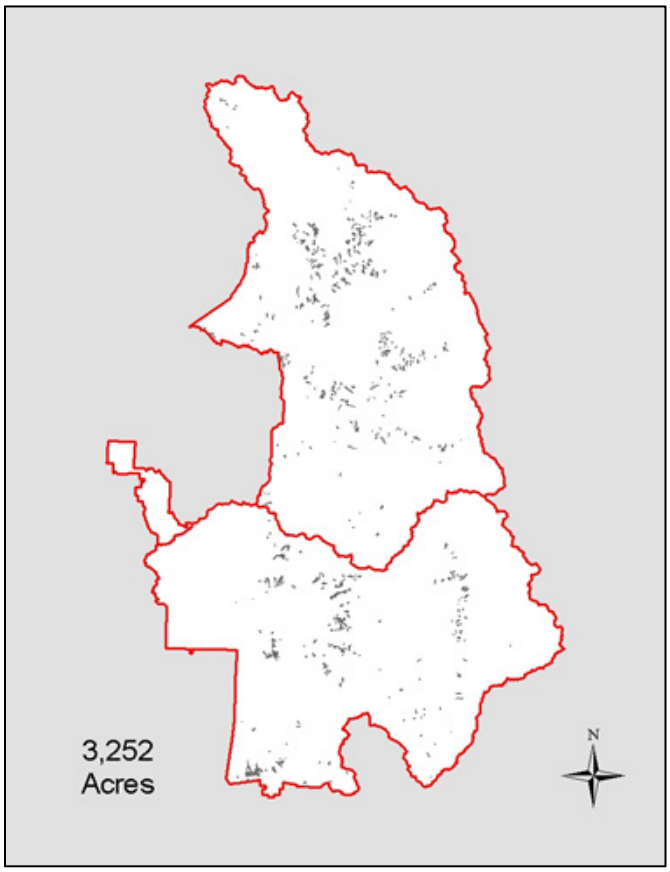


Figure 5530-1. Distribution of Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit.

Accuracy:
Producer's accuracy: 100% (n=8)
User's accuracy: 31% (n=26)

Photo Interpretation Signature:
The *Prunus emarginata–Ribes spp.–(Acer glabrum*) shrubland mapping unit generally gives off a very bright orange to reddish signature, except for areas dominated by *Prunus emarginata* where the signature tends more toward brown in color (Figure 5530-2). It is possible to confuse upland herbaceous vegetation and *Chrysolepis sempervirens* shrubland.

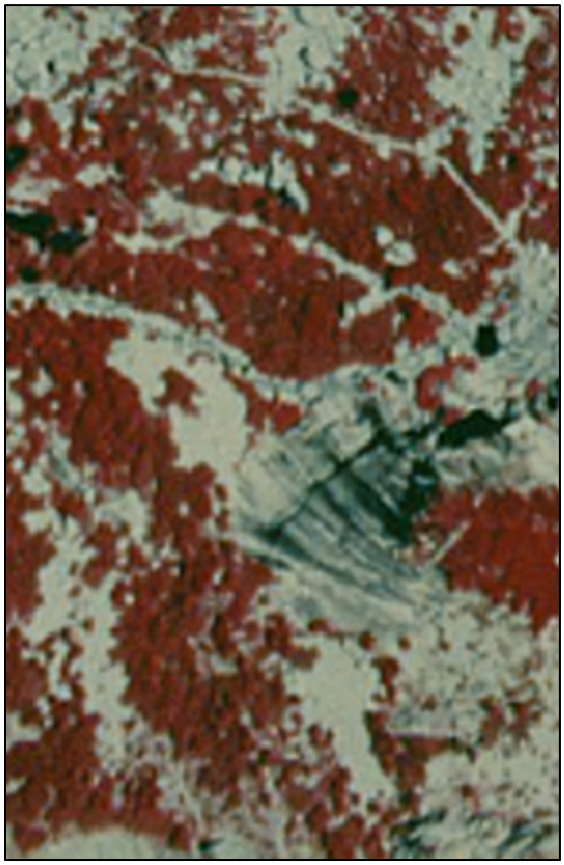


Figure 5530-2. Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit signature.

Environmental Characteristics:
Microclimate – mesic
Elevation – 1434–3417 m (4704–11211 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope
Steepness – moderate to steep
Aspect – See Figure 5530-3.

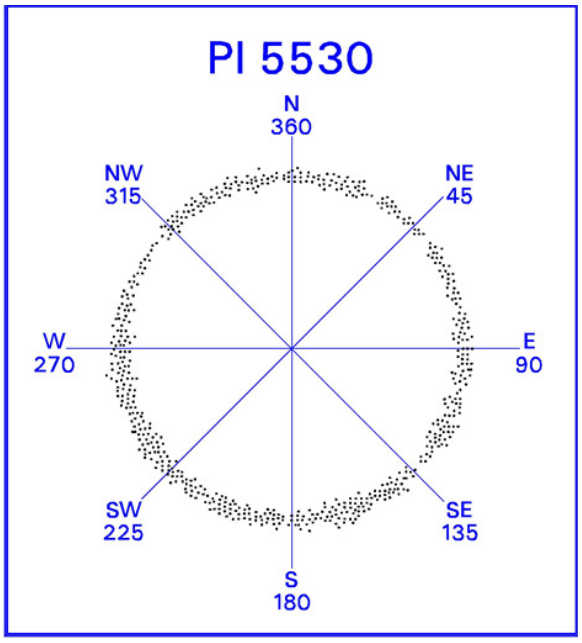


Figure 5530-3. Scatterplot of Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Quaking Aspen/Meadow Mapping Unit (2017)
- Water Birch Shrubland Alliance (5300)
- Bitter Cherry Shrubland Alliance (6300)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Willow spp. Talus Shrubland Mapping Unit (6700)
- Upland Herbaceous (7000)
- Intermittently to Seasonally Flooded Meadow (8000)

5550 – Red Mountainheather Dwarf-shrubland Alliance



Red Mountainheather Dwarf-shrubland. SEKI.0271_874.

5550 – Red Mountainheather Dwarf-shrubland Alliance
Phyllodoce breweri Dwarf-shrubland Alliance

Description:
The *Phyllodoce breweri* dwarf-shrubland alliance is mapped on gentle to moderately steep slopes of varying aspect between 2851–3880 m (9354–12729 ft) across 1,015 acres of Sequoia and Kings Canyon National Parks (Figure 5550-1). The low-lying shrub canopy is dominated by mats of *Phyllodoce breweri*; often *Holodiscus discolor* or *Vaccinium caespitosum* are also important. The herbaceous layer may be sparse or well developed. Frequently encountered herbs include *Antennaria media, Arabis platysperma, Calamagrostis breweri, Calyptridium monospermum, Carex exserta, Elymus elymoides ssp. californicus, Eriogonum incanum, Juncus parryi, Penstemon heterodoxus, Rumex paucifolius,* and *Trisetum spicatum*. Environments where *P. breweri* dominates range from low angle meadow margins and moist forest edges to rocky talus slopes. The hydrology is upland. Soils are well drained sandy loams.

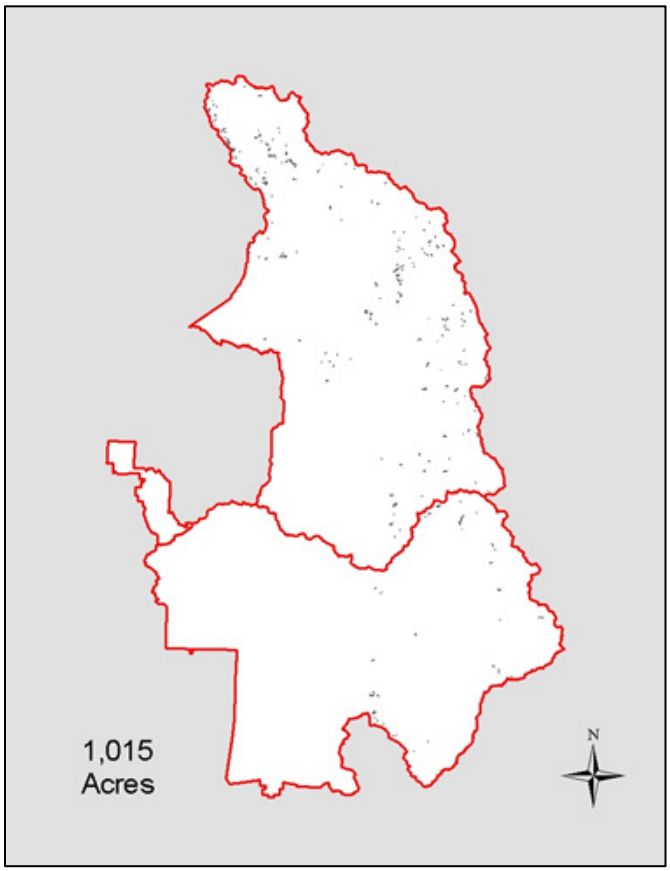


Figure 5550-1. Distribution of Red Mountainheather Dwarf-shrubland Alliance.

Accuracy:
Producer's accuracy: 100% (n=1)
User's accuracy: 100% (n=1)

Photo Interpretation Signature:
The *Phyllodoce breweri* dwarf-shrubland alliance is difficult to discern due to most patches being well below minimum mapping unit. Larger stands are brown to light brown in contrast with light rock they can be found adjacent to. The pattern is stipple, meaning individual crowns are often visible against the light soil color (Figure 5550-2).

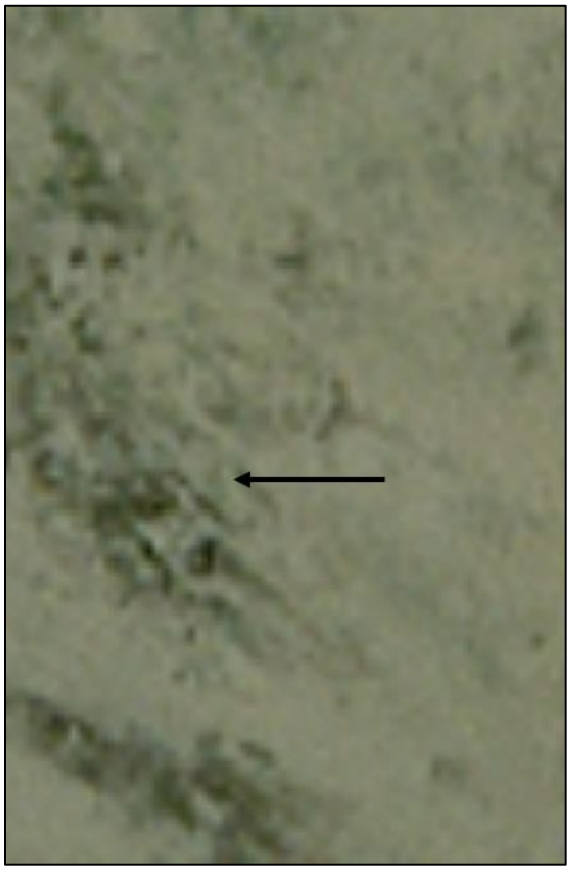


Figure 5550-2. Red Mountainheather Dwarf-shrubland Alliance signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 2851–3880 m (9354–12729 ft)
Shape – concave, convex, undulating
Slope position – low slope, midslope, high slope
Steepness – gentle to moderately steep
Aspect – See Figure 5550-3.

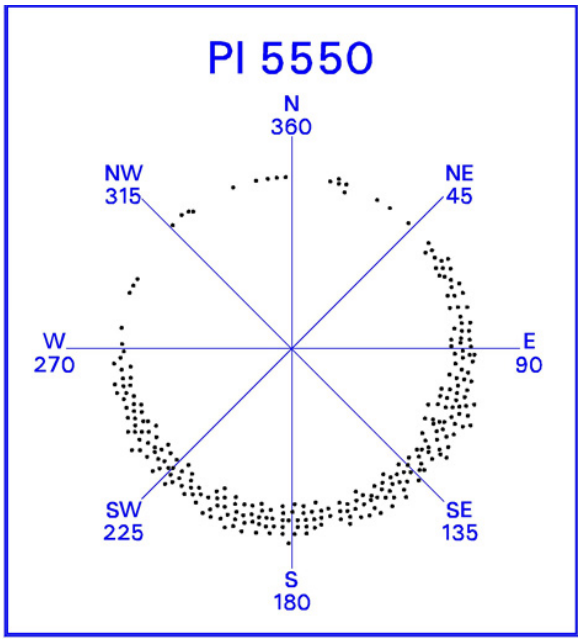


Figure 5550-3. Scatterplot of Red Mountainheather Dwarf-shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)

5590 – Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance

Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus Shrubland Superalliance

Description:

The *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland superalliance is mapped on moderate to steep primarily south to southwest facing slopes between 1627–3478 m (5338–11412 ft) across 19,988 acres of Sequoia and Kings Canyon National Parks (Figure 5590-1). These stands represent the more xeric phase of what has traditionally been treated as mixed montane chaparral. The dense shrub canopy is dominated by a mixture of *Arctostaphylos patula, Ceanothus cordulatus*, and *Chrysolepis sempervirens* in varying amounts. This superalliance can also include stands dominated by either *Chrysolepis sempervirens* or *Ceanothus cordulatus*, which are often difficult to differentiate using aerial photography. Stands dominated by *Arctostaphylos patula*, however, are easily distinguished and are mapped in the 5090 *Arctostaphylos patula* shrubland alliance. Other shrub species present may include *Acer glabrum, Arctostaphylos nevadensis, Artemisia tridentata, Chamaebatia foliolosa, Eriogonum wrightii, Holodiscus discolor, Prunus emarginata, Ribes cereum, Sambucus mexicana,* or *Symphoricarpos spp;* however, one or more of the three primary xeric chaparral species must dominate. Emergent trees may include *Abies concolor, A. magnifica, Calocedrus decurrens, Juniperus occidentalis var. australis, Pinus jeffreyi, P. lambertiana* or *P. monticola*. The herbaceous layer is typically sparse to absent, but frequently includes *Apocynum androsaemifolium, Elymus glaucus, Epilobium angustifolium, Eriogonum nudum, Lotus crassifolius, Monardella odoratissima,* and/or *Pteridium aquilinum.* In the aggregated database, the *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland superalliance includes the *Chrysolepis sempervirens* shrubland alliance (5080), the *Ceanothus cordulatus* shrubland alliance (5110) and the *Arctostaphylos patula–Chrysolepis sempervirens–Ceanothus cordulatus* shrubland mapping unit (5520).

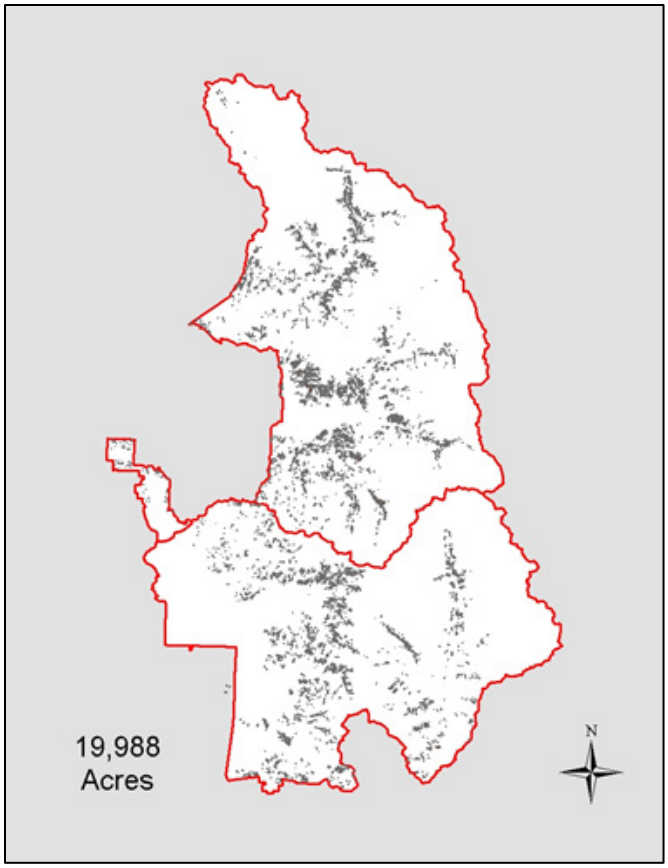


Figure 5590-1. Distribution of Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance.

Accuracy:
Producer's accuracy: 86% (n=70)
User's accuracy: 81% (n=74)

Photo Interpretation Signature:
A mix of montane chaparral species is noted in this alliance and gives off a wide variation of signatures depending on species dominance in the stand. See individual types for specific signatures. Pure stands containing one of the three primary species may be included.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1627–3478 m (5338–11412 ft)
Shape – convex, undulating
Slope position – lowslope, midslope, highslope
Steepness – moderate to steep
Aspect – See Figure 5590-2.

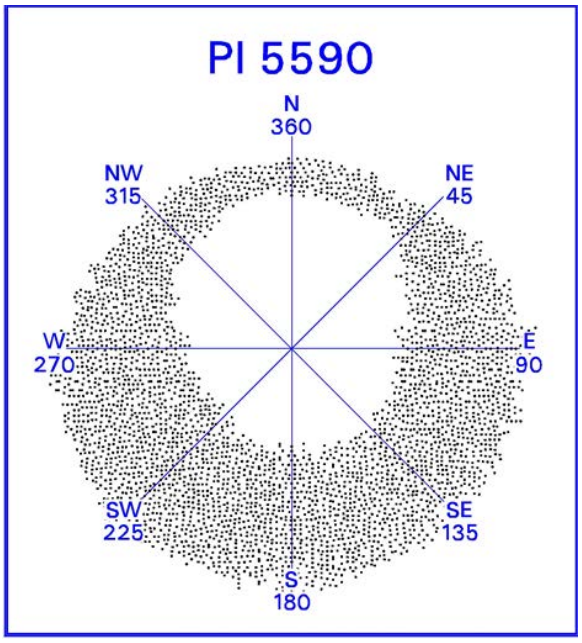


Figure 5590-2. Scatterplot of Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Superalliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen/Big Sagebrush Forest Superassociation (2016)
- Jeffrey Pine Woodland Alliance (3070)
- White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Greenleaf Manzanita) Forest Mapping Unit (4084)
- Chaparral Whitethorn Shrubland Alliance (5060)
- Bush Chinquapin Shrubland Alliance (5080)
- Greenleaf Manzanita Shrubland Alliance (5090)
- Whitethorn Ceanothus Shrubland Alliance (5110)
- Big Sagebrush Shrubland Alliance (5160)
- Pinemat Manzanita Dwarf-shrubland Alliance (5280)
- Mountain Big Sagebrush & Timberline Sagebrush & Oceanspray & Red Mountainheather Shrubland Superalliance (5510)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Deerbrush Shrubland Alliance (6010)
- Bitter Cherry Shrubland Alliance (6300)
- Willow spp. Talus Shrubland Mapping Unit (6700)
- Mesic Post Fire Herbaceous Mapping Unit (7702)

- Post Fire Shrub/Herbaceous Mapping Unit (7703)

6000 – Deciduous Shrubs



Deerbrush Shrubland. SEKI.0269_144.

6010 – Deerbrush Shrubland Alliance



Deerbrush Shrubland. SEKI.0017_590.

6010 – Deerbrush Shrubland Alliance

Ceanothus integerrimus Shrubland Alliance

Description:

The *Ceanothus integerrimus* shrubland alliance is mapped on moderate to steep slopes of varying aspect between 1305–2390 m (4281–7841 ft) across 1,191 acres of Sequoia and Kings Canyon National Parks (Figure 6010-1). The dense shrub canopy is dominated by *Ceanothus integerrimus*, but often includes *Arctostaphylos patula, C. cordulatus, C. leucodermis, Chamaebatia foliolosa, Ribes roezlii var. roezlii*, or *Sambucus mexicana*. Emergent trees may include *Abies concolor, Calocedrus decurrens, Pinus lambertiana, P. ponderosa,* or *Quercus kelloggii*. The herbaceous layer is typically sparse (0–5% cover), but may include patches of *Lotus crassifolius* and *Pteridium aquilinum* in addition to such annuals as *Bromus tectorum* and *Vulpia microstachys. C. integerrimus var. californicus* dominated stands typically occur following a major disturbance such as fire or logging, and are considered transitional to various montane forest types. The hydrology is upland. Soils are well-drained sandy clay loams. (NatureServe October 2006).

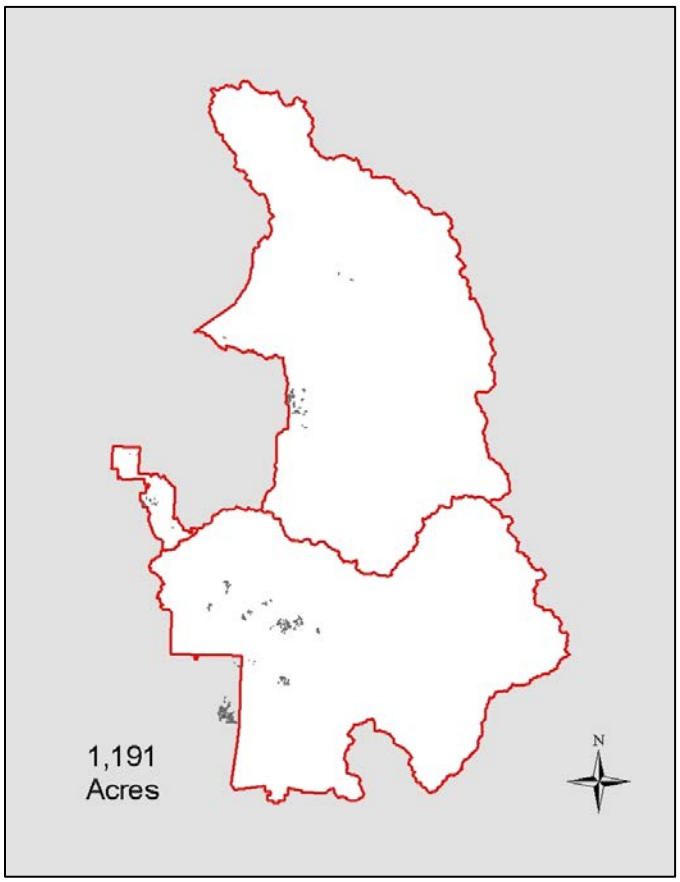


Figure 6010-1. Distribution of Deerbrush Shrubland Alliance.

Accuracy:

Producer's accuracy: 83% (n=6)

User's accuracy: 100% (n=5)

Photo Interpretation Signature:
Ceanothus integerrimus has a pink to red signature and has a characteristic early seral post burn texture that is smooth and therefore difficult to separate out from *C. cordulatus* (Figure 6010-2). *C. cordulatus* generally occurs at higher elevations. Other post burn types in similar elevations are not as red.

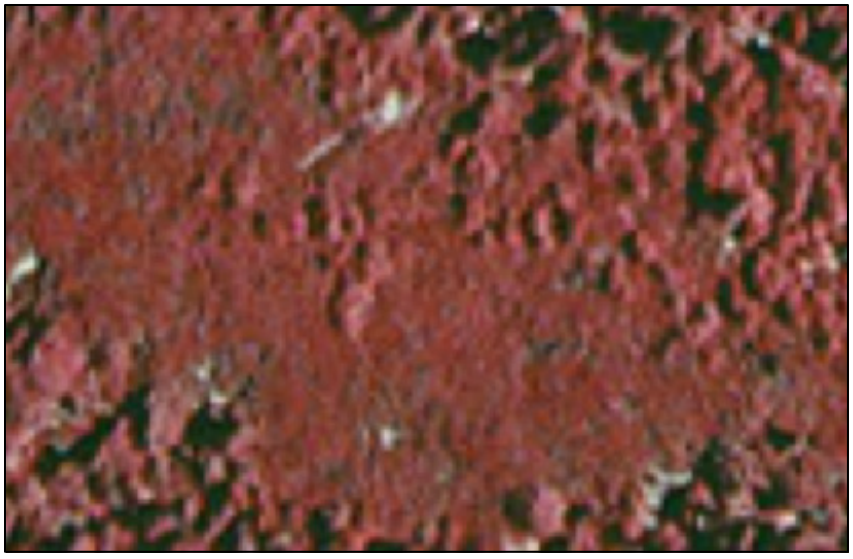


Figure 6010-2. Deerbrush Shrubland Alliance signature. Photo reference: GIFO_SW.

Environmental Characteristics:
Microclimate – xeric
Elevation – 1305–2390 m (4281–7841 ft)
Slope position – low slope, midslope, high slope
Steepness – moderate to steep
Aspect – See Figure 6010-3.

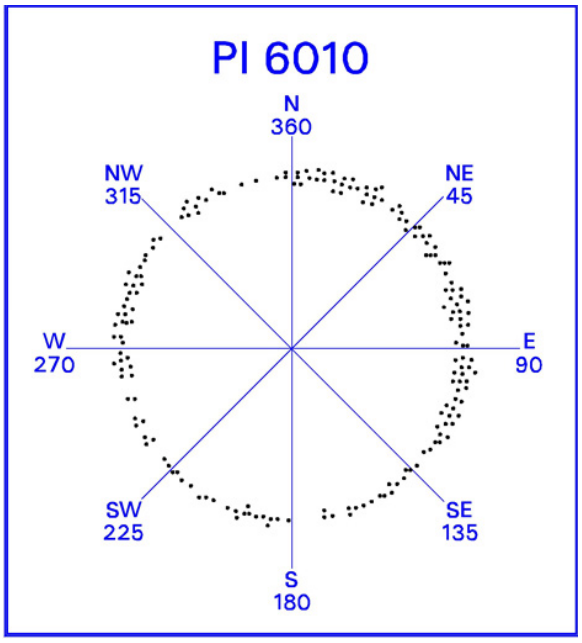


Figure 6010-3. Scatterplot of Deerbrush Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Whitethorn Ceanothus Shrubland Alliance (5110)
- Indian Manzanita Shrubland Alliance (5140)
- Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (5520)
- Bitter Cherry Shrubland Alliance (6300)
- Mesic Post Fire Herbaceous Mapping Unit (7702)
- Post Fire Shrub/Herbaceous Mapping Unit (7703)

6020 – Oregon White Oak Shrubland Alliance



Oregon White Oak / Birchleaf Mountain Mahogany Shrubland. SEKI.0209_100.

6020 – Oregon White Oak Shrubland Alliance

Quercus garryana var. *breweri* Shrubland Alliance

Description:

The *Quercus garryana var. breweri* shrubland alliance is mapped on moderate to steep slopes of primarily northfacing aspect between 890–1824 m (2919–5984 ft) across 2,561 acres of Sequoia and Kings Canyon National Parks (Figure 6020-1). The dense shrub canopy is dominated by the shrub form of *Quercus garryana var. breweri*. Other shrubs present may include *Arctostaphylos patula, Ceanothus cordulatus, C. velutinus, C. cuneatus,* and *Cercocarpus montanus var. glaber*. Emergent conifers, such as *Abies concolor* and *Calocedrus decurrens*, may be present, as well as individuals of *Quercus kelloggii.* Continuous stands of this alliance frequently occur immediately adjacent to stands of *Q. kelloggii* forest and are marked by a relatively abrupt transition. (NatureServe October 2006).

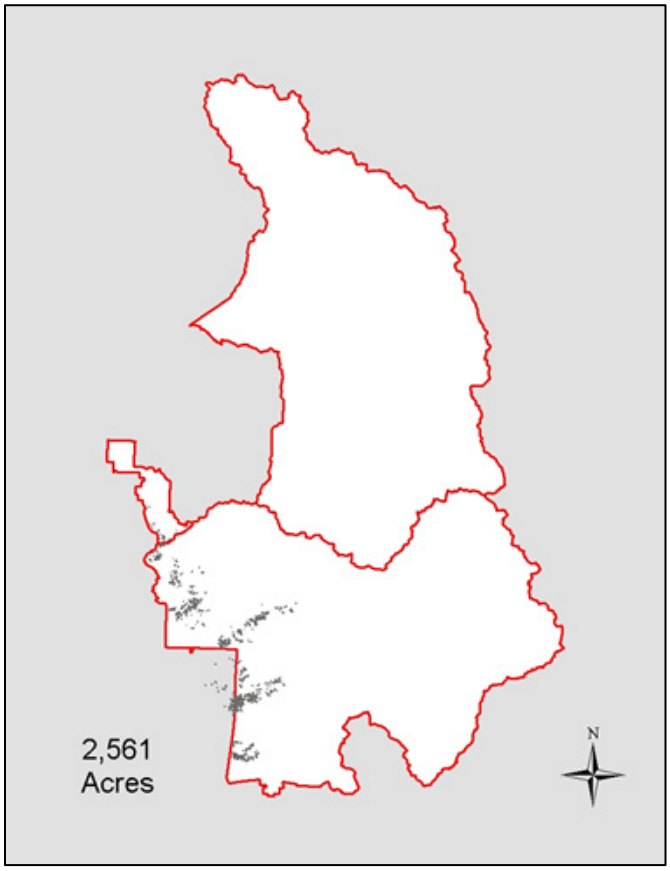


Figure 6020-1. Distribution of Oregon White Oak Shrubland Alliance.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:
Quercus garryana var. breweri yields a pink to red signature with a smooth texture (Figure 6020-2). It is often found adjacent to taller *Q. kelloggii* or *Q. chrysolepis* stands that have coarser texture reflecting their larger crown size. The adjacent *Q. kelloggii* yields a somewhat redder signature.

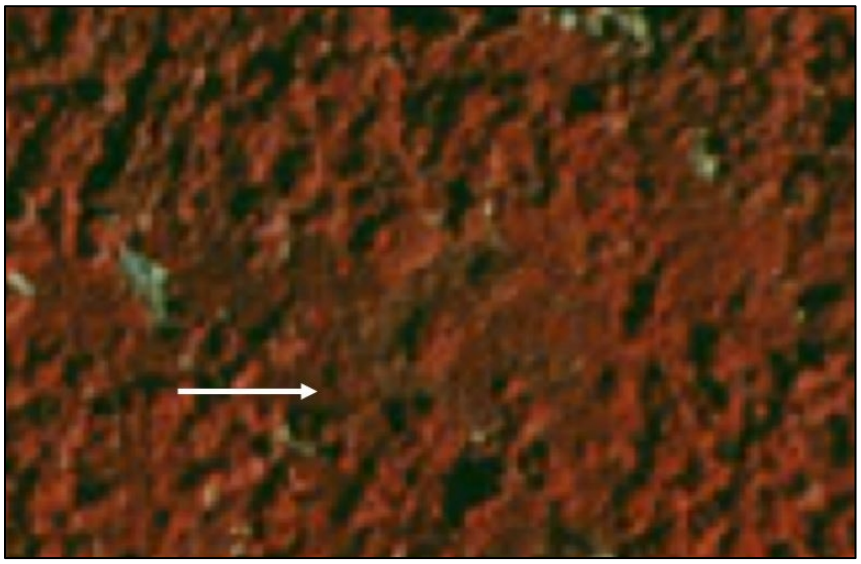


Figure 6020-2. Oregon White Oak Shrubland Alliance signature. Photo reference: SHMO_NE.

Environmental Characteristics:
Microclimate – submesic
Elevation – 890–1824 m (2919–5984 ft)
Shape – slightly concave to slightly convex
Slope position – mid to upper
Steepness – moderate to steep
Aspect – See Figure 6020-3.

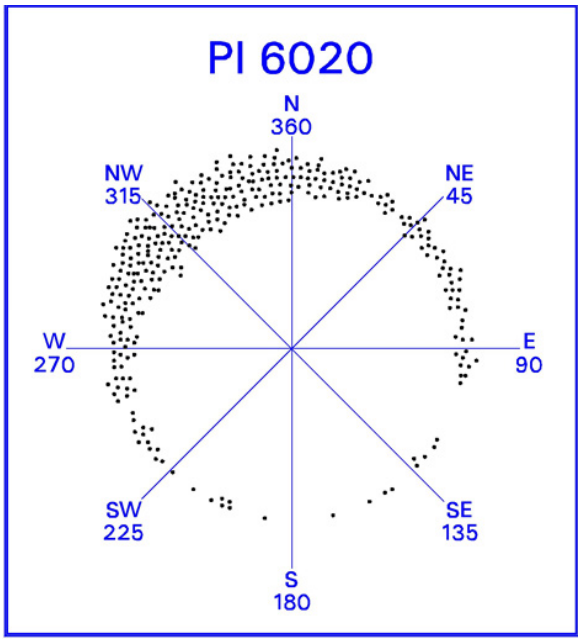


Figure 6020-3. Scatterplot of Oregon White Oak Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- California Black Oak Forest Alliance (2020)

6022 – Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association
Quercus garryana var. *breweri–Cercocarpus montanus* var. *glaber* Shrubland Association

Description:

The *Quercus garryana var. breweri/Cercocarpus montanus var. glaber* shrubland association is mapped on moderate to steep slopes of northwest facing aspect between 890–1824 m (2919–5984 ft) across 2,327 acres of Sequoia and Kings Canyon National Parks (Figure 6022-1). The shrub canopy is dominated by a mixture of *Quercus garryana var. breweri* and *Cercocarpus montanus var. glaber (C. betuloides* sensu Hickman). Other shrubs present (and which can sometimes co-dominate) include *Arctostaphylos viscida, Chamaebatia foliolosa*, and *Prunus subcordata*. Emergent conifers, such as *Abies concolor* and *Calocedrus decurrens* may be present, as well as individuals of *Quercus kelloggii*. The herbaceous layer is characteristically quite sparse. The hydrology is upland; soils are moderately well drained loams.

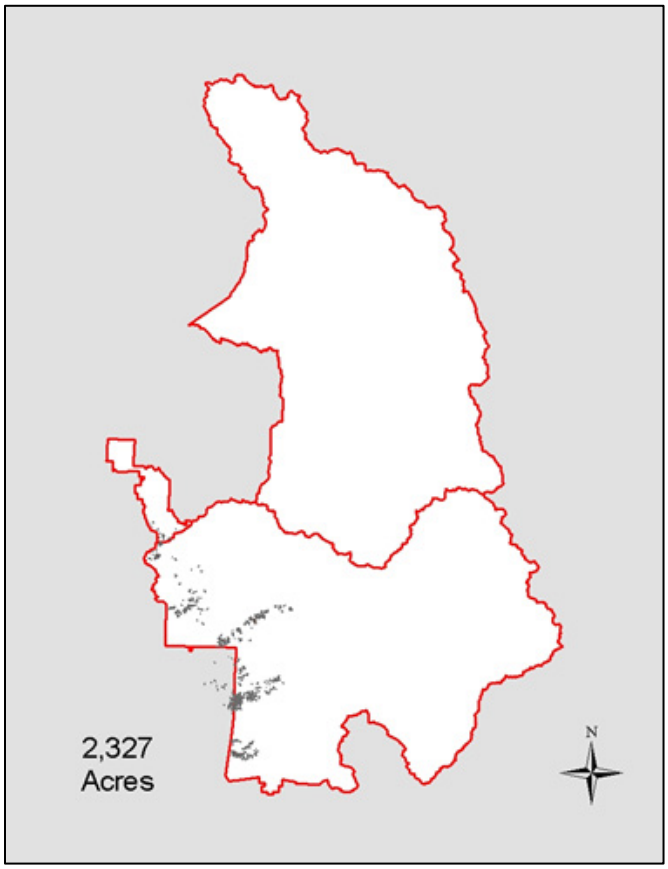


Figure 6022-1. Distribution of Oregon White Oak Birchleaf Mountain Mahogany Shrubland Alliance.

Accuracy:

Producer's accuracy: 100% (n=3)
User's accuracy: 100% (n=3)

Photo Interpretation Signature:

The signature of this type alternates with the browns of the *Cercocarpus montanus var. glaber* and pink to red signature of the *Quercus garryana var. breweri* (Figure 6022-2). The texture is smooth and a bit coarser than pure stands of *Q. garryana var. breweri.*

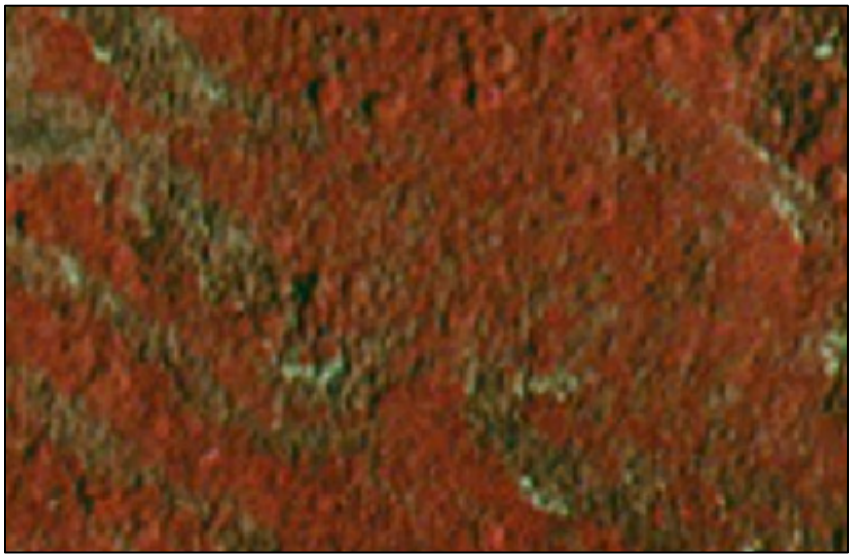


Figure 6022-2. Oregon White Oak Birchleaf Mountain Mahogany Shrubland Alliance signature. Photo reference: SHMO_NE.

Environmental Characteristics:

Microclimate – submesic
Elevation – 890–1824 m (2919–5984 ft)
Shape – convex
Slope position – midslope
Steepness – moderate to steep
Aspect – See Figure 6022-3.

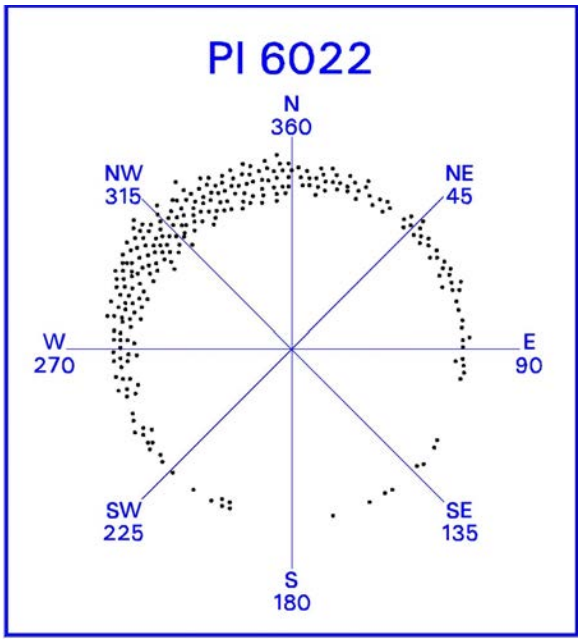


Figure 6022-3. Scatterplot of Oregon White Oak Birchleaf Mountain Mahogany Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit (1021)
- California Black Oak/Greenleaf Manzanita Forest Association (2021)
- California Black Oak/Indian Manzanita–Mountain Misery Forest Association (2026)

6030 – California Grape Association



California Grape Association.

6030 – California Grape Association

Vitis californica Association

Description:

The *Vitis californica* association is mapped on moderate to steep foothill slopes of varying aspect between 511–1122 m (1677–3681 ft) across 11 acres in Sequoia National Park (Figure 6030-1). Stands of this mapping unit are dominated by the deciduous woody vine *Vitis californica*, which can form large draping patches either over other woody vegetation (such as *Quercus wislizeni var. wislizeni*) or as a sole constituent. The hydrology is upland.

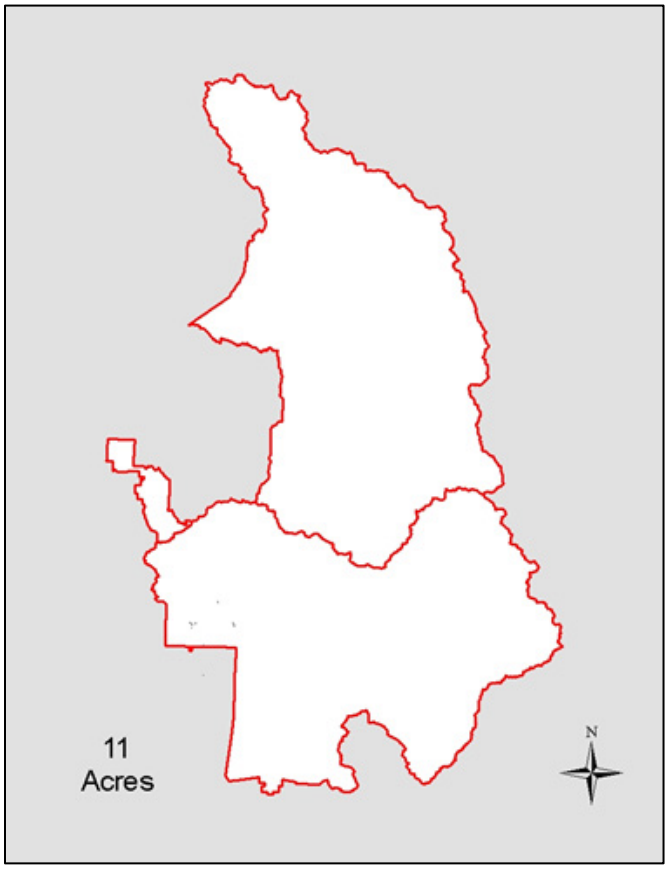


Figure 6030-1. Distribution of California Grape Association.

Accuracy:

Producer's accuracy: % (n=0)

User's accuracy: % (n=0)

Photo Interpretation Signature:

This signature generally reflects a bright red to deep red signature (Figure 6030-2). It is limited in extent and generally below minimum mapping unit.

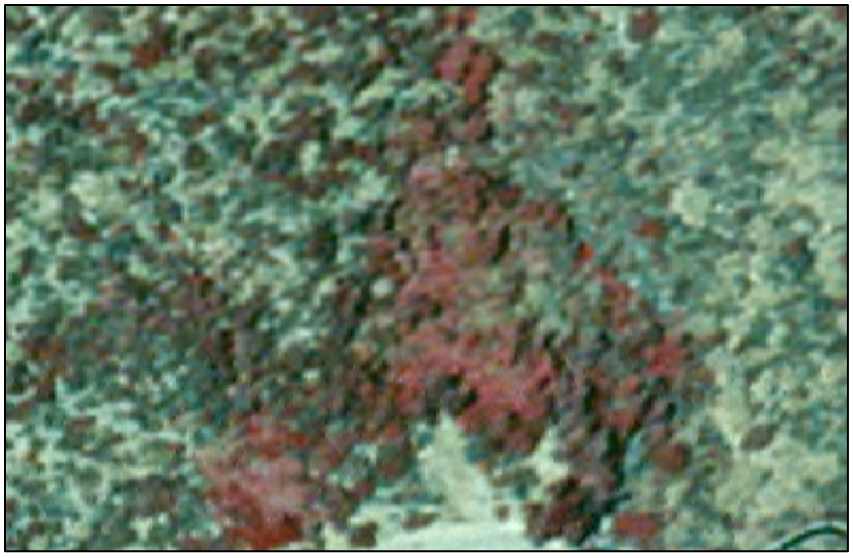


Figure 6030-2. California Grape Association signature.

Environmental Characteristics:
Microclimate – submesic
Elevation – 511–1122 m (1677–3681 ft)
Shape – convex, concave
Slope position – low slope, midslope
Steepness – moderate to steep
Aspect – See Figure 6030-3.

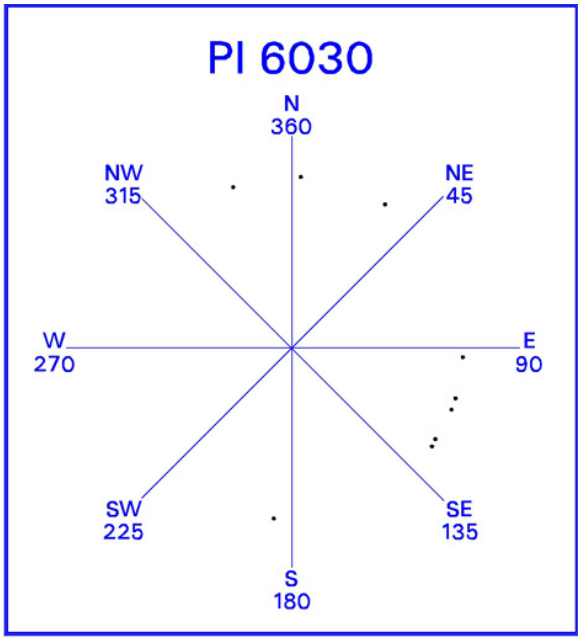


Figure 6030-3. Scatterplot of California Grape Association in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Willow spp. Talus Shrubland Mapping Unit (6700)

6110 – Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance



Sierra Willow/Swamp Onion Seasonally Flooded Shrubland. SEKI.0019_23.

6110 – Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance

Salix orestera/Allium validum Seasonally Flooded Shrubland Alliance

Description:

The *Salix orestera/Allium validum* seasonally flooded shrubland alliance is mapped on gentle to moderately steep slopes of varying aspect between 2649–3786 m (8691–12421 ft) across 8,325 acres of Sequoia and Kings Canyon National Parks (Figure 6110-1). The open to moderately dense shrub canopy is dominated by *Salix orestera*. A sub-shrub layer composed of *Kalmia polifolia, Ledum glandulosum, Phyllodoce breweri, Vaccinium caespitosum*, or *V. uliginosum ssp. occidentale* may also be present. The moderately open to dense herbaceous layer is dominated by *Allium validum* and *Carex spp*., with *Dodecatheon jeffreyi, Senecio triangularis,* and *Veratrum californicum var. californicum* often important. The hydrology is palustrine. Soils are somewhat poorly drained silty clay loams. (NatureServe October 2006)

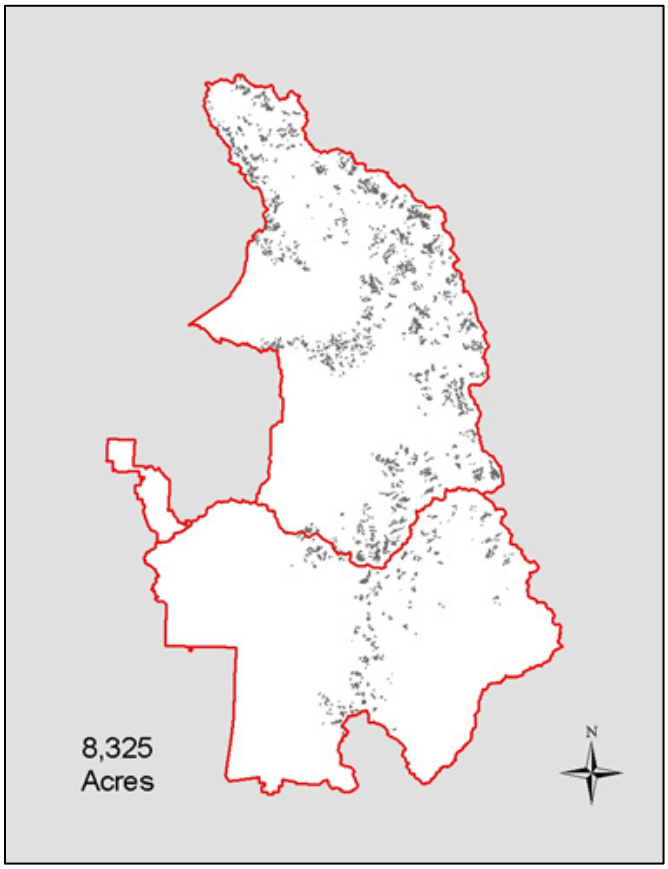


Figure 6110-1. Distribution of Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance.

Accuracy:

Producer's accuracy: 86% (n=28)

User's accuracy: 100% (n=24)

Photo Interpretation Signature:
The key to separating this type out from associated meadows with similar infrared signatures is to pay attention to the higher amount of texture present on the imagery. *Salix orestera* can be quite small, making it difficult to delineate from adjacent meadow areas. The color is generally bright red in IR imagery. Figure 6110-2 shows the signature as visible on true color DOQQ. *Salix orestera* is inferred from elevation and drainage characteristics rather than a species-specific signature.

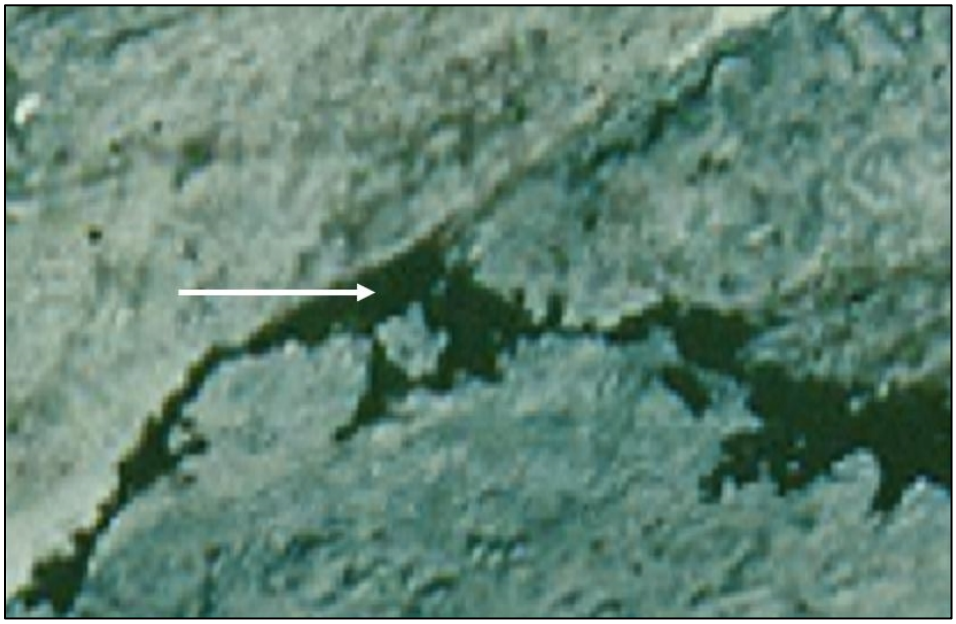


Figure 6110-2. Sierra Willow/Swamp OnionSeasonally Flooded Shrubland Alliance signature.

Environmental Characteristics:
Microclimate – seasonally flooded
Elevation – 2649–3786 m (8691–12421 ft)
Shape – concave, undulating
Slope position – low slope, midslope
Steepness – gentle to moderately steep
Aspect – See Figure 6110-3

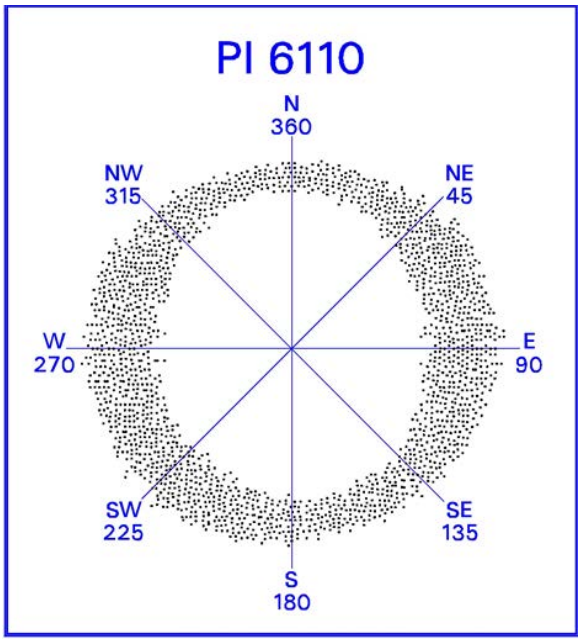


Figure 6110-3. Scatterplot of Sierra Willow/Swamp OnionSeasonally Flooded Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Alpine Talus Slope (0100)
- Alpine Scree Slope (0200)
- Mesic Rock Outcrop (0500)
- Quaking Aspen Forest Alliance (2010)
- Whitebark Pine Woodland Alliance (3140)
- Whitebark Pine/Davidson Penstemon association (3142)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Willow spp. Talus Shrubland Mapping Unit (6700)
- Intermittently to Seasonally Flooded Meadow (8000)
- Semi-permanently to Permanently Flooded Meadow (9000)

6210 – Oceanspray Shrubland Alliance



Oceanspray Shrubland. SEKI.0075_81.

6210 – Oceanspray Shrubland Alliance
Holodiscus discolor Shrubland Alliance

Description:
The *Holodiscus discolor* shrubland alliance is mapped on moderately steep to steep rocky slopes of varying aspect between 2593–3691 m (8506–12108 ft) across 395 acres of Sequoia and Kings Canyon National Parks (Figure 6210-1). The intermittent shrub canopy is dominated by *Holodiscus discolor (Holodiscus microphyllus* sensu Hickman 1993), but may also include *Artemisia tridentata, Chrysolepis sempervirens, Ribes spp.,* or *Sambucus racemosa var. microbotrys*. A sub-shrub layer of *Eriogonum wrightii* or *Phyllodoce breweri* may also be present. The herbaceous layer is typically sparse, but most frequently includes *Carex exserta, C. rossii*, and *Juncus parryi*. Sites are characterized by upland hydrology and rapidly drained sands.

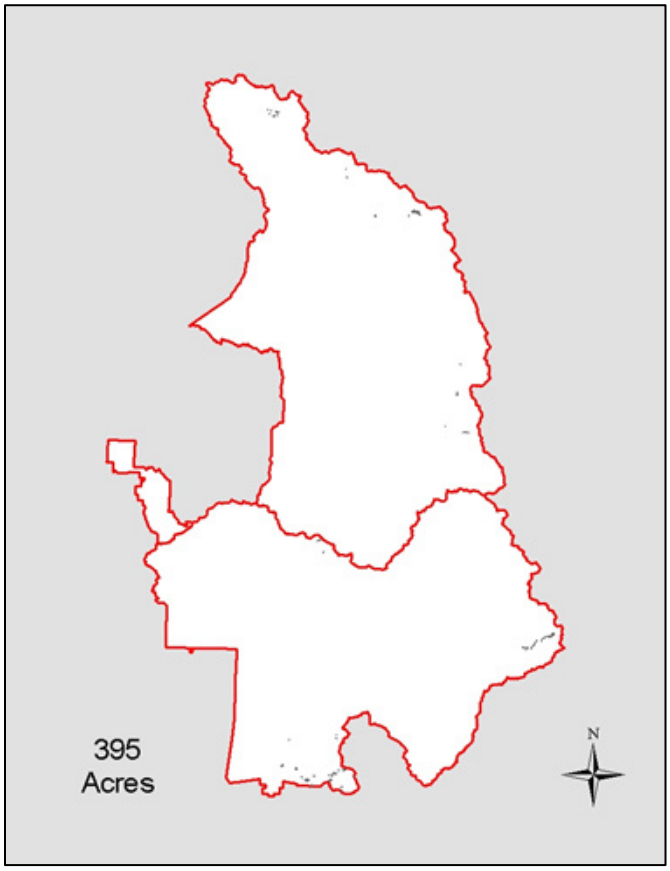


Figure 6210-1. Distribution of Oceanspray Shrubland Alliance.

Accuracy:
Producer's accuracy: % (n=0)
User's accuracy: % (n=0)

Photo Interpretation Signature:
This type can be generally observed in extremely sparse settings on top of rock (Figure 6210-2). Shrubs are hard to detect and yield little color infrared signature. The presence of *Holodiscus discolor* is modeled by photo interpreters where it is noted on dry steep rocky environments. This distinguishes it from other subalpine species that may occur more frequently on talus or scree-like settings.



Figure 6210-2. Oceanspray Shrubland Alliance signature. Photo reference: LODG_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 2593–3691 m (8506–12108 ft)
Shape – convex
Slope position – low slope, midslope
Steepness – moderately steep to steep
Aspect – See Figure 6210-3.

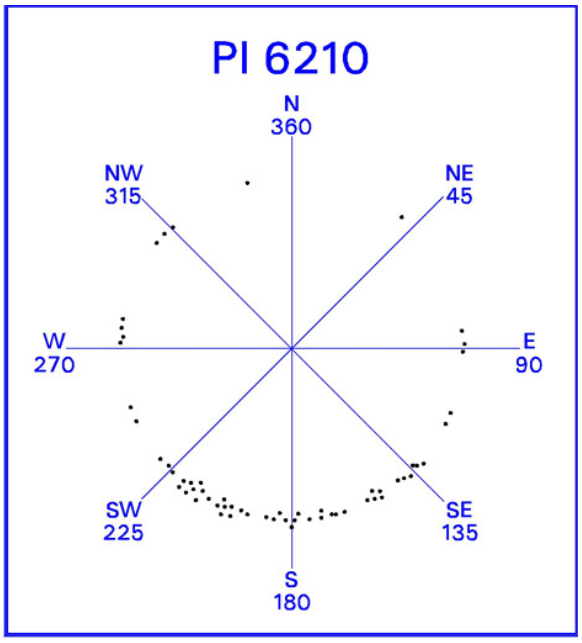


Figure 6210-3. Scatterplot of Oceanspray Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)

6300 – Bitter Cherry Shrubland Alliance



Bitter Cherry Shrubland. SEKI.0011_03.

6300 – Bitter Cherry Shrubland Alliance

Prunus emarginata Shrubland Alliance

Description:

The *Prunus emarginata* shrubland alliance is mapped on moderately steep to steep slopes of varying aspect between 1488–3189 m (4882–10461 ft) across 810 acres of Sequoia and Kings Canyon National Parks (Figure 6300-1). The dense shrub canopy is dominated by *Prunus emarginata*. Other shrub species present may include *Acer glabrum, Arctostaphylos patula, Artemisia tridentata, Ceanothus cordulatus, Chrysolepis sempervirens, Ribes cereum*, or *Sambucus racemosa var. microbotrys*. Emergent trees may include *Abies concolor, A. magnifica, Calocedrus decurrens, Pinus jeffreyi, P. lambertiana, P. ponderosa*, or *Quercus kelloggii*. The herbaceous layer is characteristically sparse, with *Angelica lineariloba, Apocynum androsaemifolium, Artemisia douglasiana, Eriogonum nudum, Monardella odoratissima*, and *Pteridium aquilinum* among the most frequently encountered species. The hydrology is upland. Soils are moderately well-drained sandy loams. *Prunus emarginata* is a generally shade-intolerant species of sparse woods, riparian sites, and open areas where there is often evidence of past disturbance, such as fire or avalanche. P. *emarginata* sprouts vigorously following fire and reaches pre-fire densities in approximate 30–40 years. (Esser 1995, NatureServe October 2006)

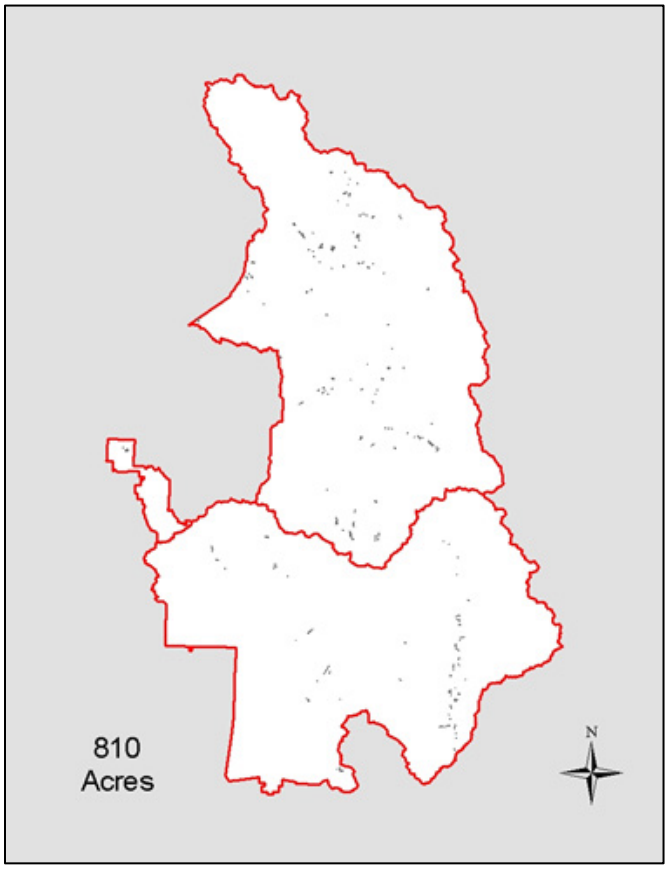


Figure 6300-1. Distribution of Bitter Cherry Shrubland Alliance.

Accuracy:
Producer's accuracy: 43% (n=7)
User's accuracy: 100% (n=3)

Photo Interpretation Signature:
Pure stands of *Prunus emarginata* are often noted on lower talus slopes just above woodlands, especially above the Kern River. The color trends reddish brown and is over a white talus background (Figure 6300-2). Stand densities vary from sparse to dense.

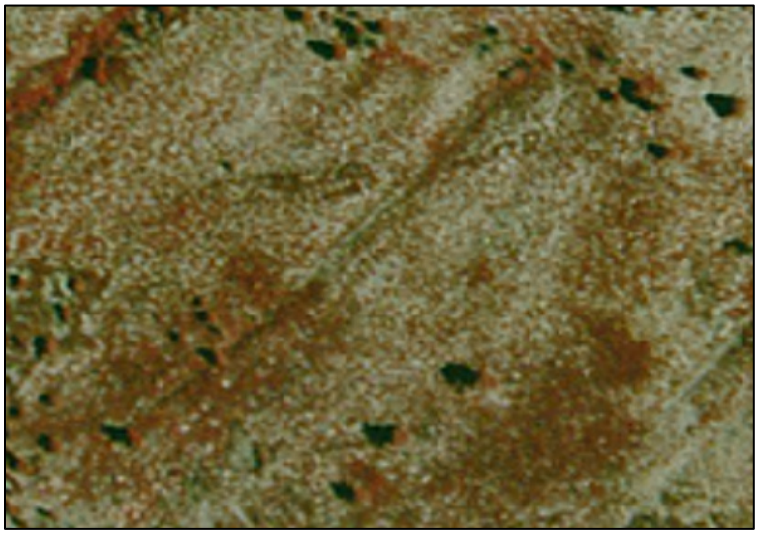


Figure 6300-2. Bitter Cherry Shrubland Alliance signature.

Environmental Characteristics:
Microclimate – submesic
Elevation – 1488–3189 m (4882–10461 ft)
Shape – convex, concave, undulating
Slope position – low slope, midslope, high slope
Steepness – moderately steep to steep
Aspect – See Figure 6300-3.

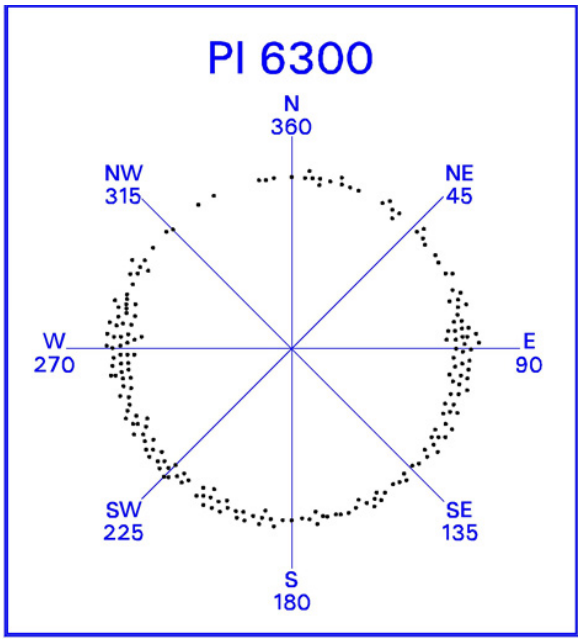


Figure 6300-3. Scatterplot of Bitter Cherry Shrubland Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Chaparral Whitethorn Shrubland Alliance (5060)
- Whitethorn Ceanothus Shrubland Alliance (5110)
- Water Birch Shrubland Alliance (5300)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Deerbrush Shrubland Alliance (6010)
- California Grape Association (6030)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Willow spp. Talus Shrubland Mapping Unit (6700)
- Mesic Post Fire Herbaceous Mapping Unit (7702)
- Intermittently to Seasonally Flooded Meadow (8000)



Willow Spp./Meadow Shrubland. SEKI.1505_484.

6500 – Willow spp./Meadow Shrubland Mapping Unit

Salix spp./Meadow Shrubland Mapping Unit

Description:

The *Salix spp.*/meadow shrubland mapping unit includes any of the *Salix* dominated alliances that occur over meadow vegetation. It is mapped on gentle to steep slopes of varying aspect between 1518–3515 m (4979–11531 ft) across 2,023 acres of Sequoia and Kings Canyon National Parks (Figure 6500-1). The open to dense shrub canopy is dominated by any of several species of *Salix*, including *S. eastwoodiae, S. exigua, S. lasiolepis, S. lemmonii, S.ligulifolia, S. lucida ssp. lasiandra, S. orestera* or *S. planifolia.* Other shrubs present may include *Cornus sericea ssp. occidentalis, Ribes inerme var. inerme,* and *Vaccinium caespitosum*. The composition of the moderately open to dense herbaceous layer varies widely with elevation and local habitat conditions, but is typically dominated by wet meadow graminoid and forb species. The hydrology is palustrine. Soils are somewhat poorly drained silty clay loams and sandy clay loams. (NatureServe October 2006)

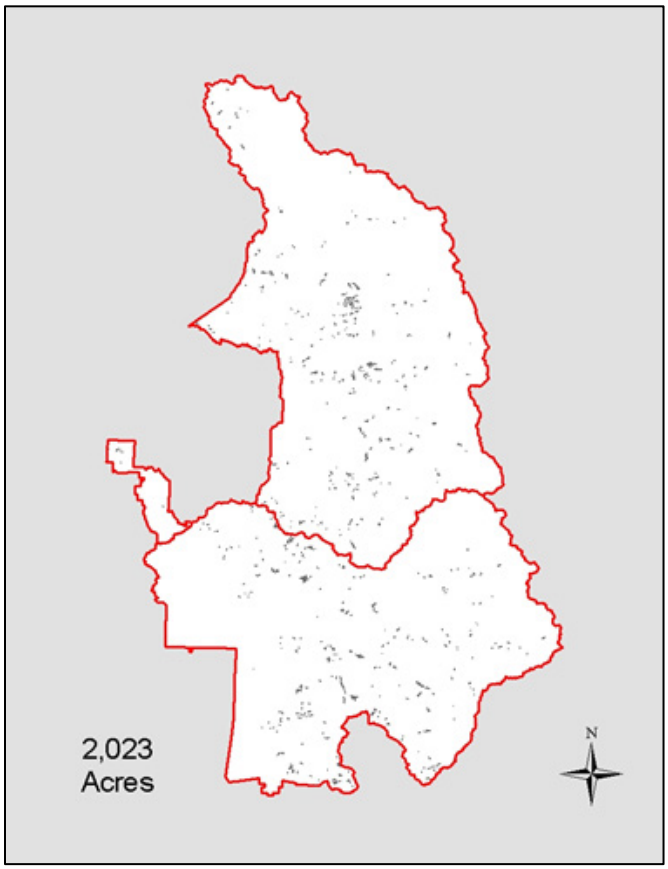


Figure 6500-1. Distribution of Willow spp./Meadow Shrubland Mapping Unit.

Accuracy:

Producer's accuracy: 86% (n=14)

User's accuracy: 71% (n=17)

Photo Interpretation Signature:
The key to differentiating between a *Salix* component and a wet meadow is examining the texture visible on the photography. Usually, the color of the willows is a bit darker, and texture from the willow mottles the overall signature of the meadow (Figure 6500-2).

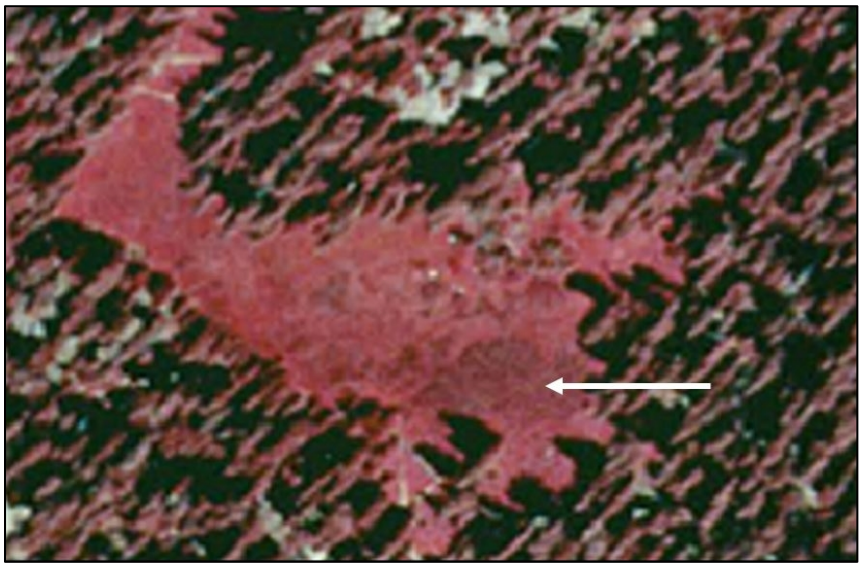


Figure 6500-2. Willow spp./Meadow Shrubland Mapping Unit signature. Photo reference: MUGR_SE.

Environmental Characteristics:
Microclimate – mesic
Elevation – 1518–3515 m (4979–11531 ft)
Shape – concave, flat, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to steep
Aspect – See Figure 6500-3.

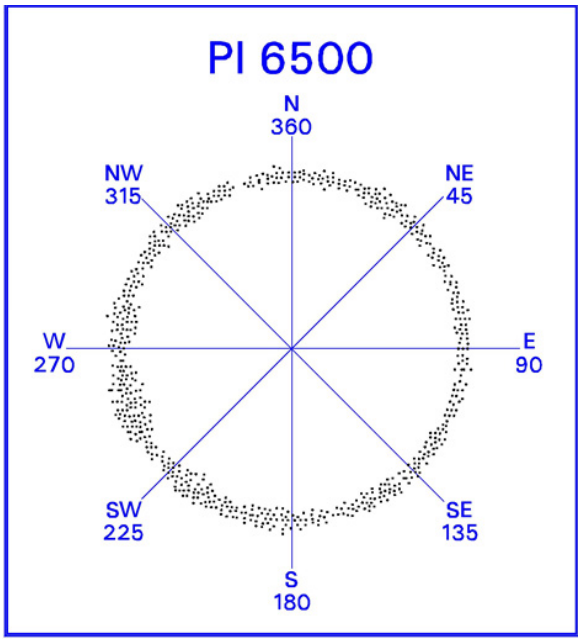


Figure 6500-3. Scatterplot of Willow spp./Meadow Shrubland Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Quaking Aspen/Willow spp. Talus Mapping Unit (2014)
- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- Black Cottonwood Forest Association (2053)
- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Water Birch Shrubland Alliance (5300)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Bitter Cherry Shrubland Alliance (6300)
- Willow spp. Riparian Shrubland Mapping Unit (6600)
- Willow spp. Talus Shrubland Mapping Unit (6700)

6600 – Willow spp. Riparian Shrubland Mapping Unit

Salix spp. Riparian Shrubland Mapping Unit

Description:

The *Salix spp*. riparian shrubland mapping unit includes any of the *Salix* dominated alliances that occur alongside rivers and streams. It is mapped on gentle to steep slopes of varying aspect between 491–3592 m (1610–11785 ft) across 5,191 acres of Sequoia and Kings Canyon National Parks (Figure 6600-1). Sites are characterized by palustrine or riverine hydrology and somewhat poorly drained sands or silt loams. The open to dense shrub canopy is dominated by any of several species of *Salix*, including *S. drummondii, S.eastwoodiae, S. geyeriana, S. goodingii, S. lasiandra, S. lemmonii, S. jepsonii, S. melanopsis, S. orestera* or *S. planifolia*, with *S. orestera* and *S. jepsonii* the most frequently encountered species. The composition of the moderately open to dense herbaceous layer varies widely with elevation and local habitat conditions, but is typically dominated by wet meadow and riparian graminoid and forb species, such as *Allium validum, Artemisia douglasiana, Carex spp., Castilleja miniata ssp. miniata, Epilobium angustifolium, Pteridium aquilinum, Senecio triangularis,* and *Veratrum californicum var. californicum.*

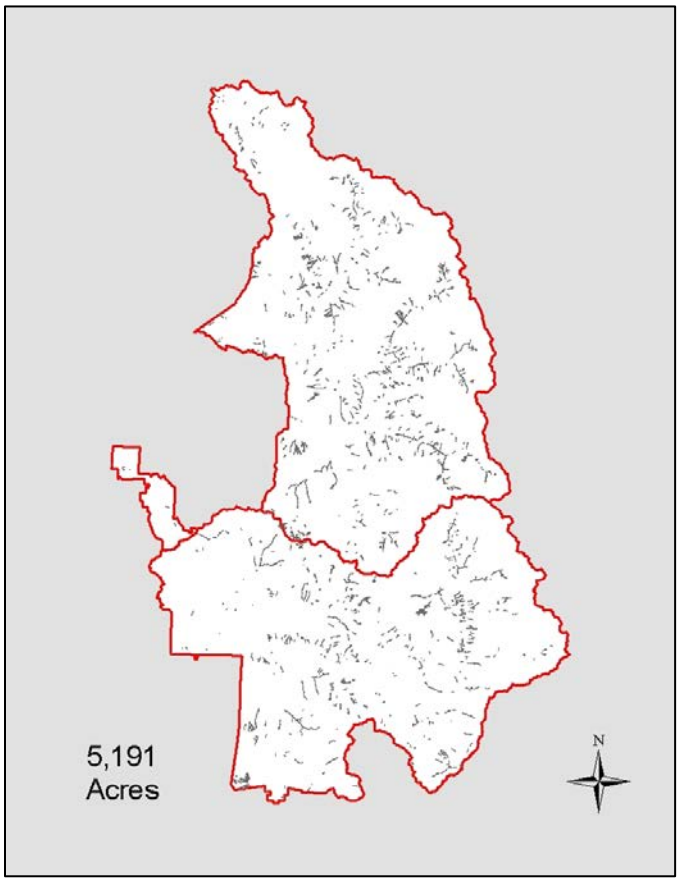


Figure 6600-1. Distribution of Willow spp. Riparian Shrubland Mapping Unit.

Accuracy:
Producer's accuracy: 77% (n=30)
User's accuracy: 100% (n=23)

Photo Interpretation Signature:
The signature of *Salix* is typically bright red in color, especially when it occurs as narrow bands along streams in rocky settings (Figure 6600-2). In forest settings, such narrow bands can be difficult to detect under the nearby forest canopy.

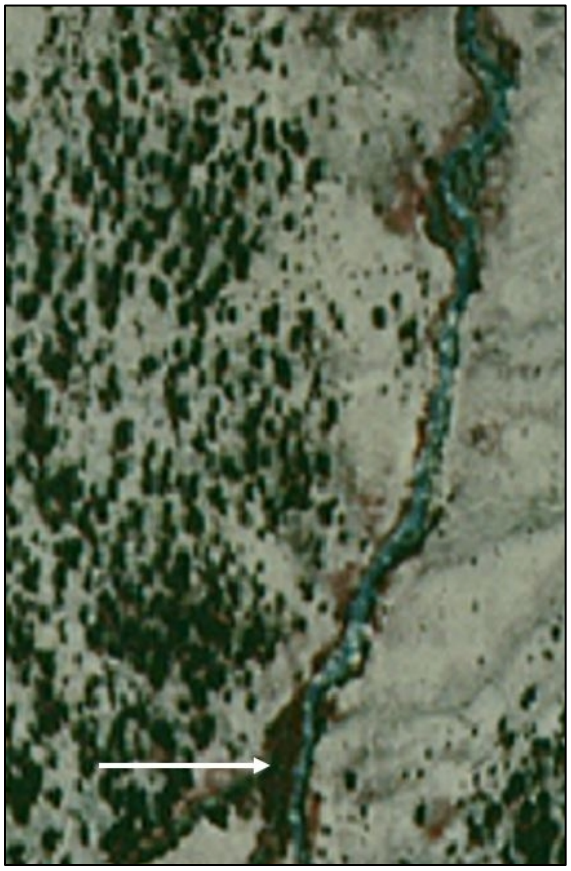


Figure 6600-2. Willow spp. Riparian Shrubland Mapping Unit signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – mesic
Elevation – 491–3592 m (1610–11785 ft)
Shape – concave, convex, flat, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to very steep
Aspect – See Figure 6600-3.

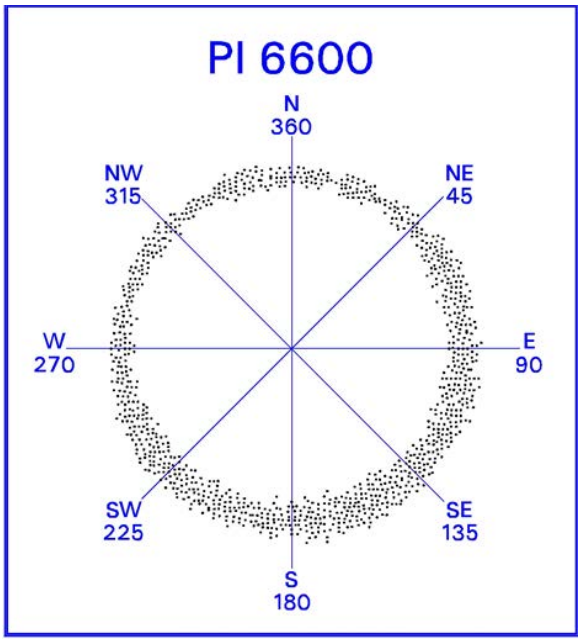


Figure 6600-3. Scatterplot of Willow spp. Riparian Shrubland Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen Forest Alliance (2010)
- Quaking Aspen/Willow spp. Forest Mapping Unit (2013)
- Quaking Aspen/Meadow Mapping Unit (2017)
- Black Cottonwood Temporarily Flooded Forest Alliance (2050)
- Black Cottonwood Forest Association (2053)
- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Water Birch Shrubland Alliance (5300)
- Bitter Cherry Shrubland Alliance (6300)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Shrub Willow Meadow Setting mapping unit (6500)
- Willow spp. Talus Shrubland Mapping Unit (6700)

6700 – Willow spp. Talus Shrubland Mapping Unit

Salix spp. Talus Shrubland Mapping Unit

Description:

The *Salix spp*. talus shrubland mapping unit includes any of the *Salix* dominated alliances that occur associated with talus fields. It is mapped on moderate to very steep slopes of varying aspect between 2069–3552 m (6789–11653 ft) across 3,830 acres of Sequoia and Kings Canyon National Parks (Figure 6700-1). The open to dense shrub canopy is dominated by any of several species of *Salix*, with *S. eastwoodiae* and *S. orestera* the most frequently encountered species. The composition of the moderately open to dense herbaceous layer varies widely with elevation and local habitat conditions, but is typically dominated by mesic graminoid and forb species, such as *Calamagrostis breweri, Carex exserta, Carex spp., Epilobium angustifolium, Penstemon heterodoxus, Pteridium aquilinum, Potentilla drummondii, Senecio triangularis,* and *Vaccinium caespitosum*. The hydrology is upland or palustrine. Soils are somewhat poorly drained sandy loams and sandy clay loams.

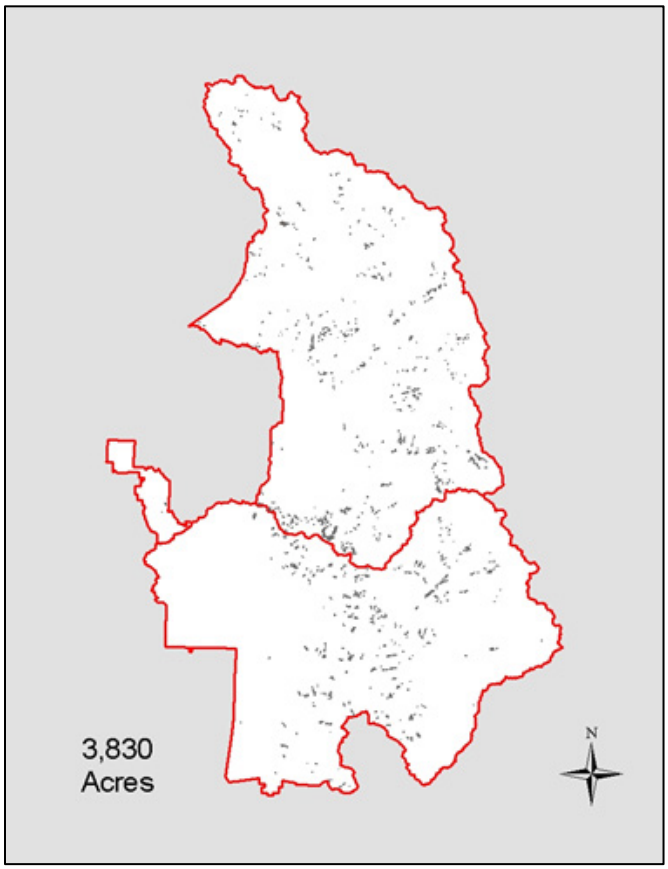


Figure 6700-1. Distribution of Willow spp. Talus Shrubland Mapping Unit.

Accuracy:

Producer's accuracy: 71% (n=21)

User's accuracy: 83% (n=18)

Photo Interpretation Signature:
The bright red signature of the *Salix* is especially evident against the rocky talus setting but may be confused with other shrubs that typically yield less color infrared signature, such as *Prunus emarginata* or *Chrysolepis sempervirens* (Figure 6700-2).

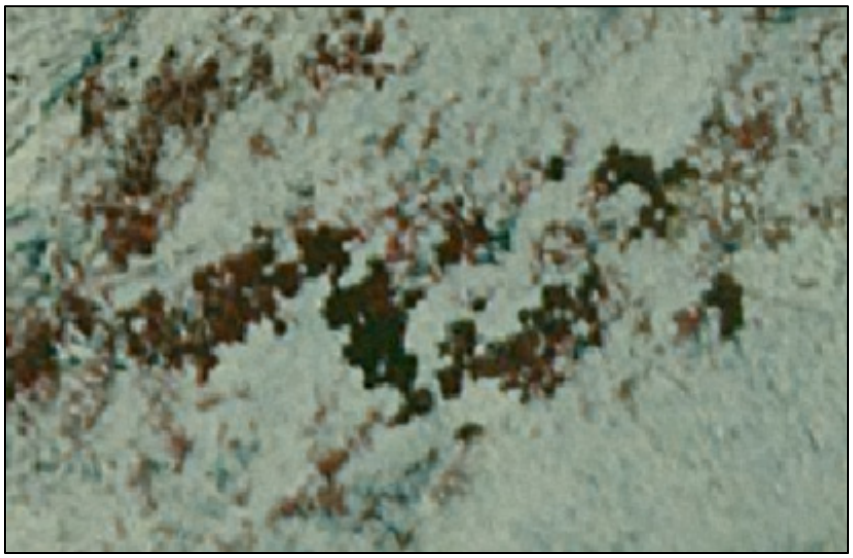


Figure 6700-2. Willow spp. Talus Shrubland Mapping Unit signature. Photo reference: LODG_NE.

Environmental Characteristics:
Microclimate – mesic
Elevation – 2069–3552 m (6789–11653 ft)
Shape – concave, convex, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – moderate to very steep
Aspect – See Figure 6700-3.

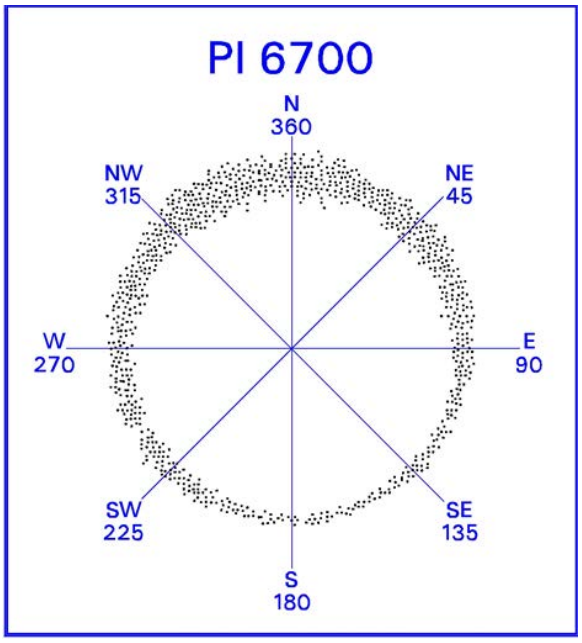


Figure 6700-3. Scatterplot of Willow spp. Talus Shrubland Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Quaking Aspen/Willow spp. Talus Mapping Unit (2014)
- Quaking Aspen/Big Sagebrush Forest Superassociation (2016)
- Bush Chinquapin Shrubland Alliance (5080)
- Water Birch Shrubland Alliance (5300)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Bitter Cherry Shrubland Alliance (6300)
- Willow spp./Meadow Shrubland Mapping Unit (6500)
- Willow spp. Riparian Shrubland Mapping Unit (6600)

7000 – Upland Herbaceous



Short Hair Sedge Association. SEKI.0175_156.

7120 – Shorthair Sedge Herbaceous Alliance
Carex exserta Herbaceous Alliance

Description:
The *Carex exserta* herbaceous alliance is mapped on gentle to moderately steep slopes of varying aspect between 2595–3797 m (8514–12458 ft) across 4,194 acres of Sequoia and Kings Canyon National Parks (Figure 7120-1). This alliance is dominated by *Carex exserta* (*Carex filifolia var. erostrata sensu* Hickman 1993) in the herbaceous layer. Other herbs may include *Achillea millefolium var. occidentalis. Calamagrostis breweri, Cistanthe umbellata var. umbellata, Erigeron algidus, Juncus mertensianus, Oreostemma alpigenum (Aster alpigenus* sensu Hickman 1993), *Penstemon heterodoxus, Potentilla spp., Ptilagrostis kingii, Saxifraga aprica,* and *Trisetum spicatum*. Emergent subshrubs may include *Eriogonum incanum* and *Eriogonum nudum.* This alliance forms the characteristic dryland meadow type of the subalpine and alpine and often intergrades with other meadow, forest, and woodland alliances. The hydrology is upland. Soils are well-drained sands and sandy loams. (NatureServe October 2006)

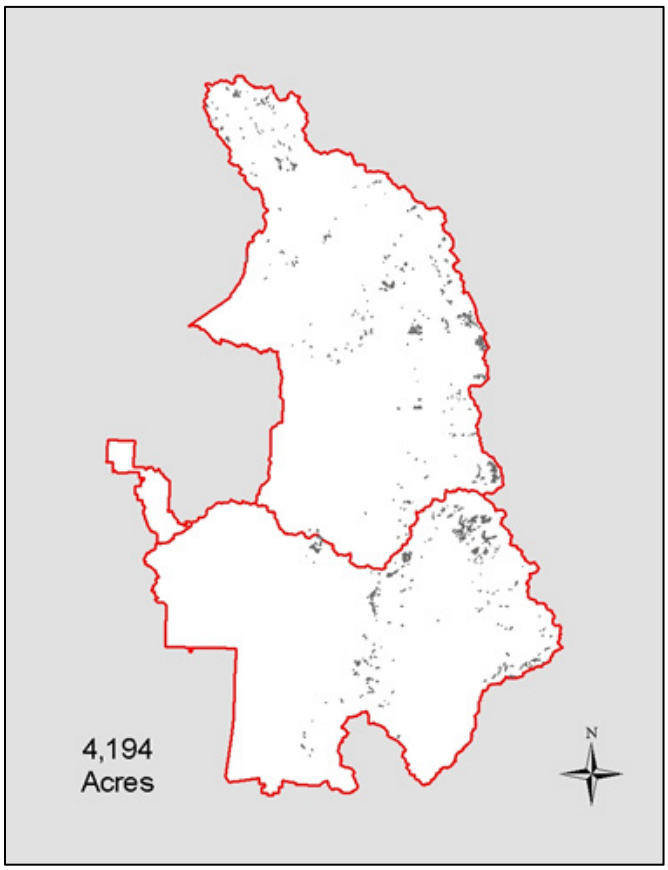


Figure 7120-1. Distribution of Shorthair Sedge Herbaceous Alliance.

Accuracy:
Producer's accuracy: 68% (n=22)
User's accuracy: 94% (n=16)

Photo Interpretation Signature:
This type is often mapped adjacent to wetter subalpine or alpine meadows. The signature of the *Carex exserta* herbaceous alliance is variable depending on the moisture status of the sedge vegetation. Drier stands generally have already died back and yield a very light signature trending towards off-white to yellow on the aerial photography (Figure 7120-2). This alliance is easily confused with dense stands of other dry-land herbaceous types at similar elevations including *Ptilagrostis kingii* and *Juncus parryi*.



Figure 7120-2. Shorthair Sedge Herbaceous Alliance signature. Photo reference: MOBR_SE.

Environmental Characteristics:
Microclimate – xeric to submesic
Elevation – 2595–3797 m (8514–12458 ft)
Shape – convex, flat, undulating
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to moderately steep
Aspect – See Figure 7120-3.

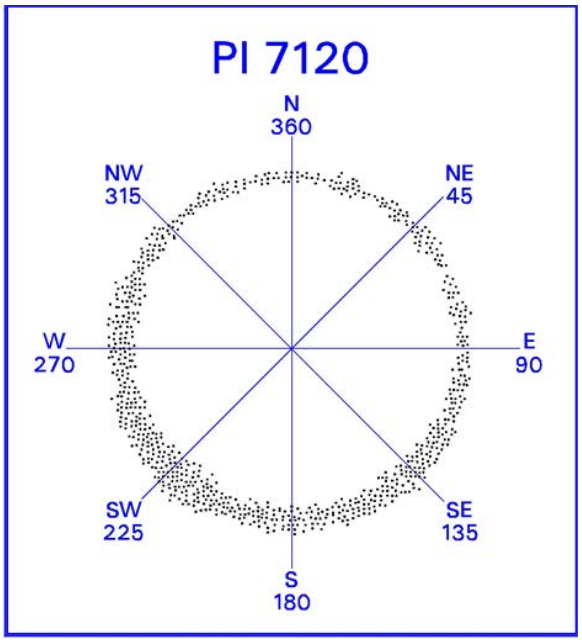


Figure 7120-3. Scatterplot of Shorthair Sedge Herbaceous Alliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Alpine Fell-field (0400)
- Mesic Rock Outcrop (0500)
- Sparsely Vegetated to Non-vegetated Exposed Rock (0961)
- Big Sagebrush Shrubland Alliance (5160)
- Upland Herbaceous (7000)
- Intermittently to Seasonally Flooded Meadow (8000)

7260 – California Annual Grassland/Herbland Superalliance

Description:

The California annual grassland/herbland superalliance is mapped on gentle to moderate south to southwest facing slopes between 506–1712 m (1659–5617 ft) across 509 acres of Sequoia National Park (Figure 7260-1). The herbaceous layer is composed of a diverse mix of annual grasses and forbs that form the characteristic annual grassland of the Sierran foothills. Dominant species include *Avena barbata, A. fatua, Bromus diandrus, B. hordeaceous, B. madritensis, Chorizanthe membranacea, Daucus pusillus,* a variety of *Trifolium spp*., and the late blooming summer annual *Holocarpha heermannii*. Associations within this alliance typically form the understory beneath *Quercus douglasii* and *Q. wislizeni var. wislizeni* dominated woodlands. Sites are characterized by upland hydrology and well developed soils. (NatureServe October 2006)

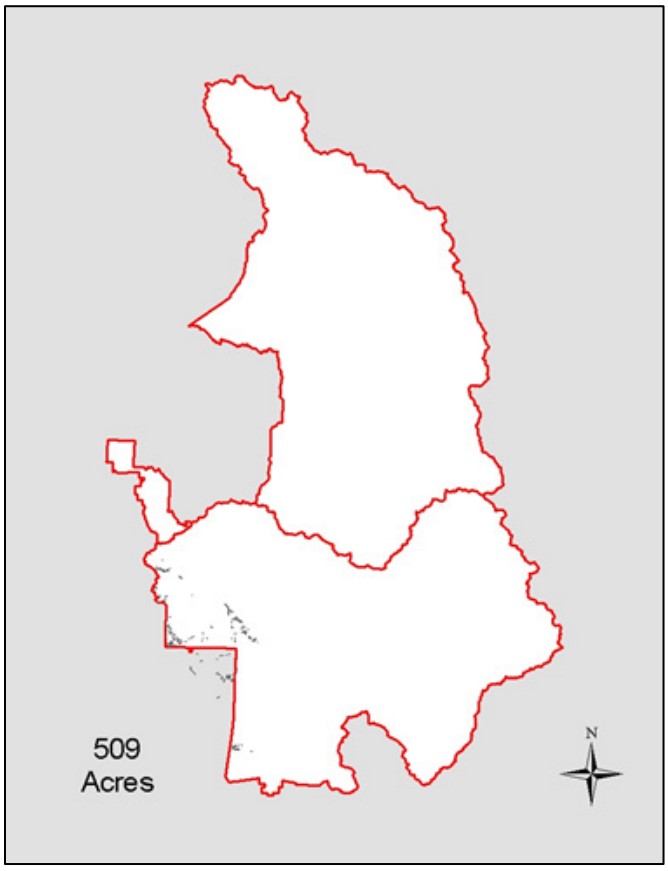


Figure 7260-1. Distribution of California Annual Grassland/Herbland Superalliance.

Accuracy:

Producer's accuracy: 100% (n=7)

User's accuracy: 100% (n=7)

Photo Interpretation Signature:
Most stands of this type yield very little color infrared signature on the aerial photography since they have long since died back following the early spring growing season. Protected settings sometimes yield some light yellow or pink hues (Figure 7260-2).

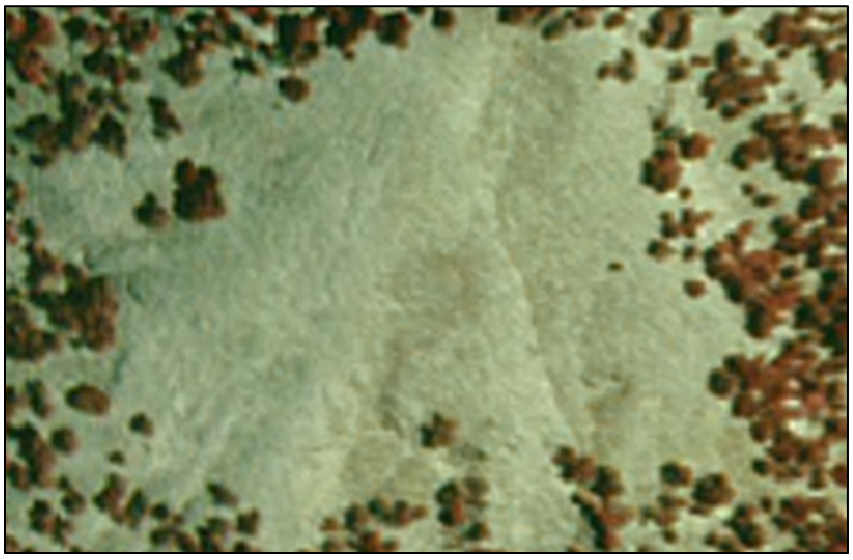


Figure 7260-2. California Annual Grassland/Herbland Superalliance signature. Photo reference: SHMO_NE.

Environmental Characteristics:
Microclimate – xeric
Elevation – 506–1712 m (1659–5617 ft)
Shape – convex, flat, undulating
Slope position – low slope
Steepness – gentle to moderate
Aspect – See Figure 7260-3.

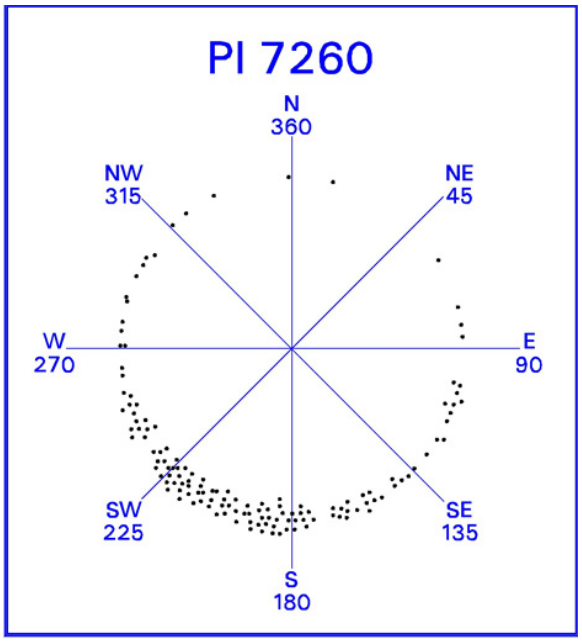


Figure 7260-3. Scatterplot of California Annual Grassland/Herbland Superalliance in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Upland Herbaceous (7000)

7702 – Mesic Post Fire Herbaceous Mapping Unit

Description:

The mesic post-fire herbaceous mapping unit is mapped on gentle to steep slopes of varying aspects between 633–3053 m (2078–10016 ft) across 525 acres of Sequoia and Kings Canyon National Parks (Figure 7702-1). Vegetation is generally herbaceous but may contain some shrubs such as *Ribes* or *Ceanothus;* individual species depend highly on elevation and adjacent or nearby vegetation.

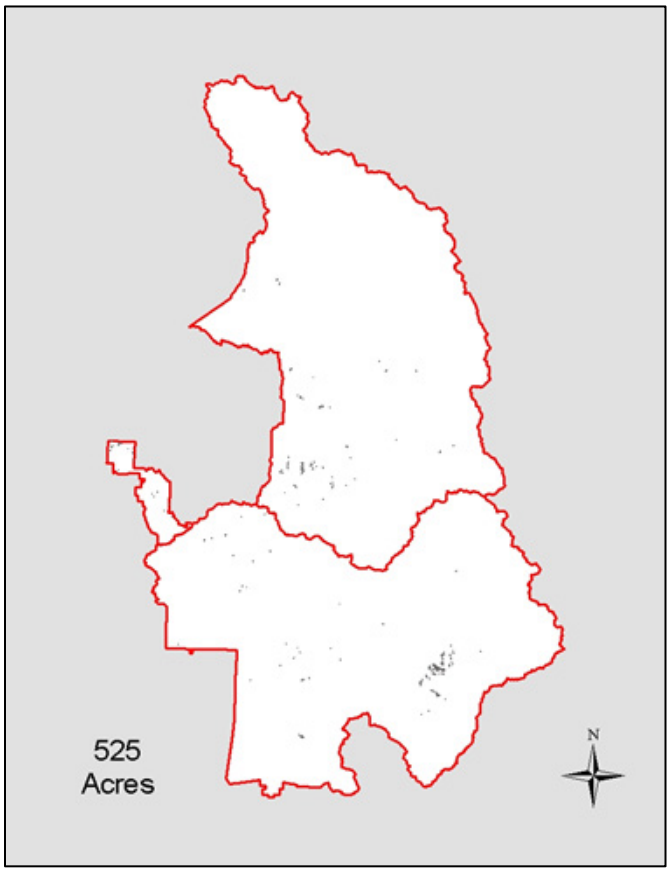


Figure 7702-1. Distribution of Mesic Post Fire Herbaceous Mapping Unit.

Accuracy:

Producer's accuracy: 100% (n=3)

User's accuracy: 100% (n=3)

Photo Interpretation Signature:

The photo signature is widely variable depending on density and duration after the disturbance event (Figure 7702-2). It is occasionally found in forest openings or in post avalanche settings.

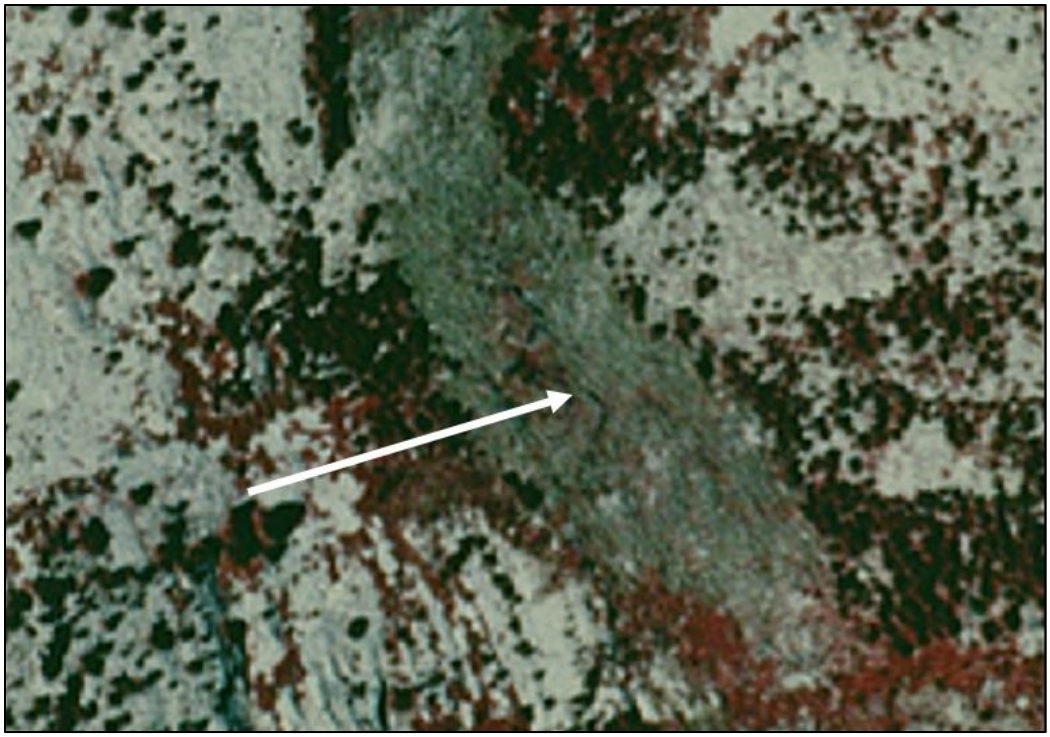


Figure 7702-2. Mesic Post Fire Herbaceous Mapping Unit signature.

Environmental Characteristics:
Microclimate – mesic
Elevation – 633–3053 m (2078–10016 ft)
Shape – convex, undulating
Slope position – midslope
Steepness – gentle to steep
Aspect – See Figure 7702-3.

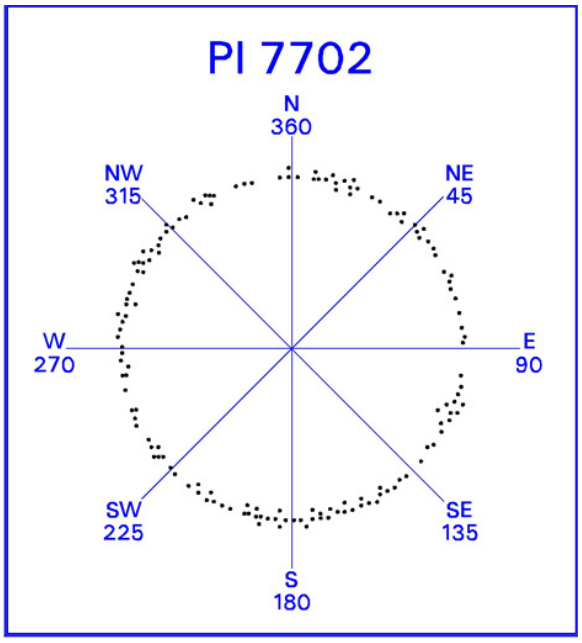


Figure 7702-3. Scatterplot of Mesic Post Fire Herbaceous Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Whitethorn Ceanothus Shrubland Alliance (5110)
- Mountain Misery Dwarf-shrubland Alliance (5130)
- Deerbrush Shrubland Alliance (6010)
- Bitter Cherry Shrubland Alliance (6300)
- Post Fire Shrub/Herbaceous Mapping Unit (7703)

7703 – Post Fire Shrub/Herbaceous Mapping Unit

Description:

The post fire shrub/ herbaceous mapping unit is mapped on moderately steep south to southwest facing slopes between 634–3312 m (2080–10866 ft) across 628 acres of Sequoia and Kings Canyon National Parks (Figure 7703-1). Any species of chaparral may dominate the stand depending on elevations, however, *Ceanothus* is by far the most common. Recent post-fire events may be strictly herbaceous grasses and forbs; less recent fire may show up as having a young conifer component.

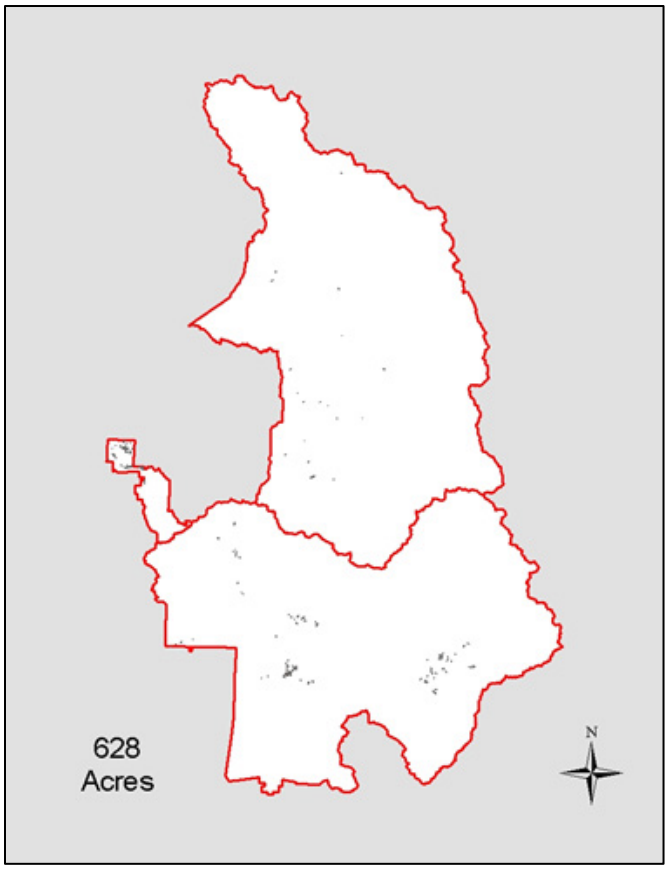


Figure 7703-1. Distribution of Post Fire Shrub/Herbaceous Mapping Unit.

Accuracy:

Producer's accuracy: 57% (n=7)

User's accuracy: 100% (n=4)

Photo Interpretation Signature:

The photo signature is widely variable depending on species and age of shrub in early seral settings (Figure 7703-2). It is found exclusively in post-fire settings.

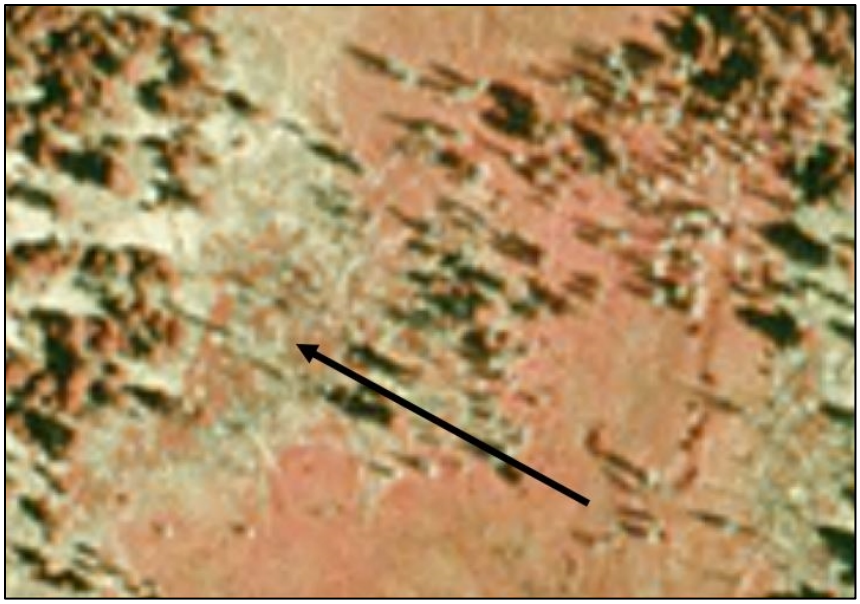


Figure 7703-2. Post Fire Shrub/Herbaceous Mapping Unit signature.

Environmental Characteristics:
Microclimate – xeric
Elevation – 634–3312 m (2080–10866 ft)
Shape – convex
Slope position – low slope, midslope, high slope
Steepness – moderately steep
Aspect – See Figure 7703-3.

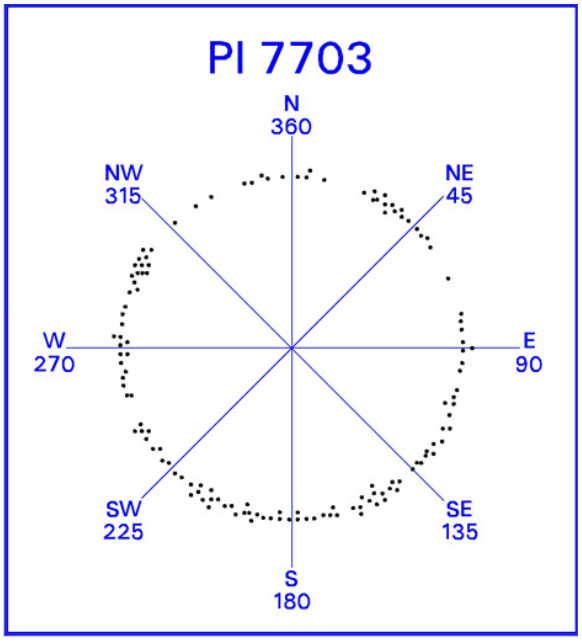


Figure 7703-3. Scatterplot of Post Fire Shrub/Herbaceous Mapping Unit in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Whitethorn Ceanothus Shrubland Alliance (5110)
- Mountain Misery Dwarf-shrubland Alliance (5130)
- Deerbrush Shrubland Alliance (6010)
- Mesic Post Fire Herbaceous Mapping Unit (7702)

8000 – Intermittently to Seasonally Flooded Meadow



Dusy Basin, Kings Canyon National Park.

8000 – Intermittently to Seasonally Flooded Meadow

Description:

Intermittently to seasonally flooded meadows are mapped on gentle to moderate concavities of varying aspect between 625–3965 m (2049–13010 ft) across 13,953 acres of Sequoia and Kings Canyon National Parks (Figure 8000-1). Associations included in this type are dominated by dense herbaceous vegetation that is generally characterized by a mixture of graminoid and forb species. A sparse shrub layer composed of emergent wetland species such as *Cornus sericea, Salix spp*, or *Vaccinium spp.* may be present. Emergent trees generally reflect the composition of the surrounding upland vegetation. The hydrology is palustrine. Wetlands included in this mapping unit have standing water present during the early part of the growing season, but generally exhibit some drying during the latter part of the season.

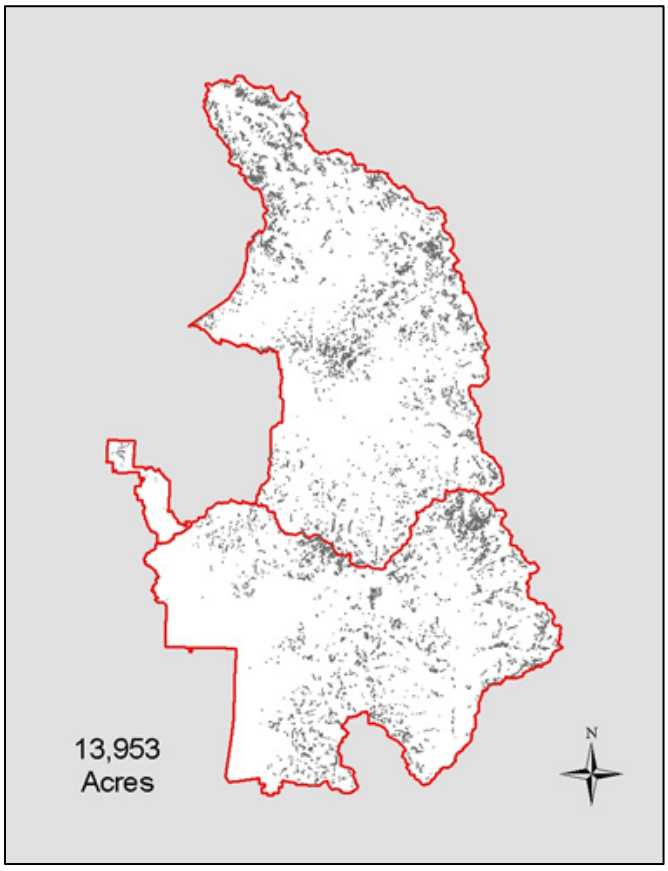


Figure 8000-1. Distribution of Intermittently to Seasonally Flooded Meadows.

Accuracy:

Producer's accuracy: 92% (n=38)
User's accuracy: 95% (n=37)

Photo Interpretation Signature:

The photo signature of intermittently to seasonally flooded meadows varies depending on wetness and species composition, but generally color infrared reflectance is high and yields bright orange to

red signatures (Figure 8000-2). The texture is always smooth but may be a bit coarser with presence of larger plants such as *Veratrum californicum.*

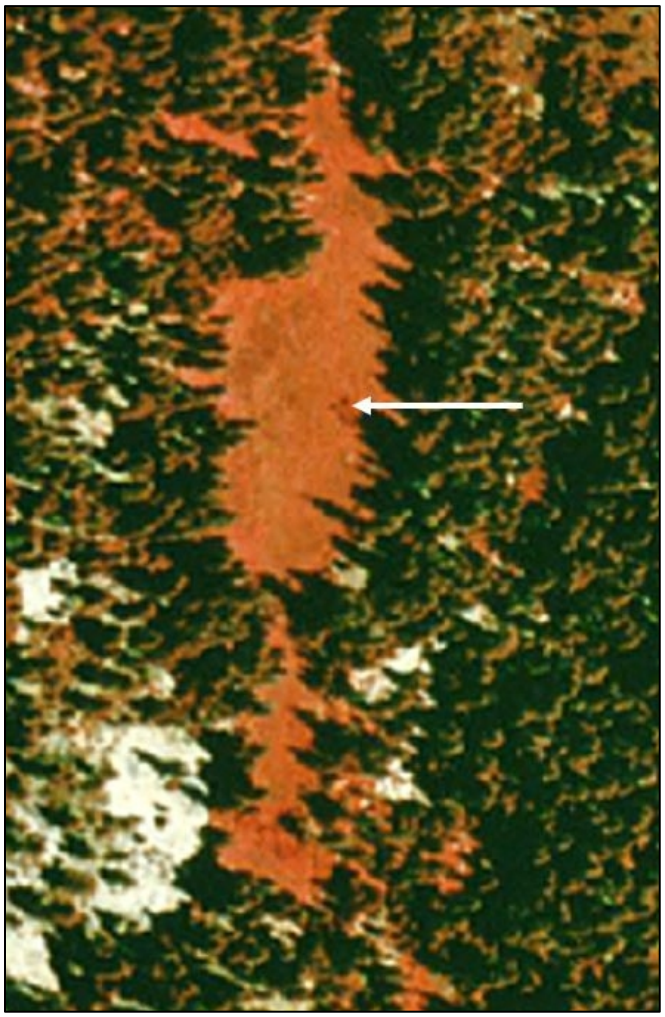


Figure 8000-2. Intermittently to Seasonally Flooded Meadows signature. Photo reference: MUGR_SW.

Environmental Characteristics:
Microclimate – mesic
Elevation – 625–3965 m (2049–13010 ft)
Shape – concave, flat
Slope position – canyon bottom, low slope, midslope, high slope
Steepness – gentle to moderate
Aspect – See Figure 8000-3.

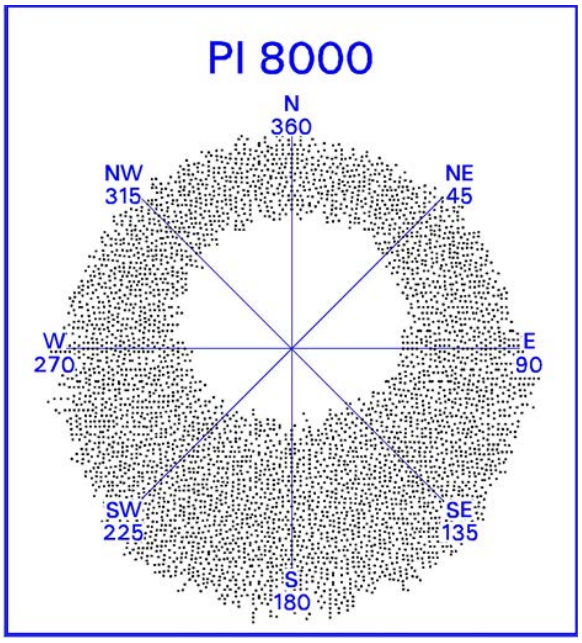


Figure 8000-3. Scatterplot of Intermittently to Seasonally Flooded Meadows in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Alpine Snow Patch Communities (0300)
- Mesic Rock Outcrop (0500)
- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit (5530)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Bitter Cherry Shrubland Alliance (6300)
- Upland Herbaceous (7000)
- Shorthair Sedge Herbaceous Alliance (7120)
- Semi-permanently to Permanently Flooded Meadow (9000)

9000 – Semi-permanent to Permanently Flooded Meadow



Chagoopa Plateau, Sequoia National Park.

9000 – Semi-permanent to Permanently Flooded Meadow

Description:

Semi-permanent to permanently flooded meadows are mapped on gentle to moderate concavities of varying aspect between 1948–3844 m (6390–12611 ft) across 1,791 acres of Sequoia and Kings Canyon National Parks (Figure 9000-1). Associations included in this type are dominated by dense herbaceous vegetation that is generally characterized by a mixture of graminoid and forb species. The hydrology is palustrine. These wetland associations generally have standing water present for the duration of the growing season.

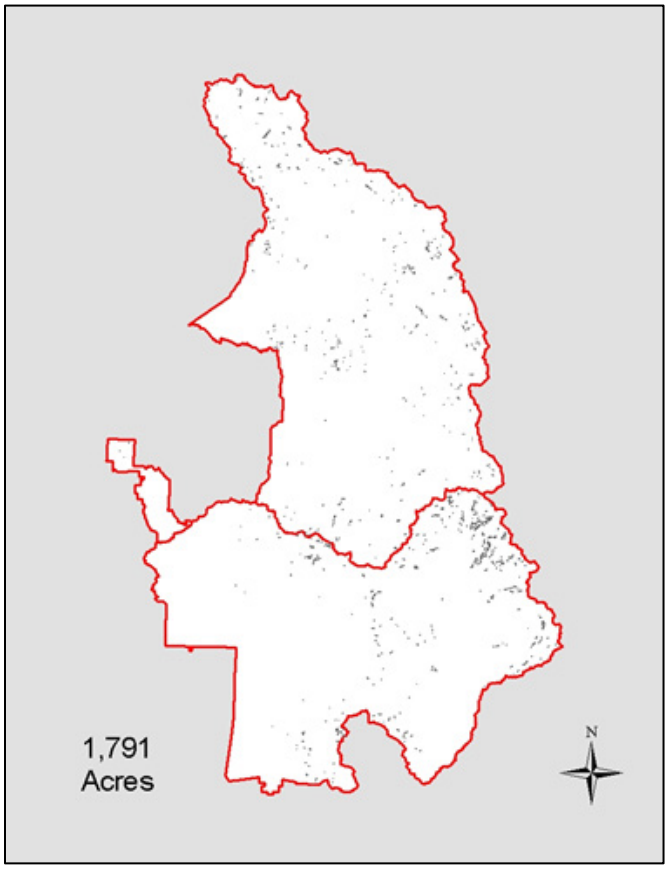


Figure 9000-1. Distribution of Semi-permanent to Permanently Flooded Meadows.

Accuracy:

Producer's accuracy: 100% (n=5)
User's accuracy: 100% (n=5)

Photo Interpretation Signature:

The presence of standing water either interspersed with or as a part of a bright red meadow signature is used in mapping to this category. Water signature may affect the brightness of the actual vegetation's reflectance (Figure 9000-2).

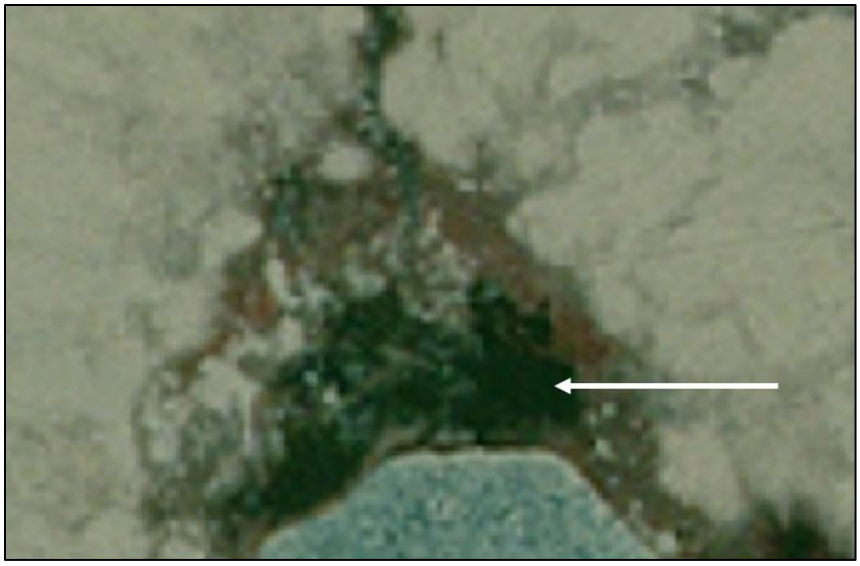


Figure 9000-2. Semi-permanent to Permanently Flooded Meadow signature. Photo reference: MOBR_SE.

Environmental Characteristics:

Microclimate – mesic
Elevation – 1948–3844 m (6390–12611 ft)
Shape – neutral
Slope position – depressions and concavities
Steepness – level to gently sloping
Aspect – See Figure 9000-3.

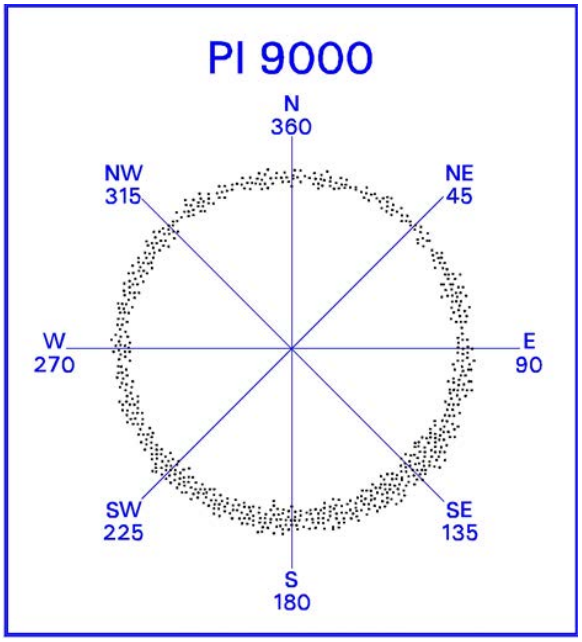


Figure 9000-3. Scatterplot of Semi-permanent to Permanently Flooded Meadows in relation to aspect.

Types With Similar Photo Interpretation Signatures:

- Alpine Snow Patch Communities (0300)
- Water (0980)
- Sierra Lodgepole Pine–Quaking Aspen/(Kentucky Bluegrass) Forest Mapping Unit (3012)
- Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit (3022)
- Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance (6110)
- Intermittently to Seasonally Flooded Meadow (8000)

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Potter, D. A. 1998. Forested communities of the upper montane in the central and southern Sierra Nevada. General Technical Report PSW–GTR 169. U.S. Forest Service, Pacific Southwest Research Station, Berkeley, California. 319 pp.

Story, M., and R. G. Congalton. 1986. Accuracy assessment: A user's perspective. Photogrammetric Engineering and Remote Sensing 52(3): 397–399.

Appendix G. Translation to Regional Classification Systems

Following delivery of the final map products, ecologists at SEKI determined that in order to share the products across agency platforms within California (primarily the US Forest Service and the California State Department of Fish and Wildlife) the spatial products would need to be translated (e.g. “cross-walked”) to the coarser classification systems in use by those agencies. The SEKI Fire GIS Specialist (K. Folger) took the lead on this process, and worked closely with vegetation specialists within the USFS to attribute the SEKI map polygons to reflect both Calveg and California Wildlife Habitat Relationships systems. Unpublished materials used to inform the translation process are provided as supplemental to the mapping products through the NPS IRMA system.

The following documentation reflects information provided on the USFS Region 5 Calveg System:

The CALVEG ("Classification and Assessment with Landsat of Visible Ecological Groupings") system was initiated in January 1978 by the Region 5 Ecology Group of the U.S. Forest Service with headquarters in San Francisco. The Calveg team's mission was to classify California existing vegetation communities for use in statewide resource planning considerations. This was originally accomplished with the use of color infrared satellite imagery and field verification of types by current soil-vegetation mapping efforts as well as professional guidance through a network of contacts throughout the state. It is a hierarchical classification originally based on "formation" categories: forest, woodland, chaparral, shrubs and herbaceous in addition to non-vegetated units. These were originally identified by distinctions calculated among canopy reflectance values used in the LANDSAT satellite. Since then, the classification has been expanded from an initial 129 types occurring throughout the eight regions of the state to the current 213 occurring in nine regions, and image resolution has been enhanced. The USDA Forest Service Region 5 employs and maintains the dynamic Calveg system and its standards for classification and naming conventions to classify existing vegetation across California.

At the state level, the Calveg system crosswalks to types in the California Wildlife Habitat Relationships System (Meyer and Laudenslayer 1988) and it's later versions. Additionally, crosswalks with vegetation types defined in the revision of the Manual of California Vegetation (Sawyer *et al.* 2009) have been developed.

Calveg is also consistent with the non-floristic guidelines of the National Vegetation Classification Standard (NVCS) supported and approved by the Federal Geographic Data Committee Vegetation Subcommittee since 1997. The "Floristic 1" level of the NVCS equates to Calveg Alliances. They are considered to be provisional alliances in the sense that, although they have been verified in the field, they are not usually determined by sets of plot data that meet NVCS protocol for collection and analysis. Under the current floristic standards, which have not yet been approved by the Federal Geographic Data Committee, the analysis of plot data is required to determine plant associations, the lowest level of the system ("Floristic 2") prior to determining alliances. For many USDA Forest Service projects, this approach to classification is not practical for larger-scale or rapid mapping and classification projects. Calveg Alliances are also defined as "Dominance Types" for the purpose of mapping vegetation in accordance with the Technical Guide's mapping standards.

Literature Cited – Appendix G

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Appendix H. Relationship between Mapped Vegetation Alliances and Associations of Sequoia & Kings Canyon National Parks and Floristic Types (as described for Yosemite National Park)

Table H-1. The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Alpine Talus Slope	–	None	0100	0100	0100
Alpine Scree Slope	–	None	0200	0200	0200
Alpine Snow Patch Communities	–	None	0300	0300	0300
Alpine Fell-field	–	None	0400	0400	0400
Mesic Rock Outcrop	–	None	0500	0500	0500
Boulder Field	–	None	0700	0700	0700
Post Disturbance Conifer Reproduction	–	None	0910	0910	0910
Conifer Plantation	–	None	0920	0920	0920
Sparsely Vegetated Undifferentiated	–	None	0940	0940	0940
Sparsely Vegetated Riverine Flat	–	None	0941	0941	0941
Non-alpine Talus	–	None	0950	0950	0950
Sparsely Vegetated to Non-vegetated Exposed Rock	–	None	0961	0961	0961
Dome	–	None	0963	0963	0963
Sparsely Vegetated Rocky Streambed	–	None	0965	0965	0965
Alpine Permanent Snowfield/Glacier	–	None	0970	0970	0970
Water	–	None	0980/ 0981	0980	0980
Urban/Developed	–	None	0990	0990	0990
Canyon Live Oak Forest Alliance	↔	Canyon Live Oak Forest Alliance	1020	1020	1020

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Table H-1 (continued). The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Canyon Live Oak/Birchleaf Mountain Mahogany Forest Mapping Unit	→	Canyon Live Oak Forest Alliance	1021	1021	1021
Canyon Live Oak/Whiteleaf Manzanita Woodland Association	←	Canyon Live Oak/Whiteleaf Manzanita Forest	1022	1022	1022
	←	Canyon Live Oak/Indian Manzanita Forest (none in YOSE)	1022	1022	1022
Canyon Live Oak–Ponderosa Pine Forest and Canyon Live Oak–Incense-cedar Forest Superassociation	←	Canyon Live Oak–Ponderosa Pine Forest	1023	1023	1023
	←	Canyon Live Oak–Incense-cedar Forest	1023	1023	1023
Canyon Live Oak–California Laurel Forest Association	←	Canyon Live Oak–California Laurel/Wood Fern Forest	1024/ 1050	1024	1024
	←	Canyon Live Oak–California Laurel/Bush Beardtongue Forest	1024/ 1050	1024	1024
	←	Canyon Live Oak–California Laurel/California Ash Forest	1024/ 1050	1024	1024
Canyon Live Oak/Greenleaf Manzanita Forest Association	↔	Canyon Live Oak/Greenleaf Manzanita Forest	1029	1029	1029
Interior Live Oak Woodland Alliance	↔	Interior Live Oak Woodland Alliance	1040	1040	1040
	←	Interior Live Oak Shrubland Alliance	1040	1040	1040
	←	Interior Live Oak/Poison Oak Shrubland	1040	1040	1040
Interior Live Oak–Canyon Live Oak Woodland Association	↔	Interior Live Oak–Canyon Live Oak Woodland	1043	1043	1043
Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany–California Redbud Forest Association	↔	Interior Live Oak–California Buckeye/Birchleaf Mountain Mahogany–California Redbud Forest Association	1044	1044	1044

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Table H-1 (continued). The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Montane Broadleaf Deciduous Trees Mapping Unit	–	None	2000/2503	2000	2530
Quaking Aspen Forest Alliance	↔	Quaking Aspen Forest Alliance	2010	2010	2010
Quaking Aspen/Willow spp. Forest Mapping Unit	←	Quaking Aspen/Wood Rose Forest	2013	2013	2013
Quaking Aspen/Willow spp. Talus Mapping Unit	–	None	2014	2014	2014
Quaking Aspen/Big Sagebrush Forest Superassociation	←	Quaking Aspen/Big Sagebrush Forest	2016	2016	2016
	←	Quaking Aspen/Big Sagebrush–Mountain Pennyroyal/Kelloggia Forest	2016	2016	2016
Quaking Aspen/Meadow Mapping Unit	←	Quaking Aspen/Kentucky Bluegrass Forest	2017	2017	2017
California Black Oak Forest Alliance	↔	California Black Oak Forest Alliance	2020/ 2021/ 2026	2020	2020
	←	California Black Oak/Indian Manzanita–Mountain Misery Forest	2020/ 2021/ 2026	2020	2020
	←	California Black Oak/Greenleaf Manzanita Forest	2020/ 2021/ 2026	2020	2020
	←	California Black Oak–Incense-cedar Forest	2020/ 2021/ 2026	2020	2020
California Black Oak/Greenleaf Manzanita Forest Association	↔	California Black Oak/Greenleaf Manzanita Forest	2021	2021	2020
California Black Oak/(Bracken Fern) Meadow Mapping Unit	–	None	2027	2025	2025

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Table H-1 (continued). The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
California Black Oak/Indian Manzanita–Mountain Misery Forest Association	↔	California Black Oak/Indian Manzanita–Mountain Misery Forest	2026	2026	2020
Blue Oak Woodland Alliance	↔	Blue Oak Woodland Alliance	2030	2030	2030
Blue Oak/Brome Spp.–American Wild Carrot Woodland Association	↔	Blue Oak/Brome Spp.–American Wild Carrot Woodland	2033	2033	2033
Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland Association	↔	Blue Oak–Interior Live Oak/Brome spp.–American Wild Carrot Woodland	2034	2034	2034
Blue Oak–California Buckeye–(Interior Live Oak) Woodland Mapping Unit	–	None	2037/ 2038	2038	2038
	←	Blue Oak/California Buckeye Woodland	2037/ 2038	2038	2038
Black Cottonwood Temporarily Flooded Forest Alliance	↔	Black Cottonwood Temporarily Flooded Forest Alliance	2050	2050	2050
Black Cottonwood Forest Association	↔	Black Cottonwood Forest	2053	2053	2053
White Alder Temporarily Flooded Forest Alliance	↔	White Alder Temporarily Flooded Forest Alliance	2060	2060	2060
	←	White Alder–Bigleaf Maple Forest	2060	2060	2060
	←	White Alder–Mulefat Forest	2060	2060	2060
	←	White Alder–Red Willow Forest	2060	2060	2060
	←	White Alder–Arroyo Willow–Canyon Live Oak–California Bay Forest	2060	2060	2060
	←	White Alder/Indian Rhubarb Forest	2060	2060	2060
	←	White Alder Forest	2060	2060	2060
White Alder–Red Willow–California Sycamore Forest Association	↔	White Alder–Red Willow–California Sycamore Forest	2101	2061	2061

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Table H-1 (continued). The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Bigleaf Maple Forest Alliance	↔	Bigleaf Maple Forest Alliance	2080	2080	2080
Water Birch Shrubland Alliance	↔	Water Birch Shrubland Alliance	2085	5300	5300
California Sycamore Temporarily Flooded Woodland Alliance	↔	California Sycamore Temporarily Flooded Woodland Alliance	2100	2100	2100
California Sycamore–(Canyon Live Oak)–(Interior Live Oak) Forest Mapping Unit	–	None	2102	2102	2102
California Buckeye Woodland Alliance	↔	California Buckeye Woodland Alliance	2110	2110	2110
California Buckeye–Canyon Live Oak Woodland Association	↔	California Buckeye–Canyon Live Oak Woodland	2114	2114	2114
Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance	↔	Sierra Lodgepole Pine–Quaking Aspen–(Jeffrey Pine) Forest Alliance	3010	3010	3010
Sierra Lodgepole Pine–Quaking Aspen/Meadow Mapping Unit	→	Sierra Lodgepole–Quaking Aspen Forest Alliance	3012	3012	3012
Sierra Lodgepole Pine Forest Alliance	↔	Sierra Lodgepole Pine Forest Alliance	3020	3020	3020
Sierra Lodgepole Pine/(Bog Blueberry) Forest Mapping Unit	←	Sierra Lodgepole Pine/Bog Blueberry Forest	3022	3022	3022
Sierra Lodgepole Pine Rocky Woodlands Superassociation	←	Sierra Lodgepole Pine/Mountain Pride Forest	3021/ 3038/ 3042	3026	3026
	←	Sierra Lodgepole Pine Woodland	3021/ 3038/ 3042	3026	3026
	←	Sierra Lodgepole Pine/Shorthair Sedge Woodland	3021/ 3038/ 3042	3026	3026

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Table H-1 (continued). The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Sierra Lodgepole Pine Sparse/Outcrop Woodland Mapping Unit	↔	Sierra Lodgepole Pine Sparse/Outcrop Mapping Unit	3021	3021	3026
Sierra Lodgepole Pine Woodland Association	↔	Sierra Lodgepole Pine Woodland	3038	3038	3026
Sierra Lodgepole Pine/Shorthair Sedge Woodland Association	↔	Sierra Lodgepole Pine/Shorthair Sedge Woodland	3042	3042	3026
Sierra Lodgepole Pine–(Whitebark Pine)/(Ross Sedge)–(Shorthair Sedge) Forest Superassociation	←	Sierra Lodgepole Pine/Ross Sedge Forest	3033/ 3041/ 3043	3028	3028
	←	Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest	3033/ 3041/ 3043	3028	3028
	←	Sierra Lodgepole Pine–Whitebark Pine/Shorthair Sedge Forest	3033/ 3041/ 3043	3028	3028
Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest Association	↔	Sierra Lodgepole Pine–Whitebark Pine/Ross Sedge Forest	3033	3033	3028
Sierra Lodgepole Pine/Ross Sedge Forest Association	↔	Sierra Lodgepole Pine/Ross Sedge Forest	3041	3041	3028
Sierra Lodgepole Pine–Whitebark Pine/Shorthair Sedge Forest Association	↔	Sierra Lodgepole Pine–Whitebark Pine/Shorthair Sedge Forest	3043	3043	3028
Sierra Lodgepole Pine/Big Sagebrush Forest Association	↔	Sierra Lodgepole Pine/Big Sagebrush Forest	3034	3034	3034
Sierra Lodgepole Pine Mesic Expression Superassociation	←	Sierra Lodgepole Pine/Bog Laurel Forest	3048	3048	3048
	←	Sierra Lodgepole Pine/Gray's Lovage Forest	3048	3048	3048
Sierra Lodgepole Pine xeric expression Superassociation	→	Sierra Lodgepole Pine Forest Alliance	3049/ 3023	3049	3049
Ponderosa Pine Woodland Alliance	↔	Ponderosa Pine Woodland Alliance	3050	3050	3050

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland Association	↔	Ponderosa Pine–California Black Oak/Whiteleaf Manzanita Woodland	3053	3053	3053
Ponderosa Pine–Incense-cedar Forest Alliance	↔	Ponderosa Pine–Incense-cedar Forest Alliance	3060/ 4110	3060	3060
Ponderosa Pine–Incense-cedar–Canyon Live Oak/Mountain Misery Forest Mapping Unit	–	None	3061	3061	3061
Ponderosa Pine–Incense-cedar/Mountain Misery Forest Association	↔	Ponderosa Pine–Incense-cedar/Mountain Misery Forest	3062	3062	3062
Ponderosa Pine–Incense-cedar–California Black Oak Forest Association	↔	Ponderosa Pine–Incense-cedar–California Black Oak Forest	3063	3063	3063
Jeffrey Pine Woodland Alliance	↔	Jeffrey Pine Woodland Alliance	3070/ 3086	3070	3070
	←	Jeffrey Pine/Bush Chinquapin Woodland	3070/ 3086	3070	3070
	←	Jeffrey Pine–White Fir Woodland	3070/ 3086	3070	3070
Jeffrey Pine–White Fir Woodland & White Fir–Sugar Pine–Jeffrey Pine Woodland Mapping Unit	–	None	3086	3086	3070
Jeffrey Pine/Greenleaf Manzanita Woodland Association	↔	Jeffrey Pine/Greenleaf Manzanita Woodland	3072	3072	3072
Jeffrey Pine/Whitethorn Ceanothus Woodland Association	↔	Jeffrey Pine/Whitethorn Ceanothus Woodland	3073	3073	3073
Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Grass Woodland Association	↔	Jeffrey Pine–White Fir/Roundleaf Snowberry/Squirreltail Grass Woodland	3083	3083	3083

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association	↔	Jeffrey Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland	3084	3084	3084
Jeffrey Pine–California Red Fir Woodland Association	↔	Jeffrey Pine–California Red Fir Woodland	3085	3085	3085
Single-leaf Pinyon Pine Woodland Alliance	↔	Single-leaf Pinyon Pine Woodland Alliance	3110	3110	3110
Single-leaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland Association	↔	Single-leaf Pinyon Pine–Canyon Live Oak/Whiteleaf Manzanita Woodland	3114	3114	3114
Western White Pine Woodland Alliance	↔	Western White Pine Woodland Alliance	3130	3130	3130
Western White Pine–Sierra Lodgepole Pine–(California Red Fir) Woodland? Mapping Unit	←	Western White Pine–Sierra Lodgepole Pine Woodland	3132/ 4055	4540	4540
	←	California Red Fir–Western White Pine–Sierra Lodgepole Pine Forest	3132/ 4055	4540	4540
Western White Pine–Sierra Lodgepole Pine Woodland Association	↔	Western White Pine–Sierra Lodgepole Pine Woodland	3132	3132	4540
California Red Fir–Western White Pine–Sierra Lodgepole Pine Woodland Association	↔	California Red Fir–Western White Pine–Sierra Lodgepole Pine Woodland	4055	4055	4540
Western White Pine/(Greenleaf Manzanita)–(Bush Chinquapin)–(Oceanspray) Woodland Mapping Unit	→	Western White Pine Woodland Alliance	3133	3133	3133
Whitebark Pine Woodland Alliance	↔	Whitebark Pine Woodland Alliance	3140	3140	3140
Whitebark Pine/Davidson's Penstemon Woodland Association	←	Whitebark Pine/Davidson's Penstemon Woodland	3142/ 3146	3142	3142
Whitebark Pine/Shorthair Sedge Woodland Association	↔	Whitebark Pine/Shorthair Sedge Woodland	3144	3144	3144

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Whitebark Pine–Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance	←	Whitebark Pine Woodland Alliance	3145	3530	3530
	←	Foxtail Pine Woodland Alliance	3145	3530	3530
	←	Sierra Lodgepole Pine Woodland	3145	3530	3530
Whitebark Pine–Mountain Hemlock Woodland Association	↔	Whitebark Pine–Mountain Hemlock Woodland	3148	3148	3148
Limber Pine Woodland Alliance	↔	Limber Pine Woodland Alliance	3150	3150	3150
Foxtail Pine Woodland Alliance	↔	Foxtail Pine Woodland Alliance	3200	3200	3200
Foxtail Pine–Sierra Lodgepole Pine Woodland Superalliance	←	Foxtail Pine–Sierra Lodgepole Pine Woodland	3201	3540	3540
	←	Sierra Lodgepole Pine–Foxtail Pine Woodland	3201	3540	3540
Foxtail Pine/Bush Chinquapin Woodland Association	↔	Foxtail Pine/Bush Chinquapin Woodland	3202	3202	3202
Foxtail Pine Woodland Superassociation	→	Foxtail Pine Woodland Alliance	3203	3203	3203
Foxtail Pine–Western White Pine Woodland Superassociation	→	Foxtail Pine Woodland Alliance	3204	3204	3204
Dead Foxtail Pine Mapping Unit	–	None	3205	3205	3205
(Foxtail Pine)–(Sierra Lodgepole Pine)–(Whitebark Pine) Krummholz Woodland Mapping Unit	–	None	3206	3520	3520
Giant Sequoia Forest Alliance	↔	Giant Sequoia Forest Alliance	4020	4020	4020
Giant Sequoia–Sugar Pine/Pacific Dogwood Forest Association	↔	Giant Sequoia–Sugar Pine/Pacific Dogwood Forest	4021	4021	4021

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Giant Sequoia–White Fir–California Red Fir Forest Association	↔	Giant Sequoia–White Fir–California Red Fir Forest	4023	4023	4023
Mountain Hemlock Forest Alliance	↔	Mountain Hemlock Forest Alliance	4030/ 4031	4030	4030
	←	Mountain Hemlock Forest	4030/ 4031	4030	4030
Mountain Hemlock–Western White Pine Forest Association	↔	Mountain Hemlock–Western White Pine Forest	4033	4033	4033
Mountain Hemlock–Sierra Lodgepole Pine Forest Association	↔	Mountain Hemlock–Sierra Lodgepole Pine Forest	4041	4041	4041
Mountain Hemlock–Sierra Lodgepole Pine–Whitebark Pine Forest Mapping Unit	–	None	4042	4042	4042
Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest Association	↔	Mountain Hemlock–Sierra Lodgepole Pine–Western White Pine Forest	4043/ 4032	4043	4043
California Red Fir Forest Alliance	↔	California Red Fir Forest Alliance	4050	4050	4050
California Red Fir Forest Association	↔	California Red Fir Forest	4051	4051	4051
California Red Fir–Western White Pine Forest Association	↔	California Red Fir–Western White Pine Forest Association	4057	4057	4057
California Red Fir–Sierra Lodgepole Pine/Whiteflower hawkweed Forest Association	↔	California Red Fir–Sierra Lodgepole Pine/Whiteflower hawkweed Forest	4063	4063	4063

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
California Red Fir–(Western White Pine)/(Pinemat Manzanita)–(Bush Chinquapin) Forest Mapping Unit	→	California Red Fir Forest Alliance	4054/ 4069	4064	4064
	←	California Red Fir–Western White Pine/Bush Chinquapin Forest	4054/ 4069	4064	4064
	←	California Red Fir–Western White Pine/Pinemat Manzanita Forest	4054/ 4069	4064	4064
California Red Fir/Pinemat Manzanita–(Greenleaf Manzanita)–(Whitethorn Ceanothus) Forest Mapping Unit	→	California Red Fir Alliance	4054	4054	4064
California Red Fir–Western White Pine/(Pinemat Manzanita)–(Bush Chinquapin) Forest Mapping Unit	→	California Red Fir Alliance	4069	4069	4064
California Red Fir–White Fir Forest Alliance	←	California Red Fir–White Fir Forest Alliance	4070/ 4071/ 4072/ 4073	4070	4070
	←	California Red Fir–White Fir Forest	4070/ 4071/ 4072/ 4073	4070	4070
	←	California Red Fir–White Fir–Jeffrey Pine Forest	4070/ 4071/ 4072/ 4073	4070	4070
	←	California Red Fir–White Fir–Sugar Pine Forest	4070/ 4071/ 4072/ 4073	4070	4070
California Red Fir–White Fir Forest Association	↔	California Red Fir–White Fir Forest	4071	4071	4070

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
California Red Fir–White Fir–Jeffrey Pine Forest Association	↔	California Red Fir–White Fir–Jeffrey Pine Forest	4072	4072	4070
California Red Fir–White Fir–Sugar Pine Forest Association	↔	California Red Fir–White Fir–Sugar Pine Forest	4073	4073	4070
White Fir–Sugar Pine Forest Alliance	↔	White Fir–Sugar Pine Forest Alliance	4080	4080	4080
White Fir Forest Mapping Unit	→	White Fir–Sugar Pine Forest Alliance	4081	4081	4081
White Fir Late Mature Even-age Stands Mapping Unit	→	White Fir–Sugar Pine Forest Alliance	4082	4082	4082
White Fir–(California Red Fir–Sugar Pine–Jeffrey Pine)/Whitethorn Ceanothus–(Pinemat Manzanita Forest Mapping Unit	–	None	4084	4084	4084
White Fir–Sugar Pine–Incense-cedar Forest Superassociation	←	White Fir–Incense cedar–Sugar Pine–Pacific Dogwood/California Hazel Forest	4094/ 4096	4094	4094
	←	White Fir–Sugar Pine/False Solomon's Seal–Hooker Fairybells Forest	4094/ 4096	4094	4094
	←	White Fir–Sugar Pine–Incense-cedar/Bush Chinquapin/Multi-stemmed Sedge Forest	4094/ 4096	4094	4094
	←	White Fir–Sugar Pine–Incense-cedar/Creeping Snowberry/Kelloggia Forest	4094/ 4096	4094	4094

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
White Fir–Sugar Pine/Greenleaf Manzanita–Whitethorn Ceanothus Forest Mapping Unit	→	White Fir–Sugar Pine Forest Alliance	4095	4095	4095
Sierra Juniper Woodland Alliance	↔	Sierra Juniper Woodland Alliance	4100	4100	4100
Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland Association	↔	Sierra Juniper/Curl-leaf Mountain Mahogany–Big Sagebrush Woodland	4107	4107	4107
Sierra Juniper Woodland Association	↔	Sierra Juniper Woodland Association	4108/ 4101	4108	4108
Sierra Juniper/Oceanspray Woodland & Sierra Juniper/Big Sagebrush Woodland Superassociation	←	Sierra Juniper/Oceanspray Woodland	4109/ 4101	4109	4109
	←	Sierra Juniper/Big Sagebrush Woodland	4109/ 4101	4109	4109
Incense-cedar–White Alder Forest Association	↔	Incense-cedar–White Alder Forest	4111	4111	4111
Birchleaf Mountain Mahogany Shrubland Alliance	↔	Birchleaf Mountain Mahogany Shrubland Alliance	5010	5010	5010
Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland Association	↔	Birchleaf Mountain Mahogany/California Redbud–California Flannelbush Shrubland	5011	5011	5011
Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland Association	↔	Birchleaf Mountain Mahogany/Whiteleaf Manzanita Shrubland	5012	5012	5012
Chamise Shrubland Alliance	↔	Chamise Shrubland Alliance	5020/ 5021	5020	5020
	←	Chamise Shrubland	5020/ 5021	5020	5020
Chamise Shrubland Association	↔	Chamise Shrubland	5021	5021	5020

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Chamise–Whiteleaf Manzanita Shrubland Association	↔	Chamise–Whiteleaf Manzanita Shrubland	5022	5022	5022
Chamise–Chaparral Yucca Shrubland Association	↔	Chamise–Chaparral Yucca Shrubland Association	5023	5023	5023
Chamise–California Yerba Santa Shrubland Mapping Unit	→	Chamise Shrubland Alliance	5025	5025	5025
	←	Chamise–California Yerba Santa–Tree Poppy Shrubland	5025	5025	5025
	←	Chamise–Fremont's Bushmallow Shrubland	5025	5025	5025
	←	Chamise–Common Deerweed Shrubland	5025	5025	5025
	←	Chamise–Chaparral Whitethorn Shrubland	5025	5025	5025
Chamise–Buckbrush Shrubland Association	↔	Chamise–Buckbrush Shrubland	5027	5027	5027
Buckbrush Shrubland Alliance	↔	Buckbrush Shrubland Alliance	5050	5050	5050
Chaparral Whitethorn Shrubland Alliance	↔	Chaparral Whitethorn Shrubland Alliance	5060	5060	5060
	←	Chaparral Whitethorn–Poison Oak Shrubland	5060	5060	5060
Whiteleaf Manzanita Shrubland Alliance	↔ ←	Whiteleaf Manzanita Shrubland Alliance Whiteleaf Manzanita–Bush Poppy Shrubland	5070/ 5074	5070	5070
Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit	←	Bush Chinquapin Shrubland Alliance	5080/ 5110/ 5502	5520	5590

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Greenleaf Manzanita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit (continued)	←	Greenleaf Manzanita Shrubland Alliance	5080/ 5110/ 5502	5520	5590
	←	Whitethorn Ceanothus Shrubland Alliance	5080/ 5110/ 5502	5520	5590
	←	Whitethorn Ceanothus Shrubland	5080/ 5110/ 5502	5520	5590
Greenleaf manzainita–Bush Chinquapin–Whitethorn Ceanothus Shrubland Mapping Unit	–	None	5502	5520	5509
Bush Chinquapin Shrubland Alliance	↔	Bush Chinquapin Shrubland Alliance	5080	5080	5590
Greenleaf Manzanita Shrubland Alliance	↔	Greenleaf Manzanita Shrubland Alliance	5090	5090	5090
Whitethorn Ceanothus Shrubland Alliance	↔	Whitethorn Ceanothus Shrubland Alliance	5110	5110	5590
Mountain Misery Dwarf-shrubland Alliance	↔	Mountain Misery Dwarf-shrubland Alliance	5130/ 5071	5130	5130
Indian Manzanita Shrubland Alliance	↔	Indian Manzanita Shrubland Alliance	5140/ 5141	5140	5140
	←	Indian Manzanita–Tree Poppy Shrubland	5140/ 5141	5140	5140
Big Sagebrush Shrubland Alliance	↔	Big Sagebrush Shrubland Alliance	5160	5160	5160
Bitter Cherry Shrubland Alliance	↔	Bitter Cherry Shrubland Alliance	5220	6300	6300
Curl-leaf Mountain Mahogany Woodland Alliance	↔	Curl-leaf Mountain Mahogany Woodland Alliance	5230	5230	5230
	←	Curl-leaf Mountain Mahogany/Roundleaf Snowberry Woodland	5230	5230	5230

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Chaparral Yucca Shrubland Alliance	↔	Chaparral Yucca Shrubland Alliance	5270	5270	5270
Pinemat Manzanita Dwarf-shrubland Alliance	↔	Pinemat Manzanita Dwarf-shrubland Alliance	5280	5280	5280
Alpine & Subalpine Dwarf Shrubs Mapping Unit	←	Mountain Big Sagebrush Shrubland Alliance	5501	5510	5510
	←	Oceanspray Shrubland Alliance	5501	5510	5510
	←	Rothrock's Sagebrush Dwarf-Shrubland Alliance	5501	5510	5510
	←	Red Mountain Heather Shrubland Alliance	5501	5510	5510
Bitter Cherry–Gooseberry spp.–(Mountain Maple) Shrubland Mapping Unit	–	None	5503	5530	5530
Rothrock's Sagebrush Dwarf-Shrubland Alliance	↔	Rothrock's Sagebrush Dwarf-Shrubland Alliance	5504	5200	5200
Red Mountain Heather Dwarf-shrubland Mapping Unit	–	None	5505	5550	5550
Deerbrush Shrubland Alliance	↔	Deerbrush Shrubland Alliance	6010	6010	6010
	←	Deerbrush–Whitethorn Ceanothus Shrubland	6010	6010	6010
	←	Deerbrush–Whiteleaf Manzanita Shrubland	6010	6010	6010
Oregon White Oak Shrubland Alliance	↔	Oregon White Oak Shrubland Alliance	6020	6020	6020
Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association	↔	Oregon White Oak–Birchleaf Mountain Mahogany Shrubland Association	6022	6022	6022
California Grape Association	↔	California Grape Association	6030	6030	6030

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Mapping Classification (SEKI)	Relation-ship*	Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)	Original PI Code	Post AA Database Code	Final Database Code
Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance	↔	Sierra Willow/Swamp Onion Seasonally Flooded Shrubland Alliance	6110	6110	6110
	←	Sierra Willow/Swamp Onion Shrubland	6110	6110	6110
	←	Sierra Willow/Arrowhead Butterweed Shrubland	6110	6110	6110
Oceanspray Shrubland Alliance	↔	Oceanspray Shrubland Alliance	6210	6210	6210
Willow/Meadow Shrubland Mapping Unit	–	None	6500	6500	6500
Willow Riparian Shrubland Mapping Unit	–	None	6600	6600	6600
Willow/Talus Shrubland Mapping Unit	–	None	6700	6700	6700
Upland Herbaceous Mapping Unit	–	None	7000	7000	7000
Shorthair Sedge Herbaceous Alliance	↔	Shorthair Sedge Herbaceous Alliance	7120	7120	7120
	←	Shorthair Sedge–Pussypaws Herbaceous Vegetation	7120	7120	7120
	←	Shorthair Sedge–Spike Trisetum Herbaceous Vegetation	7120	7120	7120
	←	Shorthair Sedge–Sierran Beardtongue Herbaceous Vegetation	7120	7120	7120
	←	Shorthair Sedge–Sierra Ricegrass herbaceous Vegetation	7120	7120	7120

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Table H-1 (continued). The relationship between types mapped in Sequoia and Kings Canyon National Parks and the floristic types described for Yosemite National Park. Original PI Code indicates the code assigned pre-accuracy assessment/codes applied to earlier versions of the map products and overlays. An annotated listing of codes and names used throughout the history of the projects is provided as an ancillary digital data product through the NPS IRMA system.

Mapping Classification (SEKI)	**Relation-ship***	**Vegetation Classification (YOSE) (Keeler-Wolf et al. 2012)**	**Original PI Code**	**Post AA Database Code**	**Final Database Code**
California Annual Grassland/Herbland Superalliance	←	California Annual Grassland Alliance	7260	7260	7260
	←	California Annual Herbland Alliance	7260	7260	7260
	←	Deer Vetch–Annual Clover–Lessingia Herbaceous Vegetation	7260	7260	7260
Mesic Post Fire Herbaceous Mapping Unit	–	None	7702	7702	7702
Xeric Post Fire Shrub/Herbaceous Mapping Unit	–	None	7703	7703	7703
Intermittently to Seasonally Flooded Meadow	–	None	8000	8000	8000
Seasonally to Permanently Flooded Meadow	–	None	9000/ 9030	9000	9000

* Notes: ↔ Vegetation and Mapping Class are equivalent; ← Vegetation class is a subset of the Mapping Class (Vegetation is at a finer level); → Mapping Class is a subset of the Vegetation class (Mapping class is at a finer level)

Appendix I. Metadata and Field Definitions

Complete metadata are available with the digital map file which is available through the NPS IRMA system, including coordinate system (NAD_1983_UTM_Zone_11N) and bounding coordinates.

Table I-1. The attribute definition portion of the metadata.

Field Name	Data Type	Definition
OBJECTID	Numeric	Internal feature number.
SHAPE	Geometry	Feature geometry
MapUnit_ID	Numeric	Numeric mapping classification code, also known as PI Code, assigned to the type of vegetation being sampled. The PI Code represents the revised or aggregated code assigned post-accuracy assessment for each mapped polygon. Mapping units may be associated with alliances or associations (associations form the lowest level of the hierarchy, and are defined by a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy). Where it was not possible to map to the alliance or association level, mapping units (aggregations of alliances and/or associations that could not be distinguished on the photography) were created.Comprehensive list of codes is available in Appendix D.
MapUnit_Name	Text	Common name of mapping unit associated with the PI Code (MapUnit_ID).
LatinName	Text	Latin Name of Mapping Unit associated with MapUnit_ID
AllianceCode	Numeric	Numeric mapping classification code assigned to the vegetation type at the alliance level. An alliance is a higher level unit in the classification hierarchy (above the association) and is defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species.
AllianceName	Text	Name associated with the numeric mapping classification code (AllianceCode) assigned to the vegetation type at the alliance level.
PI_Original	Numeric	PI Code (MapUnit_ID) associated with the vegetation type prior to Accuracy Assessment. PI_Original is included to allow users to choose which level of map detail and accuracy is required for a particular map application, while taking into account the increased error rate associated with the more detailed map.
NVCS_Class	Text	National Vegetation Classification System (NVCS) class assigned to the vegetation polygons. Development of the NVCS compliant mapping classification and accuracy assessment of the final map products, along with all associated field sampling, was performed by NPS ecologists at SEKI.
NVCS_Subclass	Text	National Vegetation Classification System (NVCS) subclass assigned to the vegetation polygon. Development of the NVCS compliant mapping classification and accuracy assessment of the final map products, along with all associated field sampling, was performed by NPS ecologists at SEKI.
CWHR_Desc	–	California Wildlife Habitat Relationship description, assigned in consultation between NPS SEKI and USFS vegetation ecologists post-delivery of the final map products.
CWHR_Code	–	California Wildlife Habitat Relationship code, assigned in consultation between NPS SEKI and USFS vegetation ecologists post-delivery of the final map products.

Table I-1 (continued). The attribute definition portion of the metadata.

Field Name	Data Type	Definition
Calveg_Code	–	U.S. Fish and Wildlife Service Region 5 Calveg system classification code, Vegetation Type 1. Assigned in consultation between NPS SEKI and USFS vegetation ecologists post-delivery of the final map products.
Calveg_Desc	–	U.S. Fish and Wildlife Service Region 5 Calveg system description associated with Calveg classification code. Assigned in consultation between NPS SEKI and USFS vegetation ecologists post-delivery of the final map products.
Landuse	Numeric	General land use categories. Codes represent a modified Anderson et al. (1976) level 3 classification. Full list of codes is available in Appendix F, mapping classification descriptions, under 0990 Urban/Developed.
Density	Numeric	Density, also referred to as vegetative cover, is a quantitative estimate of plant cover of the mapped alliance or vegetation type, derived from viewing the aerial photography in stereo magnification. Six categories were used to define density or vegetative cover: (1) Continuous to nearly continuous; (2) Discontinuous; (3) Disperse; (4) Sparse; (5) Rare; (6) Trace amounts less than 2%; and (9) Not applicable to polygon.
Area_Acres	Numeric	Acreage calculated using GIS.
Poly_ID	Numeric	Unique polygon ID used internally for building relationships with tables and other feature classes.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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